Contribution ID: **554** Type: **Oral**

Effects of Moon Transit on the Light Curve of Transitting Exoplanets

Monday 21 May 2018 15:30 (15 minutes)

To date, two exomoon candidates have been proposed but confirming their existence remains a challenging task as tools to fit light curves of exoplanets with moons are not yet available. Transit Timing Variation (TTV) and Transit Duration Variation (TDV) signals of transiting exoplanets due to the presence of moon, which have a phase difference of 90 degrees, provide a unique feature that can be used to confirm exomoon detection. In this work, we study how light curves generated from the moon-planet-star transit model differ from such light curves that are re-fitted using the Transit Analysis Package (TAP), where the simple planet-star model is adopted. The results give a qualitative explanation of how dynamical processes give rise to certain features present in TTV, TDV and transit depth signals. The identified features in these signals are described. Interesting features include the systematic rise and fall of variation signals at primary and secondary moon transit within the planet disc, and excess TDV signals for all moon phases. This study provides a concrete framework for confirming moon detections.

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Session Classification: A7: Astronomy I

Track Classification: Astronomy, Astrophysics, and Cosmology