

Maryland-Magellan Tunable Filter (MMTF)

Tunable filter for IMACS on the Baade 6.5m telescope with broad wavelength coverage ($\sim 5000 - 9200 \text{ \AA}$), bandwidth ($\sim 5 - 50 \text{ \AA}$) and wide FOV ($27'$)

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- **Additional Support:** ~ 7 OCIW technicians and engineers (4.2 months)
- **Funding Agency:** NSF/ATI (3 years, \$780K including \$73K to OCIW)

MMTF: Description

■ Host instrument: IMACS

- In collimated beam of short camera
- FOV = 27'
- DIQ = 0.6"
- CCD: 8 x SITe ST-002A 2048 x 4096 x 15 μm pixels

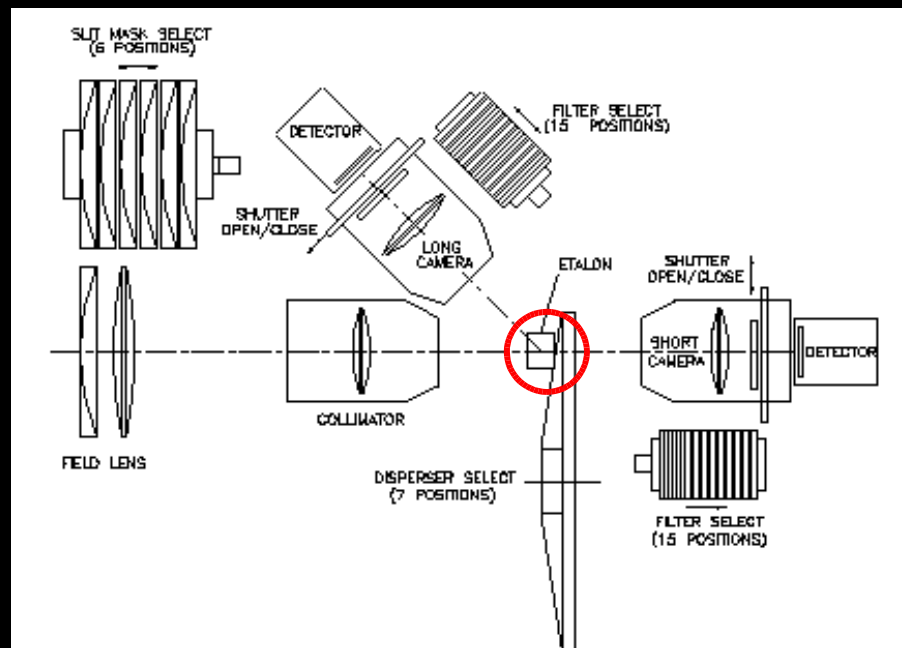
■ Low-order Fabry-Perot etalon:

- IC Optical Systems ET-150-FS-100: 150 mm, $\lambda/100$
- Finesse: $\sim 40 \rightarrow \sim 80\%$ throughput
- Broad-band coating: $\sim 5000 - 9200 \text{ \AA}$
- Bandwidth: $\sim 5 - 50 \text{ \AA}$
- Monochromatic FOV: from $\sim 22'$ @ 50 \AA to $\sim 10'$ @ 10 \AA

■ Electronic controller:

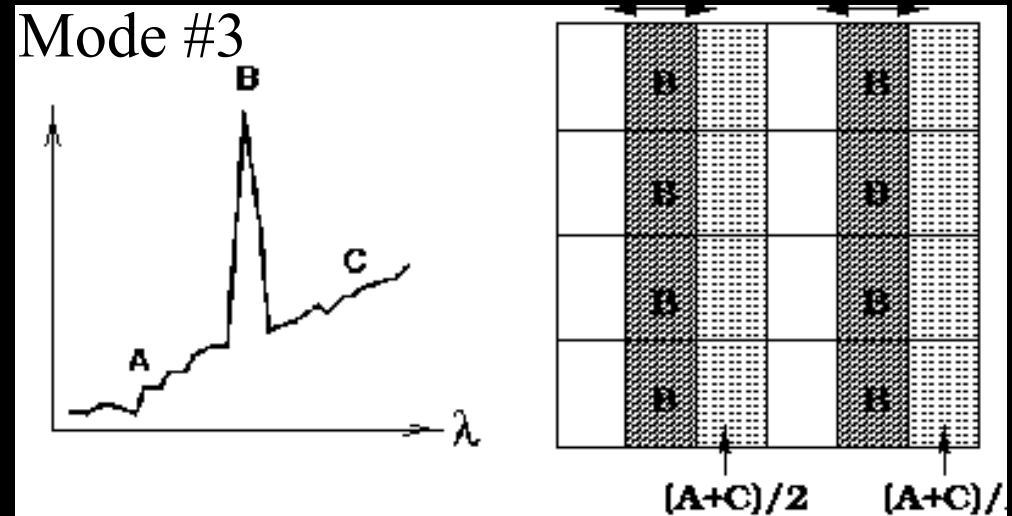
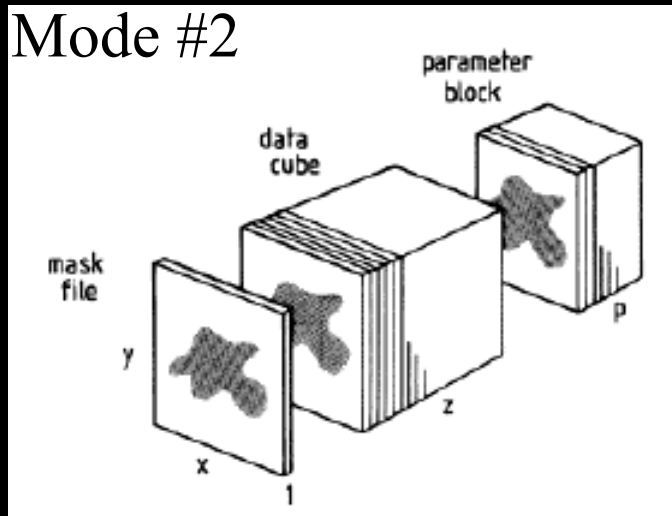
- Installed outside of IMACS in equipment rack on Nasmyth platform

■ Order-blocking filters (R ~ 25)



MMTF: Observing Modes

- **Mode #1:** stare mode = fixed-gap narrow-band imaging over whole FOV
- **Mode #2:** gap scanning mode to produce a low-resolution data cube
- **Mode #3:** charge shuffling & frequency switching mode
 - The charges on each CCD are shuffled left and right at the same rate that the etalon plates are scanned between two/three discrete gap positions
 - FOV = $2 \times 4.5' \times 27' \sim 250'$
 - Need two telescope nods of $\pm 4.5'$ for contiguous FOV



MMTF: Calibrations

■ Parallelism & Wavelength Calibration

- Parallelism: once at the beginning of the run (≤ 30 minutes)
- Wavelength calibration: $\sim 2 - 3$ times a night (~ 5 minutes)
- Use external neon and argon lamps
- Use scanning mode of MMTF to produce “sausage cubes” at two different positions in the field
- Very stable!

MMTF: Science

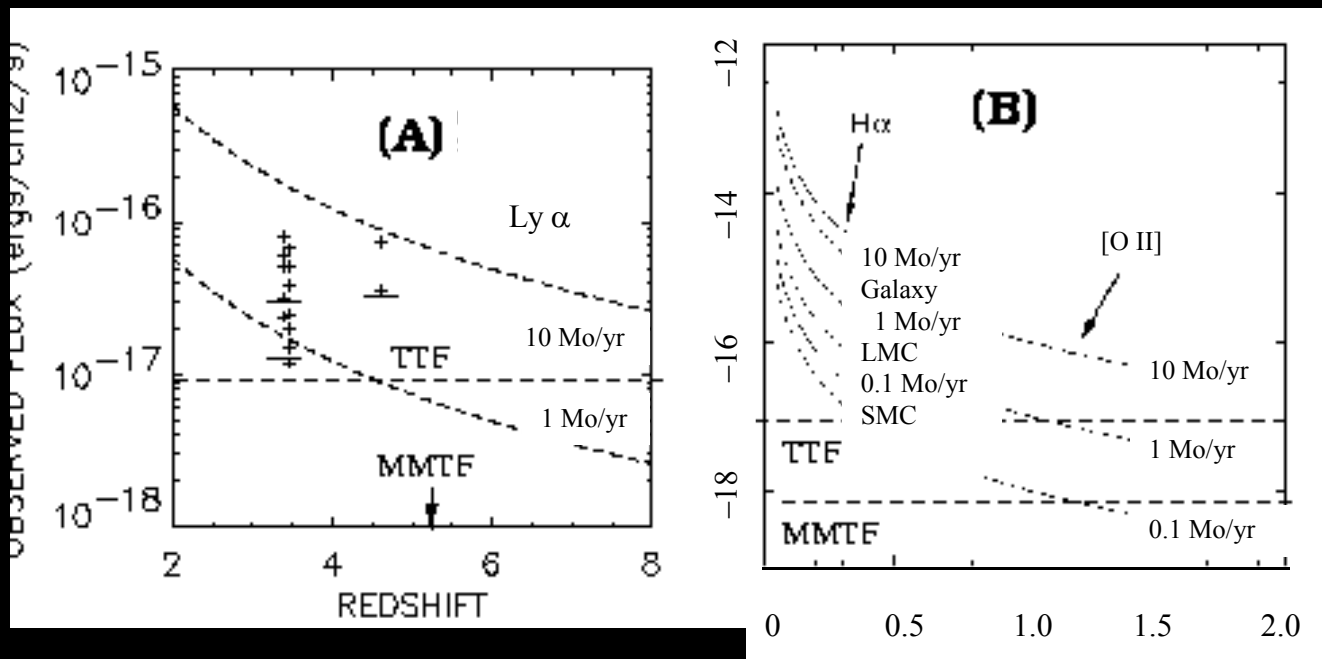
Sensitivity: $\sim 1 \times 10^{-18}$ erg s⁻¹ cm⁻² in 1 hour @ 6000 Å

- Survey of emission-line galaxies at low- and high-redshifts in the field, cluster and supercluster environments
- Cooling flows in galaxy clusters
- Survey of intracluster planetary nebulae
- Deep multi-line imaging of nearby galaxies and galaxy groups
- Emission-line imaging of galactic nebulae
- **Your project here!**

MTTF Science

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MMTF: Implementation

■ Mechanical Integration (T. Hare, OCIW)

- The etalon will be mounted in a fixture which will stiffly mount the etalon to a matrix ring and allow the etalon to be carried in the disperser server
- Controller unit will be mounted outside of IMACS in a cooled equipment rack on the Nasmyth platform to prevent dumping excess heat into the dome

■ Cabling (OCIW/LCO)

- Etalon has 5 small cables which carry power and control for internal piezo-electric actuators and capacitance sensors
- Cables from the etalon to the controller unit are already installed in IMACS (August 2003)
- Cables will run from the controller unit to the telescope control room

MMTF: Implementation

- **Data Acquisition System (Birk et al. + MMTF Team)**
 - MMTF data acquisition will be fully integrated within the GUI of the existing IMACS control system
 - IMACS will be able to command the etalon controller as well as query the current state of the etalon
 - System will control IMACS, etalon, and CCDs to allow charge shuffling and frequency switching
- **Data Reduction System (MMTF team; UMD postdoc)**
 - Use techniques for standard narrow-band imaging
 - Subtraction of azimuthally-symmetric sky w/r to optical axis
 - Parallel processing of each CCD?
 - Data pipeline?

MMTF: User Support

■ Expectations

- MMTF is a key component to IMACS, a facility instrument
- Users with some basic knowledge of Fabry-Perot imaging and with one night of training by an experienced observatory staff member will be able to use the MMTF on their own

■ MMTF Webpage

- User's manual
- Useful tips for proposal writing
 - ❖ Java-based S/N calculator
- Useful tips for run preparation
- Step-by-step procedures during an observing run
- Useful tips for data reduction

MMTF: Tentative Schedule

- **August 15, 2003:** Award notification
- **December 2003:** Procurement of etalon from IC Optical Systems
- **March 2004:** MMTF MOU signed
MMTF postdoc hire (*B. Weiner*)
- **April - May 2004:** Procurement of order-blocking filters
- **August – September 2004:** Delivery of etalon and filters at LCO
[assumption: $\Delta t = 8$ months for etalon, 4 – 6 months for filters]
- **Fall 2004:** Implementation of basic modes of operation of MMTF
- **Semester 05A or 05B:** MMTF available to users

Installation Plan: <http://www.ociw.edu/instrumentation/mmtf>