

# VIPA spectrometer: first light

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**Univ. Montréal:** René Doyon, Etienne Artigau, Philippe Vallée



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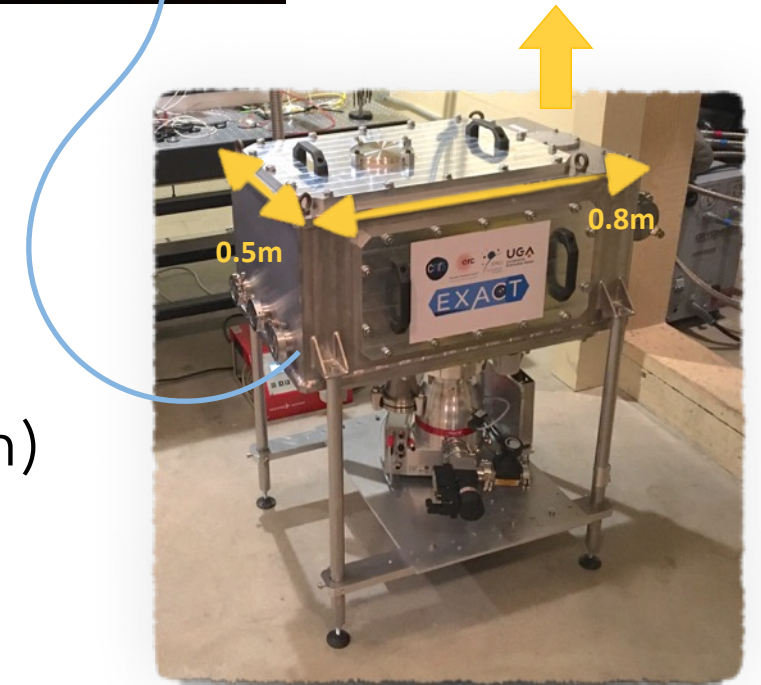
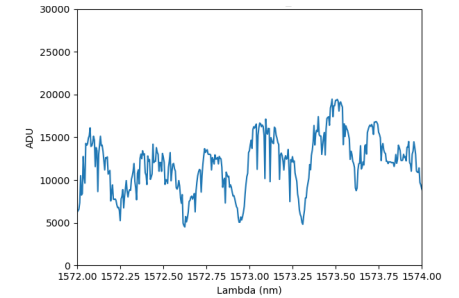
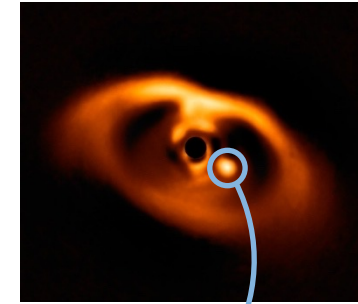
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# What makes VIPA interesting

- **Astrophysics perspective**
  - Enable characterization of exoplanets
  - Could be used as radial velocity instrument
- **Instrumental perspective**
  - More efficient than other spectrometers for AO-assisted telescopes
  - Telescope independent (fits all sizes!)
  - Fiber injection unit also filters speckles!
  - Compact, versatile, cost efficient (detector driven)



# Why an on-sky demonstration at Palomar

- **Palomar Mountain: an ideal location**
  - 5m telescope with AO system, and fantastic staff
  - Hosts fiber injection unit for J & H bands
  - Hosts PARVI, only other monomode fiber-fed spectrometer
  - Managed by close collaborators at Caltech
- **Objectives**
  - On-sky operability demonstration
  - Signal extraction & performance estimation with real stars
  - Comparison with PARVI



# How FOCUS helps VIPA & other projects

- Kickstart projects

- Key hardware purchased with FOCUS funding
- 1.5yr engineer time (S. Curaba) H2RG control software

- High efficiency leverage for larger projects

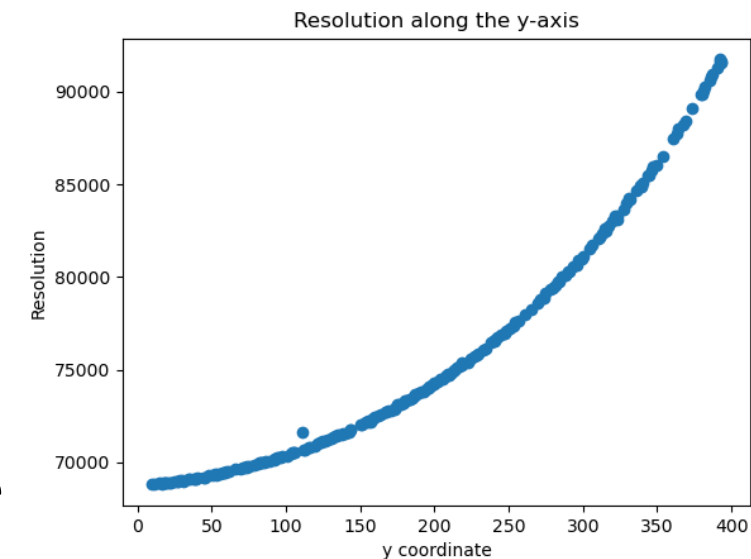
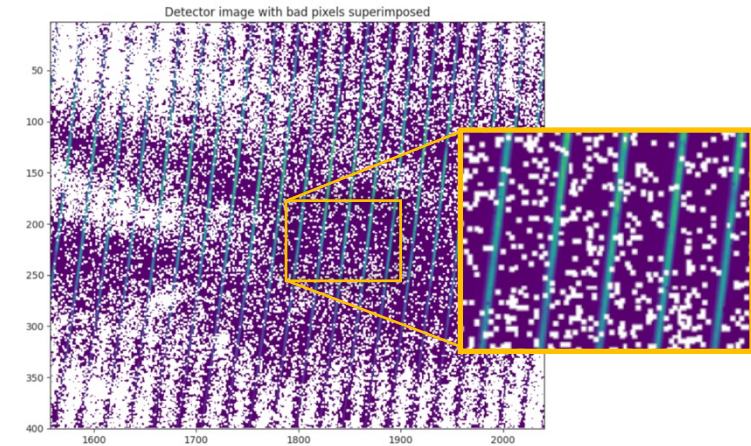
- Enabled ERC EXACT; May enable a second one (PI: X. Bonfils)
- VIPA part of PEPR spectroscopic proposed developments
- Potential application with ELT (ANDES, PCS) & Space

- Community for detector-driven projects

- ALFA detectors could have benefited VIPA; instead, used engineering grade H2RG with challenging cosmetics!
- Discussion on formats, performances, capabilities, processing, etc.

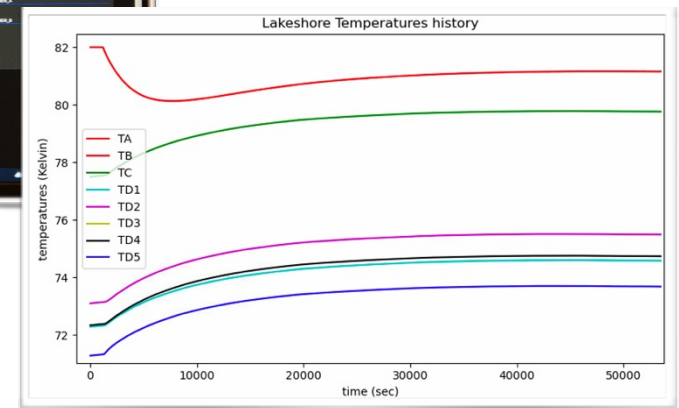
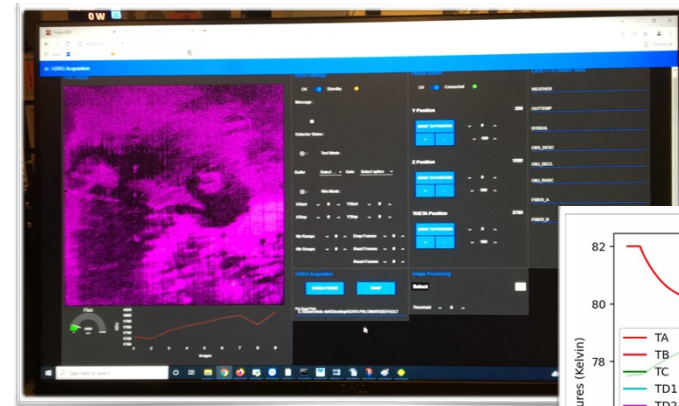
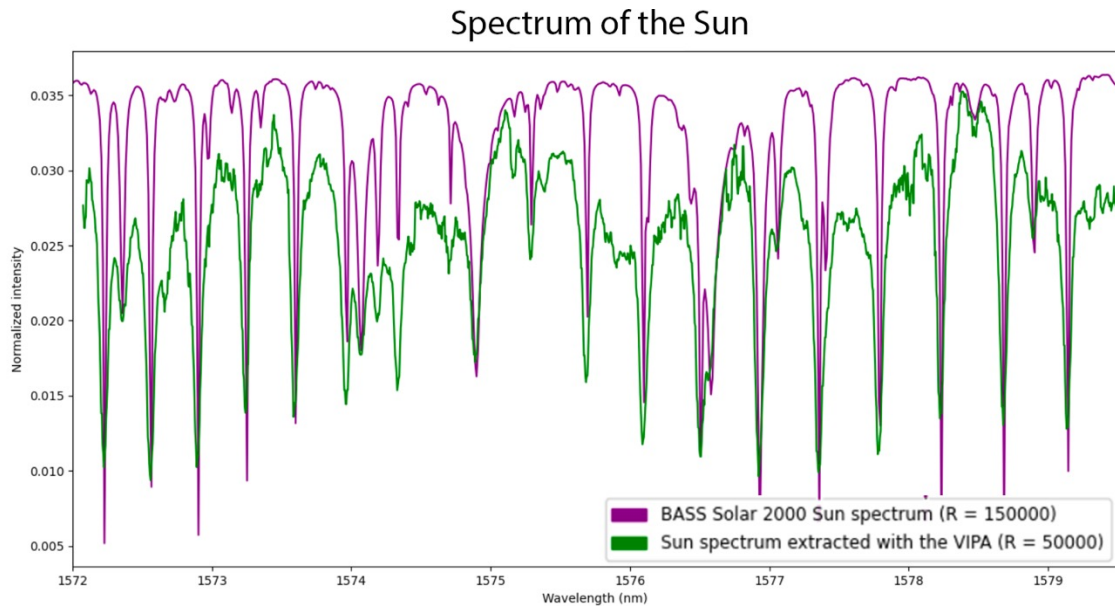
# Preparation - Readiness

- Pre-shipping review with Caltech & Palomar
  - Check interfaces (fluids, power, etc.) ✓
  - Schedules & crates deliveries ✓
- Concept validation
  - Calibration procedure (order flats, pixel map) ✓
  - Resolution along orders & after extraction ✓
  - Transmission (fiber output to detector) ⚠ / ✓
    - 40-50% by design, and validated
    - Currently 20% due to faulty grating
    - New grating tested in the lab, solves the issue



# Preparation - Software development & First spectra

- Control software developed by Stéphane Curaba (H2RG, piezo actuators, temperature & pressure monitoring)
- Reduction pipeline developed by Alexis Bidot (2<sup>nd</sup> year PhD)
- AIV activities assisted with C-RED2 camera (high frame/sec) & H2RG



# Mission schedule

January

February

March

April

VIPA shipping

H2RG shipping



Team #1

Team #2

Team at Palomar

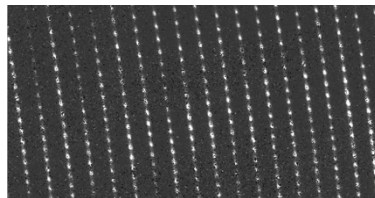
Alignement & Calibration

Observing nights

VIPA & H2RG packing

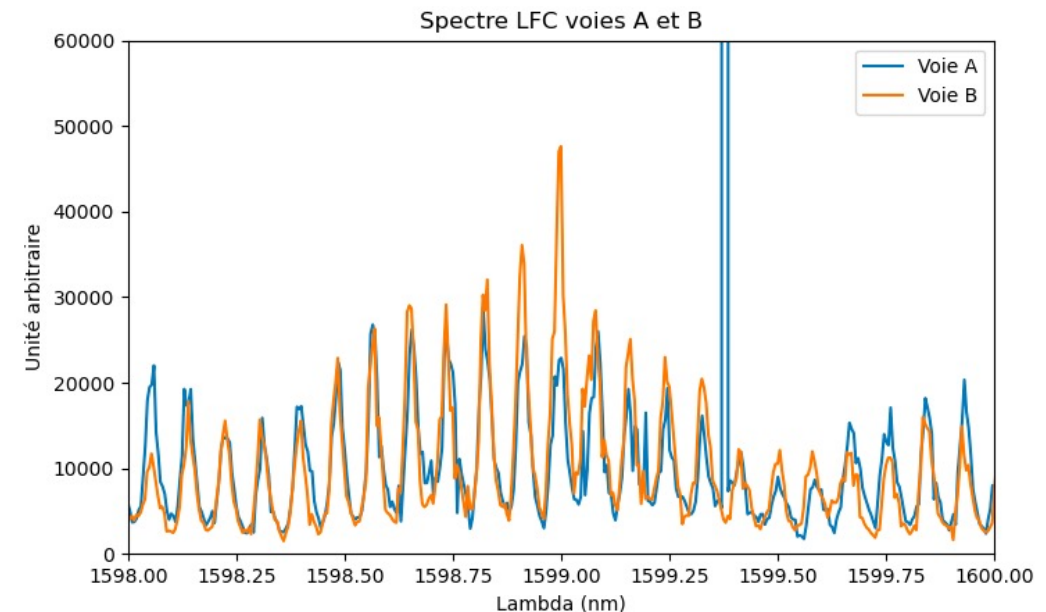
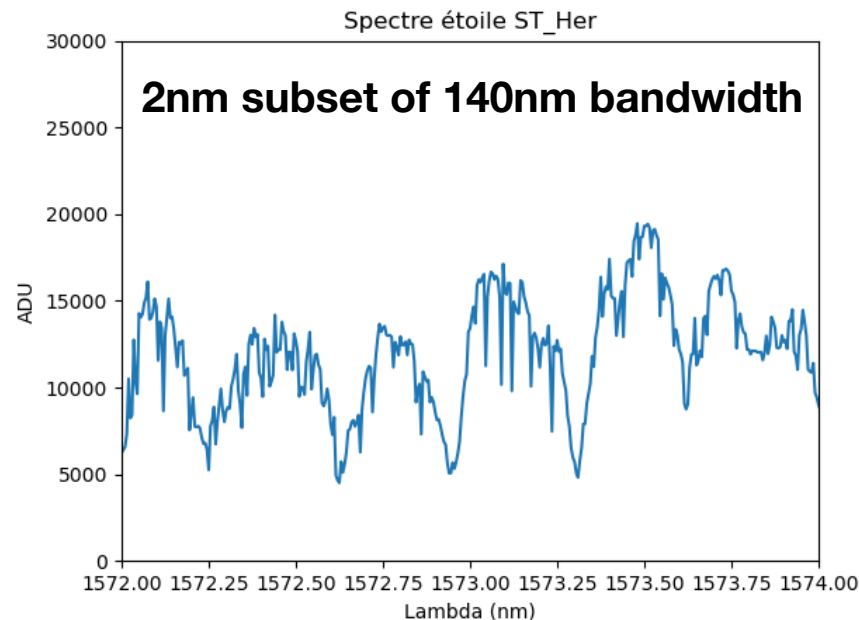
VIPA shipping

H2RG shipping



# 8 stars observed over 3 nights

- Hmag = 1 to 7, feature-less & feature-rich stars (IRTF spectral library w/ known spectro-photometry)
- 1 stars observed together with PARVI (GL388, also a SPIROU ref. star)
- 1 low contrast binary & 1 star with a transiting planet (GJ436), before & during transit





# What's next?

- Early 2023: 1<sup>st</sup> light of new H2RG detector
- Mid 2023: K-band channel AIT completed

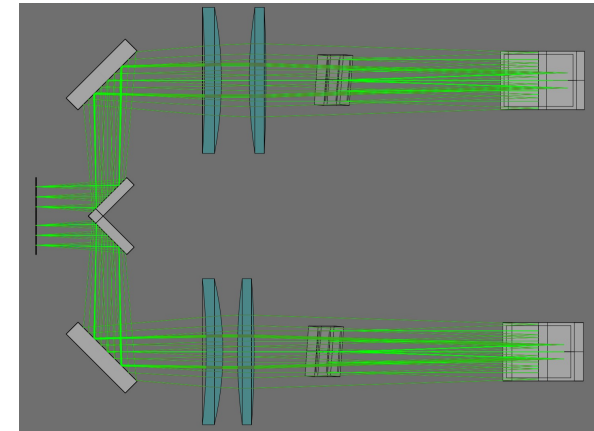


2023-2025: Observations of planets w/ Keck or VLT (KPIC or SPHERE/HiRISE)

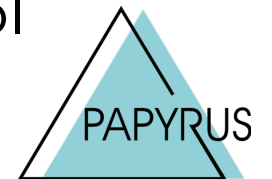
Two very different H2RGs!  
Much better cosmetics with new one



H+K band optical design (fits in cryostat!)



- New design from P. Rabou for an H+K mode (same resolution, AIT is TBD)
- Demonstration on OHP's Papyrus testbed of advanced AO control techniques (dark-hole)



# Take home messages

- On-sky test confirms VIPA as 'plug-and-play' instrument
- Resolution & transmission in accordance with design
- Instrument ready in 2023 for H or K band observations
  
- New designs, new science goals, and new detectors are closely linked!
- **FOCUS** is key to helping projects like this one!

