NGTS: Next Generation Transit Survey

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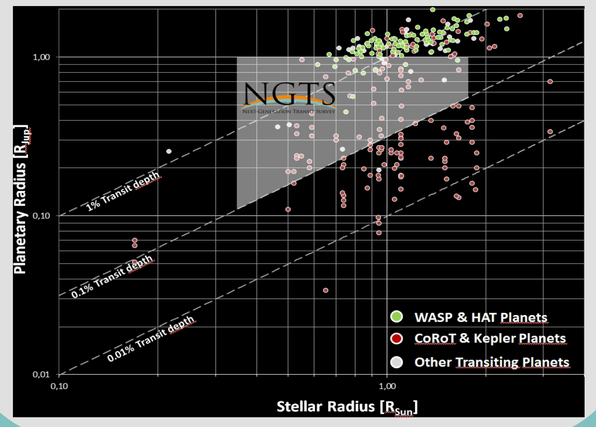
Abstract

NGTS is a new wide-field transiting exoplanet survey aimed at discovering super-Earth and Neptune-sized exoplanets around nearby bright K and M-type stars. NGTS is currently under construction at ESO Paranal. Siting at Paranal allows us to benefit from the excellent observing conditions and follow-up possibilities from the Southern hemisphere.

Motivation

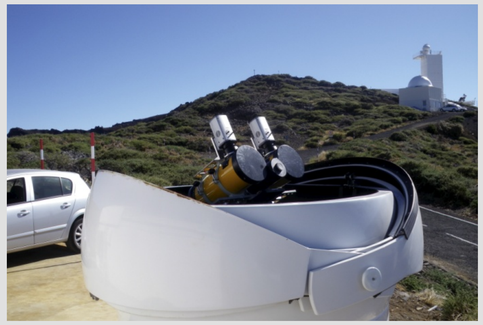
The goal of NGTS is to discover sub-Neptune sized planets around bright (V<13), nearby stars. Such interesting objects are ideal targets for characterisation using existing and future facilities (e.g. VLT, E-ELT & JWST). The aim is to understand atmospheric and bulk compositions of small exoplanets, as well as planetary formation, evolution and migrational processes.

Kepler has shown that many stars host planets the size of Neptune or smaller. However Kelper is limited to a single field. Many bright stars remain to be surveyed and these will yield the most interesting candidates. The plot below shows the proposed parameter space for NGTS. Our goal of discovering sub-Neptune sized exoplanets hinges on our ability to perform mmag photometry.

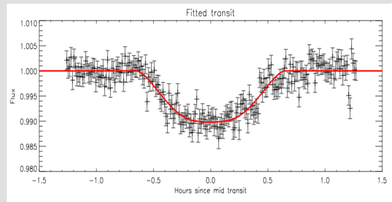


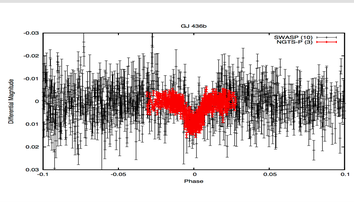
Prototyping

NGTS-P was tested on La Palma in 2009/10 proving the main concepts for the full instrument. NGTS-P showed that we can perform mmag photometry even under sub-optimal conditions (flexure, scattered light etc). The initial prototyping phase identified several key areas which have been addressed for NGTS (e.g. autoguiding, baffling).

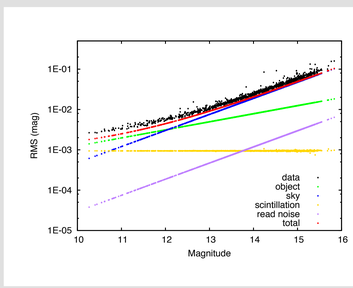


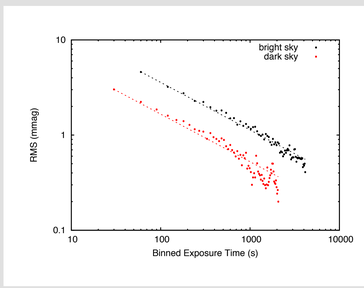
Below (left) is a transit of the hot-Neptune GJ 436b (V=10.7, Depth=1%) observed with NGTS-P. Below (right) is a comparison between SuperWASP (10 transits - black) and NGTS-P (3 transits - red). NGTS-P is clearly superior.





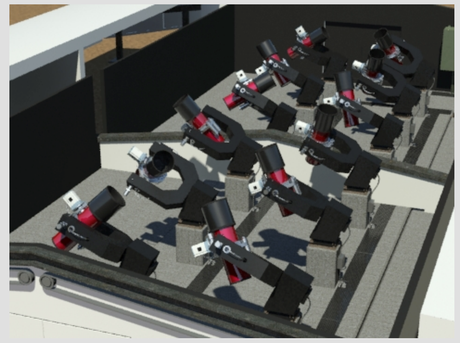
It was shown that the noise performance of the instrument matched well with a theoretical noise model (below left). It was also found that red noise was minimal, allowing for sub-mmag precision on transit timescales (below right).

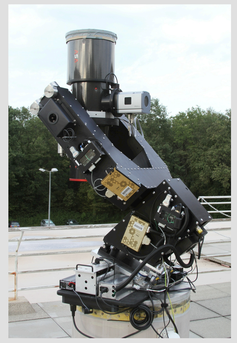


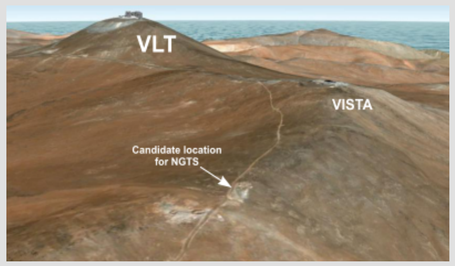


NGTS Facility

NGTS consists of twelve 20cm, f/2.8 Newtonian telescopes, each mounted on its own equatorial fork. Each is equipped with a large format (2k x 2k) red-sensitive CCD camera. Each telescope is autoguided using the high-cadence science images, resulting in unprecedented tracking performance.

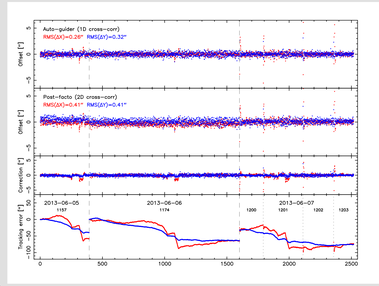


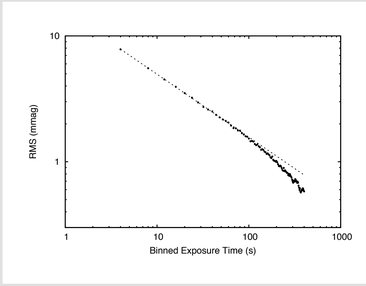




NGTS is currently under construction at ESO Paranal (left). Preliminary tests with the first NGTS telescope (NGTS-1, top right) at the Geneva Observatory, Switzerland, have returned exciting results.

Photometric performance (below right) is essentially free from red noise and tracking stability using DONUTS (McCormac et al. 2013 - below left) fixes each star to the same pixels across several nights.





1: Isaac Newton Group of Telescopes, 2: University of Warwick, 3: Geneva Observatory, 4: University of Leicester, 5: DLR Berlin, 6: Universidad Catolica de Chile, 7: Queens University Belfast

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