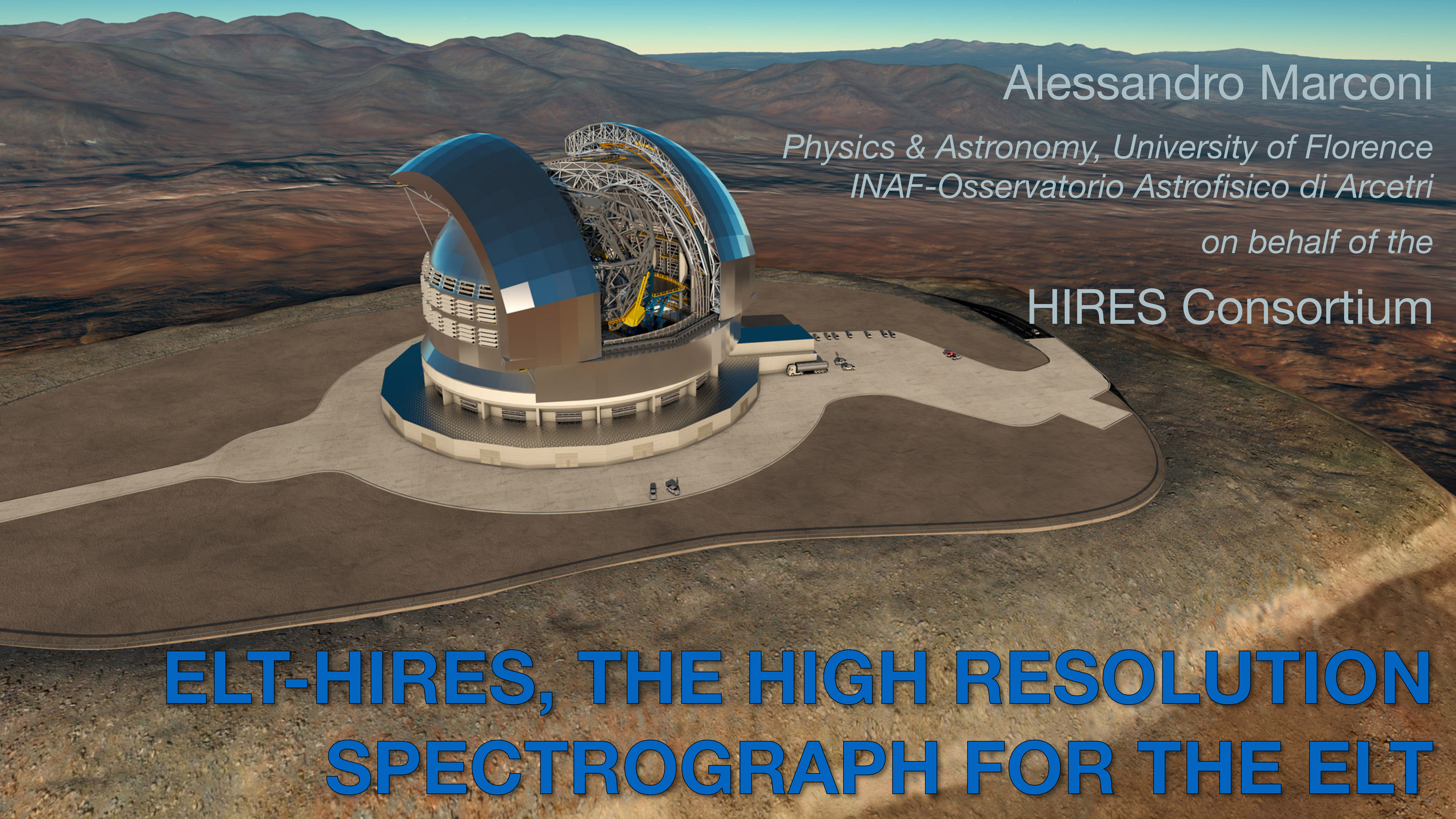


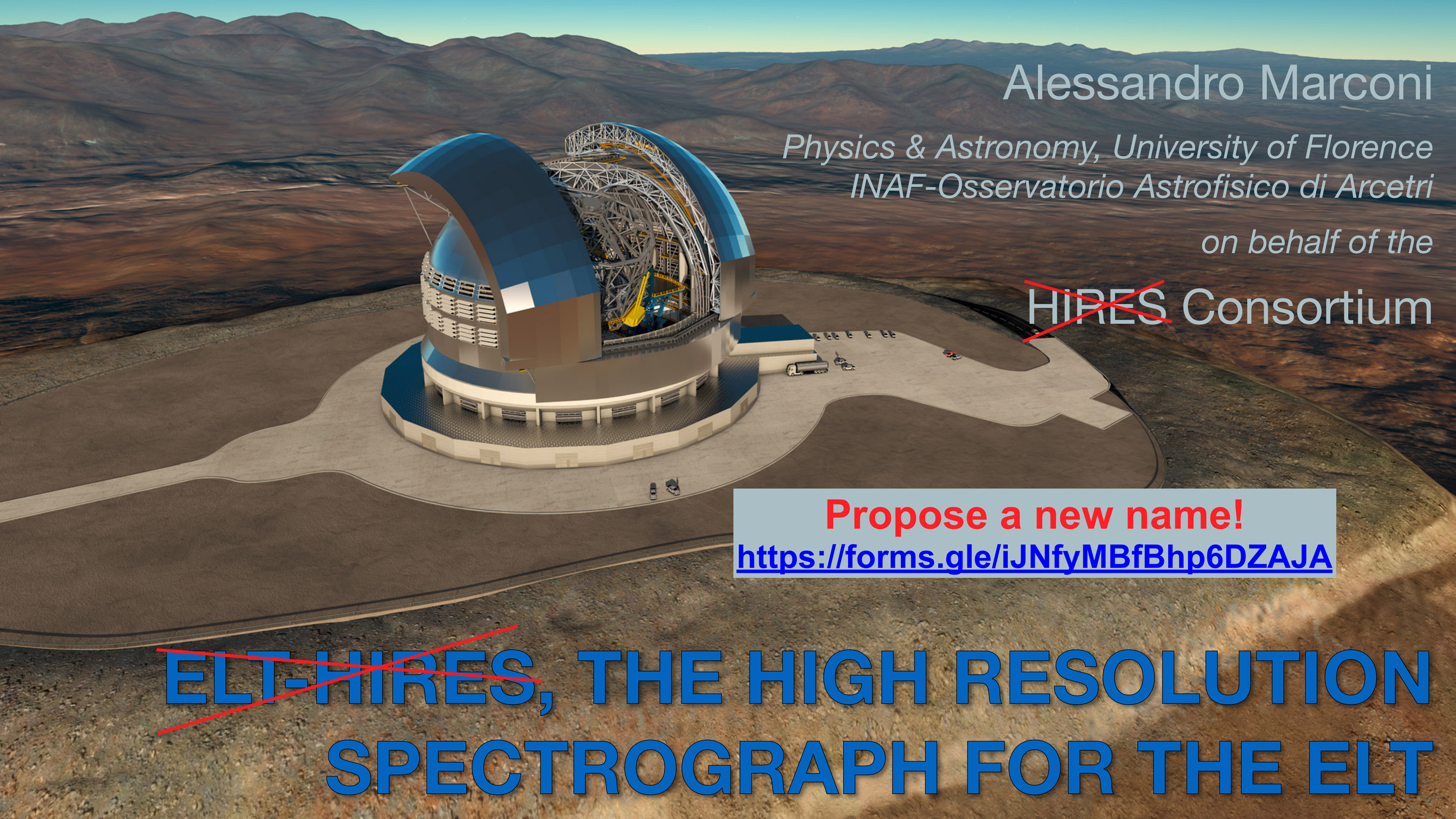
Alessandro Marconi

Physics & Astronomy, University of Florence
INAF-Osservatorio Astrofisico di Arcetri

on behalf of the

HIRES Consortium

ELT-HIRES, THE HIGH RESOLUTION SPECTROGRAPH FOR THE ELT



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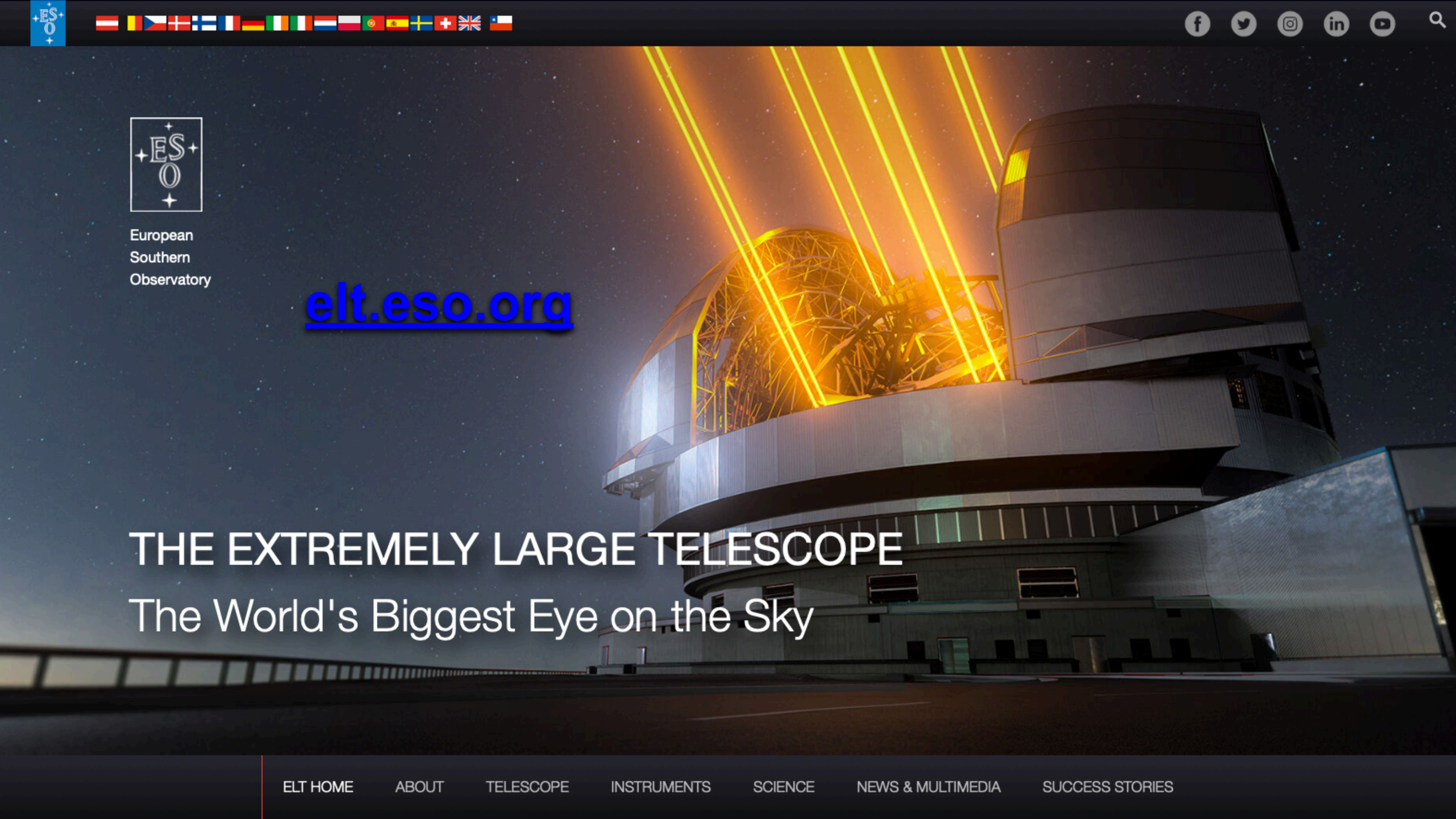
on behalf of the

~~HIRES~~ Consortium

Propose a new name!
https://forms.gle/iJNfyMBfBhp6DZAJA

~~ELT-HIRES~~, THE HIGH RESOLUTION SPECTROGRAPH FOR THE ELT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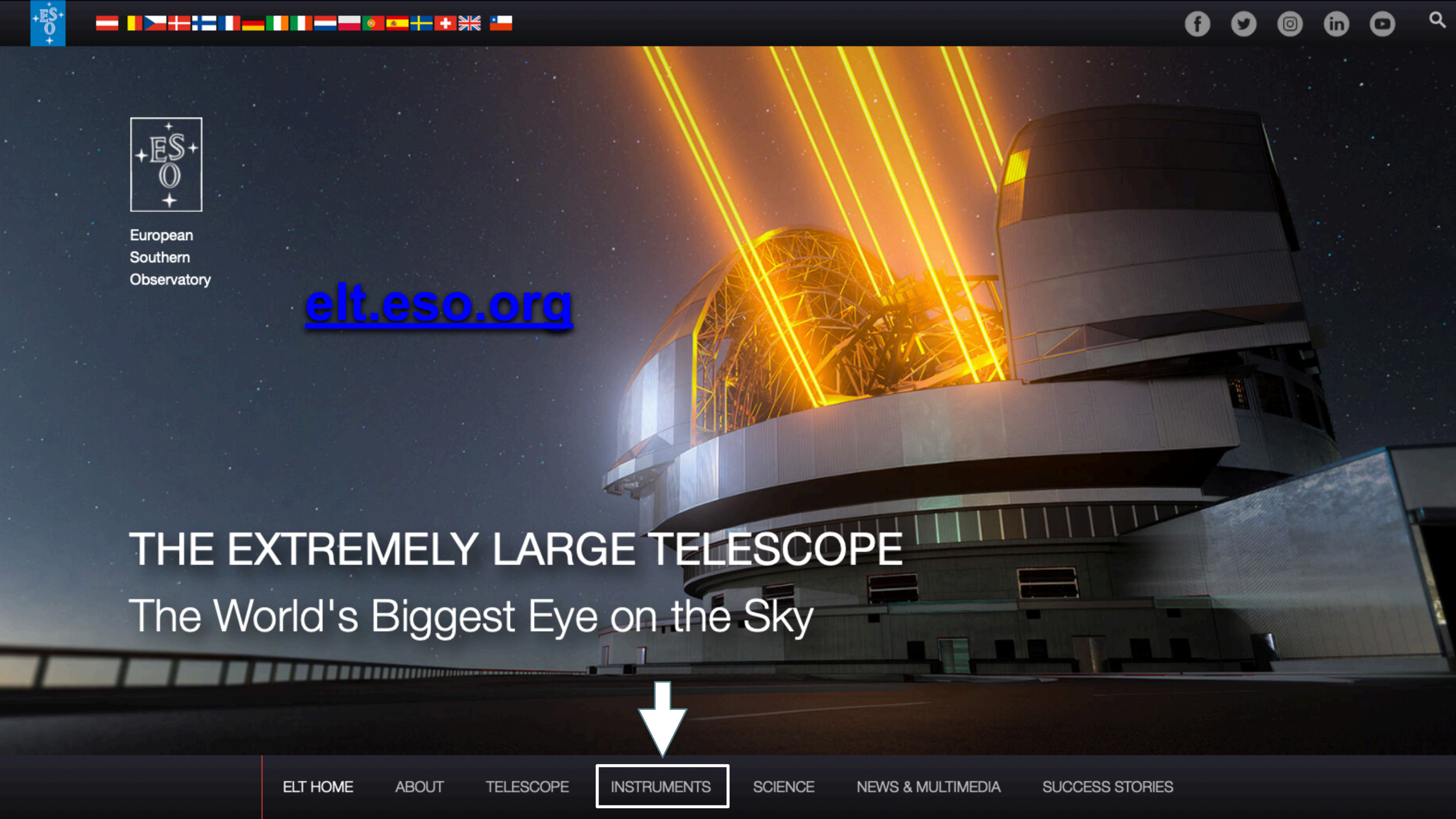
ELT HOME
ABOUT
TELESCOPE
INSTRUMENTS
SCIENCE
NEWS & MULTIMEDIA
SUCCESS STORIES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The HIRES Consortium

Principal Investigator (PI): A. Marconi

Executive Board & Institutes

- **Brazil: J. Renan de Medeiros**
  Federal Univ. of Rio Grande do Norte
- **Canada: R. Doyon**
  Univ. De Montreal, Herzberg Astrophysics Victoria
- **Denmark: L. Christensen**
  Univ. Copenhagen, Univ. Aarhus, Danish Tech. Univ.
- **France: I. Boisse**
  LAM Marseille, LAGRANGE Nice, IPAG Grenoble, IRAP/OMP Toulouse, LUPM Montpellier
- **Germany: K. Strassmeier**
  AIP Potsdam, Univ. Göttingen, Landessternwarte Heidelberg, MPIA Heidelberg, Thüringer Landesternwarte Tautenburg, Univ. Hamburg
- **Italy: A. Marconi**
  INAF Istituto Nazionale di AstroFisica (Lead)
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- **Poland: A. Niedzielski**
  Nicolaus Copernicus Univ. in Toruń
- **Portugal: N. Santos**
  Inst. Astrofísica e Ciências do Espaço, CAUP Porto, Lisbon
- **Spain: R. Rebolo**
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- **Switzerland: C. Lovis**
  Univ. de Genève, Univ. Bern
- **United Kingdom: M. Haehnelt**
  Univ. of Cambridge, UK Astronomy Technology Centre, Heriot-Watt Univ.
- **USA: T. Bergin**
  Univ. of Michigan

The HIRES Consortium

The state-of-the-art scientific and technological expertise in high-resolution spectroscopy in Europe

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Broad Context & History

- European Extremely Large Telescope (ELT) will be the largest ground-based telescope at visible and infrared wavelengths
  - Flagship science cases: the detection of life signatures in Earth-like exoplanets and the direct detection of the cosmic expansion re-acceleration (both require high resolution spectroscopy)
- High resolution spectroscopy (HRS)
  - Interdisciplinary (from Exoplanets to Cosmology and Fundamental Physics)
  - Successful ESO tradition (UVES, FLAMES, CRIRES, X-shooter, HARPS; ESPRESSO)
  - More than 30% of ESO publications can be attributed to its high-resolution spectrographs.
- HRS At 8m-class telescope entered into photon starved regime
- **Merging of CODEX and SIMPLE concepts into HIRES spectrograph R~100.000 in 0.37-2.4 μm**
- **HIRES Phase A study started March 2016, completed March 2018**
- Several activities completed in “pre-Phase B”, including modified baseline design
- ESO Council approval of HIRES Construction Agreement on December 7 2021
- **Phase B kick off by first half of 2022 following:**
  - signature of Construction agreement by ESO and INAF
  - signature of Consortium agreement by all Consortium Partners

A subset of HIRES Science Cases

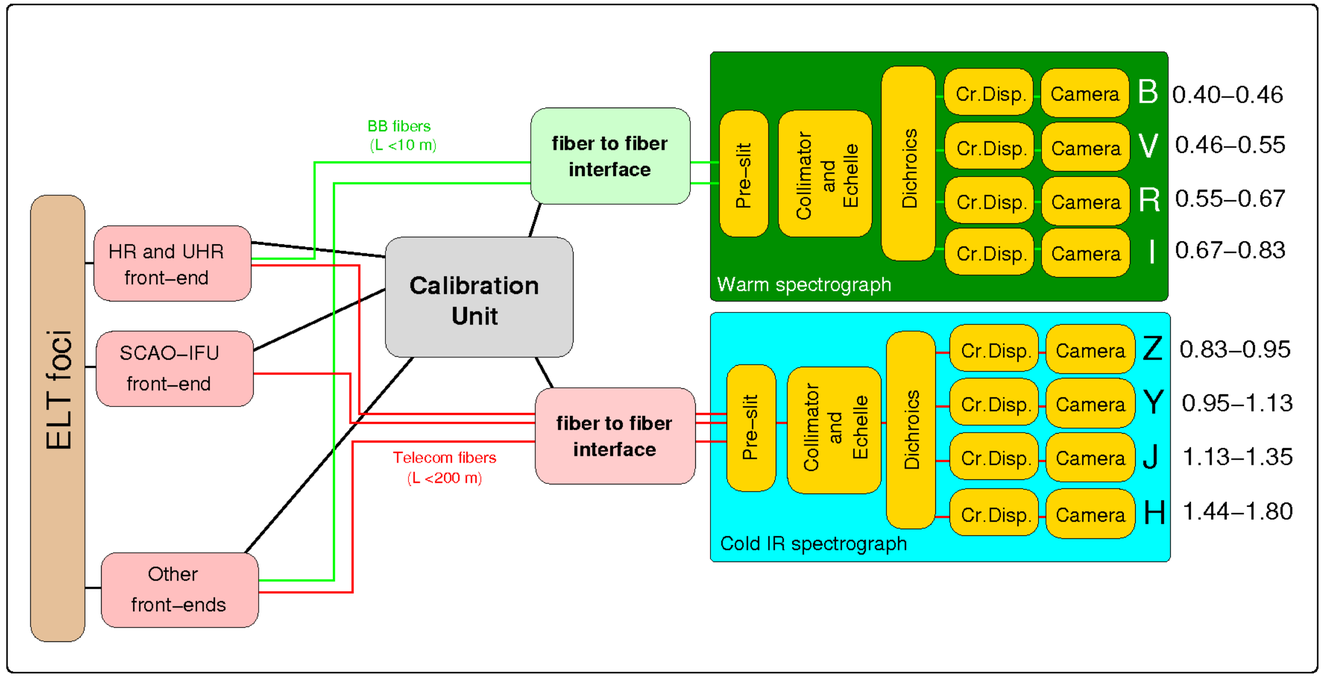
- **Exoplanets** (characterisation of Exoplanets Atmospheres: detection of signatures of life)
- **Protoplanetary Disks** (dynamics, chemistry and physical conditions of the inner regions)
- **Stellar Astrophysics** (abundances of solar type and cooler dwarfs in galactic disk bulge, halo and nearby dwarfs: tracing chemical enrichment of Pop III stars in nearby universe)
- **Stellar Populations** (metal enrichment and dynamics of extragalactic star clusters and resolved stellar populations)
- **Intergalactic Medium** (Signatures of reionization and early enrichment of ISM & IGM observed in high-z quasar spectra)
- **Galaxy Evolution** (massive early type galaxies during epochs of formation and assembly)
- **Supermassive Black Holes** (the low mass end)
- **Fundamental Physics** (variation of fundamental constants - α, m_p/m_e Sandage Test)

Community White Paper: Maiolino et al. 2013, ArXiV:1310.3163

Science Priorities → TLRs

1. Exoplanet atmospheres via transmission spectroscopy (potential detection of bio-signatures)
2. Variation of the fundamental constants of Physics
3. Exoplanet atmospheres via reflection spectroscopy (potential detection of bio-signatures)
4. Redshift drift (Sandage test)

★ All the science cases enabled by the TLR from the top priorities are excluded from the prioritisation



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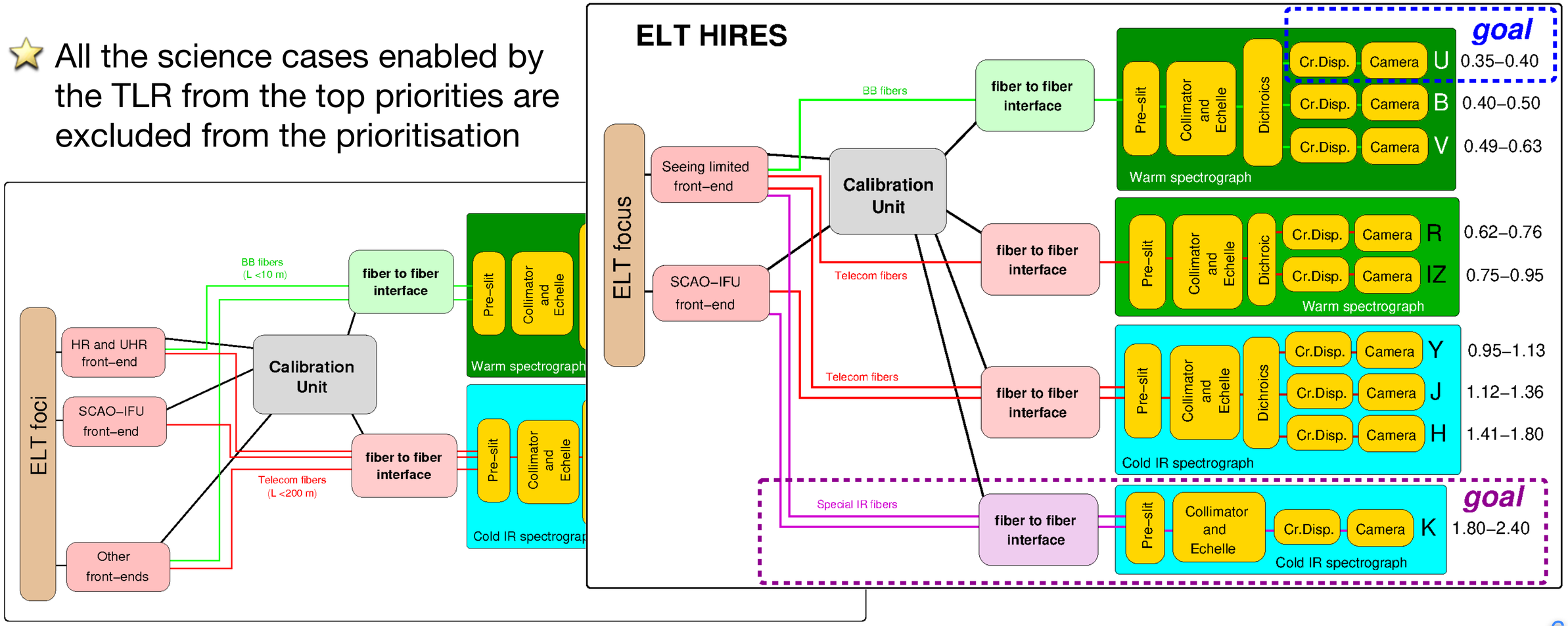

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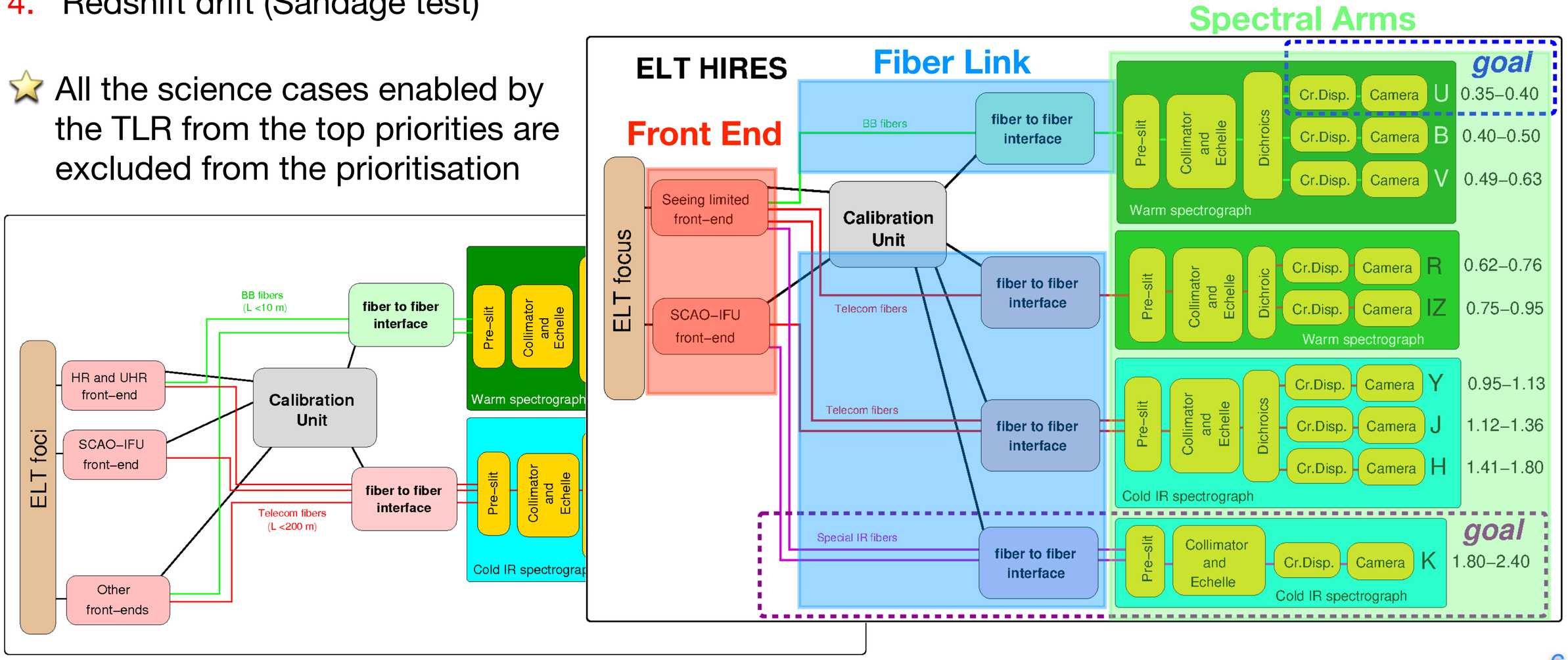
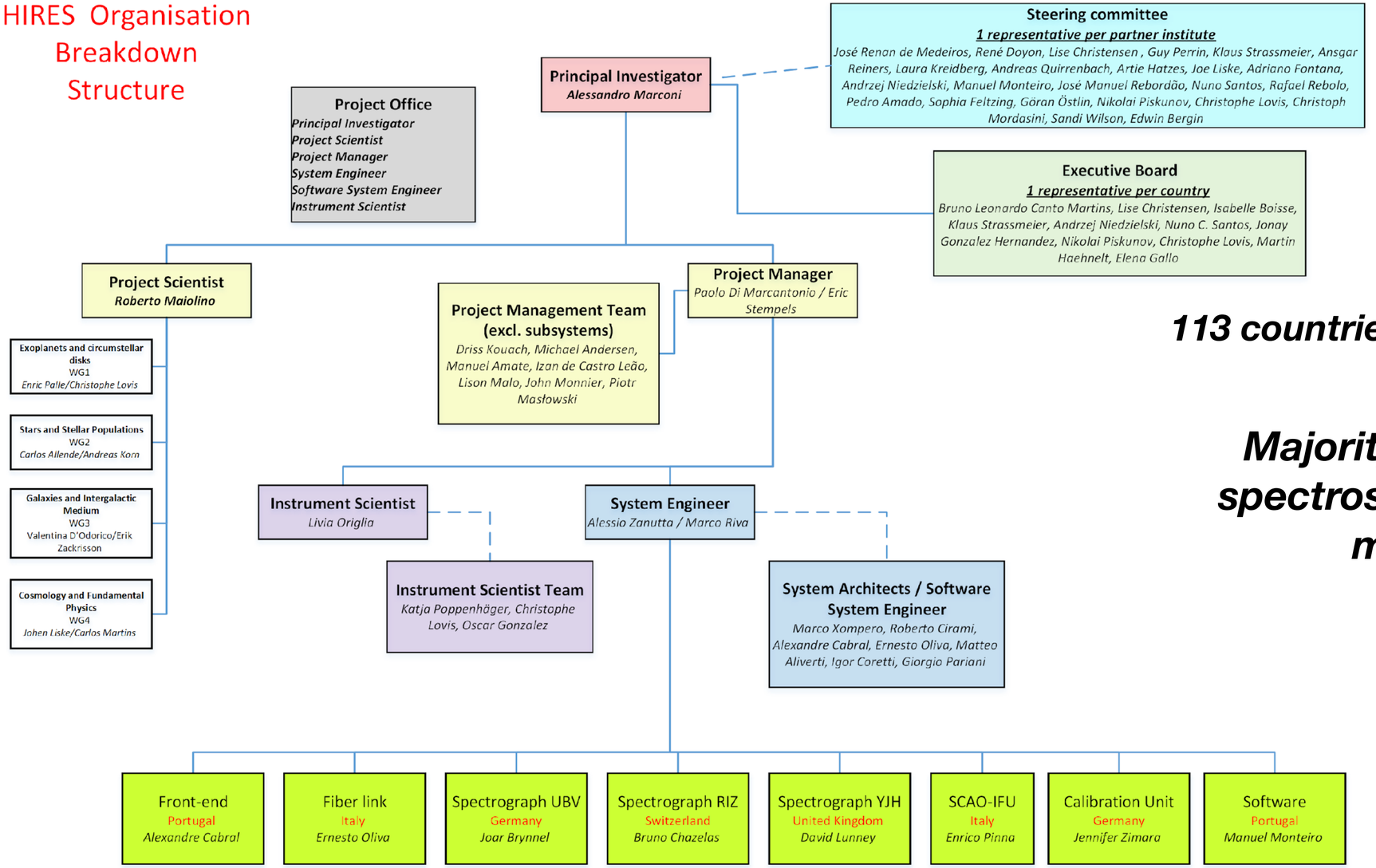


The HIRES Consortium Organization

HIRES Organisation Breakdown Structure

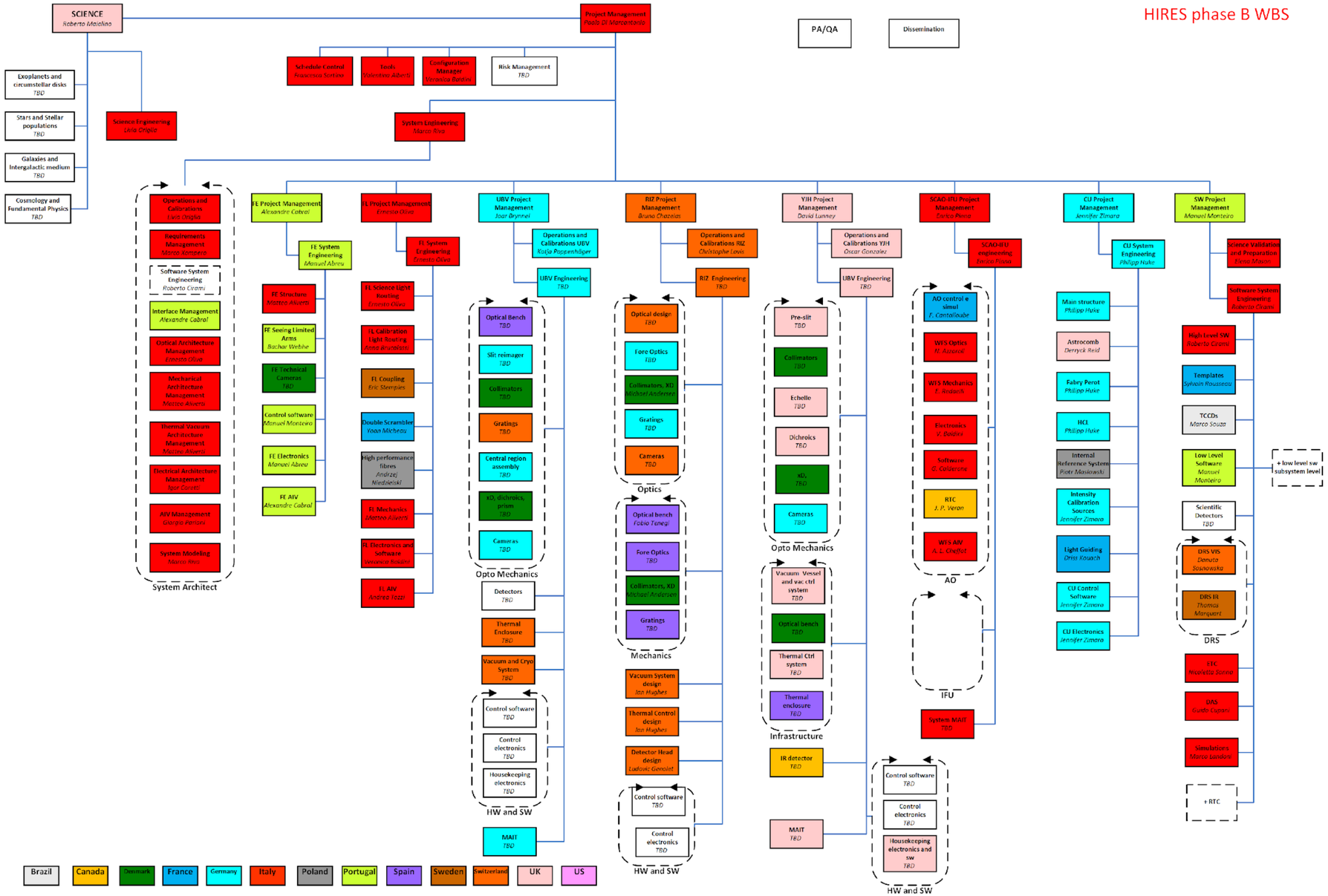


113 countries, more than 30 institutes

~200 people

Majority of high resolution spectroscopy experts in ESO member states

HIRES Work Breakdown organization



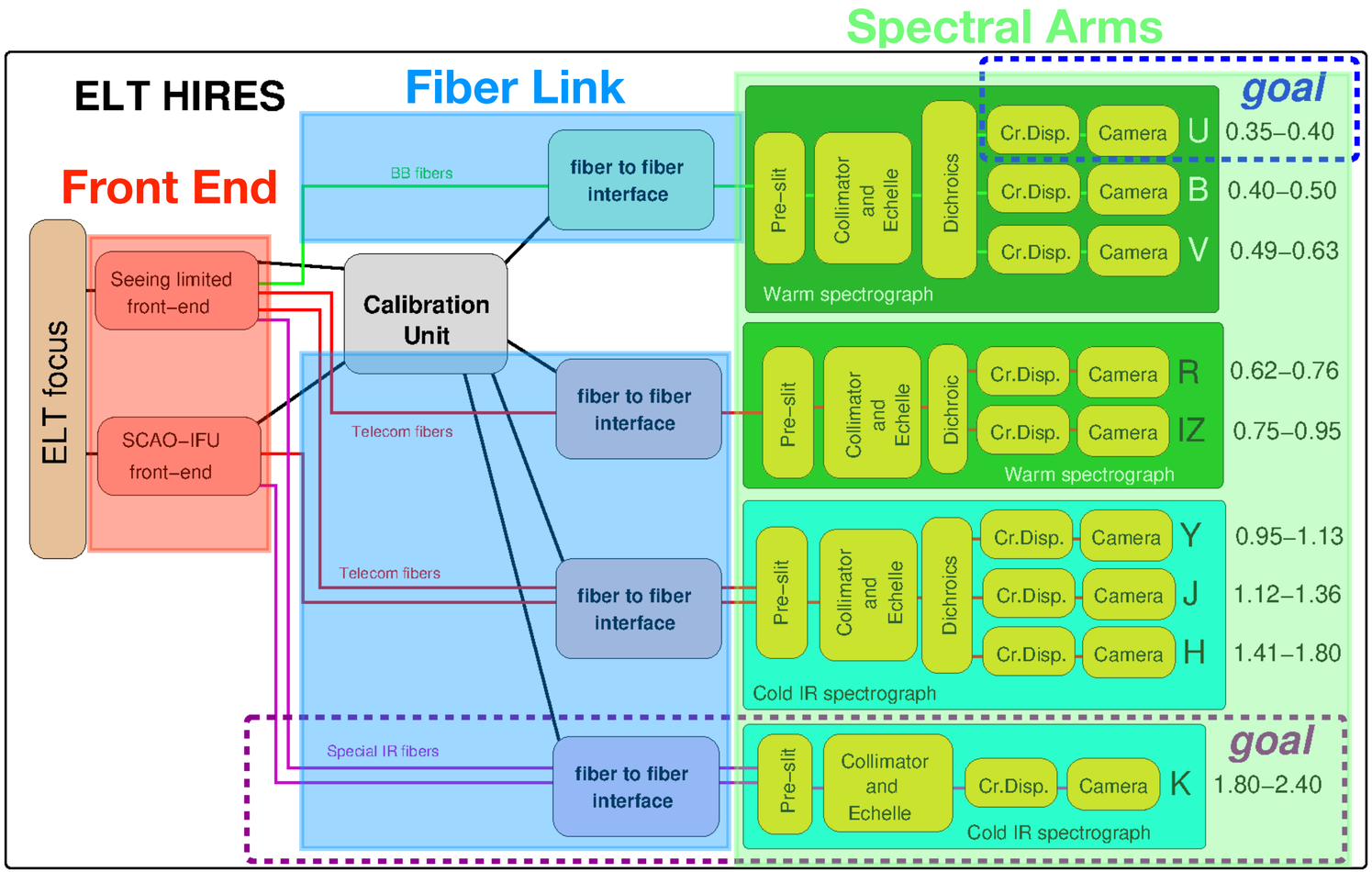
Cost, GTO & Schedule

Total estimated cost of baseline design is ~35 MEUR, + 600 FTEs

>125 GTO nights which will be used for Consortium science programs

Schedule

- **Phase A: 2016-2018 Completed!**
- **Phase B (PDR): 2022-2023**
- **Phase C (FDR): 2024-2025**
- **Integration (PAE): 2026-2029**
- **Commissioning & PAC: 2029/2030**



Summary of ELT HIRES project

- International consortium: **32+ institutes, 13 countries, >200 people**
- Successful Phase A study 03/2016 - 03/2018
- **Aggressive schedule: Start Phase B ~2022, @ELT in 2029-2030**
- **Science priorities (plus many other great science cases …):**
  1. biomarkers from exoplanet atmospheres in transmission
  2. variation of fundamental constants of Physics
  3. biomarkers from exoplanet atmospheres in reflection
  4. direct detection of Cosmic acceleration through Sandage effect
- **Modular fiber-fed cross dispersed echelle spectrograph**
- **Simultaneous range 0.4-1.8 μm (ultrastable BLUE+RED+NIR)**
  Resolution ~100,000
- **Several interchangeable, observing modes:**
  Seeing limited & SCAO+IFU
- **Total estimated cost of baseline is 35 MEUR, + 550 FTEs**
  - technically “simple”
  - almost pupil independent
  - great science cases (fulfills top 4 priorities)
  - modular, staged deployment possible