Demographics of giant exoplanets from the CORALIE survey

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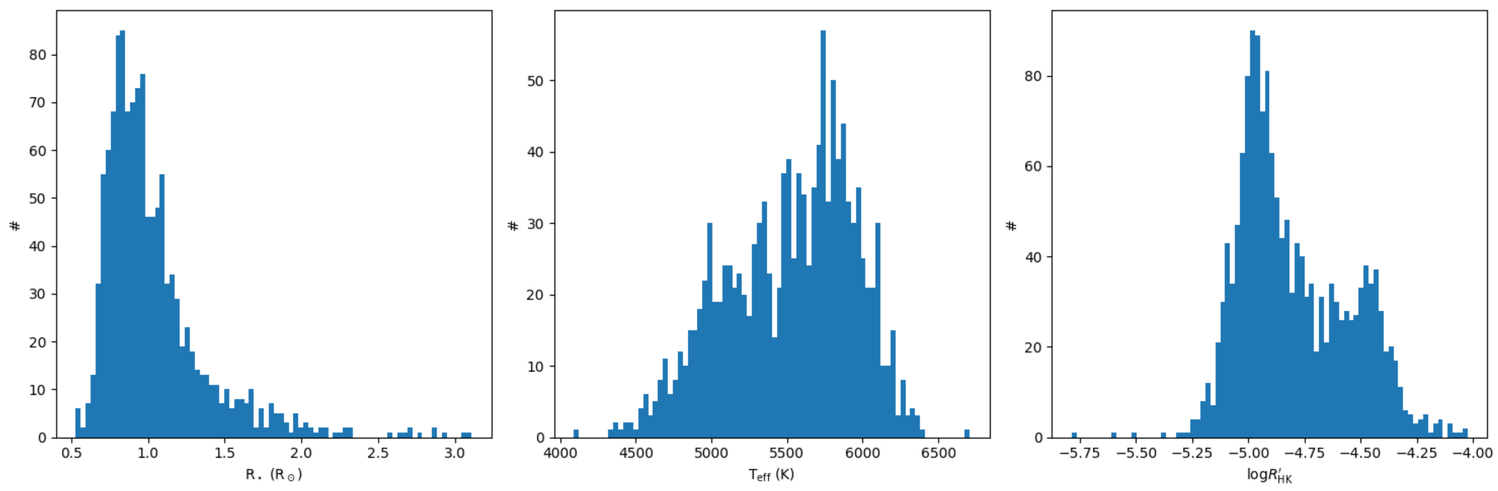
The CORALIE survey for southern extrasolar planets

Since June 1998, the CORALIE spectrograph (1.2m Euler Swiss telescope, La Silla Observatory) has been searching for exoplanets around nearby stars, detecting and contributing to the discovery of numerous new planetary companions, in addition to massive candidates for direct imaging follow-up and low-mass candidates for HARPS and ESPRESSO follow-up. The volume-limited planet-search sample is composed of 1647 FGK nearby ($d < 50$pc) stars in the southern hemisphere, with median radius 0.94 $R_\odot$ and effective temperature 5590 K.

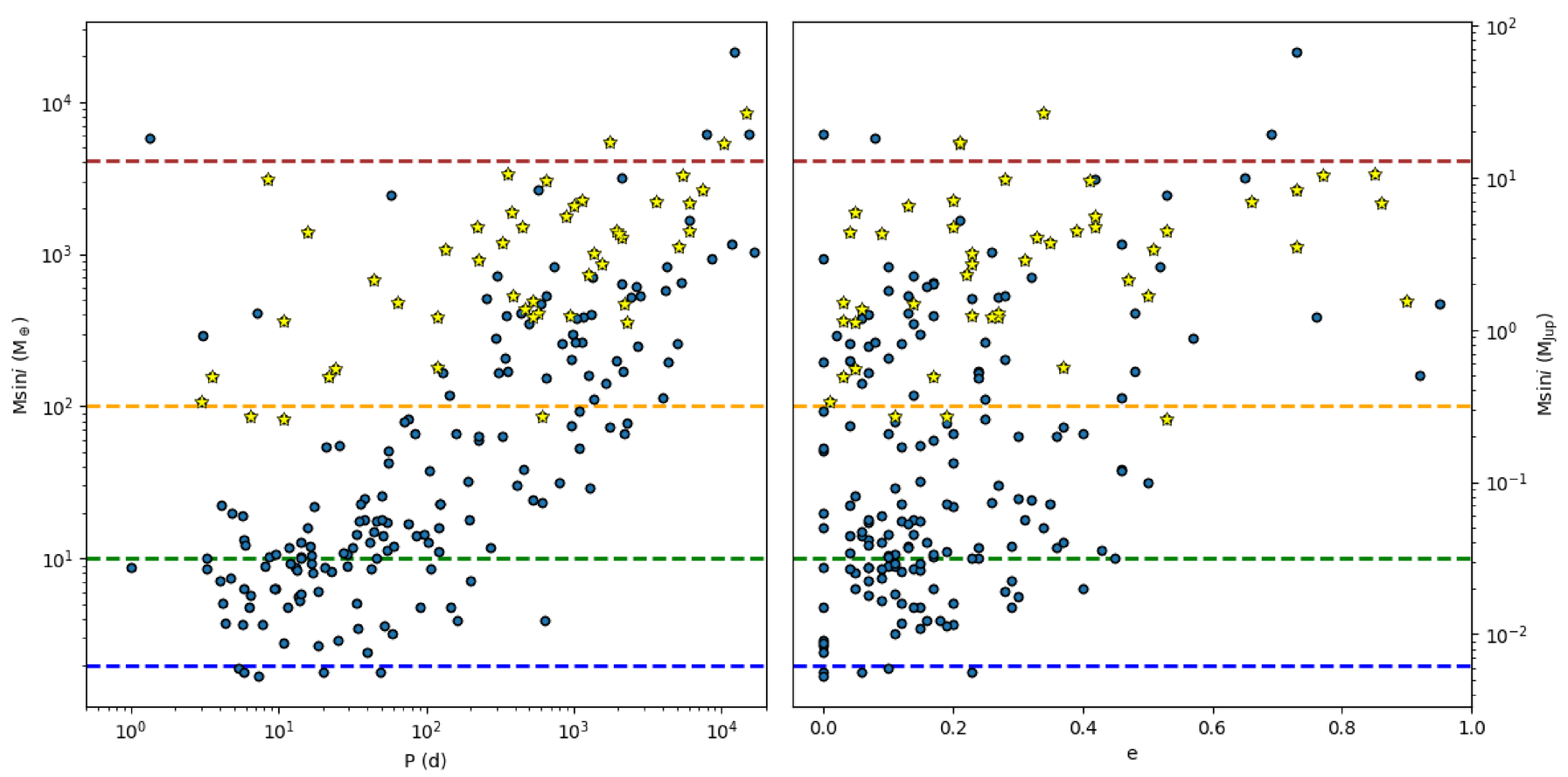


RV measurements

During the 20 year planet-search survey, CORALIE collected a total of 48000 radial velocity measurements, averaging 30 observations per star, with an average timespan of 5900 days and an individual measurement precision ranging between 3.5 and 6 m/s.
Joining with all literature and archival radial velocity measurements available for the stars in the sample we then have a total of 120000 datapoints, averaging 70 data per star and a mean timespan of 6200 days.

This massive dataset is optimally suited for the systematic search of massive long-period exoplanets and for investigating the statistical properties of exoplanetary systems, the occurrence rates of different exoplanetary populations and their ties with the dynamical history of the systems.

Known exoplanets in the sample



The 1647 stars in the sample host 220 known planetary companions and brown dwarfs (yellow stars: discovered by CORALIE). Massive companions are more likely to be found on longer orbits and a wider range of eccentricities, while lower-mass ones favour shorter periods and moderate eccentricities. Dashed lines indicate upper mass limits for terrestrial (blue), superterrestrial (green), Neptune-mass (orange) and giant planets (brown).

Occurrence rates of giant planets: preliminar results

In order to assess the completeness of the survey and provide preliminar estimates of the occurrence rate of giant exoplanets in the sample, we produce a completeness map from the bestfit residual of the full radial velocity timeseries of the stars in the sample. Considering only the 456 stars for which we have more than 50 datapoints, we inject into the residual timeseries sinthetic planetary signals over a range of $M \sin i$ and P, with 200 random values of e and ω for every realization. The signal is considered detected if the statistical evidence between the Keplerian and the flat model is at least $\Delta\mathrm{BIC} > 10$.

From the detection mass is clear that the survey is complete for $M \sin i \geq 3\ M_{\mathrm{Jup}}$ and $P \leq 4000$d, region in which most of the planets discovered by CORALIE (yellow stars) and published so far are located.

Focusing on giant planets in the sample ($0.3 \geq M \sin i \leq 13\ M_{\mathrm{Jup}}$), we can compute preliminar updates on their frequency at different period regimes:

$$f(\mathrm{P} < 10\mathrm{d}) = 1.10^{+0.73}_{-0.31}\%$$
$$f(10 \leq \mathrm{P} < 10^3\mathrm{d}) = 9.95^{+1.61}_{-1.24}\%$$
$$f(10^3 \leq \mathrm{P} < 10^4\mathrm{d}) = 10.15^{+1.70}_{-1.31}\%$$
$$f(\mathrm{P} \geq 10^4\mathrm{d}) = 0.55^{+0.73}_{-0.18}\%$$

all comparable with literature values; intermediate-period giant planets are significantly more common than hot Jupiters and more distant giants.