First light for NEID

Jason T. Wright (Penn State University) on behalf of the NEID instrument team
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NEID will be 3x more precise than the previous generation of Doppler spectrographs

- Higher precision means lower-mass (and more Earth-like) planets
- Previous state-of-the-art was 1 m/s precision
- NEID is designed to have instrumental stability 3x better than this
- This is less than 1/1000 of a pixel!
- Only 15 silicon atoms!
The National Research Council decadal survey of astronomy & astrophysics recommended that:

“NASA and NSF should support an aggressive program of ground-based high-precision radial velocity surveys of nearby stars in order to validate and characterize exoplanet candidates.”
This workshop will be devoted to a thorough presentation of the precision radial velocity instrumentation, capabilities and a future potential of the radial velocity technique, and characterizing exoplanets. Emphasis will be placed on discussion in instrumentation, calibration techniques, and how to further improve the precision of radial velocity measurements at visible and near-infrared wavelengths.

Recommendations for NASA/NSF Investment in Precise Radial Velocity Hardware and Facilities

William Cochran, Dawn Gelino, Sara Heap, John Johnson, David Latham
On behalf of the Precision Radial Velocity Community
1. Initiate an open, competitive program to develop advanced precise radial velocity (PRV) spectrographs for existing U.S.-affiliated observatories both in the optical to achieve the 10 cm/s goal set by the Decadal report, and in the near-infrared to provide initial PRV capabilities of 1-10 m/s¹;

2. Augment the existing program of PRV observations of Kepler candidates by obtaining observing time at existing facilities having the requisite instrumentation;

3. Support upgrades of existing spectrographs and the building of new PRV spectrographs (~1 m/s) on NASA-, NSF-, or privately-funded telescopes. These instruments would provide the cadence, precision, and wide sky coverage needed for surveys to find rocky planets orbiting nearby stars. Some of these upgrades or new instruments using existing technology could proceed on a rapid enough timescale to be valuable for Kepler follow-up;

4. Accelerate the development of PRV spectrographs by explicitly encouraging instrumentation subteams to take fellowship initiatives.
NN-EXPLORE asks for proposals for the Extreme Precision Doppler Spectrograph to be installed at the WIYN 3.5 m telescope and available to the US and world community.

The team led by Penn State wins the competition with NEID, which will be temperature stabilized to 1/1000 of a degree.

NEID will have unprecedented instrumental stability enabling the most precise radial velocity measurements ever.
pronunciation: knew-id (like ‘fluid’)

definition: `to see’ in the language of the Tohono O’odham

Kitt Peak National Observatory in southern Arizona sits on Iolkam Du’ag, within the Tohono O’odham Nation
October 2019
“First light” is a key milestone in an instrument’s development

• It represents the first useful data taken by a telescope or instrument

• We chose to observe 51 Pegasi, the first Sun-like star found to have a clear exoplanetary signal, in honor of last year’s Nobel Prize in physics

• This is the first stellar spectrum from NEID that will be archived for posterity
The NN-EXPLORE partnership enables powerful new science

- NASA is purchasing time on the WIYN 3.5m at Kitt Peak National Observatory to be used under the NSF’s Open Skies policy
- Anyone worldwide can propose to use NEID
NEID First Light: 51 Pegasi

NEID Order Trace

Calibration
51 Peg

Graphic available at nationalastro.org
NEID will begin producing science this year

- We are working very hard to get the instrument stable and producing precise radial velocities
- When we are meeting our strict operational requirements to meet on guiding, focus, and corrections provided by the port, we will undergo a review by NASA to determine that the “mission” is ready
- Until then science will happen on a “shared risk” basis, at limited precision and efficiency

Calibration image from the telescope.
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