VLTI/Hi-5: detection yield predictions for young giant exoplanets

Conference or Workshop Item

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INTRODUCTION

The scarcity of giant exoplanets discovered by ongoing single-aperture direct imaging surveys currently challenges our understanding and theories of planet formation. For the nearest population of young stars, surveys are typically sensitive to planets further away than 10 AU from their host stars due to the instrument’s limited angular resolution. It gives access to the semi-major axes where giant planets could have formed in-situ. However, it hardly fills the gap with the exoplanet population discovered by radial velocity surveys. Filling this gap is essential because it can provide critical constraints on planet formation theories and evolution models.

We present our simulations of potential detections around young extra-solar planetary systems and a potential target list for the Hi-5 instrument.

Hi-5 is a high-contrast L’ band (3.8 µm) nulling interferometric instrument. It is currently being proposed to ESO as a visitor instrument for the Very Large Telescope Interferometer (VLTI) and became the first long-baseline nuller in the Southern hemisphere.

METHODS

At young ages, the planet formation process can be constrained by measuring the flux of the planet1.
We identified 4002 stars (Figure 1) as members of young stellar associations within 150 pc of the Sun thanks to the BANYAN algorithm and other searches for young moving group members2.

RESULTS

Cold-start model

The occurrence of sub-giant and giant planets with the Bern model is low and depends on the stellar mass3. The probability of generating these planets is below a few percent.

Our simulations show that no planet can be detected with Hi-5. The L’ band magnitude histogram (Figure 3) indicates that massive planets (M > 0.75 Mjup) have a too high magnitude (sensitivity around 12-13 for the ATs).

Hot-start model

Contrary to the Bern model, planets with the hot-start model are generated from statistics (Kepler and radial velocity surveys) and more precisely with the Fernandez power-law distribution5.

CONCLUSIONS

1. A catalog of 4002 stars (< 300 Myr) is derived.
2. Synthetic exoplanet systems are generated around these stars using two planet formation models (cold and hot start).
3. With the large AT configuration, more than 30 planets could be detected assuming 20 nights of observations and two stars per night.
4. Yield computation shows that Hi-5 is able to detect more than 50% of the hot-start planets with a mass larger than 4 Mjup.

REFERENCES

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