PLANETARY SYSTEMS

Random juggling?

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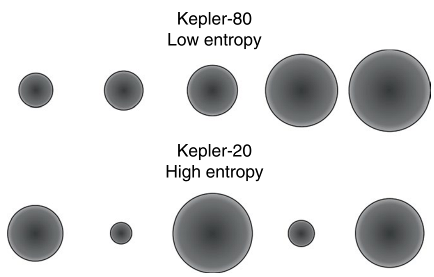

Credit: Oxford University Press on behalf of the Royal Astronomical Society.

At the time of writing (January 2018), we have discovered more than 220 planetary systems with at least three planets. We are thus starting to be able to extract some general principles on planetary formation. However, this goal is complicated by the fact that the known systems display an astounding variety of architectures. This diversity accounts for the evolution of planetary systems after formation, which is unique to the story of each system. The question arises as to whether a system retains memory of its initial conditions or if these are completely diluted with time. David Kipping studies the issue by associating an entropy value to each known Kepler multi-planetary system.

Entropy, in this specific study, is related to the size-ordering of the planets according to distance: seemingly random systems will have higher entropy than ordered ones (see pictured examples). There are some subtleties to consider in translating this concept to analytical expressions, as a good definition of entropy needs to 'feel' the global structure of the system (a system with a planet bigger than Earth in the place of Mars should have lower entropy than the actual Solar System, for example) and be as robust as possible with respect to eventual missing planets. Kipping uses three different entropy formalisms, finding consistent results: the Kepler systems have lower entropy than synthetic systems generated with random planet-swapping. This means that planetary systems do retain some memory of their initial state and we can still hope to gather some clues on their formation even when their current architecture looks very disordered.

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