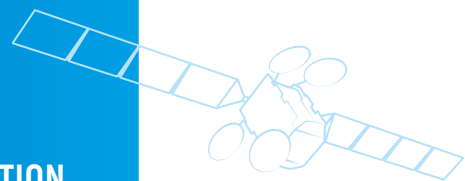


60 YEARS OF TRANSFORMATION

AT THE HEART OF SOVEREIGNTY, AT THE FRONT OF NEW SPACE:
STORY OF A S.M.E. THAT HAS BECOME A WORLD LEADER





IN 1962 SODERN, THE ENGINEERING AND NUCLEAR REALIZATION COMPANY, WAS FOUNDED.

The company was created to perform a strategic mission: design and build the core of France's nuclear weapons, the "neutron initiators". Sodern succeeded in mastering this highly complex know-how and is still today the only company to have this expertise in France.

On the back of this success, France and Europe entrusted the young company with other complex projects, including cutting-edge scientific instruments lying at the heart of the French Earth observation satellites, and disruptive military technologies. 60 years later, Sodern remains true to this technological pioneering legacy, and builds exceptional instruments for the armed forces and space agencies such as NASA, ESA (European Space Agency), and CNES (French Space Agency). From Mars to Venus and Jupiter, Sodern's instruments have journeyed throughout the Solar system.

But while this technological excellence runs through the company's blood, it is not an end in itself. Sodern's goal is two-fold: to stimulate disruptive innovations both for French sovereignty and for private markets, and to become the world leader in its fields of activity. This is a real challenge, demanding the perfect balance between quality and competitiveness.

HAS THIS AMBITION BEEN ACHIEVED?

Simply looking at a few facts will provide the answer.

As of the 1970s, Sodern designed civil applications derived from its "military neutron initiators". The company then became the world leader in civil neutron generators, before creating material analysis neutron technologies exported to the five continents.

In space, since the 1980s, Sodern has become the world leader in Earth sensors that enable a satellite to orient itself. Then, in the 2000s, the company democratized the star tracker, which gradually became the reference solution on markets around the world, from North America to Asia and Europe. In 2022, one third of the world's satellites of more than 150kg are equipped by Sodern.

In 2015, the company successfully took up the NewSpace challenge with a technological, industrial and commercial breakthrough: its ultra-competitive "Auriga" star tracker for small satellites. In 2016, it was selected by OneWeb for its constellation, and "Auriga" has since then been driving growth at Sodern: more than 200 star trackers are being sold every year to start-ups and major groups worldwide. Sodern is the undisputed leader on this NewSpace star trackers market.

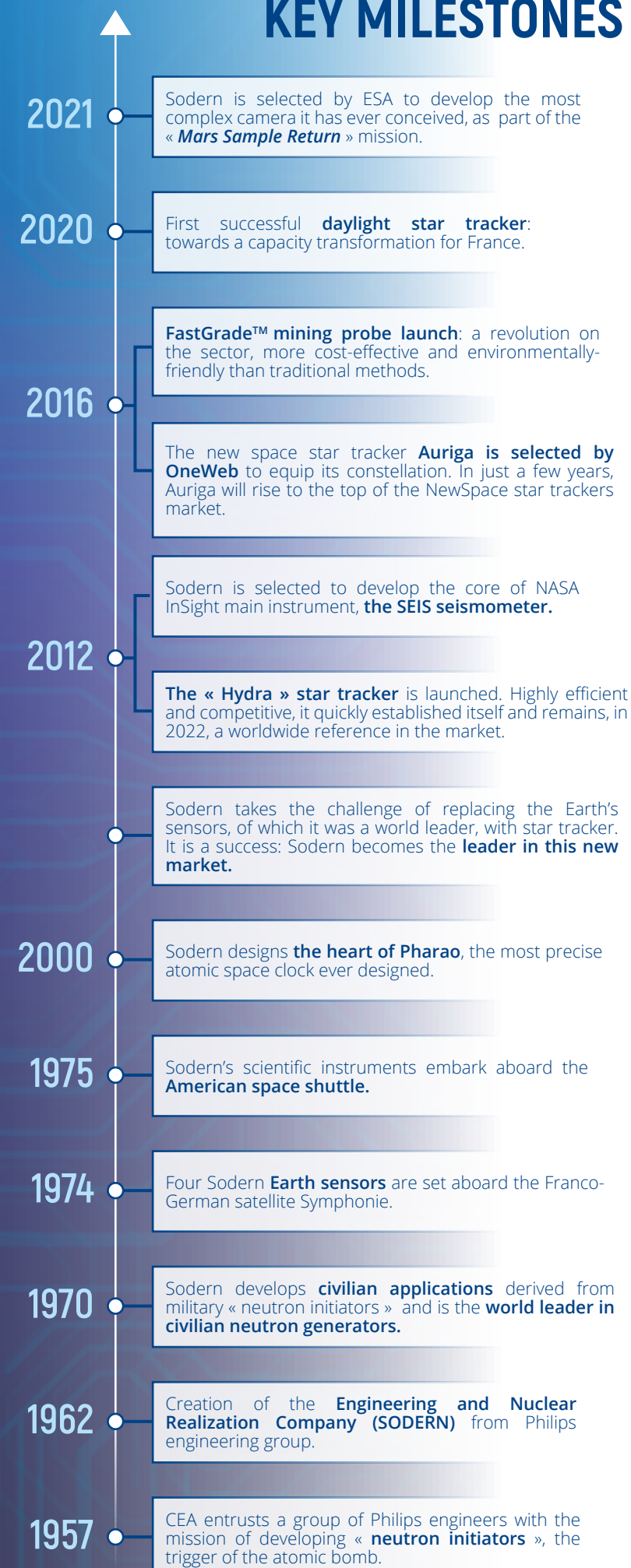
At the end of 2020, Sodern, Safran Electronics & Defense and the French defense procurement agency (DGA) successfully carried out a historic test: locating a Government aircraft in broad daylight using a star tracker coupled with an inertial navigation unit. For France, this technological leap opens up extremely promising prospects with the ability to determine the position of military vehicles even in a conflict situation, when satellite positioning signals are being jammed.

In 60 years, from one breakthrough to another, the Sodern range of products and activities has constantly evolved. Two constants alone have remained: the company's pioneering spirit and the ambition of the teams, which have enabled Sodern to establish itself as the world leader on its markets, from the ultra-competitive NewSpace to ultra-high-quality scientific instrumentation.

KEY FIGURES



KEY MILESTONES





AT THE HEART OF SOVEREIGNTY

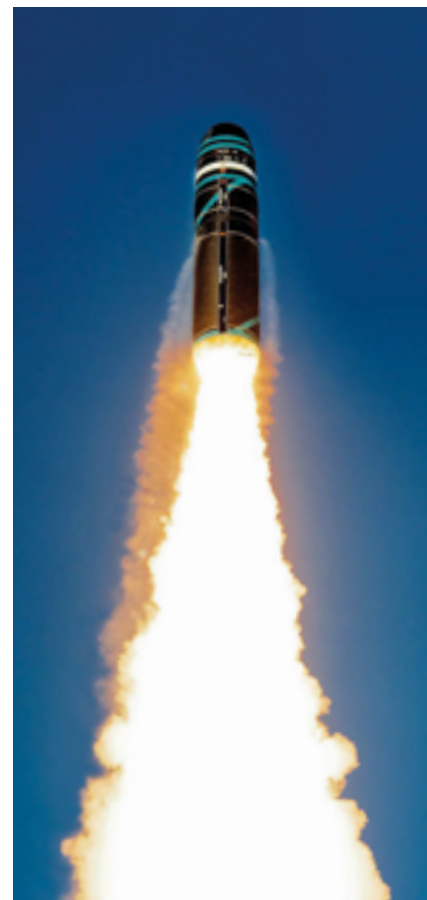
The Sodern adventure began in 1957. For a number of years, spearheaded by Pierre Mendès France and General de Gaulle, who created the French Alternative energies and Atomic Energy Commission (CEA) in 1945, France sought to develop the ultimate guarantee of its sovereignty: nuclear deterrence.

The most complex technological challenges it faced included the “**neutron initiator**” or “neutron tube”, which is the actual trigger of the weapon. CEA worked relentlessly on its development but, given the criticality of the mission, the decision was taken to create a “**plan B**”. In strict secrecy, a team of engineers from the Philips group, based in Limeil-Brévannes near Paris, was tasked with **working in parallel with CEA** on a neutron initiator of a different design.

The difficulties were immense. Most of the technological processes had to be invented, the technical means and physics expertise at the time were limited, and the “secret” group had only a few engineers.

Against all expectations, “plan B” was a success and the **Engineering and Nuclear Realization Company (SODERN)**, the direct heir of the group of engineers from Philips, **was officially founded in 1962**.

Since then and until today, Sodern is in charge of the French neutron initiators.



“
SODERN WAS ESTABLISHED
AS THE WORLD LEADER
FOR EARTH SENSORS
”



SPACE AS A NEW HORIZON

As of the 1970s, Sodern underwent a first fundamental transformation. The company set its sights on a new, complex and strategic horizon: space. The French space adventure was just beginning and everything was still to be created.

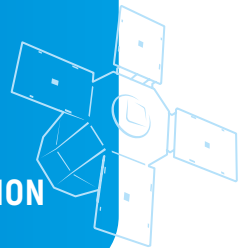
Earth observation in the visible and infrared spectra, photo-detectors, optical equipment for sounding rockets and satellites: Sodern developed a wide range of technologies in the fields of space optics and electronics. It was notably one of the first European companies to fully master the space applications of microprocessors.

Among the products developed by Sodern, one in particular was destined for a brilliant future: Earth sensors, which enable a satellite to orient itself by observing the Earth.

In 1974, for the first time, four Earth sensors were set aboard the Franco-German Symphonie satellite, followed by Europe’s first telecom satellites - METEOSAT, SPOT, ERS.

As early as the 1980s, Sodern has established itself as the world leader for Earth sensors, which were then the main attitude sensors used for orienting satellites.





PUSHING BACK THE LIMITS OF SCIENTIFIC KNOW-HOW

While the Earth sensors business was taking off, Sodern worked alongside the space agencies and built its reputation as a reliable partner in another field: the design of custom-made, very-high-precision scientific instruments.

In 1975, Sodern flew on the American Space Shuttle. It built optical instruments for the SpaceLab, the Space Shuttle's crewed laboratory.

From 1980 to 2000, many exceptional instruments or instrument sub-assemblies were built for European Earth and climate study satellites (ERS, ENVISAT, Copernicus), and then for the METOP (meteorology) and CALIPSO (atmospheric studies) missions.

In the 2000s, under an ESA program, with CNES as Prime Contractor, Sodern developed the heart of Pharaos, the most accurate space atomic clock ever made: its accuracy is 1×10^{-16} , or a time error of about... 1 second in 300 million years.



SEIS SEISMOMETER - INSIGHT MISSION

In 2012, Sodern was selected to develop the core of the main instrument for NASA's InSight mission, the SEIS seismometer, with CNES as Prime Contractor. InSight landed on Mars in 2018 and examines seismic activity on the red planet. Owing to its exceptional precision, it is capable of detecting movements the size of a hydrogen atom.

Starting in 2017, Sodern was tasked with designing the navigation cameras for the ESA JUICE and NASA Europa Clipper missions to explore the Jupiter system. These cameras were specially designed to withstand the very high levels of radiation that would be experienced during the mission, as radiation in the Jupiter system is the most intense in the entire Solar system.

In 2021, Sodern was selected by ESA to develop the most precise camera it has ever designed, for the Mars Sample Return (MSR) mission. This camera will be required to detect a capsule of Martian samples the size of a soccer ball, at a distance of more than 3,000 kilometers, while being subjected to the glare of the light reflected by Mars.



ATOMIC CLOCK PHARAO



SPACE CAMERA
NAC MARS SAMPLE RETURN MISSION



NEUTRON TUBE

CIVIL NEUTRON TUBES

70

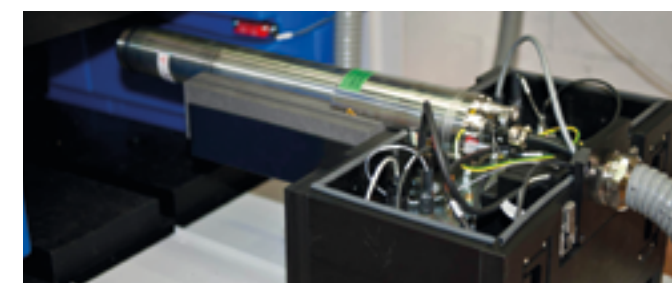
TUBES SOLD ON
AVERAGE PER
YEAR

A FONDAMENTAL TRANSFORMATION: CIVIL NEUTRON TUBES

In the 1980s, Sodern initiated a transformation that was to be one of the most fundamental in its history. Everything started with one question: how to find a civil technology which utilizes the same know-how as military neutron initiators, to help sustain the skills and industrial resources needed for deterrence?

Decision was taken to develop neutron generators, or neutron tubes, for civil applications. These are sufficiently different from military neutron tubes to rule out all risk of proliferation, but similar enough to enable engineers and technicians to develop common skills to both technologies, and to use the same industrial tools to build them.

This technology enables an analysis of the material. The neutrons generated by the neutron tubes come into contact with the material being analyzed. This material reacts by emitting gamma rays and thanks to their analysis, the atomic composition of the material can be precisely determined. Sodern tubes are sold to industrial firms, such as oil companies, which use this fundamental component to develop complete material analysis systems. Sodern is rapidly establishing itself as a world leader, delivering to more than 40 countries on four continents.



CIVIL NEUTRON TUBE IN MATERIAL
ANALYZER CNA

In the 1990s, Sodern decided to go even further and creates new opportunities by designing an innovative quality control system. On-line material analyzers, called CNA, were thus created. They are used by cement, nickel, copper, etc. producers for real-time inspection of the quality of a material stream on a production line. The first units were sold in the United States, Argentina and Mexico.

The product has rapidly become an essential tool and more than 250 CNAs are now in operation around the world.

IN OPERATION AROUND THE
WORLD

+250
CNA

60 YEARS
OF TRANSFORMATION



ON AVERAGE
100
STAR TRACKERS

SOLD PER YEAR

1/3

OF GLOBAL
SATELLITES

EQUIPPED BY OUR
STAR TRACKERS



STAR TRACKERS TAKE OFF

In the mid-2000s, Sodern gambled on a technology it considered to be highly promising: star trackers.

Although they had been known for several years, they were very expensive and little used. Sodern aimed to democratize them as star trackers were **more robust and more accurate than Earth sensors** and the company felt sure they were the solution of the future.

The company made the **risky decision** to gradually phase out production of Earth sensors – the sector in which it was then the world leader – and replace them with star trackers, which it would produce on an industrial scale to make them more competitive.

After intense commercial efforts, the development of several versions to meet the various needs of the market, and the gradual ramp-up of a production line designed to limit costs and optimize lead times, **the gamble paid off** and indeed exceeded all expectations. Star trackers created themselves a market, in France and above all abroad, in the United States, Europe, Asia and the Middle East... **Sodern gradually becomes the undisputed world leader for star trackers, equipping nearly one third of the world's satellites.**

Backed by a range of competitive products, suited to all missions, the company continued to consolidate its market share, with output doubling between 2016 and 2021.



STAR TRACKER
TEST TECHNICIAN

HORUS STAR TRACKER

HYDRA STAR TRACKER

FASTER, MORE COMPETITIVE, MORE INDUSTRIAL: NEW SPACE WAS BORN

In 2016, to meet the needs of the emerging market for small, ultra-competitive satellites, Sodern develops Auriga, an ultra-light, ultra-miniaturized star tracker, several times cheaper than traditional models with a drastically shortened lead-time.

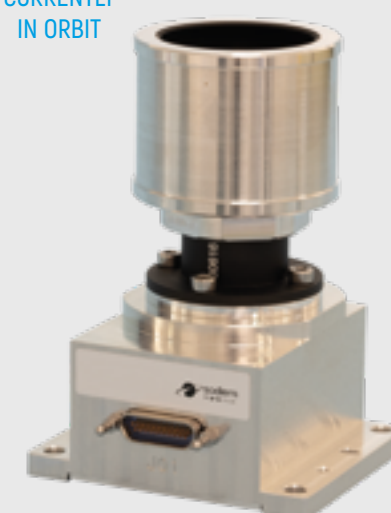
Selected in 2016 by OneWeb to equip its constellation, Auriga has since been the engine of Sodern's growth: **the star tracker sells more than 200 units a year, equally to start-ups as to established leaders of the space sector in the world.**

1683
SOLD

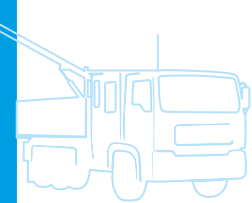
SINCE PRODUCT'S
LAUNCH IN 2016

+700
AURIGA

CURRENTLY
IN ORBIT



AURIGA STAR TRACKER



FASTGRADE™ PROBE - MATERIAL ANALYSIS

THE FASTGRADE™ INNOVATION: ENVIRONMENTAL AND ECONOMIC GAINS

FastGrade™ is a material analysis probe which replaces core-sampling operations in a mine with real-time analysis.

This is a true breakthrough for customers. Whereas a core-sampling operation used to take weeks, the analysis is now completed in a matter of minutes. **FastGrade™ is more respectful of the environment** because it enables the mine to be worked with greater precision, thus limiting ore-sorting operations after extraction, which consume large quantities of water and energy.

First exported to Australia, FastGrade™ has now won the South-American market.

A DARING GAMBLE DAYLIGHT STAR TRACKING

Sodern's star trackers function in the dark of space but can't be efficient in Earth's atmosphere, **stars being hidden by sunlight during the daylight hours.**

New challenge for the company which is working on daytime star tracking so that stars, which should be seen permanently, become a reliable reference point.

At the request of the DGA, in 2016 Sodern and its partner Safran Electronics & Defense began to develop star trackers coupled with an inertial navigation unit capable of working at night and during the daytime, on an extremely fast and highly unstable carrier – for example an aircraft.

At the end of 2020, flight tests were an historical success: to determine the position of an aircraft in daylight with extreme precision thanks to this system. For France, this technology represented a major capacity disruption: military vehicles and carriers today depend on satellite positioning systems, which are regularly jammed in theatres of operations. **A locating solution based on star tracking is by definition totally impossible to jam.**



PROTOTYPE TEST OF DAYLIGHT STAR TRACKER ON A 4X4 VEHICLE

// PIONEERING IS SIMPLY A STATE OF MIND \\

SODERN IS SIXTY, BUT SODERN'S ADVENTURE IS ONLY JUST BEGINNING.

Through major technological advances and unique expertise, the company has constantly conquered new markets, anticipating and even **generating fundamental disruptions** in the service of our sovereignty. In sixty years, Sodern has demonstrated its ability to adapt, its agility and its pioneering spirit. Building on all these assets, it sees the transformations occurring in its markets as opportunities to reaffirm its ambition: to be and to remain the world leader in its business sectors.

The challenges are enormous. **The space and neutronics markets are undergoing a full-scale revolution**, and now need to combine exponential dynamism with unavoidable ecological challenges.

Every ten-year anniversary, the employees take a look back over the company's history and see that its activities are constantly evolving.

We are proud of Sodern's innovative strength and competitiveness. We hope that these changes will accelerate, and that **the next 10 years will shape Sodern completely differently.**



THANK YOU

TO OUR CUSTOMERS AND PARTNERS, KEYS TO OUR SUCCESS.

The Sodern adventure has only been possible thanks to the company's customers and partners.

Whether major groups, government agencies, or start-ups, we have more than sixty direct international customers whose regularly renewed confidence is an honor for us.

Our French and European **institutional partners** are also a vital source of support.

The **French Alternative energies and Atomic Energy Commission (CEA)**, a minority shareholder of Sodern, has been by our side since the very beginning. It has built a high-quality partnership with us and has significantly contributed to the growth of our company.

The **French defense procurement agency (DGA)**, the **French space agency (CNES)** and the **European Space Agency (ESA)** are valued customers and partners, who have contributed to making Sodern – and indeed the French and European space industry as a whole – the world-class player that it is today.

The French public investment bank **Bpifrance** has accompanied Sodern in the development of its "Auriga" NewSpace star tracker, which has won the global NewSpace market.

Finally, **ArianeGroup**, our main shareholder, gives us the full benefit of its strength and support, while at the same time preserving our independence and agility.

www.sodern.com

SODERN
20, Avenue Descartes
94450 Limeil-Brévannes
FRANCE

CONTACT
Rémy LAMBERTIN
remy.lambertin@sodern.fr

SODERN – APRIL 2022
COPYRIGHT PHOTOS: SODERN, SHUTTERSTOCK