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research highlights

EXOPLANETS

The history of hot gas giants

Astron. J. (in the press); preprint at https://arxiv.org/abs/1612.04372 (2016)

Measuring the abundance of carbon and oxygen in the atmospheres of close-in gas giant exoplanets ('hot Jupiters') and in their host stars can determine the formation environment and mechanism of those planets, and whether they have migrated during their lifetimes. John Brewer and co-workers have collated these measurements for ten exoplanet systems. The oxygen abundance (O/H) and carbon-to-oxygen ratio (C/O) indicate where giant planets have accreted their gas and ice, in relation to 'snow lines' in the natal protoplanetary disk. Moving radially from the hot inner disk, where C and O are roughly stellar, to the cold outer disk, one encounters the snow lines of water, carbon dioxide and then carbon monoxide, according to the freeze-out temperatures of these molecules. At each stage the C/O ratio changes, generally increasing radially. The initial imprint of carbon and oxygen abundances upon gas giant planets will then be mitigated by planetary migration, making any history challenging to unravel.

In one case (HD 209458b), Brewer *et al.* see the opposite of what would be expected from recent theories of *in situ* formation of hot gas giant exoplanets: high planetary C/O and low O/H. Such abundances would indicate planet formation occurred far beyond the water snow line, without the accretion of significant amounts of (oxygen-rich) solids during inwards migration. This result would rule out *in situ* formation for most hot gas giant exoplanets.

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