Tenth anniversary of 51 Peg-b : Status of and prospects for hot Jupiter studies
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PASS prototype observations in 2005

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Abstract. The Permanent All Sky Survey (PASS) will consist of arrays of wide angle CCD cameras, that will permanently survey the entire visible sky from several observing sites. Its major objectives are the detection of *all* giant-planet transits across bright stars and the detection and continuous tracking of any variable or transient phenomena in the full sky. A prototype with one CCD camera has been set up at Teide Observatory, Tenerife, and has been in regular operation since April 2005. Here we given an overview over the ongoing observations and the quality control that has been implemented.

1. Introduction

PASS will consist of several arrays of wide angle CCD cameras, each with short-focal optics (f≈50mm), that would cover completely the entire visible sky at a given observing site. Its major objectives are the detection of *all* giant-planet transits across bright stars and the detection and continuous tracking of any variable or transient phenomena in the full sky. The cameras would be placed on a common fixed mount, which has the advantage of mechanical simplicity and avoids any guiding errors. With images taken at exactly the same sequence of sidereal times every night, stars will move over exactly the same pixels every night, which allows a very precise calibration of pixel, and inter-pixel response functions. The instrument and its objectives are described in more detail in Deeg et al. (2004a).

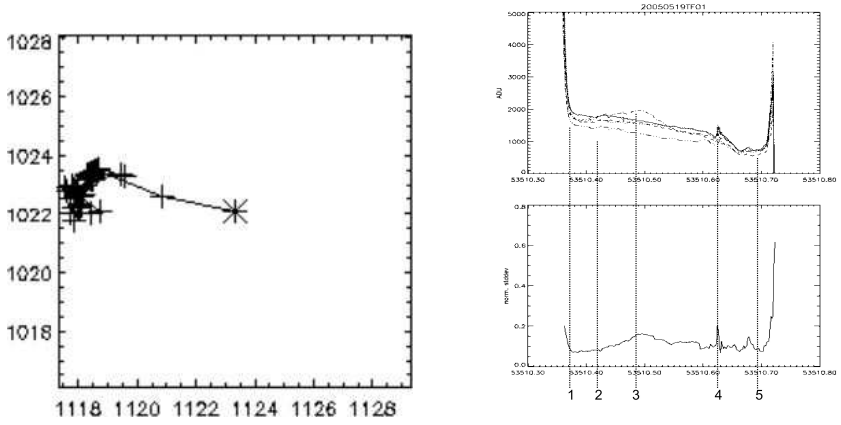

Figure 1.: *Left: Position of a star in pixel coordinates during 61 nights at the same sidereal time. After a settling during the first 2-3 nights, it remains stable with an rms of 0.4 pixels. Right: Sky-brightness in 5 regions of an image during one night (top), and a normalized standard-deviation among them (bottom). The numbers indicate: 1: initial twilight, 2: photometric conditions with moon, 3: a reflex from the moon, 4: an individual cloud, and 5: dark sky after moon-set.*

2. PASS prototype observations and quality control

A prototype of the PASS instrument has been mounted at Teide Observatory, Tenerife, with the aim to: show that the required photometric precision can be achieved; acquire real observational data that serve for the development of a data analysis pipeline; and to optimize the instrumental set-up and the observational procedures (Deeg et al. 2004b for more details). The prototype operates with one Apogee 2k x 2k CCD camera and a Nikon f=50mm lens, set to an aperture of f/2.0. The camera is controlled by a script which synchronizes exposures with the sidereal time, and two exposures of 20 seconds are taken every minute. The instrument has been in operation since 2004, but only with the addition of a solid enclosure in March 2005 regular stable observations could be performed. The current pointing towards +29°declination, in effect since June 2005, was chosen to include the transiting system HD209458. Since stars will cross the field of view (30°x 30°) in somewhat over 2 hours, no complete coverage of a transit is achievable yet, but several partial transit events during summer and fall of 2005 are being recorded.

Images taken by the prototype currently undergo the following procedure: adding of astrometric information, archiving, and quality con-

trol. A photometric analysis based on image-subtraction techniques is currently under development in the frame of a PhD thesis project and will be presented elsewhere.

One first concern with the PASS instrument has been pointing stability. The instrument is mounted fixed and stars will move across the field. However, for precise photometry, stars should appear at exactly the same sport every night in images taken at the same sidereal time. While early tests showed large motions, a much improved pointing stability with an rms of 0.4 pixels has been achieved since April 2005 (Fig. 1, left). Remaining residuals may arise from flexions of the mount or optics (possibly from temperature changes), or from errors in the timing (which we are confident to be minor). Nightly observing runs result in approximately 1000 images, requiring 8 Gbyte of storage space. For an efficient data analysis, the rejection of poor data and the classification of useable ones is therefore needed. Evaluation of the individual nights is based on a measurement of the sky brightness in the four image corners and in the center (Fig. 1, right). Based on comparisons with low-resolution movies from nightly data, it has been found that these brightness levels, and the standard deviation among them, provide a reliable indicator of a nights meteorological quality. An automatic quality classification based on such graphs is currently under development.

3. Future development of PASS

The principal goal of the current prototype is the undertaking of a feasibility study. A thorough analysis of these data will show, if modifications to the instrument design or to the observing procedure will be required. A complementary system of two further cameras with more efficient CCD detectors is scheduled to start operation in late 2005 as part of the WASP planet detection project in La Palma. When instrument design, observing routines and data analysis have matured, the adding of further cameras or instrument locations would lead to a start of the Permanent All Sky Survey.

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References

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