The Search for Planets at the End of the Main Sequence

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Summary

- Initiated a comprehensive search for planets around the lowest-mass stars
- Current survey includes 36 M2 – M9 stars, mostly below 0.2 $M_{\text{sun}}$, median = 0.15 $M_{\text{sun}}$
- NIR radial velocities with CRIRES at the VLT
- Current program is being run as an ESO “Large Program” -- 33 nights over two years (2009 – 2010)
- New gas absorption cell for calibration
- Ultimate goal of 5 m s$^{-1}$ per visit precision
- Aim for the detection of Neptune-mass planets in short period orbits; Saturn-mass in intermediate and longer period orbits
- Expand the survey in 2011+ to include ~100 stars with $M < 0.2 M_{\text{sun}}$
Motivation

• Explore the correlation between planet formation efficiency and stellar mass

  *Are gas giants rare around low-mass stars?*

• Improve the galactic planet census

  *These stars are the most numerous stars in the Galaxy, but yet we have very little information on the nature of their planetary systems*

• Identify new planets for follow-up study

  *Low-mass stars are the short-cut to finding transiting habitable planets*

• Provide a foundation for future high-precision NIR radial velocity work

  *What are the important things to consider when designing the next generation of radial velocity instruments?*
Method: A new gas cell for the NIR

- Wedged windows to eliminate fringing
- Filled with 50 mb ammonia (NH\(_3\))

Dimensions:
- Length: 18 cm
- Width: 5 cm
Method: CRIRES at the VLT

gas cell goes here to enable calibration of each observation

Image credits: ESO
Method: Gas cell lines overlap for in situ calibration
Demonstration

High-precision radial velocities of a V=17.5 M8 star in 20 minutes

![Graph showing radial velocities over time](image)