Technology Development Programme

ELT-Instrumentation Procurement Webinar, Bridging Science and Industry

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Samuel Lévêque

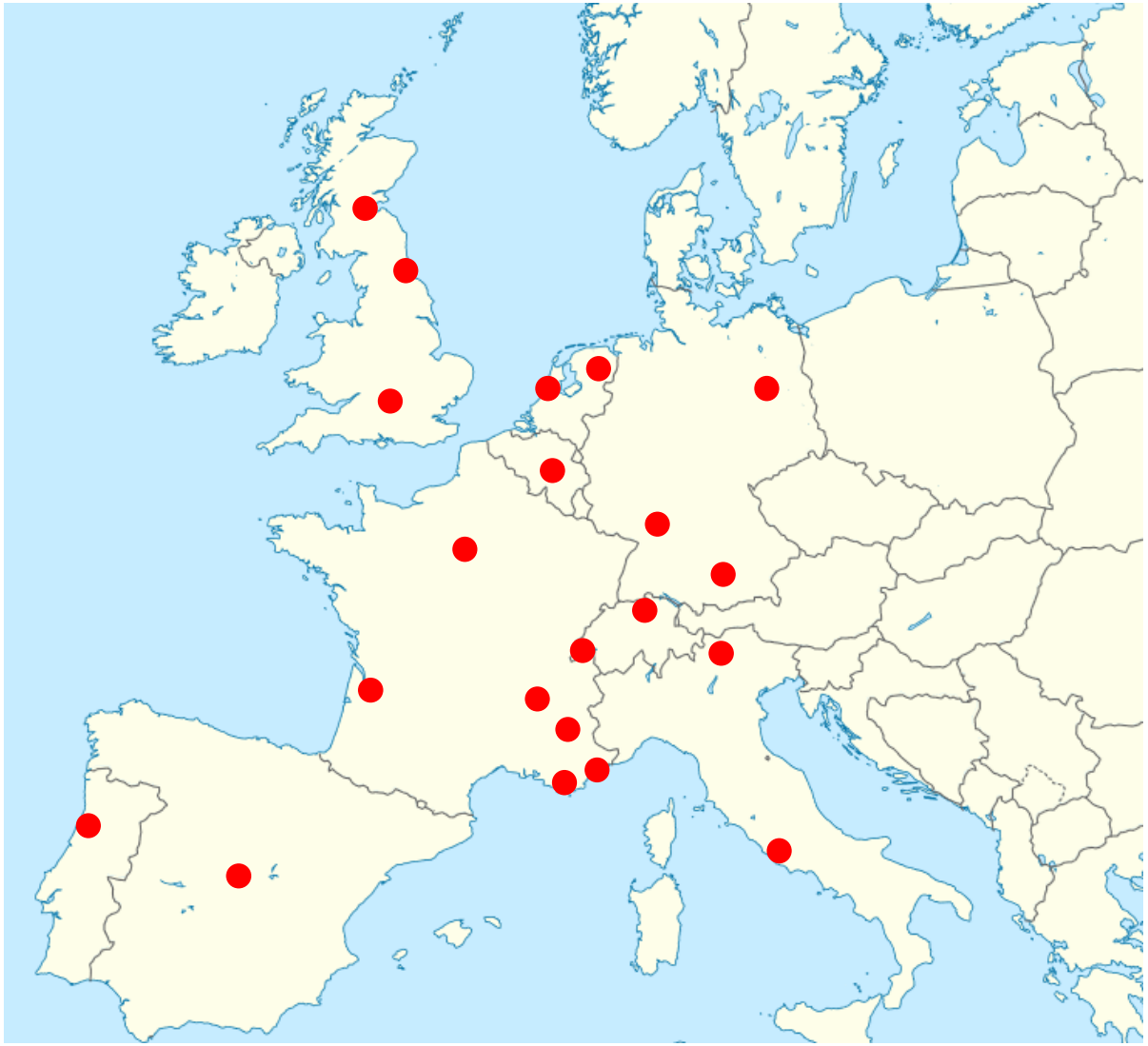
sleveque@eso.org

Overview

- Objectives of the Technology Development Programme
  - Develop & secure key technologies (Low TRL) for derisking projects, enabling Science and maintaining ESO's leadership in astronomy
  - Contribute to the development of new ESO standard where appropriate (e.g. *NGCII*)
- Identification/approval of new projects:
  - Top-down: Anticipation of future needs in close collaboration with ESO's programmes ; Proposals through ESO governing bodies or expertise of the community with opportunities of collaboration.
  - Bottom-up: based on the expertise of ESO Staff (e.g. *output of internal R&D*)
  - Project Approval by ESO Director's Team
- Consultation role of an "*Advisory Team*" (*currently ESO internal*) & Support from the Programme Control Office
- Follow ESO Contracts & Procurement rules and Technology Transfer Policy
- Budget ~1MEu/Year and 12FTEs: <u>Leverage through collaborations needed and encouraged</u> !

Collaborations

Institution / Organization	City / Region	Country
1. Université de Liège	Liège	Belgium
2. CNRS/LESIA	Paris	France
3. CNRS/LAM	Marseille	France
4. CNRS/CRAL	Lyon	France
5. CNRS/IPAG	Grenoble	France
6. CNRS/LAGRANGE (OCA)	Nice	France
7. CNRS/INSU	Paris	France
8. IOTA/IOGS (Institut d'Optique)	Palaiseau	France
9. CEA	Paris-Saclay	France
10. LAB	Bordeaux	France
11. MPIA Heidelberg	Heidelberg	Germany
12. Toptica	Munich	Germany
13. AIP, Leibniz Institute for Astrophysics	Potsdam	Germany
14. INAF	Rome	Italy
15. INAF Osservatorio di Roma	Rome	Italy
16. Microgate	Bolzano	Italy
17. NOVA / Leiden University	Leiden	Netherlands
18. ESA/ESTEC	Noordwijk	Netherlands
19. ASTRON	Dwingeloo	Netherlands
20. Instituto de Astrofísica e Ciências do Espaço	Porto	Portugal
21. Universidade do Porto	Porto	Portugal
22. Instituto de Astrofísica de Canarias	Tenerife	Spain
23. Astronómico Nacional de España	Madrid	Spain
24. University of Geneva	Geneva	Switzerland
25. ETH Zurich	Zurich	Switzerland
26. Durham University	Durham	UK
27. UKATC Edinburgh	Edinburgh	UK
28. University of Oxford	Oxford	UK



Current Project Portfolio

1. **PCS Roadmap/High Order Deformable Mirror**: towards a compact 128x128 actuators DM for future ExoEarth imaging (ELT/PCS)
2. **CMOS detectors**: Address the obsolescence of CCDs, European supply chain; availability of curved detectors
3. **New Generation Detector Controller** (NGCII): serving a suite of state-of-the-art detectors for new VLT & ELT instruments. ESO standard (~100 units)
4. **Cryogenic Low Noise Amplifier & GPU correlator** for ALMA+: Process extreme amounts of data ; Near real-time requirements, improve power consumption
5. **Laser Frequency Combs** : Improve reliability and wavelength coverage for accurate spectrograph calibration
6. **Advanced Laser Guide Star Adaptive Optics** for Astronomy. Towards visible AO and improved sky coverage. Synergy with ESA for ground-to-satellite communications.
7. **PCS Roadmap/SAXO+** : pathfinder for PCS installed on VLT-Sphere. Implement 2 stages cascaded AO, Machine learning robust predictive control and advanced wavefront sensors.
8. **Planètes** (ERC grant): towards a J-Band integrated-optics-based instrument for VLTI, including internal metrology. Include European 2Kx2K IR detector. Potential for piggybacking Astrophotonics instrument concepts.

components

system

"Instrument" like

Future perspectives

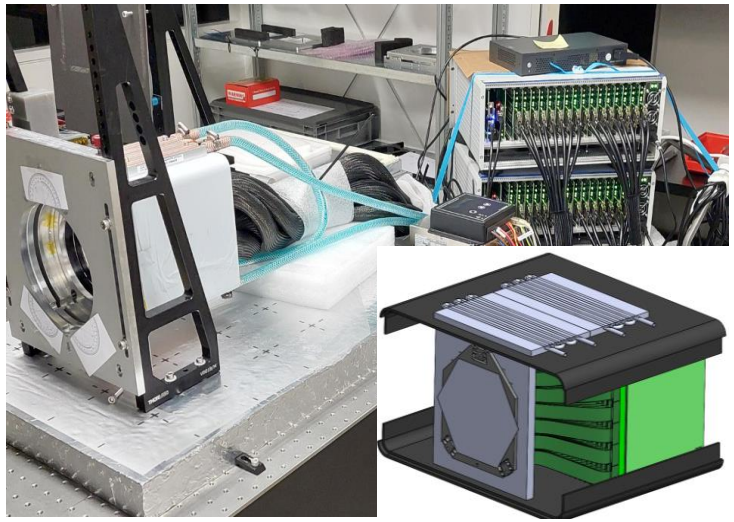
- Future activities 2026 targeted to Advanced Detector Simulator (Pyxel), Astrocombs, Astrophotonics, Artificial Intelligence applications (TBC), next generation of LNA and GPU for ALMA
- Concentrate on
  - Low TRL (maximizes the overlap with external partners)
  - Mid TRL (incentive for opportunities of field testing using ESO foci.
  - {High TRL: remains within the scope of approved instrument projects}
- TecDev can be a tool for preparing the “Next” ESO project (~ post 2035/2040)
  - E.g. Pathfinder studies/projects may emerge to anticipate the post-ELT transition (e.g. similar to AOF VLT-> ELT)
  - Identify/anticipate potential disruptive technologies: e.g. combination of LFC, Photonics correlators & SNSPD detectors towards heterodyne interferometry at 10μm

Potential Procurements

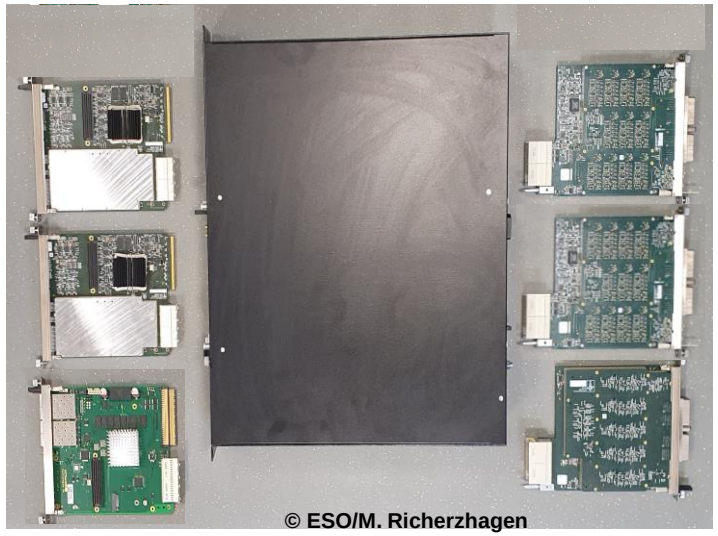
Project	Procurement type	Timeline
PCS Roadmap High Order Deformable Mirror	Test Bench; Opto-mechanics; RTCs	2026-2029
CMOS/Curved CMOS	Test bench; Cryogenic systems; Opto-mechanics	2026-2027
NGCII	(see dedicated presentation)	(see dedicated presentation)
Cryogenic Low Noise Amp	Test Bench;High-end electronics;Cryogenic systems; MMIC	2026-2029
GPU correlator	Test Bench; High-end Electronics; GPUs (e.g Nvidia)	2026-2029
Astrocombs	CFT Phase 2 (TBC)	2026-2029
Advanced LGS AO	Opto-mechanics;Photonics components; Study high Power	2026
PCS Roadmap/Saxo+	Opto-mechanical components; High-end electronics;	2025-2026
Planètes	Test bench; Optoelectronics/ photonics components;	2025-2027
Astrophotonics	Test bench; Photonics components; on-chip Multiplexed Photonics spectrograph	2026-2029 (TBC)

Examples of current projects

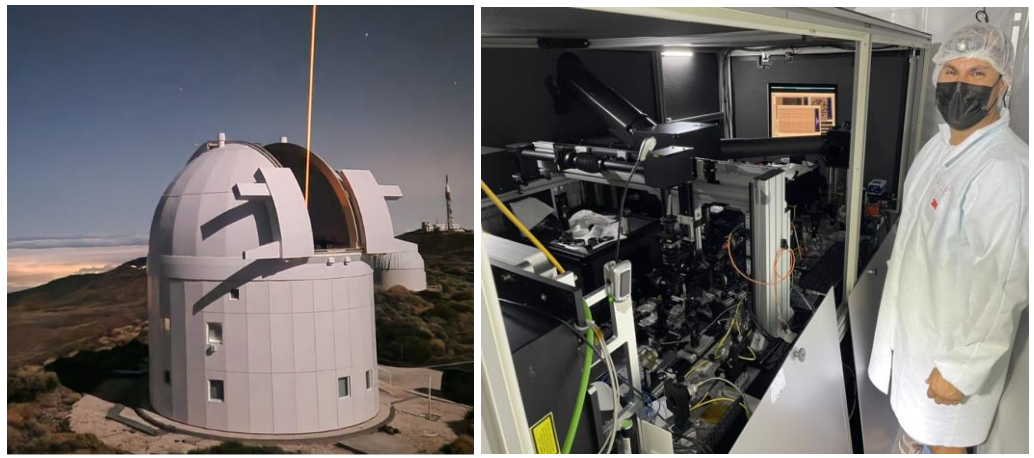
From VLT/MAVIS 64x64 DM to ELT PCS 128x128 DM

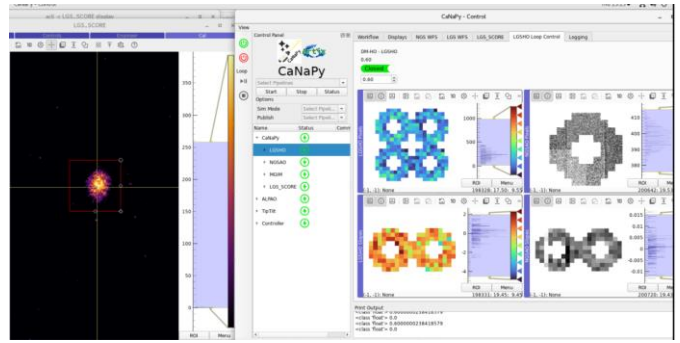


NGC II

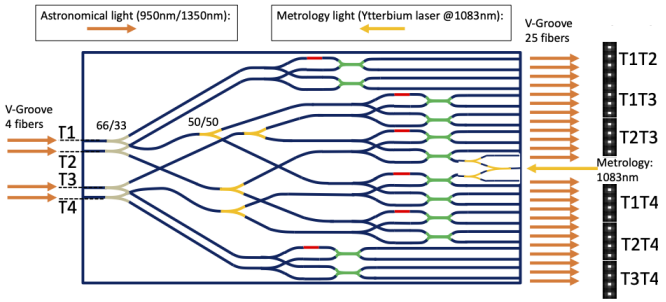


LGS at ESA OGS (Day&night time LGS propagation/detection)

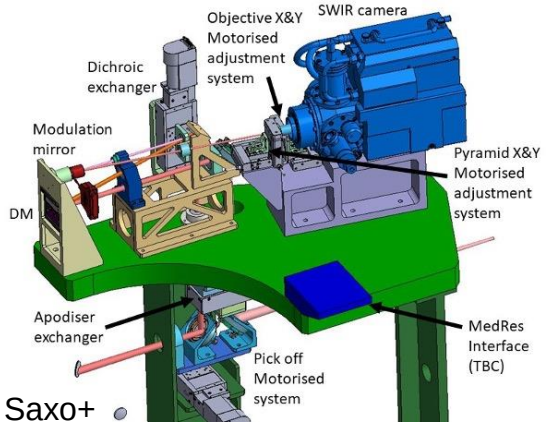




Closed-loop AO on LGS with a Pyramid sensor



Planètes, integrated optics beam combiner for VLTI



Saxo+