

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 ($\sim 6 - 30 \text{ \AA}$) and wide FOV ($27'$)

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

MMTF: Description

■ Host instrument: IMACS

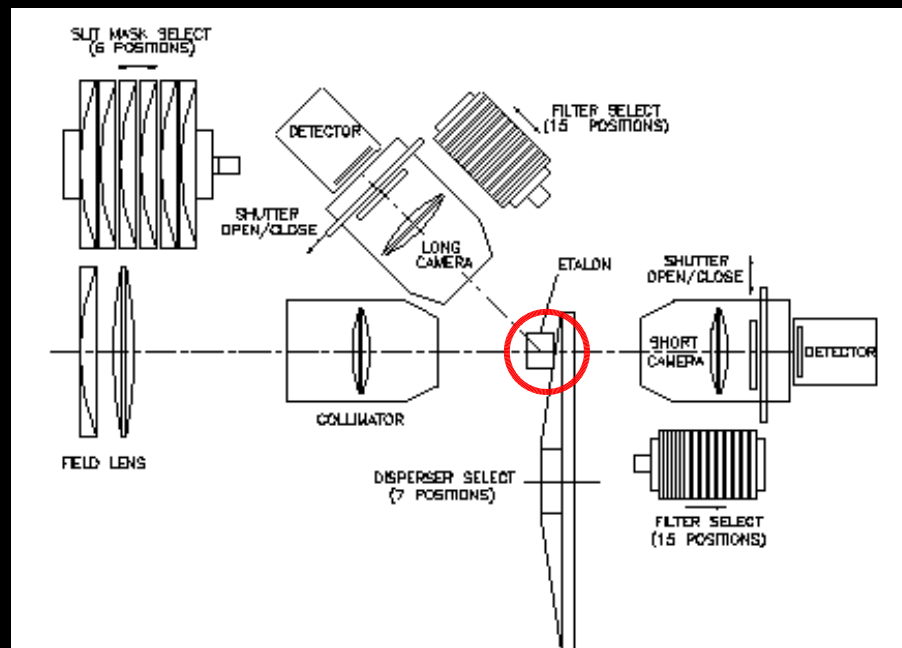
- In collimated beam of short camera
- FOV = 27'
- DIQ = 0.6"
- CCD: 8 x SITe ST-002A 2048 x 4096 x 15 μm pixels

■ Low-order Fabry-Perot etalon:

- IC Optical Systems ET-150-FS-100: 150 mm, $\lambda/100$
- Finesse: $\sim 30 \rightarrow \sim 60\%$ throughput
- Broad-band coating: $\sim 5000 - 9200 \text{ \AA}$
- Bandwidth: $\sim 6 - 30 \text{ \AA}$
- Monochromatic FOV: from $\sim 17'$ @ 30 \AA to $\sim 10'$ @ 10 \AA

■ Electronic controller:

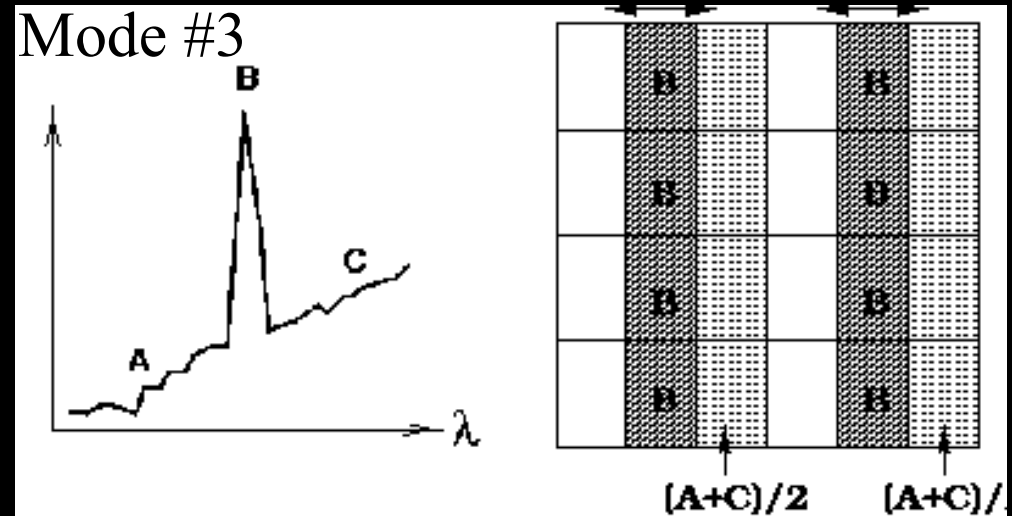
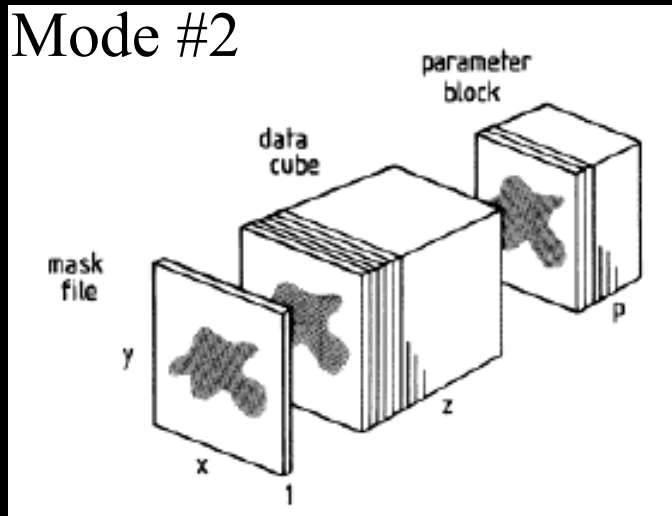
- Installed outside of IMACS in equipment rack on Nasmyth platform



2 ■ 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
- Good stability

MMTF: Science

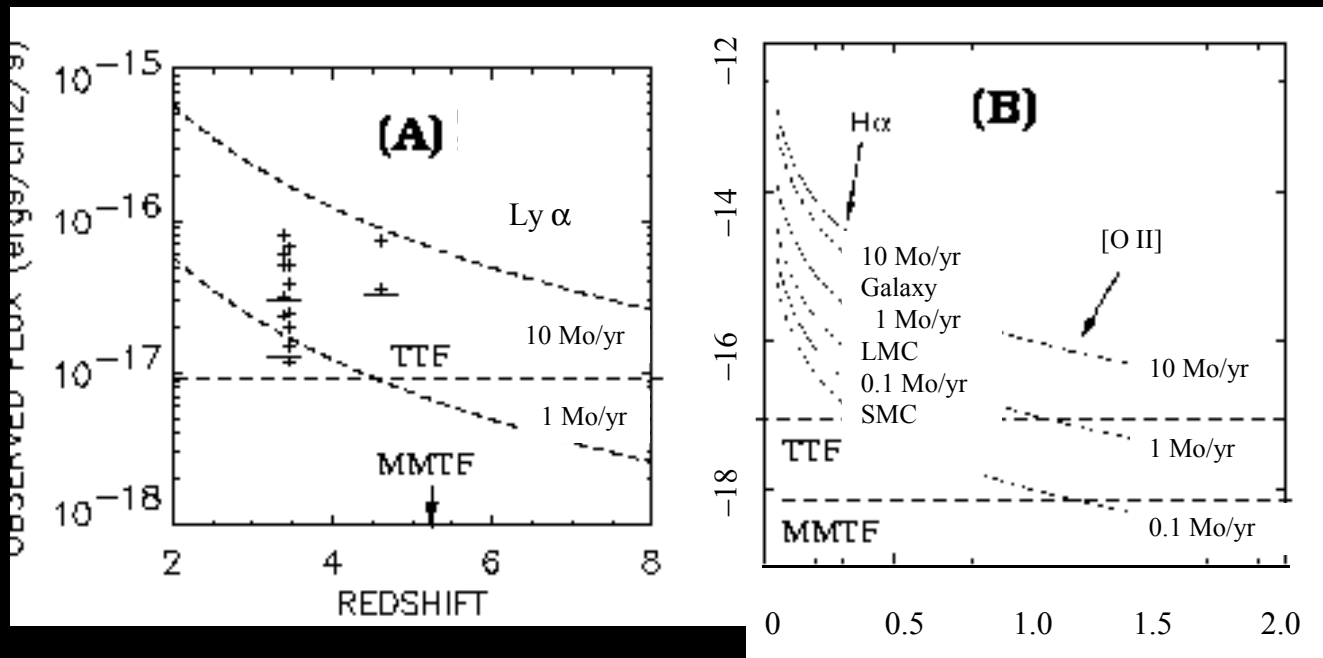
Sensitivity: \sim few $\times 10^{-18}$ erg s $^{-1}$ cm $^{-2}$ in 1 hour @ 6000 Å (point source)

- 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
- **Projects from the Magellan community**

MMTF Science

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

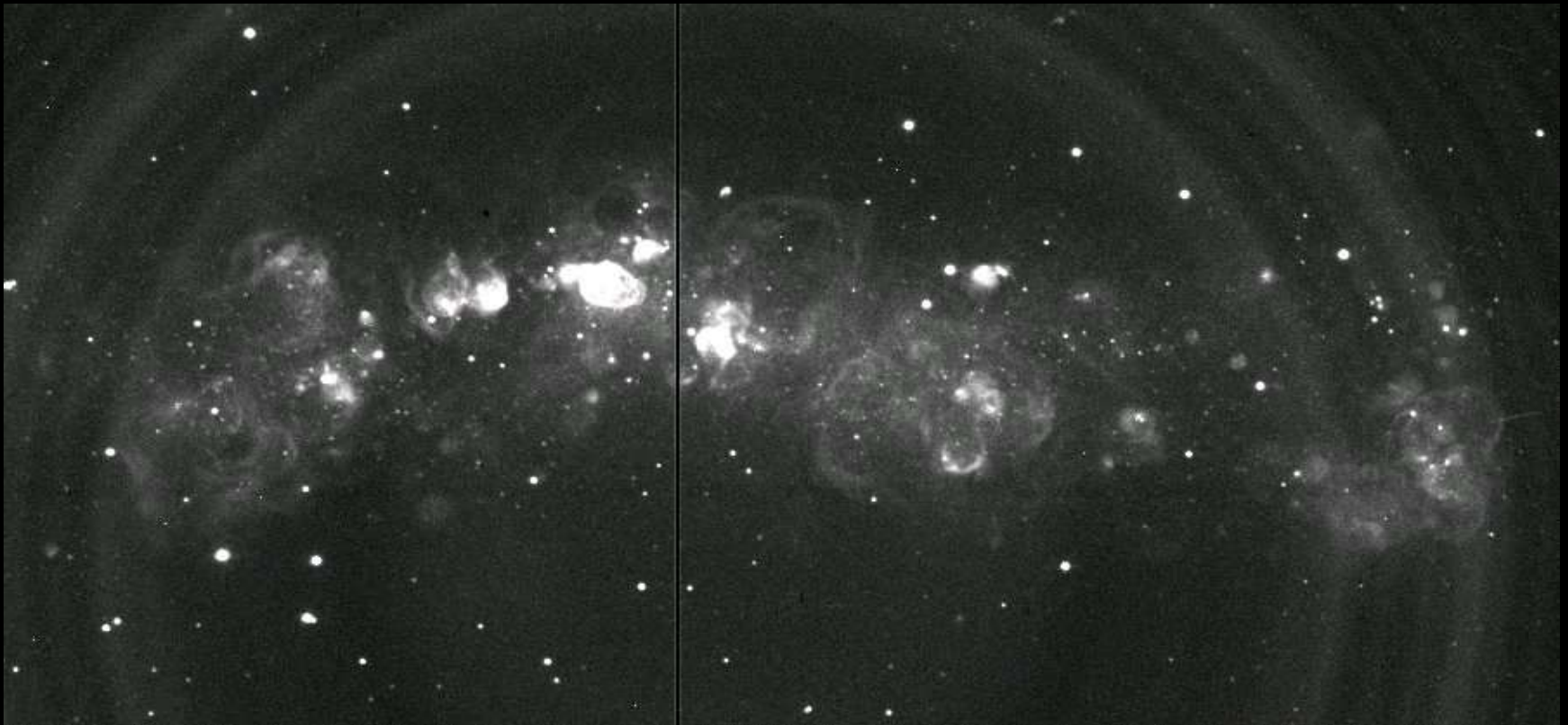
- Survey of emission-line galaxies at low- and high-redshifts in the field, cluster, supercluster environments



MMTF Science

Wide field, low background, good image quality

- Narrow band imaging of nearby galaxies



NGC 3109 dwarf with Fabry-Perot at Dupont 100''

MMTF: Implementation

■ Mechanical Integration (T. Hare, OCIW)

- The etalon is 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 within IMACS
- Instrument computer cabled to controller over ethernet-RS-232

MMTF: Implementation

- **Data Acquisition System (Birk et al. + MMTF Team)**
 - MMTF data acquisition is fully integrated within the GUI of the existing IMACS control system
 - IMACS is 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)**
 - Use techniques for standard narrow-band imaging
 - Subtraction of azimuthally-symmetric sky w/r to optical axis
 - Adoption of previous Fabry-Perot software to mosaic data
 - Pipeline software

MMTF: User Support

■ Expectations

- MMTF is a key component to IMACS
- MMTF is initially a PI instrument
- Eventually users with some basic knowledge of Fabry-Perot imaging and with one night of training by an experienced user/observer will be able to use the MMTF on their own

■ MMTF Webpage

- User's manual, technical documentation
- 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