EXPRES NEWS

Count-down to commissioning...

Building EXPRES

EXPRES is the EXtreme PREcision Spectrograph. Designed and built at Yale, this instrument will be the first spectrograph with the precision to detect analogs of our Earth around nearby stars. The Discovery Channel Telescope (DCT) near Flagstaff, Arizona is the perfect telescope for collecting the photons that EXPRES will use for exoplanet detection.

Vacuum chamber

The vacuum chamber was fabricated by Dynavac and trucked from Massachusetts to the DCT in May 2017. The chamber was pumped down and the pressure and temperature are monitored from a web-based GUI. The vacuum is holding beautifully!

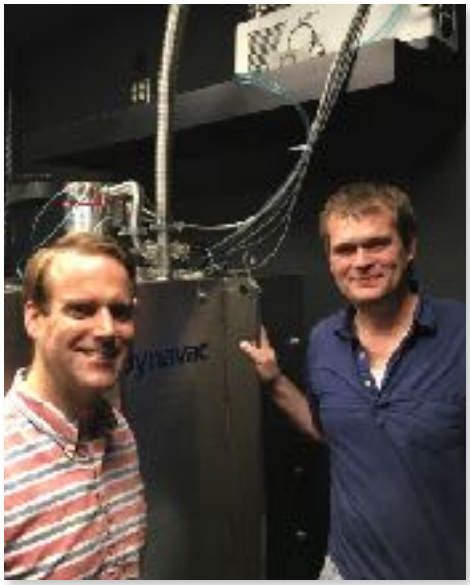
Front end module

The front end module (FEM) is mounted to the instrument cube behind the primary mirror. It includes a fast tip/tilt mirror that runs at 100 Hz to keep the image of the star fixed on the fiber; the atmospheric dispersion compensator; the fiber mirror mount; and the guiding and acuisition camera.

While the spectrograph is being completed in the Yale Exoplanet Lab this summer, the first stage of commissioning at the DCT was just completed, with installation of:

- the 3-ton vacuum enclosure (being hoisted by DCT engineers, Frank and Ben in the picture above)
- the front end module
- critical software: the GUI interface for controlling EXPRES and communicating with the telescope control system.

The DCT telescope pointing exceeded expectations. Thanks to the extraordinary support from the DCT team and the excellent planning by the Yale instrument team, a star was acquired and commisioning tests began 30 minutes after going on-sky. Once the pointing offsets were determined for the guiding and acquisition system, new targets always fell within a 10" radius of the fiber. Yale system engineer, Dave Sawyer, said this was the smoothest commissioning that he has seen in his 25 year career.



What makes EXPRES unique?

The extreme environmental stability is a new standard for all precision radial velocity spectrographs. However, EXPRES is truly unique in ways that will improve the fidelity of the data:

- Spectral resolution: 150,000 - important for disentangling velocities from the surface of the star and orbital velocities.
- the 4.3-m Discovery Channel Telescope with flexible scheduling.
- Unique extended fiber system for 2-d flat-fielding and a 25-LED flat-fielding lamp with voltages tuned to an inverse spectral response of the instrument.
- Interferometric measurement of the CCD pixel positions coupled with a laser frequency comb will provide wavelength calibration that is accurate to ~1 cm/s.
- Chromatic sampling for the exposure meter for precise barycentric corrections.

What is left to do?

The high-resolution CCD has been put into a dewar and and first images reveal a flawless 9-micron pixel 10k x 10k device. In late June, the CCD will be taken to Mike Shao's lab at the Jet Propulsion Laboratories where the pixel positions will be measured with a single mode fiber interferometer, enabling a wavelength calibration precision for EXPRES of about 1 cm/s with our Menlo System laser frequency comb.

The optical fibers will be shipped to the DCT and installed in the cable wrap in August or September.

The invar spectrograph bench and optics are now in the lab at Yale and the team is beginning assembly and alignment. Once the spectrograph is assembled, the exposure meter and the optical fibers will be integrated. We will obtain calibration and solar spectra in the lab in August and then pack up EXPRES and drive it to the DCT in October to complete commissioning in November and begin our search for 100 Earths.

Software pipelines for data reduction, wavelength calibration and Doppler analysis are being developed and tested now. EXPRES users will receive wavelength calibrated spectra and velocities.

One of the most important areas of research is development of new statistical techniques for disentangling velocities that arise on the surface of stars from orbital velocities. The high fidelity data from EXPRES are critical to the results that are beginning to emerge from this new work.