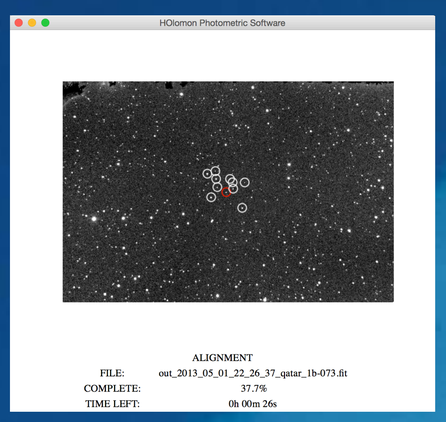
HOPS: the photometric software of the Holomon Astronomical Station

A. Tsiaras[1]; K. Karpouzas[2]; A. Kokori[3,4]; M. Aspridis[2] & J. H. Seiradakis[2]

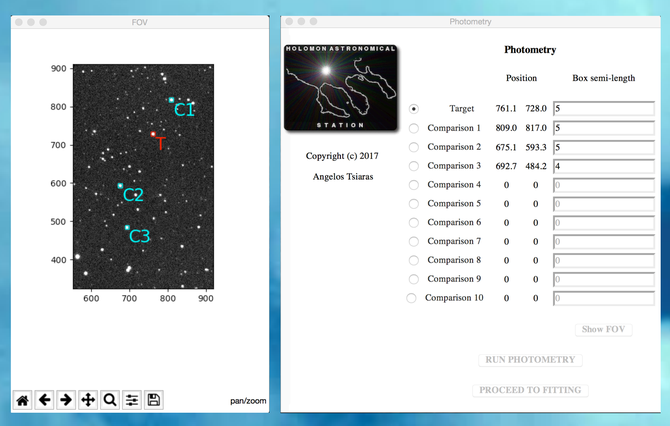
1 Department of Physics & Astronomy, University College London, Gower Street, WC1E6BT London, United Kingdom
2 Department of Physics, Section of Astrophysics, Astronomy and Mechanics, Aristotle University of Thessaloniki, 541 24 Thessaloniki, Greece
3 Faculty of Humanities and Social Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland
4 Blackrock Castle Observatory, Cork Institute of Technology, Castle Rd, Blackrock, T12 YW52 Co. Cork, Ireland

ABSTRACT

We present here a software developed for the analysis of observations from the Holomon Astronomical station. HOPS (HOlomon Photometric Software) is a python-based package which includes a user interface and it is compatible with Linux, OS X and Windows. It is open-source (https://github.com/atsiaras/hops) and it is designed to analyse data from small and medium class telescopes. The basic features included, are: a) reduction, which includes the calculation of master bias/dark/flat frames and the correction of the scientific frames, b) frame selection, which provides interactive graphs for selecting the damaged images, c) alignment, an automatic detection of star patterns in the field of view, despite large shifts or meridian flips, d) photometry, which includes an interactive window for selecting the target and comparison stars and extracts the light-curves using both aperture and PSF photometry, e) transit fitting, which provides the fitting of the transit model on the relative light-curve using mcmc sampling. HOPS makes use of the python package PyLightcurve which is completely developed in Python and provides routines for: a) finding planetary parameters from the open exoplanet catalogue, b) calculating limb darkening coefficients, c) calculating the planetary orbit, d) calculating the transit light-curve model using numerical integration. The PyLightcurve package can be found on github: https://github.com/ucl-exoplanets/pylightcurve.

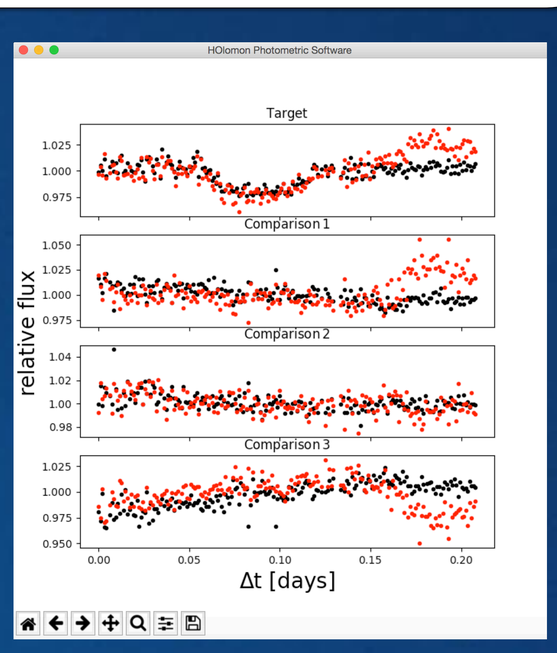


The frames are automatically aligned using a star pattern in polar coordinates. Able to handle large shifts and rotation / meridian flip.

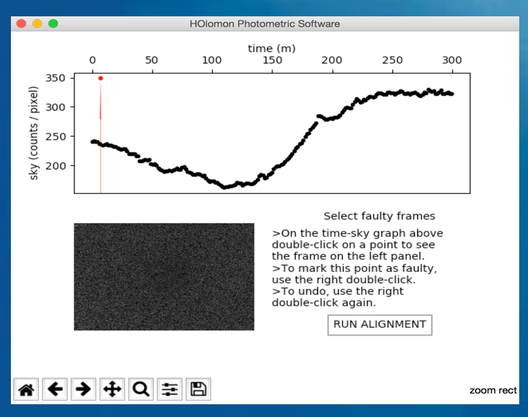


A window showing the field of view allows the user to select the target and the comparison stars and set the size of the extraction apertures.

PHOTOMETRY

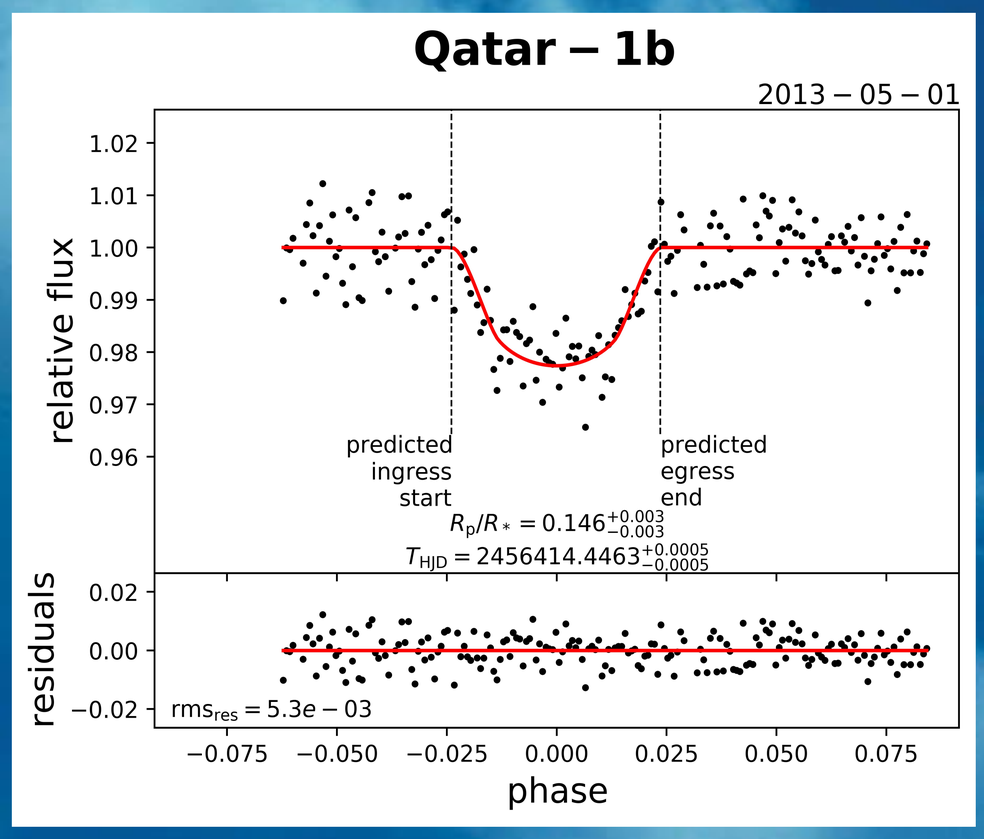


Two light-curves are extracted, one using an aperture and one using 2D ellipsoidal function. This plots helps the user identify and exclude bad comparisons.

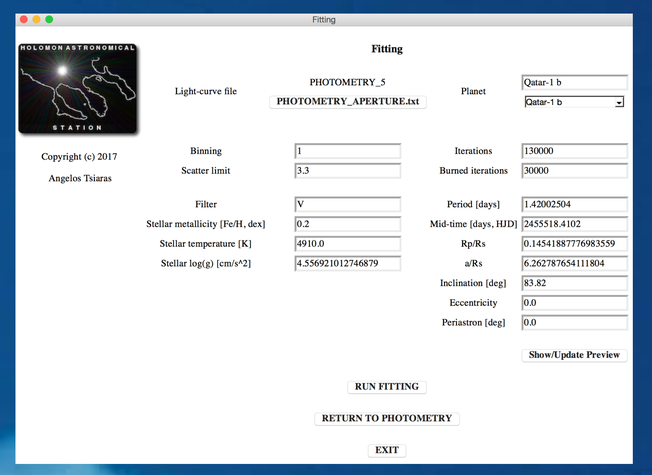


A sky vs. time plot helps the user identify any damaged frames.

BAD FRAMES



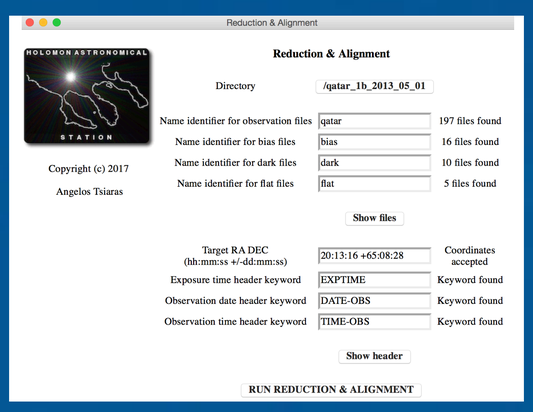
FITTING

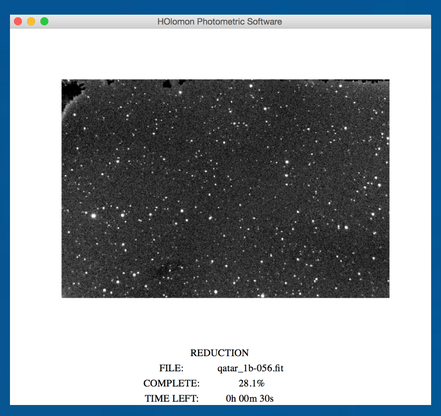


The planet is automatically detected and the parameters are chosen based on the Open Exoplanet Catalogue. However, the user can insert manually different parameters. The 4 limb darkening coefficients are calculated based on the stellar parameters.

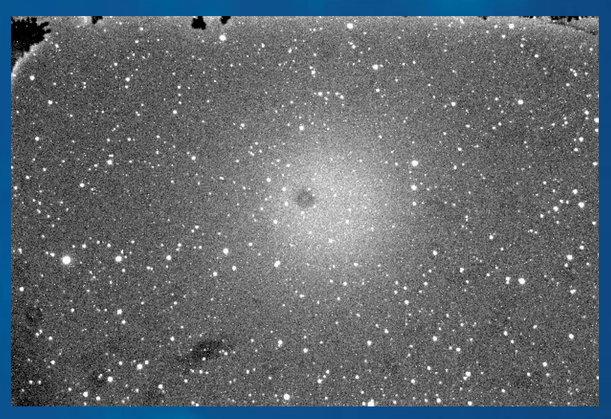
REDUCTION

The user provides a small number of input parameters.





Master bias, dark and flat frames (median) are automatically created and applied to the raw images.



Raw image of the Qatar-1 field obtained from the Holomon Astronomical Station.