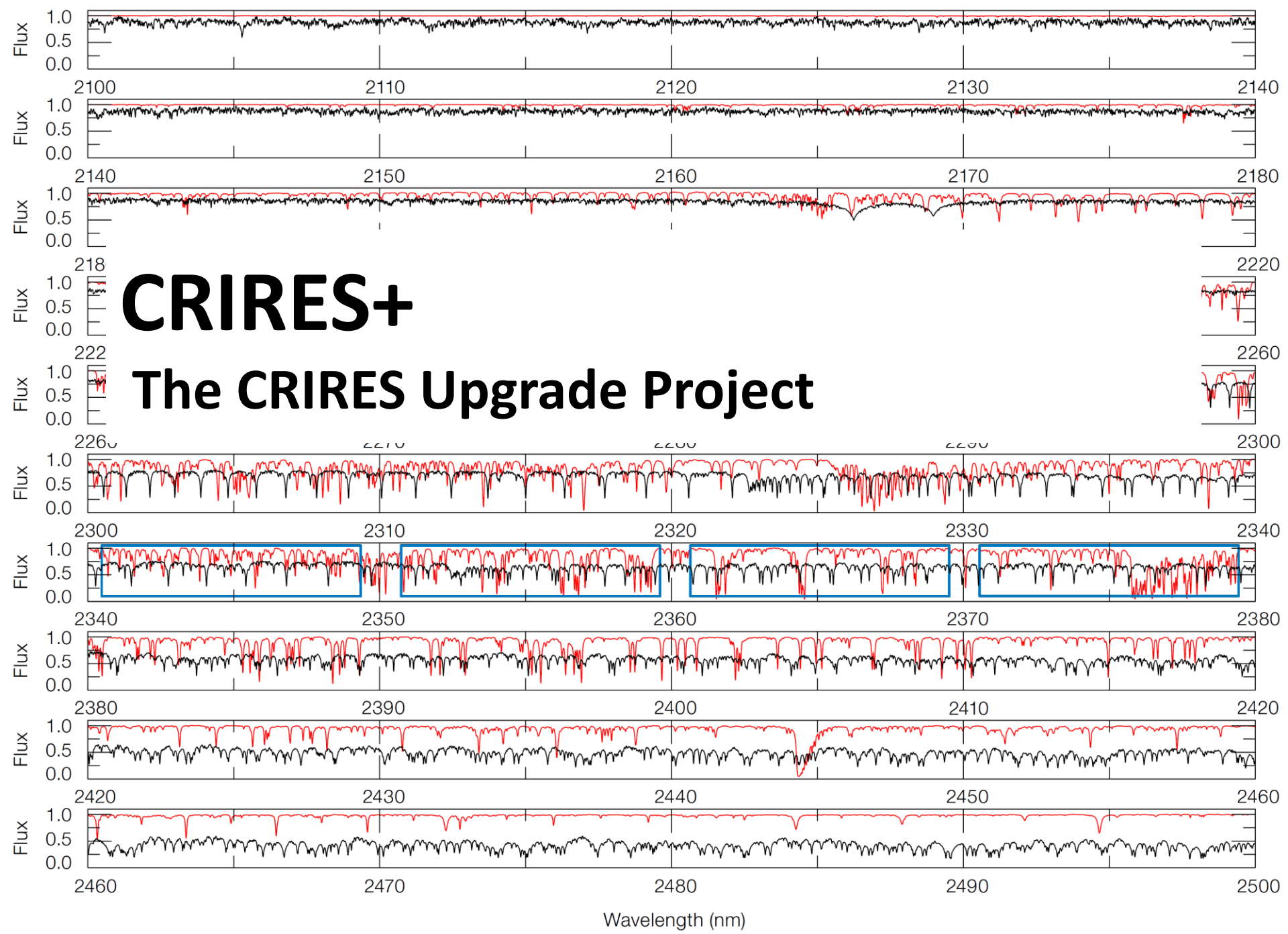
CRIRES+
The CRIRES Upgrade Project
Flux
Wavelength (nm)

Overview

- What was CRIRES?
- Scientific Goals
- CRIRES Upgrade – Technical Details
- The CRIRES+ Consortium and schedule

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What was CRIRES?

- CRyogenic InfraRed Echelle Spectrograph
- Installed at VLT UT1
- R~100,000
- Accessible YJHKLM (0.98 -5.3 µm)
- But: only 15 nm instantaneous wavelength coverage

Pictures courtasy of ESO

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Scientific goals

- Search for exoplanets around cool stars
- Characterization of exoplanet atmospheres
- Origin and evolution of stellar magnetic fields

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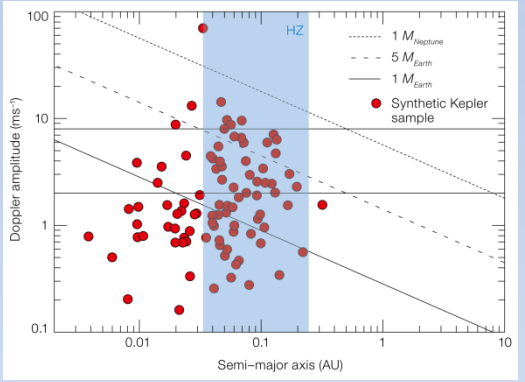
Search for exoplanets around cool stars

- Search for exoplanets via radial velocity measurements
- at visual wavelength widely applied (eg HARPS)
- Exoplanet population around cool and/or young stars unknown
- To find exo earth, wavelength solution to better than 2 m/s required
- Corresponds to ~1/1000 resolution element



R. Dorn, ESO Messenger June 2014

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Characterization of exoplanet atmospheres

- Spectrum taken in and out of transition, subtract to obtain planetary atmosphere absorption spectrum
- Requires very high SNR, but limited transit time
- Co add data from several transits
- Requires very high instrument repeatability

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Origin and evolution of stellar magnetic fields

- Measure magnetic field of other stars with Zeeman effect (line splitting)
- Easier in polarized light

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Upgrading CRIRES: What do we need?

- Turn CRIRES into a cross-dispersed echelle spectrograph
- Upgrade detectors
- Provide proper wavelength calibration from 1-5 µm
- Add Polarimetry
- Support the instrument with data reduction software
- Refurbish subsystems as required

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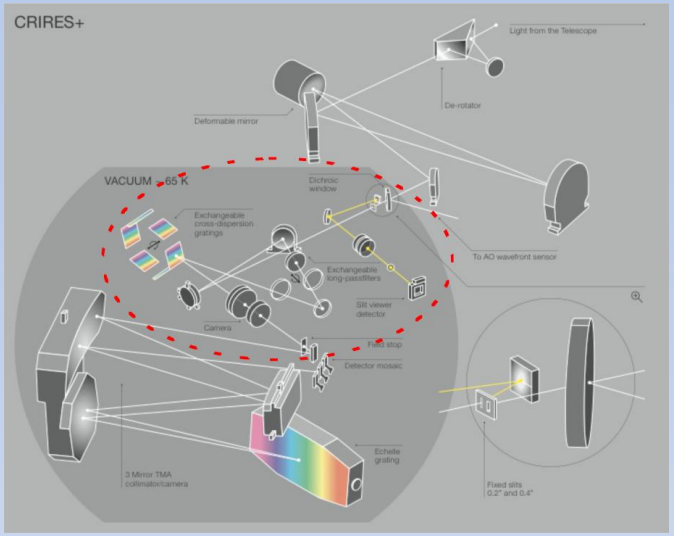
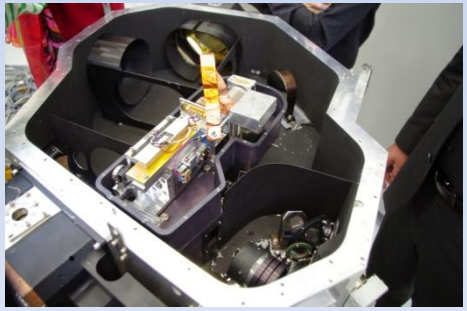
CRIRES+: A cross-dispersed echelle spectrograph

- Pre-Optics Unit exchanged for new Cross-Dispersion Unit
- Grating wheel with 6 gratings
- New CDU Camera 1-5 µm
- New slit assembly (0.2 and 0.4 arcsec) and slit viewer
- New entrance window dichroic
- Upgrade metrology system
- Spectrograph unit retained



CRIRES+ optical design, R. Dorn, ESO Messenger June 2014



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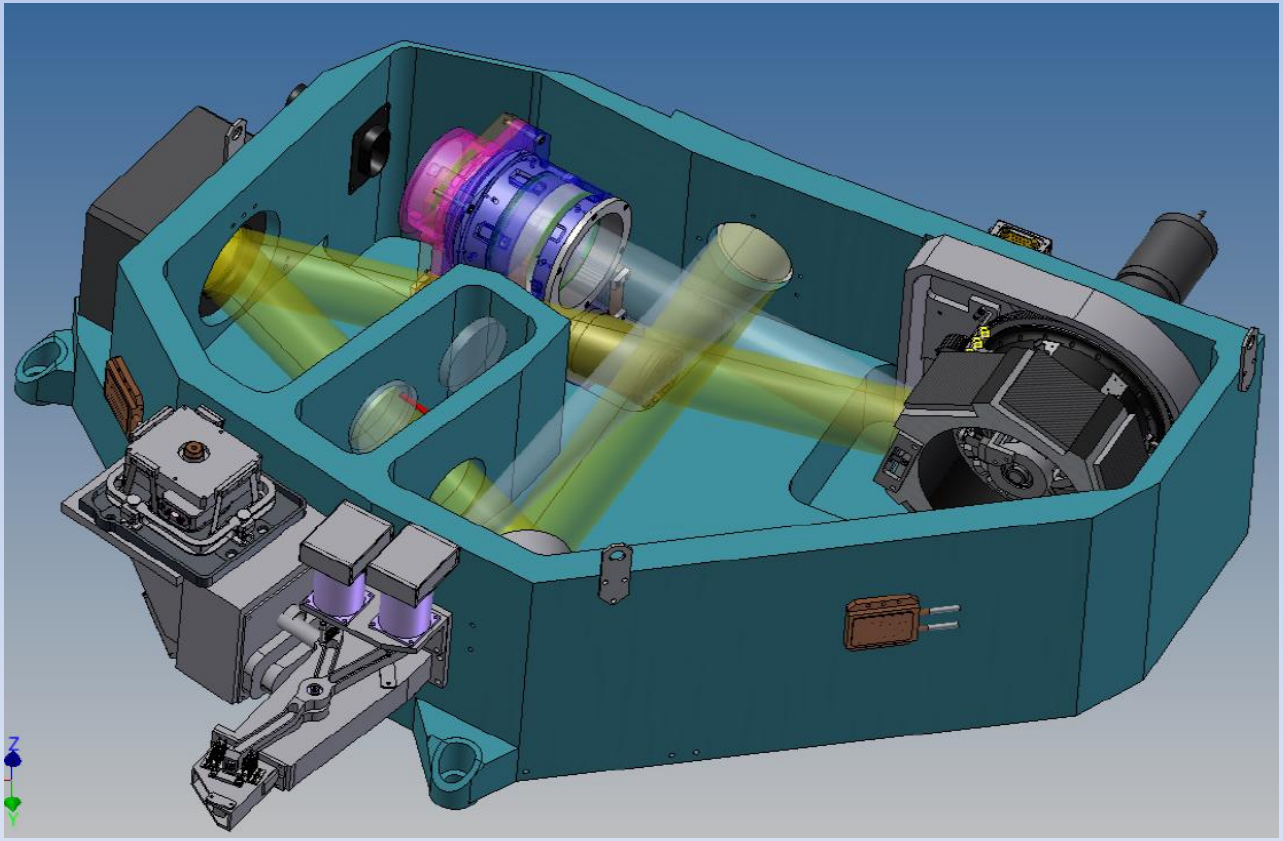
CRIRES+: A cross-dispersed echelle spectrograph



Astro Tech Talk MPIA 2014

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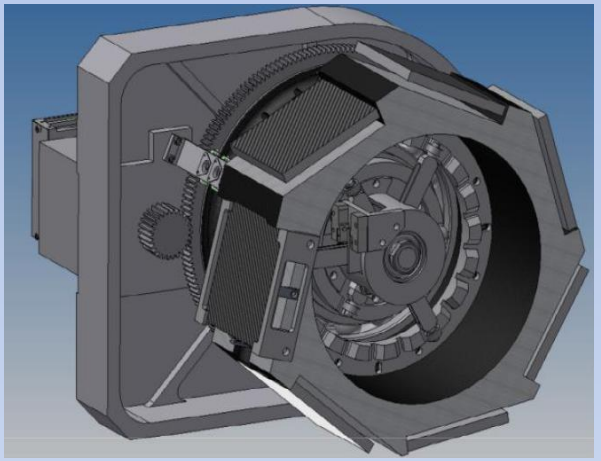
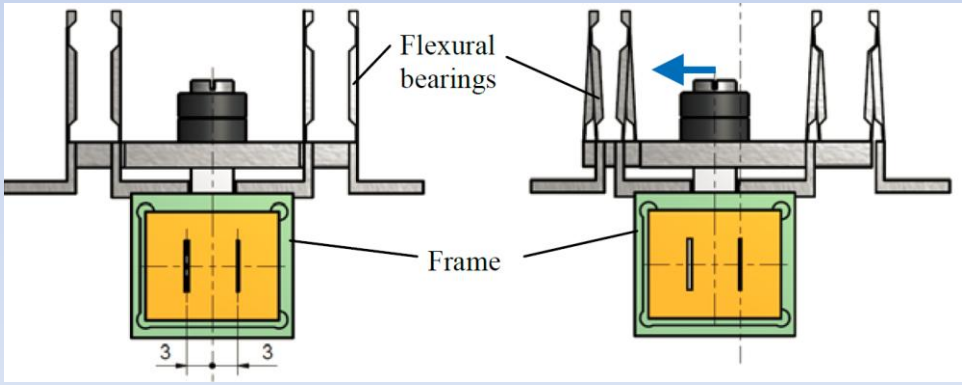
CRIRES+: A cross-dispersed echelle spectrograph

- High precision Grating wheel for 6 gratings and mirror
- each grating > 70% average efficiency
- some from RGL, other custom made
- slit mechanism designed for maximum stability
- additional decker for polarimeter





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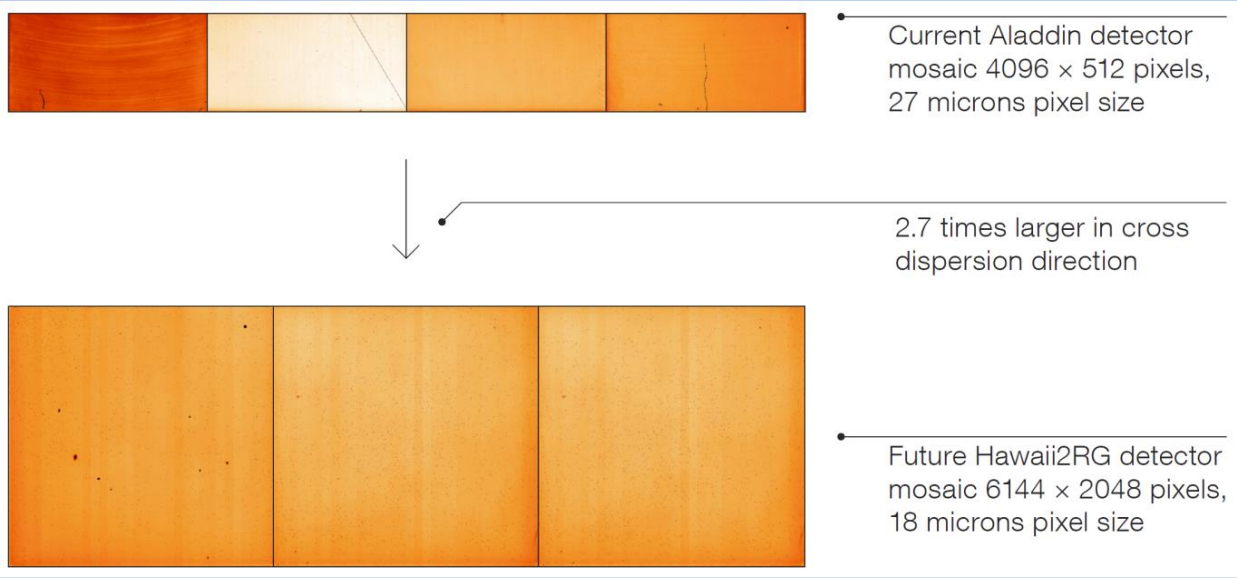
The new scientific focal plane detector array

- HAWAII2RG detectors with 5.5 µm cutoff
- Increases the accessible focal plane by factor 2.7
- Supported by ESO NGC detector system



Comparison prior and future focal plane array, R. Dorn, ESO Messenger June 2014

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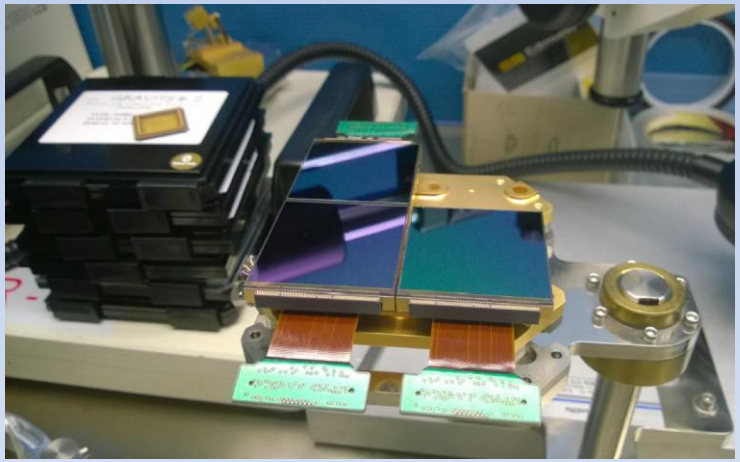
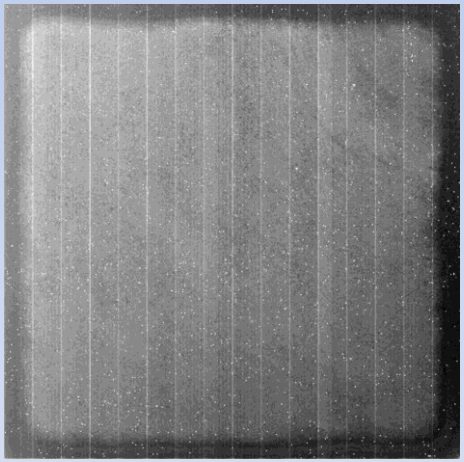
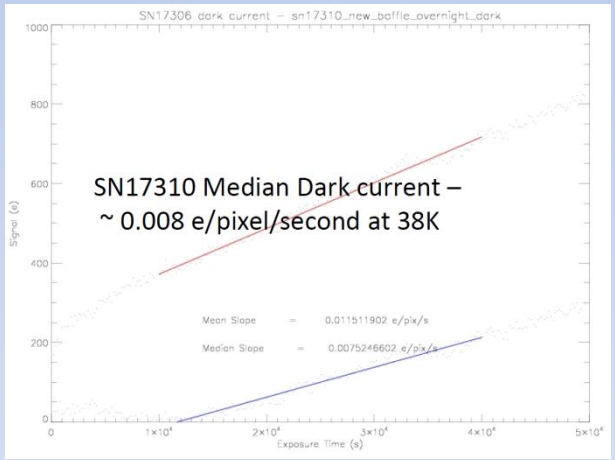
The new scientific focal plane detector array

- New detectors in testlab since June
- Outstanding performance (good uniformity, very low dark)







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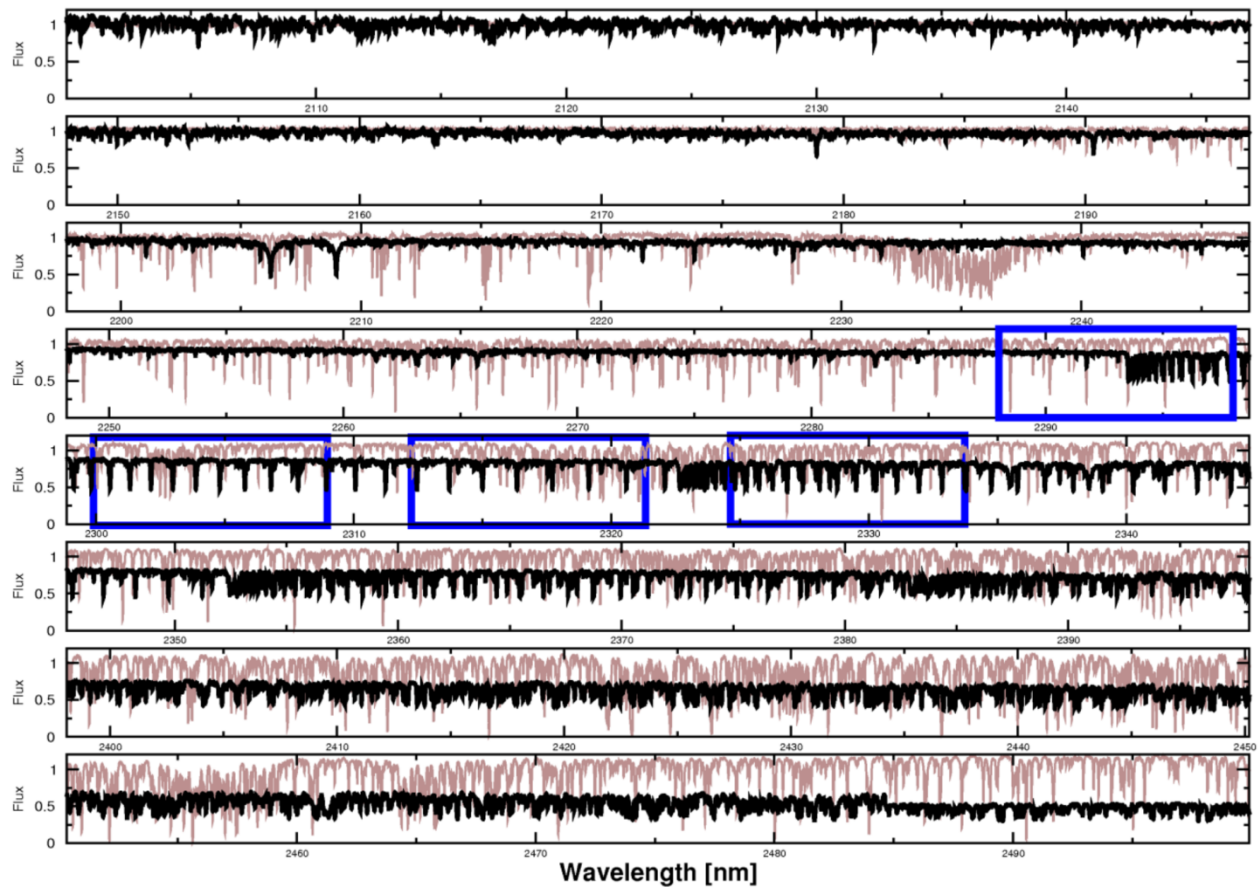
Cross-Dispersion + New Detectors

Blue boxes: Current CRIRES single shot

- Black line: M4 dwarf
- Brown line: New gas cell



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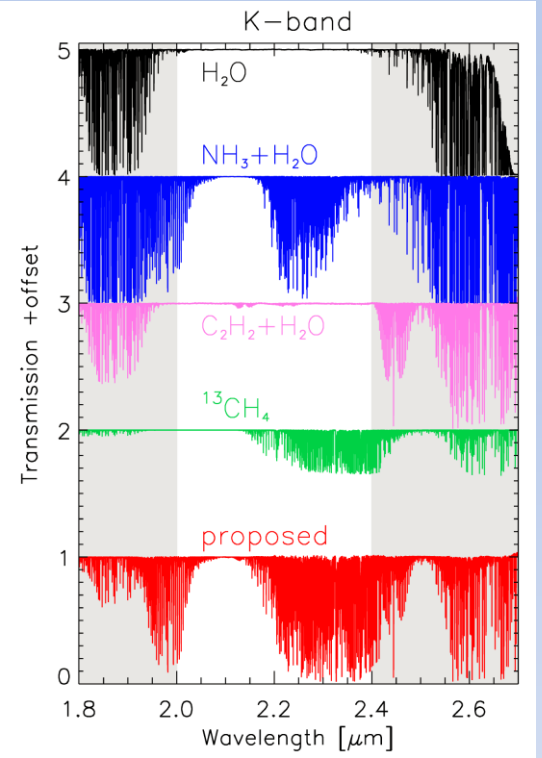
New Wavelength Calibration

- New short absorption cell
- Long cell design under investigation
- Etalons under tradeoff study
- Most of the current calibration elements will remain



Absorption gas composition , R. Dorn, ESO Messenger June 2014

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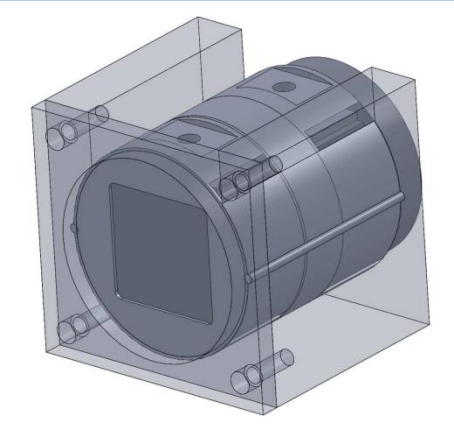
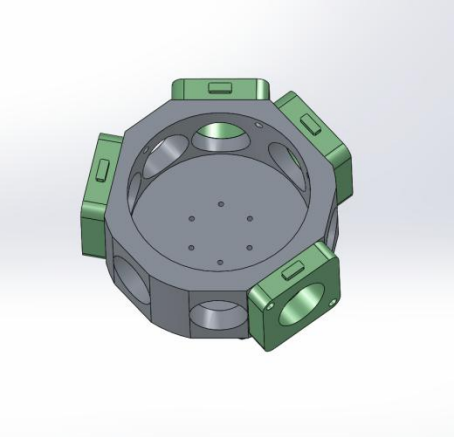
Polarimetry with CRIRES+

- New circular polarization unit
- Based on Polarization Gratings
- Very compact design
- Polarized Echellogram with 2 arcsec slits
- Accessible wavelength: 1-2.5 µm
- Two units to cover wavelength range
- Linear Polarimeter trade off study





Design studies, N.Piskunov

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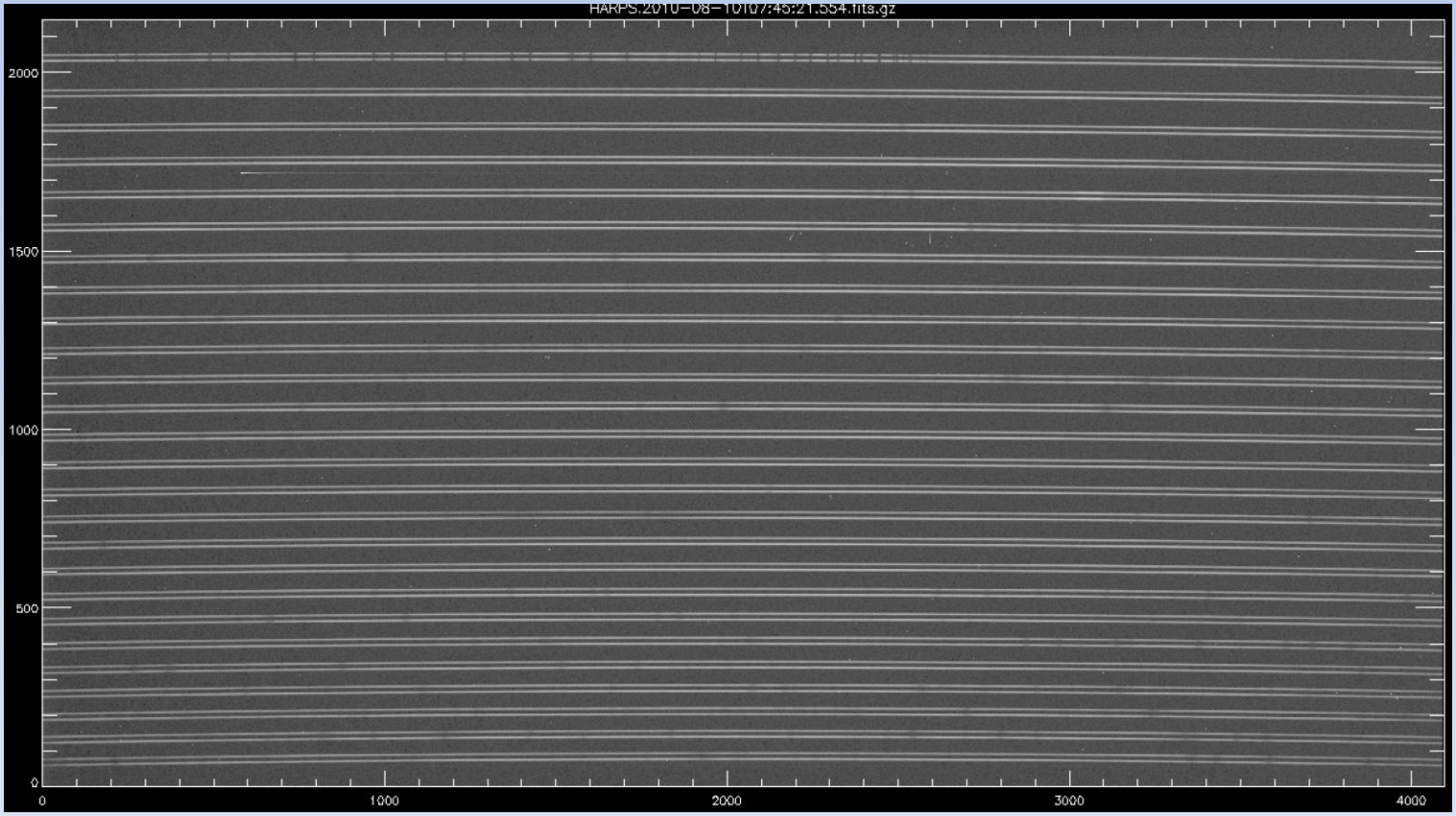
Polarimetry with CRIRES+ HARPSPol example



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New data reduction software

- Data reduction software in collaboration with ESO
- Science ready data products for all modes (goal)
- Fixed settings to reduce effort (mech. locking for echelle tradeoff study)
- Daily calibration only offered for subset of fixed settings

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New metrology system

- Fiber based
- Will control internal tiptilt mirror to obtain required repeatability

AO System refurbishment

- MACAO obsolescence programm
- In addition refurbish optics were necessary

Control electronics/control obsolescence

- Applied were necessary, standard ESO compents

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The CRIRES+ Consortium

- Thüringer Landessternwarte (PI Artie Hatzes)
- Institut für Astronomie Göttingen (Ansgar Reiners)
- Institute of Astronomy Uppsala (Nikolai Piskunov)
- Osservatorio di Arcetri, INAF (Tino Oliva)
- European Southern Observatory (PM Reinhold Dorn)

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Timescale

Milestone	When?
Start project / Phase A	End 2011
End Phase A / Kick Off ESO	June 2013
Preliminary Design Review	April 2015
Final Design Review	December 2015
Acceptance Europe	End 2016
Acceptance Chile	End 2017

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Conclusion / What to remember from this talk

- Unique combination of characteristics (main aperture, accessible and instantaneous wavelength range, resolution)
- New calibration and data reduction software to reach instrument limit
- Polarimetry (circular yes, linear maybe)
- Ready in end of 2017 (We‘re fully financed)
- Visit www.crir.es for news (under construction)

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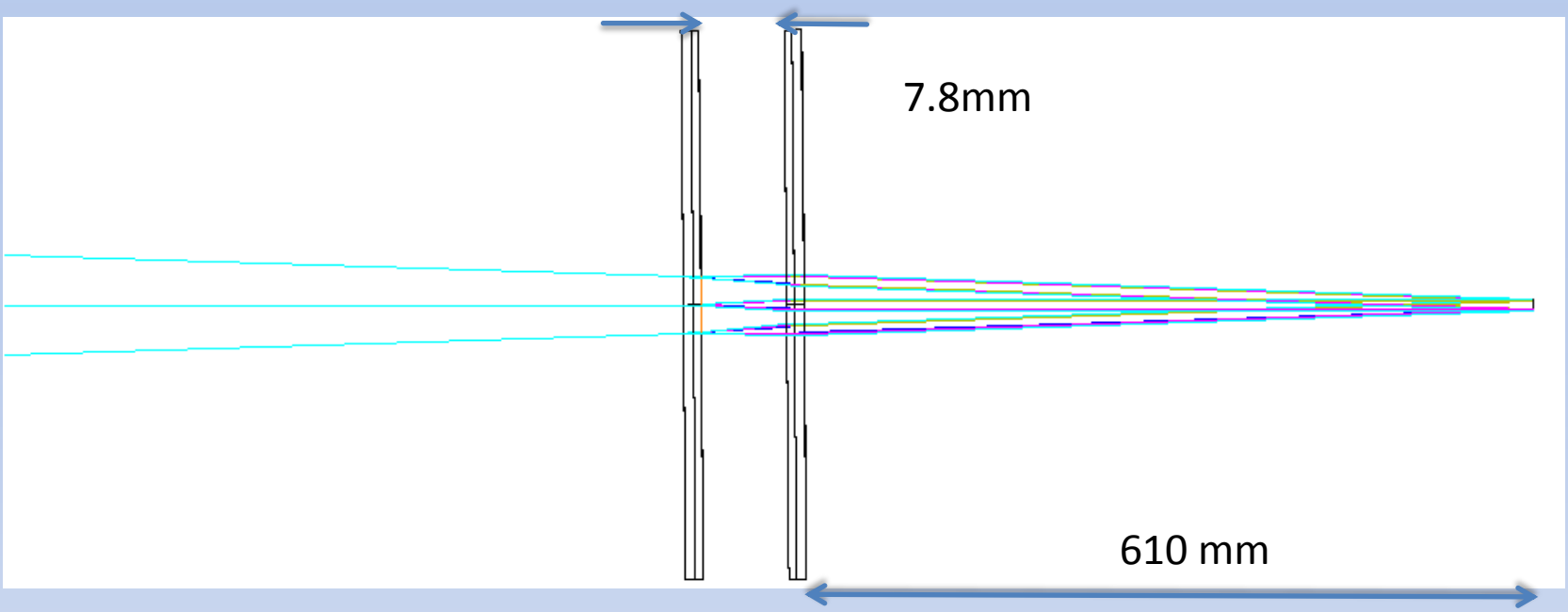
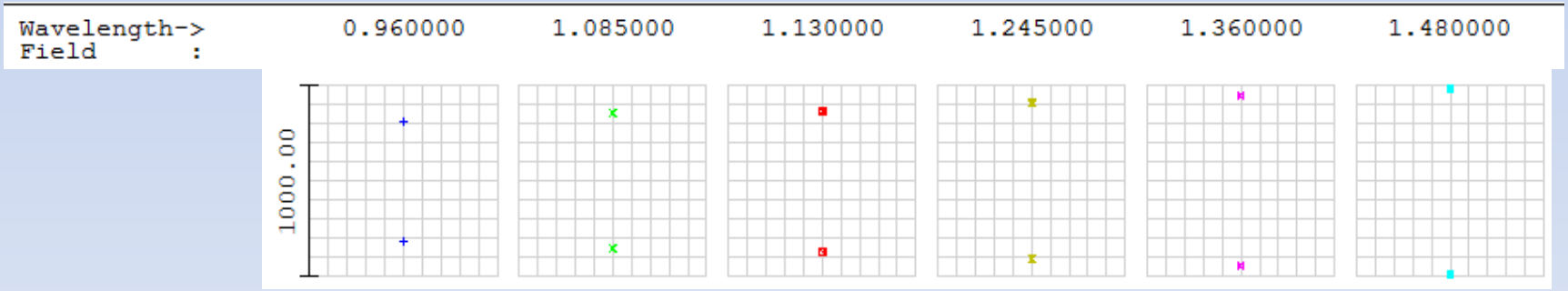
Appendix: Polarimeter YJ Band





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