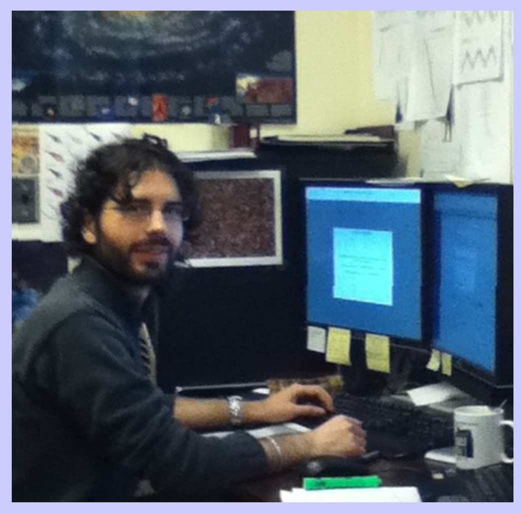
TASTE: The Asiago Search for Transit timing variations of Exoplanets



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A promising method to detect earth-sized exoplanets is the timing analysis of a known transit. This technique allows us to search for variations in the transit duration (TDV) or transit central time (TTV) induced by a second planet or by an exomoon. We recently started a project (TASTE: The Asiago Search for Transit timing variations of Exoplanets) to collect high-precision, short-cadence light curves for a selected sample of know transits with the Asiago 1.82m telescope facilities. The first light curves show that our project can already provide a competitive timing accuracy.

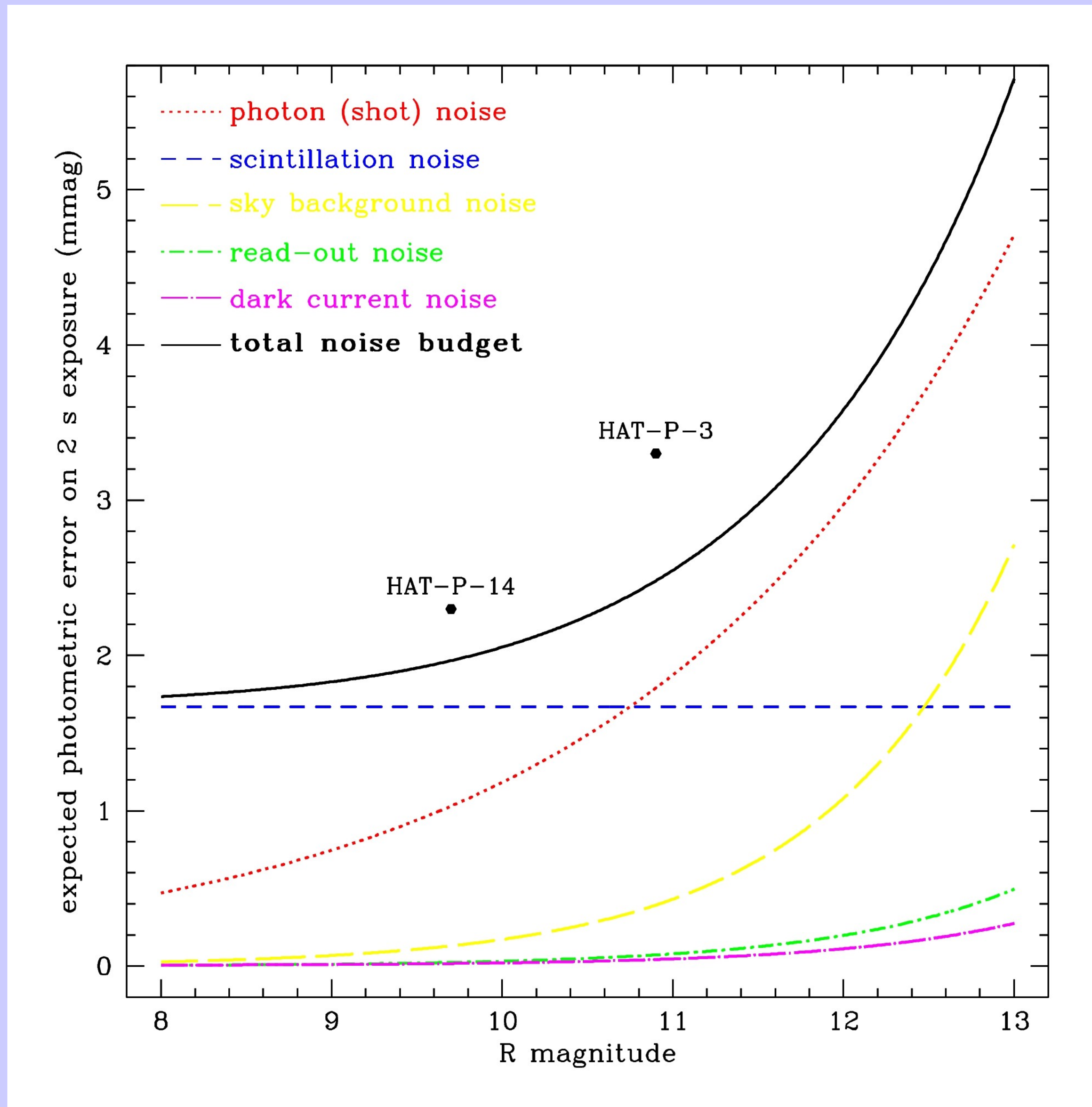
The Asiago 1.82m "Copernico" telescope

Instrumental setup and data reduction

Data reduction is carried out with home-made software tools in order to be able to maximize the photometric information extracted from the data and have full control on the error budget, with particular attention to systematic errors which are known to plague TTV/TDV surveys (Gibson et al. 2009).

Target selection

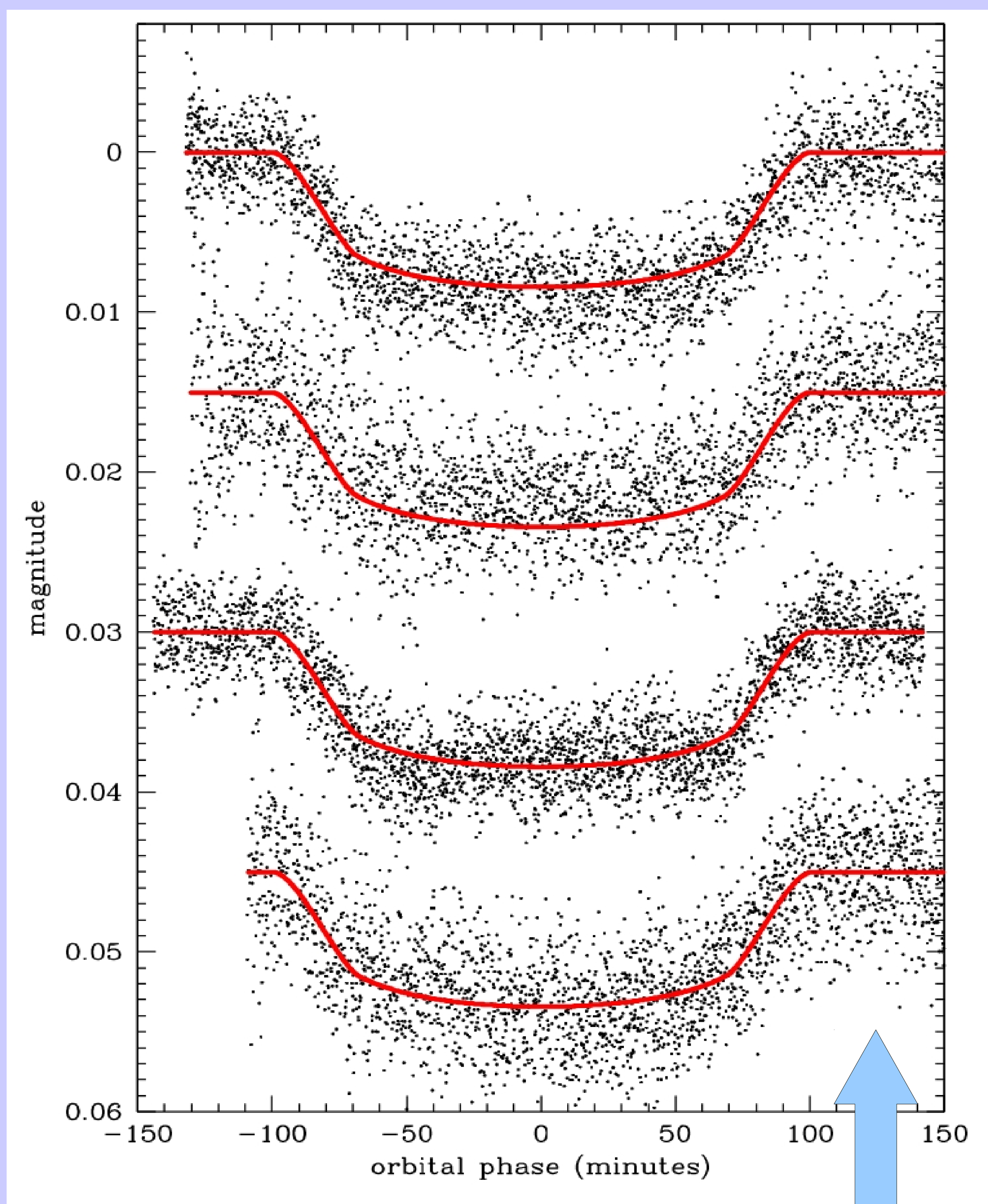
Among the ~100 transits known, we chose to follow systems: 1) whose positions/ periods/durations will allow us to monitor several full transits/yr 2) whose expected TTV/TDV signal for a 1 $M_\oplus$ companion or exomoon is highest, and 3) for which the magnitude and the presence of suitable reference stars within our FOV allow us to achieve a suitable S/N. 12 candidates were selected. On typical observing conditions ($10<R<12$, 2-5 s exposure), our noise budget is dominated by photon noise and scintillation, as shown in Fig. 2.

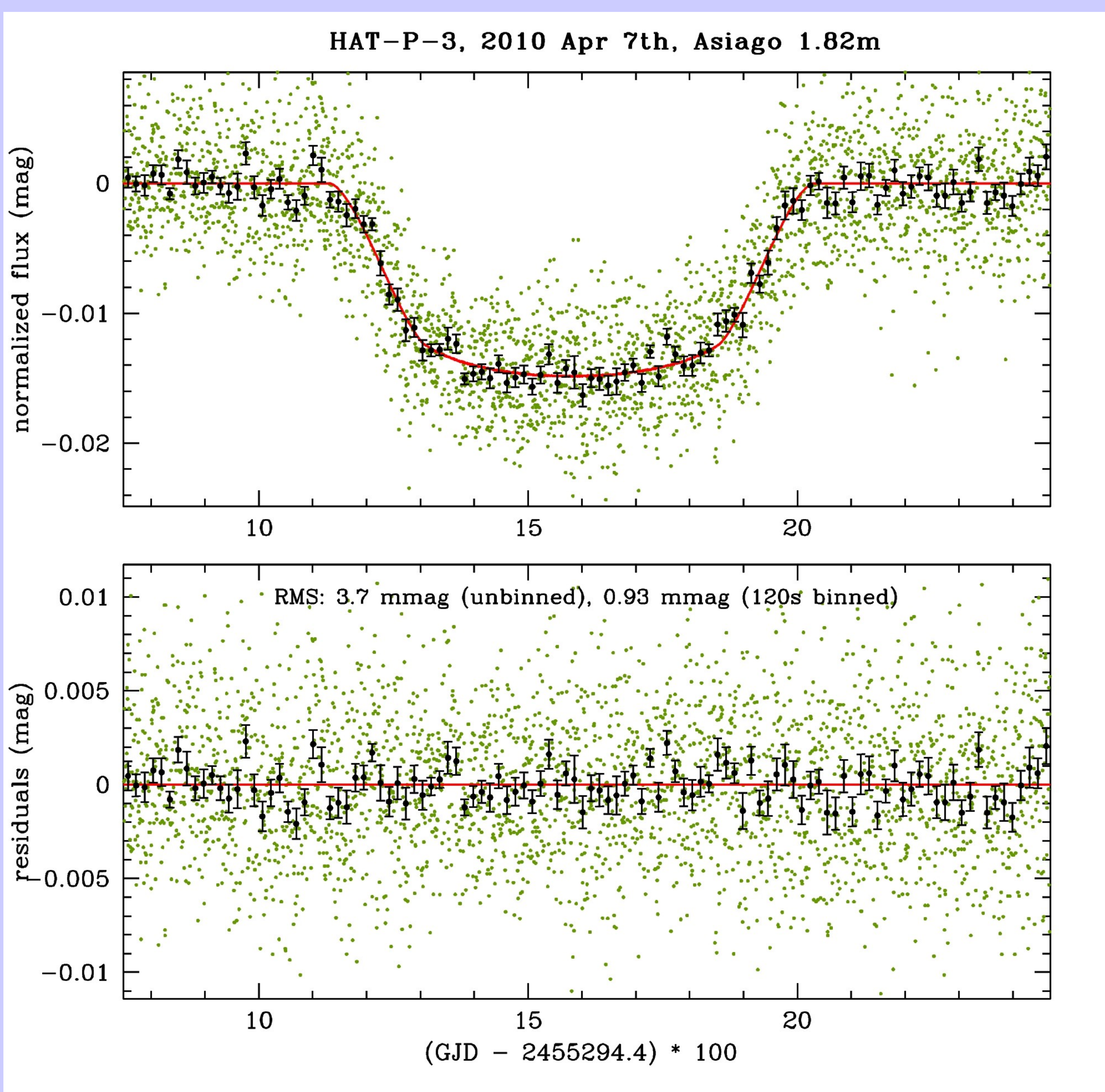


2) Total expected noise budget (black line) for a single 2s frame, in typical conditions. Measured RMS for HAT-P-14 and HAT-P-3 are shown.

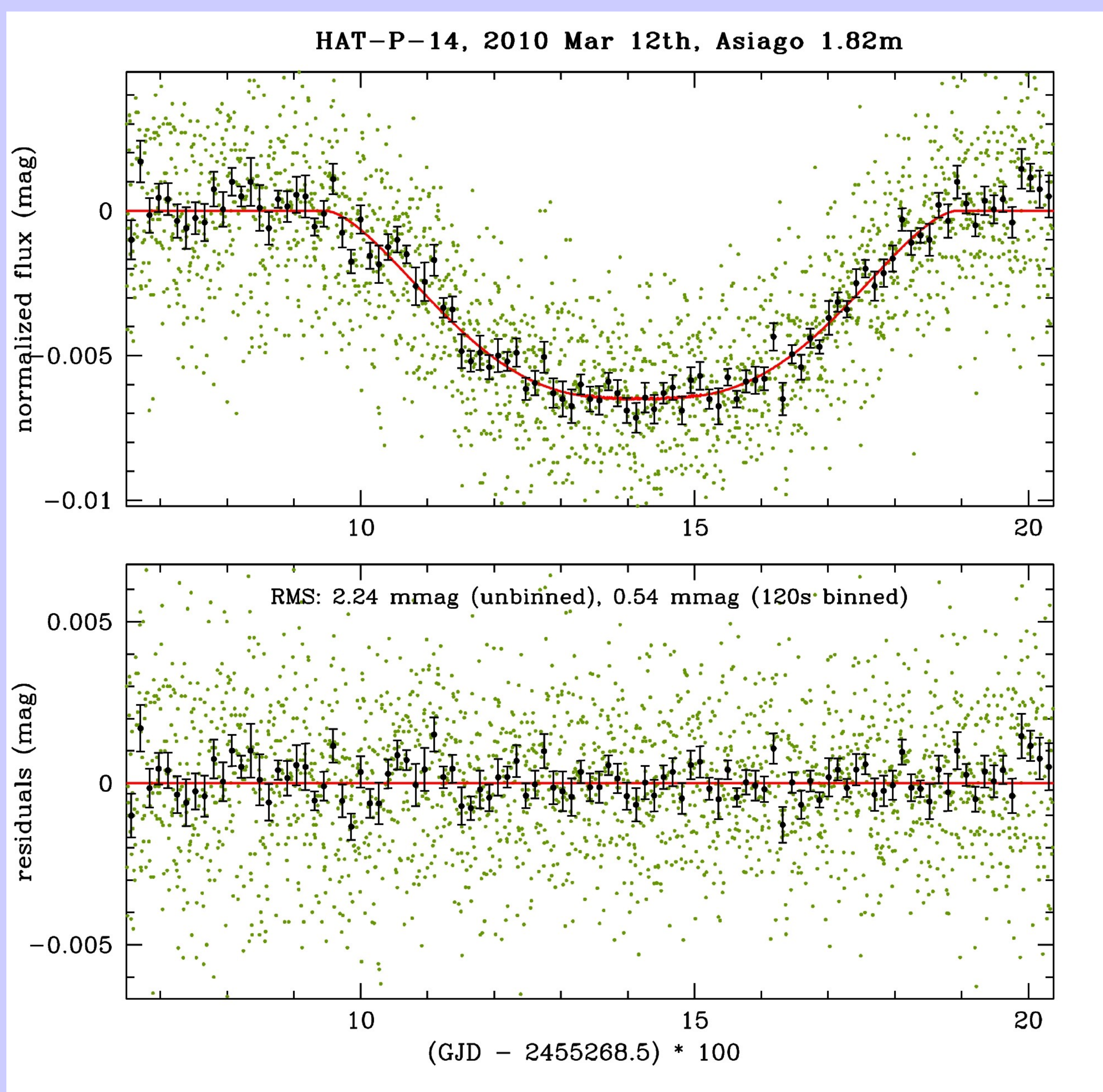
The light curves

Fig. 3&4 show our first published light curves (**Nascimbeni et al. 2011, A&A 527 A85**), collected in the *R* band last 2010 March 12th and April 7th, with a net time sampling of ~5 s. After the fitted model is subtracted, the scatter of the unbinned series (2247 and 2882 points) is 2.2 and 3.7 mmag, respectively. Binned to 120 s, HAT-P-14 shows an RMS of **0.54 mmag**. The achieved timing accuracy is **~25 s** (HAT-P-14) and **~11 s** (HAT-P-3), as estimated by Montecarlo tests (JKTEBOP, Southworth et al. 2005). We are still working to further improve the data acquisition software and observing strategy, and the data reduction pipeline.





4) *Top*: light curve for HAT-P-3b (V~11.9, ΔV~ 0.013 mmag), unbinned (green points) and 120s-binned (black points). *Bottom*: residuals (data - model)



3) *Top*: light curve for HAT-P-14b (V~10, ΔV~0.007 mmag), unbinned (green points) and 120s-binned (black points). *Bottom*: residuals (data – model)

The future

We are going to submit our first TTV study on the most promising target of our sample. The duty-cycle is now increased up to ~80%, and four consecutive transits allowed us to constrain the ephemeris (and the detected TTV signal) with an unprecedented accuracy...

STAY TUNED!