



BinOSpec and Hectospec

Wide field optical spectroscopy at the MMT

Benjamin Weiner (MMTO)
Observers' Lunch, April 7, 2021

Binospec: multi-slit, high throughput

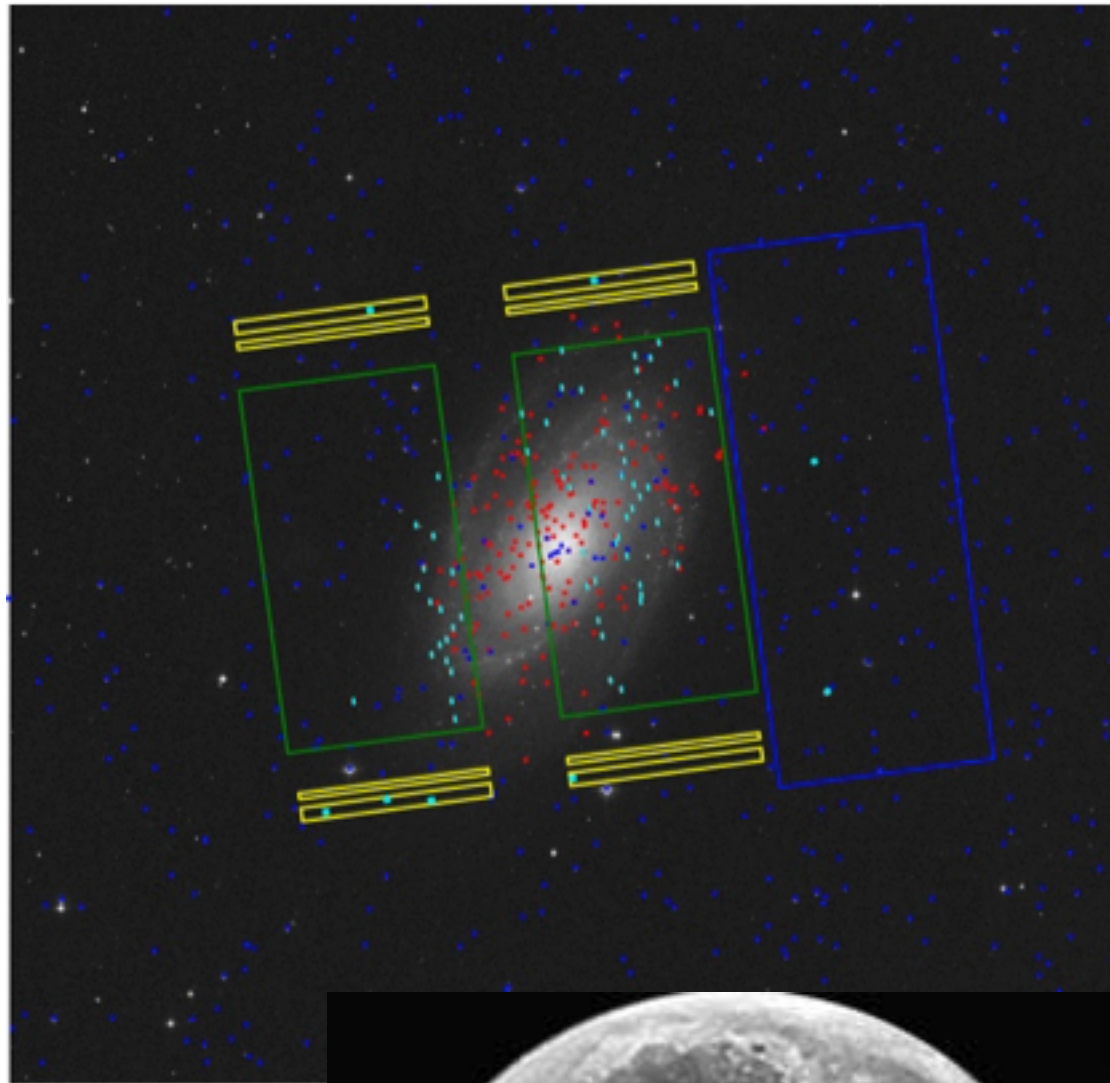
- 2-side multislit spectrograph + imager, PI Dan Fabricant, SAO. Commissioned 2018.
- Two 8x15' fields, each with identical spectrograph.
- Up to ~100 slitlets per side.
- Three gratings for resolution $R \sim 1300-4400$.
- Coverage up to 3900-9200 Å at once, approx 3500 - 10,000 Å is accessible.
- Excellent throughput and sky subtraction.
- User-friendly slitmask design written by Sean Moran at SAO.
- Pipeline data reduction by SAO TDC.
- “Binospec is the first of the ELT instruments” [in its complexity and capability] - Steve Shectman

Hectospec: multi-fiber, very wide area

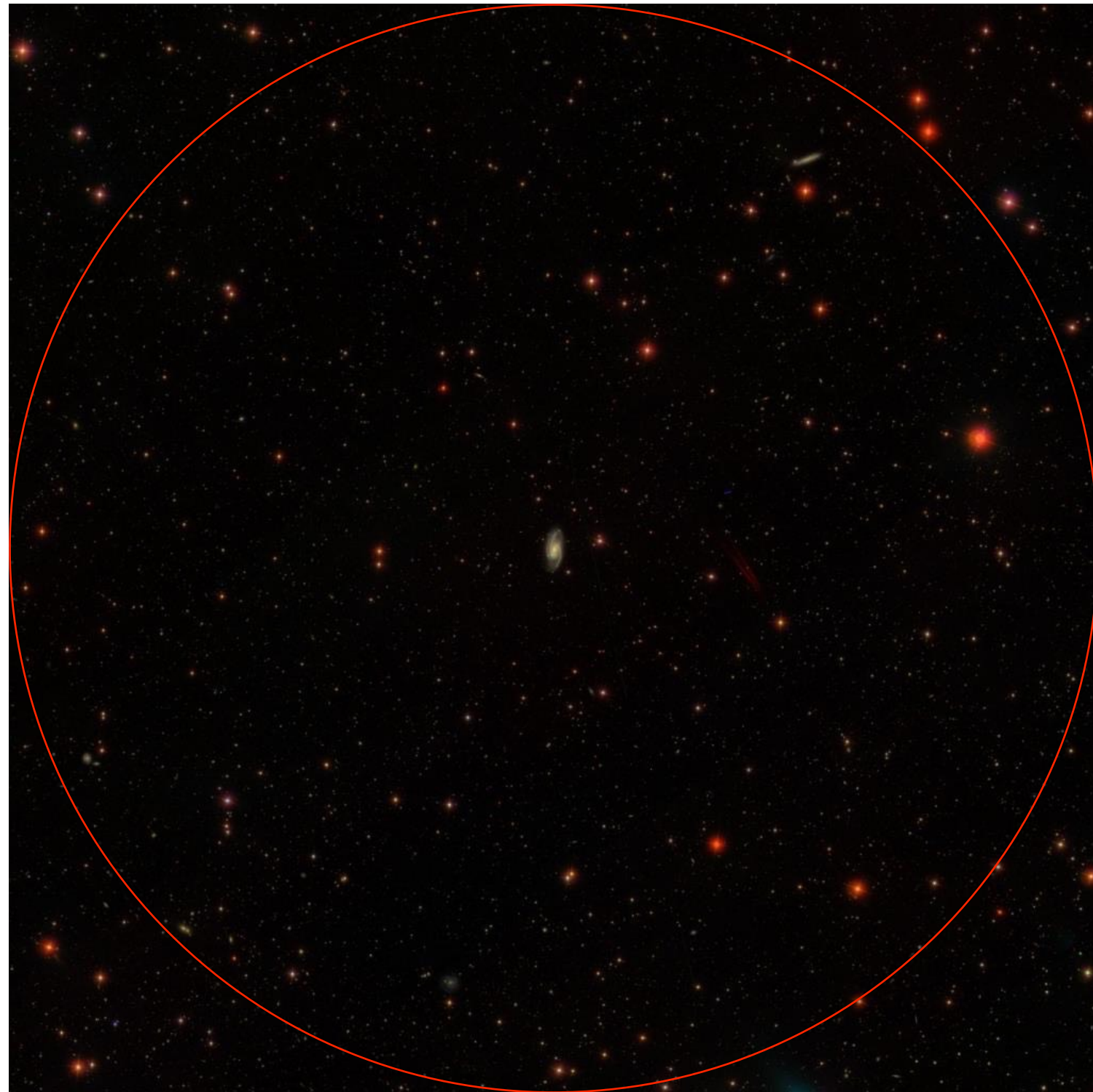
- Multi-fiber wide field spectrograph, PI Dan Fabricant, SAO. Commissioned 2004.
- 300x 1.5” fibers within a 1 degree diameter, robotic fiber positioner.
- Two gratings, resolution $R \sim 1100$ is most often used.
- Coverage ~ 3800-9000 Å at once.
- Throughput is adequate but not like Binospec. Sky subtraction in red is not as good.
- SAO software for designing fiber configurations.
- HSRED IDL pipeline written by Richard Cool, supported by Sean Moran and Ben Weiner.
- **Hectochelle**: same fibers, single-order hi-res echelle spectra, different data reduction.

Visit www.mmt.org > Observing > Instrument Suite for detailed information.

Binospec field - 2 x 8x15'



Hectospec field - 1 deg



To scale - Moon ~ 30 arcmin

What MMT optical spectrograph should I use?

- Need high sensitivity, moderate resolution, quality of spectra, sky subtraction in red, or less than 15' area: **Binospec**
- Many targets spread over fields \gg 15' in size: **Hectospec**
- Many single-slit targets with short exposure times and need to minimize overhead: **Blue Channel** (classically scheduled)
- Highest sensitivity blueward of \sim 3600 Å: **Blue Channel**
- Many targets, high resolution in a short wavelength range: **Hectochelle**
- P*1*rimetry: **SPOL**

Visit www.mmt.org > Observing > Instrument Suite for detailed information on each instrument.

Operations

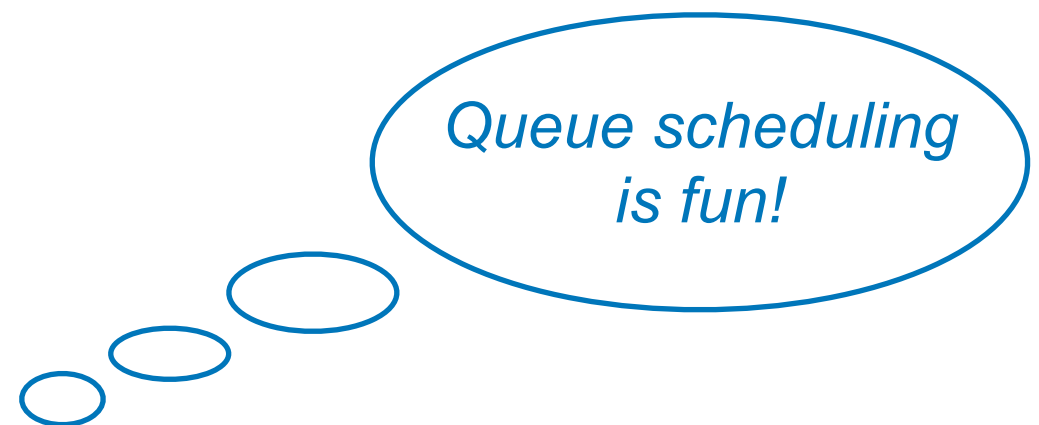
- **Binospec**: queue scheduled, MMT staff observers, scheduled by MMTO scheduler software and administered by instrument scientist (Ben Weiner). Many modes (gratings, masks, imaging) switchable during night.
- **Hectospec**: queue scheduled, MMT staff observers, scheduled and administered by Nelson Caldwell (SAO). Typically one mode / at most two gratings per night. MMTCam is available for imaging on same night.
- **Hectochelle**: same as Hectospec. Switching between Hectospec and Hectochelle is a daytime operation that must be scheduled.
- **Blue Channel**: classically scheduled with remote observing only during COVID.

Current operating status

- **Hectospec/Hectochelle**: Fiber positioner is under repair; see earlier talks. Hecto nights in Jan-March 2021 had to be cancelled/shifted.
- **Binospec**: operating normally. Some poor weather in winter 2021 leading to low program completion, but we are catching up.
- **Blue Channel**: operating normally.
- **Red Channel**: CCD failure means Red Channel is not operational.

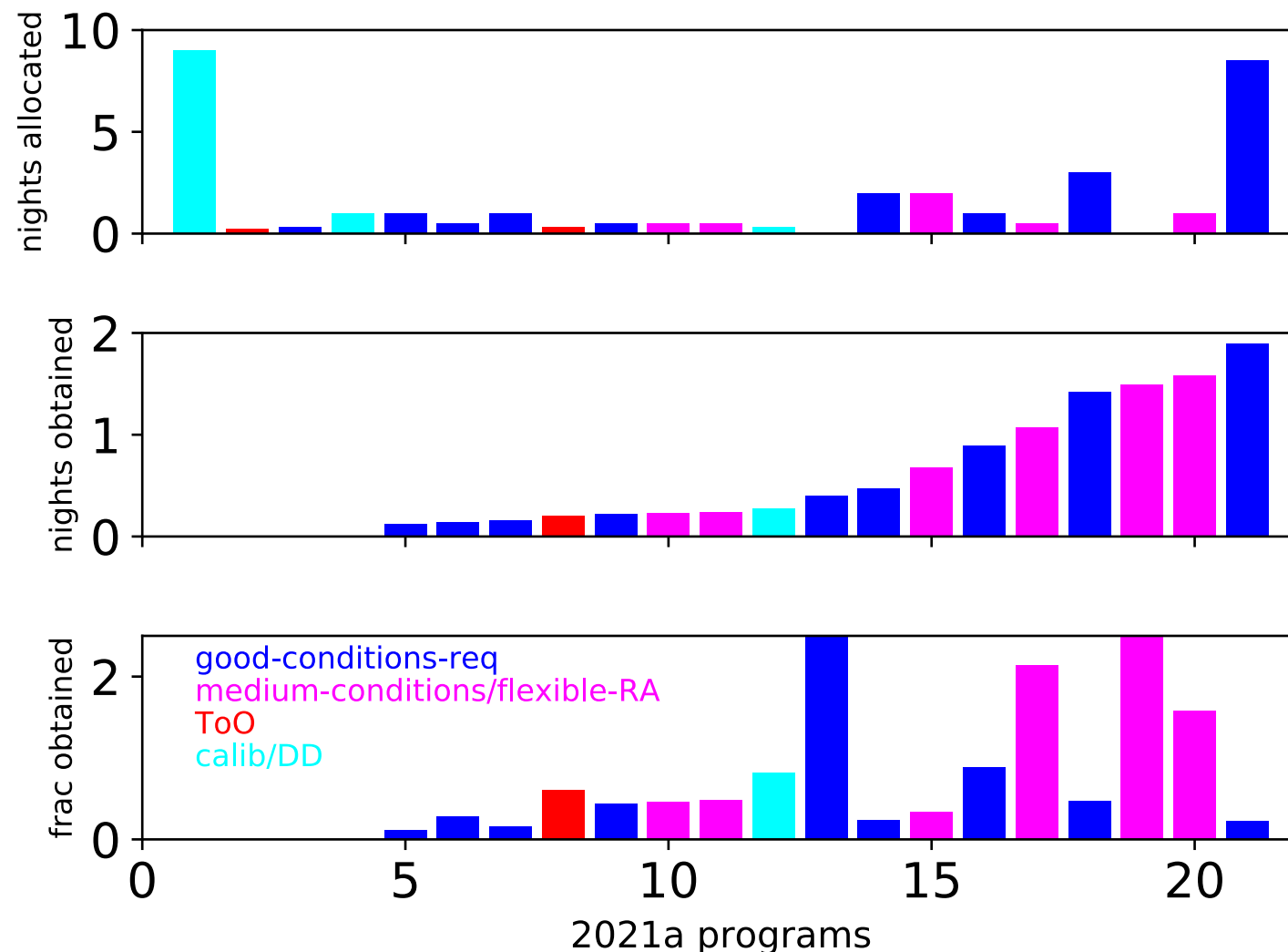
How the Binospec queue works

- Users upload targets/set priorities; subdivided into max 2-hour observing blocks.
- Scheduler software ranks the OBs based on elevation, priority, program completion. Based on astroplan, written by D. Gibson, maintained by B. Weiner. Queue observer chooses among the high ranked OBs with regard to conditions: moon, seeing, wind, clear/cirrus, etc.
- Instrument scientist manages queue, mask exchanges, relays between PIs and observers, advises PIs on observation setups.
- Issues: RA oversubscription; many programs need good conditions for deep integrations on a few extragalactic survey fields, for which the instrument is highly suited. We could use more programs that can cover less-popular RAs, or accept below-average weather.



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Feb-Mar 2021 programs
~ 1/3 completed,
normal over time ~ 2/3

What can I do with my data?

- Hectospec data can be reduced by the user with HSRED; also fits galaxy redshifts.
- Use “qplot” to inspect the 1-d spectra and redshifts from HSRED, and record quality codes. <https://github.com/bjweiner/qplot>
- Binospec data are reduced with a SAO pipeline by SAO staff; code is public and can be run by users as well.
- Binospec reduced data can be post-processed to view 2-d and 1-d spectra and fit templates for redshifts, using Specpro GUI (by Dan Masters, adapted by BJW for Binospec). <http://www.mmt.org/instrument-suite/binospec/using-specpro-to-review-binosp-ec-spectra/>

