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ONERA
THE FRENCH AEROSPACE LAB

SPACE OBSERVATION

PROVIDENCE

EXPERTISE IN ADAPTIVE OPTICS FOR OBSERVING AND MONITORING SPACE

In late 2023, ONERA initiated the PROVIDENCE project (Research platform in optics, vector of innovation for defense, propagation environment understanding and space object characterization), aiming to develop a research platform optimized for high-angular-resolution space surveillance.

By 2029, the goal is to equip a 2.5m telescope with specific imaging means corrected by Adaptive Optics for identifying and characterizing objects in orbit. The telescope will be installed at the Haute-Provence Observatory, in a building provided by CNRS.

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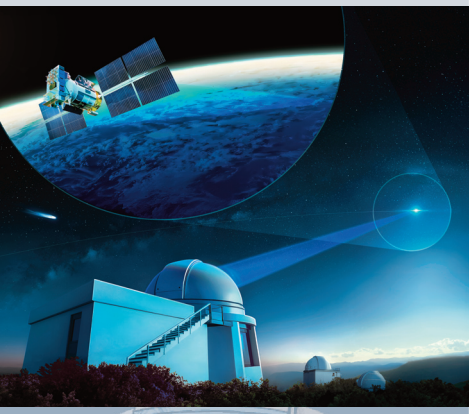

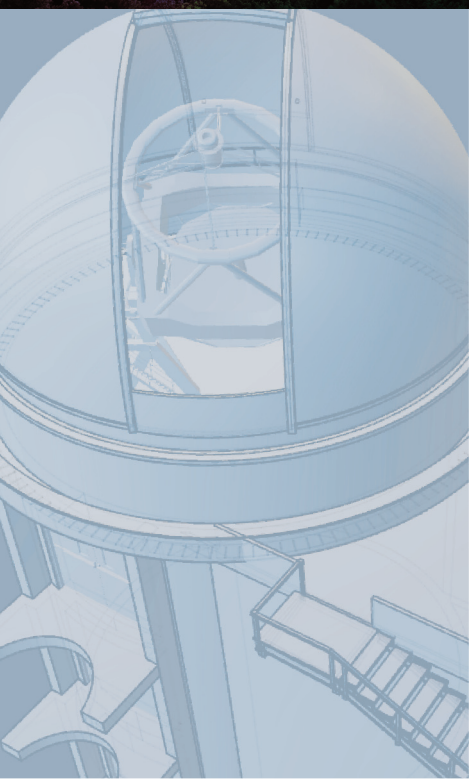

FINALITY

The PROVIDENCE project contributes to ONERA's expertise in space surveillance, providing France with a unique European capability. This research platform will offer ONERA a unique observation means of satellites ranging from Low Earth Orbit (LEO) to Geostationary Orbit (GEO), benefiting DGA, the French army procurement agency, and armed forces. It will also enable innovative concepts for observing satellites and debris to be tested, in addition to the wide-field (CICLOPE) and lower-resolution (FEELINGS) observation resources also developed at ONERA. The primary ambition is to improve knowledge of orbiting objects (characterization, identification). Open to academic, industrial, and institutional partners, it will provide dual-application observation capabilities and will be exploited for astronomy and innovative instrumentation development. Additionally, it will address cross-disciplinary issues like propagation environment characterization, laser focusing, and optical telecommunications (Quantum Key Distribution and Deep Space communications).

PROVIDENCE'S ASSETS

At launch, the PROVIDENCE platform will feature second-generation Adaptive Optics instruments, assisted by lasers and combined with a multi-spectral imager. ONERA's technologies and expertise, coupled with Europe's largest telescope capable of tracking low-orbit satellites, promise a resolution of approximately 10 centimeters for satellites at 500 km altitude.

The telescope's specifications include:

- **Diameter:** 2.5m, optimized for High Angular Resolution?
- **Pointing and tracking**: compatible with LEO observation.
- **Spectral bands**: 380 – 2200 nm (possibility to extend to 3-5µm).
- **Accessible field**: 10 to 20 arcmin.
- **Optimized field for High Angular Resolution**: ~2 arcmin.
- **Available foci**: Coudé and Nasmyth.
- **Compatible with Bi-static Laser Emission**.
- **Adaptive secondary mirror** (extended capability envisioned).
- **Rayleigh/Sodium laser star** (auxiliary equipment envisioned).

ONGOING DEVELOPMENTS

The platform definition process is underway: telescope, dome, and control system specifications are complete, and procurement has begun. The design of the high-resolution multi-spectral satellite imaging system is in progress. In parallel, the building adaptation phase is being conducted with CNRS's collaboration.

MAIN PARTNERS

The PROVIDENCE project is collaborative by nature:

- **Telescope procurement**: The supply of the telescope is made possible thanks to the support of the French Defence Procurement Agency (DGA), via the exceptional subsidy for investment costs granted to ONERA,
- An application for FEDER funding is currently being prepared as part of the 2021–2027 FEDER–ESF+–JTF Operational Programme of the SUD Region (Provence-Alpes-Côte d'Azur),
- **Site and building**: The site, the building housing this extraordinary infrastructure and some key skills required to operate this type of facility are being provided by CNRS,
- **Development of the Adaptive Optics multi-spectral imager**: The development of the multi-spectral imager corrected by adaptive optics, the first instrument to equip the platform, is being carried out thanks to the EMISSARY project of the European Defence Fund, led by the European Commission and involving 46 partners in 13 European countries.

The platform will be open to French and European institutional, academic, and industrial partners to contribute to strengthening European sovereignty in space surveillance.