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Title: Lessons from Kepler exomoon surveys: planets host not much larger moons than Ganymede

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Abstract: Co-authors A. E. Simon and L. L. Kiss, Konkoly Observatory, Hungary
Since giant planets in our Solar System host large moons (up to 0.4 Earth radius, e.g. Ganymede), it is likely that giant exoplanets on long-period orbits host moons, among one the largest ones are at least as large as Ganymede. In about the past year, several attempts has been done to reveal TTVs of hot Jupiters with Kepler that may be attributed to periodic perturbations of a large moon (Szabo et al. 2013, Mazeh et al. 2013, Kipping et al. 2013). A considerable number of hot Jupiters has indeed been reported to exhibit TTVs, which are often periodic (Steffen et al. 2012, Ford et al. 2012). We found that in some cases, TTVs exhibited prominent frequencies that can be easily explained by sampling effects (Szabo et al. 2013). Since the orbital period is not an exact multiple of the cadence rate, the consecutive transits are sampled at different positions, resulting in TTVs with a stroboscopic period. A similar stroboscopic artefact occurs in the case of active stars, which is a main source of false positive TTVs.

We performed a complete survey of 574 single transiting Kepler planet candidates in the 5--100 days range. Several methods were applied to detect exomoon effects, such as TTVs, photometric timing variations and scatter peak (Simon et al. 2012). As a result, none of these systems were considered as a serious candidate for presence of large exomoons. To interpret the finding, we simulated the detection limit of exomoons in the surveyed systems. Depending on the depth of planetary transit, the brightness of the central stars and the number of transit observed, we suggest that detection limits can go down to 0.6--0.7 Earth radii in the best cases.

This is an evidence that moons forming around Jupiters cannot exceed the size of 1.5 times the Ganymede as a rule of thumb, which we interpret as an important boundary condition in solar system formation theories.