Photometric transit search for planets around cool stars from the Western Italian Alps: the APACHE Project

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on behalf of the APACHE Team

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The new instruments

The scientific platform has been completely renewed

Technical/scientific commissioning phase just ended

Four 40-cm telescopes are already installed and functioning

Telescope: RC Pro 400 LT, f/8.4
CCD: FLI PROLINE 1001E
Mount: 10 MICRON GM 2000 QCI

Pixel scale: 1.5 arcsec/pixel
Field: 26.3’X26.3’
Operational control software: RTS-2

RTS2 is an integrated open source package for observatory control under the Linux operating system.

Developed by Petr Kubanek → http://rts2.org

Its goals is to create a system which, accessing to a customized database, takes images, ensures a good pointing, keeps track of what was done.

RTS2 is designed to:

- run the observatory in a fully autonomous mode
- perform an high level scheduling (e.g. using genetic algorithms)
- store the image meta-data in a database;
- process the images (photometry and astrometry) and store the results in a database.
The input catalogue

~3000 APACHE targets have been selected from Lépine & Gaidos (2011)

They have:

a) at least 45 days in a row of good visibility from our site
b) no very bright stars in the FoV
c) a suitable number of potentially good comparison stars in the FoV

Several catalogues have been cross-checked to get information about the targets:

a) precise determination of spectral class
b) projected rotational velocity $v_{\text{sin}i}$
c) inclusion in high-precision Doppler surveys
d) proximity to other bright objects (to avoid blending)
e) exclusion of spectroscopic binary systems

The number of the Gaia transits for each target has been determined

A final ranking has been determined to define the priority for observations
A good strategy must maximize the number of objects observed and keep constant the detection probability.

To determine this we perform a simulation with the same characteristics of the pilot study.

We iteratively change, for each object, the number of points in a night and the time sampling.

Under these assumptions we calculate the detection probabilities.
Scheduling

One night, one schedule

The schedule contains the list of objects for one telescope and one night

To make the schedule:

- test the presence of already “running” objects
- test the visibility constraints for each target of the input catalogue
  - Moon distance > 40°, Visibility >3 hr with H > 40°
- sort the selected targets taking into account the known physical properties
- fill the final schedule accordingly to the observing strategy (e.g. 3 points each 20 minutes)

We perform a simulation to test the scheduling algorithm over 1 yr of observations (taking into 45 % of photometric nights) with four telescopes.

Results:

227 observed targets

>40% of the targets have a phase coverage > 50% in the period range 0.5-5 days
Data reduction and analysis pipeline

TEEPEE (Transiting ExoplanEts PipELinE)
APACHE: support observations

- We started a spectroscopic survey @ the Asiago Astrophysical Observatory using the Galileo (122cm) and Copernico (182cm) telescopes.
- This is a collaboration with the Dept. of Physics and Astronomy-Univ. of Padova, INAF-OAPd and INAF-OAPA.
- The APACHE stars represent the major component of the target list. Above all we want to:
  - determine their spectral type
  - search for evidence of chromospheric activity.

Active dM3, well classified

Early dK, but it is classified as a dM1
Follow APACHE on the Web

http://apacheproject.altervista.org/

Spectroscopic characterization of the APACHE M dwarfs

Since February 2012 we started a National collaboration aimed at spectroscopically characterizing dozens of M dwarfs which are listed in the APACHE Input Catalog.

Low-resolution spectra are acquired with the Copernico (182 cm) and Galileo (122 cm) telescopes at the Asiago Astrophysical Observatory, and they will be used mostly:

1) to determine an accurate spectral type of the stars;
2) to search for evidence of chromospheric activity.

The red dwarfs photometrically observed by the APACHE team represent a major component of the stars observed at the Asiago Observatory, and...
Thank you!