GMACS Summary

1. Instrument Motivation

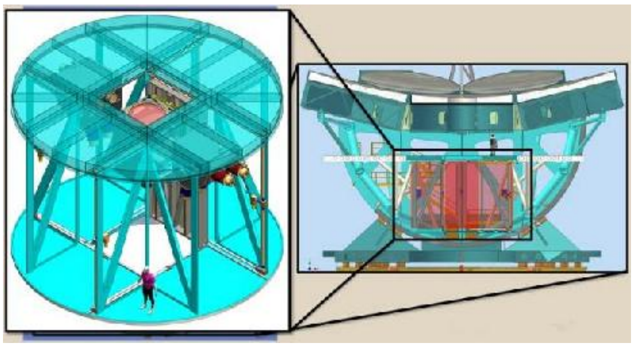
- GMT science requirement: "A spectrometer operating in the **visible spectrum (0.32 μm to 1μm)** with the capability to observe **multiple targets** simultaneously is critical to our goals in the areas of star formation, stellar populations and most extragalactic science"

- Highest impact (and cost-effective) instruments on large telescopes are consistently the multi-object spectrographs with low/moderate resolution (LRIS, DEIMOS...) and high-resolution spectrographs (ESI, HIRES ....) - S. Kulkarni, white paper, in prep.

2. Full GMACS Concept

- Wide-Field
  - 4 channels covering **8'x18'** (full configuration and wavelength coverage)

- Multi-object with multi-slits
  - **0.7 arcsec width**
  - Large number of slitlets and masks available during night
  - Roughly **100 x 5 arcsec long slits**
  - More at lower resolution (1000's)



- Moderate resolution, **R~2000**
  - R=2700 at 850nm
  - R=1400 at 500nm

- Additional resolutions
  - Low (50-200)
  - High(er): roughly twice the moderate resolution mode
  - Working on timescale for changing resolution

- Optical wavelengths

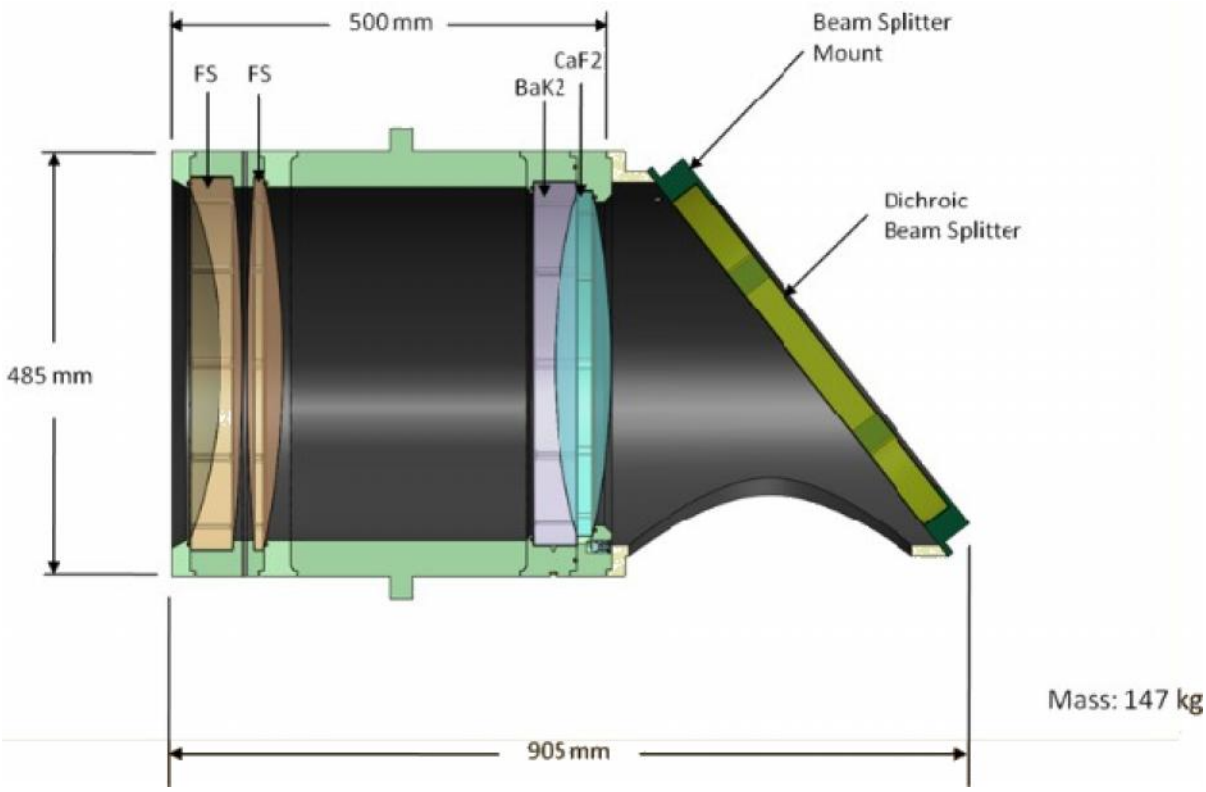
- Simultaneous coverage using separate red & blue channels: 400-900nm
  - 350-1100nm goal

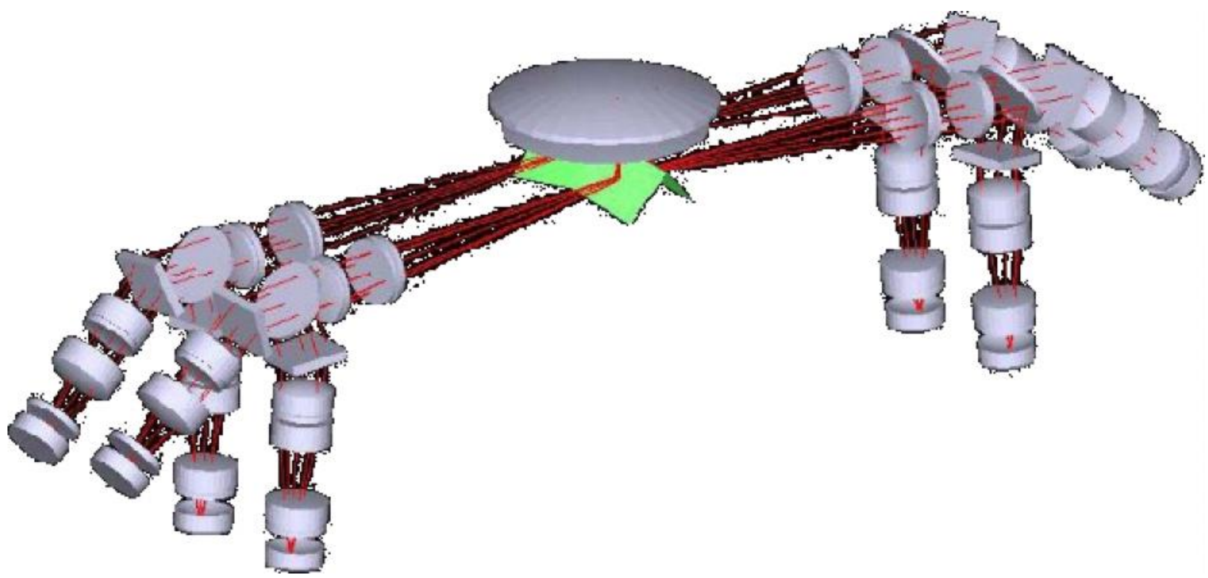
3. GMACS Optical Layout

- Four collimators split focal plane into four channels.

- Four beams are divided by dichroic into blue and red channels.

- Each of the 8 beams are then dispersed by VPH grating.





4. GMACS Concept ⊗ GMT Budget

- The reality of the GMT budget and GMT First Light requirements force major Tradeoffs in GMACS capabilities.

- Lack of wide-field corrector will restrict FOV to ~8′ diameter (offset by MANIFEST?)

- There are higher challenges (= increasing cost) for other Tradeoffs and decisions need to be made to fit technical capabilities into GMT Budget.

- **Priorities/Decisions ultimately based off scientific input**.

Parameter	Range of Values to Study	Comments
Field of view	6, 8, and 10 arcmin diameter	Original GMACS channels each have 4.5 x 9 $arcmin^2$ (equiv. 10 arcmin diameter) fields.
Wavelength Coverage	Blue limit: 350, 375, 400 nm Red limit: 930, 980, 1030 nm near-IR arm ? limit of 1.3, 1.5 um	Bluer than 350 nm requires change of lenses and becomes very expensive.
Resolution	Blue: R=1200, 2500 Red: R=2500, 5000 Higher?: R~7500, 10000?	At higher resolution, wavelength coverage may be sacrificed.
Peak Throughput	45, 55, 65%	spectrograph only, not including telescope
Image Quality	80% EE at 0.2, 0.4 arcsec Imaging-Only Mode: in what capacity?	If imaging-only mode, what filters and IQ needed?
Wavelength Stability	$d\lambda/dt$ = 0.1, 0.3 resolution elements per hour	
Options for wide-field corrector / ADC		Likely linked to FOV, IQ, wavelength coverage, and throughput
Channels	Dual (Red & Blue) channels, or single only. Triple channel that includes IR ?	
Mask Storage	8 to 16 per night	
Cooling System	LN2, Cyrocooler, Refrigeration	
Grating Exchange	Manual vs. Motorized	

5. Science Drivers for GMACS

- Crucial science capability
  - Galaxy formation and assembly
  - Dark energy and Dark Matter Halos
  - First light and reionization
  - Follow-up of LSST/DES/etc.

- Information content very high
  - Most basic capability required for any telescope
  - Expect that use will spread across a wide spectrum of topics
    * Metallicity/dynamics of halo stars and local group galaxies
    * Star formation at z=2
    * Mineralogy of KBOs

- Any science project with more than a few targets per sq. arcminute

6. Estimated Sensitivity

- System throughout roughly 30%

- In 1 hour in dark sky & good seeing
  - S/N = 10 for 24 to 26 mag (Y- to u-band) @ R~2000
  - S/N = 10 for 25 to 27 mag (Y- to u-band) @ R~100

- Good S/N spectrum of anything in current sky surveys
  - G dwarf Ca H&K in LMC
  - F dwarfs in Local Group
  - Giants in Virgo
  - PN in z=0.5 clusters
  - L* galaxies at z=4 to z > 7

- GMACS will never run out of targets!
  - Particularly from DES, LSST, etc.

- **Exposure Time Calculator** (beta) - http://snagglepuss.as.utexas.edu/cgi-bin/gmacs.cgi