

Searching for planetary companions around solar-type stars within 25 pc using *Gaia* astrometry

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Introduction

- The hunt for exoplanets is a thriving field driven by a variety of **complementary techniques**, including astrometry and direct imaging with next-generation telescopes.
- This work surveys nearby solar-type stars and aims to detect new giant exoplanets using *Gaia* **renormalized unit weight error (RUWE)**, complemented by *Gaia*–*Hipparcos* **proper motion anomaly (PMA)**.
- The targets studied in this investigation are limited to a **25-pc sphere** to ensure possible direct detection with the forthcoming Extremely Large Telescope (ELT).

Filtering the CNS5 sample

- The Fifth Catalogue of Nearby Stars (CNS5) is used to select eligible **solar-type stars** within 25 pc [1].
- The stars are filtered based on their spectral type to select **F, G, K stars**. Targets with **astrometric excess** are identified as stars that show greater than 2σ excess noise in the *RUWE* or *PMA*.

Filtering
Conditions

- $0.25 < G - RP \text{ Colour} < 1.2$
 - Mass $> 0.5 M_{\text{Sun}}$
 - $\delta\text{-RUWE} > 2.0$ OR $\delta\text{-PMA} > 2.0$
- $\Rightarrow$ **245 stars** in our final sample

Solar-type
stars within 25
pc with $>2\sigma$
astrometric
excess

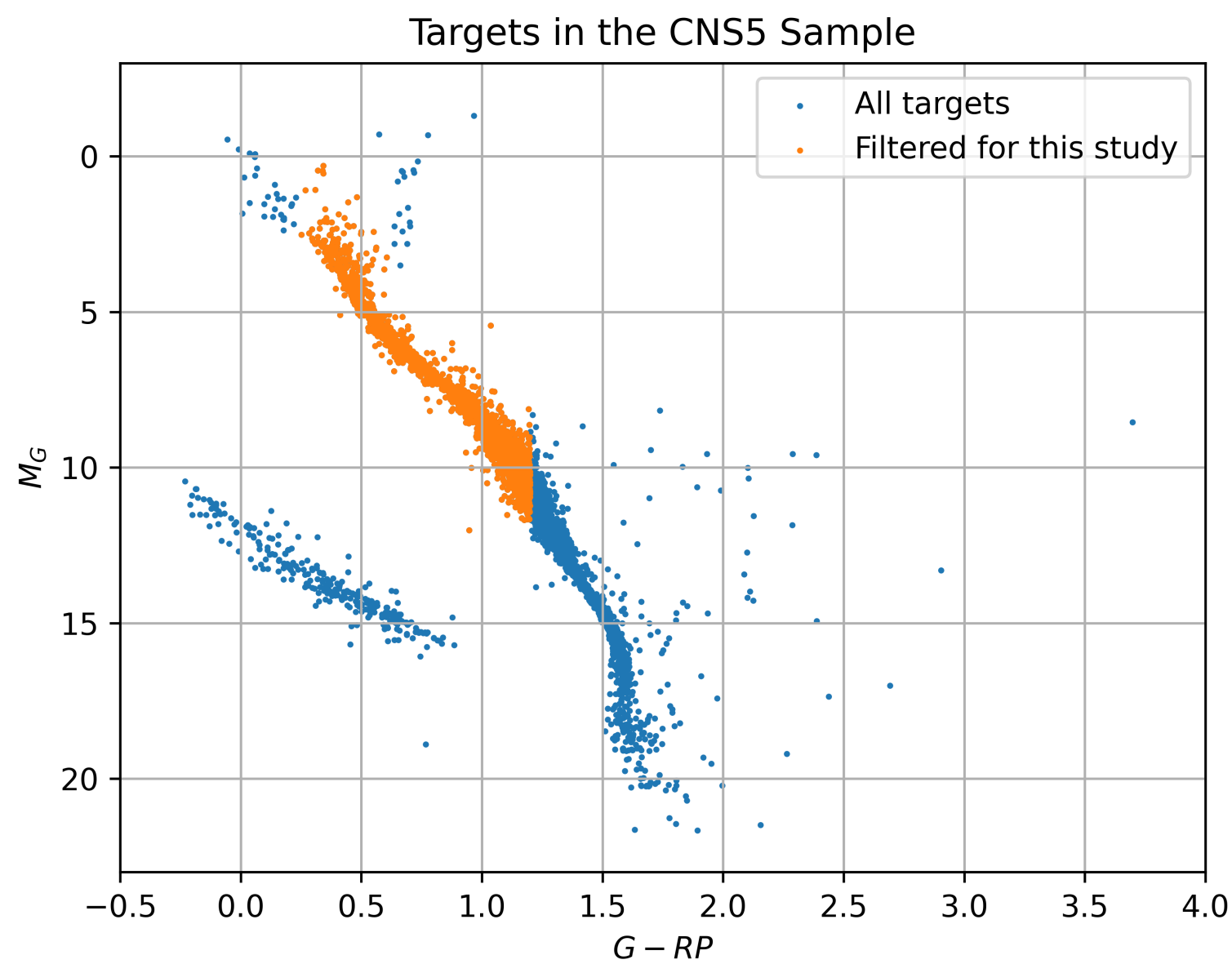


Figure 1: Colour-Magnitude Diagram of the targets in CNS5 [1]. The solar-type stars filtered for this study are highlighted in orange.

GaiaPMEX Analysis

- Search for bound companions using the **GaiaPMEX** tool [2], which makes use of the *RUWE* from *Gaia* and the *PMA* between *Hipparcos* and *Gaia*.
- We compare with catalogues of stellar and planetary companions [3, 4, 5, 6] to **exclude known companions** (136 targets removed).
- Set **detection limits** on the parameter space using **direct imaging** surveys.

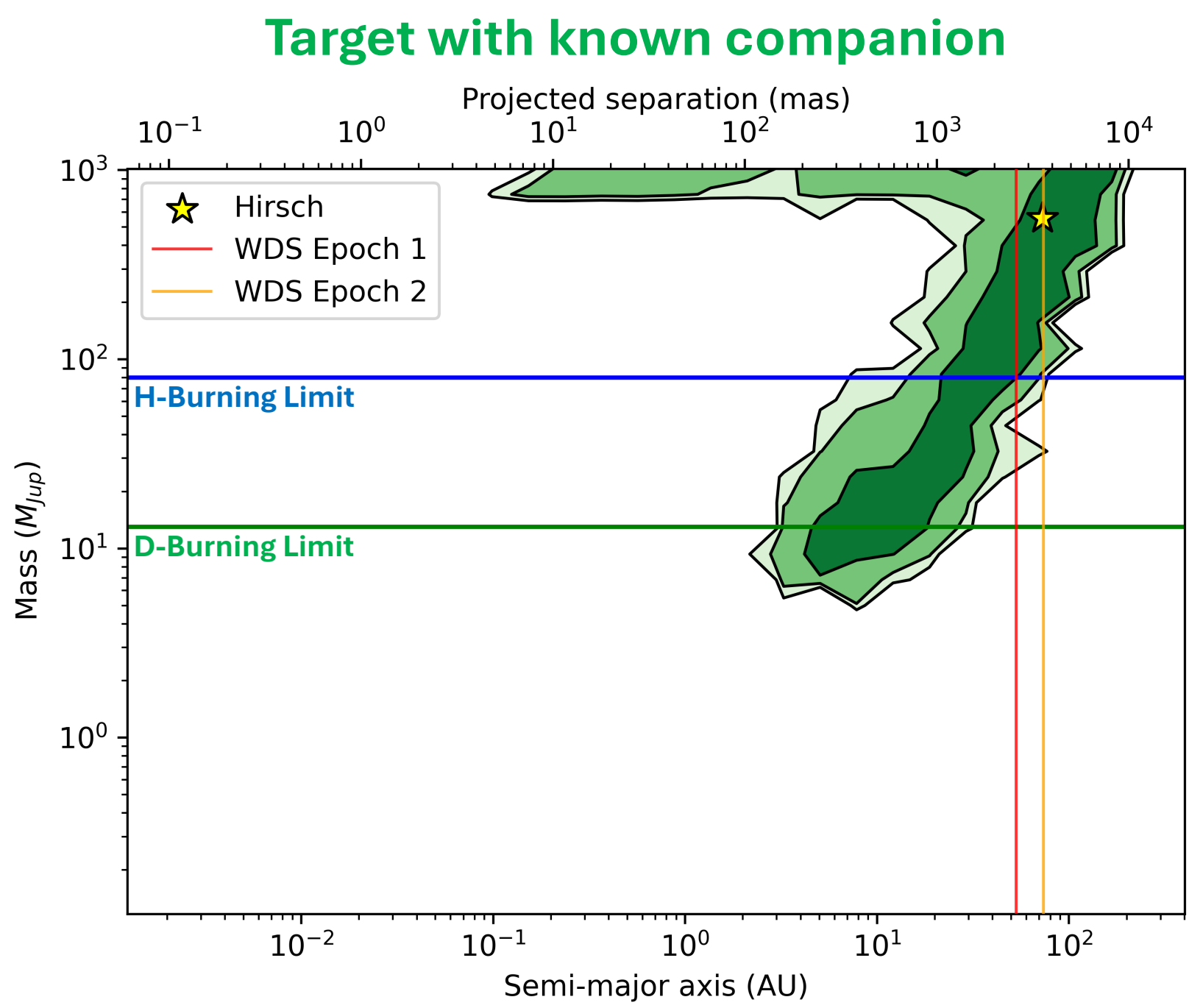


Figure 2: GaiaPMEX solution for a target with a known stellar companion. The result is overlaid with the mass and semi-major axis from Hirsch et al. 2021 (yellow star in the plot). From the WDS catalogue [5], only the separation is known.

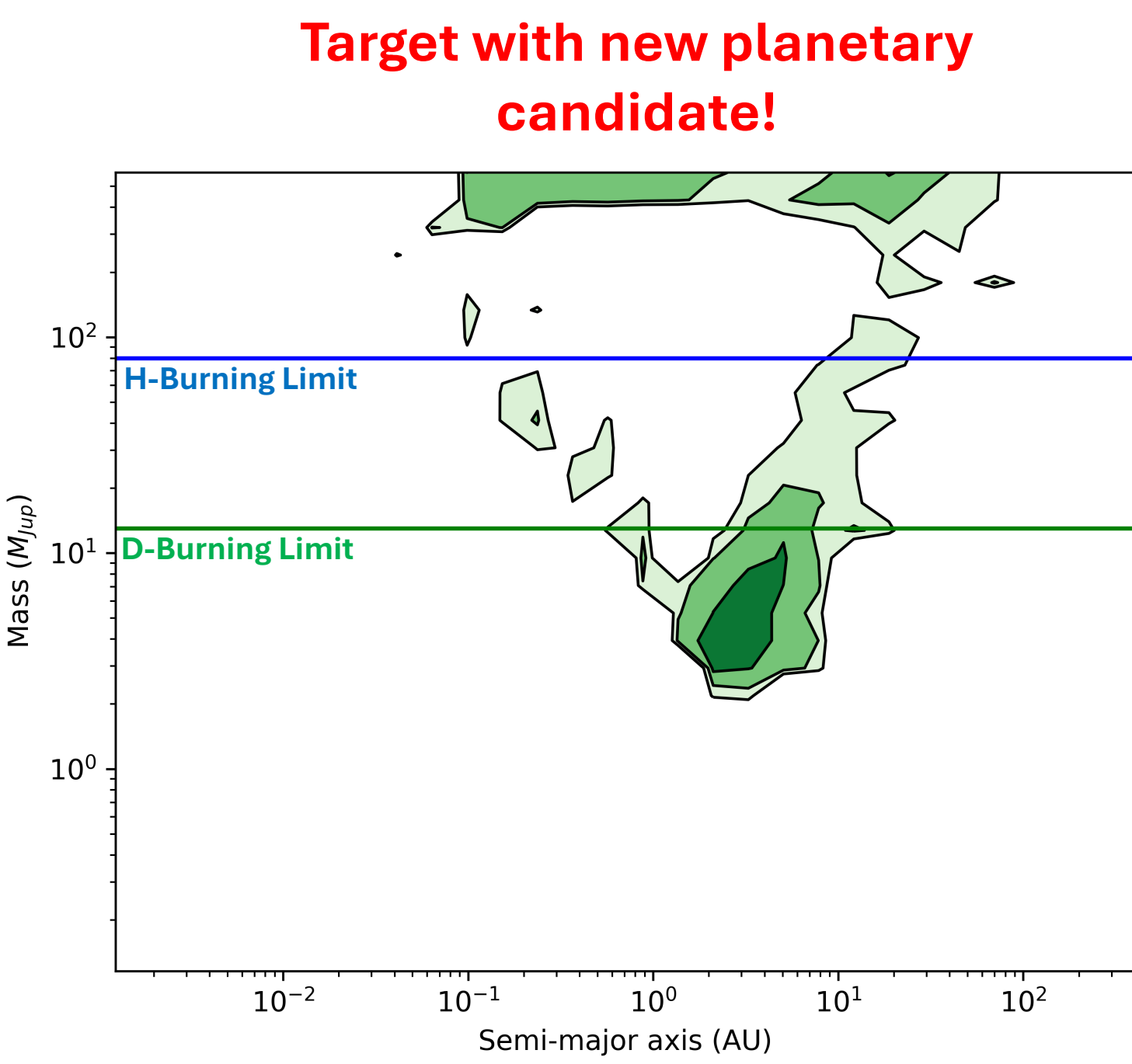


Figure 3: GaiaPMEX solution for a target without any known companions. The plot suggests that the candidate companion has a mass of about $5 M_{\text{Jup}}$ with a semi-major axis of around 3 AU.



Link to paper presenting
the GaiaPMEX tool [2]

Future Work

- Analyse **archival radial velocity data** with an MCMC framework to characterise new planetary companions and **constrain their masses and semi-major axes**.
- The newly identified planetary candidates will be prime targets for **future follow-up observations** with JWST, ELT and HWO, offering opportunities to study giant planets that may influence potentially habitable exoplanets.

References

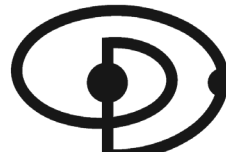
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