Exoplanet discovery with MOA, PRIME, Roman and CLEoPATRA

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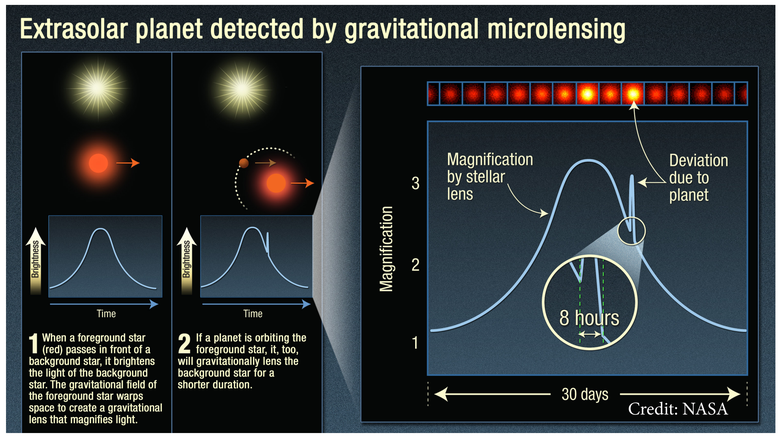
Gravitational Microlensing

Gravitational microlensing is an exoplanet detection technique in which light from a background star is temporarily magnified by a foreground planetary system passing between it and an observer [1]. The deflection of the background light by the gravitational field of the foreground object(s) is analysed to determine the characteristics of the foreground "lens" system. This could be, for example, a star and one or more planets.

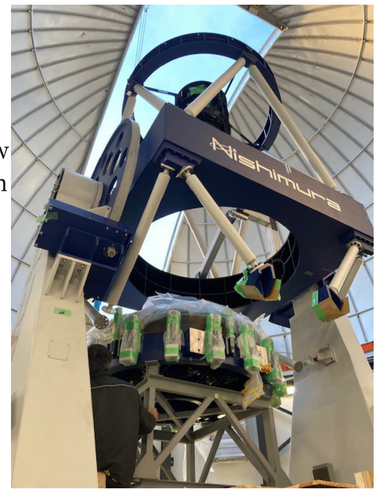


The MOA Project

The Japan-New Zealand-US Microlensing Observations in Astrophysics (MOA) project has been surveying the central Galactic bulge and Magellanic Clouds for over 25 years, searching for microlensing events and evidence for exoplanets. The MOA collaboration uses the 1.8m Nishimura telescope at The University of Canterbury's Mount John Observatory at Takapō [2].

200 planets have been discovered by microlensers world-wide [3].

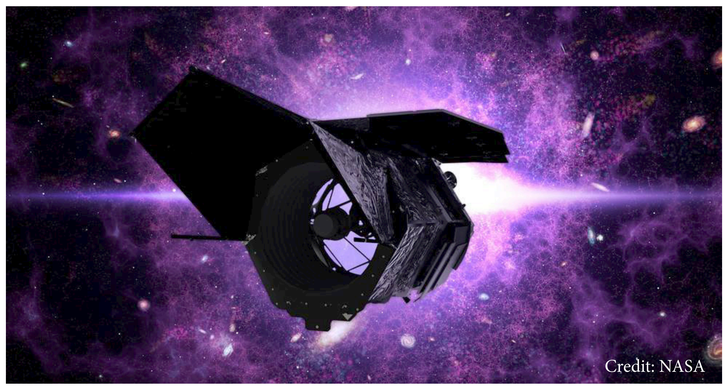
PRIME



A second 1.8m Nishimura telescope has been installed at a new observatory at the South African Astronomical Observatory. The PRime-focus Infrared Microlensing Experiment (PRIME) will conduct a survey of the inner Galactic bulge to inform the observing strategy of the exoplanet survey that will be done by the Nancy Grace Roman Telescope. The PRIME experiment is expected to detect planetary signals for around 50 planets per year [4].

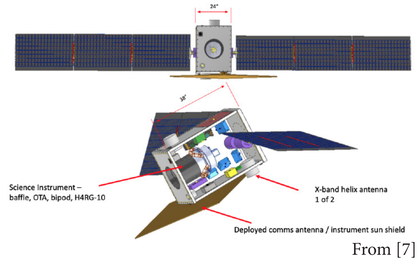
Roman

The Nancy Grace Roman Telescope (NGRT, formerly the Wide Field InfraRed Survey Telescope) will be the next flagship NASA space telescope launched. One of its primary goals is to discover exoplanets using microlensing. The NGRT comprises a 2.4 m telescope and will cover a survey area of approximately 2 deg² towards the Galactic Bulge. The NGRT will discover hundreds of exoplanets, including those not orbiting a host star, with sensitivities to planets with the mass of 0.02 that of Earth [5,6].



CLEoPATRA

Key to precisely estimating the mass of a planet discovered by microlensing is a measurement of the distance to the lensing system, and the Einstein ring radius of the microlensing event. The Einstein ring radius can be estimated by a careful analysis of the source star characteristics and the effect the finite size of the source star has on the observed light-curve. The distance to the lens system can be estimated using a measurement of parallax, using two observatories separated by a baseline. The Contemporaneous LEnsing Parallax and Autonomous TRansient Assay (CLEoPATRA) a proposed space mission comprising a 20 cm -- 50 cm telescope to make simultaneous observations of Roman microlensing events, to enable a finer measurement of parallax [7]. CLEoPATRA will also comprise novel on-board techniques and hardware, such as machine-learned algorithms for image analysis running on GPUs to minimise the amount of data requiring transmission to Earth.



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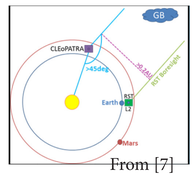

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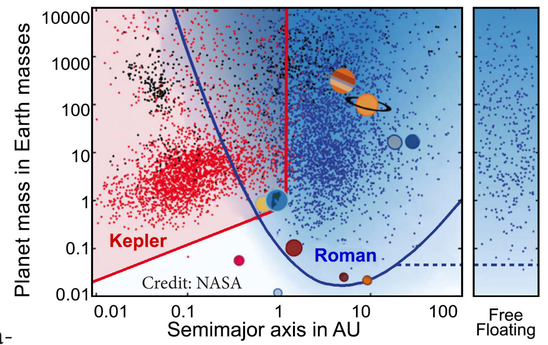

References
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