HETDEX

Hobby-Eberly Telescope Dark Energy Experiment

Illuminating the Darkness

VIRUS Spectrograph Assembly and Alignment Procedures

Travis Prochaska[a†], Richard D. Allen[a], Emily Boster[a], D. L. DePoy[a], Benjamin Herbig[a], Gary J. Hill[b], Hanshin Lee[b], Jennifer L. Marshall[a], Emily C. Martin[a], William Meador[a], Jean-Philippe Rheault[a], Sarah E. Tuttle[b], Brian L. Vattiat[b]

[a]Department of Physics & Astronomy, Texas A&M University, 4242 TAMU, College Station, TX 77843-4242;
[b]McDonald Observatory, University of Texas at Austin, 1 University Station, C1402, Austin, TX, USA 78712-0259
[†]E-mail: tprochaska@physics.tamu.edu

Abstract

We describe the mechanical assembly and optical alignment process used to construct the Visual Integral-Field Replicable Unit Spectrograph (VIRUS) instrument. VIRUS is a set of 150+ optical spectrographs designed to support observations for the Hobby-Eberly Telescope Dark Energy Experiment (HETDEX). To meet the accuracy, interchangeability, time and cost constraints, a production line will be set up to construct and test modular subassemblies in parallel. To facilitate the VIRUS production, fixtures and adjustment apparatuses have been designed to aid in assembly and alignment. This poster describes the details and operations of the camera mirror, collimator mirror and grating adjustment apparatuses used to in the VIRUS spectrographs.

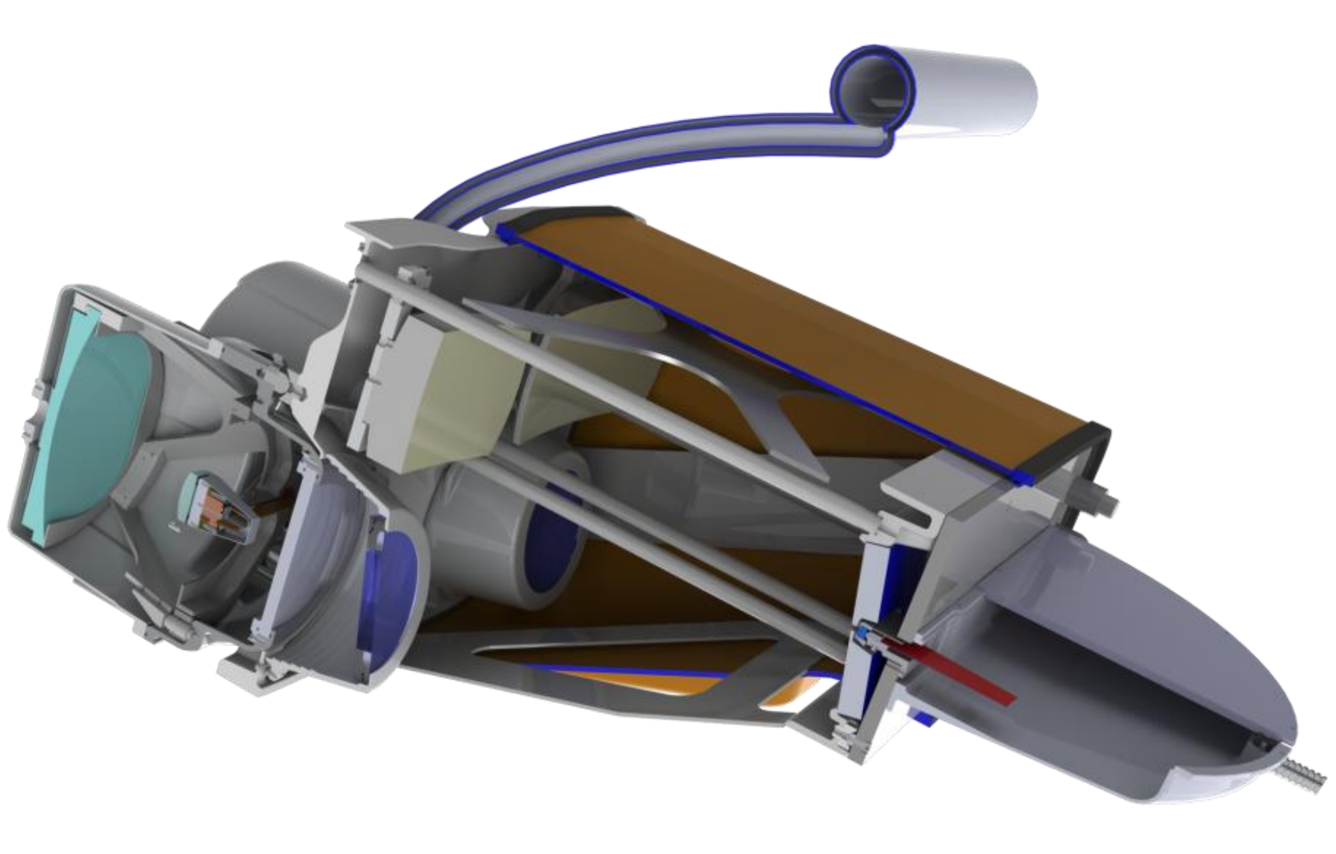
Introduction

Visual Integral-Field Replicable Unit Spectrograph (VIRUS) is an instrument that will support observations for the Hobby-Eberly Telescope Dark Energy Experiment (HETDEX) Project. HETDEX will use VIRUS with the upgraded Hobby-Eberly telescope (HET) to probe for Dark Energy at high redshifts. VIRUS is comprised of 150 to 192 optical spectrographs, for which Texas A&M University is responsible for much of the manufacturing, assembly, and testing.

This poster describes conceptual and prototyped designs of the alignment fixtures and adjustment apparatuses that will be used to accurately and precisely align the optics in the VIRUS instrument. The alignment fixtures and apparatuses are necessary to allow the 150+ unit spectrographs to be assembled in a timely fashion and in such a way as to maximize the throughput of the instrument and therefore produce the most science possible.

Instrument Overview

The VIRUS instrument consists of between 150 and 192 simple fiber-fed optical spectrographs. The unit spectrographs are assembled in pairs, and consist of a simple Schmidt spectrograph (referred to as the "collimator") with an on-axis Schmidt vacuum camera. A volume phase holographic (VPH) grating provides a wavelength range of 350-550 nm. The detailed optical and mechanical designs of the instrument are described in more detail in other papers. The VIRUS unit spectrographs will be mounted on the sides of the telescope structure; each spectrograph is fiber-fed from the focal plane of the HET. The following figure shows a rendering of a pair of VIRUS unit spectrographs.



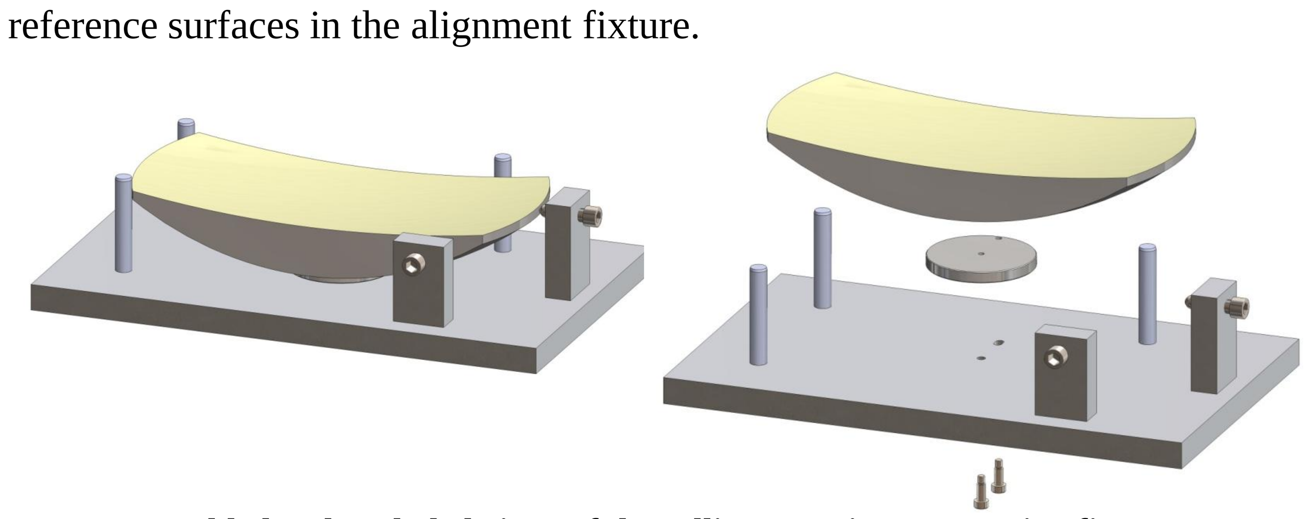
Section-view drawing of a pair of VIRUS spectrographs

Optical Fixtures

The assembly process of the VIRUS unit spectrographs requires a precise alignment of most mechanical and optical components. This will be accomplished by mounting each optical component in its subassembly before incorporating it into the instrument. The main fixtures under development at Texas A&M University accurately align optical components in their assemblies and are used on the collimator mirror and fold flat mirror.

Collimator Mirror Mounting Fixture

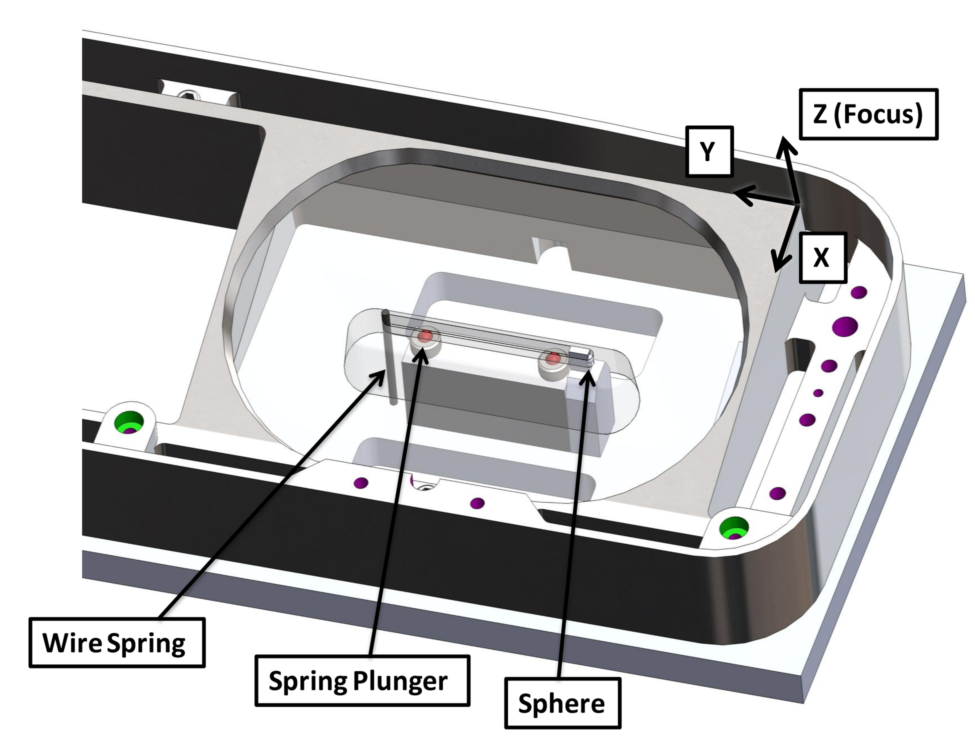
The collimator mirror will be glued to an invar puck, which will allow it to be mechanically fastened to an aluminum mounting plate. The collimator mirror must be attached to the puck to within 0.5 mm concentricity and $\pm 0.1^{\circ}$ rotation. The cylindrical and flat surfaces of the mirror will be used as the reference surfaces in the alignment fixture.



Assembled and exploded views of the collimator mirror mounting fixture

Fold Flat Mirror Mounting Fixture

The fold flat mirror will be glued into the head plate, which will define its tip, tilt and focus. To ensure light from the fiber bundle is not obscured by the slit's edge and the fiber head does not hit the mirror, the mirror must be glued into its head plate so that the ends of the slots do not deviate more than 0.500 mm from its nominal position. To satisfy this requirement, a fixture will position the fold flat mirrors' slots relative to three vee blocks on the head plate.



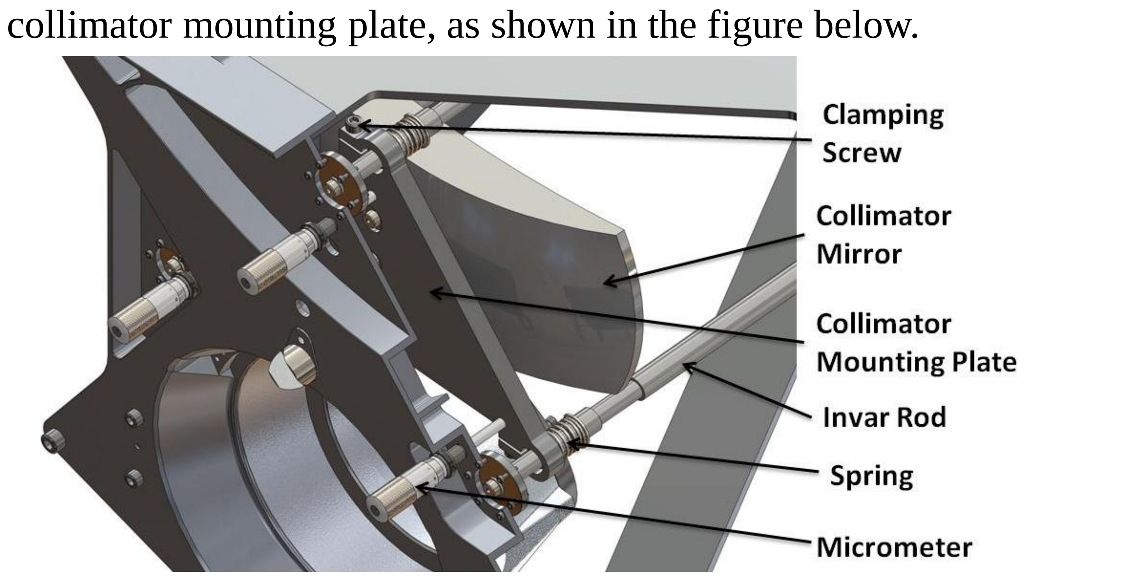
Rendering of the fold flat alignment fixture

Optical Adjustments

Several optics in the VIRUS spectrograph are designed to be adjusted after they are mounted in their assemblies. This allows the spectrograph to achieve a much greater alignment than would be possible with only fixed mechanical positioning. The optics that can be adjusted are the collimator mirror, the camera mirror, and the grating.

Collimator Mirror Adjustment

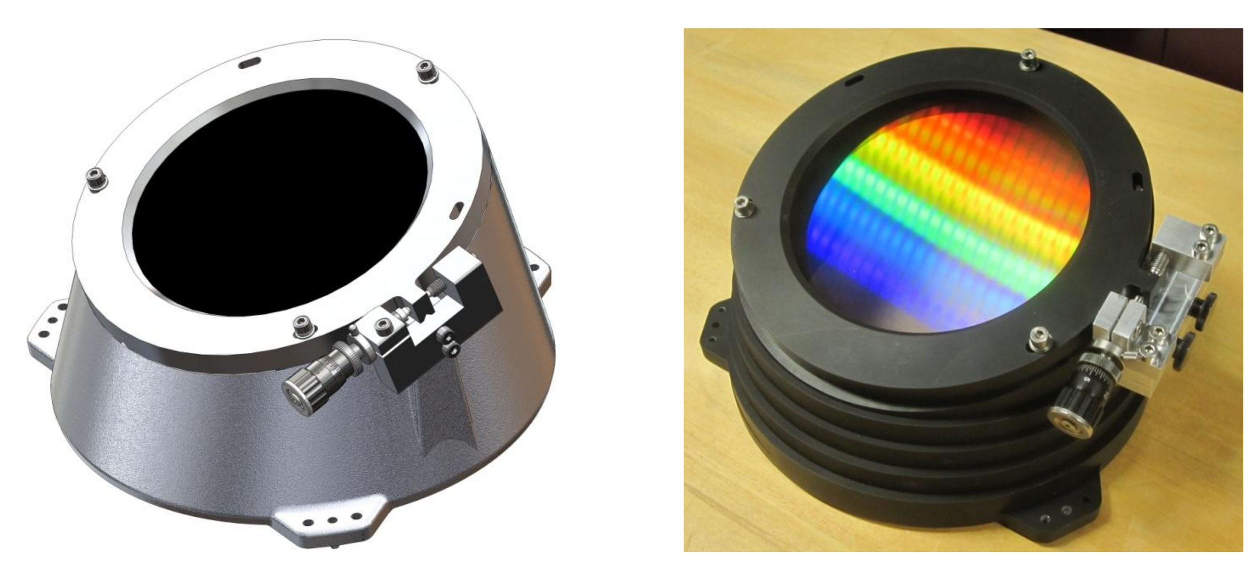
After the collimator mirror has been installed into the collimator assembly, its tip, tilt and focus need to be adjusted until it is aligned to a fiducial camera. To adjust these degrees of freedom, a three point adjustment system will be used on the collimator mounting plate, as shown in the figure below.



Section view of the collimator adjustment system

Grating Adjustment

It is necessary for the clocking of the grating substrate to be aligned and locked within 0.1° of the CCD's center plane. To adjust the grating, it will be glued to a cell, which can rotate on a housing unit. Two pins fixed to the housing unit will slide in arced slots in the grating cell, causing the cell to follow a circular path. To control the rotation of the grating, a micrometer and spring plunger assembly is temporarily fastened to the grating housing which pushes and pulls on the cell's tab to force it to rotate.

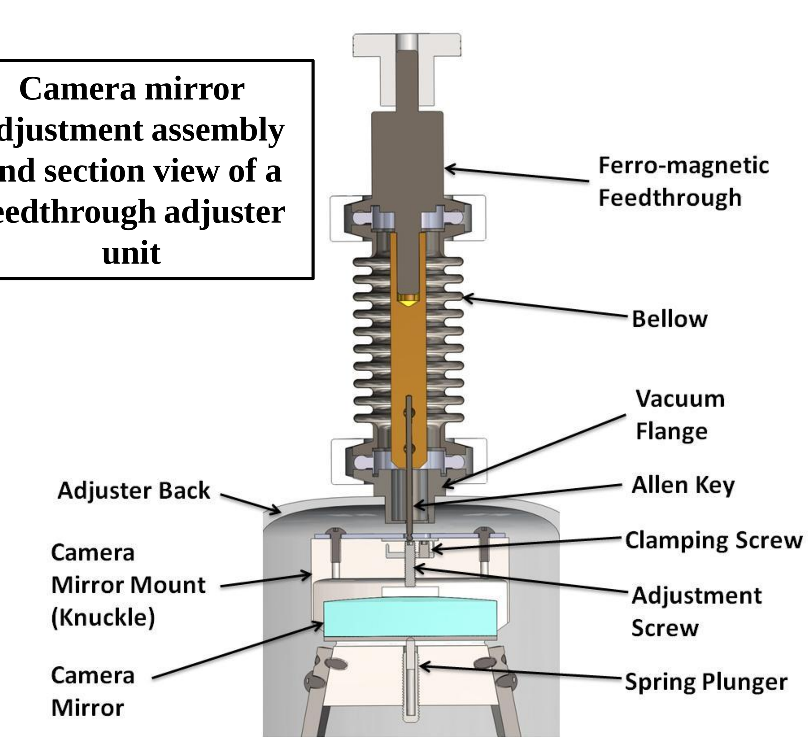


Rendering and prototype of the adjustable grating system

Camera Mirror Adjustment

There is a need to adjust the camera mirror's tip, tilt, and focus to bring it into alignment with a fiducial collimator while the camera is under vacuum and the detector is cooled. To adjust these dimensions, a three point adjustment system is used. To do the adjustments under vacuum, a camera cover was modified to add 6 vacuum ports. With the vacuum ports, ferro-magnetic feedthroughs can be attached and turn the adjustment screws via allen keys, as shown in the 2nd figure below.

Camera mirror adjustment assembly and section view of a feedthrough adjuster unit



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VENDORS