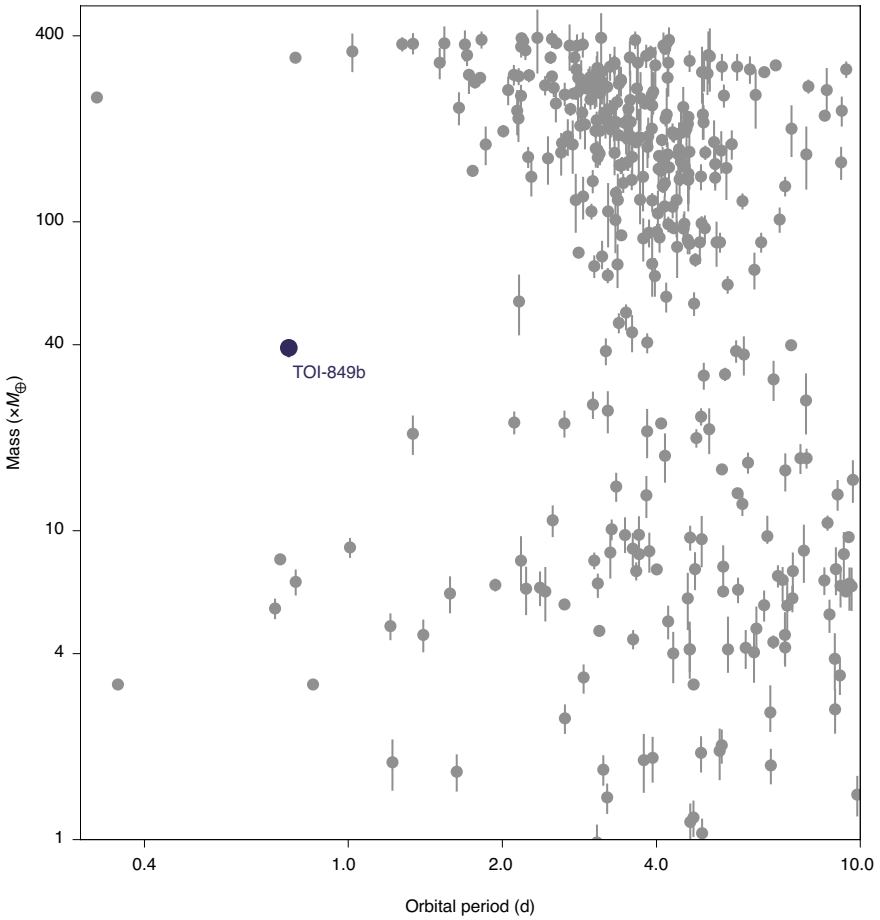
EXOPLANETS

A naked gas giant

Nature **583**, 39–42 (2020)



Credit: Springer Nature Ltd

The existence of a 'hot Neptune desert' tells us that it is very rare to find Neptune-mass exoplanets orbiting very close to their star. In fact, such planets either lose their atmosphere — and thus most of their mass — very efficiently due to photoevaporation; or are destroyed by tidal forces; or migrate outward. TOI-849b, discovered by David Armstrong and colleagues, is a double rarity: not only is it fully in the hot Neptune desert, but it also has a density comparable to the Earth's.

TOI-849b is almost the same size as Neptune but has a mean density of $5.2^{+0.7}_{-0.8}$ g cm^{-3}, comparable with that of 5.51 g cm^{-3} for Earth. Such a high density is very unusual for such a big planet — the density of Neptune itself is barely 1.64 g cm^{-3} — meaning it has a very thin atmosphere, ~4% of its mass. It also orbits its star, a ~6.7 billion-year-old Sun twin, in less than one day, which makes it very hot. TOI-849b is clearly in an isolated sector of the mass–period diagram (pictured). How it could exist is therefore puzzling.

Armstrong et al. advance the hypothesis that TOI-849b might have been born as a standard hot Jupiter, but its gaseous envelope was very efficiently removed by tidal disruption or giant impacts, leaving its massive core behind. Alternatively, it might not have accreted a lot of gas to begin with owing to some local conditions like a gap in the protoplanetary disk. TOI-849b might thus offer us the chance to directly observe the core of a giant planet (albeit affected by billions of years of exposure to its star) without the usual thick atmosphere that encases it.

Luca Maltagliati

Published online: 29 July 2020
https://doi.org/10.1038/s41550-020-1184-2