WHY DO PROTOPLANETARY DISKS APPEAR NOT MASSIVE ENOUGH TO FORM THE KNOWN EXOPLANET POPULATION?

When and how planets form in protoplanetary disks is still a topic of discussion. Exoplanet detection surveys and protoplanetary disk surveys are now providing results that allow us to have new insights.

We collect the masses of confirmed exoplanets and compare their dependence with stellar masses with the same dependence for protoplanetary disk masses measured in ~13 Myr old star-forming regions. The latter are recalculated by us using the new estimates of their distances derived from Gaia DR2 parallaxes. We note that single and multiple exoplanetary systems form two different populations, probably pointing to a different formation mechanism for massive giant planets around very low mass stars.

RESULTS:

While expecting that the mass in exoplanetary systems is much lower than the measured disk masses, we instead find that exoplanetary systems masses are comparable or higher than the most massive disks. This same result is found also by converting the measured planet masses into heavy-element content (core masses for the giant planets and full masses for the super-Earth systems) and by comparing this value with the disk dust masses. Unless disk dust masses are heavily underestimated, this is a big conundrum.

POSSIBLE SOLUTIONS:

We suggest either (or a combination of) these possibilities to solve this conundrum:

1) the cores of planets have formed very rapidly (<0.1-1 Myr) and large amount of gas is expelled on the same timescales from the disk,

2) that disks are (continuously?) replenished of fresh planet-forming material from the environment.

These hypotheses can be tested by measuring disk masses in even younger targets and by better understanding if and how the disks are replenished by their surroundings.

**TWO FIGURES ARTISTIC TAKE HOME MESSAGE:**

Plots appear to emerge from very little (from Quanta Magazine).

WANT TO READ MORE ON THIS SUBJECT? Check also these other papers:

Greaves, J. S., & Rice, W. K. M. 2010, MNRAS, 407, 1981

Williams, J. P. 2012, Meteoritics and Planetary Science, 47, 1915

Najita, J. R., & Kenyon, S. J. 2014, MNRAS, 445, 3315

Mulders, G. D. 2015, ArXiv e-prints, arXiv:1505.00023

WANT TO TALK TO ME? Look for me at the workshop or send me an email to cmanara@eso.org

REFERENCES: Ansdell, M., Williams, J. P., van der Marel, N., et al. 2016, ApJ, 828, 46; Pascucci, I., Testi, L., Herczeg, G. J., et al. 2016, ApJ, 831, 125; Schneider, J., Dedes, C., Le Sidaner, P., Savalle, R., & Zolotukhin, I. 2011, A&A, 532, A73; Thognren, D. P., Fortney, J. J., Murray-Clay, R. A., & Lopez, E. D. 2016, ApJ, 831, 64.