The BlueMUSE project and the contributions by German partners

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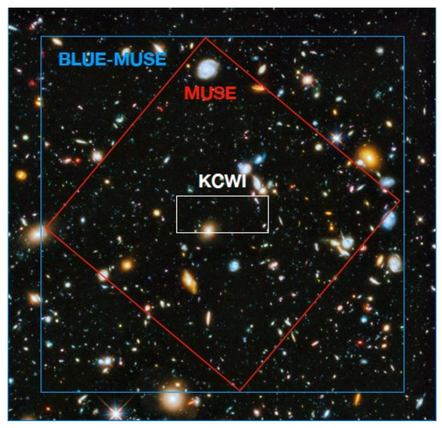
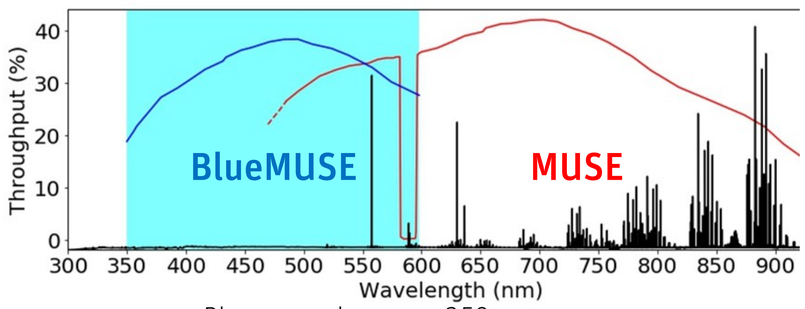
The BlueMUSE instrument

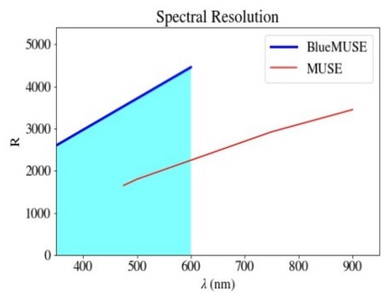
- Rationale: MUSE legacy — unique, highly over-subscribed, high publication rate
- BlueMUSE concept, ongoing internal Phase A
- Blue sensitive, larger field, higher resolution
- Outperforms ELT instruments in the blue
- White paper: Richard et al. arXiv:1906.01657
- European/Australian consortium led by CRAL
- Key science cases:
  - Massive stars (Local Group)
  - ISM and HII regions and extreme starbursts (nearby galaxies)
  - Gas flows around and between galaxies (distant universe)
- Launch full Phase A with ESO starting 2024



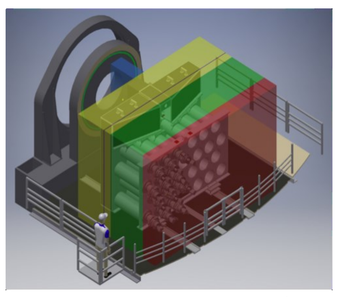
Field-of-View up to 2 arcmin^2, sampling 0.3 arcsec (seeing limited, no-AO)

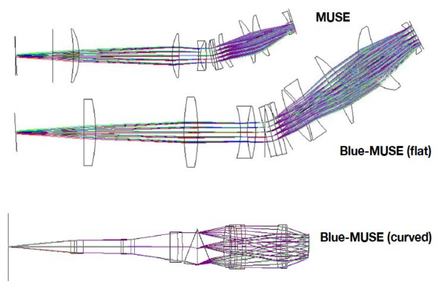


Blue spectral range to 350nm

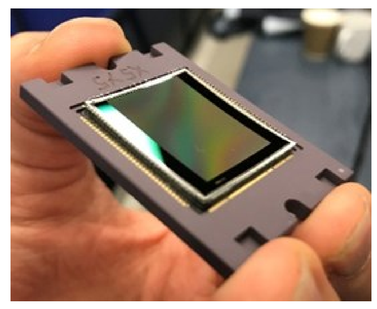


Spectral resolution <R>=3600





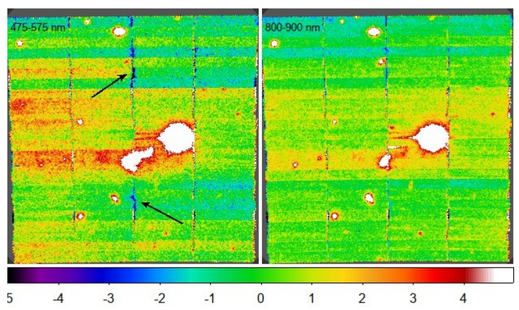
Concept and optical design based on MUSE



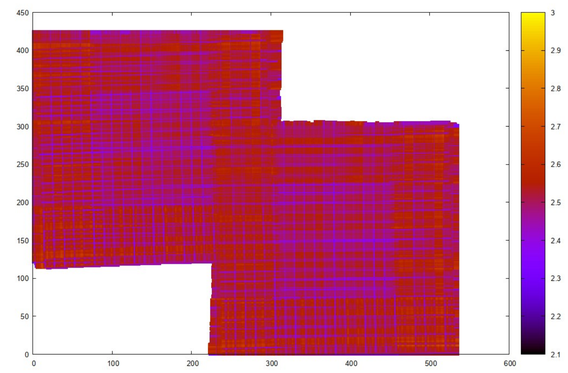
Novel curved detectors

The Data Reduction Software for BlueMUSE

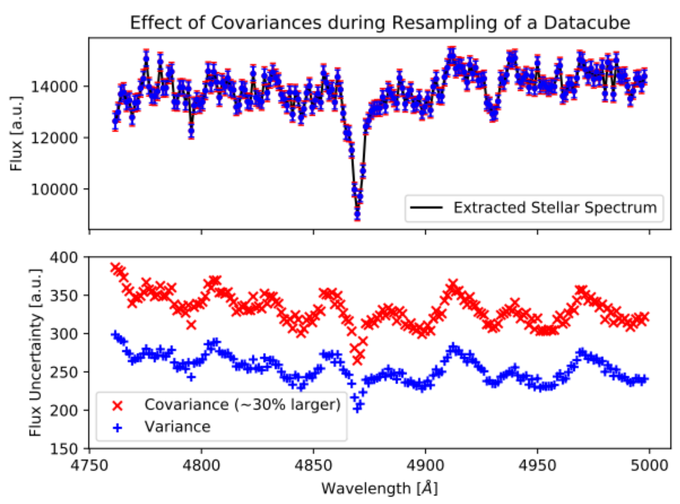
- Review capabilities of the MUSE pipeline
- Investigate remaining deficiencies of MUSE cubes
- Check how different properties influence data properties
- Advanced features:
  - wavelength calibration with frequency comb or Fabry-Perot
  - improved measurement of the instrumental line profile
  - propagation of the line profile through the resampling process
  - propagate the covariance (in addition to the variance)
- Pipeline structure
  - science processing flowchart
  - more integrated parallelization
  - association map
- Adapt to new ESO environment (EDPS)



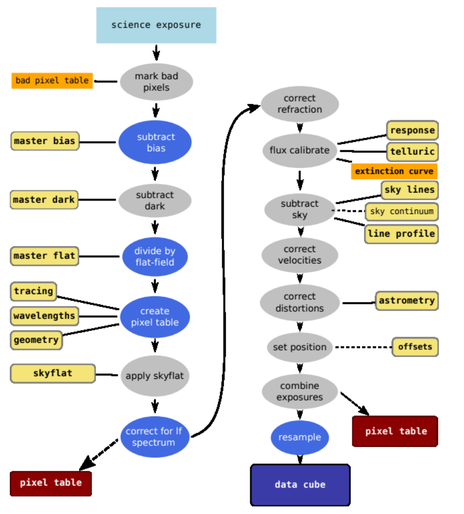
Flat-fielding deficiencies of MUSE data: “dark gaps” in between the slicer stacks (arrows), large-scale throughput variations (horizontal striping)



First tests of instrumental line profile propagated through the cube creation process



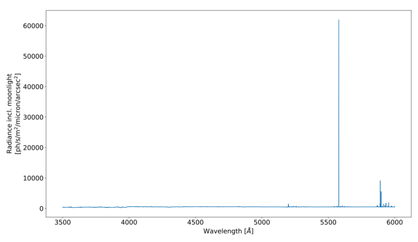
Stellar spectrum extracted from test cube: with (red) and without (blue) propagation of the covariance

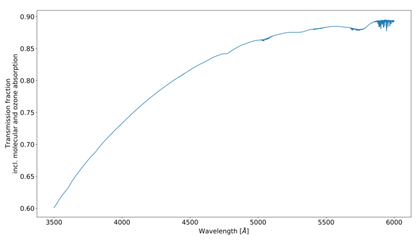


Science processing flowchart for the BlueMUSE pipeline

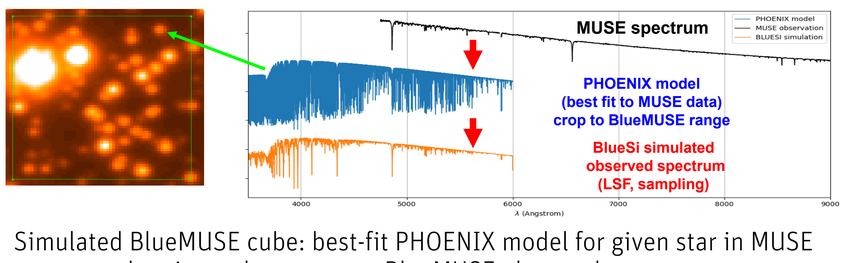
Simulations of BlueMUSE data

- Simulate raw (calibration) data for pipeline development and testing
- Science data simulation: “BlueSi”
  - simulate cubes with instrumental features
  - take into account atmospheric effects
- Use existing MUSE data as basis for simulations: Globular cluster data to generate population





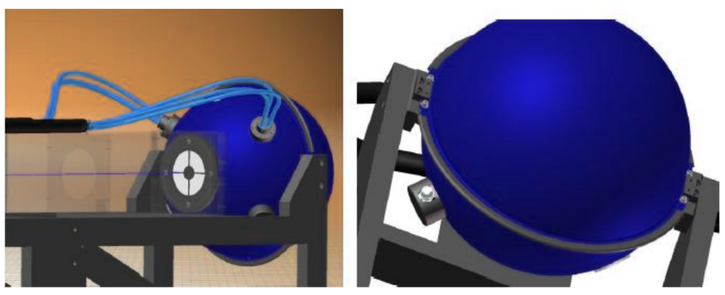
Sky models for exemplary conditions at the Paranal Observatory; parameters include scattered moonlight, Zodiacal Light as well as molecular absorption/emission of the atmosphere and general Rayleigh scattering



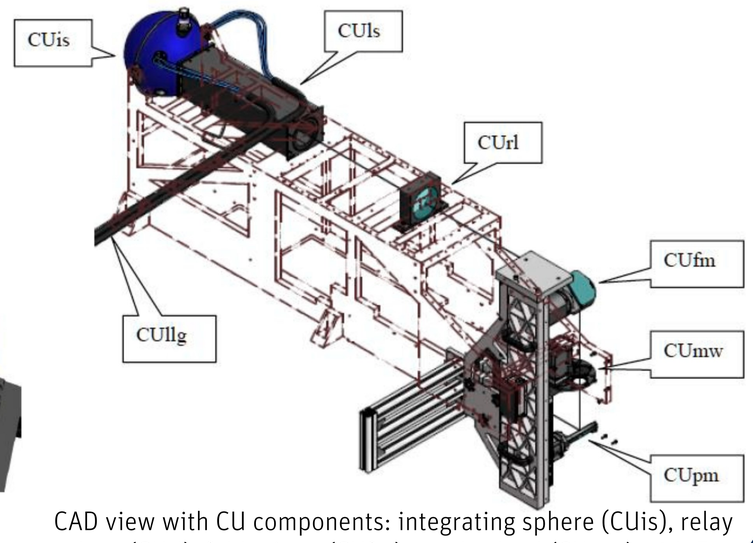
Simulated BlueMUSE cube: best-fit PHOENIX model for given star in MUSE data is used to generate BlueMUSE observed spectrum

The BlueMUSE Calibration Unit

- Calibration types the CU needs to support:
  - Internal flat-field & tracing
  - Geometry
  - Wavelength calibration
  - Illumination correction
- Inherit design mostly from MUSE: mimic VLT telescope beam as closely as possible
- Main new item: Fabry-Perot or laser frequency comb to create sufficient arc lines for wavelength calibration in the blue



CAD view of the CU integrating sphere including a mask to simulate the secondary obstruction of the VLT (left). A photo diode at one CUis exit port records the lamp input flux right).



CAD view with CU components: integrating sphere (CUis), relay lens (CUrl), fold mirror (CUfm), mask wheel (CUmw) with 5 calibration masks, pick-up mirror (CUpm)

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