The early stage of chemically peculiar stars

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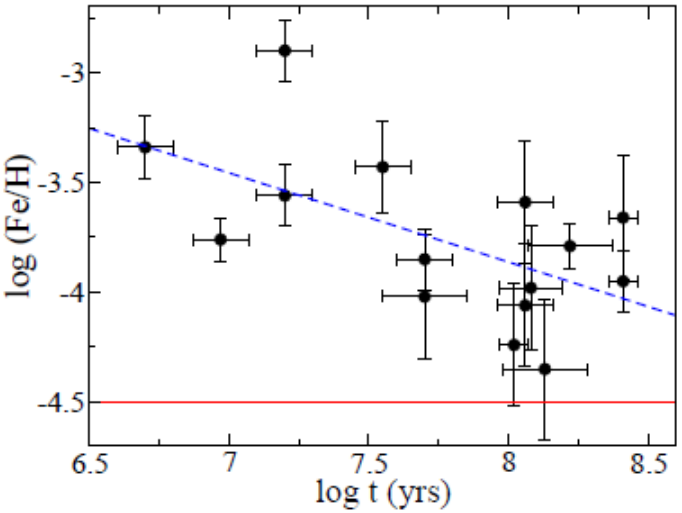
Characteristics of CP stars

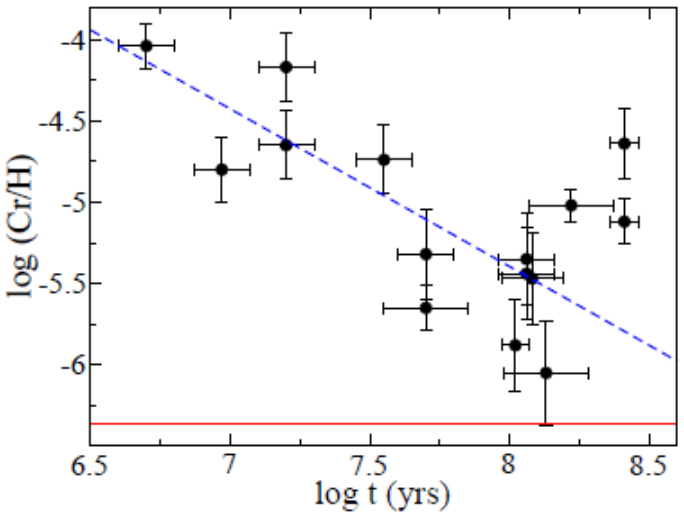
Bp/Ap	Am
magnetic fields up to ~ 30 kG	non-magnetic
overabundances of Si,Cr, Eu, …	oa. of metal. elements heavier than Fe; underabundances of Ca, Sc, C, N, O
mostly single stars	mostly in binary systems
~ 1.5 – 8 M⊙	~ 1.5 – 2.5 M⊙

they are known as main-sequence stars
the incidence is about 15% among B-F type stars
they are slow rotators
abundance anomalies are explained by diffusion processes

Characteristics of CP stars

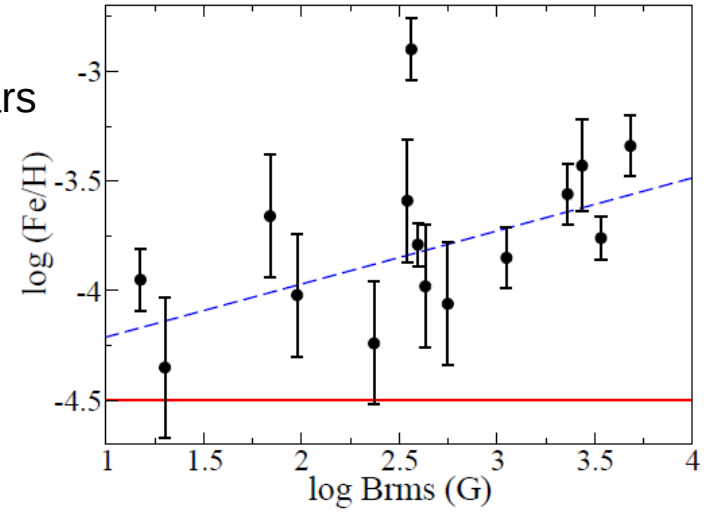
Bp stars: The evolution of abundances and magnetic field strengths





Bailey et al. 2014:
using main-sequence cluster stars in the mass range 3-4 M⊙

decline of magnetic field strength with age already found by Landstreet et al. 2007



The early stage of CP stars

To provide further observational constraints to the diffusion theory, very young CP stars are needed.

~10% of Herbig Ae/Be stars have strong structured magn. fields (Alecian et al. 2013)
similar incidence as the Bp/Ap stars on the MS …

⇨

but only 1 candidate known with magnetic field + at least weak Bp/Ap peculiarities:
V380 Ori A (Folsom et al. 2012)

What about PMS Am stars?

The very first PMS Am star?

using Δa photometry, Paunzen et al. (2005) detected one CP candidate in the young (~3-8Myr) open cluster Stock 16.

inconclusive follow-up observations with low resolution (classification) spectroscopy

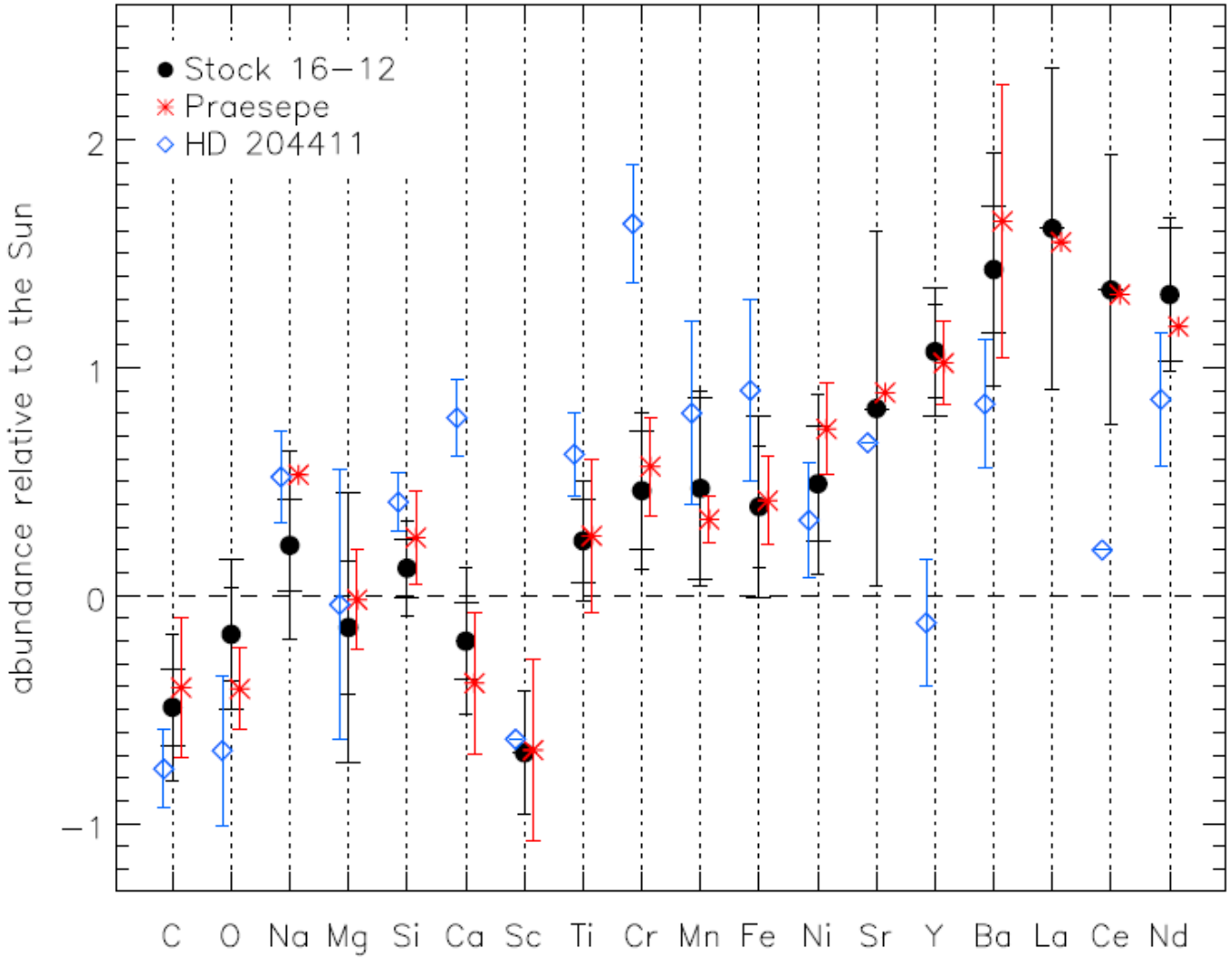
⇒ high-quality spectroscopic data necessary

objects brightness: V ~ 13.4mag

⇒ UVES (VLT UT2)

R~40000; 4170–6200Å; S/N~200 (50min exposure time)

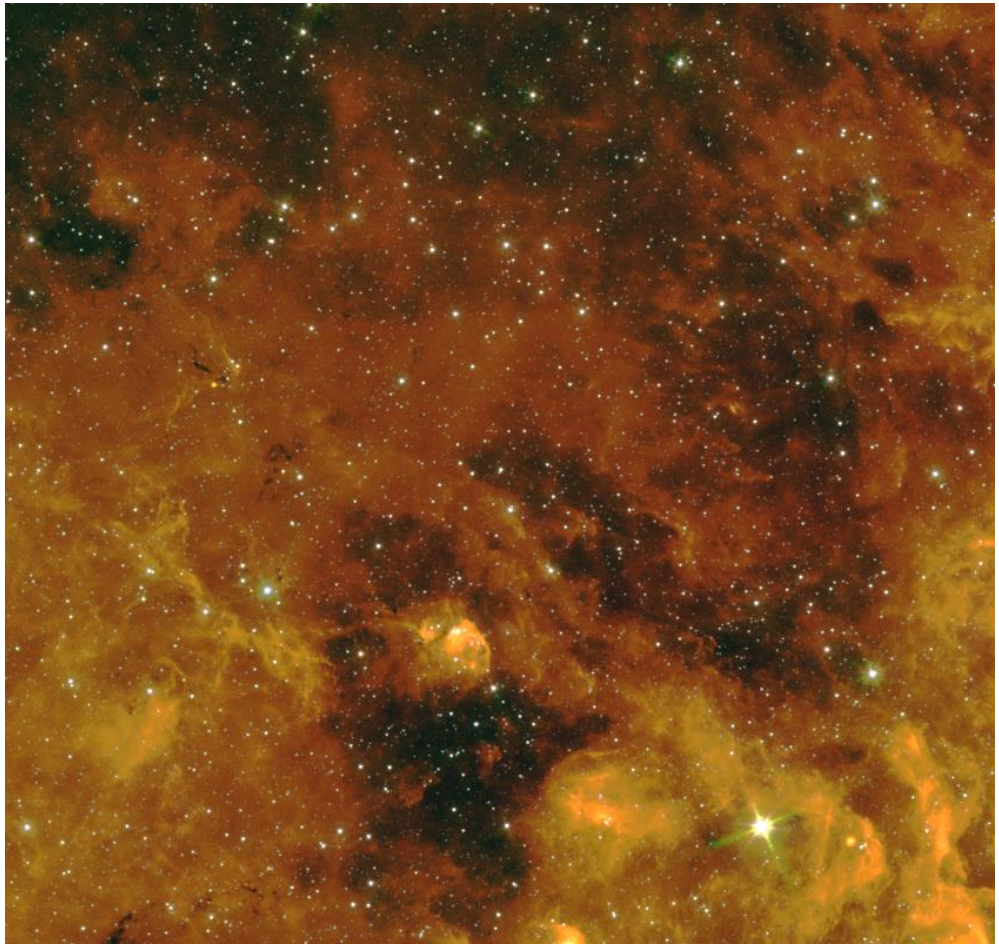
The very first PMS Am star?



T_{eff} = 8400 ± 400 K
log g = 4.1 ± 0.4 dex
v_{mic} = 3.4 ± 0.5 km/s
vsini = 68 ± 4 km/s

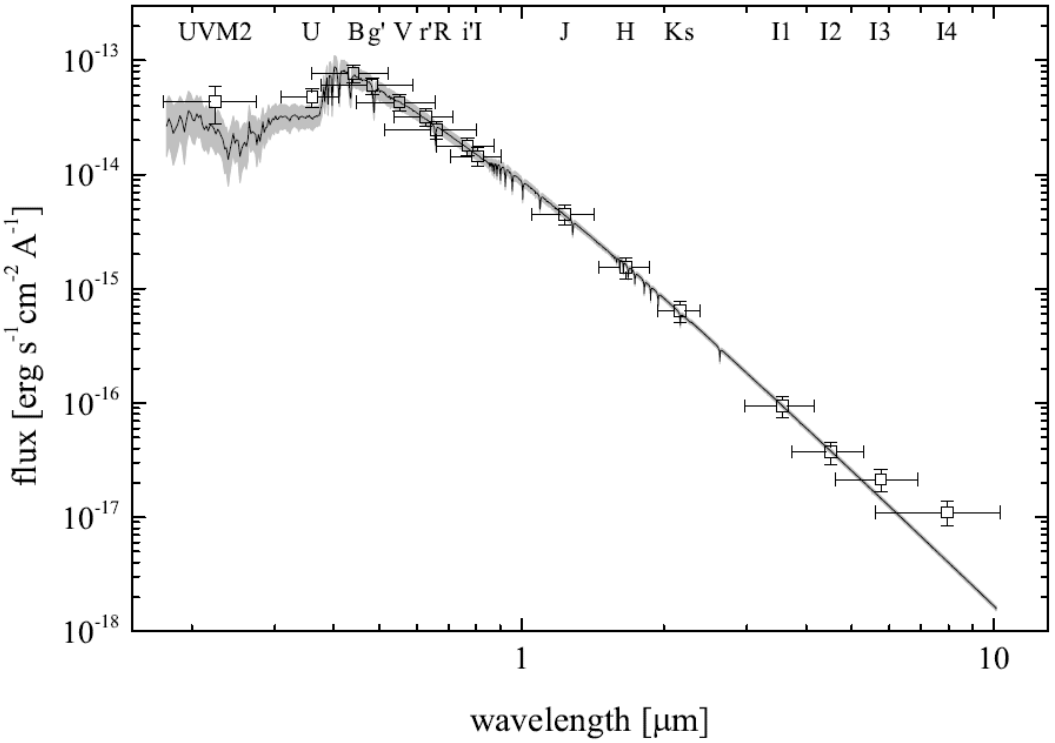
The very first PMS Am star?

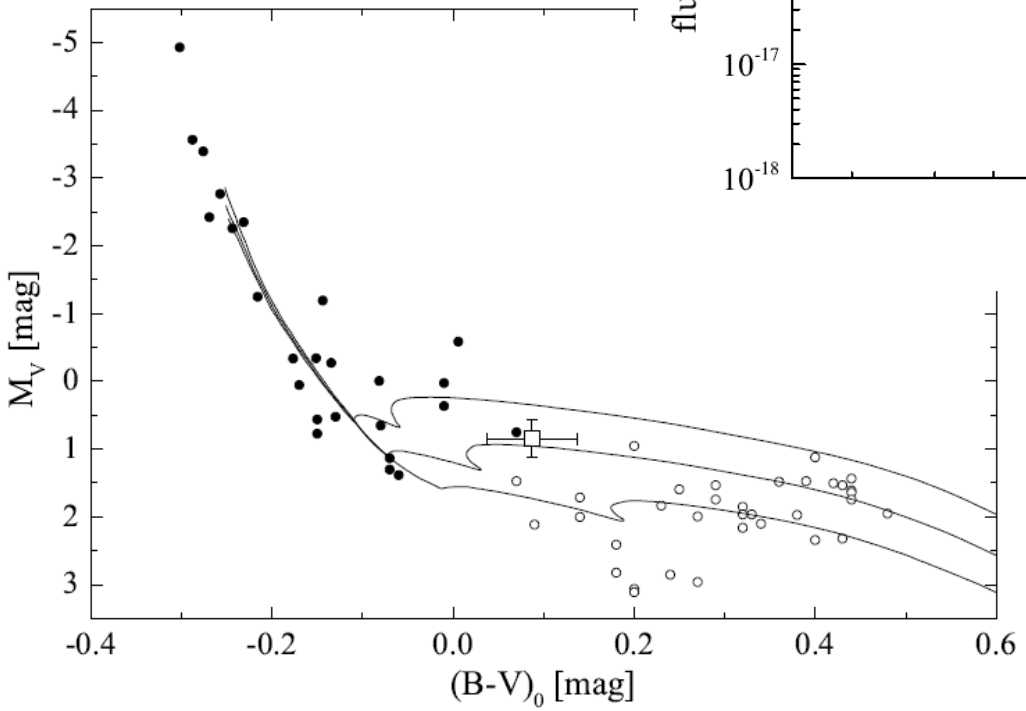
The cluster is part of the Cen OB1 association,
and the target star kinematic cluster member.



False colour image of the Stock 16 area using Spitzer Glimpse data

The very first PMS Am star?





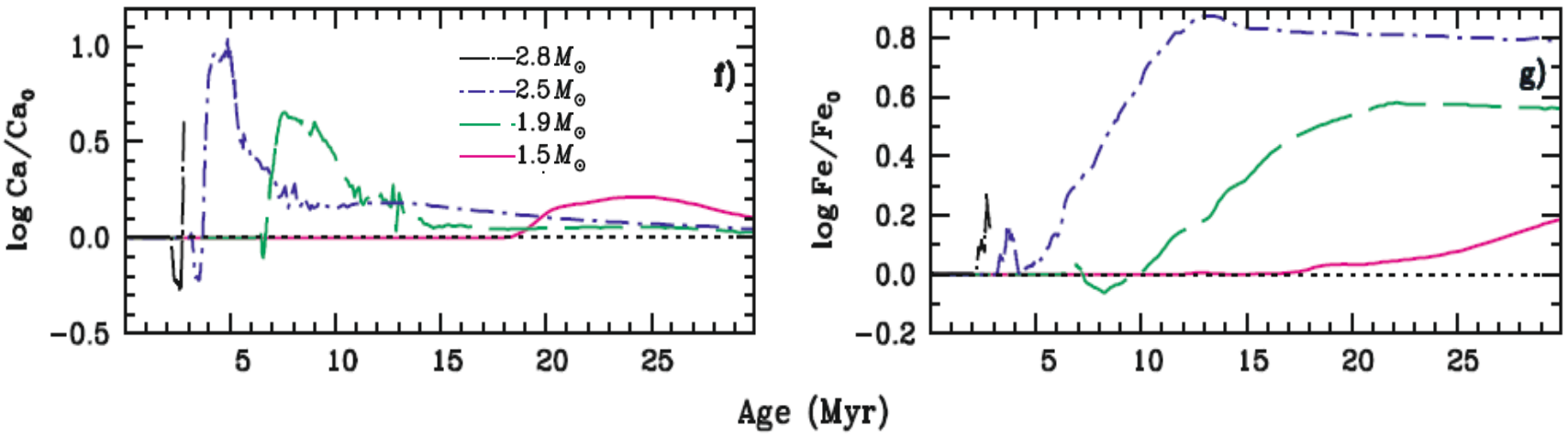
mass ~ 2.3M⊙; age ~4Myr

⇨ ~70% of PMS lifetime

The very first PMS Am star?

comparison to theory

Vick et al. 2011: stellar evolutionary models, including the effects of atomic diffusion



observed: Ca = -0.20 dex; Fe = +0.39 dex

Conclusion and Outlook

We have found the first PMS Am star, which shows already after 4Myr the typical Am abundance pattern (known from MS stars)

⇨ important constraint for diffusion theory

further observations just accepted (ESO DDT):

second epoche UVES spectrum ⇨ hint for binarity
2h @ FORS2 (polarimetry) ⇨ magnetic field?