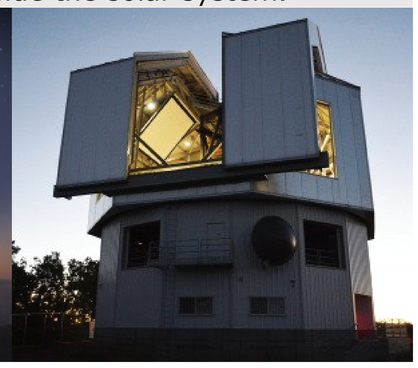
EXPRES - the *EX*treme *PRE*cision *S*pectrograph

C.A. Jurgenson, D.A. Fischer, M.J. Giguere, T.M. McCracken, D.G. Sawyer, & A.E. Szymkowiak

The 100 Earths Project

The design and construction of EXPRES is an NSF-funded MRI Development award. The primary purpose will be to serve as the work-horse instrument for the 100 Earths Project. This project will search for planets that are similar in mass to our world and that orbit their host stars at a distance where liquid water might flow in rivers and oceans. The NASA Kepler mission has been searching stars that are several hundred light years away and has demonstrated that Earth-sized planets are common. Armed with this important statistical information, we will take a census of the nearest neighboring stars to find terrestrial worlds. These planets will be the targets of intense searches for life outside the solar system.



Lowell Observatory - DCT

Yale University has entered into an agreement with Lowell Observatory to use the newly commissioned 4.3 meter Discovery Channel Telescope (DCT) for the 100 Earths Project. EXPRES will have near-nightly observational cadence of target stars. The DCT is located forty miles southeast of Flagstaff, AZ. Built in the Coconino National Forest near Happy Jack, it sits at an elevation of 2360 meters. The spectrograph will be housed in a environmentally stabilized room, and its front-end fiber feed permanently mounted on one of the instrument cube ports.

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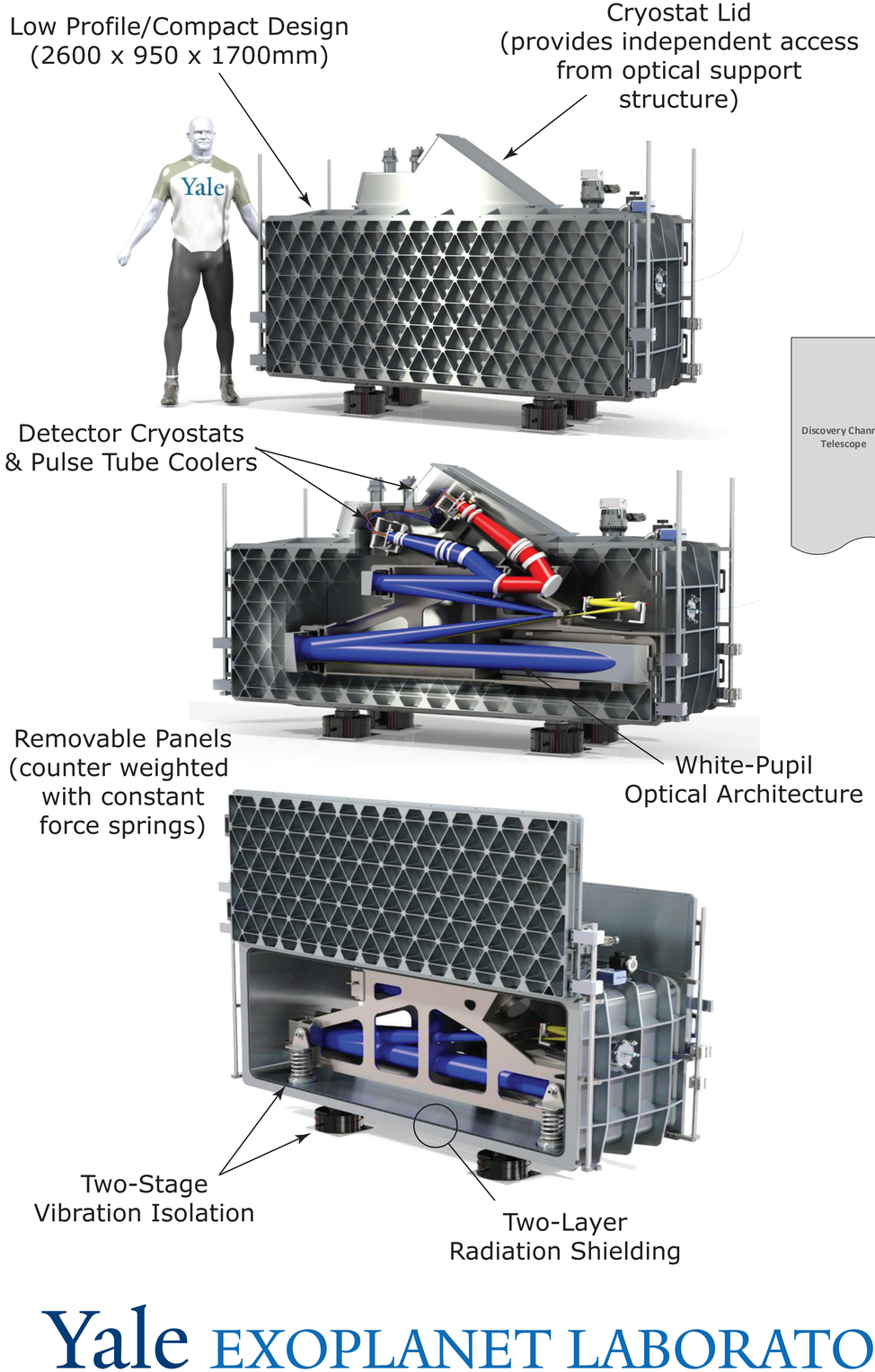
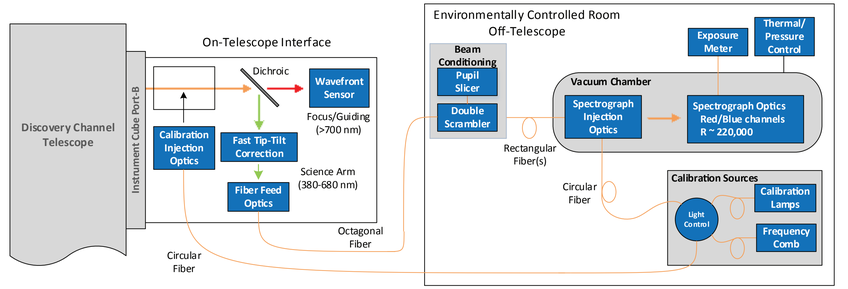


Design Specifications

Parameter	Requirement
Instrumental RV Precision	10 cm/s
Wavelengths	Blue Arm: 380 - 450 nm Red Arm: 450 - 680 nm
Spectral Coverage	Full
Resolving Power	220,000
Aperture On-Sky	0.9 arcseconds
Number of Slices	3
Spectral Format	72 orders/3 spectra per order
Spectral Sampling	4 pixels



Instrument Architecture

A schematic of the EXPRES instrument package is presented above, and consists of four subsystems:

1) The telescope interface can inject light from calibration sources, it will do fast tip-tilt correction on the science fiber, wavefront sensing for focus control at a bandpass separate from the science band.

2) The beam conditioning optics interface the near and far-field fibers of a double-scrambler, as well as pupil slicing to reach a resolution of 220,000.

3) The spectrograph (white-pupil architecture), vacuum chamber, injection optics, exposure meter, and thermal and pressure control.

4) The calibration system will consist of a lab developed broadband source for flat-fielding, a laser frequency comb, and Th-Ar emission line source. It can inject light either directly into the spectrograph, or out at the telescope instrument cube into the science fiber.

Yale EXOPLANET LABORATORY