

Thirty years, One Million Spectra: Public Access to the SAO Spectral Archives

Jessica Mink and Sean Moran Smithsonian Astrophysical Observatory

Low Dispersion Spectrographs

Z-Machine Spectrograph

Spectrograph using photon-counting Reticon detectors, a 2x936 pixel self-scanned photodiode array, coupled to a 3-stage image tube intensifier package, and fed through video amplifiers and electronics to a photon event discriminator, FIFO, and computer.

MMT Blue Channel Reticon Spectrograph

Moderate-resolution, multiobject optical spectrograph fed by 300 optical fibers at the f/5 Cassegrain focus of the 6.7-meter MMT, composed of a robotic positioner and a large, bench-mounted spectrograph, joined by a bundle of 25m long optical fibers. Dual robots, dubbed Fred and Ginger, reconfigure all 300 optical fibers in just 300 seconds.

FAST Spectrograph for the Tillinghast Telescope (FAST)

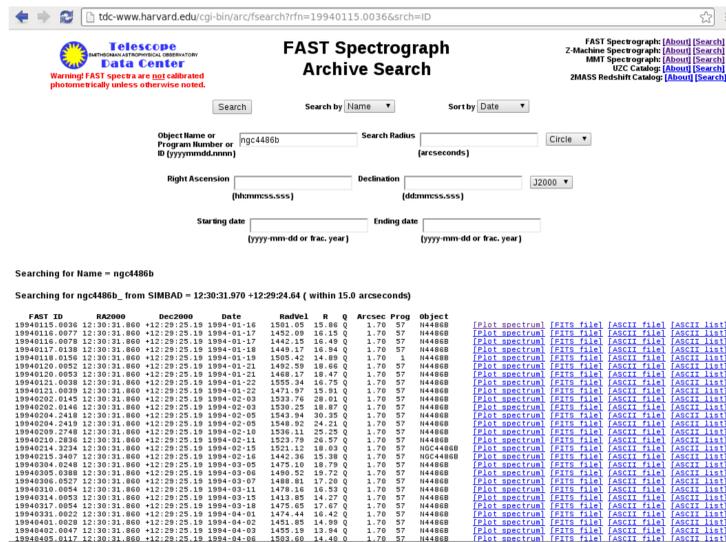
High-throughput optical spectrograph that has been in operation at the Cassegrain focus of SAO's 1.5-m telescope

Hectospec Multi-Fiber Spectrograph

Moderate-resolution, multiobject optical spectrograph fed by 300 optical fibers at the f/5 Cassegrain focus of the 6.7-meter MMT, composed of a robotic positioner and a large, bench-mounted spectrograph, joined by a bundle of 25m long optical fibers. Dual robots, dubbed Fred and Ginger, reconfigure all 300 optical fibers in just 300 seconds.

	Z-Machine	MMT Reticon	FAST	Hectospec (CfA only)
Telescope	Tillinghast 1.5-m reflector	Multiple Mirror Telescope	Tillinghast 1.5-m reflector	MMT 6.5-m Reflector (f/5)
Location	Mt. Hopkins, AZ	Mt. Hopkins, AZ	Mt. Hopkins, AZ	Mt. Hopkins, AZ
Years of operation	1978-08-03 to 1993-11-09	1980-05-10 to 1994-03-15	1994-01-12 to present	2003-10-23 to present
Wavelength coverage	3600-7000Å (usually)	3100-6800Å (median)	3700-7500Å (300 l/mm)	3700-9100 Å (300 l/mm)
Aperture	3.2 arcsec	3.2 arcsec	3,2,5,1.5,1.1 arcsec	1.5 arcsec
Resolution	4.8Å	4Å	3.0Å (300 l/mm) 1.5Å (600 l/mm)	5Å (270 l/mm) 2Å (600 l/mm)
Number of Spectra	26,990	6,064	>140,636	>358,532
Number of Objects	14,290	2,856	>18,914	>257,543

Over the last 30 years, the SAO Telescope Data Center has reduced and archived over 1,000,000 spectra, consisting of 287,000 spectra from five high dispersion Echelle spectrographs and 717,000 spectra from four low dispersion spectrographs, across three telescopes. 151,000 spectra from six instruments are currently online and publicly available, covering many interesting objects in the northern sky, including most of the galaxies in the Updated Zwicky Catalog which are reachable through NED or Simbad. A majority of the high dispersion spectra will soon be made public, as will more data from the MMT multi-fiber spectrographs. Many objects in the archive have multiple spectra over time, which make them a valuable resource for archival time-domain studies. We are now developing a system to make all of the public spectra more easily searchable and viewable through the Virtual Observatory.



High Dispersion Spectrographs

Oak Ridge, Tillinghast, and MMT, Reticon Echelles

Cross-dispersed echelle spectrographs using photon-counting Reticon detectors, a 2x936 pixel self-scanned photodiode array, coupled to a 3-stage image tube intensifier package, and fed through video amplifiers and electronics to a photon event discriminator, FIFO, and computer.

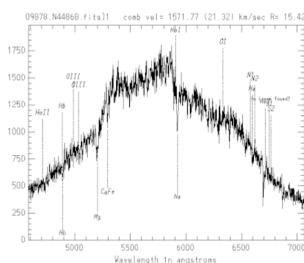
Tillinghast Reflector Echelle Spectrograph (TRES)

High-throughput fiber-fed echelle spectrograph with sky and object fibers. Cross-dispersed, with 2 optical fibers for science object and sky connected to a bench-mounted spectrograph which records 51 orders simultaneously

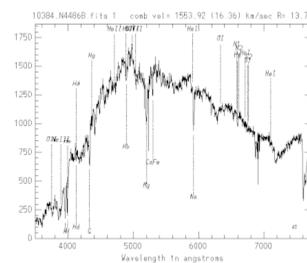
Hectochelle Multi-Fiber Spectrograph

High-resolution, multi-object optical spectrograph fed by 240 optical fibers, operating at the f/5 Cassegrain focus. Fibers are positioned on the focal plane (all 240 in 5 minutes) by two robots, Fred and Ginger, and connect to a bench-mounted spectrograph

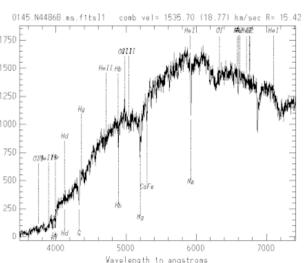
Telescope	Oak Ridge Echelle	Tillinghast Echelle	MMT Echelle	TRES	Hectochelle (CfA only)
Telescope	Oak Ridge 1.5-m reflector	Tillinghast 1.5-m reflector	Multiple Mirror Telescope	Tillinghast 1.5-m reflector	MMT 6.5-m Reflector (f/5)
Location	Harvard, MA	Mt. Hopkins, AZ	Mt. Hopkins, AZ	Mt. Hopkins, AZ	Mt. Hopkins, AZ
Years of operation	1982-07-05 to 2005-05-11	1978-12-13 to 2009-05-11	1981-04-20 to 1998-01-15	2007-09-25 to present	2008-02-24 to present
Wavelength coverage	5166-5611Å (usually)	5166-5611Å (usually)	5166-5611Å (usually)	3900-9100Å (in 51 orders)	3800-9000 Å (any 150 Å order)
Aperture	1.5 arcsec x 9 arcsec	1.5 arcsec x 9 arcsec	1.5 arcsec x 9 arcsec	1.4, 2.3, and 3.2 arcsec	1.5 arcsec
Resolution	R=20K 0.3Å	R=20K 0.3Å	R=20K 0.3Å	R= 60K,48K,30K 0.1,0.12,0.18Å	R~38,000 0.15Å
Number of Spectra	141,948	90,886	6,064	>30,474	>138,371
Number of Objects	10,155	14,290	2,856	>6,833	>45,101



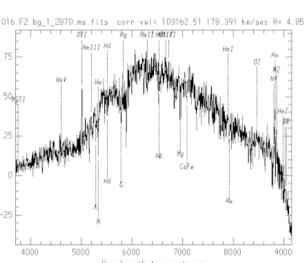
Z-Machine 600 sec exposure of NGC 4486B



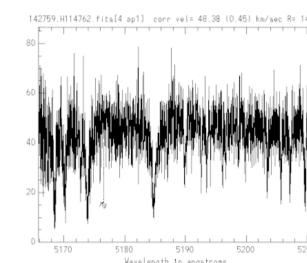
MMT Reticon 240 sec exposure of NGC 4486B



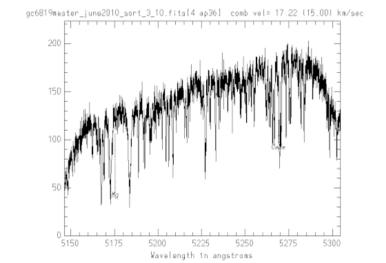
FAST 180 sec exposure of NGC 4486B



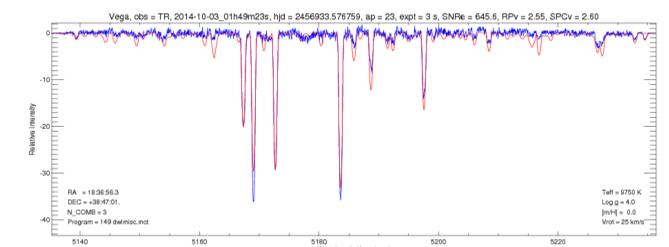
Hectospec 900 sec exposure of z=0.3 galaxy



Typical Reticon Echelle spectrum



Hectochelle single order spectrum



Single order of TRES Vega spectrum

A Modern VO-Compliant Interface for the Archive

Passing the one million spectra milestone demands a newer, friendlier and more powerful interface for searching and retrieving our public data

- More Public:** CfA reviewing policies on proprietary periods, aiming to increase public dissemination of the data we archive for all CfA observers.
- Better Infrastructure:** Currently transitioning our internal databases of (raw and reduced) data holdings from Starbase to PostgreSQL. Implemented for Hectospec already, with other datasets from low-resolution spectrographs next.
- Enable Power Users:** Experimenting with GAVO DaCHS as the VO platform for public access to our reduced spectra holdings
- Drawing in "Just find me the spectra" Users:** Developing custom code to implement target-list search (lists of Ra, Dec pairs)
- Inspect Before Download:** Our long-term goal is to write tools that improve the user experience for interactive visualization of spectra on the web



Jessica Mink and Sean Moran
jmink@cfa.harvard.edu
http://tdc-www.harvard.edu

