Astronomy in Belgium – ESO – and the E-ELT

Christoffel Waelkens
Scientific Delegate in ESO Council
Belspo, 18 June 2015

Astronomy in Belgium

- Vigourous research tradition (four Francqui prizes already!)
- Solar system, stars, galaxies, the Universe
- Distributed over universities and ROB
- Excellent internal collaboration
- International networks and projects
- Ground and space

Big science in a small country

- Astronomy drives technology, but is also driven by technology.
- For a small community, access to large facilities logically implies need for international collaboration.
- Belgium played a founding role in ESO and ESA.
- Astronomy has historically always played a forefront role in internationalisation of science.
- The total has proven to be much more important than the sum of the parts, and currently all member states are ‘small’ with respect to ESO and ESA.

Astronomy and Technology Development

- However clever we think we are, we have to acknowledge that the Universe has always more imagination than we have.
- Technology more than ever drives progress in our understanding of the Universe.
- But it remains fair to say that the quest for answers to fundamental science questions has benefited the technological advances in our societies.
- Within Belgium, where both could go together, success stories followed.

Ground versus Space

- Advantages of space
  - In situ exploration
  - Better images
  - Access to the whole electromagnetic spectrum
- The role of ground-based observations
  - It happens that the main energy sources (stars) radiate in the UV-optical-IR domain
  - Much cheaper per photon received
  - Larger telescopes and more versatile instruments possible
- Combining both in a clever way is the evident trade-off.

ESO versus ESA

- Both rely on the mutual enforcement of science and technology, but with a different emphasis.
- At ESA, technology development is a primary goal, at ESO it is a tool for the fundamental objective, which is the science of the Universe.
- Return on investment is a requirement for ESA, and is a goal for ESO.
- The scientific communities largely overlap.

Community involvement

- Both agencies rely on community involvement for the development of payload/instruments.
- Within ESA this also involves technology development, for us through Prodex.
- There is no Prodex for ground-based astronomy.
- How do we cope then?

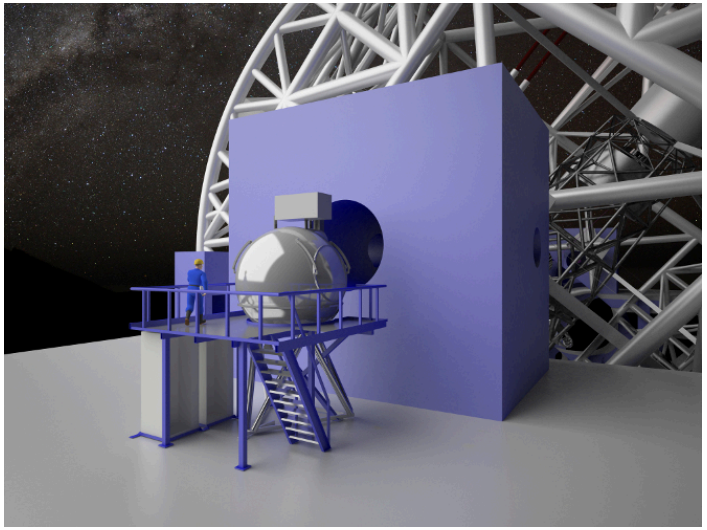
ELT instrument development in Belgium

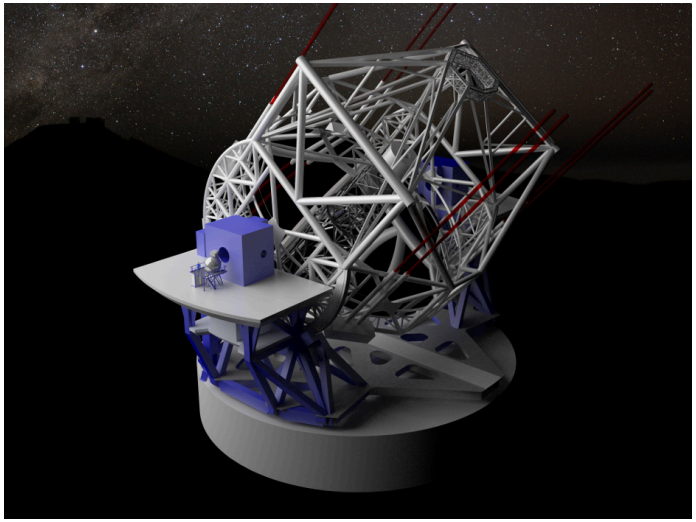
ESO instruments developed by international consortia

- Hardware costs ESO-funded
- Manpower locally funded

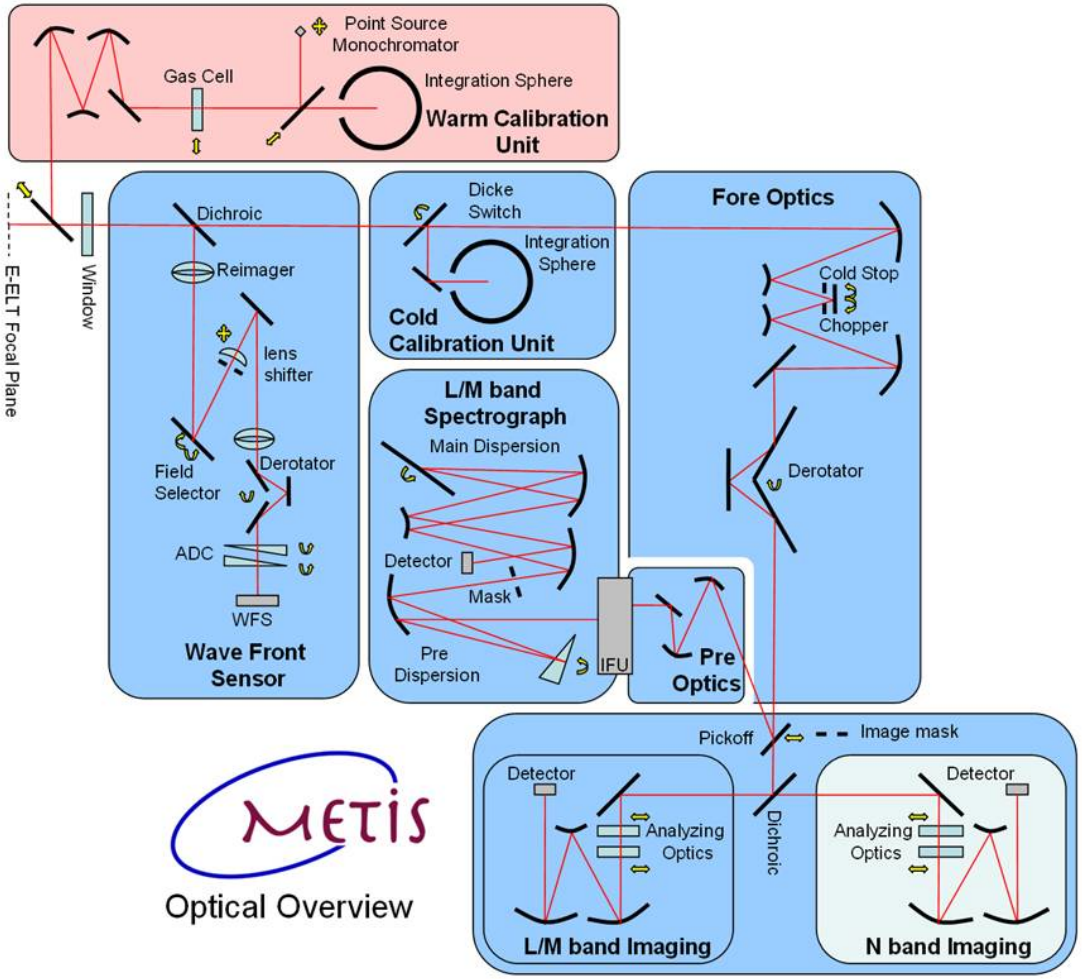
METIS instrument for ELT (3rd ELT science instrument)

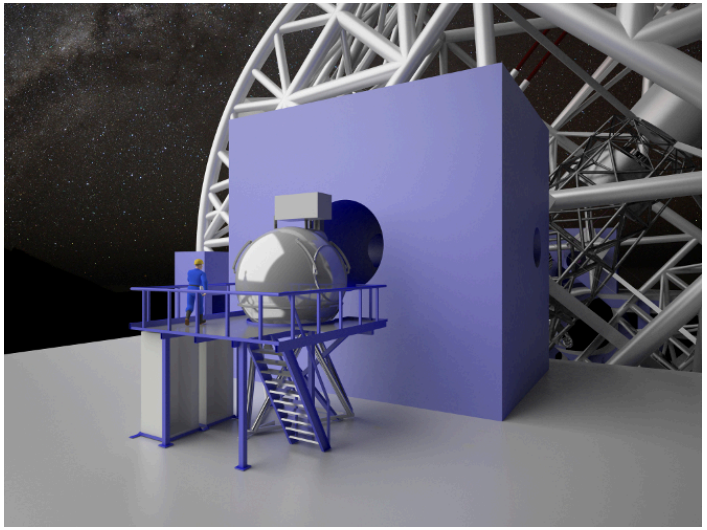
- Mid-infrared Spectroscopy & Imaging
- Belgian contributions:
  - Instrument Control system,
  - Calibration (KU Leuven)
    - FWO Big Science, internal funding
  - Coronagraphs - Université de Liège
    - ERC project O. Absil 'VORTEX'





METIS


Point Source
Monochromator
Gas Cell
Integration Sphere
Warm Calibration Unit
E-ELT Focal Plane
Window
Dichroic
Reimager
lens shifter
Field Selector
Derotator
ADC
WFS
Wave Front Sensor
Dicke Switch
Integration Sphere
Cold Calibration Unit
L/M band Spectrograph
Main Dispersion
Detector
Mask
Pre Dispersion
IFU
Fore Optics
Cold Stop
Chopper
Derotator
Pre Optics
Pickoff
Image mask
Detector
Analyzing Optics
L/M band Imaging
Dichroic
Detector
Analyzing Optics
N band Imaging
METIS
Optical Overview



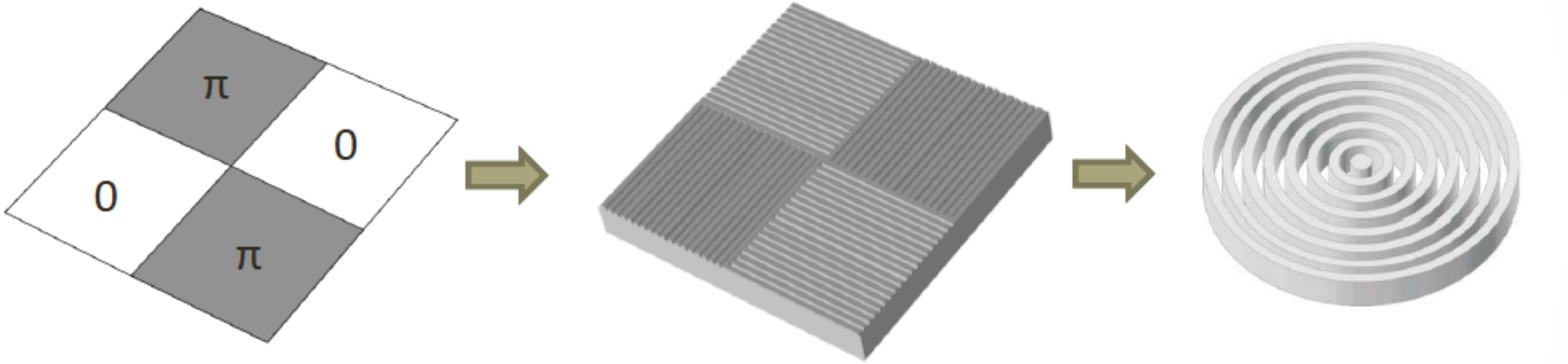
Coronagraphic masks

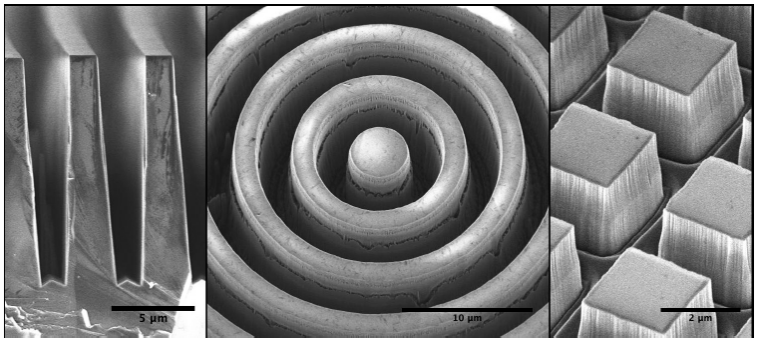
Olivier Absil (Université de Liège) – ERC project 'VORTEX'

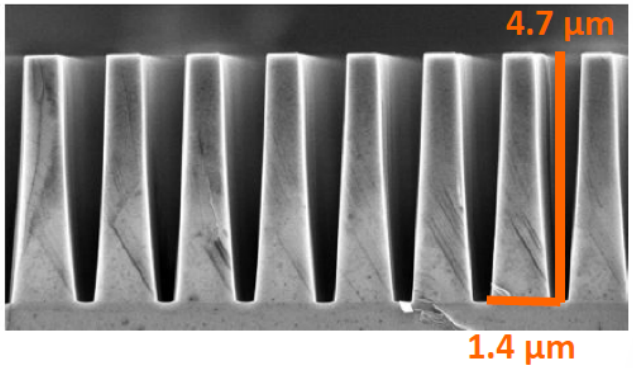
Annular groove phase masks (AGPM) : on-axis light cancellation

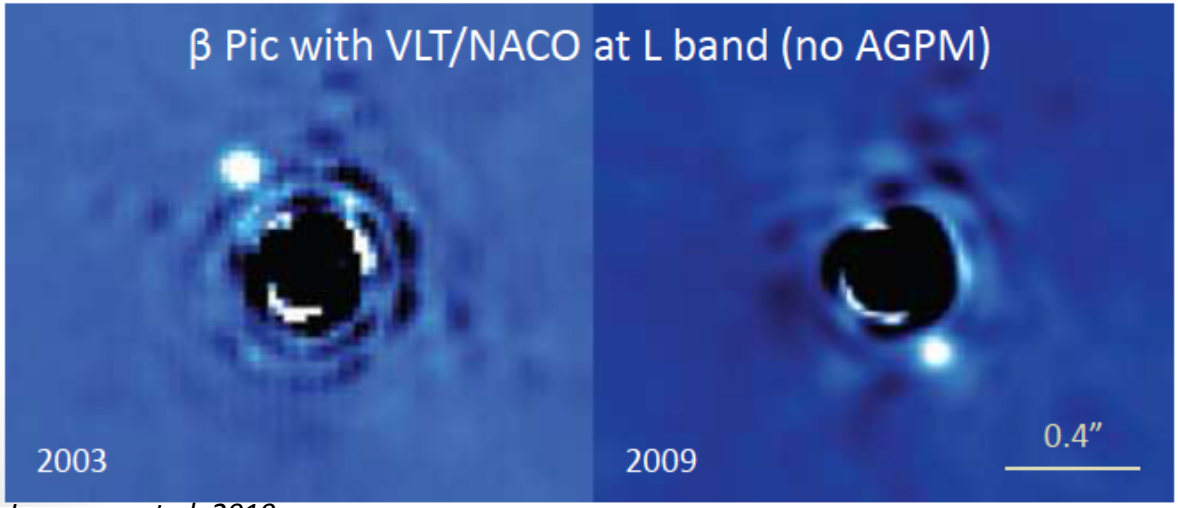
Mid-infrared AGPM (VTL/VISIR, ELT/METIS)

Near-infrared AGPM (VLT/SPHERE, ELT/MICADO)

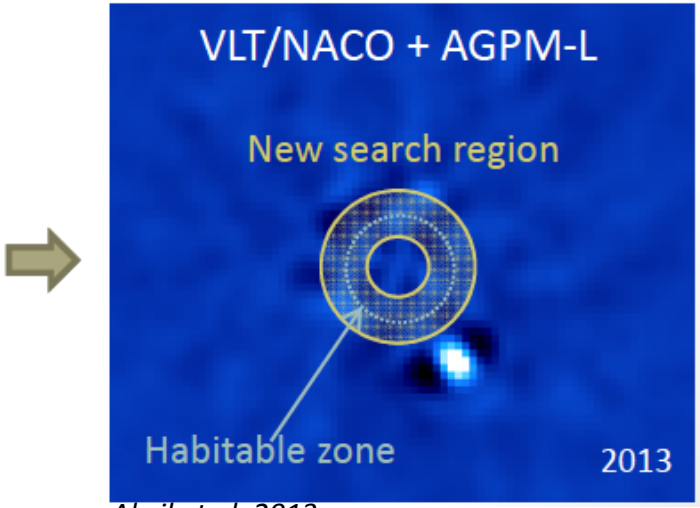








Lagrange et al. 2010



Absil et al. 2013

Why should you care?

- For the same reasons as we do!
- Not: in order to get very rich with little effort.
- But:
  - To be part of an extraordinary adventure
  - To ensure your international competitivity
  - To truly innovate
- It is in our common interest to show that challenges in fundamental science and technological innovation go together.