CHARACTERIZATION OF THE TESS YOUNG TRANSITING PLANETS WITH GAPS

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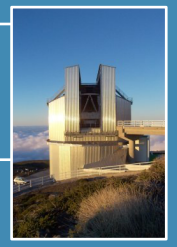
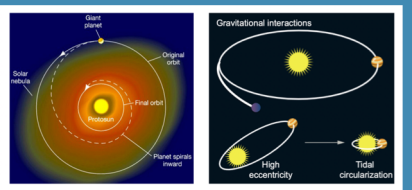
GAPS [1] is a project gathering the Italian community working on exoplanets. Our spectroscopic survey with GIARPS [2] at TNG, is focused on the search and the characterization of young planets and the planetary atmospheres





Disk migration vs high-eccentricity migration

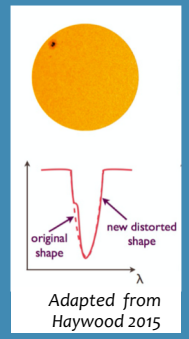
Adapted from Dawson & Johnson 2018

FACT 1

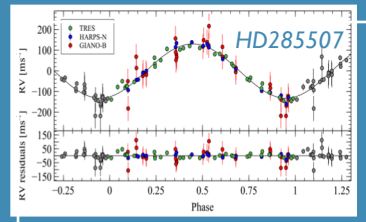
Young planets are the only targets able to reveal the early conditions of planetary systems, providing us the necessary information to understand the origin of the planetary system diversity.

FACT 2

Young planets are difficult to detect with blind radial velocity (RV) surveys because the stellar activity hampers the recovery of the planetary signal. This is why the current statistic is far from being completed and suffers for detections that are not confirmed by independent investigations.



Adapted from Haywood 2015

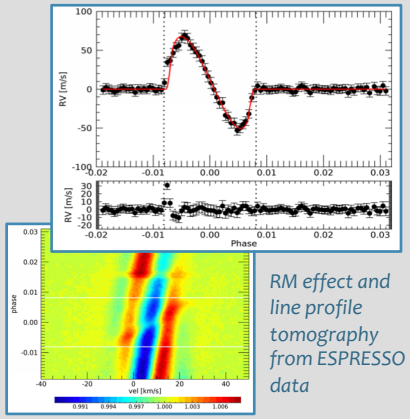


Within GAPS, we observed members in young associations (e.g., Taurus, Hyades). We validated the previous RV detection of HD285507 b [3] but cannot confirm the apparent high frequency of hot Jupiters around very young stars [4], as in the case of V830 Tau b [5].

Transit space missions such as TESS, are changing our view of young planetary systems at close separations. They provide robust candidates we are following-up with the RV technique, not only with HARPS-N but also with a dedicated program with HARPS at the ESO-3.6m telescope. Several works in preparation will be presented in forthcoming papers.

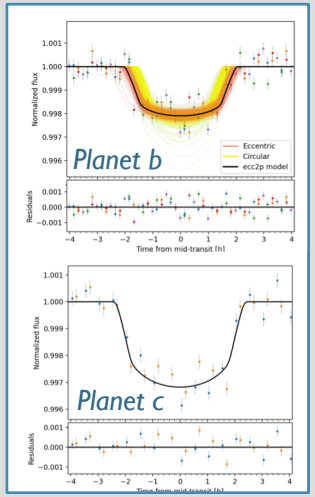
DS Tuc A b (TOI-200)

We validated the 8.14-days planet around the 40 Myr old star DS Tuc A [6, see also 7] and arranged a spectroscopic characterization for this Netune-sized planet (5.6 $R_\oplus$) [8]. We obtained a **mass upper-limit of 14.4 $M_\oplus$** from our RV monitoring with HARPS, and a maximum density of 0.44 g cm^3. From transit spectroscopy with ESPRESSO at VLT we obtained an **orbital obliquity of 12.1±1.4 deg** by analyzing the Rossiter-McLaughlin (RM) effect. No atmospheric compounds are detected since the stellar activity significantly affected our spectra. Finally, we simulated the effects of the **high-energy irradiation** of the young host on the planetary atmosphere showing that the planet radius could decrease by a factor of ~3.



RM effect and line profile tomography from ESPRESSO data

TYC 5909-319-1 b & c (TOI-942)



TESS light-curve modelling

An RV monitoring with HARPS-N and a careful analysis of the TESS light curve allowed us to validate candidate b and detect an additional transiting planet around TOI-942 [9, see also 10]. This is the **youngest multi-planet system identified by TESS** so far (30-80 Myr). The two hot-Neptunes orbit with a period of 4 and 10 days. Given the relatively high stellar activity, we could only infer an upper limit on their mass, **16** and **37 $M_\oplus$**, respectively. TOI-942 is part of the CHEOPS sample, which will soon allow the investigation of transit time variations to explore the possibility of additional planets. Our HARPS-N monitoring is still ongoing to improve our system characterization.

References

[1] Covino+ 2013, A&A 554, A28
[2] Claudi+ 2017, EPJP 132, 364
[3] Carleo+ 2020a, A&A 638, A5
[4] Yu & Donati, SF2A 2017, 69
[5] Damasso+ 2020, A&A 642, A133
[6] Benatti+ 2019, A&A 630, A81
[7] Newton+ 2019, ApJ 880, 17
[8] Benatti+ 2021, A&A 650, A66
[9] Carleo+ 2020b, A&A 645, A71
[10] Zhou+2021, AJ 161, 2