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Global results from the HARPS metal-poor sample

N.C. Santos[1,2], M. Mayor[3], X. Bonfils[3,4], X. Dumusque[1,3], F. Bouchy[5], P. Figueira[1], C. Lovis[3], C. Melo[6], F. Pepe[3], D. Queloz[3], D. Ségransan[3], S.G. Sousa[1], S. Udry[3]

[1] *Centro de Astrofísica, Universidade do Porto, Rua das Estrelas, 4150-762 Porto, Portugal [nuno.santos@astro.up.pt]*

[2] *Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, Portugal*

[3] *Observatoire de Genève, Université de Genève, 51 ch. des Maillettes, 1290 Sauverny, Switzerland*

[4] *Laboratoire d'Astrophysique, Observatoire de Grenoble, Université J. Fourier, CNRS (UMR5571), BP 53, F-38041 Grenoble, Cedex 9, France*

[5] *Institut d'Astrophysique de Paris, UMR7095 CNRS, Université Pierre & Marie Curie, 98bis Bd Arago, 75014 Paris, France*

[6] *European Southern Observatory, Casilla 19001, Santiago 19, Chile*

Abstract. In this paper we present the global results of a HARPS-GTO program to search for planets orbiting a sample of metal-poor stars. The detection of several giant planets in long period orbits is discussed in the context of the metallicity-giant planet correlation.

1. Introduction

The stellar metallicity is among the key parameters controlling the formation of giant planets (Santos et al. 2004; Fischer & Valenti 2005). This result provides important clues about the processes of planet formation and evolution (Ida & 2004; Mordasini et al. 2009). It is thus crucial to have a clear picture about how the frequency of giant planets varies as a function of the metal content of the star, as well as the limit below which planets can no longer be formed.

One of the HARPS GTO sub-samples was built to explore these issues. In this paper we present the global results of this program. A detailed presentation is done in Santos et al. (submitted).

2. The Sample

Our initial sample was built based on a preliminary version of the Nordström et al. (2004) catalogue. From this, we selected all FGK stars with $b-y > 0.33$, with declina-

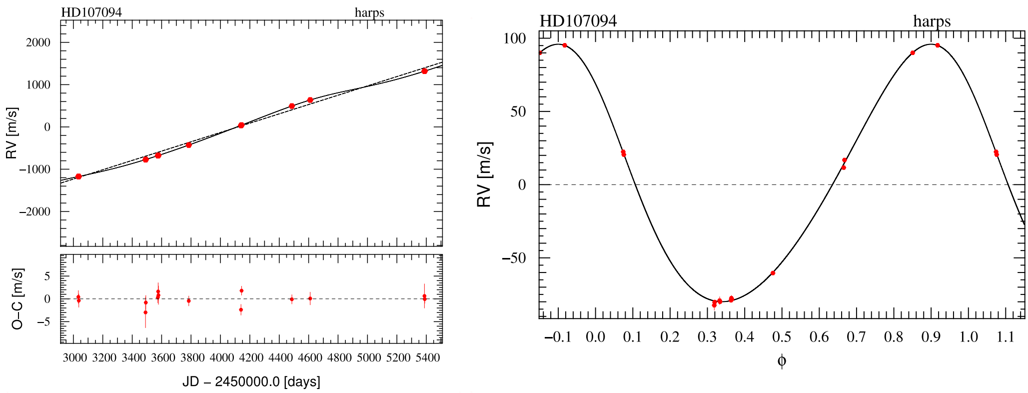

Figure 1: *Radial velocities (RV) of candidate giant planet around HD107094. Left: RV time series, with linear+Keplerian fit model; Right: phase folded RV with period of Keplerian fit (after subtraction of linear fit). From Santos et al. (submitted).*

tions south of $+10°$, with photometric metallicities $-1.5<$[Fe/H]<-0.5, V magnitudes below 10.9 (average 8.7), and not *a priori* known to be fast rotating or active. A total of 104 stars were chosen that have metallicities between -1.5 and -0.5 dex (with a few exceptions), with the peak of the distribution at ∼-0.6 dex.

After a few HARPS measurements, a few stars were excluded since they were found to be binaries (SB1 or SB2), active, or fast rotating. These objects are not suitable for a high precision planet search program. The final sample of 88 stars was followed during 6 years.

3. Planets in the sample

Three new giant planets were announced as part of the survey (Santos et al. 2007, 2010) orbiting the stars HD 171028, HD 181720, and HD 190984. All these planets have minimum masses between 0.37 and 3.1 M_{Jup}, orbital periods above 550 days, and moderate eccentricities (between 0.26 and 0.59). The three host stars have metallicities between -0.48 and -0.53, and are in the high metallicity range of our sample.

A fourth very good 4.5 M_{Jup} candidate giant planet, orbiting the star HD 107094, was also found (Santos et al., submitted), in a 1870 day period, nearly circular orbit (Fig. 1). The host star has a metallicity of -0.51. The radial velocities of this star also present a long term drift, possibly due to the existence of a longer period stellar or sub-stellar companion.

4. Discussion

In total, 3 to 4 giant planets were discovered in the sample, implying that at least 3.4% of stars in our sample have planets. Considering only objects with $-0.6<$[Fe/H]<-0.4, this value increases to at least 11%. All the discovered planets have long period orbits around stars in the upper [Fe/H] end of the sample.

These results imply that giant planets are common around mildly metal poor stars, although not as much as around high metallicity objects - Santos et al. (2004). Such previously unexpected high frequency may reflect the high precision of HARPS (increasing the detection rate), and suggests that planets are more common than thought. The results of our survey further suggest that the frequency of planets is a rising function of metallicity also in the [Fe/H] regime of study (see discussion in Santos et al. 2004).

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