The MACRO Consortium

MACRO's Next Generation Capabilities:
an Integral Field Spectrometer for the *Robert L. Mutel Telescope*

AAS 244
Madison, WI

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Fiber Spectrometer Motivation

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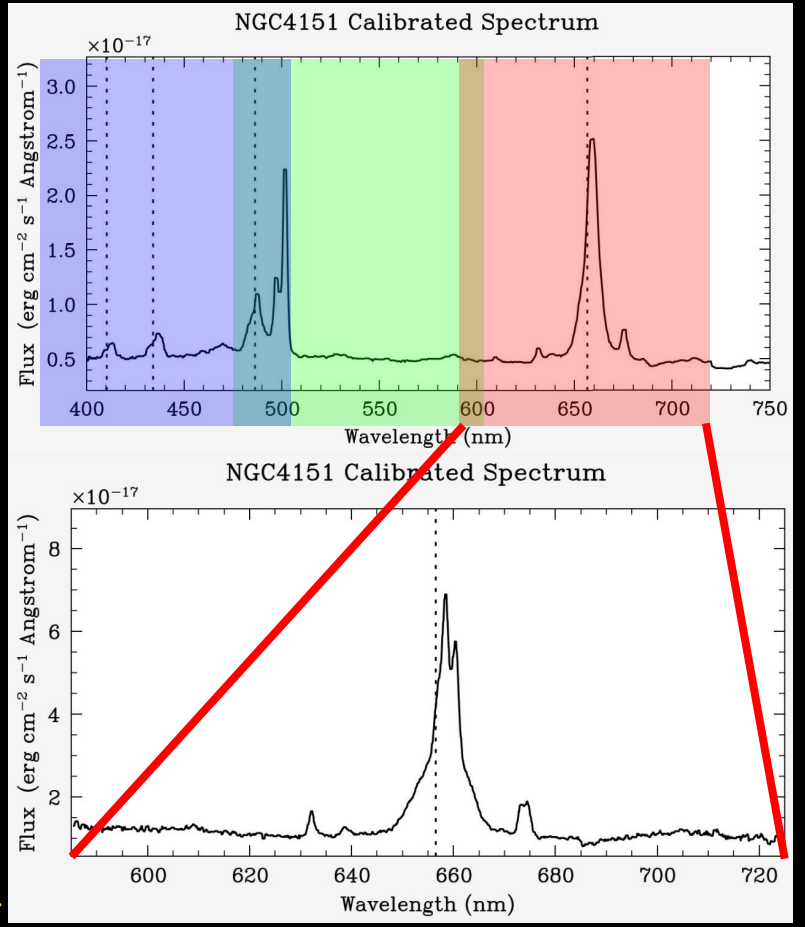
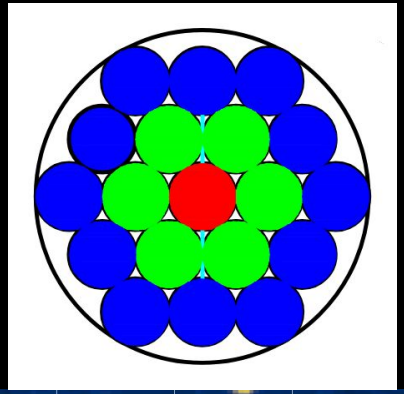
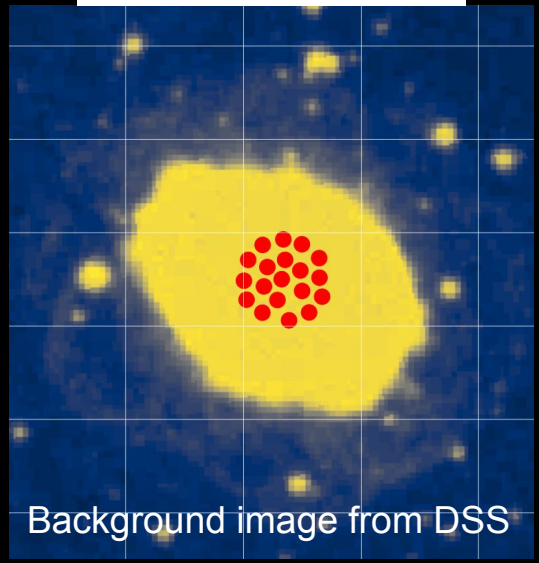
- Have low and high resolution (slitless) grism spectrometers
  - Limited to point sources, resolution limited by seeing and grism-detector separation
  - 400-720 nm (R~300)
  - 600-720 nm (R>2000)
- Want high resolution (R~3000) across visible range with slit
  - Could design more grisms (expensive and no slit)

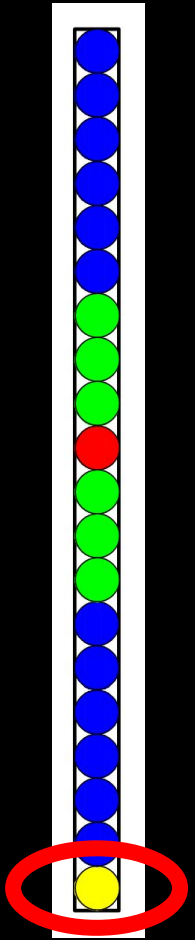


Fiber Spectrometer Motivation

- Novel opportunity to add a unique capability to the RLMT - a 19-fiber integral field spectrometer
- Additional single fiber for wavelength calibration
- Nominally ~5 arcsecond fibers, bundle covers ~30 arcseconds



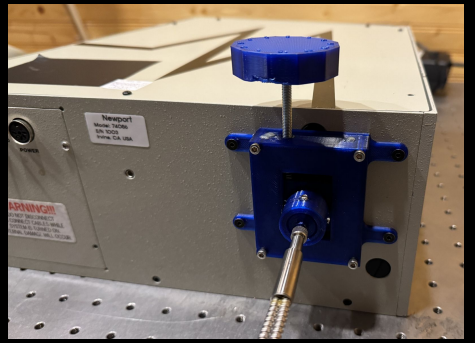


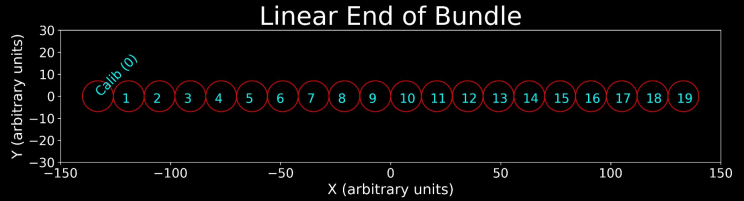


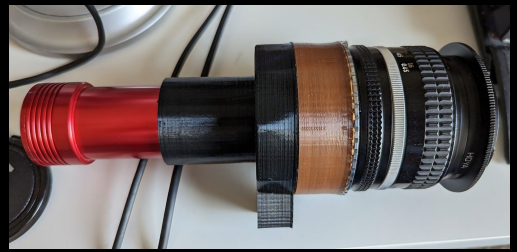
Design Challenges

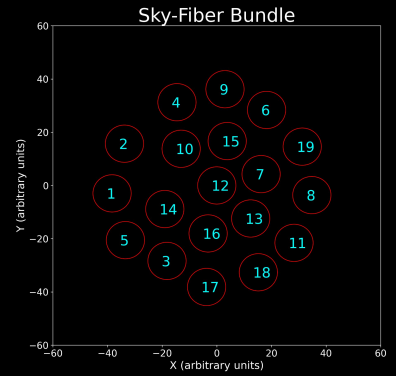
Design Challenges

- Need to map fiber orientation on-sky to spectrometer
  - Mapping not provided by manufacturer
- Designed a fiber mapping system
  - Scans spectral line across linear end of bundle
  - Camera on circular end to see lit fibers



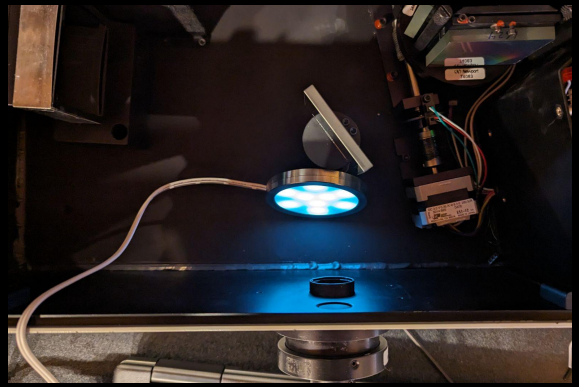




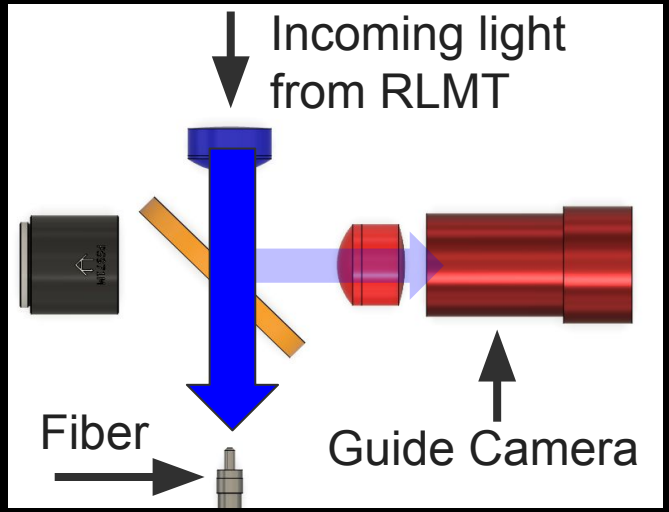


Design Challenges

- Need method to align on-sky
- Inspired by WIYN 3.5m and MINERVA (Swift et al. 2015) backlight systems
- Guide camera, pellicle beamsplitter, retroreflector



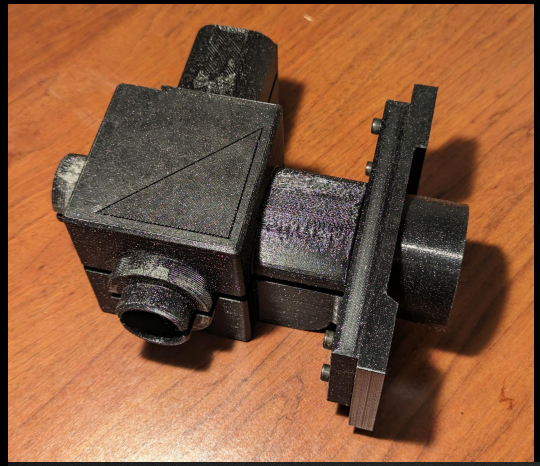
- Need pickoff for remote change from imaging/grisms to fiber spectrometer
- Made prototype (at our poster session)



Sky Test

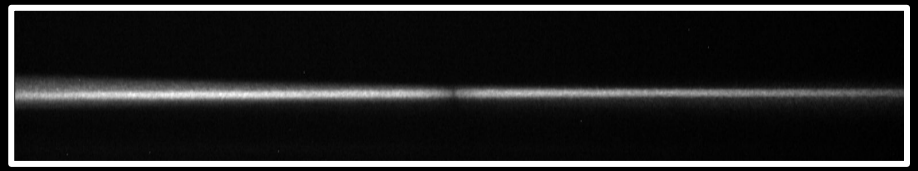
Sky Test

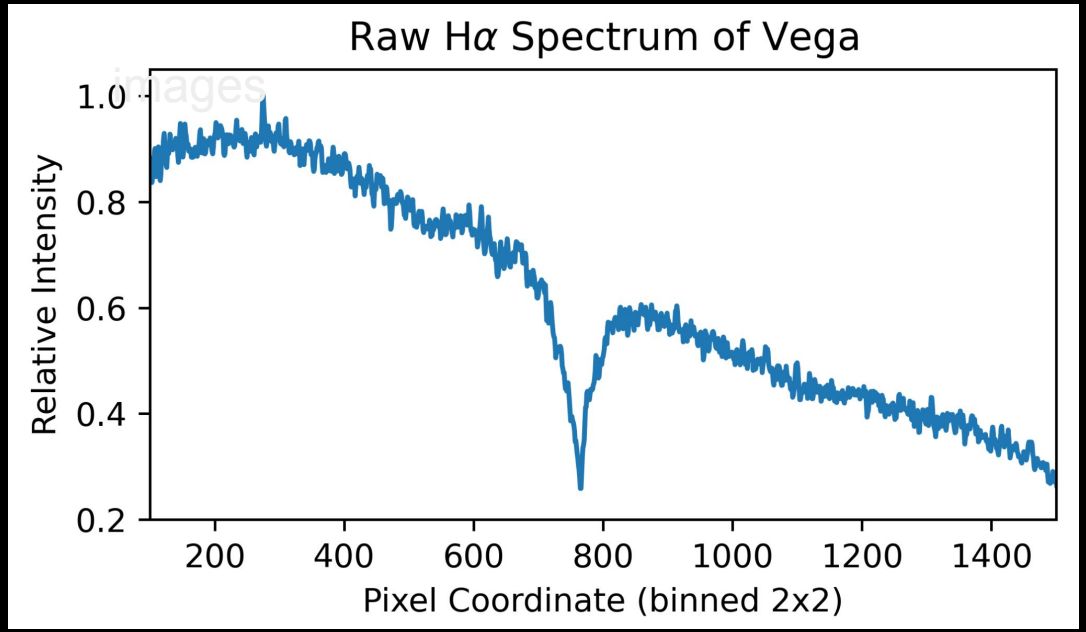
- 3D printed housing to hold optics
- Tested on-sky at Knox
  - Meade 10” f/6.3 SCT
  - May 17, 2024
- Purpose - ensure optics function as expected



Sky Test

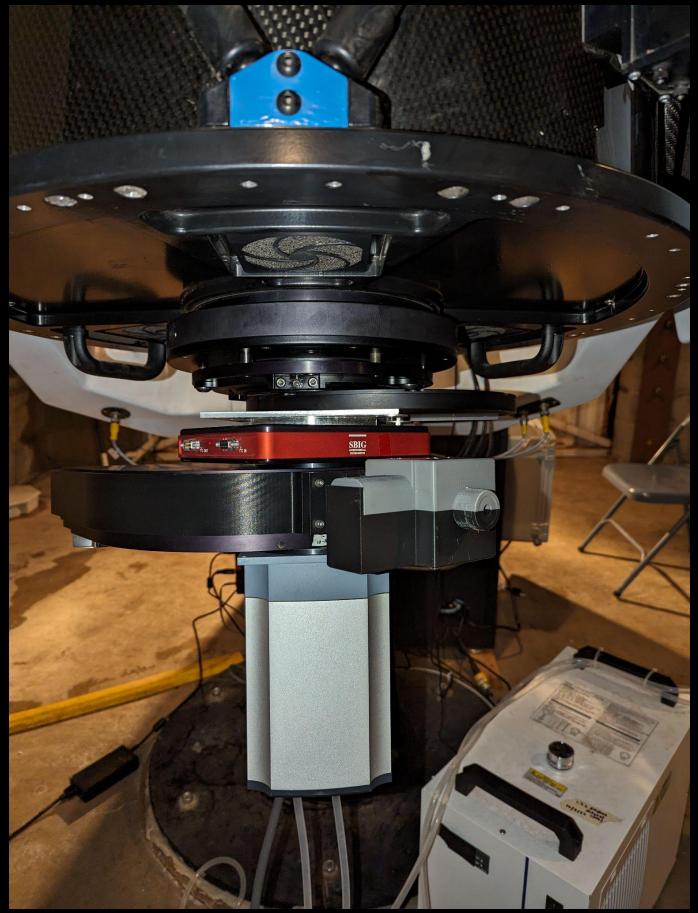
- Captured spectrum of Vega centered on Hα
- Each pixel ~0.2 Å (binned 2x2, so ~0.4 Å)
- Median of 20 at 0.7 seconds each





Conclusions

- Much more to do with spectrometer and pickoff system
- Will expand capabilities and opportunities for undergraduate classroom learning and research



Thanks!