The PTF Orion Planet-Search: Early Results from the First Data Set

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BACKGROUND

The PTF Orion project is a part of the Palomar Transient Factory (PTF), a survey for astronomical transients being undertaken with a dedicated wide-field (3-CCD) array installed on the Palomar 48" telescope. The Orion project is an experiment that during its first year is focusing on a single pointing in the Orion star-forming region. The project has been assigned 40 consecutive nights per year for three years — the first 40 nights of which are now complete — to perform intensive time-series observations with the aim of detecting close-in Jupiter-sized planets transiting young stars. Little is known about the distribution and frequency of planets around stars that are 1-100 Myr old — the time frame in which the giant planets are expected to form.

Our principal goal is to investigate the frequency of planets around stars at young ages. In addition, the observations will provide a unique data set to study a variety of stellar phenomena, including varying binary systems by testing our formation and evolution models, and characterizing previously unknown young stars in the Orion region.

At this point, light curves from two of the eleven functioning chips have been inspected by eye, and others are scheduled to be presented early in the next light curves.

FIELD CENTRED ON 25 ORI CLUSTER:

- Within Orion 1a region — matches 5-10 Myr disk dissipation age.
- Not overly reddened/attenuated.
- Optimises number sources without overcrowding.
- Maximises fraction of PMS stars.

OBservATIONS

Field Selection

- Field centred on 25 Ori cluster:
  - Within Orion 1a region — matches 5-10 Myr disk dissipation age.
  - Not overly reddened/attenuated.
  - Optimises number sources without overcrowding.
  - Maximises fraction of PMS stars.
  
Data Obtained

- Open: Total no. of exposures taken in R
- Filled: No. of frames unflagged and fully processed.

- E.g. Stab. star, RMS 4.5 mmag
- Clear eclipsing binary
- Scuti? RMS 8 mmag, but still shows clear signal
- Contact binary
- Probable Scuti
  - E.g. known WTTS (K4, Briceño et al. 2007)
  - E.g. interesting light curves
  - Pre-flare
  - Approx. peak Light curve
  - A strong flare
  - Flare ~1% secondary ~4% primary eclipse
  - Small secondary (~blue curve)
  - P = 0.679732d
  - Poss. low-mass binary

- One chip, all unflagged data
- Same, single night

One chip, all unflagged data

The results shown here represent some of the initial findings from differential photometry of the 25 Ori data set from Winter 2009/2010. The detection of the 1% secondary eclipse shown above (equivalent to the eclipse depth of a Jupiter-sized planet orbiting a Solar-like star) demonstrates the precision should be adequate for finding planets.

- ~10,000 sources per chip implies ~100,000 total light curves
- Mag. range ~13.5 to ~R ~20
- Precision ~2% over wide range down to ~R ~14.5
- Current noise floor ~4.5% median level
- ~35 clear variables found by eye on one chip suggests ~300-400 such variables will result from the data.

Next steps:
- Detrending: slow linear systematic trends seen on some chips owing to technical issues with detector.
- Periodogram analysis — find any periodic variables, and begin planet transit search of all light curves.
- Summary

REFERENCES

van Eyken et al. (2010), these proceedings.

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E.g. important article by Robert Smith.