Accretion signatures in the X-Shooter spectrum of the substellar companion to SR 12

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The planet zoo is quite complex: different masses, distances and formation stages need to be explained.
Lonely and massive objects are our targets
What about our objects?

• Planet scattering

• Gravitational instability

• Collapsing protostellar cloud
SSCs have been found by imaging surveys which is only possible due to their large orbital separation.

Size of Neptune's orbit (30 AU)

Location of host star

HD 106906 b
650 AU
97 billion km
60 billion mi
Accretion is a key parameter in the formation of PMCs.
SR 12C is a young object, at 1100 AU from the central binary system.
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| Age      | ~2 Myr  |
|----------|---------|
| SpT host | K4-M2.5 |
| Mass     | ~13 Mj  |
| Distance | 125 pc  |
Theoretical fit was according to a temperature of 2600K and log g equals to 4
Spectral type is L0 using observational fits.
Several accretion lines can be seen at first glance
Hα and the Ca II triplet are classical accretion indicators and they are present in SR 12C.
Other Balmer lines are found too and can also be used to estimate the accretion rate.
Scatter in the obtained accretion rates is related to the uncertainties in the methodology.
Accretion seems to be present in SSCs younger than 10 Myrs as in single stars.
Accretion rates and masses of SSCs agree with values measured for single low-mass objects.
Conclusions

- The most comprehensive study of accretion in SSCs
- SR 12 C is an object of 13 Mjup (L0 spectral type)
- SR 12 C is accreting at a rate similar to single brown dwarfs
- Most plausible theory is collapsing protostellar cloud but gravitational instability can not be discarded