A Global Network for Planet Detection and Asteroseismology Study using Extremely high Precision Extrasolar Planet Tracker Instruments

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Global Extremely High Precision Exoplanet Tracker Network



Offer continuous high precision radial velocity measurements for V<8 FGK stars with 0.5-1 m/s Doppler precision in 30 min
Follow up planet candidates from SDSS-III MARVELS planet survey
Compact and low cost design (~\$750K per instrument including hardware and labor)

Global Extremely High Precision Exoplanet Tracker Network



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High Precision RV Mode



A combination of a fixed-delay interferometer with a high throughput cross-dispersed echelle spectrograph with R=18,000
A simultaneous wavelength coverage of 0.39-0.70 μm
0.5-1 m/s in 30 min for V< 8 solar type stars with 2 m telescopes

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Photon limited RV precision in 30 min exposures with EXPERT

Magnitude	RV precision
V=6	0.4 m/s
V=7	0.6 m/s
V=8	1.0 m/s



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Detection of Earth-like short period planets with 1 m/s Doppler precision



•2 Earth mass planet, 2.2 day period around a solar type star, K= 1m/s
•σ= 1m/s, 60 measurements, clear detection with 0.1% FAP
•Need good orbital phase coverage to eliminate other noises

Opt-mechanical layout of EXPERT



The thermal enclosure dimension: 69" x 45" x 39.9".
Temperature and pressure controlled

EXPERT hardware setup at Kitt Peak 2.1m in Sept. 2009

EXPERT inside a 2.1m Coude room



EXPERT control chassis



EXPERT inside a Thermally Controlled Chamber at Kitt Peak in Sept. 2009



Solar Spectra on the Detector with EXPERT



Early RV measurement results with EXPERT

Observations with Iodine absorption



solar: 10 orders combined Photon Limit : 1,17669 m/e Photon error =1.2m/s with 12 orders combined

5.50914×10⁴ 5.50916×10⁴ 5.50916×10⁴ 5.50920×10⁴ 5.50922×10⁴ 5.50924×10⁶ 5.50925×10⁶ Julian Date - 2400000

Observations with 51 Peg



Observations with sky

Cross-dispersed echelle spectra of NSV 860 (K2 EB, V=8.7) in Jan. 10

Order 52, 0.39 μm →

R=27,000

Order 20, 1.0 μm

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Order 52, 0.39 μm –

R=27,000

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RV Drifts vs. Pressure and Temperature variation with EXPERT in Oct. 2009



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RV Drifts vs. Pressure and Temperature variation with EXPERT in Oct. 2009



•Need to control pressure and temperature to reach higher RV stability

EXPERT Instrument Temperature Monitoring in Dec. 2009



•Instrument temperature varies within 10 mK over 5 days











LiJET hardware setup at the UF lab in Jan. 2010

LiJET setup in the UF lab



LiJET Instrument Temperature Monitoring in Mar. 2010



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LiJET Instrument Temperature Monitoring in Mar. 2010



Science operation
Science operation with EXPERT at Kitt Peak in April 2010
Science operation with LiJET at Lijiang, China in September 2010
Complete the Spanish Exoplanet Tracker (SET) in early 2011 pending on remaining fund raising and telescope negotiation

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Primary science targets
•V<8 FGK main sequence stars with slow rotation and low activities for super Earth mass planet detection and characterization
•Followup of MARVELS planet and brown dwarf candidates to confirm and characterize new giant planets and find additional planet companions
•A few very bright solar type stars (V<5) for asteroseismology study

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Future plan

•Looking for more partners to complete 6 network instrument development and implementation

•Raising federal, state and private funds for operating the network

•Combining with up-coming space transit missions for bright stars to detect and characterize habitable rocky planets

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Follow up MARVELS planet candidates

MARVELS planet candidate I

MARVELS planet candidate II



K = 180.43 m/s, P= 10.35 days, V= 9.9, T_{eff} = 4357K Log(g) = 4.7, *Msini* = $2.1M_J$ K = 207.91m/s, P = 25.43days, V = 11.0, T_{eff} = 6106 Log(g) = 4.386, *Msini* = 1.9M_J

EXPERT Network Team Members

Principal investigator: Jian Ge (UF)

UF team members:

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