Hunting for exoplanets in Stellar Associations using TESS

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Stellar Associations (SAs)

- SAs are loose star clusters usually formed by a small number of stars
- Ages of SAs' members can be derived with high accuracy using theoretical models
- SAs' members in our sample have ages that span between (1-680) Myr

Scorpius-Centaurus Stellar Association (© CFA Harvard & Smithsonian)

Exoplanets in SAs

- For the vast majority of exoplanets' hosts the age is not well constrained
- The understanding of the formation and evolution mechanisms of exoplanets needs an accurate knowledge of the age of the host star
- Searching for exoplanets in SAs offers the unique opportunity of mapping planetary systems at different stages in their early life

Finding exoplanets in SAs: a difficult task

- **TESS** has observed many SAs, but the resolution of the instrument sometime makes these objects hard to analyse.
- We adopted the PATHOS pipeline to extract high-precision light curves from the FFIs for **11380 members** in **41 SAs**.
- We injected simulated transits of planets with radii (0.8-28)R_{Earth} in the observed light curves to probe the detection efficiency of our pipeline and used a logistic regression model to classify the detected signals.
- We validated the transiting objects of interest in our sample through a series of vetting tests (e.g. odd/even, secondary transit depth, analysis of the centroid and of different photometric apertures).

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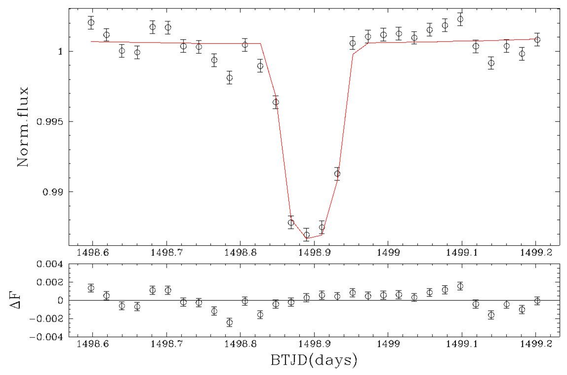
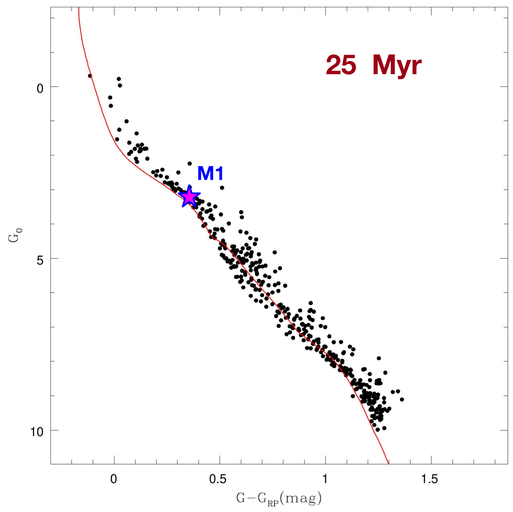
Candidate Exoplanets in SAs

- **10 candidate exoplanets** discovered with ages between 10 and 35 Myr.
- All the candidates are giant planets with R_P > 7x R_{Earth}.
- 5 candidates are in the all-sky PIC

Local polynomial & single transit fit of candidate M1.

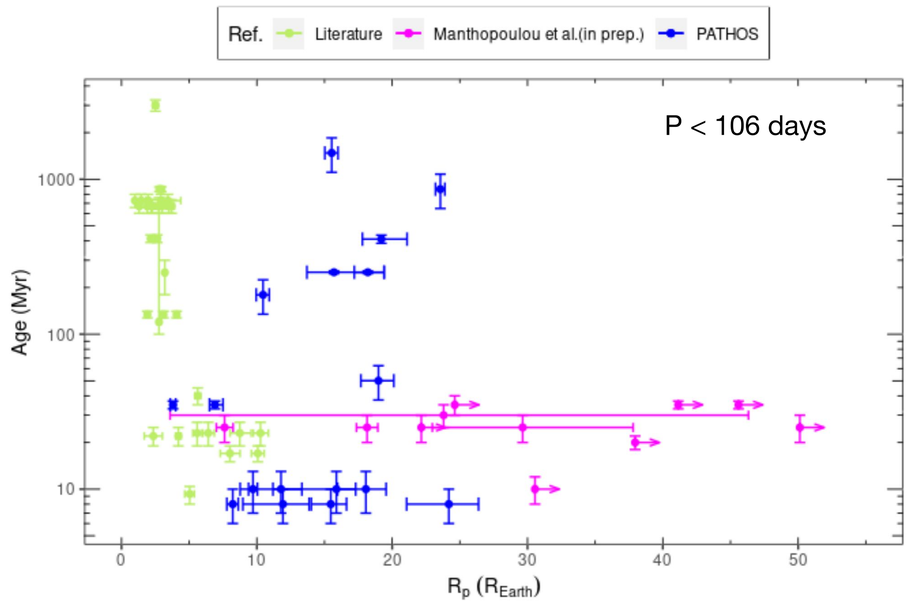




Age vs. R_P

We analysed the relation between stellar age and R_P also including data from the literature (see figure), which can allow us to study the evolution of the atmosphere of young, short-period exoplanets.

- No peculiar trend for R_P>1 x $R_{Jupiter}$ ~ 11 x R_{Earth}
- For R_P<11 x R_{Earth} :
  - older planets (>100-200 Myr) are concentrated at R_P<4 x R_{Earth} ~1 x $R_{Neptune}$
  - young planets (<100 Myr) have radii 4x R_{Earth} < R_P<11 x R_{Earth}
  - hint of evolution of the exoplanetary atmosphere (photo-evaporation)



Future perspectives

- Estimation of the frequency of exoplanets in SAs (and also stellar clusters) as a function of the age
- Analysis of the results with a view to exoplanet formation and evolution

More info on the ESPG webpage: