The A-Star Puzzle
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The abundances of A/F and Am/Fm stars in open clusters

Richard Monier and Olivier Richard
GRAAL, Universite Montpellier II, Place E. Bataillon, 34095 Montpellier, France
email: Richard.Monier@graal.univ-montp2.fr, Olivier.Richard@graal.univ-montp2.fr

Abstract. A short review on abundance determinations of A and F dwarfs in the Hyades is presented. The spectroscopy was carried out with AURELIE, a monorder spectrograph at the Observatoire de Haute Provence (France) at a resolving power close to 40000 with Signal-to-Noise ratios varying from 100 to 300. Abundances of 11 chemical elements have been derived by using Takeda's (1995) procedure.

Keywords. Stars: abundances, stars: chemically peculiar, Galaxy:open clusters and associations: individual: Hyades, diffusion

1. Abundance determinations of A and F stars in the Hyades

Very few studies have so far addressed the chemical composition of A stars in the Hyades. They usually have focused on a very limited numbers of stars not necessarily well distributed in mass along the main sequence. For the Hyades cluster, Burkhart & Coupry (1989) have derived the abundances of Li, Al, Si and Fe for 5 Am and 1 A stars. Takeda & Sadakane (1997) found the abundances of O and Fe for 8 Am and 10 normal stars and Hui-Bon-Hoa & Alecian (1998) those of Mg, Ca, Sc, Cr, Fe and Ni for 4 Am and 2 normal A dwarfs. Varenne & Monier (1999) have determined the abundances of 11 chemical elements (C I, O I, Na I, Mg I, Si I, Ca I, Sc II, Fe I, Ni I, Y II, Ba II) for a much larger sample of stars: 19 A/Am dwarfs and 29 F dwarfs using AURELIE spectra centered at three wavelengths (6160 Å, 5080 Å and 5530 Å). These stars are regularly distributed in spectral type along the main sequence to sample the expected masses in a uniform manner. All these stars were analysed in a uniform manner using spectrum synthesis as a few of them are fast rotators. For the Hyades, Varenne & Monier (1999) found large star-to-star variations for the normal A stars in particular for O, Na, Ni, Y and Ba. The Am stars are almost all deficient in Sc and Ca and overabundant in Fe, Ni, Y and Ba and also show star-to-star variations. In contrast, the F stars show very little scatter in their abundances. The A stars show a much larger scatter than the F stars on graphs displaying the abundances of individual elements [X/H] versus the effective temperature ($T_{\rm eff}$). No convincing anticorrelation between the abundances and rotational velocity ($v_e \sin i$) was found.

2. Conclusions

In the Hyades, we find evidence for large star-to-star variations in the normal A stars and in the Am stars as in Coma Berenices. There is very little scatter among the F dwarfs in both clusters. We believe that the differences in abundances among the A stars born from the same original interstellar matter may be the signature of the occurence of transport processes in their interiors.

We are currently observing A/Am and F/Fm stars in other open clusters of various

Table 1. Abundances relative to hydrogen $[\frac{X}{H}]$ for the A stars in the Hyades. Values in brackets are uncertain.

VB	SpT	C I	O I	Na I	Mg I	Si I	Ca I	Sc II	Fe I	Ni I	Y II	Ba II
38	A3m				-0.22		-0.60	-1.31	0.12	0.10		
47	A7V/A8V	0.07	-0.11	0.26	-0.13	0.07	0.01	0.11	-0.06	0.20	0.30	0.02
54	A7IV/A6V	0.05	0.08	0.60	0.04	0.13	0.07	0.13	0.07	0.17	-0.10	-0.05
55	A7V/A6V		0.10	0.19	-0.64	-0.41	-0.36	0.06	-0.30	-0.52		-0.71
56	A2IV/Am	-0.20	-0.34	0.50	0.08	0.13	-0.02	-0.99	0.28	0.80	0.76	0.99
60	A8V		0.07	-0.28	-0.79	-0.60	-0.46	0.41	-0.57	-0.54		-0.94
67	A3m	-0.55	-0.46	0.19	-0.16	0.03	-0.47	⩽-1.2	0.19	0.33	0.70	0.77
72	A7III/A7IV	-0.15	-0.19	-0.40	-0.16	0.11	-0.14	-0.05	-0.13	0.12	0.00	-0.20
74	A7V/A5m	-0.10	-0.29	-0.06	-0.28	0.22	-0.31	⩽-1.5	0.17	0.49	0.50	0.78
82	A6IV/A7V		-0.37	0.08	-0.14	0.05	-0.03	0.11	0.07	0.48	0.74	0.48
83	A5m	-0.20	-0.43	0.23	-0.01	0.06	-0.26	-0.47	0.18	0.63	0.80	1.21
95	A8V/A7V	(-0.70)	-0.18	0.54	-0.01	-0.05	-0.08	0.22	0.10	0.27		0.70
104	A6V	0.00	0.09	0.54	0.05	0.05	0.16	0.17	0.02	0.14	0.11	-0.03
107	A5m/A9III		-0.08	0.45	0.14	0.22	0.15	0.27	0.23	0.52	0.60	0.57
108	A5V/A6V		0.02		-0.15	-0.11	0.12	0.21	-0.05	-0.05		-0.07
112	A2m	(-0.75)	-0.81	0.41	-0.03	0.17	-0.56	⩽-1.5	0.38	0.78	1.17	1.48
123	A7V/A9V				-0.02		-0.25	0.10	-0.24			
129	A7V	(0.00)	0.03	0.36	0.05	0.12	0.02	0.14	0.00	0.08		-0.03
131	A5m	-0.44	-0.49	0.16	-0.20	0.09	-0.23	-0.61	0.19	0.64	0.89	1.19
α CMi	F5IV/V	0.12	-0.12	0.05	0.06	0.03	-0.05	0.04	-0.02	-0.01	-0.07	0.03

ages with 2-meter class telescopes (Monier & Richard 2005) and will soon start observing more distant clusters with UVES.

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