[JJ] Evening Poster | P (Space and Planetary Sciences) | P-AE Astronomy & Extrasolar Bodies

[P-AE20]Exoplanet

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Exoplanetary science, which began with the discovery of a hot Jupiter in 1995, has reached a major turning point by the discovery of countless super-Earths by the Kepler mission. More recently, planets that are similar in size to the Earth and also receive similar amounts of stellar radiation (namely, located in the so-called habitable zone) have been discovered around nearby stars such as Proxima Centauri and TRAPPIST-1. As a result, not only theoretical, but also observational studies on the atmospheres and surface environments of Earth-like exoplanets have been started. Moreover, the number of planets discovered around early-type and late-type stars has become large enough that the occurrence rate and orbital distribution of planets around a wide variety of host stars have become clear. Thus, new observational insights, which become the basis of pan-planet formation theory, are now gathering. While exoplanets have been mainly targeted for astronomy until recently, it can be said that earth planetary science is finally becoming a research field to make a central contribution. In this session, we aim to share cutting-edge research results in exoplanetary science which is in such a transition period.

[PAE20-P01]On the surface composition of planet-harboring stars: Impact of protostellar accretion

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Recent observations have suggested a correlation between the existence of planet and the surface composition of the host star: The Sun, harboring many planetary objects, is depleted in refractory elements compared to most solar twins (Melendez et al. 2009) and in some binary systems the stellar surface compositions depend on the total mass of their planets (e.g., Ramirez et al. 2011). Since the stellar surface composition is one of the important quantities in exoplanetary sciences to characterize the planetary systems, the understanding of the observed correlations is crucial. In this study, we explore the possibility that planet formation processes affect the stellar surface compositions. The formation of planetary objects in protoplanetary disks implies that the composition of disk gas is not constant with time. The stellar surface composition must then differ from the primordial one. In order to determine the magnitude of this effect, a key ingredient is the stellar surface convective zone whose thickness determines the dilution of the “planet pollution” signature. First, we investigate the evolution of young stellar objects in the new framework of disk accretion. From stellar evolution calculations, we find that the evolution can significantly deviate from the classical picture. Using up-to-date stellar evolution models, we estimate the compositional changes due to planet formation. We find that the magnitude of the modification is sensitive to the entropy of accreting materials during the protostellar phase. Last, we apply our models to determine whether the composition anomaly between the Sun and solar twins may be explained by the retention of refractories during solar system formation. We find that this is possible, but only if the ice-to-rock ratio in the solar-system planets is less than 0.23.