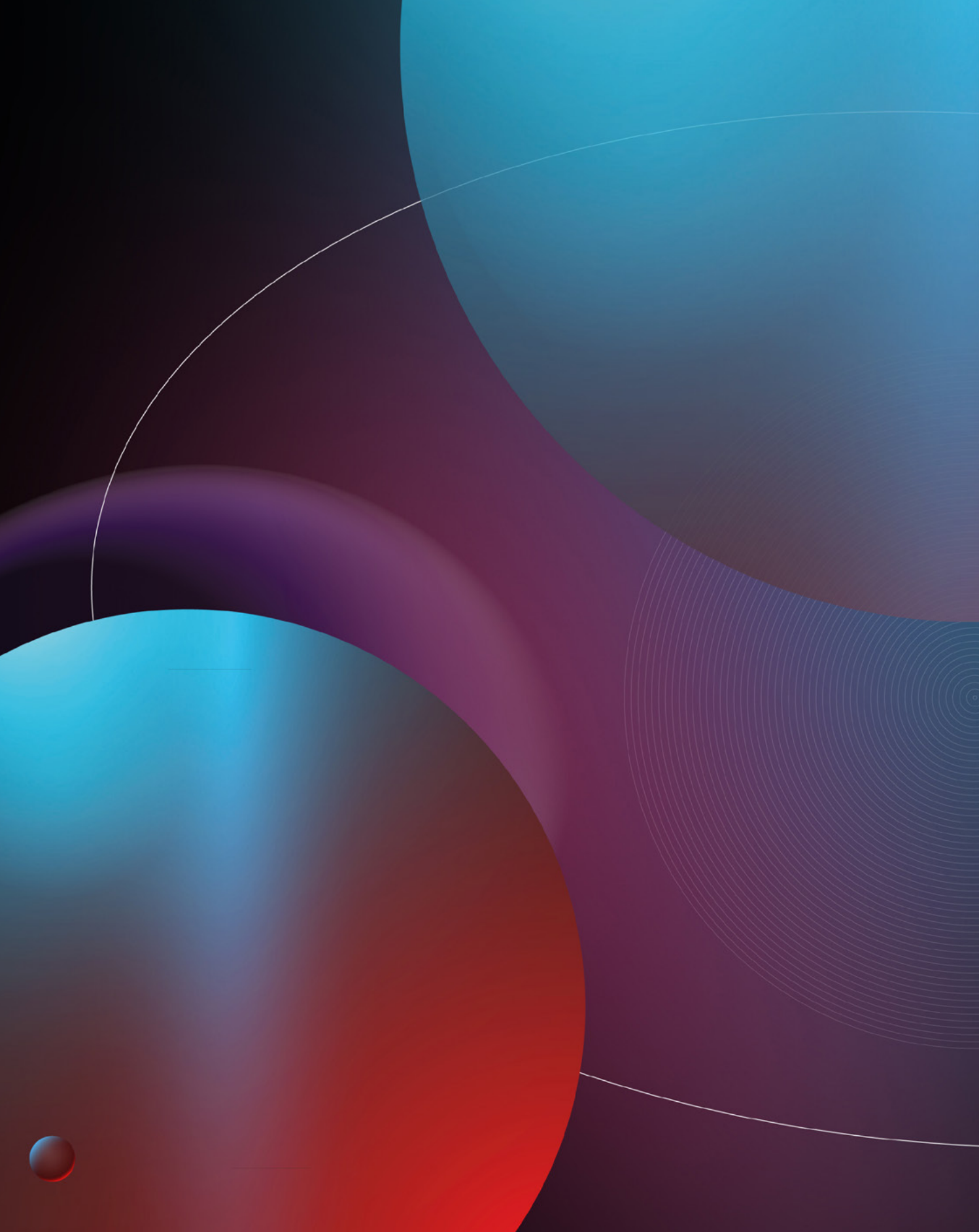
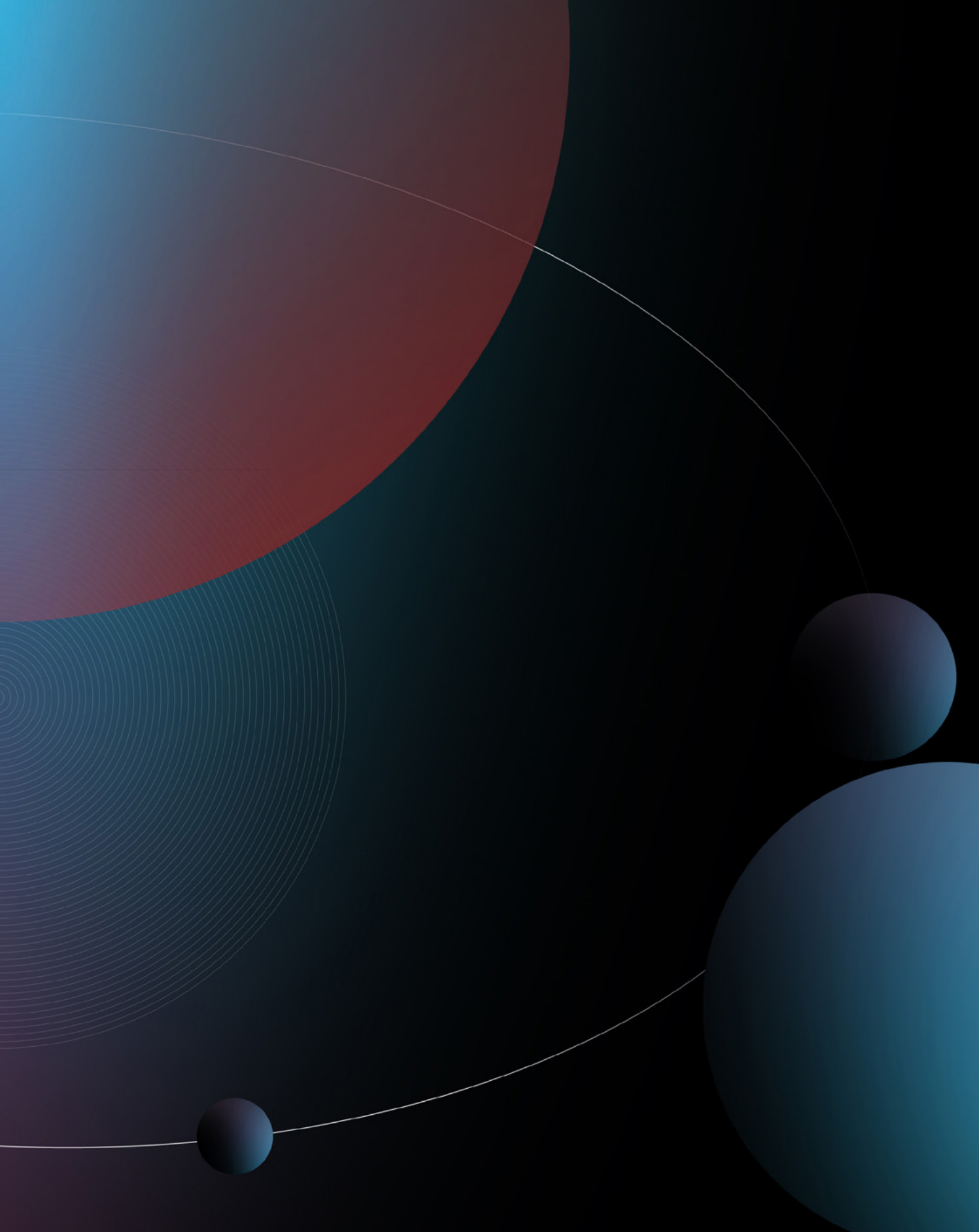

POLSA
Polish Space
Sector
ENTITY
DIRECTORY
2022





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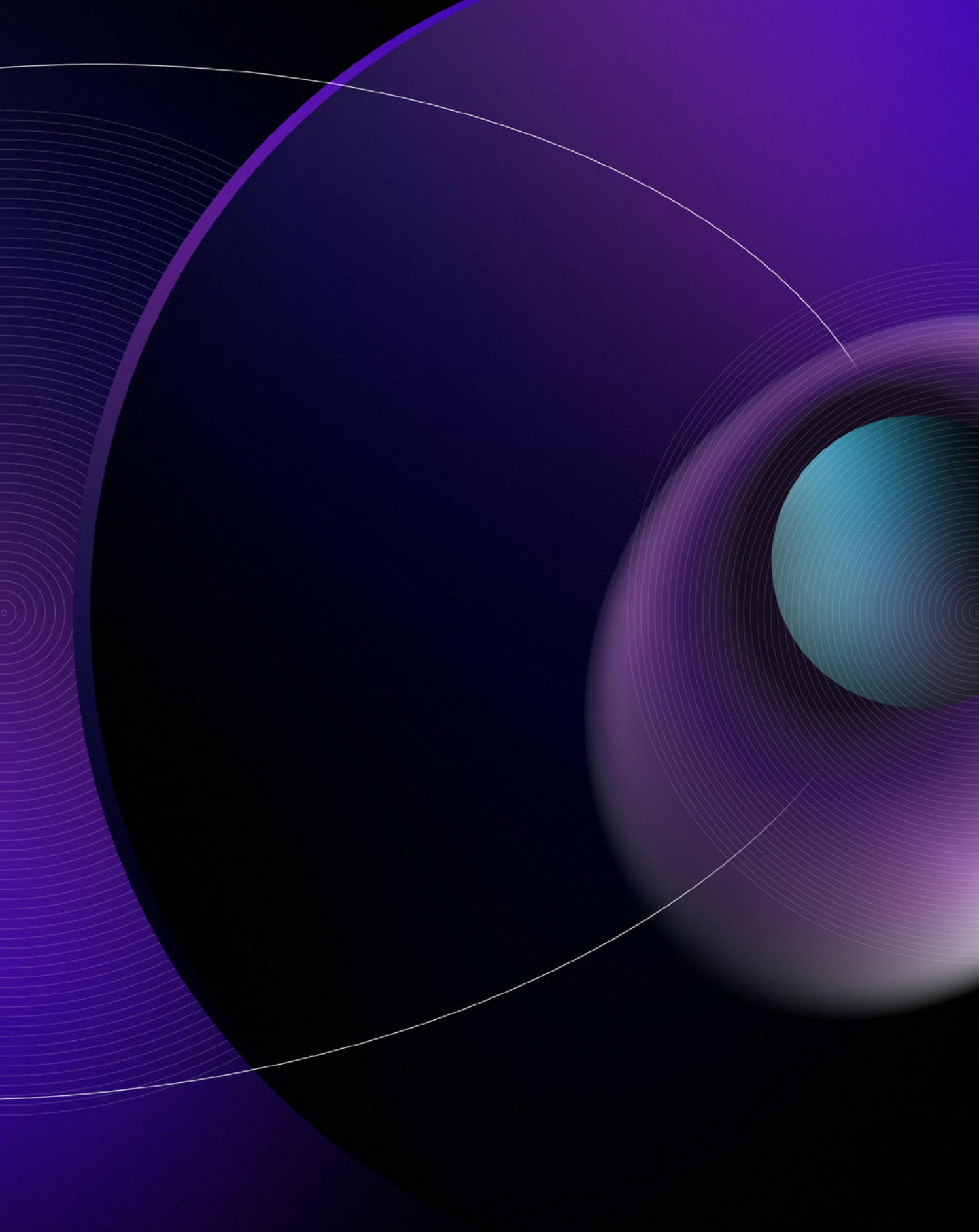


Directory of the space sector entities

Poland can look back on over 500 years of experience in space research and exploration. They were based on the revolutionary ideas of Nicolaus Copernicus and his followers, including Jan Heweliusz, great Polish astronomers from the 20th century and scientists working today. Over the years, scientists and engineers with Polish roots, working in the country and abroad, have created many valuable scientific concepts, inventions and devices that have become a permanent part of the history of the conquest of space.

Konstantin Ciołkowski and Ary Sternfeld created the theoretical foundations for the construction of multi-stage rockets and the calculation of spacecraft orbits. Mieczysław Bekker, Werner Kirchner, Eugeniusz Lachocki, Wojciech Rostafiński, Stanisław Stankiewicz and Kazimierz Piwoński worked on the American Apollo program. For over 40 years, the Space Research Center of the Polish Academy of Sciences has been implementing projects for on-board satellite devices and interplanetary space probes. The culmination of Poland's participation in the Soviet Inter-space program was the orbital flight of Mirosław Hermaszewski, and the descendants of Polish emigrants, Karol Bobko, Scott Parazynski, James Pawelczyk, George Zamka and Christopher Ferguson participated as astronauts in the American shuttle flight program. Over the last half century, Polish scientists and engineers have designed and constructed over eighty instruments used in space missions, such as Cassini-Huygens, Mars Express, Rosetta, Mars Curiosity Rover, Mars InSight, Venus Express, Herschel, Phobos-Grunt, BepiColombo, Solar Orbiter, or the planned Proba-3, Euclid, Juice, Arcus, Gamov, IMAP, Athena and others.

The domestic space sector currently gathers over 300 companies, employing nearly 12,000 people. Several dozens of them locate their business model entirely in the space sector, while for the rest it is part of their activity. These companies are particularly active in robotics and automation, mechatronics, on-board power supply systems, optical and communication systems for satellites, scientific sensors and soil penetrators for space probes, and software testing systems and subsystems of objects launched into orbit. For several years, work has also been underway on fully recoverable Polish suborbital missiles. They are intended to reach an altitude of over 100 km and take with them a load of several dozen kilograms, which would consist of various types of experiments, for which microgravity conditions are required.

The importance of the domestic space sector is constantly growing, because the exploitation of space is a development field based on the development of the latest technologies, setting ever new and ambitious goals. The growing importance of the space sector in the national economy also means a social return in the form of taxes paid to the state budget and building a positive image of the country. The cosmic industry, through its intensive development in the latest technologies, also inspires the young generation to self-improvement in the perspective of achieving the most ambitious goals.

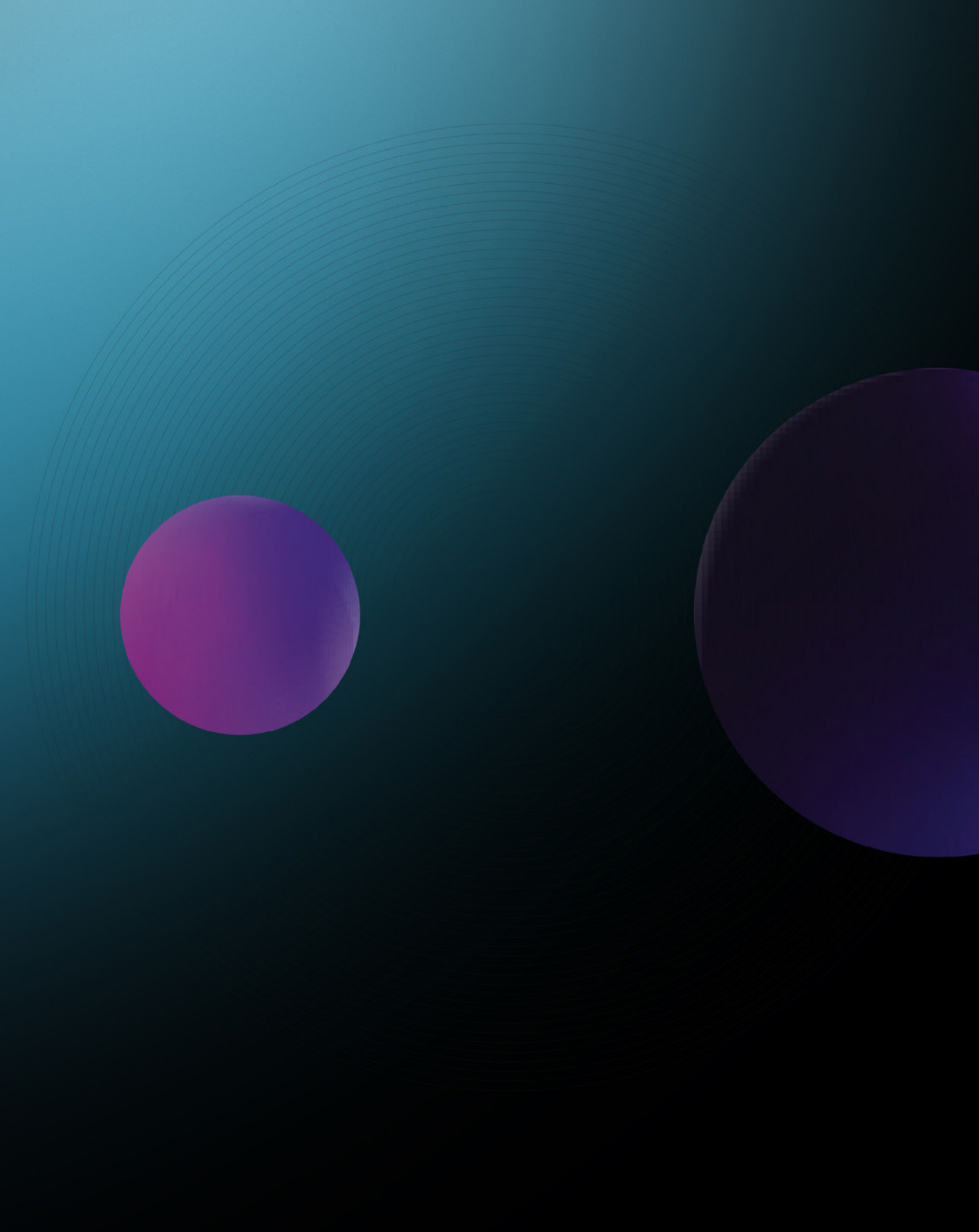
Poland's accession to the European Space Agency (ESA) in 2012 became a catalyst for the development of the domestic space sector. As part of ESA programs, over the last 10 years Polish entities have obtained contracts for the amount of EUR 140 million under the European Space Agency. Thanks to membership in ESA, we have access to ground and space infrastructure, we cooperate with national agencies and the largest companies in the space sector, having the opportunity to develop native technologies and a significant share in the supply chain of international space projects. We also have the opportunity to develop human resources and participate in numerous educational programs.

The Polish Space Strategy adopted in 2017 – the basic document of Polish space policy – assumes the support for the Polish space sector in order to fully meet its expectations and needs and to be able to effectively compete on the European market. This goal is to be implemented, among others thanks to the introduction of the National Space Program, on which work is currently underway. The signing of the Artemis Accords agreement in 2021 also opens up prospects for our country to participate in the international exploration of the Moon and other bodies of the Solar System under the strategic leadership of the United States. This places Poland in the group of countries actively participating in the global market of space and satellite technologies, the use of which will determine future decades.

This catalog of Polish entities from the space sector is another study prepared by the Polish Space Agency. The publication contains information about the Polish space sector and its competences related to industry and science in the field of exploration and use of space. It is a useful and up-to-date source of information about the Polish space sector. We hope that our catalog will be helpful in making contacts that will result in new interesting projects.

prof. Grzegorz Wrochna
President of the Polish Space Agency

About the Polish space sector



The country in a nutshell

Poland is a Central European country with a population of 37.84 million in 2021. Poland's GDP increased by 5.7% in 2021. In 2020, the country invested 1.39% of its GDP in research and development. Poland joined the European Space Agency (ESA) in 2012.

Cosmic traditions

Poland's early space activities took place as part of the Soviet Union's Intercosmos program, which consolidated the countries of Eastern Europe and included them in the space activities of the USSR. Poland took part in the experimental satellite mission Copernicus-500 in 1973, and the first - and so far, only - Polish cosmonaut reached space in 1978.

After the end of the Cold War, Poland redirected its space cooperation to the west by signing the Agreement on cooperation with ESA in 1994, the ECS Agreement in 2007 and the PECS Charter in 2008. The country became a member of ESA in 2012 and in the same year launched its first native satellite, CubeSat PW-Sat 1, constructed by the Faculty of Power and Aeronautical Engineering of the Warszawa University of Technology in cooperation with the Space Research Center of the Polish Academy of Sciences.

Space management

The Polish Space Agency (POLSA) is responsible, inter alia, for supporting the Polish space industry, coordinating the participation of Polish industrial and scientific units in the ESA, EU, EUMETSAT, ESO and EDA programs, and promoting space research, space technology and satellite technology.

The agency operates under the supervision of the Ministry of Economic Development and Technology and reports to the POLSA Council, which includes representatives of several ministries, as well as representatives of space research and industry. In December 2021, the updated version of POLSA's statute entered into force, introducing a new organizational structure of the Agency, corresponding to the needs related to the implementation of the goals set by the Polish Space Strategy.

In May 2020, the position of the space plenipotentiary responsible for the departmental preparation and implementation of a comprehensive space strategy was created at the Ministry of National Defense. The plenipotentiary will represent the Ministry of National Defense at various international forums and will closely coordinate with POLSA the implementation of the Polish Space Strategy, especially in the field of security and defense.

The Space and Satellite Research Committee of the Polish Academy of Sciences, established in 1966, contributes to the development of the national space research policy. The Committee represents Poland together with the Ministry of Foreign Affairs and the Ministry of Economic Development and Technology in international forums: COPUOS (Committee on the Peaceful Uses of Outer Space) and COSPAR (Committee for Space Research).

National Space Strategy

In February 2017, the Polish government adopted the Polish Space Strategy, perceived as an important step in the modernization of the Polish economy, that emphasizes the importance of space for the global competitiveness and security of the nation now and in the future. The Polish Space Strategy covers the years 2017–2030.

The goal of the Polish Space Strategy until 2030 is to obtain a 3% market share by the Polish industry in Europe and the best possible use of satellite data for security and defense purposes, as well as to meet the domestic market's demand for related services. The strategy emphasizes that the creation of space infrastructure can significantly help to achieve these goals. In addition, increased capital investment in space assets, as well as optional ESA programs, should help Poland achieve its desired place in the European space sector, and thus constitute an important part of the national space strategy.

In addition to European cooperation with and through ESA, Poland has signed space cooperation agreements with China, Mexico, Brazil, Ukraine, Italy and France. In 2019, a joint declaration on space cooperation (in particular on space exploration) was signed with NASA, as well as an agreement with the US Strategic Command on space situational awareness (SSA) services and data. In 2020 POLSA became an associate member of the Committee for Earth Observation Satellites (CEOS) and in the same year Poland signed an agreement with NASA on cooperation in the heliophysical mission - Interstellar Mapping and Acceleration Probe (IMAP). In July 2021, POLSA published an analysis of the space sector in selected countries, indicating possible directions for international cooperation.

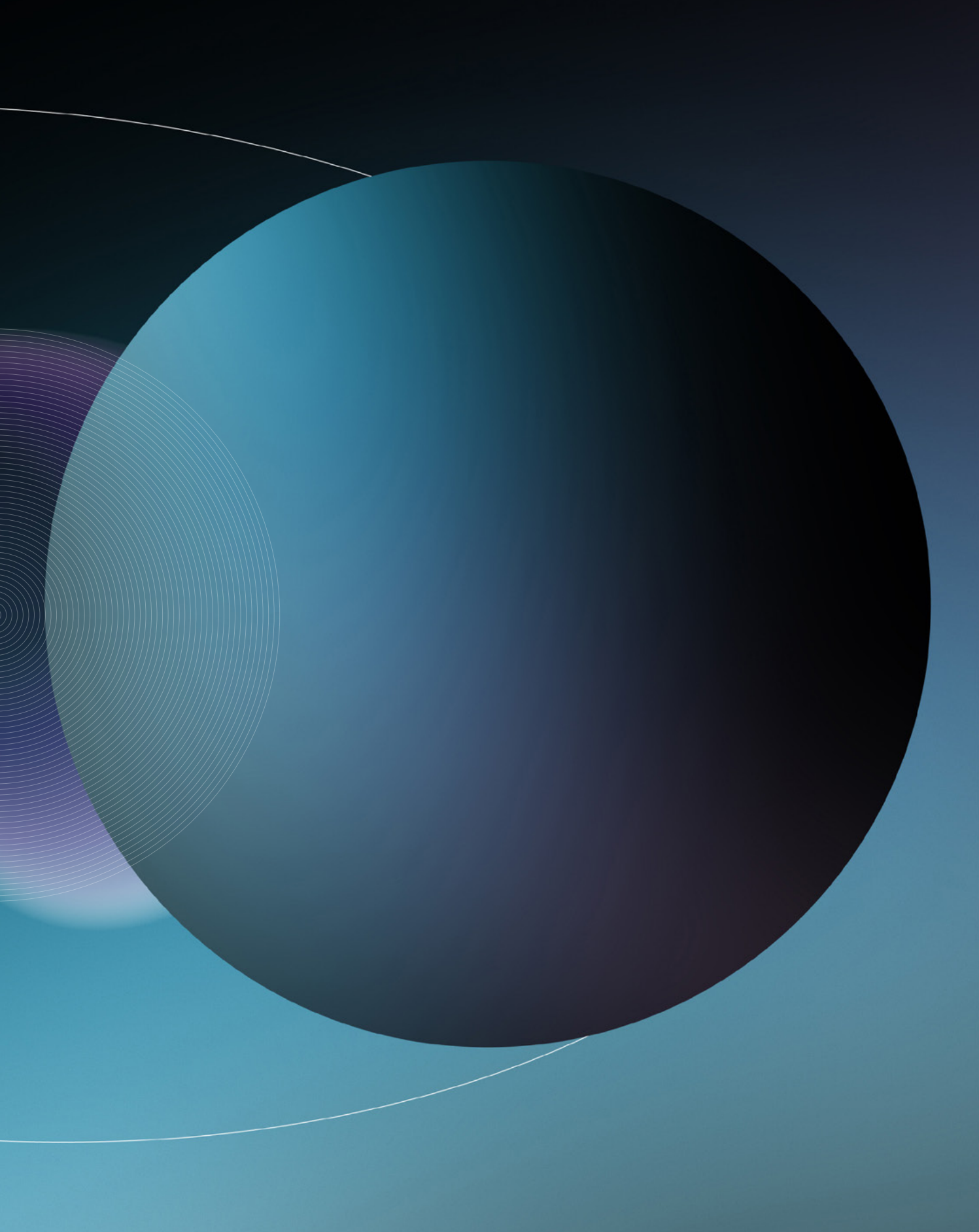
In October 2021, POLSA signed the Artemis Accords Agreement.

Outer space budget and the most important opportunities

Poland's total expenditure on space (including ESA and EUMETSAT) amounted to EUR 65.5 million in 2021. ESA contributions amounted to EUR 39.0 million in 2021, while EUR 12.4 million was allocated to EUMETSAT in 2021.

The European Space Education Resource Office (ESERO) is located in Warsaw, co-financed by ESA and the Copernicus Science Center - the largest science center in Poland (not related to the EU Copernicus program). ESA_Lab @ Gdańsk Technical University under the patronage of POLSA was inaugurated in November 2020, while another ESA_Lab @ Kozminski University was opened in February 2021.

About the Polish Space Agency

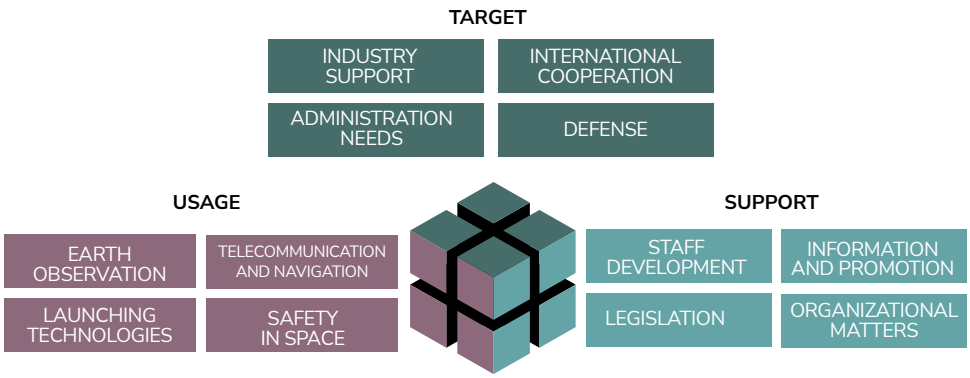


Polish Space Agency

POLSA is an executive agency of the Ministry of Economic Development and Technology, established under the Act of September 26, 2014. Its task is to support the Polish space industry by implementing the priorities of the Polish Space Strategy.

The tasks carried out by the Agency include:

- supporting the Polish space sector by connecting the world of science, business and administration,
- supporting the introduction of regulations concerning the space sector in Poland,
- supporting entrepreneurs in participating in international space missions and programs,
- initiating agreements with entities from the space industry in Poland and abroad,
- supporting state security and increasing defense capabilities through the use of satellite systems,
- promoting the Polish space sector domestically and abroad.



The Polish Space Strategy adopted by the Council of Ministers in January 2017 sets goals for the Polish space sector until 2030:

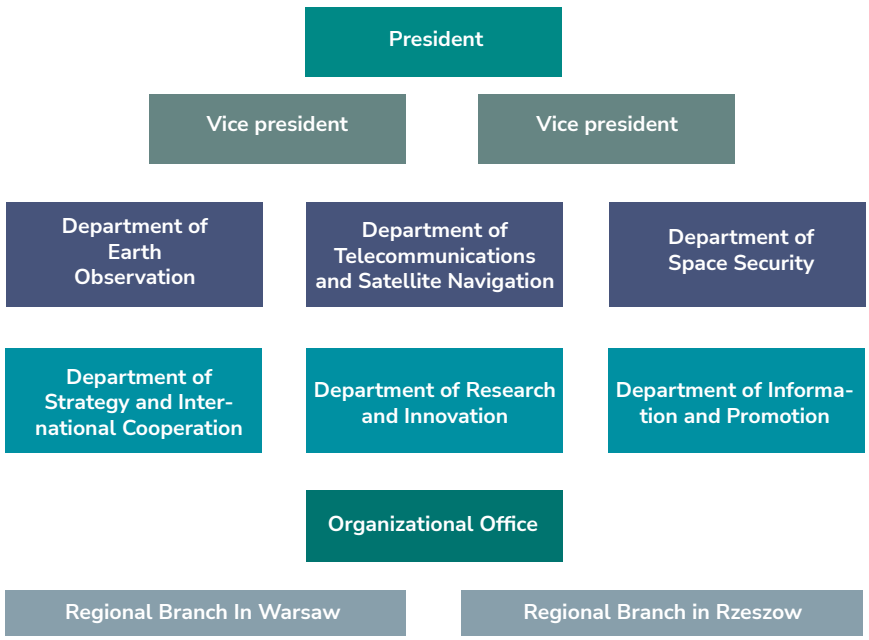
- Polish economy and public institutions will have access to satellite infrastructure enabling them to meet their needs, especially in the field of security and defense.
- Polish public administration will use satellite data for faster and more effective implementation of its tasks, and domestic enterprises will be able to fully meet the internal demand for this type of services and export them to other markets.
- Polish economy and public institutions will have access to satellite infrastructure enabling them to meet their needs, especially in the field of security and defense.

The Polish Space Agency cooperates with international agencies and state administration in the field of space research and use. One of the important tasks is also to support the Polish industry in order to increase its competitiveness on the European market and to obtain contracts by domestic companies with international organizations and institutions, especially the European Space Agency and the European Commission.

POLSA cooperates in the preparation and implementation of the National Space Program, which includes a number of instruments and mechanisms needed to engage Poland in ESA missions and programs, also serving the implementation of national goals in line with the Polish Space Strategy.

In accordance with the Polish Space Strategy, POLSA runs, among others, national space situational awareness system project. It also works for the development of satellite techniques (including navigation, observation and communication) in the economy, administration and everyday life – incl. in agriculture, forestry, land and sea transport, environmental monitoring, crisis management and weather forecasting. POLSA also conducts activities in the field of education and promotion.

Organizational structure of POLSA



Entities of the Polish space sector

6ROADS sp. z o.o.

6ROADS is a highly specialized company focused on providing solutions for the SSA domain including SST and NEO. The infrastructural core of 6ROADS is a network of eight optical observatories located in various locations across the globe. As a company 6ROADS was established in 2016, however its experience can be traced back to 2003. Throughout the years of being an active contributor to the European SSA domain the company was continuously gaining valuable experience, mostly from the projects conducted for the European Space Agency.

Main products and services:

- Observation of space objects.
- Activity within SST (Space Surveillance and Tracking).

The most important achievements in the space sector:

- Polish Telescopes Qualification for SST (POLTELSST)
- E2E POC no. 4000126546/19/D/CT
- Space Surveillance and Tracking in Observational Network with Event-Based
- Sensors no. 4000128842/19/D/MB

Entity type: SME

Main technological domains

Others (TD 26)

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Absiskey Polska sp. z o.o.

● Entity type: SME

Absiskey Polska (formerly Kapitech) is a Polish company, founded in 2014 with headquarters in Warsaw, specializing in innovation management in the space business and consulting. Absiskey Polska's mission is to increase the potential of our clients and partners by offering them strategies, tools and financing options (national and European) best suited to their research, development and innovation projects. The company provides a range of experts with 25 years of professional experience in various areas of the space sector.

Absiskey Polska has been selected by the European Space Agency to act as ESA Space Solutions Network representatives in Poland as ESA Technology Broker and ESA Business Ambassador.

The most important achievements in the space sector:

- ESA Technology Broker and ESA Business Applications Ambassador
- SpaceHub

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Asseco Poland S.A.

Asseco Poland S.A. is the largest Polish software producer listed on the Warsaw Stock Exchange. For 30 years, it has been creating technologically advanced software for companies and organizations from sectors of key importance to the economy and for the Ministry of National Defense.

Main products and services:

- Ground Segment
- Ground Station
- Mission Control

The most important achievements in the space sector:

- ESOC-LWMCS - Development of Light-Weight Mission Control System (LWMCS) for Cube and small satellite operations in the context of the OPS-SAT mission.
- EGNOS-SDATS - SBAS Data Analysis Tool Set. Supplement to SBAS Validation tools for quick extraction and parsing of data obtained from RIMS and CFP for deviations detection and reporting on EGNOS key parameters.
- ESOC SIMSAT Web HMI - Software Infrastructure for Modelling Satellites Web Human-Machine Interface - 3D visualization of spacecraft on orbit, simulation tree based on spacecraft architecture.

Entity type:
Large enterprise

Main technological domains

Mission Operation and Ground Data Systems (TD 9)

RF Subsystems, Payloads and Technologies (TD 6)

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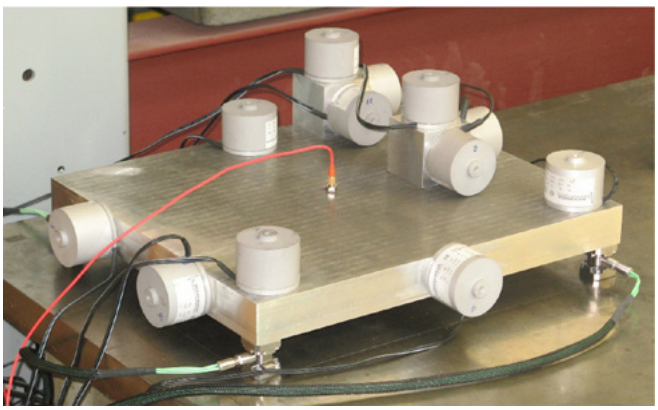
Adaptronica Sp. z o.o.



Adaptronica is a small company of research and development profile, with the expertise in structural mechanics, mechatronics and vibroacoustics. The activity of the company manifests itself in realization of R&D projects, development of own services and products as well as being a representative of foreign companies in Poland. Within the Polish Industry Incentive Scheme program, the company has carried out five contracts focused on passive and active damping of vibrations and impact for variuos subsystems of a satellite, e.g. cryocoolers, control moment gyroscopes and pyrovalves. The competences in the space sector comprise the design and testing of passive and active systems for damping of structural vibrations, including microvibrations, as well as mitigation of impact loads acting on the structure through efficient dissipation of impact energy.

Main products and services:

- Design and testing of active and passive systems for damping of structural vibrations and and mitigation of impact loads for satellite subsystems
- Developing dedicated software to perform the elaborated strategies of damping of structural vibrations and mitigation of impact energy
- Selection and testing of actuators and sensors for systems of vibration and impact attenuation
- High-stability supporting structure with active microvibration damping for cryocooler
- Pyrovalve support capable of pyroshock isolation

The most important achievements in the space sector:

- Active system for damping of microvibrations generated by a cryocooler (TRL6)
- Support of a pyrovalve passively attenuating the influence of pyro-explosion on the structure (TRL5)
- Passive system for damping of microvibrations generated by a control moment gyroscope (TRL4)

Entity type: SME

Main technological domains

- Space System Control - A) Control Systems Engineering (TD5)
- Space System Control - B) Control Systems Innovative Technologies (TD5)
- Structures - A) Structural Design and Verification Methods and Tools
- Structures - B) High Stability and High Precision Spacecraft Structures
- Structures - E) Active/ Adaptive Structures

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Akademia Górniczo-Hutnicza Space Technology Centre

CeThe AGH UST Space Technology Center is a unit established to carry out didactics, coordinate, and conduct research in space technologies. Research work is carried out at the level of basic and applied research, in particular in the fields of Science of Signature (processing of information into knowledge), materials and structures dedicated to space applications, and Space Resources (in the field of minerals), in national and international cooperation with companies in the space sector using a mechatronic approach. The center promotes academic entrepreneurship by providing conditions for the creation and development of spin-off and start-up companies, business mentoring and research laboratories for developing space products and technologies.

Main products and services:

- IJ Thermal Control
- II Satellites & Probes
- III D Mechanism
- III F Power

The most important achievements in the space sector:

- Member of the UNIVERSEH project - European Space University for Earth and Humanity
- Analog missions with Analog Astronaut Centre
- 2nd place for SpaceTeam AGH in the finals of the „Over the Dusty Moon Challenge" - a solution for transporting regolith on the Moon (TOLRECON) and the 4th place of the Kalman AGH Space Systems rover in the University Rover Challenge 2022 competition

Entity type: University Unit

Main technological domains

- Space Systems Environments and Effects (TD 4)
- System Design & Verification (TD 8)
- Structures (TD 20)
- Thermal (TD 21)
- Materials and Manufacturing Processes (TD 24)

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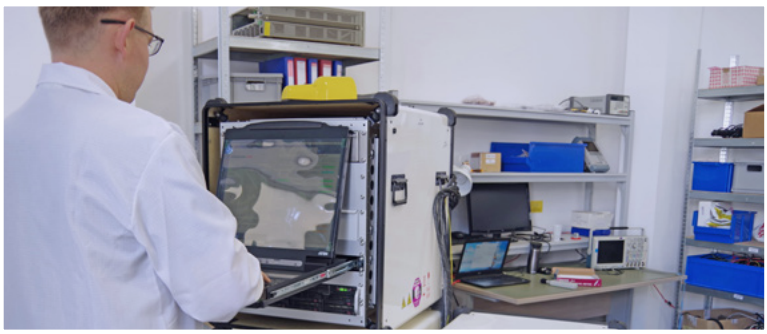
Astri Polska sp. z o.o.



Astri Polska specialises in the field of electronics - designing and manufacturing of Electrical Ground Support Equipment (EGSE), advanced check-out apparatus used for testing of the electronic systems of the satellites and validation of the radio communication systems of the ground stations, and space applications and services - the company develops dedicated satellite-technology-based IT systems. The company is the principal Polish participant in programmes implemented by the European Space Agency (ESA). It delivers dedicated solutions to the European Commission (European Environmental Agency, Horizon 2020), the World Bank, the Polish National Centre for Research and Development, and other customers. Since its foundation in 2010, Astri Polska has been involved in over 50 projects.

Main products and services:

- Assembly Integration and Test - Electrical Ground Support Equipment (EGSE) and Special Check Put Equipment (SCOE)
- Assembly Integration and Test - RF Suitcase
- EEE components - wires and cables
- On-Board Data Management

The most important achievements in the space sector:

- GALILEO Transition Satellites (GTS) Platform Interface Simulator Assembly (PISA) and ISL Platform Interface Simulator (PISA ISL) - design, manufacturing and testing of PISA and PISA ISL equipment
- MetOp-SG RF Suitcases - devices for the „S", „X" and „Ka" bands test
- JUICE Real Time Simulator Models Development - A test infrastructure for the JUICE explorer along with dedicated software to test and simulate the functioning of specific sub-systems of the explorer

Entity type:
Large enterprise

Main technological domains

010101
010101
010101 Space System Software (TD 2)

System Design & Verification (TD 8)

Mission Operation and Ground Data System (TD 9)

Ground Station System and Networks (TD 12)

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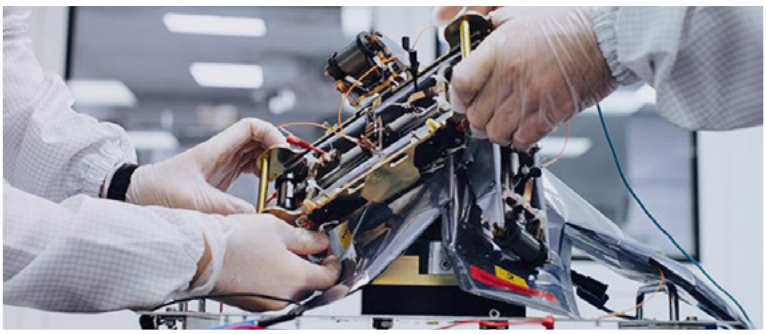
Astronika sp. z o.o.



ASTRONIKA is a private company founded in 2013 by a unique group of engineers from the Space Research Center of the Polish Academy of Sciences (CBK PAN). We specialize in space instruments and mechanisms. We have in our portfolio planetary missions to Mars InSigth and orbital missions like Juice. We also operate in the market of small and medium-sized satellites. We provide booms solutions for CubeSats, such as for the RadCube and HERA Juventas missions. We have our own machining workshop, ISO 8 clean room and a prototyping laboratory. In the scope of tests, we have a thermal-vacuum chamber and shock generation equipment, as well as bake - out chamber for composite structures.

Main products and services:

- Deployment (SADM, SADE, ...)
- Antenna mechanisms (Including control electronics)
- Hold down and release mechanisms.
- Instrument specific mechanisms
- Flow control and distribution devices (pipes, valves, actuators, filters,pressure transducers, pressure regulators)

The most important achievements in the space sector:

- Radio Wave Instrument oraz LP-PWI Intrument
- Penetrator HP3 Mole for NASA InSigth mission
- RadMag Boom for RADCUBE mission

Entity type: SME

Main technological domains

Automation, Telepresence & Robotics (TD 13)

Mechanisms (TD 15)

Structure (TD 20)

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aXpir

Entity type: SME

Main technological domains

System Design & Verification (TD 8)

Automation, Telepresence & Robotics (TD 13)

Mechanisms (TD 15)

aXpir offers consulting services (Engineering, Project Management and Business development) for a specified period, or for a given work package/ project, in the space and Hi-Tech industries.

The company also offers recruitment support. Beyond the hard skills, the company focuses on soft skills and adaptation to the partners' culture. The goal is to find people that will support the development of partners effectively and in the long run.

The company also offers workshops and trainings for new employees.

aXpir's goal is to support progress. We believe that crossing the experiences of open minded people brings a lot of Innovative ideas.

Main products and services:

- Materials, mechanisms, parts and structures for satellites and space probes.
- Development of the space sector (ground segment).

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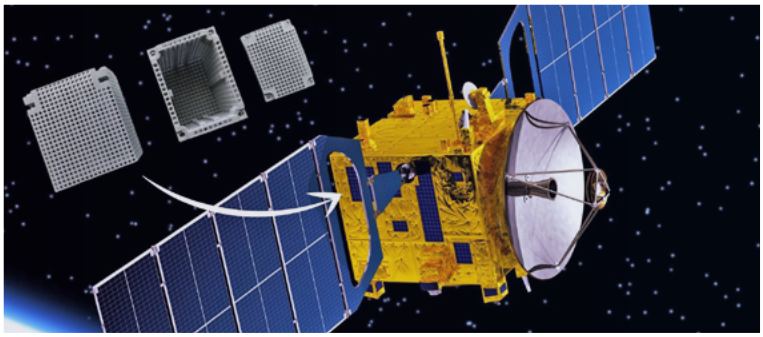
Blue Dot Solutions sp. z o.o.



The company offers services related to technological expertise and defining products using satellite data as well as information and operational services related to the space sector and the development of entrepreneurial and design activities at an early stage of development.The company implements projects based on satellite navigation (including fields of jamming, indoor positioning, etc.), Earth observation, integrated applications, as well as modern materials with a porous (net) structures and mechanics. In its projects the company uses the expertise of a extensive network of contacts in over 50 countries and the International Space University network.As part of the Space3ac accelerator mechanism, the company helped to obtain financing for R&D activities in the total amount of over PLN 23 million for over 100 small companies.

Main products and services:

- Casings, components produced from net structures (Secondary Structures, also Primary Structures) in Structures (N) within Satellite & Probes (II)
- Design and verification methods for structures manufactured from novel materials (nanotube reinforced, foams, self-healing materials etc)
- Data analysis (User Operations, D), Ground Segment (IV)
- Casings, components produced from net structures (Other, d) in Mechanical, Optical and Magnets parts (H) in Satellite & Probes (II) segment

The most important achievements in the space sector:

- Project: „Development of a multifunctional housing for the needs of space and aviation electronics, with particular emphasis on the so-called power electronics and power sources", POIR.01.01.01-00-0581/17
- Project: „Fulfilling enhanced location accuracy in the mass-market through Initial Galileo Services", H2020 Project 776436, www.flamingognss.com
- Project: „GroundEye - a technological platform for monitoring mobile elements of ground infrastructure at airports", RPPM.01.01.01-22-0099/16.

Entity type: SME

Main technological domains

- Flight Dynamics and GNSS (TD 10)
- Space Systems Electrical Power (TD 3)
- Thermal (TD 21)
- Structures (TD 20)
- Mechanisms (TD 15)

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BitByBit Sp. z o.o.

BitByBit sp.z o.o. is a company dealing with solving complex business and scientific issues with the use of information technology. Our engineers specialize in optimization, algorithmics and machine learning. Using agile methodologies, we create web and mobile applications for our clients using the Python, Java and Javascript programming languages and accompanying tools. We work with large companies, research units, NGOs and startups. Since the beginning of BitByBit, we have been intensively cooperating with companies from the space sector, creating software for the European Space Agency. In the space sector, the company focuses on software supporting the ground segment, including monitoring and management of space missions.

Main products and services:

- Ground Station Monitoring & Control

The most important achievements in the space sector:

- Designing and building a WebUI web user interface for EGS-CC (European Ground Systems Common Core). WebUI is now officially part of the EGS--CC and will be used by ESA to manage and monitor future space missions.
- Close cooperation with the EGS-CC consortium and ESA in the design, construction and implementation of automation of the validation scenarios of the EGS-CC system.

Entity type: SME

Main technological domains

- Space System Software (TD 2)
- System Design & Verification (TD 8)
- Mission Operation and Ground Data Systems (TD 9)
- Ground Station Systems and Networks (TD 12)

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Centrum Badań Kosmicznych Polskiej Akademii Nauk

(Space Research Center of the Polish Academy of Sciences)

● **Entity type: Research and Development unit**

● **Main technological domains**

- On-board Data Subsystems (TD 1)
- Space System Software (TD 2)
- Space Systems Electrical Power (TD 3)
- Space Systems Environments and Effects (TD 4)
- Automation, Telepresence & Robotics (TD 13)

The only interdisciplinary research institute in Poland, whose entire substantive activity is related to the research of the surrounding space, the bodies of the Solar System and the Earth, using space technologies and satellite techniques. Established by the decision of the Presidium of the Polish Academy of Sciences on September 29, 1976, it began operating on April 1, 1977. Since 1991, he has been cooperating with the European Space Agency, and since Poland entered the ESA structures in 2012, CBK PAN has been the main institution coordinating the activities of Polish companies from the space industry sector within ESA projects.

The Center cooperates with the world's largest institutions in the field of space exploration, including conducts its own experiments as part of the NASA and ESA missions, cooperates, among others with Center National d'Études Spatiales, JPL, NASA and many others.

More than 70 research instruments sent into space on board satellites and interplanetary probes have been developed at the CBK PAN, incl. Solar Orbiter, Chang'E-4, InSight, Herschel, Koronas-Foton, Rosetta, Mars Express and Cassini-Huygens; the first Polish scientific satellites „Lem" and „Heweliusz" were also integrated and expanded here.

Main products and services:

- Satellites & Probes
- Electronics
- Payloads /Instruments
- RF / Microwave Communication (Platform and Payloads)
- On-board Data Management

The most important achievements in the space sector:

- Participation in the NASA IBEX and IMAP missions: the discovery of the IBEX Ribbon, i.e. the area of increased energy fluxes of hydrogen atoms, was a surprising result of the NASA Interstellar Boundary Explorer (IBEX) mission, in which a team of researchers from CBK PAN participated. Thanks to these scientific achievements, NASA decided to participate in the next interstellar mission, Interstellar Mapping and Acceleration Probe (IMAP), the launch of which is scheduled for 2024. The GLOWS instrument, the development and delivery of which is the responsibility of the CBK PAN, is the only non-American instrument in the IMAP mission and its author - prof. Maciej Bzowski, regardless of the prestigious role of the Primary Investigator of the instrument, is also a Co-Investigator (Co-I, Co-Investigator) of the second instrument in the mission.

- The IBEX project was financed by the National Science Center, while IMAP is financed from an increased statutory subsidy granted for this purpose by the Ministry of Science and Higher Education.
- Involvemet in ESA's first major flagship mission Jupiter Icy Moon Explorer (JUICE), whose main scientific goal is to understand the complex system of interactions within the Jupiter system. Since Jupiter is the archetype of the solar system's giant planets, this mission provides the opportunity to learn about the environment around Jupiter and its moons, conduct advanced basic research and technological development. The JUICE mission will spend 3 years in the orbit of Jupiter, during this time making precise observations of the largest planet of our solar system and its largest moons: Ganymede, Callisto and Europa. CBK PAN is responsible for the development and delivery of essential elements in two scientific instruments for this mission, in cooperation with Polish industrial entities.
- Involvement in JUICE resulted in the invitation of CBK PAN to participate in the next ESA Comet Interceptor mission, in which, similar to GLOWS / IMAP, a Polish scientist is responsible for the entire instrument (PI of the instrument).
- The participation of CBK PAN in the JUICE mission is financed from Poland's contribution to the ESA PRODEX program.
- Development of the concept of an advanced, reconfigured on-board computer for future satellite missions, which involves a departure from the standard, very expensive and hard-to-reach element base in favor of using components commonly used in commercial electronic devices (the so-called COTS - Commercial Off-The-Shelf). The idea of a cheap and possible to produce in a short time device, meeting the requirements of space missions, fits in with the assumptions of the new strategy for the development of the space market, the so-called New Space. The concept of the device was verified as part of the ESA project (technological level TRL3, corresponding to the laboratory prototype), and is currently being developed under the Foundation for Polish Science program (technological level TRL6, corresponding to the prototype tested in conditions corresponding to the space mission), and planned for the future for implementation (the highest technological level TRL9, meaning verification of the device's operation in a real space mission).
- Sources of financing: the HIPERO project from ESA / PLIIS funds and its continuation under the FNP TeamTECH program.

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Centrum Astronomiczne im. Mikołaja Kopernika Polskiej Akademii Nauk (CAMK)

(Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences)

● **Entity type: Research and Development unit**

● **Main technological domains**

- Ground Station Systems and Networks (TD 12)
- Mission Operation and Ground Data Systems (TD 9)

Nicolaus Copernicus Astronomical Center Polish Academy of Sciences is a leading astronomical institute in Poland. It was established in 1978. The main subjects of research include: stellar astrophysics, binary systems, circumstellar matter, dense matter and neutron stars, black holes, accretion processes, structure and evolution of active galaxies, cosmology, extrasolar planets, recording of gravitational waves.

Main products and services:

- Operation of the BRITE Ground Station and data analysis.

The most important achievements in the space sector:

- Antenna system for BRITE mission
- Antenna system for university missions
- Mission control room of BRITE Ground Station

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CIM-mes Projekt sp. z o.o.

CIM-mes provides advanced engineering design and analysis services (CFD/FEM - structural, thermal and multi-physics modelling) and custom engineering software tools. We work for such clients like VALEO, AVIO, ArcelorMittal.

Our clients often face a lack of sufficient engineering resources or competences. We provide reliable solution with reasonable cost. We specialize in performing tailored simulations often combining various engineering fields (detailed modelling, system modelling, predictive control systems). We also specialise in complex cross-domain R&D projects.

Main products and services:

- Aerothermodynamic Tools for Design a Computational Fluid Dynamics (CFD)
- Environment Models and Computational Tools a
- System Modelling & Simulation a Dedicated simulation tools
- Struct. Eng. SW a SW for Structure design, analysis, simulation, etc.
- Thermal Engineering SW a SW for Thermal design, analysis, simulation, etc.

The most important achievements in the space sector:

- FEA analysis of the M10 VEGA-E rocket engine for AVIO SpA
- Simulation tool for modeling particulate contamination during pre-launch and launch phase inside fairings

Entity type: SME

Main technological domains

- Space System Software (TD 2)
- Fluid Dynamics (TD 18)
- Propulsion (TD 19)
- Structures (TD 20)
- Thermal (TD 21)

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CloudFerro sp. z o.o.

Entity type: SME

Main technological domains

010101
010101
010101 Space System Software (TD 2)

CloudFerro provides cutting-edge cloud services. The company delivers and operates cloud computing platforms for demanding markets, such as the European space sector, climate research and science. Its broad experience and in-depth expertise include storing and processing big data sets, such as multipetabyte repositories of Earth Observation satellite data.

The company offers cost-effective, open-source-based, flexible cloud solutions in a public, private or hybrid model, customized to meet user needs. Extensive range of ancillary services and dedicated technical support are provided by the highly experienced local team of IT specialists with unmatched competences.

CloudFerro has been trusted by leading European firms and scientific institutions from various big-data-processing market sectors, including the European Space Agency (ESA), EUMETSAT, the European Centre for Medium-Range Weather Forecasts (ECMWF), Mercator Ocean International, German Aerospace Centre (DLR), the EGI, to name a few.

The most important achievements in the space sector:

- CloudFerro developed, operates and provides cloud computing services for thetwo out of five European Copernicus DIAS (Data and Information Access Services) platforms: CREODIAS and WEkEO.
- CODE-DE - German national platform, developed and operated by CloudFerro, that combines access to Earth observation data with flexible processing environment.
- Implementation and maintenance of the Copernicus CLIMATE DATA STORE hybrid cloud, on behalf of the European Centre for Medium-Range Weather Forecasts.

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creotech

Creotech Instruments S.A.

Creotech Instruments is Poland's leading manufacturer of satellite systems and components as well as advanced electronics for use in, among others, quantum computer control systems. The company is also active in the field of unmanned aerial systems, where it delivers devices and software for, among others, drone movement supervision.

The Company has its own electronics production plant as well as small satellite integration facilities. Its portfolio consists of 26 projects realised for the space sector, while 10 space missions took place including Creotech sub-systems, 4 of which were realised for the European Space Agency.

Main products and services:

- On-board software.
- On-board data management.
- Power monitoring and control.
- Satellite Bus.
- Heat storage and rejection.

The most important achievements in the space sector:

- Participation in the ExoMars mission.
- Participation in the ASIM mission.
- Participation in the OP-SAT mission.

Entity type: SME

Main technological domains

- System Design & Verification (TD 8)
- Materials and Manufacturing Processes (TD 24)
- On-board Data Subsystems (TD 1)
- Space Systems Electrical Power (TD 3)
- Structures (TD 20)

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ELPROMA

ELPROMA ELEKTRONIKA Sp. z o.o.

ELPROMA - EU manufacturer of M2M telemetry sensors and instruments. The company provides IEEE1588 NTP Time Servers solutions in critical infrastructure synchronization . The latest product is the Sagnac optical interferometer - dual-use sensor: seismograph for rotational seismology and FOG optical gyroscope. The sensors have a unique precision 10E-9 rad/s and it operates Earth gravity independent. Connected in a synchronized network, they create a fusion allowing us to determine the exact centre of tremors from a vast distance. It provides a new type of valuable information in many areas of science, defence and space industry.

Główne produkty i usługi

- https://elpromatime.com/nts-5000-brochure/
- https://elpromatime.com/nts-level3-gnss-simulator-time-firewall/
- https://fosrem.eu
- http://teleorigin.com/images/download/RBMTX4-Pro.pdf
- https://elpromatime.com/nts-pico3-brochure/

Najważniejsze osiągnięcia w sektorze kosmicznym

- DEMETRA Horizon2020 project from GSA (EUSPA)
- GALILEO / DLR ground synchronization suport
- GIANO - 1st EU professional GALILEO receiver with crypto authentication from satellite vehicle (together with Thales Alenia Space and PIK Time)

Entity type: SME

Main technological domains

RF Subsystems, Payloads and Technologies (TD 6)

Electromagnetic Technologies and Techniques (TD 7)

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EXATEL S.A.

EXATEL S.A. is a Polish telecommunications operator with more than 20 years of experience and a provider of proven cyber security services. Since 2017, the company has been wholly owned by the State Treasury. The company operates in the business market, both locally and internationally. The company manages a fiber-optic data transmission network with a total length of 21,700 kilometers. EXATEL actively pursues R&D projects, developing its own devices based on SDN (Software Defined Network) technology and cyber security tools. The company's business offerings include data transmission services, lease of telecommunications lines, voice services, collocation, SOC services, antimalware, anti-DDoS and other cyber security services, voice wholesale, construction and maintenance of ground infrastructure and satellite communications services (own teleport).

Główne produkty i usługi

- II G1 Optical terminals
- II G1.1d Telescopes
- II E1e Other (Quantum encryption and communication units)
- IV Ca Interface Equipment (NDIU)

Najważniejsze osiągnięcia w sektorze kosmicznym

- Development and implementation of satellite communications teleport (2021)
- Establishment of Space Technology Cluster (2021)

Entity type: SME

Main technological domains

010101
010101
010101
Space System Software (TD 2)


Ground Station System and Networks (TD 12)


Optoelectronics (TD 17)

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Fundacja Partnerstwa Technologicznego TECHNOLOGY PARTNERS

(Technology Partnership Foundation)

- **Entity type: Foundation, Research and Development unit**

- **Main technological domains**

  - Materials and Manufacturing Processes (TD 24)
  - Structures (TD 20)

TECHNOLOGY PARTNERS is a scientific and research organisation set up in 2003, with the status of an Advanced Technology Centre awarded by the Polish Minister of Science. Its mission is to support the development of Polish Science and Technology sector organisations' cooperation with the international industry and scientific community and to stimulate the transfer of innovative technologies to SMEs. TECHNOLOGY PARTNERS specialises in research and innovation management, as well as in the development, performance and coordination of large-scale multidisciplinary research projects, in which it plays the role of General Contractor, creating and managing research teams of best scientific and research talents and professionals in project areas. TECHNOLOGY PARTNERS' reserach topics of interest include a wide range of areas, especially material engineering, aviation and space transportation, and processing/applications of data obtained from EO satellites.

Main products and services:

- Composite materials for launching systems.
- Composite materials used in satellites and space probes.

The most important achievements in the space sector:

- Development of a production technology of CNT-doped thermoplastic nonwoven veils allowing to tailor mechanical, electrical and thermal properties of GFRP and CFRP composite structures.
- Development of waterborne polyurethane coatings for icephobicity or hydrophobicity of various surfaces.
- Collaboration on incubation and acceleration of young SMEs from the space sector, i.a. within the scope of the H2020 Go2Space-HUBs project – Generating new sOlutions 2 and from Space through effective local start-up HUBs. https://cordis.europa.eu/project/id/690819

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GIAP sp. z o.o.

The GIAP company is a key supplier of solutions based on GIS-class software for Public Administration, Institutions, business and selected sectors of the economy. GIAP products enable comprehensive analysis and management of terrestrial data, supporting companies and public institutions in obtaining comprehensive information about space.

By integrating spatial, satellite and aviation data, the GIAP software allows you to create analyzes that enable effective space management, investment planning and environmental protection.

Through the acquired experience and knowledge, a wide portfolio of products and services, and the company's flexible policy, the company's solutions are a key pillar in activities for the digital transformation of local governments and the transformation of analog processes into digital. Cooperation with GIAP opens the way for clients and partners to a competitive, technological and strategic advantage.

Main products and services:

- GIS software.
- Terrestrial data management.
- Dedicated map portals, 3D data portals.

The most important achievements in the space sector:

- In the GIAP systems that we create and deliver, we use and integrate various types of data, creating comprehensive and integrated GIS systems. We schedule, combine and organize spatial data from many sources - terrestrial, satellite, aerial and photogrammetric data, thus making the interpretation of information about the indicated area consistent.
- In the GIAP portfolio, we have over 300 implementations in Poland in the field of delivery and implementation of dedicated Spatial Information Systems for public administration, institutions, business and selected sectors of the economy. The input data for our implementations are satellite, aviation and photogrammetric data on the basis of which system users perform various types of comparative analyzes of the area, spatial statistics and inventory of space, e.g. inventory of squares, parks and green areas in the city.
- We provide dedicated mapping portals and 3D portals for Investors. With the use of our online tools, each User can easily visualize the planned investment in relation to the terrain conditions, the level of urbanization and can analyze the shading of the area. The input data for three-dimensional studies are numerical terrain models (DTMs).

Entity type: SME

Main technological domains

010101
010101
010101 Space System Software (TD 2)

System Design & Verification (TD 8)

Mission Operation and Ground Data Systems (TD 9)

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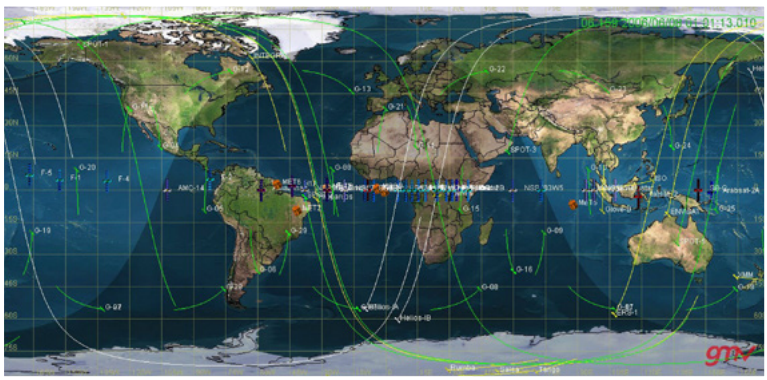
GMV Innovating Solutions sp. z o.o.



GMV Innovating Solutions Sp. z o.o. was founded in 2008 as a fully owned subsidiary in Poland of the international technology group GMV. The company develops in Poland the whole GMV portfolio of activities and performs their own projects with particular focus on three industries: Space, Intelligent Transportation Systems (ITS), defense and security. The global aim of GMV Innovating Solutions Sp. z o.o. activities is to provide IT solutions, integrated systems, specialized hi-tech products and services with close cooperation with clients and end-users. Within few years GMV Poland become reliable partner, products and service provider for European Space Agency, European prime contractors and satellite operators. GMV Poland possesses their own technical and service facilities and 80% of its employers are engineers (IT specialists, mechanics and telecommunication specialists).

Main products and services:

- Mission control.
- AOCS & GNC On Board SW
- Ground Station Monitoring & Control
- GNSS receivers
- Operations Execution.

The most important achievements in the space sector:

- On-board software – Delivery of full on-board software for OPS-SAT satellite, deliver of ADCS and FDIR system (OPS-SAT Phase B2/C/D/E1). Satellite on-orbit from 2019.
- GNSS SW receivers – GNSS software receivers line of products for microsatellites and microlaunchers. In flight tests foreseen onboad MIURA-1 launcher and GOMX-5 satellite under ESA programme.
- Data processing – Development of data processing alghortims, data quality, data orchestrators for many different missions in examp: SWARM, EarthCARE, ALEOS, BIOMASS.

Entity type:
Large enterprise

Main technological domains

- On Board Data Subsystems (TD 1)
- Space System Software (TD 2)
- Mission Operation and Ground Data systems (TD 9)
- Flight Dynamics and GNSS (TD 10)
- Space Debris (TD 11)

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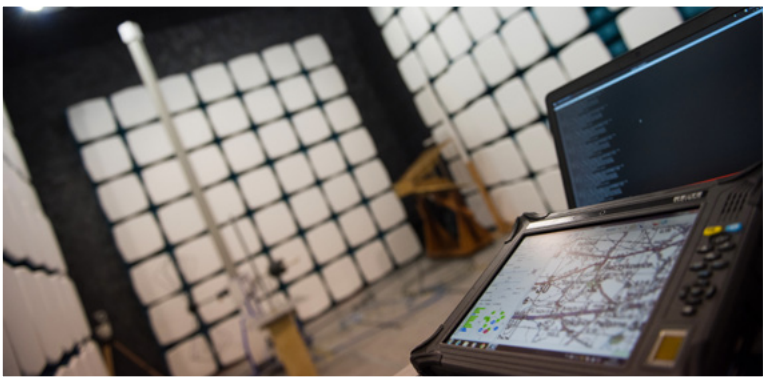
Hertz Systems sp. z o.o.



Hertz Systems has been operating with passion for technology for over 32 years, providing comprehensive services - from design to production, assembly, integration, testing, training. The company offers hardware and software solutions for the army, governmental and European institutions and private sector. Hertz Systems for over a decade has been active on the military market, providing the Polish Armed Forces with a satellite navigation receiver integrated with the cryptographic module. The entity is executing space projects related to GNSS systems for downstream applications, and sensors for upstream use. The company is also working on development of the European GALILEO PRS service, actively striving the produce PRS receivers in Poland.

Main products and services:

- Military GPS receivers integrated with SAASM cryptographic module
- GNSS receivers
- Hawk system – detection and neutralization of drones
- TEMPEST equipment.

The most important achievements in the space sector:

- Participation, as the only Polish entity, in a project related to the development of the Galileo PRS receiver
- The company is a member of the Consortium building the Space Technology Park, which will be located in the western part of Poland (near Zielona Góra, the company's headquarters). A number of specialized laboratories will be built in the aforementioned facility.
- Development of dual GPS/Galileo receivers dedicated for downstream applications, aiming to improve users safety.

Entity type: SME

Main technological domains

- Space Systems Software (TD 2)
- RF Subsystems, Payloads and Technologies (TD 6)
- System Design & Verification (TD 8)
- Flight Dynamics and GNSS (TD 10)
- Ground Station System and Networks (TD 12)

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ICEYE

Iceye Polska sp. z o.o.

ICEYE is a world leader in the use of SAR (synthetic aperture radar) technology in microsatellites.The company supports better decision making by providing access to up-to-date and reliablesatellite images for any place on Earth, regardless of the time of day or weather conditions.

Main products and services:

- Development and Construction of Space Segment (PT IV.E)
- Mission Operations (PT IV.A)
- Ground Station Monitoring & Control (PT IV.B5)
- RF and microwave Instruments (PT II.I1)
- On Board Data Management (PT II.F1).

The most important achievements in the space sector:

- World's first successfully launched SAR microsatellite.
- The world's largest commercial constellation of SAR satellites (14 missions)
- The only existing advanced solution for global flood impact analysis

Entity type: SME

Main technological domains

- System Design & Verification (TD 8)
- Mission Operation and Ground Data Systems (TD 9)
- RF Subsystems, Payloads and Technologies (TD 6)
- On-board Data Subsystems (TD 1)
- Space System Software (TD 2)

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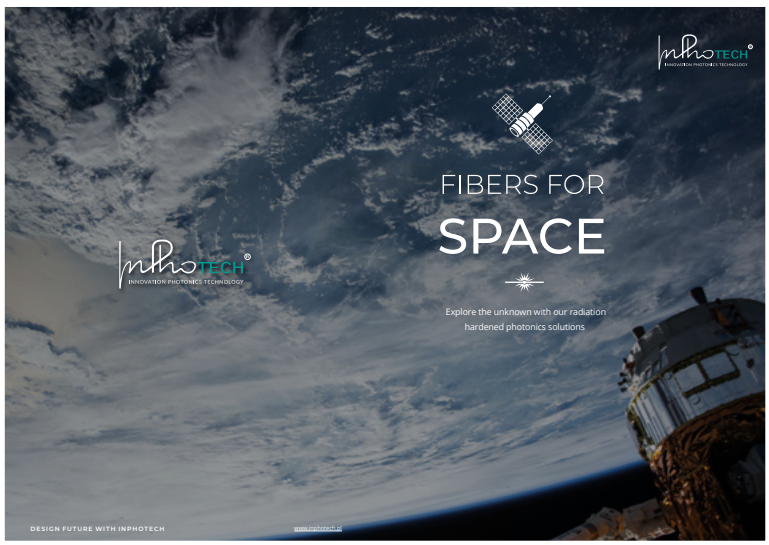
InPhoTech sp. z o.o.



InPhoTech is a Polish company providing advanced solutions based on fiber optics photonics technologies. We provide solutions for a broad spectrum of business areas, including rail, the gas industry, telecommunications and many more.

We know the potential of optical fibers and how to apply them, creating completely new solutions that are intended for use in demanding conditions on land, underground and in space. We create intelligent structures integrated with the fiber optic sensor enabling real-time monitoring of many parameters throughout the structure. Our products are used to enhance the efficiency and competitiveness for our clients and to improve their security.

Main products and services:

- Sensors used in satellites and space probes.
- Manufacture of parts for satellites and space probes.

The most important achievements in the space sector:

- Radiation hardened multicore optical fiber amplifier V.C. Duarte, J.G. Prata, C.F. Ribeiro, R.N. Nogueira, G. Winzer, L. Zimmermann, R. Walker, S. Clements, M. Filipowicz, M. Napierała, T. Nasiłowski, J. Crabb, M. Kechagias, L. Stampoulidis, J. Anzalchi and M. V Drummond,
- Finesse project – ESA Contract No. 4000123665/18/NL/BJ.

Entity type: SME

Main technological domains

Optics (TD 16)

Optoelectronics (TD 17)

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Instytut Agrofizyki im. Bohdana Dobrzańskiego Polskiej Akademii Nauk

(Bohdan Dobrzański Institute of Agrophysics of the Polish Academy of Sciences)

Institute of Agrophysics (IA PAS) is a research institution of the Polish Academy of Sciences. IA PAS is an institute of Division II of Biological and Agricultural Sciences of the Polish Academy of Sciences. The main object of research is focused on transport processes in the soil-plant-atmosphere system, properties and processes affecting soil and plant quality, processing for food and energy purpose. The interdisciplinary approach applies physics, physicochemistry and biology for solving contemporary problems of agriculture. Applicable research is focused on developing and improving methods and devices for evaluation and monitoring of soil, agricultural plant materials and gas emission, and on creating new food technologies of biomass processing for energy or new biomaterials and biopreparations.

Main products and services:

- User operations in the ground segment – tool management, data analysis etc.

The most important achievements in the space sector:

- Implementation of the SWEX/R project „Soil, Water and Energy Exchange / Research" financed under the ESA - PECS program (Agreement on the European Cooperating State between the Government of the Republic of Poland and the European Space Agency), theme package No. 98084, coordinator from the Space Research Center of the Polish Academy of Sciences: Dr. Wojciech Marczewski, representative of the Institute of Agrophysics of the Polish Academy of Sciences: prof. dr hab. Bogusław Usowicz
- Implementation of the project „ELBARA_PD (Penetration Depth)" No. 4000107897/13/NL/KML (AO 1-7021) financed under the ESA - PECS program (Agreement on the European Cooperating State between the Government of the Republic of Poland and the European Space Agency), PI: Dr. Mateusz Łukowski
- Implementation of the project „Technical Support for the Fabrication and Deployment of the Radiometer ELBARA-III in Bubnow, Poland" No. 4000113360/15/NL/FF/gp financed by the European Space Agency, PI: Dr. Mateusz Łukowski

Entity type: Research and Development unit

Main technological domains

Thermal (TD 21)

Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU) (TD 22)

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Instytut Fizyki Jądrowej im. Henryka Niewodniczańskiego Polskiej Akademii Nauk

(Henryk Niewodniczański. Institute of Nuclear Physics of the Polish Academy of Sciences)

The Henryk Niewodniczański Institute of Nuclear Physics (IFJ PAN) is one of the largest institutes of the Polish Academy of Sciences, with an A+ category in the group of sciences and engineering since 2014. The Institute conducts fundamental and applied research in the field of physics and related sciences. Using the latest achievements in technology and informatics at the IFJ PAN, research is conducted on the structure of matter and properties of fundamental interactions from the cosmic scale to elementary particles. The results of our research are published annually in more than 600 reviewed articles in high-scoring scientific journals and in more than 100 other publications: monographs, conference proceedings and reports. Every year the Institute is an organiser or co-organiser of many international and national scientific conferences and a number of seminars and other scientific meetings.

Main products and services:

- Building Blocks (BB) sensors used in satellites and space probes.
- **Electrical, electronic and electromechanical components.**

The most important achievements in the space sector:

- European Space Agency (ESA) Project Experiment Matroshka 2a and 2b: Measuring Radiation Hazards in Space. The experiment was based on long-term (2004-2009) measurements of cosmic radiation doses in anthropomorphic models of the human body on the International Space Station in Earth orbit. The results of the measurements allowed a realistic assessment of the radiation exposure of astronauts. An effect of the Matroshka project and its continuation are unique investigations that are the main scientific task of the planned first flight of the new American manned space vehicle Orion to the Moon orbit (Artemis-1 mission) at the end of 2021: „MARE - the Matroshka AstroRad Radiation Experiment".
- DOSIS 3D experiment (from 2012 to present): Participation in the ESA „DOSIS 3D" experiment (participation funded by the NCN HARMONIA project „Spatial distribution of cosmic radiation dose on the International Space Station - DOSIS 3D" in 2013-2016). Measurements with thermoluminescence and track detectors in the Columbus module of the International Space Station to determine the cosmic ray field and its variation in time.
- Space electronics irradiation: For the irradiation of space electronics, two sites at the cyclotron AIC-144 were adapted at the IFJ PAN. The first irradiation of elements of the Polish artificial satellite Hevelius was performed in 2012. In the following years, in the framework of radiation resistance tests of electronic systems designed for use in space, in a dedicated site, proton beam irradiations were carried out for commercial companies.

Entity type: Research and Development unit

Main technological domains

Space Systems Environments and Effects (TD 4)

Electrical, Electronic and Electro-mechanical (EEE) Components and Quality (TD 23)

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Instytut Fizyki Plazmy i Laserowej Mikrosyntezy im. Sylwestra Kaliskiego

(Sylwester Kaliski Institute of Plasma Physics and Laser Microfusion)

IFPiLM's activity focuses on nuclear synthesis in the aspect of power generation. The scope of research (in cooperation with leading entities from other countries) includes methods of creating, physical properties and governing processes of inertially confined laser plasma and magnetically confined thermonuclear plasma. Another important avenue of research carried out in IFPiLM, based on the experience of group from IPPT PAN in cooperation with the French CNRS, is the study of plasma propulsion for satellites. Prototypes of such devices (Hall Thrusters and Pulsed Plasma Thrusters) made in IFPiLM are studied in Plasma Nudge for Satellites Laboratory, created from ground up in recent years, and were also measured in Propulsion Laboratory of the European Space Agency.

Main products and services:

- Mission control and use of ground system.

The most important achievements in the space sector:

- KLIMT – Krypton Large IMpulse Thruster, ESA Contract No.4000107746/13/NL/KLM
- HIKHET – High Voltage Krypton Hall Effect Thruster, ESA Contract No. 4000122415/17/NL/GE
- LμPPT Innovative Liquid Micro Pulsed Plasma Thruster system for nanosatellites,EC/FP7, Grant Agreement No. 283279.

Entity type: Research and Development unit

Main technological domains

Propulsion (TD 19)

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Instytut Geodezji i Kartografii

(Institute of Geodesy and Cartography)

Institute of Geodesy and Cartography was established in 1945. The Institute's primary task is to carry out research in the field of geodesy and cartography for the needs of science, geodetic and cartographic practice for the purposes of government and local government administration, state security, and also for the needs of geodetic and cartographic service providers. An important part of the Institute's activity is also research and development in the field of aerial and satellite remote sensing in agriculture, environmental protection, spatial management and public statistics. Institute cooperates with many domestic, foreign and international institutions and organisations.

Main products and services:

- User operations in the terrestrial segment – data analysis.

The most important achievements in the space sector:

- ESA EOStat: Agriculture Poland: Services for Earth Observation-based statistical information for agriculture
- ESA 4 Drought System of crop growth monitoring with satellite data to detect drought and monitor its expansion in order to estimate its impact on crop production and plan the mitigation was elaborated. The System of drought forecasting and monitoring is based on synergy of NOAA/AVHRR (from 1997 to 2020), meteorological and Sentinel2 data. The developed model for drought includes indices based on surface temperature and meteorological data for each 1km2 and is delivered for every 10 days of the crop growth. The crop classification and crop development index of actual conditions based on Sentinel2 may be overlaid on spatial distributed drought conditions based on NOAA/AVHRR.
- ESA SAT4EST: Earth observation based service supporting local administration in non-state forest management

Entity type: Research and Development unit

Main technological domains

010101 Space System
010101 Software (TD 2)
010101

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Instytut Łączności - Państwowy Instytut Badawczy

The National Institute of Telecommunications is a scientific research institute with the status of the State Research Institute. Its activity includes research in the field of telecommunications and information technology. The Institute provides scientific, research and technical support to state institutions and implements numerous research projects financed from domestic and international resources. NIT conducts works in the field of, among others, planning and designing of telecommunications networks, radio communication systems, broadband access networks and optical networks, network and service security, network management, designing of computer methods for decision support and methods of knowledge management, electromagnetic compatibility of devices, networks and systems, software for telecommunications and information technology, optoelectronics, satellite techniques, development of special communication systems.

Główne produkty i usługi

- II.I.1 RF and microwave Instruments
- II.L.1 Antennas
- III.B.2 GNSS receivers
- III.H.2 TX, RX, Repeaters and Transceivers
- IV.B.2 RF equipment

Najważniejsze osiągnięcia w sektorze kosmicznym

- RIDETA project – testing of the new algorithms detecting different types of interferences in GNSS signals using especially inertial techniques (INS)
- VDE Future/Jericho VDE project – identification and specification of two new services for maritime sector using satellite and ground elements of VDES system
- SAT-AIS-PL Phase A project – providing at the level of the feasibility study a mission of AIS microsatellite

Entity type: Research Institute

Main technological domains

RF Subsystems, Payloads and Technologies (TD 6)

Electromagnetic Technologies and Techniques (TD 7)

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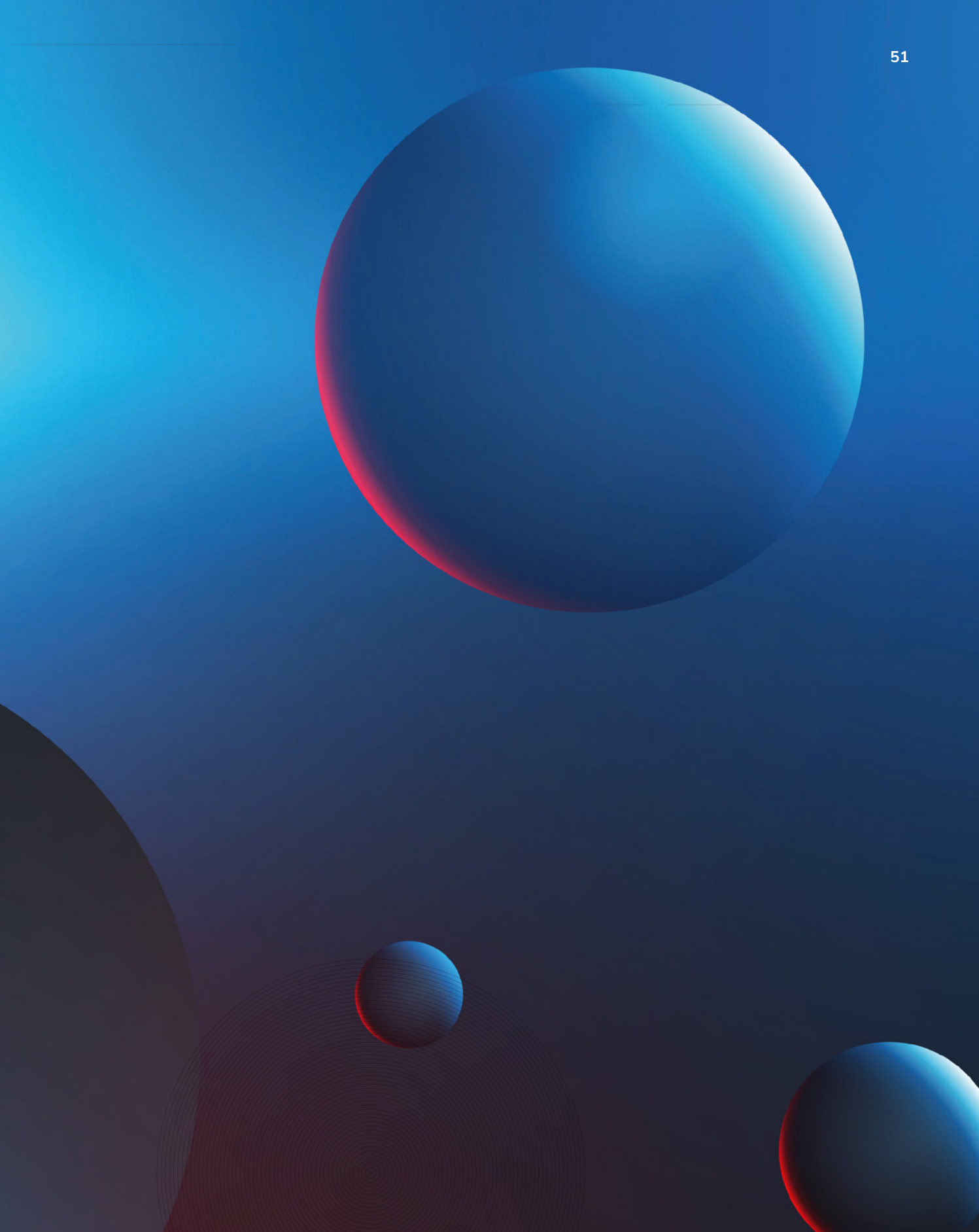

Instytut Obserwatorium Astronomiczne, Wydział Fizyki, Uniwersytet im. Adama Mickiewicza

(Astronomical Observatory Institute, Faculty of Physics, Adam Mickiewicz University)

Astronomical Observatory Institute of Adam Mickiewicz University (AOI AMU) is a leading institution in Poland in satellite dynamics and near Earth asteroid research.The Observatory participates in the SSA Programme, carrying out various research and development projects. The Observatory participates in satellite dynamics research since the dawn of space era. Two of our instruments, PST1 telescope in Borowiec and PST2/RBT in Arizona (Fig. 3), have been participating in the SSA Programme for several years. The latest accomplishment in this area is PST3 – a unique, heterogenous cluster of 5 telescopes.

Main products and services:

- Optical Comm – BB/Software.
- Systems Engineering – software.

The most important achievements in the space sector:

- Design, construction, and operation of the PST3 satellite telescope cluster. Development of a dedicated planning software and data analysis system.
- Participation in an international project: FP7 CLEANSPACE Small debris removal by laser illumination and complementary technologies
- ESA project leader: NEO & SST Observation Assistant Service (NOAS).

Entity type: University

Main technological domains

- Flight Dynamics and GNSS (TD 10)
- Space Debris (TD 11)
- Ground Station Systems and Networks (TD 12)
- Life & Physical Sciences (TD 14)

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Instytut Oceanologii Polskiej Akademii Nauk

(Institute of Oceanology of the Polish Academy of Sciences)

Institute of Oceanology of the Polish Academy of Sciences (IO PAN) was established in 1983. Today, it is a leading oceanographic institution in Poland, also having an established position in European and global marine research. The mission of the Institute is to conduct basic research of the marine environment and broaden the knowledge of the phenomena and processes taking place in it. The Institute of Oceanology conducts research mainly in the Baltic Sea and in the European Arctic. The Institute also conducts research and applications related to various aspects of satellite remote sensing of the properties of the oceans and the air-sea interface. It has extensive experience in the processing and use of satellite data in research and monitoring of the marine environment.

Main products and services:

- Processing and analysis of EO satellite data.
- In situ radiometric measurements for satellite data calibration.

The most important achievements in the space sector:

- Creation and operational maintenance of the SatBałtyk System - enabling routine monitoring of the environmental parameters of the Baltic Sea on the basis of satellite data and dedicated hydrodynamic models (IO PAN is the consortium leader and the main operator of the system).
- Participation in the development of a virtual platform enabling the search and handling of various EO data for selected areas and related model data sets and in-situ measurements in a selected area – Ocean Virtual Laboratory Project.

Entity type:

Research and Development unit

Main technological domains

010101 010101 010101 Space System Software (TD 2)

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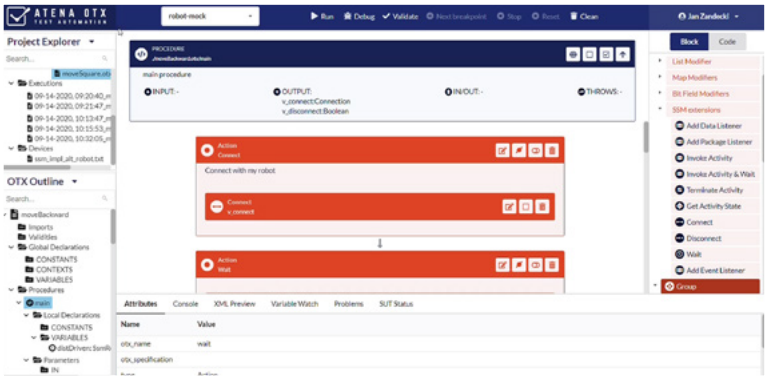
ITTI sp. z o.o.



● Entity type: SME

● Main technological domains

- On Board Data Processing (TD 1)
- Space System Software (TD 2)
- System Design & Verification (TD 8)
- Mission Operation and Ground Data Systems (TD 9)
- Space Debris (TD 11)

ITTI is an IT company (SME) providing software solutions for companies and institutions in Poland and other countries. We have operated since 1996 and are located in Poznan, Poland. Currently, we have a team consisting of ca. 85 peoples.

Our main goal is to develop and provide innovative applications and dedicated software solutions that are adjusted to customer needs (e.g. software for R&D activities, systems supporting manufacturing processes and the management of warehouses, as well as systems supporting space missions).

In the Space Area, our interests revolve around Ground Segment Support Software, Space Situational Awareness and On-board data handling protocols.

Main products and services:

- Satellites & Probes - On-board Data Management
- Ground Segment - Development and Construction of Space Segment
- Ground Segment - Mission Operations

The most important achievements in the space sector:

- Contribution in build and development of EGS-CC (European Ground Systems Common Core) components for operational supervision of future space missions.
- Build of the Polish National Expert Centre and development of the SST Core Software for the national operator.
- Build of the universal, multi-protocol „SPACEMAN" tool for discovering, configuring and management of the on-board communications network; development of the network protocol NDCP v.2 for the management of SpaceFibre and mixed SpaceWire/SpaceFibre networks.

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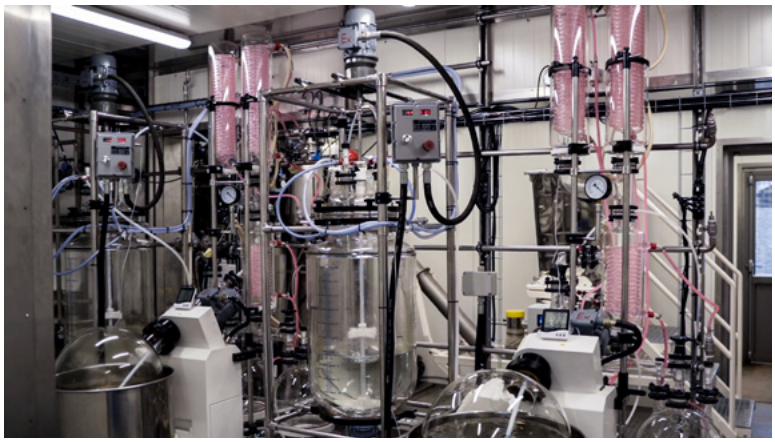
Jakusz SpaceTech sp. z o.o.



For several years, Jakusz SpaceTech has been a respected producer of ‚green' propellant - HTP (hydrogen peroxide with a concentration of up to 98%) and has been conducting scientific research on it in cooperation with the European Space Agency (ESA). The company is also working on other rocket fuels such as DMAZ or ionic liquids.

The Jakusz SpaceTech research laboratory was established in 2015 on the basis of a team of chemical specialists and focused its activities on space technologies, mainly in the fields of propellant production and technological research projects. The team of specialists came from the Jakusz company, which was established in 1985 and is one of the leaders in security and defense systems.

Main products and services:

- Production and sale of HTP, DMAZ rocket fuel and ionic liquids and for re-entry systems.
- Performing chemical tests and analysis.
- Material compatibility tests for rocket fuels
- Hypergolic fuels testing.

The most important achievements in the space sector:

- "Development of a catalyst bed for the 1N thruster" – ESA project
- "High Concentration Hydrogen Peroxide Safety Validation Testing" – ESA project
- „Optimization of passivation parameters for different aluminum alloys" – ESA project
- "Hydrogen Peroxide Storability/Compatibility Verification" – ESA project

Entity type: SME

Main technological domains

Propulsion (TD 19)

Materials and Manufacturing Processes (TD 24)

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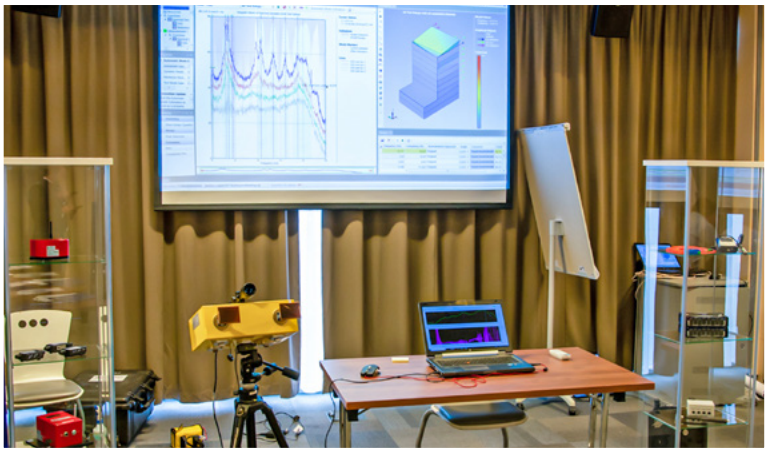
KOMES sp. z o.o.

● Entity type: SME

● Main technological domains

- Mechanisms (TD 15)
- Structures (TD 20)
- Thermal (TD 21)
- Materials and Manufacturing Processes (TD 24)
- Quality, Dependability and Safety (TD 25)



The KOMES company is to undertake and solve unusual engineering projects. Main activity of the company focus on Computer Aided Engineering (CAE) simulations at the expert level.

The functionality and safety of customer's solutions are verified. Measurements, tests and diagnosis of prototypes as well as already in use structures are carried out. The company prepare expertises, opinions and recommendations regarding issues in the field of structural theory, dynamics, mechanics of interaction of vehicles and equipment, uncon-ventional solutions. Laboratory and technical facilities are constantly being developed.

The company own the Mobile Laboratory of Mechanical Measurements.

Main products and services:

- Designing mechanisms and structures.
- Designing structures supporting the integration and satellite testing.
- Design of adapters, launching, turning, and supporting devices.
- Execution and production of structures and mechanisms.
- Testing, consulting in the field of physical and virtual tests.

The most important achievements in the space sector:

- Participation and support in the PW-Sat2 satellite construction project.

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KPGeo sp. z o.o.

KPGeo is a global photogrammetric mapping and surveying company that provides its customers top quality geospatial services and products. Our offices are located in Cracow, Poland and in Kansas City, USA. We combine the best of two worlds: American perfectionism, work organization and innovative technology, with high quality production in Poland, performed by highly educated and trained professionals ready to face challenges of the most complicated and technically sophisticated projects. KPGeo is ISO 9001:2015 and AQAP 2110:2016 certified. We are a full-service geospatial mapping and survey firm.

The most important achievements in the space sector:

- Land Use Land Cover Map for Philippines
- ETOD and AMDB satellite imagery based products
- 3D buildings models based on monoscopic satellite imagery

Entity type: SME

Main technological domains

010101 Space System
010101 Software (TD 2)

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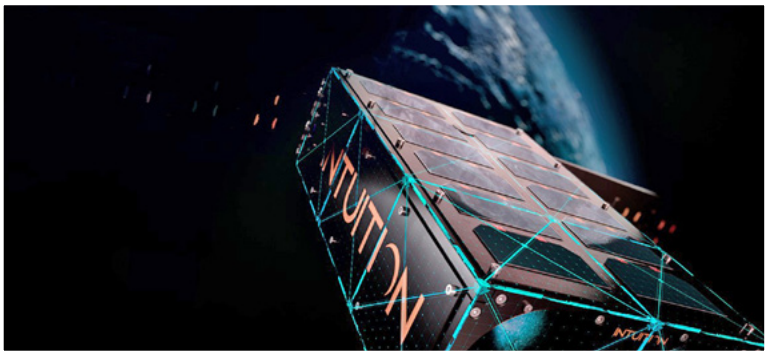
KP LABS

KP Labs sp. z o.o.



● Entity type: SME

● Main technological domains

010101 010101 010101 Space System Software (TD 2)

On-board Data Subsystems (TD 1)

Mission Operation and Ground Data Systems (TD 3)

KP Labs – is a new space company whose mission is to accelerate space exploration through the development of autonomous spacecraft and robotic technologies. The experience includes development of on-board software, hyperspectral imaging devices, artificial intelligence algorithms and high-performance computers. Its flagship project is the Intuition-1 mission, the launch of which is planned for the turn of 2022 and 2023. The goal is to launch a satellite for Earth observation into a low orbit, which, thanks to artificial intelligence solutions and a dedicated on-board computer, will automate and accelerate the process of acquiring and processing photos already on board the satellite. From 2019, the company has the status of a R&D Center, and in 2022 it plans to open a Research and Development Center.

Main products and services:

- On-board software for spacecrafts management.
- Designing highly efficient on-board computers.
- On-board data management.
- Artificial intelligence solutions.
- Thermal design.

The most important achievements in the space sector:

- Construction of the Intuition-1 Earth observation satellite, which will be placed in orbit in Q4 2022 – Q1 2023. The project is implemented under the Smart Growth Operational Program (POIR) 2014–2020, and its value exceeds PLN 19 million.
- Development of a set of innovative products called Smart Mission Ecosystem, consisting of algorithms, software and satellite hardware, that will reduce the time and operational costs of the mission.
- Building its own, modern Research and Development Center with an area of over 2,300 m2. Thanks to its infrastructure and research facilities, the center will enable the construction, testing and integration of the satellite's volatile components, as well as the complete control of the mission from the ground station. The value of the investment is over PLN 15 million.

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N7 Space sp. z o.o.

● **Entity type: SME**

● **Main technological domains**

010101
010101
010101 **Space System Software (TD 2)**

System Design & Verification (TD 8)

N7 Space specializes in software development for space industry. Company has a broad experience in projects of on-board software for satellite systems for ECSS criticality B level.

Main products and services:

- application software for on-board systems (Leon3, ARM),
- boot software and Board Support Packages for Leon3 and ARM CPUs,
- Model Based Systems Engineering technologies,
- test scripting engines,
- database software,
- ground segment software,
- EGSE & SVF software,
- Independent Software Validation & Verification,
- ECSS qualification processes

The most important achievements in the space sector:

- On-board software development for PROBA3 (ESA)
- Execution of the project (ESA): ECSS-E-ST-50-15C Protocol On-Board SW Implementation
- Execution of the project (ESA): Model checking for formal verification of space systems

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Narodowe Centrum Badań Jądrowych

(National Center for Nuclear Research)

National Centre for Nuclear Research is the largest research Institute in Poland. We are also the only Polish research institution operating a nuclear reactor (the MARIA reactor). Currently we are hiring over 1100 employees. Our research staff includes about 70 Professors and holders of the Dr hab. post-doctoral degree, as well as over 200 PhDs.

The most important achievements in the space sector:

- Research and publication: J. Jagielski, A. Piatkowska, A. Merstallinger, Z. Librant, P. Aubert, R. Groetzschel, T. Suszko, „Friction properties of implanted alumina for vacuum applications", Vacuum 81 (2007) 1357 –1362.

Entity type: Research and Development unit

Main technological domains

Materials and Manufacturing Processes (TD 24)

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PCO S.A.

● **Entity type:**
Large enterprise

● **Main technological domains**

Optics (TD 16)

PCO S.A. is a company with over 45 years of experience. It is the biggest Polish producer of optoelectronic devices with use of night vision, thermal imaging and laser technology. All products are a result of research and development activities of the company.

PCO SA produces a wide range of optoelectronic observation and aiming devices with laser, night vision and thermal vision technologies to military personnel and uniformed services. These include night vision goggles and monoculars, aviator's goggles, as well as day-night thermal imaging and night vision aiming sights, collimator sights.

Main products and services:

- II Sat.and Probes, Parts, 1. Mechanical, Optical and Magnetic parts, b. Optical Parts (lenses, beam-splitters, ...)
- II Sat.and Probes, Parts, 1. Mechanical, Optical and Magnetic parts, a. Connecting parts (nuts, bolts, etc), Separating parts (springs, cutters, etc), Spacing Parts, Bearing Parts, Control Parts (gears),
- II Sat.and Probes, B Electronics, 1. EEE Components, p. Optoelectronic Devices (including opto-couplers, LED, CCDs, displays, sensors)

The most important achievements in the space sector:

- PROBA-3 coronograph. PCO responsible for the design and manufacture of the mechanical part - Coronograph Optical Box (COB) housing.
- CIROP (ESA-PLIIS). Feasibility study of the possibility of observation in the infrared (IR) band to optimize the work and data transfer for the main observation system.
- HESS Telescope (High Energy Stereoscopic System). As part of the cooperation, PCO responsible for the manufacture of mechanical parts and the installation of hydraulic actuators to control the mirrors.

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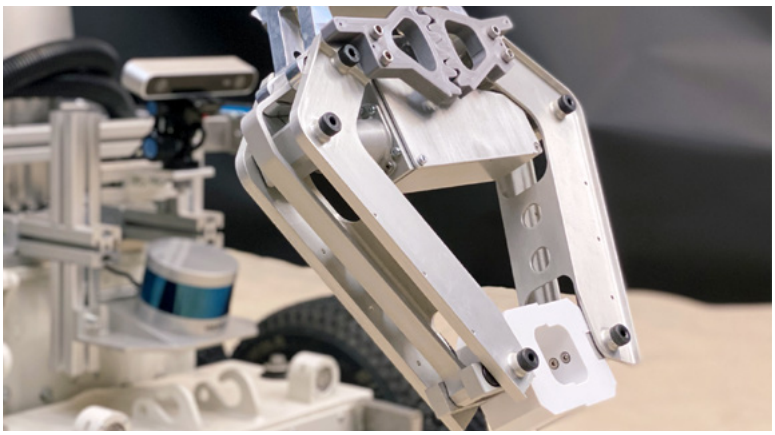
PIAP Space sp. z o.o.



PIAP Space is active in the space and satellite engineering sector. The company specializes in the following areas: robotics, automatics and mechanics. PIAP Space develops technologies and products in the field of satellite integration and testing equipment (MGSE), active space debris removal, manipulators and grippers, in-orbit satellites operation, human-robot interaction, vision systems and mechanisms.

Main products and services:

- Solutions and products for orbital robotics, incl. grippers, force and moment sensors, robotic arms.
- Field tests as well as assembly and integration of subsystems of mobile robots.
- Mechanical Ground Support Equipment (MGSE).

The most important achievements in the space sector:

- TITAN project - The project involves the development of a robotic arm for servicing satellites. During the project a prototype of a multi-articulated robotic arm for the future deorbitation and servicing of satellites in orbit will be designed and produced. (TRL6).
- EROSS/EROSS+ project - The aim of EROSS+ (European Robotic Orbital Support Services) is to demonstrate European solutions for servers and serviced LEO/GEO satellites, enabling a wide range of efficient and secure orbital support services.
- PRO-ACT project - The aim of the project was to develop methods for autonomous robotic cooperation - joint manipulation and synchronized movement in the construction of a simulated lunar base.
- ADRexp project - Development and verification of a system for reliable, unsupervised visual recognition of the movement of an uncooperative capture satellite in orbit.
- ORBITA project - The aim of the project is to develop a family of modular interceptors for orbital and planetary applications. The project will develop three types of innovative grippers: for satellite capture, satellite servicing and planetary missions.

Entity type:
Large enterprise

Main technological domains

- System Design & Verification (TD 8)
- Space Debris (TD 11)
- Automation, Telepresence & Robotics (TD 13)
- Mechanisms (TD 15)

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Planet Partners sp. z o.o.

● Entity type: SME

● Main technological domains

Others (TD 26)

Planet Partners is consulting company specializing in communication consulting, campaign implementation, and crisis management. We support B2B companies, companies from innovative sectors of the economy (including the high-tech industry), and public sector entities in achieving their business goals through effective communication with the environment.

We prepare communication strategies, take care of their good relations with the environment and react to crises. We provide comprehensive services in cooperation with experienced marketing partners. We are part of the international Globalcom PR network, providing our clients with a network of branches located in 60 countries. Thanks to this, we can effectively support the communication of any brand in Poland and abroad.

The most important achievements in the space sector:

- Building and creating brand awareness of the international European Rover Challenge space
- The only communications agency in Poland specializing in services for the space sector
- Initiated the creation of an international PR network specializing in serving space sector entities around the world.

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Politechnika Śląska

(Silesian University of Technology)

The Silesian University of Technology is the oldest public technical university in Upper Silesia and one of the largest in the country. As the only university in the region it is among the prestigious laureates of the Ministry of Education and Science competition „Excellence Initiative - Research University".More than 60 fields of study and about 200 specialisations are currently offered in 15 units, covering the entire range of engineering activities. Scientific research is conducted in all disciplines of engineering and technical sciences, as well as the disciplines of chemical sciences, Earth and related environmental sciences and management and quality studies. On the basis of in-depth analyses of the achievements of the staff, international cooperation, technology transfer and owned infrastructure, 6 priority research areas have been identified.

The most important achievements in the space sector:

- Preparation of image processing techniques for obtaining precise results of photometric measurements in the mission of First Polish Scientific Satellites BRITE-PL
- Preparation of the design of optics and procedure of adjusting the telescope for hyperspectral observations within the NCBiR project

Entity type: University

Main technological domains

Materials and Manufacturing Processes (TD 24)

Space System Control (TD 5)

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Polskie Zakłady Lotnicze sp. z o.o.

● **Entity type:**
Large enterprise

● **Main technological domains**

Materials and Manufacturing Processes (TD 24)

Structures (TD 20)

PZL Mielec is one of the largest aircraft manufacturer in Poland and the largest production site for Lockheed Martin outside the USA. PZL Mielec has a fully functional airframe manufacturing facility, a final assembly production line, an aircraft completion and a flight operations center.

PZL Mielec capabilities included:

- design and production of detail and assembly tooling,
- production of formed Al sheet metal parts,
- production of CNC machined Al and steel parts,
- assembly of complex aerostructures,
- conceptual and detail design of aerostructures,
- fatigue & material testing.

From 2020 PZL Mielec realize project and activities for Polish and European space industry.

Main products and services:

- Metallic materials
- Composite materialc (glass, carbon and aramid fibres)
- Propellant tanks
- Connecting parts (nuts, bolts, etc.) separating parts (springs, cutters, etc.), spacing parts, bearings parts, control parts (gears), ...

The most important achievements in the space sector:

- Analysis of Block Structures type connections for Lockheed Martin Space
- Developement of innovative snap-fit T-rap connections for space application for Lockheed Martin Space
- Participation in realisation of the project for ESA: „<40l monopropellant demisable tank" (ESA Contract No. 4000129800/2020/NL/CBi).

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ProGea 4D sp. z o.o.

The ProGea 4D company was established as a result of the development of the ProGea Consulting, which has been operating since 1991 and enjoys the trust of the market. ProGea 4D provides high-level geoinformatics services thanks to a qualified specialists with professional experience in the field of geoinformatics, remote sensing, photogrammetry, natural environment and landscape architecture. We have extensive experience in the implementation of various environmental and research and development projects related to the use of satellite data, performed both for the needs of private companies, local government institutions established to protect nature. We are also a long-term distributor of satellite data from companies such as: Planet Labs, European Space Imaging (MAXAR), HEAD, Capella Space, SI Imagine Services.

The most important achievements in the space sector:

- Life URBANGREEN „Innovative technological platform to improve management of green areas for better climate adaptation" - project financed by UE and realized with R3GIS (project coordinator), ZZM Krakow, Anthea and University of Milano. The final objective of the project was to provide an innovative platform GreenSpaces for a more efficient management of Urban Green Areas, allowing cities to better respond to climate changes. ProGea has done analysis of changes in urban green areas based on the object classification of high-resolution satellite data (WorldView), and developed a methodology for monitoring the health of trees using PlanetScope satellite data.
- „The use of remote sensing to manage the Treasury Agricultural Property - pilot" research and scientific project commissioned by the National Center for Agricultural Support. The ProGea participated in the implementation of scientific research and development works using satellite remote sensing data in the detection and monitoring of crops damages based on the synergy of satellite, meteorological and thermal data.
- AGROEYE - Remote Sensing Application for Supporting the GAEC Assesment. Project implemented as part of the competition launched by ESA: „2nd CALL FOR OUTLINE PROPOSALS UNDER THE POLISH INDUSTRY INCENTIVE SCHEME". The company's role was to program the OpenSource application to support the control of good agricultural condition standards, as well as to conduct automatic land cover and use classification (LULC).

Entity type: SME

Main technological domains

010101
010101
010101

Space System Software (TD 2)

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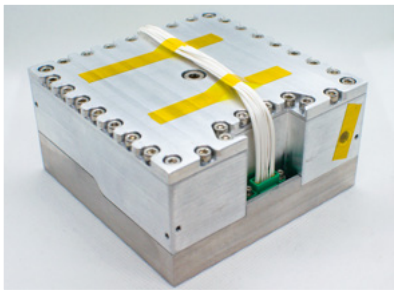
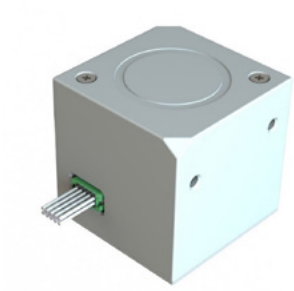
Progresja Space sp. z o.o.





Progresja Space is New Space startup working on cutting-edge technologies. Our mission is to provide advanced propulsion and ADCS solutions to small satellites to push the frontier of our civilization by enabling disruptive services to function in the emerging space economy.

Main products and services:

- „BLINK" cold-gas thruster for nano and micro-satellite
- „FLARE" resisto-jet thruster for nano and micro-satellite
- „FLASH" pulse plasma thruster for nano and micro-satellite
- „MRW" reaction wheels series for nano and micro-satellite

Entity type: SME

Main technological domains

- Propulsion (TD 19)
- Space System Control (TD 5)
- Materials and Manufacturing Processes (TD 24)

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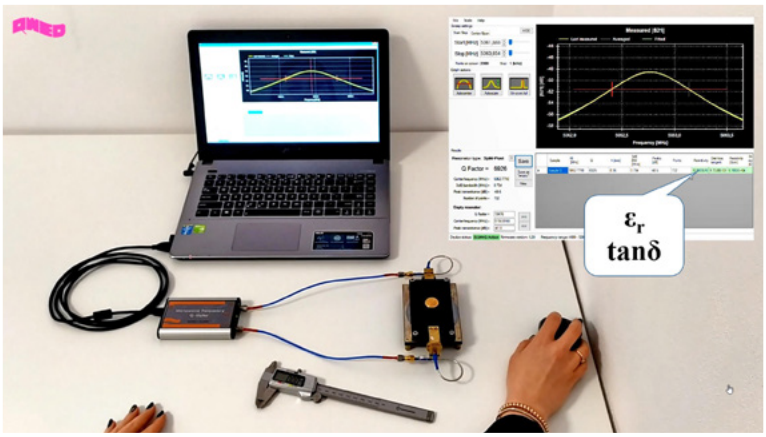
QWED sp. z o.o.



QWED was founded in 1997 to develop and commercialise QuickWave EM simulation software, co-authored by the company co-founders. Currently, over 200 licences have been implemented in academia, research, and industry. Since 2000, QWED further specialises in high-precision microwave material measurements. QWED mission is to promote the use of computer modelling and modelling-based material measurements in science and industry, with a focus on space applications. The team is led by Dr. M. Celuch and includes 2 IEEE Fellows (Profs. W. Gwarek and J. Krupka) and 4 Ph.Ds.

Main products and services:

- System Modelling and Simulation
- System Engineering software
- Thermal Engineering software
- RF and microwave instruments
- Antennas

The most important achievements in the space sector:

- QuickWave software licences implemented in institutes and companies of the global space sector (e.g. National Radio Astronomy Observatory (USA), Jet Propulsion Laboratory (USA), Lyrebird Antenna Research (Australia).
- Test-fixtures for precise measurement of electromagnetic material parameters implemented in institutes and companies of the global space sector.
- Commercial projects on designing dual-reflector antennas and feeding systems for SATCOM applications.

Entity type: SME

Main technological domains

- RF Subsystems, Payloads and Technologies (TD 6)
- Electromagnetic Technologies and Techniques (TD 7)
- Optoelectronics (TD 17)
- Thermal (TD 21)
- Materials and Manufacturing Processes (TD 24)

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RECTANGLE sp. z o.o.

Entity type: SME

Main technological domains

- On-board Data Subsystems (TD 1)
- RF Subsystems, Payloads and Technologies (TD 6)
- Flight Dynamics and GNSS (TD 10)
- Space System Software (TD 2)
- Ground Station Systems and Networks (TD 12)

RECTANGLE Sp. z o.o. is the SME established to develop innovative hi-tech products and solutions dedicated to transport, telecommunication, navigation, public security and safety, crisis management and critical infrastructure sector. The RECTANGLE team was involved in large number of R&D initiatives distinguished by a high innovation potential.

Main products and services:

- radio and inertial navigation systems
- active location systems based on radars, optics or sound
- on-board command&control systems
- designing solutions based on FPGA and Systems-on-a-Chip technology
- telecommunications systems
- designing electronic devices and systems
- developing specialized algorithms and dedicated software

The most important achievements in the space sector:

- A Robust Interference DETection Algorithm for the hybrid GNSS/INS receivers – RIDETA (ESA contract under PLIIS)
- A robust anti-spoofing and anti-interference GNSS receiver front-end (project co-funded by the National Centre for Research and Development under the call „Fast track - Space technologies")

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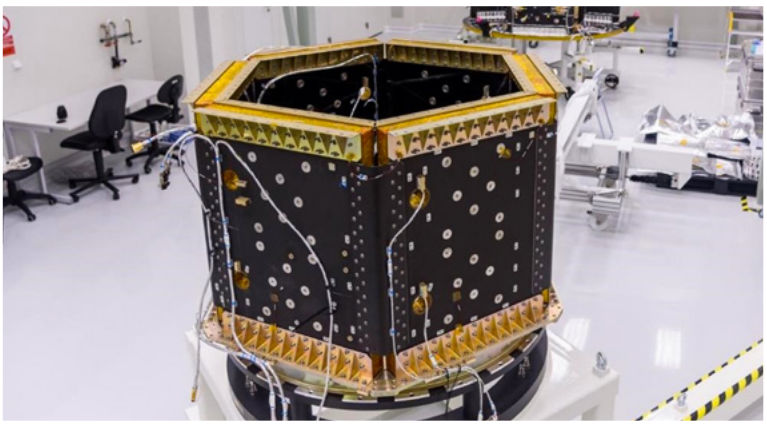
SAB Aerospace sp. z o.o.



S.A.B. Aerospace Sp. z o.o. is a small-medium size enterprise, part of the SAB group, engaged in the development of space subsystems and products for satellites and launchers. The company organization is based on a cluster of SMEs located in different territories with a center of gravity in Central Europe. Besides the specific competencies in Project Management, System Engineering, Product Assurance, mechanical design, and structural verification domain, the SAB strategy to act as a small system integrator in Poland is very ambitious and its implementation started. The company can count on the headquarter based in Warsaw and the engineering as well as the AIT plant located in Zielona Gora.

The most important achievements in the space sector:

- Involvement in the PLATO Project (scientific mission from ESA).
- Set up of the consortium to develop ISRU O2 extraction payload.
- Cooperation in the development of IOSHEXA (In-Orbit Servicing HEXAgonal module of the SSMS Dispenser) for VEGA launch system.

Entity type: SME

Main technological domains

- Structures (TD 20)
- Thermal (TD 21)
- System Design & Verification (TD 8)
- Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU) (TD 22)
- Space Debris (TD 11)

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SatAgro sp. z o.o.

● Entity type: SME

● Main technological domains

010101 Space System
010101 Software (TD 2)
010101

In SatAgro we specialise in creating tools and providing services using satellite data for the agricultural sector. Our main product is SatAgro service (app.satagro.pl), the most actively developing project in the field of precision agriculture in Poland.We act as a link between a dynamically developing sector of satellite observations on one hand and a wide group of agricultural companies on the other. Our services provide access to products based on satellite observations from NASA, ESA and private operators.We also carry out research and consulting in the field of crop harvest monitoring, crop identification, yield forecasting and loss estimation.

Main products and services:

- SatAgro service - app.satagro.pl.
- The use of satellite data for the agricultural sector.
- Tools and services in precision agriculture.
- Conducting research and consultations in the field of monitoring the harvest of crops, identifying crops, forecasting yields, estimating losses and more.

The most important achievements in the space sector:

- SatAgro Service for farmers and agronomists
- ESA project - EO4SD - Earth Observation for Eastern Partnership
- ESA project - ACCESS4FI - Automated Crop Classification and yield Estimation online ServiceS for Food Industry.

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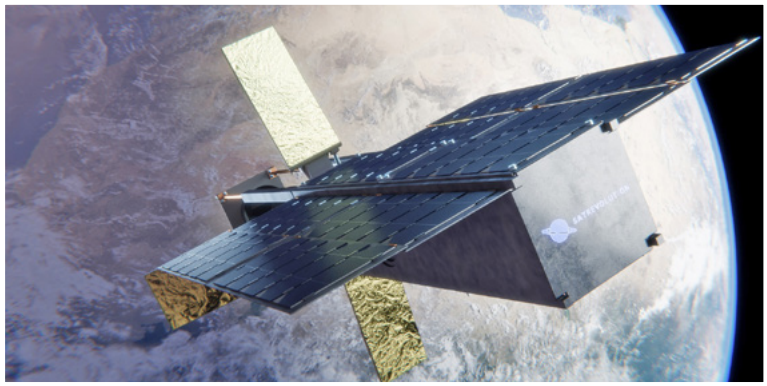
SatRevolution S.A.



SatRevolution was established in 2016 with the aim of developing the real-time earth observation constellation. The company was the first in Poland to place its satellites: Światowid (2019), KRAKsat (2019), and AMICal Sat (2020) in orbit around the Earth. NASA's State of the Art Small Spacecraft Technology report lists SatRevolution as one of only 12 companies in the world that comprehensively design, manufacture and place observational nanosatellites collecting optical data in orbits. Currently, SatRevolution is implementing the next steps to build a functional, commercial constellation of 1,500 observation satellites (REC) by 2028.

Main products and services:

- Design and production of observation nanosatellites.
- Placing nanosatellites in orbit.
- Production of satellite platforms.
- System testing.
- Earth observation images – their analysis and processing, related services.
- Production of commercial components.

The most important achievements in the space sector:

- Design, tested on LEO and perfected own nano bus satellite platform, that is applicable for future projects and customers, as well as developed own optical payload for satellites.
- First Polish fully in-house built earth observation satellite (Światowid) successfully placed in low earth orbit. Resulting in producing the first optical data.
- Creating an actual product for Smart City projects that were acquired by few local governments - data that allows optimizing the costs of taxation collection procedures. Long-term results are going to be increased efficiency of the administration sector in Poland and building foundations for the platform of cooperation of public and private space sector in Poland.

Entity type: SME

Main technological domains

- On-board Data Subsystems (TD 1)
- Space System Software (TD 2)
- Space Systems Electrical Power (TD 3)
- System Design & Verification (TD 8)
- Optics (TD 16)

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Scanway sp. z o.o.

● Entity type: SME

● Main technological domains

- Optics (TD 16)
- On-board Data Subsystems (TD 1)
- Optoelectronics (TD 17)
- Automation, Telepresence & Robotics (TD 13)

We are a commercial supplier of optical instruments for the space industry. We create observation systems for micro and nanosatellites. Our specialists are the authors of, among others: the 3D laser system for orientation in the space of drilled particles (DREAM experiment), the Earth observation satellite system (ScanSAT) or (currently) designers and creators of the optical part for the EagleEye microsatellite and the PIAST - Polish Imaging SaTellite project. Our software and optical devices worked in space. We are in the process of implementing orders and projects that will fly into orbit on board at least 3 satellites within 4 years.

Main products and services:

- Manufacture of optical instruments for outer space applications.
- Design and production of optical parts for satellites.
- Laser system for orientation in space.
- ScanSAT – Satellite Earth Observation System.

The most important achievements in the space sector:

- Designing and launching a measuring chamber in the DREAM project
- Designing an imaging instrument for the ScanSAT project
- Designing an imaging instrument for the EagleEye project

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Semicon sp. z o.o.

Company has been distributing electronic components, materials, tools, measurement equipment and accessories for over 30 years. We provide comprehensive electronic manufacturing services. We specialize in assembling complex projects on rigid and flexible PCBs. We provide Chip-On-Board assembly services, cable harnesses and BGA reballing. We produce laser cut SMT stencils. We offer stencils in the VectorGuard® standard, with nano-coatings and steps. We convert industrial single- and double-sided adhesive tapes, die cut and kiss cut. We are also the largest manufacturer of laser modules in Poland. Our services find recipients in the medical, automotive, space, aviation service, science and military industries

Main products and services:

- Electronic Manufacturing Services (EMS).
- Installation of projects on rigid and flexible PCB.
- Chip-On-Board Assembly.
- Installation of cable harnesses.
- BGA Reballing.
- Production of laser cut SMT stencils.
- Converting industrial single- and double-sided adhesive tapes.
- Die cut and Kiss cut patterns.
- Production of laser modules.

Entity type: SME

Main technological domains:

Materials and Manufacturing Processes (TD 24)

Optoelectronics (TD 17)

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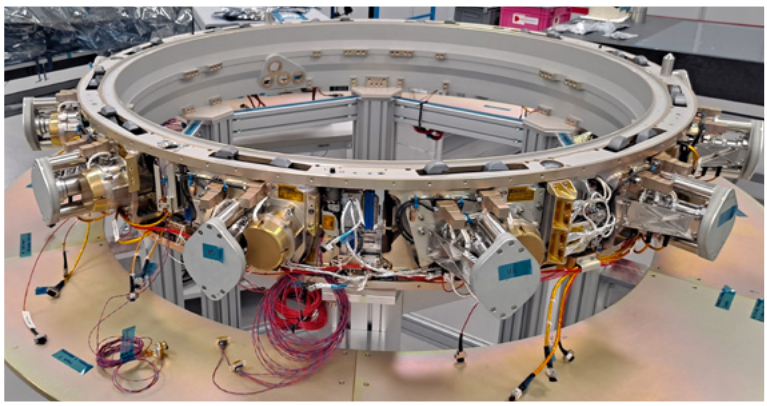
SENER Polska sp. z o.o.

(SENER sp. z o.o.)



SENER Poland commenced its activities in 2006, and since 2012 has focused on developing innovative solutions in space engineering for the key projects of ESA, NASA and ESO. SENER Poland specialises in two fields of mechanical engineering:• Deployment and hold-down mechanisms – essential for transportation of space vehicles in the launch vehicles' loading spaces, and for subsequent deployment of solar panels, antennas and measuring instruments.• Mechanical ground support equipment (MGSE) – used e.g. for precise repositioning of satellites in order to facilitate access for technicians, and for transportation to test chambers and loading spaces. There are just a few companies in Europe that design such devices.

Main products and services:

- Design and production of mechanisms: unfolding and holding, positioning.
- Custom made space engineering solutions.
- Mechanical Ground Support Equipment (MGSE).

The most important achievements in the space sector:

- Umbilical Release Mechanism - ExoMars 2022 (Target TRL - 9)
- Multiple systems for International Berthing and Docking Mechanism - Hard Capture System (IBDM - HCS) (Target TRL - 9)
- Complete sets of MGSEs for missions like: EUCLID, Extremely Large Telescope (ELT) Mirrors 2 and 3, PLATO, ELECTRA Biomass.

Entity type:
Large enterprise

Main technological domains

Mechanisms (TD 15)

System Design & Verification (TD 8)

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Łukasiewicz
Instytut Lotnictwa

Sieć Badawcza Łukasiewicz – Instytut Lotnictwa

(Łukasiewicz Research Network – Institute of Aviation)

The Łukasiewicz Research Network – Institute of Aviation is one of the most modern research institutions in Europe, with traditions dating back to 1926. The Institute closely cooperates with global giants of the aviation industry, such as GE, Airbus, Leonardo, Lockheed Martin or Ariane Gorup, as well as with institutions from the aviation and space industry, including the European Space Agency. The strategic research areas of the Institute are aviation, space and unmanned technologies. It also provides research and services for domestic and foreign industries in the field of material, composite, additive, remote sensing and many other technologies. In the field of space technologies, the Institute specializes in satellite propulsion, rocket systems, avionics, environmental research and satellite remote sensing.

The most important achievements in the space sector:

- Development of several technologies allowing obtaining hydrogen proxide of HTP class (with concentration exceeding 98%)
- ILR-33 AMBER 2K suborbital rocket - the first vehicle in the world to demonstrate in-flight use of 98% hydrogen peroxide in a propulsion system
- Prequalification of the first in the world solid propellant dedicated for Space Debris Mitigation and de-orbiting motors, meeting ESA CleanSpace requirements
- First in the world demonstaration of a hot-firing of a 5 kN rocket hypergolic regeneratively cooled rocket engine using green hypergolic propellants
- Leadership and involvement in 23 out of 29 ESA Chemical Propulsion and Space Transportation projects taking place in Poland
- First in the world in-flight demonstration of a rocket powered solely by a Rotating Detonation Engine.

Entity type: Research and Development unit

Main technological domains

- Space Debris (TD 11)
- Fluid Dynamics (TD 18)
- Propulsion (TD 19)
- Structures (TD 20)
- Thermal (TD 21)

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Solar System Resources Corporation Sp. z o. o.

● Entity type: SME

● Main technological domains

- Space Systems Environments and Effects (TD 4)
- Mission Operation and Ground Data Systems (TD 9)
- Automation, Telepresence & Robotics (TD 13)
- Mechanisms (TD 15)
- Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU) (TD 22)

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Solar System Resources Corporation Sp. z o. o. is a technology startup dealing with the subject of space mining and energy transformation. We strive for a green transformation of the mining industry through the use of space resources. The company designs technologies for the needs of future deep space missions, in particular the exploration and exploration of the Moon's resources, developing unique technological and business solutions enabling the construction of transport and mining infrastructure on the lunar surface. It has competences in the field of space technologies, robotics, automation, and technological scouting. As a registered space mining lobbyist, the company successfully lobbied for Poland's accession to the international NASA Artemis Accords agreement. The company operates on the Polish and American market as USN Solar Sky Mining LLC (usnsolarskymining.com) - joint venture company of US Nuclear Corp. & Solar System Resources Corporation Sp. z o. o.

Main products and services:

- Technological and business planning for commercial deep space missions
- Planning of space mining and resource exploration missions
- Technology scouting and lobbying (a space mining and space technology lobbyist registered in Poland and at the EU Parliament)
- Testing and hardening of materials with a proton beam for deep space missions
- Consulting in the transformation of high-carbon industries with the use of space resources

The most important achievements in the space sector:

- Effective lobbying successfully completed for Poland to join the international NASA Artemis Accords agreement
- Historic Letter of Intent from the US Nuclear Corp. for the delivery of 500 kg of Helium-3 isoalloy from the Moon
- Historic Transantlantic Trade Agreement with the US Nuclear Corp. initiating the construction of the Cis-Lunar value chain

Space Kinetics sp. z o.o.

● Entity type: SME

● Main technological domains

- Flight Dynamics and GNSS (TD 10)
- RF Subsystems, Payloads and Technologies (TD 6)
- Space System Software (TD 2)
- On-board Data Subsystems (TD 1)

Space Kinetics is a consultancy company specialised in Global Navigation Satellite Systems (GNSS). Our main field of expertise is precise orbit determination for GNSS and LEO satellites, scientific applications of GNSS and real-time high-accuracy positioning services. We develop state-of-the-art algorithms for GNSS data processing and analysis.

Main products and services:

- Accurate determination of orbits.
- Satellite Precise Point Positioning.
- Positioning for the commercial market.
- GNSS in space applications.
- Time synchronization with GNSS.
- GNSS data monitoring.
- GPS Products.

The most important achievements in the space sector:

- Real-time Precise Point Positioning on-board LEO satellites
- Multi-constellation multi-frequency GNSS precise orbit determination and point positioning
- Development of machine-learning algorithms for orbital dynamics.

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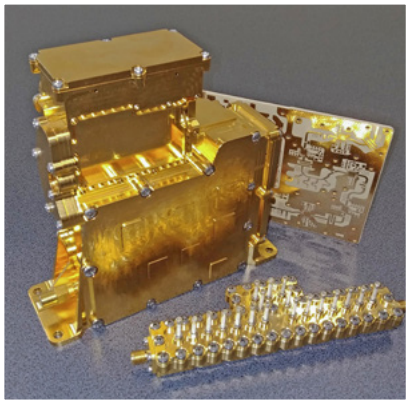
SpaceForest sp. z o.o.



SpaceForest develops and commercializes innovative solutions specializing in microwave techniques, artificial intelligence, advanced electronics and rocket technologies. The company provides a wide range of services in the field of design and prototyping of microwave equipment, precision mechanics and electronics, as well as launching experiments on board of internally developed experimental rockets.

SpaceForest implements internally developed technologies applied in aerospace systems, autonomous tracking and communication system for flying vehicles, or Filter Tuning Solutions for manual and automatic cavity filters tuning. Cooperation with ESA lead to developing low-noise high frequency generators and solid state power amplifiers used in the satellite communication systems

Main products and services:

- Antennas
- Communication
- RF equipment
- TX, RX, Repeaters and Transceivers
- Composite materials

The most important achievements in the space sector:

- ESA projects - „Development and Qualification of Frequency Generators" (PLDRO) and „Development and Qualification of Dual Redundant Medium Power Master Signal Source" - completed at TRL7
- ESA project Solid State Power Amplifier for X-band completed at TRL5. TRL7 scheduled in 2022
- Project "Controllable and recoverable suborbital rocket with hybrid engine SF1000 based on eco-logical propellants- project co-financed by the European Regional Development Fund. Project duration: April 2018 – December 2023. The main objective of the project is to design and build first Polish suborbital rocket able to carry up to 50 kg of commercial payload to altitudes up to 150 km. Successful test flight at the altitude 10km and recovery.

Entity type: SME

Main technological domains

- RF Subsystems, Payloads and Technologies (TD 6)
- Electromagnetic Technologies and Techniques (TD 7)
- Ground Station Systems and Networks (TD 12)
- Propulsion (TD 19)
- Materials and Manufacturing Processes (TD 24)

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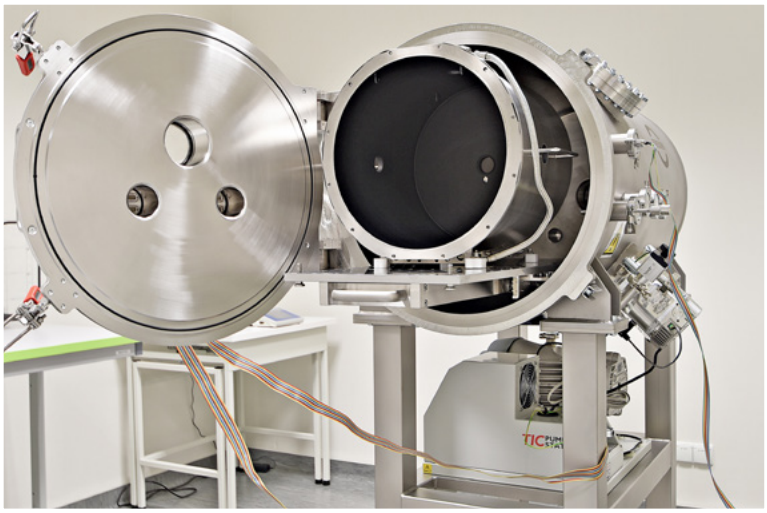
SPACIVE

Spacive sp. z o.o.

● Entity type: SME

● Main technological domains

- Thermal (TD 21)
- Mechanisms (TD 15)
- Materials and Manufacturing Processes (TD 24)



Spacive Sp. z o. o. is a spin-off company founded in 2014 by a group of managers and engineers from the Space Research Center of the Polish Academy of Sciences. We specialize in thermal control systems, designing mechanisms and conducting structural and thermal analyzes of the satellite and its components. We design and manufacture MLI thermal insulation. We conduct R&D research on components for the construction of thermal control systems.

Main products and services:

- Design and production of MLI thermal insulation.
- Conducting thermal-vacuum tests.
- Performing structural and thermal analyzes of satellites and their components.
- Design of thermal control systems for satellites and space probes.
- Constructing mechanisms and structures for space applications.

The most important achievements in the space sector:

- Solar Orbiter - STIX, our engineering team was responsible for Thermal Control System
- PLIIS - implementation of 2 ESA projects related to the development and qualification of MLI technologies

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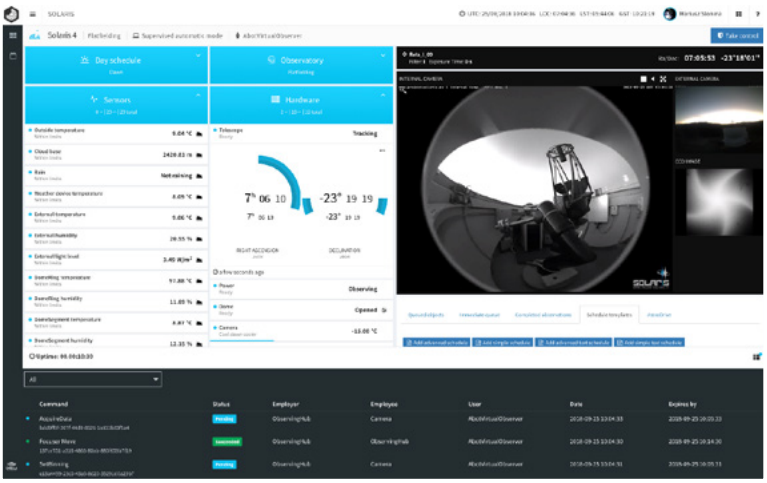
Sybilla Technologies sp. z o.o.



Sybilla Technologies Sp z o.o. specializes in the construction and software development for ground sensors, operates fourteen telescopes on five continents. The sensors provide data for the Space Surveillance and Tracking (SST) and Near-Earth Objects (NEO), commercial and educational fields. The company designs, delivers and integrates observing systems based on its own and third-party solutions.Enterprise solutions are created and maintained by software experts for autonomous and robotic telescope networks with an expert understanding of planning, scientific data evaluation and analysis processes. Sybilla Technologies employs active scientists in the field of precise photometric and astrometric measurements and space traffic management.

Main products and services:

- Monitoring and control of ground systems.
- Mission control – engineering support.

The most important achievements in the space sector:

- ABOT - software for managing robotic sensors observing space
- WebPlan - software for managing and planning a network of sensors and maintaining a catalog of space objects
- LightStream - software for processing optical space observations from CCD and CMOS cameras (NCBR project).

Entity type: SME

Main technological domains

- Space Debris (TD 11)
- Ground Station System and Networks (TD 12)
- Automation, Telepresence & Robotics (TD 13)
- Life & Physical Sciences (TD 14)

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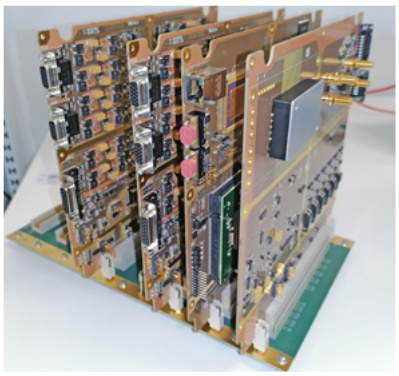
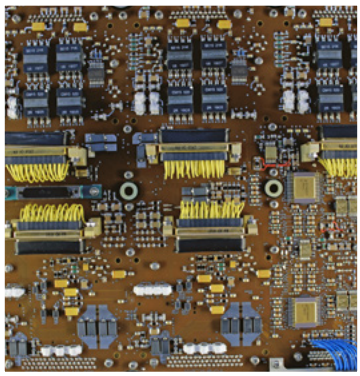
SYDERAL Polska sp. z o.o.





SYDERAL Polska Sp. z o.o. (Ltd.) specializes in providing solutions in the field of electronics and software for the space industry. The company was founded in 2016. It currently employs 20 highly qualified specialists and is based in the Gdańsk Science and Technology Park. The dynamic development of SYDERAL Polska was possible thanks to the involvement in the flight projects of the European Space Agency (ESA), including the EUCLID Antenna Pointing Mechanism Electronics and the FLORIS Instrument Control Unit projects. As part of a project co-financed by the National Centre for Research and Development (NCBiR), the company develops technologies for the satellite Quantum Key Distribution.

Company mission is to become one of the leaders for the development of the Polish space sector, as well as playing a key role in the European and global market in the areas related to quantum communication, control electronics and Flash mass memories. SYDERAL Polska is in the process of developing a local ecosystem (Tri-City area) that will enable comprehensive implementation of control electronics for space missions - including development, production and testing of satellite equipment.

Main products and services:

- Technologies used in electronic control system.
- On-board data processing systems – data storage and processing.
- Technologies used in the production of optical equipment.

The most important achievements in the space sector:

- Selection within the Core Consortium by Airbus Defence & Space in the ARIEL mission - reponsible for delivery of the MGA PME unit.
- Nomination to the „Economic Award of the President of the Republic of Poland" in year 2021.
- Developments within Quantum Key Distribution technology domain - completion of the engineering model in the SECSEQS project.

Entity type: SME

Main technological domains

- On-board Data Subsystems (TD 1)
- Space System Software (TD 2)
- Mechanisms (TD 15)
- Optoelectronics (TD 17)

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Śląskie Centrum Naukowo-Technologicznego Przemysłu Lotniczego sp. z o.o.

(Silesian Science and Technology Centre of Aviation Industry sp. z o.o.)

The company is focused on development and manufacture of advanced composite structures intended mainly for aerospace industry. Currently the only one qualified Polish supplier for Space structures.

Its organizational structure is composed of 2 main elements:

- composite structures plant (manufacturing of composites and production tooling)
- material testing laboratory (conducting mechanical tests and non-destructive tests).

The company also operates as an innovation center, i.e. provides technical support to other companies and scientific institutes in the application of composites in various industrial fields.

Main products and services:

- Manufacturing of composite structures used in the construction of spacecraft.
- Design and production of prototypes.
- Testing of materials and structures:
  - resistance tests,
  - thermal imaging,
  - environmental,
  - resonant fatigue tests.

The most important achievements in the space sector:

- Successful Validation of company's own competences as well as technological infrastructure in order to obtain a significant position on the European market of suppliers of primary and secondary structures for spacecraft manufacturing.
- Performence of „flight" contracts for manufacture of structural panels for telecom satellites for a leading European prime company.
- Participation in a Polish industrial consortium to design and manufacture of ATHENA Focal Plane Module Development Model..

Entity type:
Large enterprise

Main technological domains

Structures (TD 20)

Materials and Manufacturing Processes (TD 24)

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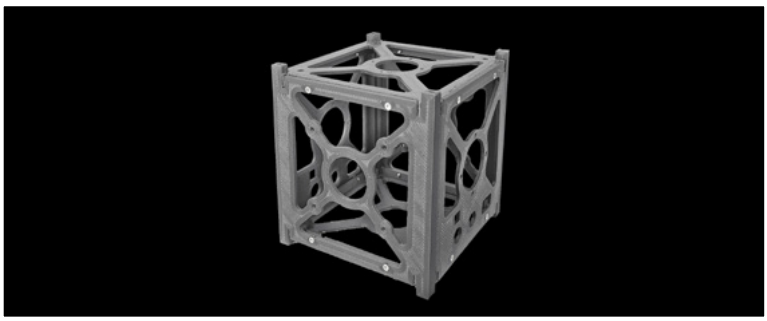
TechOcean sp. z o.o.



● Entity type: SME

● Main technological domains

- Materials and Manufacturing Processes (TD 24)
- Automation, Telepresence & Robotics (TD 13)
- Structures (TD 20)

TechOcean is a team of engineers for special tasks. We specialise in designing and implementing products on the market. We create innovative devices using such technologies as Bluetooth, IoT, RFID, Machine Learning or image analysis. We have strong competences in rapid prototyping, electronics design, industrial design, mechatronics, machine construction and software development.

In addition to its service activities in the area of implementing demanding projects for innovative companies, TechOcean also focuses on the development of its own products, such as VisionQb in the area of optimising production lines for industry, as well as 3DZodiak filaments designed for use in space.

Main products and services:

- Design and production of devices for electronic machines.
- Design and construction of prototypes.
- Consulting and design services in the field of:
  - mechatronic structures,
  - robotics and automation,
  - software,
  - industrial design,
  - 3D printing.

The most important achievements in the space sector:

- 3D Zodiac.

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Thales Alenia Space Polska sp. z o.o.

Thales Alenia Space has been designing, integrating and managing innovative space systems for over 40 years. Thales Alenia Space is a joint venture between French Thales (67%) and Italian Leonardo (33%). It employs over 8,000 people in nine countries. In 2016, it generated approximately EUR 2.5 billion in revenue. In addition, Thales Alenia Space and Telespazio form the Space Alliance, which offers a full range of services and solutions for satellite systems.

It inaugurated its activity in Poland in 2015. The Polish company has experience in implementing telecommunications and navigation projects, Earth observation, planetary exploration, environmental protection and research related to orbital infrastructure. Thales Alenia Space Polska implements projects for the European Space Agency and cooperates with scientific and research centers, as well as with the Polish industry.

Main products and services:

- Designing satellites.
- Equipped satellite structures – slabs, panels, load-bearing walls.

The most important achievements in the space sector:

- ATHENA SIB Program.
- MMPF Phase 1 Program.
- COPERNICUS CHIME, iHAB programs.

Entity type:
Large enterprise

Main technological domains

Structures (TD 20)

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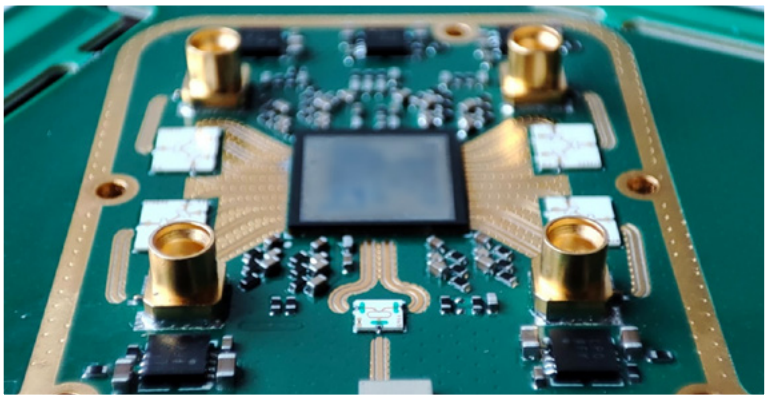
Thorium Space sp. z o.o.

● Entity type: SME

● Main technological domains

- RF Subsystems, Payloads and Technologies (TD 6)
- On-board Data Subsystems (TD 1)
- Electromagnetic Technologies and Techniques (TD 7)



Thorium Space Technology creates next-generation Small LEO/MEO/GEO HTS satellite platforms and RF payloads, particularly Multi-Beam communication transponders in K/Ka and E-Band. We redefine the future of satellite communications by pushing beyond the possible.Our flagship projects are Flat Panel Active Antenna for Ka-Band, Multi-Beam E-Band AESA Transponder, Polish 5G mmWave MicroCell, and Satellite Sensing and Communication System for Suborbital Rockets (SUBCOM). The company consists of an interdisciplinary team of space technology engineers and specialists in related fields.In 2021, www.startus-insights.com announced Thorium Space as one of the ten most innovative space technology startups and our Ka-band transponder and antenna - one of the 5 Top Space Tech Global Manufacturing Solutions 2021.

Main products and services:

- Ka-band transponder and antenna.
- E-band transponder and antenna.

The most important achievements in the space sector:

- Technology of fully digital Beamforming in Ka and E Bands
- Satellite Sensing and Communication System for Suborbital Rockets
- In 2021, www.startus-insights.com announced Thorium Space as one of the ten most innovative space technology startups and our Ka-band transponder and antenna - one of the 5 Top Space Tech Global Manufacturing Solutions 2021.

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TTcomm S.A.

TTcomm is one of the largest providers of satellite services in Central and Eastern Europe.

It has the necessary certificates and approvals to operate on the world and national market. Since 1997, it provides global telecommunications solutions for government and military institutions, telecoms, telecommunications operators, national and international corporations as well as radio and television broadcasters. Since 2007, TTcomm has been included in the list of entrepreneurs of special economic and defence importance. Highly qualified team with the knowledge of satellite solutions and the only teleport in the country with a park of antennas operating in the C, X, Ku bands. Cooperating with the largest operators and suppliers of satellite equipment, TTcomm successfully implements projects for the construction and implementation of extensive VSAT networks, comprehensive turnkey telecommunications solutions and solutions for foreign military missions.

Main products and services:

- Teleport antenna park, antennas with a diameter of 3.7 to 9.3 m in the C, X, Ku bands
- KaSAT broadband satellite communication system for Maritime platforms
- IDirect, DVB-S / S2 & DVB multiplexing satellite platform

The most important achievements in the space sector:

- Providing the first commercial satellite Teleport in Poland in the C, Ku, X bands.
- Providing satellite services as part of expeditionary military missions since 2003.
- Providing satellite services for the research station of the Institute of Geophysics of the Polish Academy of Sciences in Spitsbergen (Polish Polar Station Hornsund)..

Entity type: SME

Main technological domains

Ground Station Systems and Networks (TD 12)

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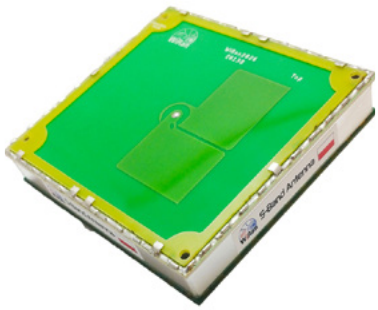
WiRan sp. z o.o.



WiRan manufactures TRL9 flight RF hardware. WiRan is a comperhensive RF solutions provider since 2002. Experienced in the aerospace, military, rail and IoT markets with particular emphasis on wireless communication systems. Our RF design office carries out the design of electronic devices from the concept to the working prototype including dedicated tests to ensure the required quality of the product. Our engineering team assists the customer with their EMC troubleshooting process.For more tahn 4 years WiRan develops S and X band radio modules under contracts for ESA

Main products and services:

- Microwave communication.
- RF signal distribution systems.
- Antennas used in the terrestrial segment.
- Designing electronic devices.
- Final Assembly, Integration and Test (AIT).
- Support in solving problems of Electromagnetic Compatibility (EMC)

The most important achievements in the space sector:

- Flight HW TRL 9 S band diplexer, antenna and splitter for nanosatellites.
- Flight HW TRL7 X band diplexer, antenna and splitter for nanosatellites.
- Flight HW TRL 9 L band splitter for navigation.

Entity type: SME

Main technological domains

- RF Subsystems, Payloads and Technologies (TD 6)
- Electromagnetic Technologies and Techniques (TD 7)
- System Design & Verification (TD 8)
- Ground Station Systems and Networks (TD 12)
- Electrical, Electronic and Electro-Mechanical (EEE) Components and Quality (TD 23)

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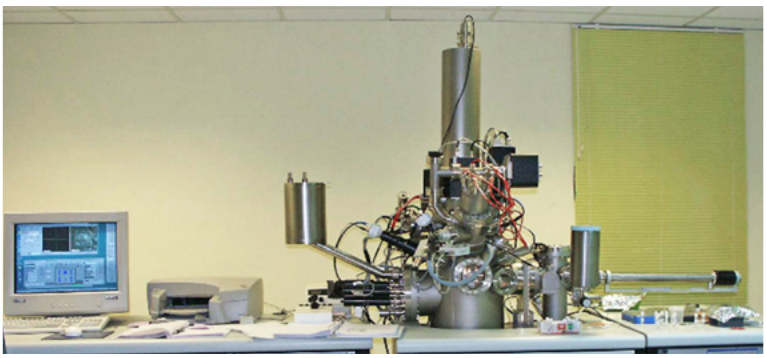
Wydział Chemiczny Politechniki Łódzkiej

(Faculty of Chemistry, Lodz University of Technology)



The faculty is known in Poland and abroad as a strong research and teaching center (category A). It employs 428 people, of which 258 are research and development staff. Over 100 PhD students. The unit is equipped with the most modern equipment that allows conducting research at the highest level in the directions indicated in the LORIS 2030 Regional Innovation Strategy of the Lodzkie Region and in technologies of key importance for the development of the region and the country, which include among

others: nanotechnology and functional materials, special polymer materials and hybrid and biomass conversion. Apart from the traditional ones, the department conducts interdisciplinary research in cooperation with other research units (65 projects for nearly PLN 11 million in 2020).

Main products and services:

- Composite materials (polymer fibers) for launching systems, satellites and space probes.

The most important achievements in the space sector:

- Research and edition of the publication: D.M. Bieliński, U. Ostaszewska, J. Jagielski, "Application of ion bombardment to modify tribological properties of elastomers", Polimery (Warszawa) 2014, 59 (5), 54–57.
- Research and edition of the publication: J. Jagielski, U. Ostaszewska, D.M. Bieliński, D. Grambole, I. Jóźwik, „Hydrogen Release From Irradiated Elastomers Measured by Nuclear Reaction Analysis", Nuclear Instruments and Methods in Physics Research 2016, B 371, 216–219.
- Research and edition of the publication: K.S. Bandzierz, L.A.E.M. Reuvekamp, G. Przybytniak, D.M. Bieliński, "Effect of electron beam irradiation on structure and properties of styrene-butadiene rubber", Rad. Phys. Chem. 2018, 149, 14–25.

Entity type: University

Main technological domains

- Mechanisms (TD 15)
- Structures (TD 20)
- Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU) (TD 22)
- Materials and Manufacturing Processes (TD 24)

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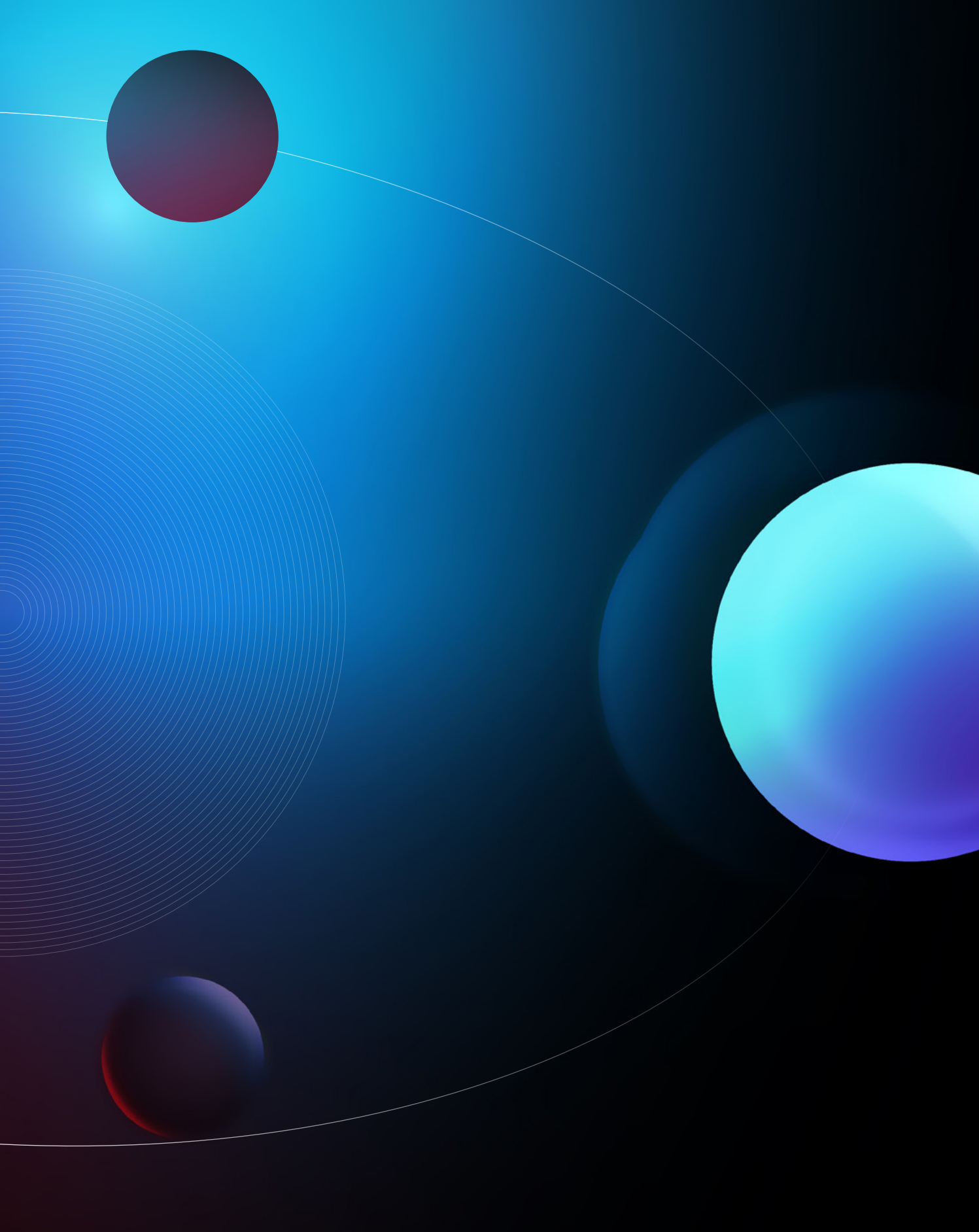
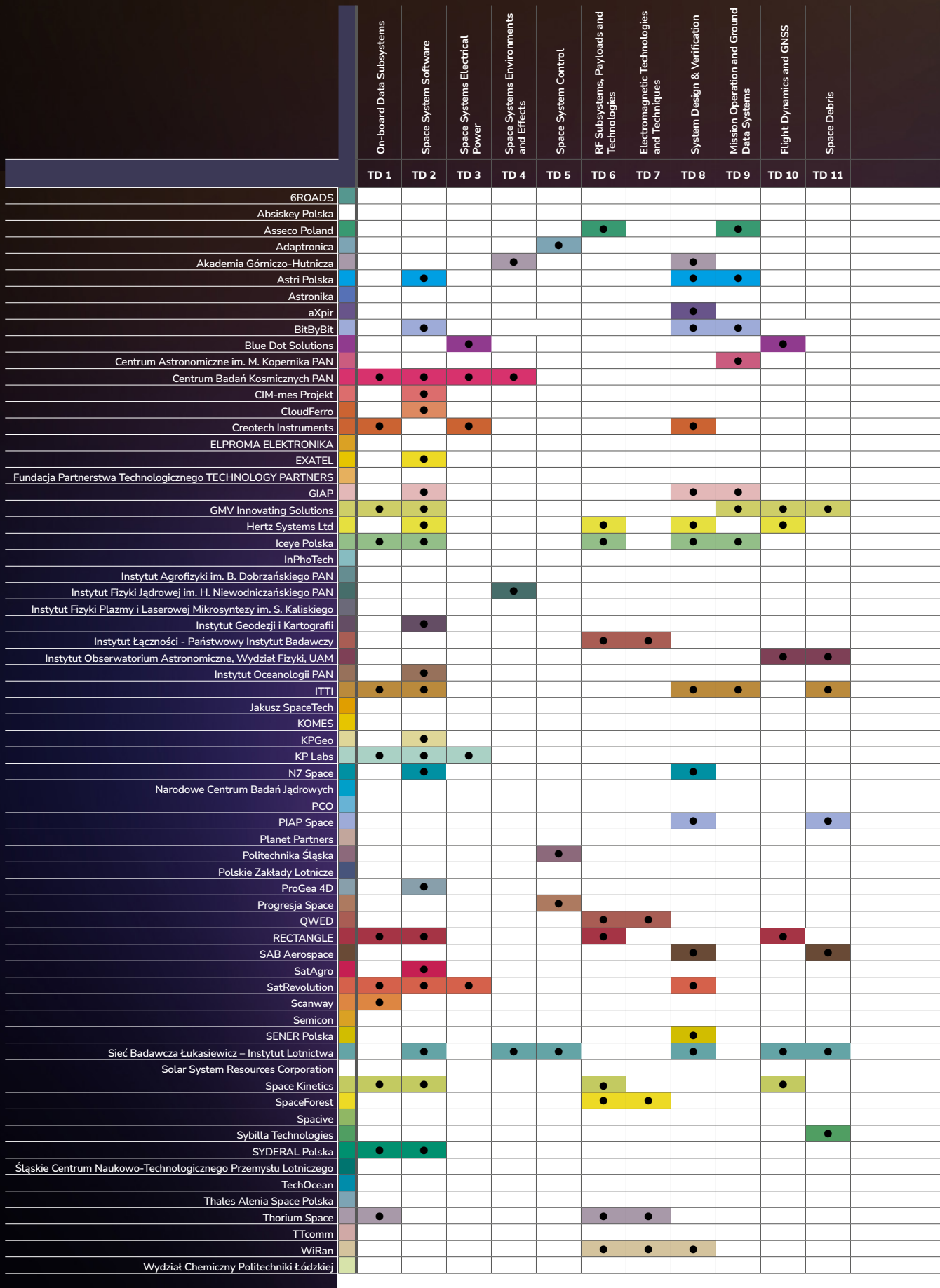
Technology matrix




On-board Data Subsystems
Space System Software
Space Systems Electrical Power
Space Systems Environments and Effects
Space System Control
RF Subsystems, Payloads and Technologies
Electromagnetic Technologies and Techniques
System Design & Verification
Mission Operation and Ground Data Systems
Flight Dynamics and GNSS
Space Debris
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TD 3
TD 4
TD 5
TD 6
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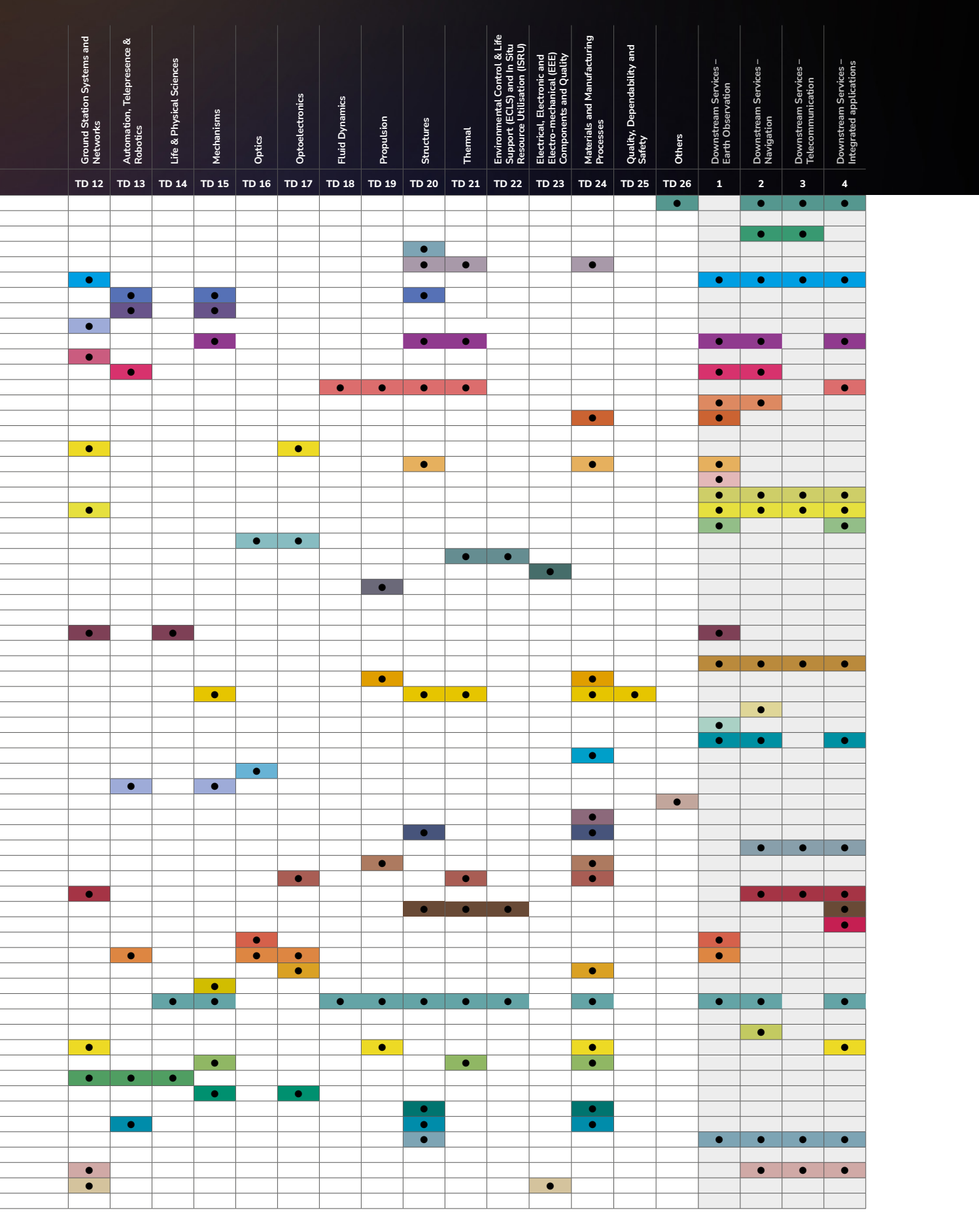
TD 10
TD 11
6ROADS
Absiskey Polska
Asseco Poland
Adaptronica
Akademia Górniczo-Hutnicza
Astri Polska
Astronika
aXpir
BitByBit
Blue Dot Solutions
Centrum Astronomiczne im. M. Kopernika PAN
Centrum Badań Kosmicznych PAN
CIM-mes Projekt
CloudFerro
Creotech Instruments
ELPROMA ELEKTRONIKA
EXATEL
Fundacja Partnerstwa Technologicznego TECHNOLOGY PARTNERS
GIAP
GMV Innovating Solutions
Hertz Systems Ltd
Iceye Polska
InPhoTech
Instytut Agrofizyki im. B. Dobrzańskiego PAN
Instytut Fizyki Jądrowej im. H. Niewodniczańskiego PAN
Instytut Fizyki Plazmy i Laserowej Mikrosyntezy im. S. Kaliskiego
Instytut Geodezji i Kartografii
Instytut Łączności - Państwowy Instytut Badawczy
Instytut Obserwatorium Astronomiczne, Wydział Fizyki, UAM
Instytut Oceanologii PAN
ITTI
Jakusz SpaceTech
KOMES
KPGeo
KP Labs
N7 Space
Narodowe Centrum Badań Jądrowych
PCO
PIAP Space
Planet Partners
Politechnika Śląska
Polskie Zakłady Lotnicze
ProGea 4D
Progresja Space
QWED
RECTANGLE
SAB Aerospace
SatAgro
SatRevolution
Scanway
Semicon
SENER Polska
Sieć Badawcza Łukasiewicz – Instytut Lotnictwa
Solar System Resources Corporation
Space Kinetics
SpaceForest
Spacive
Sybilla Technologies
SYDERAL Polska
Śląskie Centrum Naukowo-Technologicznego Przemysłu Lotniczego
TechOcean
Thales Alenia Space Polska
Thorium Space
TTcomm
WiRan
Wydział Chemiczny Politechniki Łódzkiej


Ground Station Systems and Networks
Automation, Telepresence & Robotics
Life & Physical Sciences
Mechanisms
Optics
Optoelectronics
Fluid Dynamics
Propulsion
Structures
Thermal
Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU)
Electrical, Electronic and Electro-mechanical (EEE) Components and Quality
Materials and Manufacturing Processes
Quality, Dependability and Safety
Others
Downstream Services – Earth Observation
Downstream Services – Navigation
Downstream Services – Telecommunication
Downstream Services – Integrated applications
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4

Technological domains


TD 1 On-board Data Subsystems

TD 2 Space System Software


TD 3 Space Systems Electrical Power


TD 4 Space Systems Environments and Effects


TD 5 Space System Control


TD 6 RF Subsystems, Payloads and Technologies


TD 7 Electromagnetic Technologies and Techniques


TD 8 System Design & Verification


TD 9 Mission Operation and Ground Data Systems


TD 10 Flight Dynamics and GNSS


TD 11 Space Debris


TD 12 Ground Station Systems and Networks


TD 13 Automation, Telepresence & Robotics

TD 14 Life & Physical Sciences

TD 15 Mechanisms

TD 16 Optics

TD 17 Optoelectronics

TD 18 Fluid Dynamics

TD 19 Propulsion

TD 20 Structures

TD 21 Thermal

TD 22 Environmental Control & Life Support (ECLS) and In Situ Resource Utilisation (ISRU)

TD 23 Electrical, Electronic and Electro-mechanical (EEE) Components and Quality

TD 24 Materials and Manufacturing Processes

TD 25 Quality, Dependability and Safety

TD 26 Others

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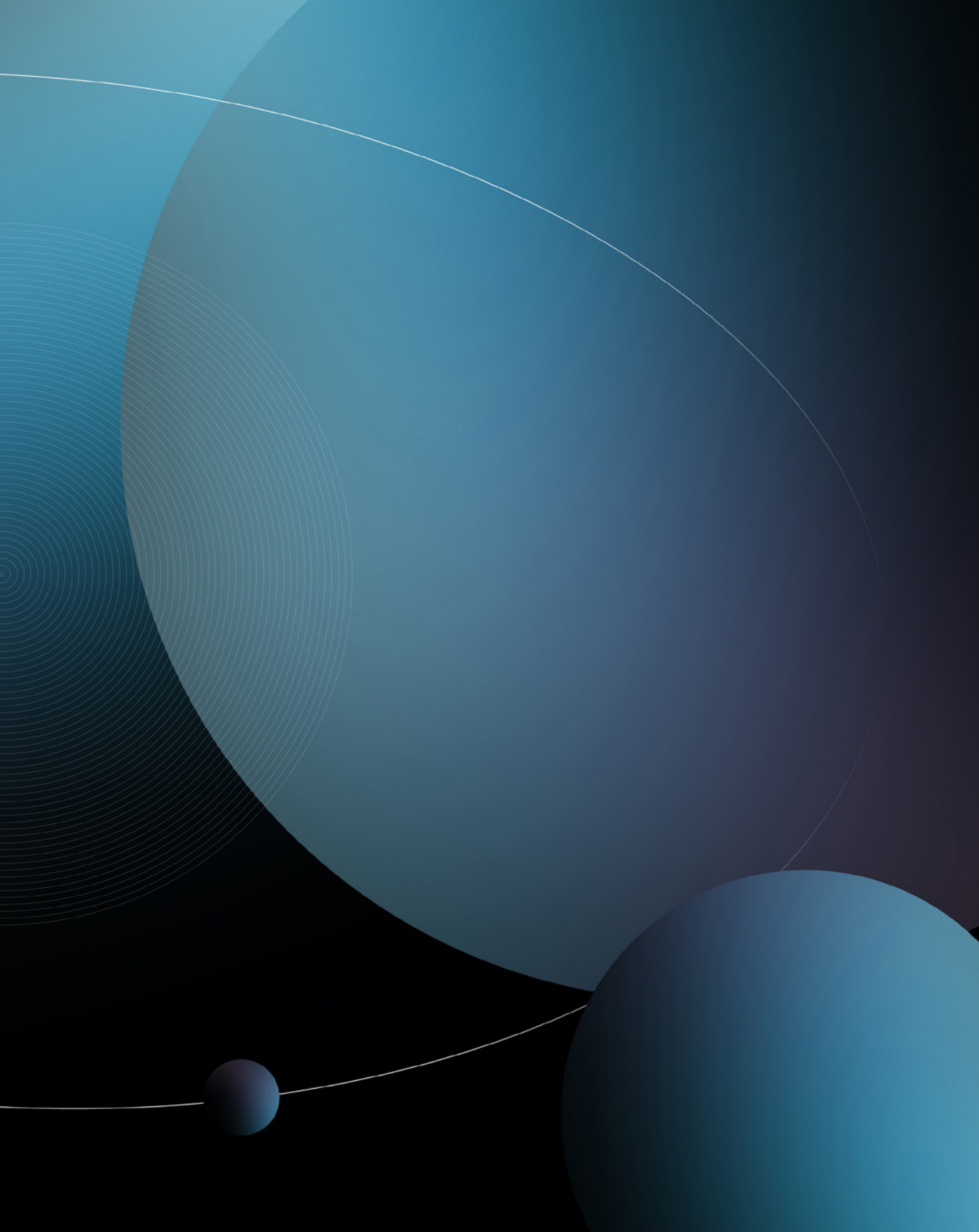

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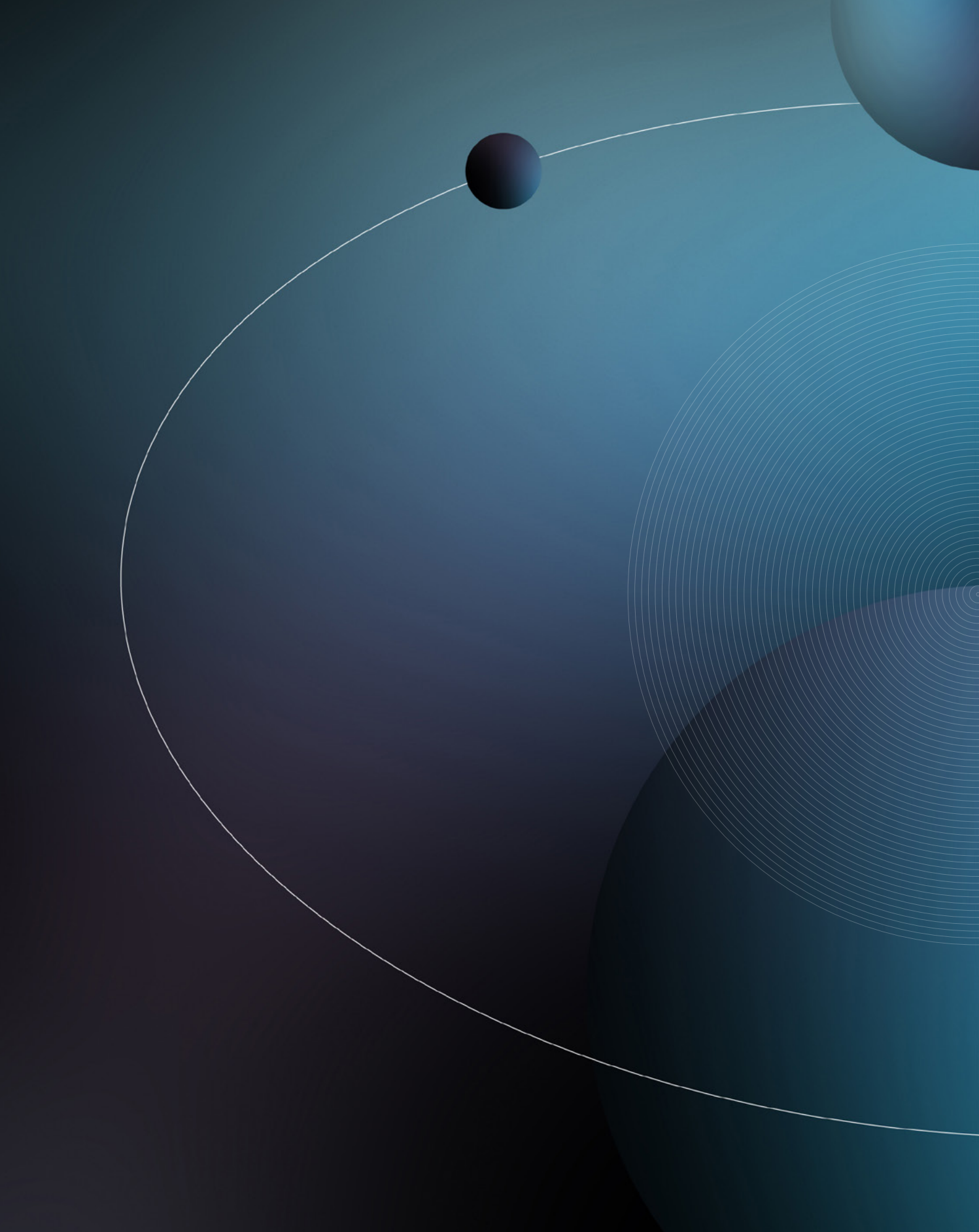

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