OU-SIR
Overview and calibration needs

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OU-SIR purpose

OU-SIR task is to create the spectroscopic data reduction and calibration pipeline

OU-SIR, with OU-SPE (tasked with creating the redshift measurements pipeline), is the main data handling OU for the Galaxy Clustering side of the Euclid mission

OU-SIR outline

The OU-SIR pipeline is composed of 3 main Processing Blocks

- The NISP data pre-processing (in common with OU-NIR)
- The Spectra Location PE
- The Spectra Extraction PE

OU-SIR requirements

Other than the “trivial” requirements, like “you have to extract spectra”, OU-SIR has two main scientific requirements

- The accuracy of the wavelength calibration
- The accuracy of the spectrophotometric flux calibration

Wavelength Calibration

Wavelength calibration accuracy is the main component in determining redshift measurements accuracy

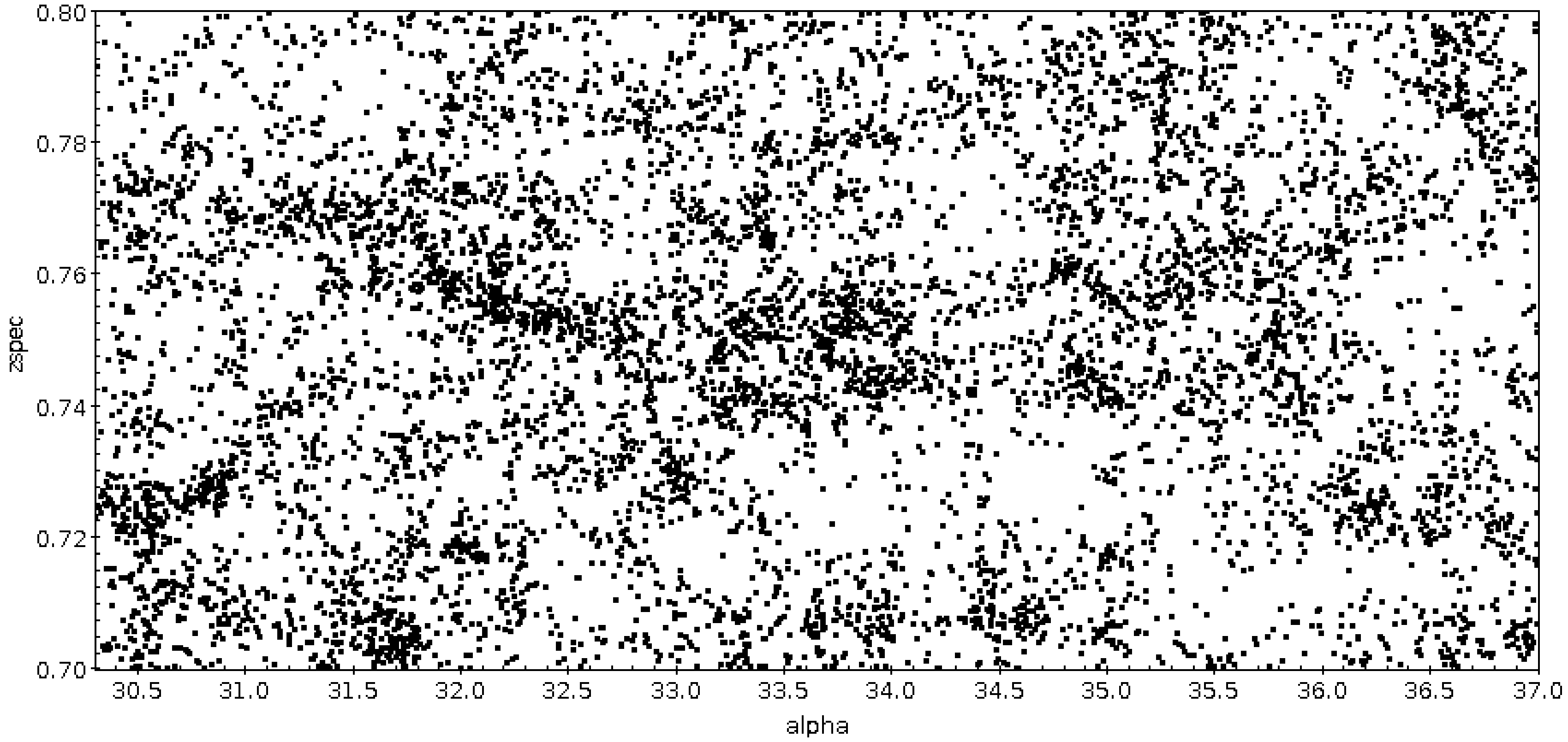
- Redshift uncertainty components:

1) Object position in imaging catalog (0.3 pixel)

2) Em. Line measurement (0.2 pixel)

3) Wavelength calibration (0.8 pixel: 0.5 pixel zero point + 0.5 pixel dispersion)

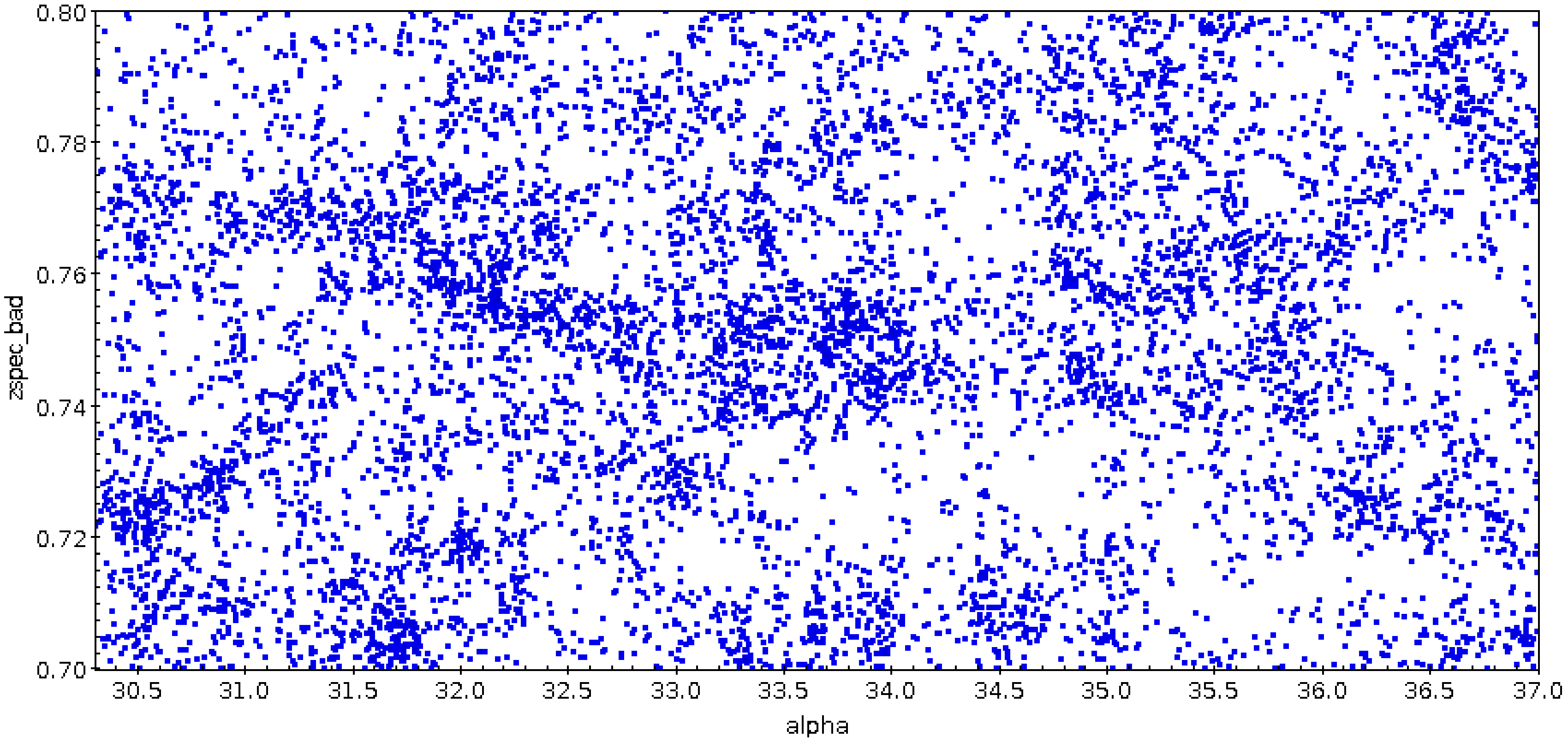
Wavelength calibration accuracy is the main component in determining redshift measurements accuracy



VIPERS Survey data (Guzzo et al. 2014), original calibration accuracy

Wavelength Calibration

Wavelength calibration accuracy is the main component in determining redshift measurements accuracy



VIPERS Survey data (Guzzo et al. 2014), Euclid-like calibration accuracy

Wavelength Calibration

Wavelength calibration biggest concern: if we have the calibration derived only at a small number of positions inside the NISP field of view, then we need to interpolate the calibration solution over the whole field of view

The alternative is to have a very accurate instrument model, that will predict accurately the variation of instrument properties across the field of view

Validation totally within the spectroscopic data-set should be possible

Flux Calibration

Because of the slitless nature of the Euclid spectroscopic observations, it is absolutely vital to have a very accurate spectrophotometric calibration for all NISP spectra

In a "normal" spectroscopic survey the parent sample is chosen using photometric data

In slitless spectroscopy this is not the case: the parent sample must be determined from the data themselves

Flux Calibration: MOS

In a "normal" Multi Object Spectrograph redshift survey

- Parent catalog is selected based on some magnitude
- Redshift is measured for a fraction of parent sample
- Completeness is the ratio N(z) / N(parent)
- Photometric quality (and stability) is needed to make sure N(parent) does not change as a function of sky position

Flux Calibration: slitless

In a slitless spectroscopy redshift survey

- There is no parent sample: in principle all objects are observed
- Redshift measurement depends strictly on intensity of emission line(s)
- Completeness would be given by N(z) / N(line) but N(line) is not known a priori and must be derived from survey data
- Spectrophotometric stability is needed to make sure N(line) does not depend on sky position

Flux Calibration

Flux calibration biggest concern is the large-scale stability requirement.

Using overlaps we can sample hour-scale fluctuations, using repeated visits to a calibration field we can sample month-scale fluctuations

Do we need something in between ??

Does validation require a comparison with external data, or will it be enough to use just the internal data ??

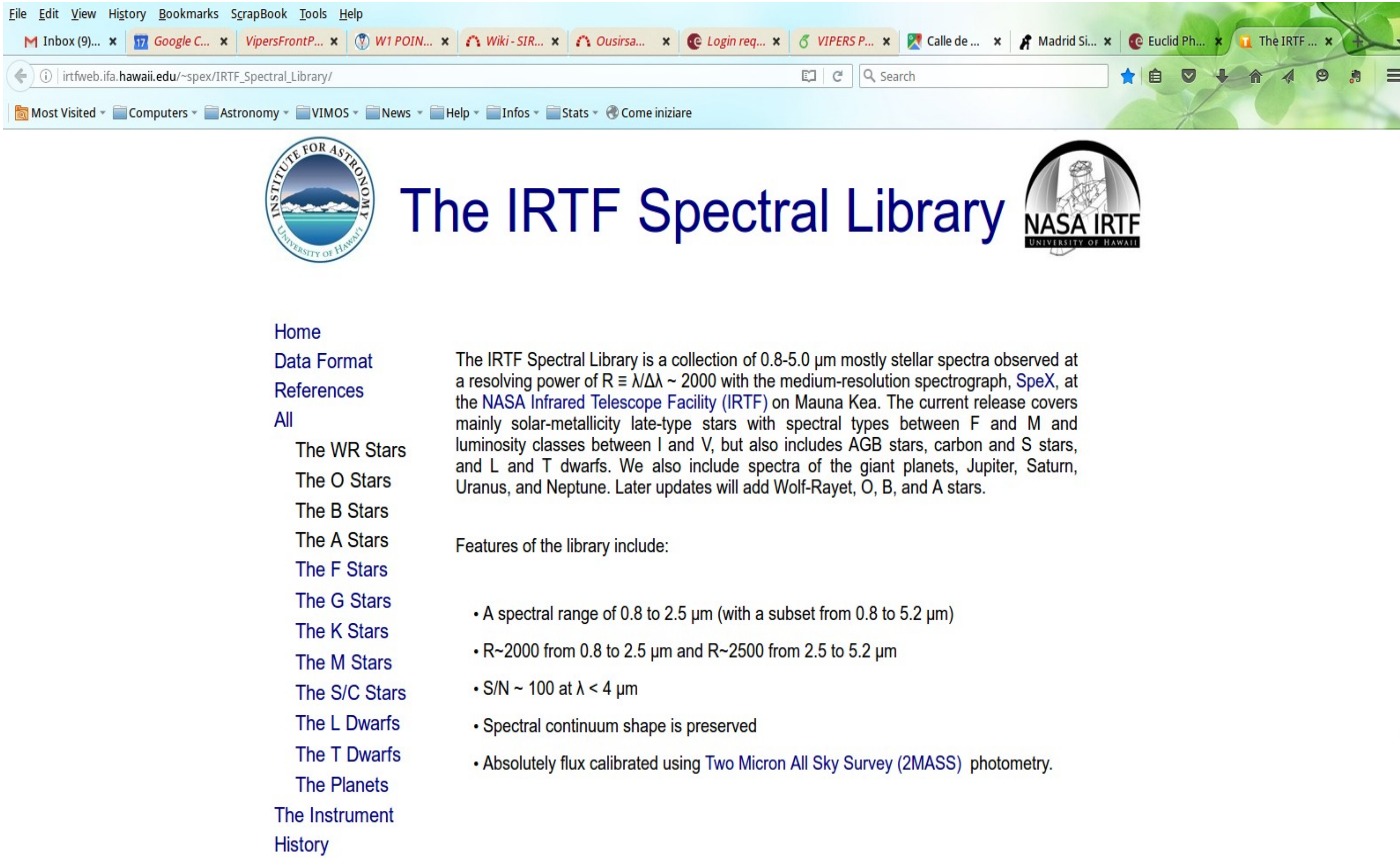
Calibrations Data Flow

Do we handle differently pre-observation and post-observation calibrations ??
(keeping in mind that post-obs will become pre-obs for the next data reduction run)

Is it worth to keep the calibrations separate (from the uncalibrated data) to make it faster/easier to apply a new and improved calibration ??

Stellar Spectra to the rescue

Euclid Consortium



irtfweb.ifa.hawaii.edu/~spex/IRTF_Spectral_Library/

The IRTF Spectral Library

- Home
- Data Format
- References
- All
  - The WR Stars
  - The O Stars
  - The B Stars
  - The A Stars
  - The F Stars
  - The G Stars
  - The K Stars
  - The M Stars
  - The S/C Stars
  - The L Dwarfs
  - The T Dwarfs
  - The Planets
- The Instrument
- History

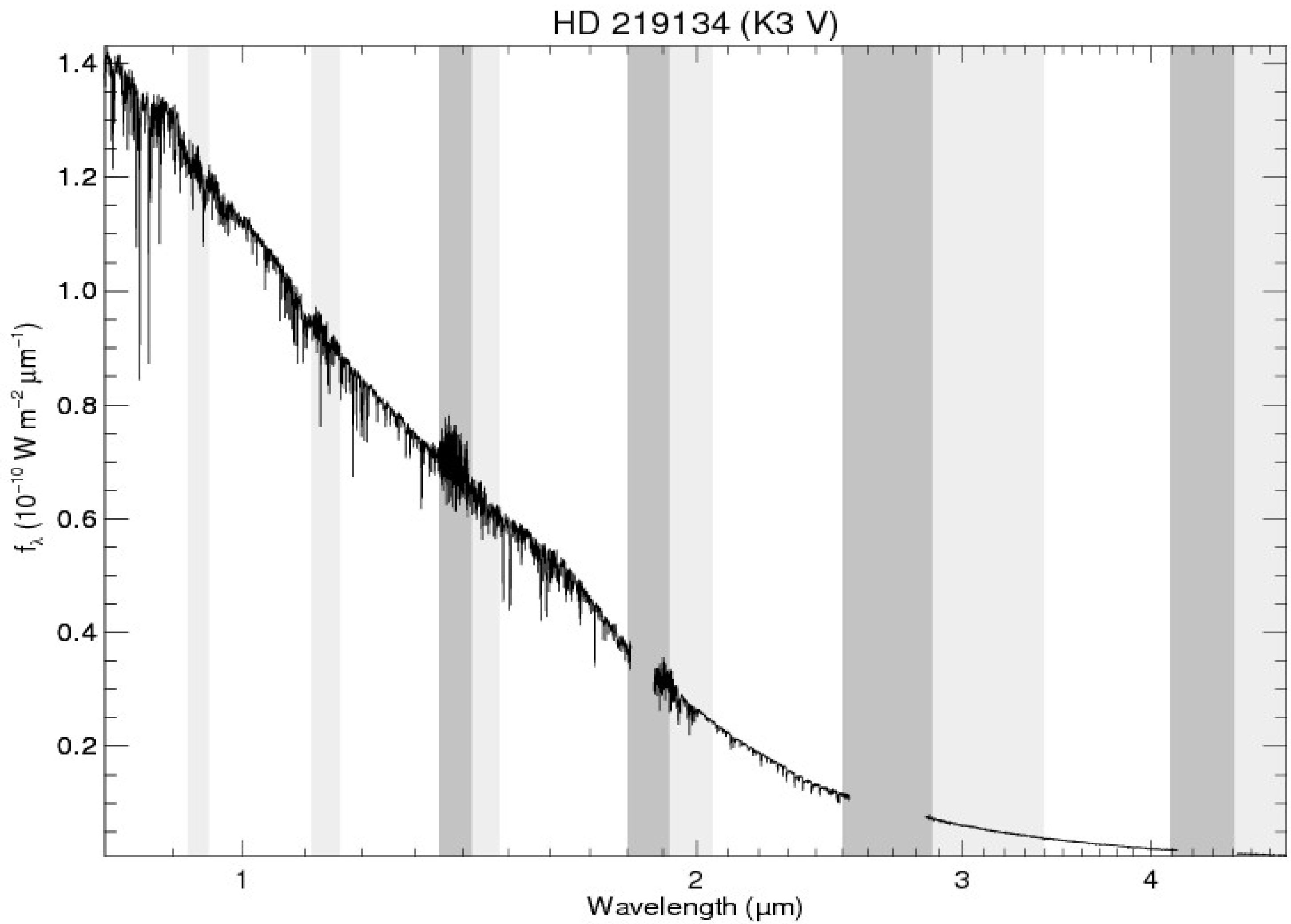
The IRTF Spectral Library is a collection of 0.8-5.0 μm mostly stellar spectra observed at a resolving power of $R \equiv \lambda/\Delta\lambda \sim 2000$ with the medium-resolution spectrograph, SpeX, at the NASA Infrared Telescope Facility (IRTF) on Mauna Kea. The current release covers mainly solar-metallicity late-type stars with spectral types between F and M and luminosity classes between I and V, but also includes AGB stars, carbon and S stars, and L and T dwarfs. We also include spectra of the giant planets, Jupiter, Saturn, Uranus, and Neptune. Later updates will add Wolf-Rayet, O, B, and A stars.

Features of the library include:

- A spectral range of 0.8 to 2.5 μm (with a subset from 0.8 to 5.2 μm)
- R~2000 from 0.8 to 2.5 μm and R~2500 from 2.5 to 5.2 μm
- S/N ~ 100 at $\lambda < 4$ μm
- Spectral continuum shape is preserved
- Absolutely flux calibrated using Two Micron All Sky Survey (2MASS) photometry.

Stellar Spectra to the rescue

IRTF Library: high S/N, high resolution, flux calibrated spectra of stars with spectral type from G to M

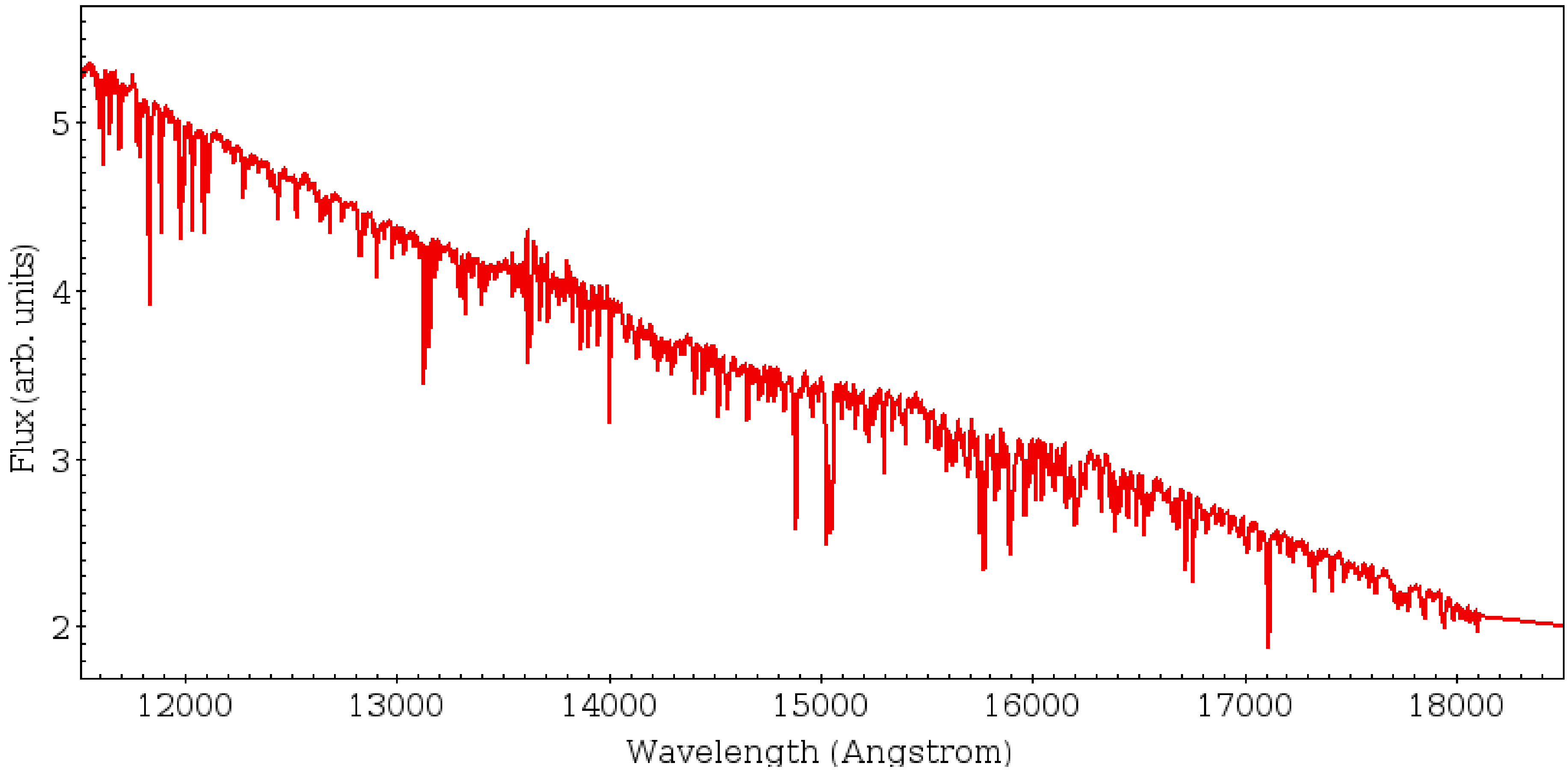


Stellar Spectra simulations

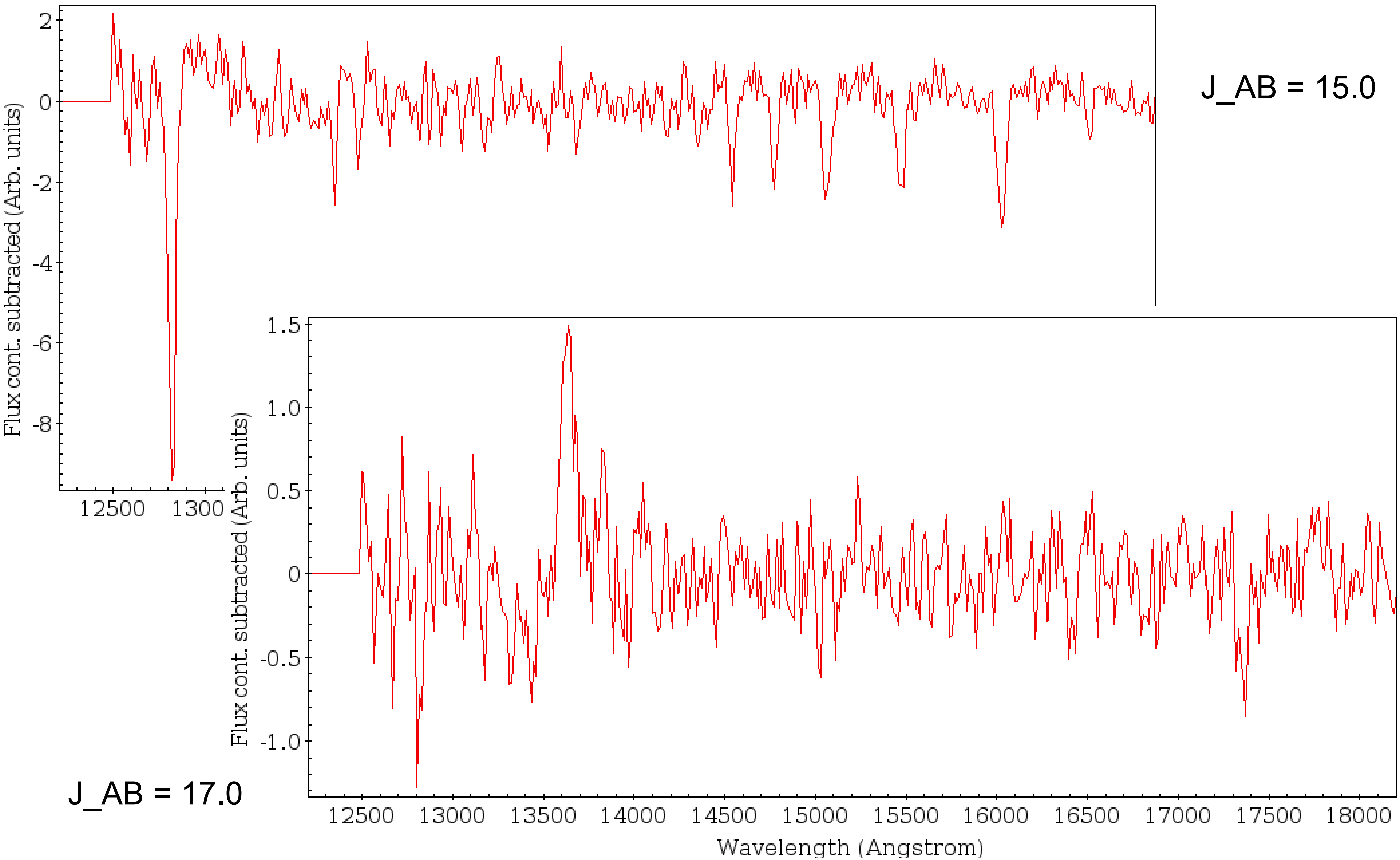
- Extracted some 70 spectra from IRTF Library
- Fed them to TIPS to generate NISP-like spectra
- Extracted spectra with Imodel
- Cross-correlated extracted spectra with template

Stellar Spectra simulations

Template: K5 III

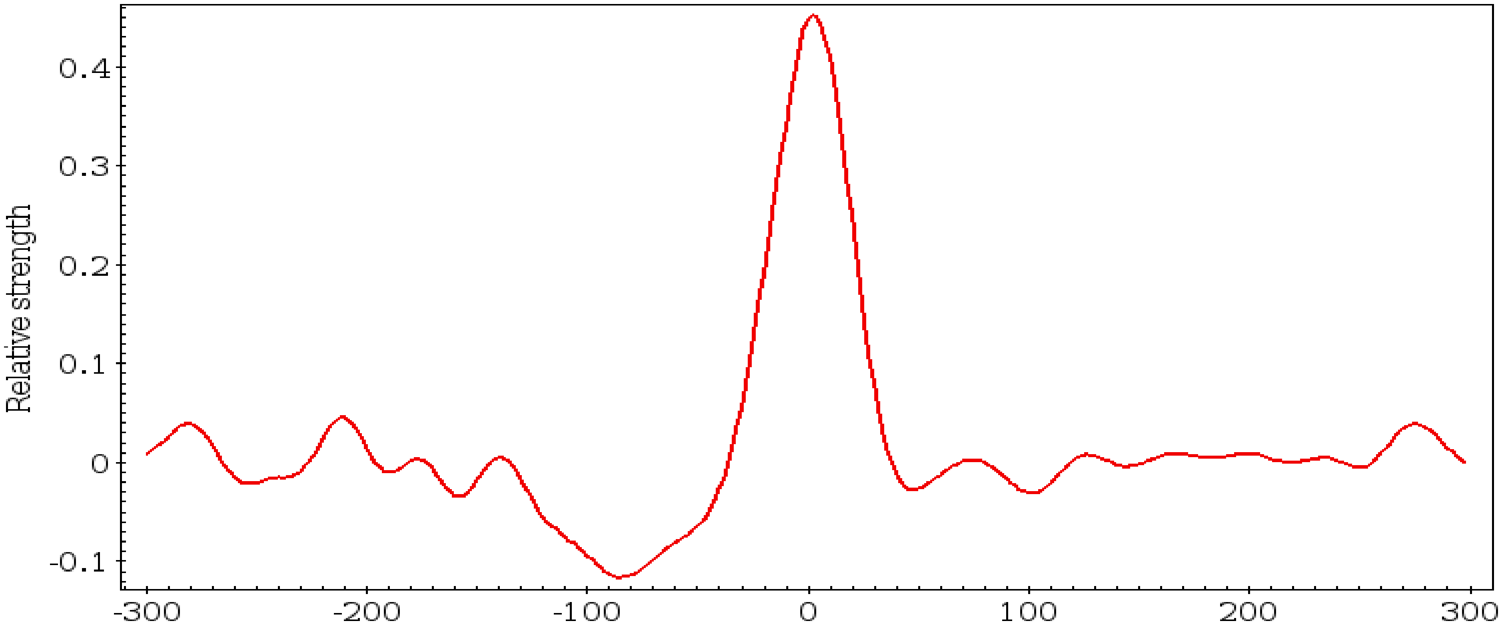


Stellar Spectra simulations

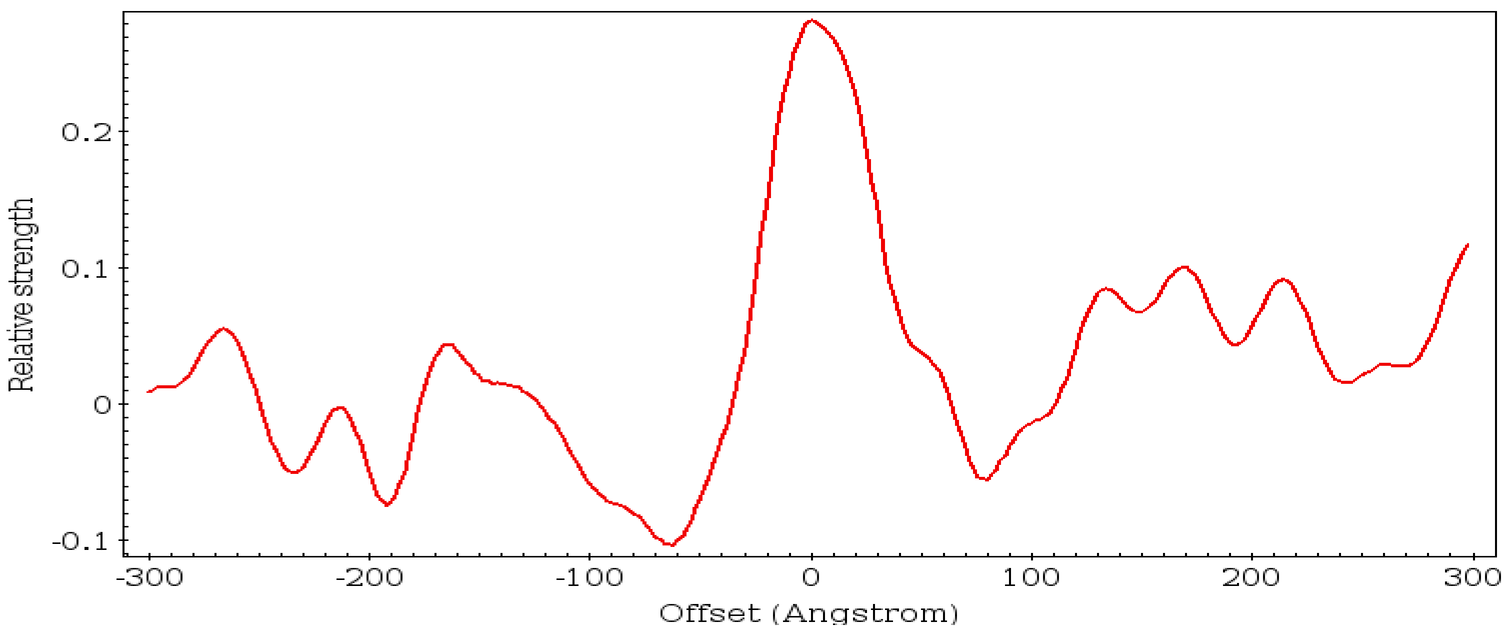


Stellar Spectra simulations

Euclid Consortium



J_AB = 15.0



J_AB = 17.0

Stellar Spectra as calibrators