The optomechanical design concept for the Giant Magellan Telescope Multi-object Astronomical and Cosmological Spectrograph (GMACS)

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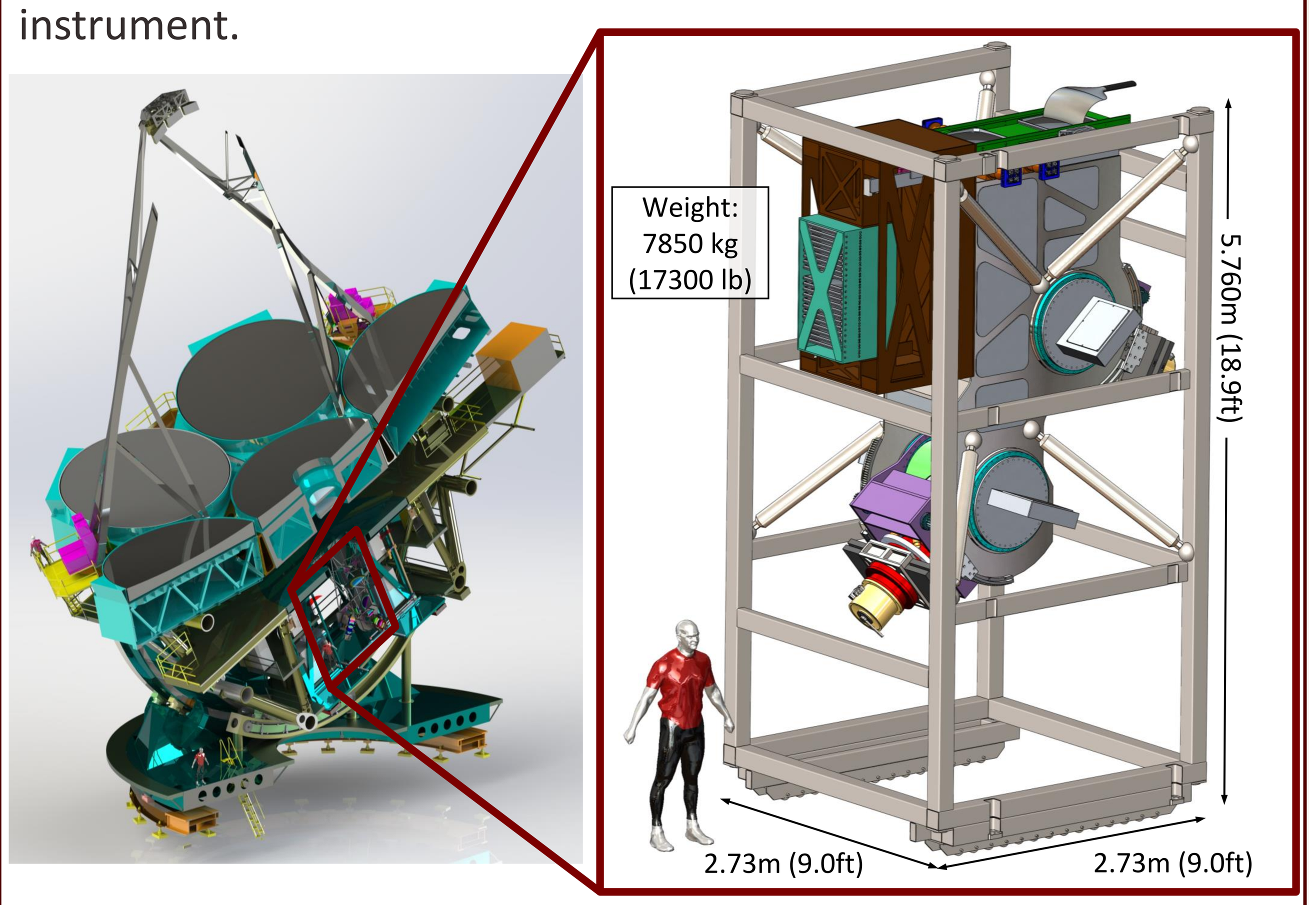
ABSTRACT

We describe the latest optomechanical design of GMACS, a wide-field, multi-object, moderate-resolution optical spectrograph for the Giant Magellan Telescope (GMT). Specifically, we discuss the details of the structure, mechanisms, optical mounts and deflection tracking/compensation as well as the requirements and considerations used to guide the design. We also discuss GMACS's interfaces with GMT and other instruments.

INTRODUCTION

This poster presents the current conceptual optomechanical design of the wide field, multi-object, moderate-resolution, optical spectrograph, called GMACS. GMACS is a first light instrument for the Giant Magellan Telescope (GMT). High throughput, simultaneous wide wavelength coverage, moderate resolution, and wide field are the crucial design drivers for the instrument.

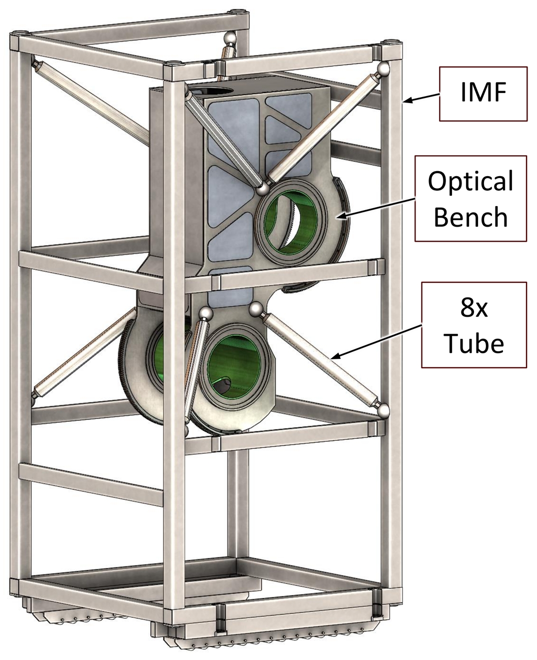


Location of the GMACS instrument within GMT

The current GMACS conceptual design is an evolution from the previous designs that were first described in SPIE proceedings in 2012. The scope of the conceptual optomechanical design is to illustrate how the optics and subsystems will be packaged, to simulate articulation ranges of the moving components and identify potential collisions, estimate initial instrument envelope and weight, investigate GMT interfacing, and determine expected deformations.

INSTRUMENT FRAME

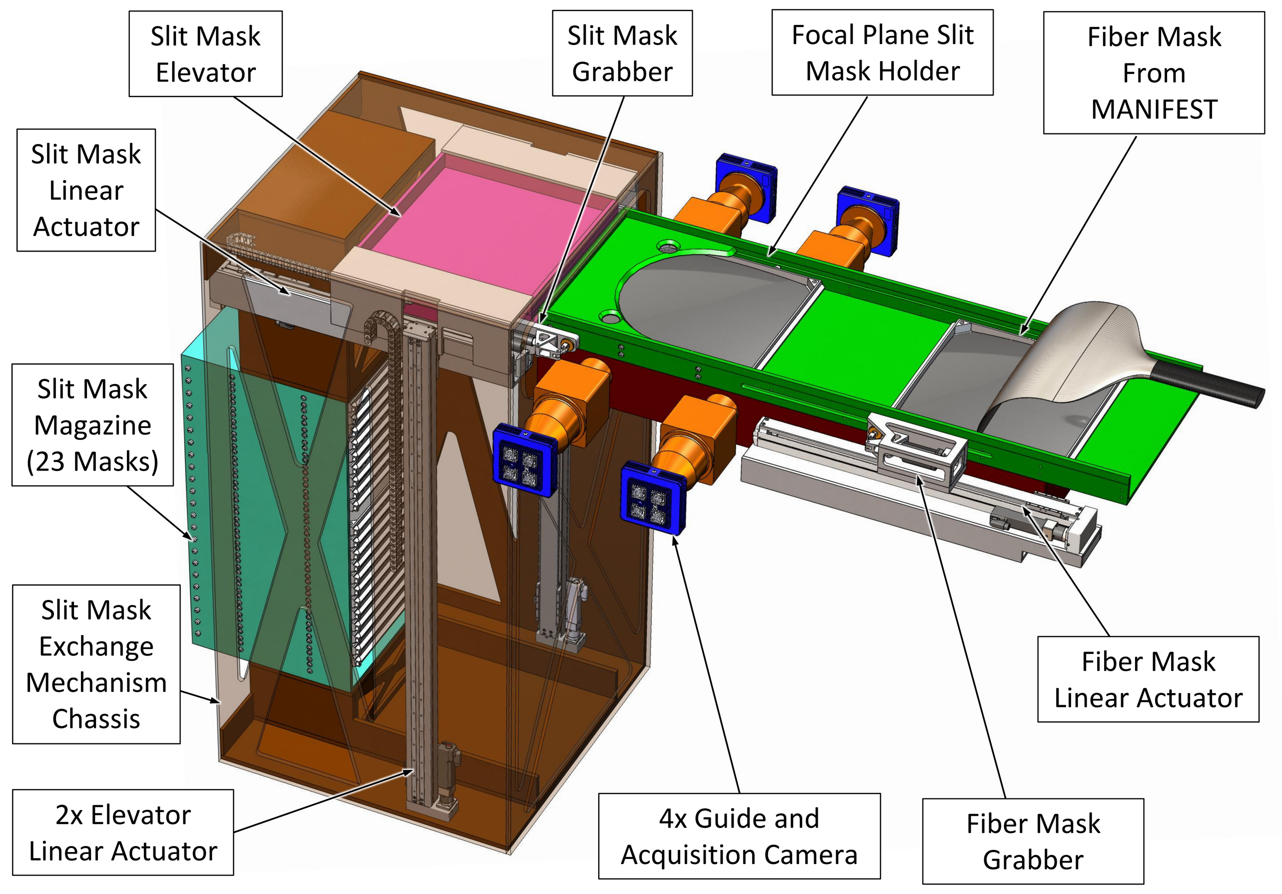
GMACS's optical bench holds the instrument subassemblies and attaches to the GMACS specific Instrument Mounting Frame (IMF). The IMF allows GMACS to interface with the Gregorian Instrument Rotator (GIR) which holds instruments in the focal plane.



GMACS structure

FOCAL PLANE ASSEMBLY

The focal plane assembly contains the Slit Mask Exchange Mechanism (SMEM), guide and acquisition camera, and the fiber mask deployment mechanism.



Focal Plane Assembly

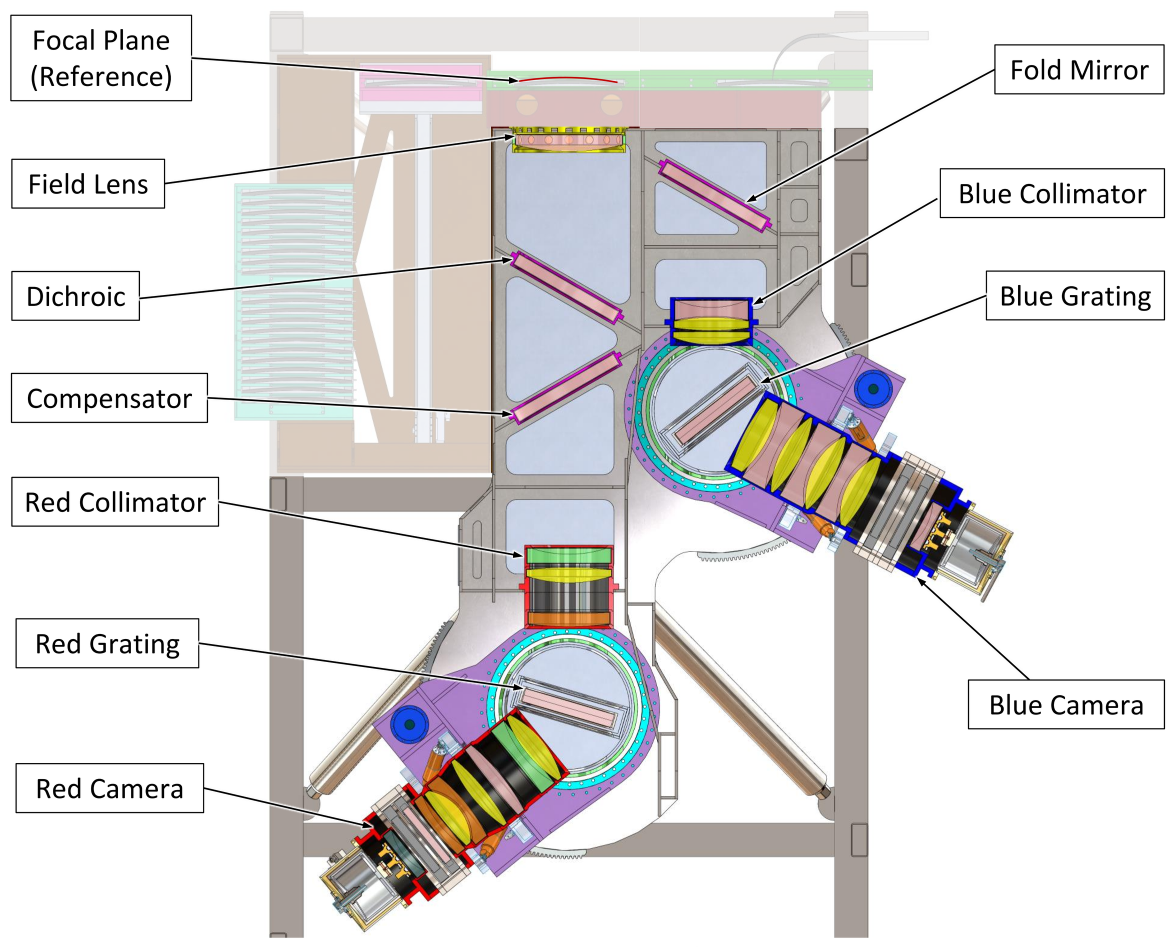
The four alignment and acquisition cameras are behind the focal plane and will allow precision alignment of the slit masks relative to reference stars.

To observe objects in different fields, a jukebox style exchange mechanism will be used to move slit masks between the focal plane and magazine. The slit mask magazine can hold 23 masks.

GMACS has a mode that uses fibers from MANIFEST to allow for higher spectral resolution and wavelength coverage. To do this, MANIFEST will handoff a fiber mask to GMACS's fiber mask deployment system where it is moved into the focal plane.

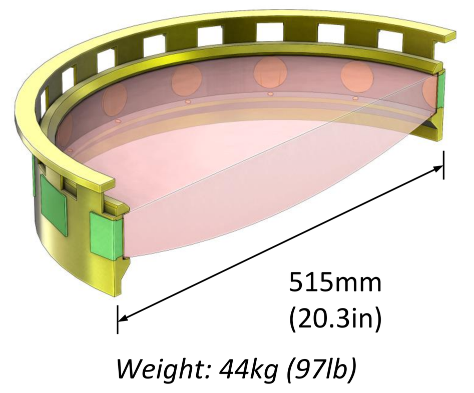
OPTICS MODULE

The optics module contains the field lens, dichroic, fold mirror, compensator, collimators, gratings, and cameras .

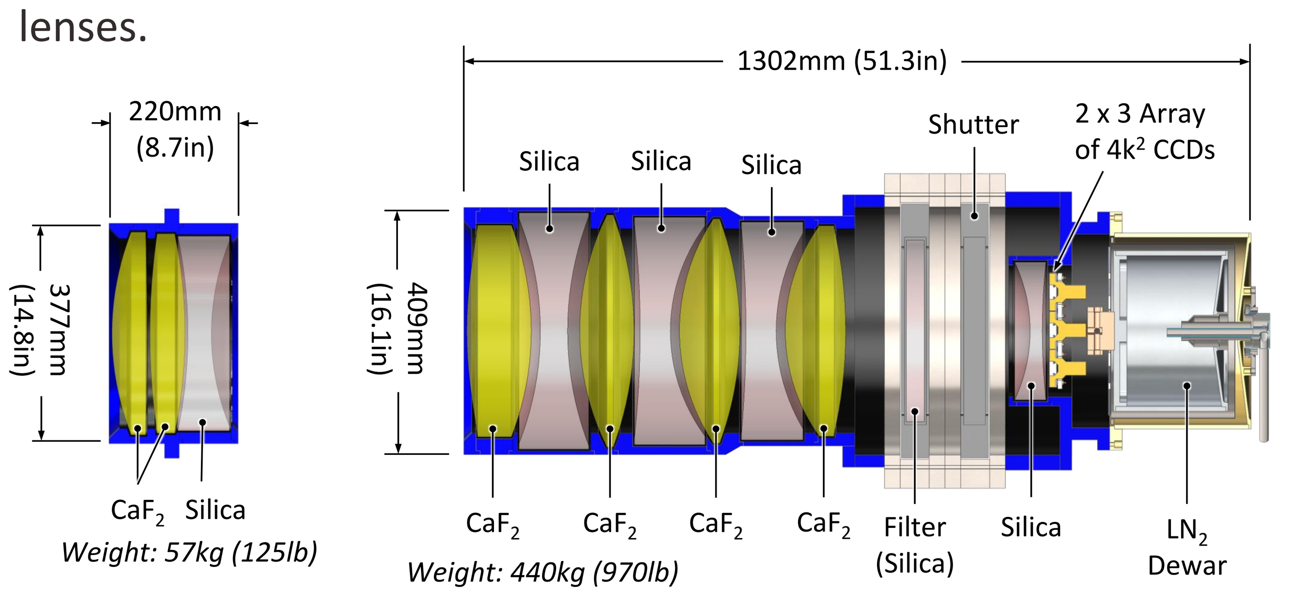


Optics Module

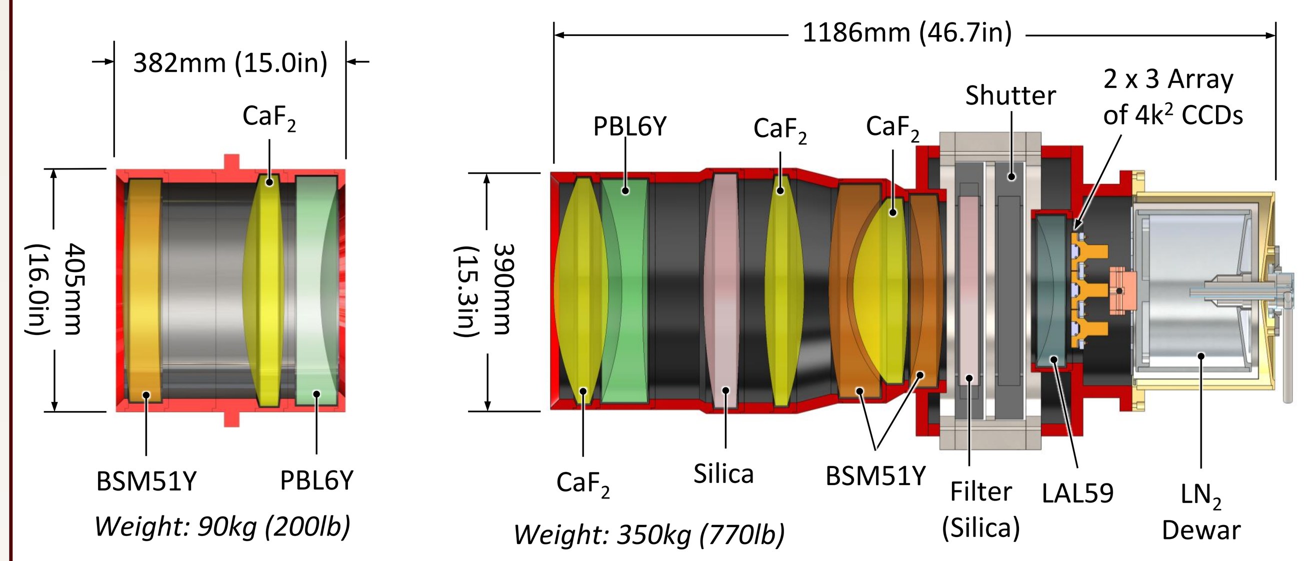
The field lens's cell design utilizes RTV pads and invar flexure blades to hold the lens in alignment over varying temperatures. The cells for the collimator, dichroic, compensator fold mirror, and cameras optomechanical systems will use roller pin flexures and glass filled Teflon plugs to hold the lenses.



Field Lens



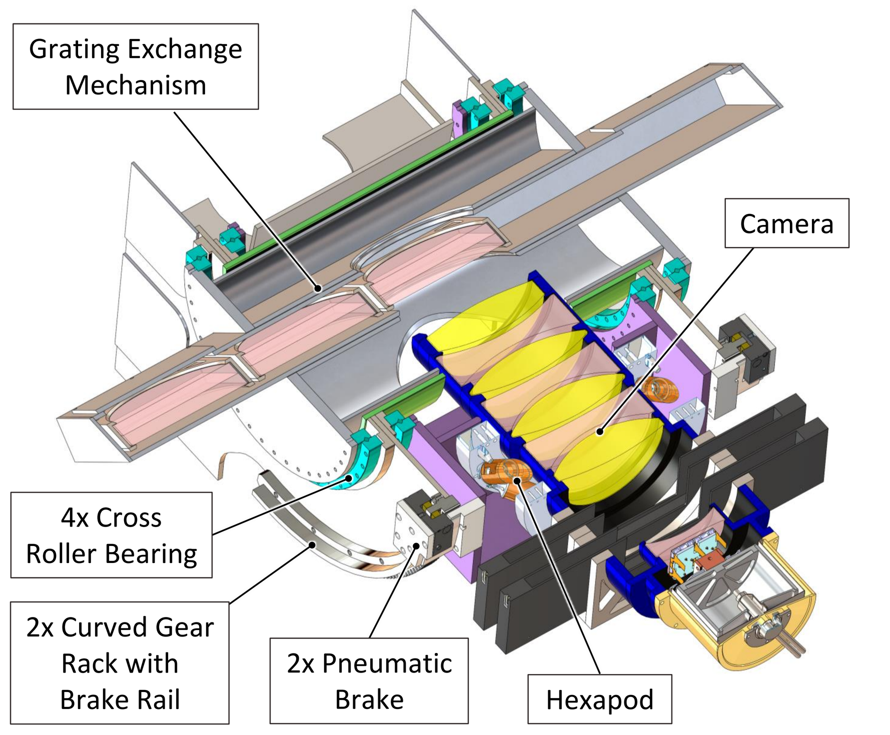
Blue Collimator **Blue Camera**



Red Collimator **Red Camera**

This module contains systems to independently articulate & hold the cameras and gratings at various angles to accommodate multiple grating resolutions. In low resolution mode (R~1000) and high resolution mode (R~6000) the collimator-camera angle must be ~18.2° and ~88.9°, respectively. The grating-collimator angles will be half of the collimator-camera angle. The cameras and grating rotate on large cross roller bearings.

To change the grating, the grating exchange mechanism (GEM) simply translates the gratings until the correct one is in the light path. The GEM can hold up to 3 gratings.



Camera and grating rotation systems

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GMT
HETDEX Hobby-Eberly Telescope Dark Energy Experiment
LSST Large Synoptic Survey Telescope
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