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Abstract: Systems Co-author: Amaury Triaud, MIT

To date, circumbinary transit searches, in Kepler, have been restricted to eclipsing binaries. This confines planet discoveries to a small fraction of all binary systems. Furthermore, those discoveries are heavily biased towards coplanarity. We propose that future searches should include non-eclipsing binaries, which geometrically can only be transited by circumbinary planets that are misaligned with the binary plane. Doing so not only increases the number of binary systems searched by twenty-fold, but also allows a complete sampling of circumbinary inclinations, which is crucial for the understanding of planet formation. Whilst misaligned circumbinary systems have yet to be discovered, there are theoretical and observational results that suggest their plausibility.

I will present results from a suite numerical simulations. A set of binaries was constructed, based on radial velocity surveys, and shown to be consistent with the Kepler eclipsing binary catalog. Synthetic planets were inserted, drawn from various distributions including those pertaining to single stars. Using an N-body code, the systems were integrated over a 4 year period and transits on each star were counted. Our results indicate that transits of planets orbiting non-eclipsing binaries are likely. In fact, Kepler may have observed more systems in such configurations than it has discovered circumbinary planets transiting eclipsing binaries. Moreover, by comparing the simulated transits on eclipsing binaries to the current circumbinary discoveries, we deduce differences between circumbinary and circumstellar planet formation. I will argue that the current pile-up of circumbinary planets near the stability limit has a physical origin, and is not a mere observation bias towards the shortest possible periods. Finally, I will also describe how the geometry and orbital dynamics produce several interesting effects, including rapid orbital evolution, time-dependent transit probabilities, significantly varied transit shapes and unique "genome-like" transit timing signatures.