Measuring Starlight with Ultrafast Lasers

Wavelength calibration for the world's largest telescope

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The Extremely Large Telescope (ELT)

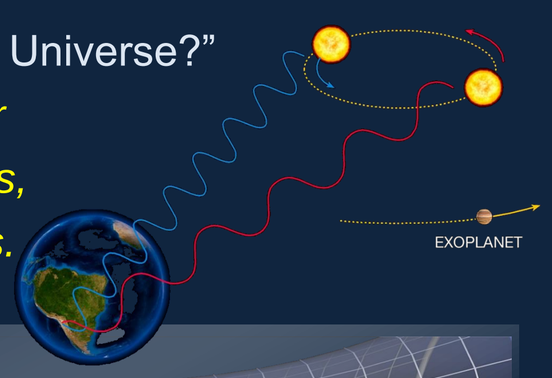
- Will be the largest ever optical telescope, after completion in 2028
  - 6× better camera than James Webb Space Telescope
  - 4 spectrographs – including the €35m ANDES spectrograph
  - 39.3 metre mirror – huge light collecting area!
- Consortium of 17 countries
- Major UK roles for Cambridge, Durham, UKATC, and Heriot-Watt.

Heriot-Watt is developing the wavelength calibrator for ANDES.

Key Science Questions

"Are we alone in the Universe?"

The ELT will hunt for Earth-like exoplanets, orbiting nearby stars.



"What is the fate of our Universe?"

With studies like

- Galaxy and star formation
- Real time Universe Expansion

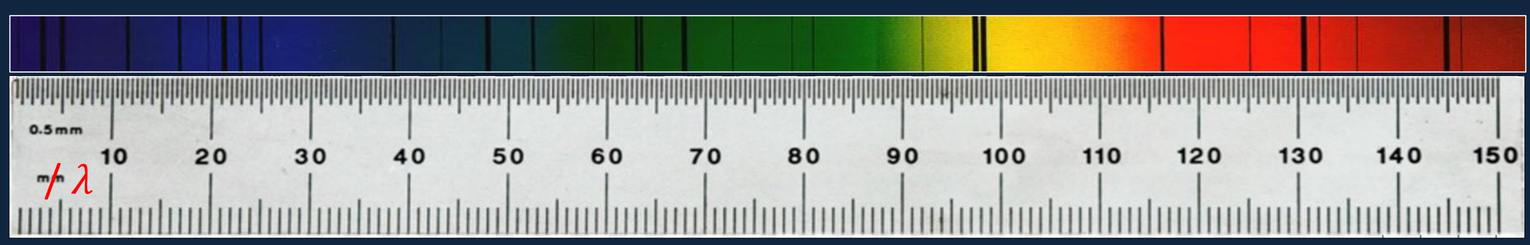
The ELT will will deepen our understanding of the Universe.

Image credits: ESO

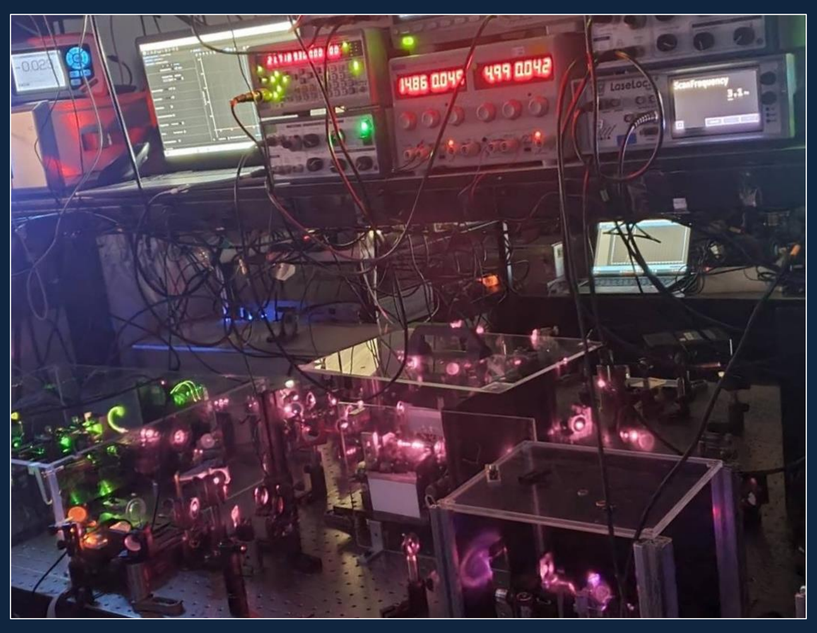
Starlight Has the Answer

- The colour (Wavelength, λ) of starlight from distant planets and galaxies reveals their motions
- ANDES spreads starlight into its different colours – much like the cover of Pink Floyd famous album.
- Atomic features in the light must be tracked for days, months, years and decades
- Tiny fluctuations will identify Earth 2.0, or even changes in so-called "fundamental constants"!

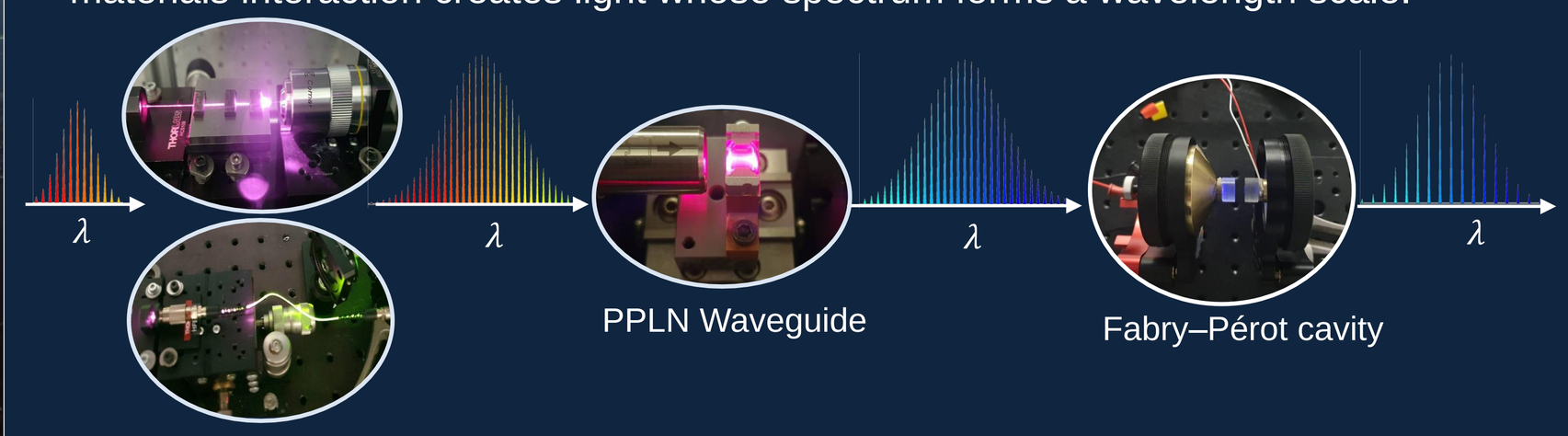
Heriot-Watt is developing a "laser ruler" that will provide a high-precision wavelength scale for measuring these subtle changes over time.



Building a "Wavelength Ruler"

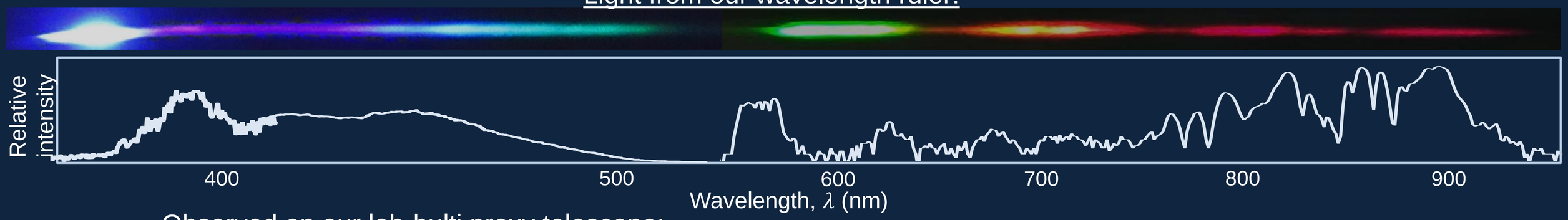


- (Left to right below) Starting with a Near-Infrared ultrafast laser, a chain of lasers-materials interaction creates light whose spectrum forms a wavelength scale.

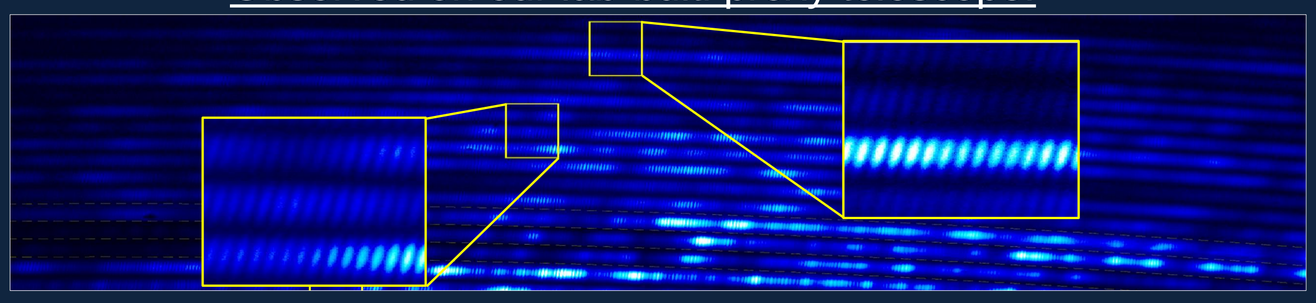


Our Results

Light from our wavelength ruler:



Observed on our lab-bulti proxy telescope:



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Article

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Continuous ultraviolet to blue-green astrocomb

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Check out the Ultrafast Optics Group at Heriot-Watt University

Scan for more details on our newest paper!