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CPD -55° 5216: A COOL Ap STAR SHOWING EXTREMELY  
LARGE VARIATIONS AT 4100Å

In 1971-72 a large programme of uvby photometry of bright southern stars was carried out by Grønbech and Olsen (1976). Many visual companions brighter than about 9<sup>m</sup> were also observed for the purpose of a later investigation of visual double stars. CPD -55° 5216 (=CoD -55° 4778 = SAO 240236 = GC 17353 = IDS 12406S5556B) is a companion to HR 4848 (about 53" distant) for which two very discordant measures were obtained. Our immediate reaction was that two different companions had been measured, and since the magnitude and indices of the last measure fitted very well to the information in the Henry Draper catalogue concerning HD 110910 (8.9, A5), which is about 150" from HR 4848, this measure was ascribed to HD 110910 and so published in the catalogue.

To settle the matter beyond doubt two more uvby observations and two  $\beta$  observations were made of each star in 1976. Again, the two uvby measures of CPD -55° 5216 disagreed violently, and it was concluded that the two measures from 1972 did indeed both refer to CPD -55° 5216 (cf. Olsen, 1977).

In March-April 1977 twelve uvby observations were made and in the Table the 16 available measures are listed. The magnitudes  $u$ ,  $v$  and  $b$  on the standard system have been computed by combining the  $y$  (=  $V$ ) magnitude with the indices. The photometric variations are very remarkable, but not unique. In the  $u(3500\text{Å})$  and  $b(4700\text{Å})$  bands the range of variation is relatively small, 0.<sup>m</sup>08 and 0.<sup>m</sup>05, respectively, and the variations are approximately in the same sense, as shown by a graph or by the scatter in the  $(u-b)$  index, which is only 0.<sup>m</sup>019. In sharp con-

trast to this behaviour the  $v(4100\text{\AA})$  band, situated between  $u$  and  $b$ , shows a photometric range of  $0^m.25$ , while the  $y(5500\text{\AA})$  band has a more moderate range of  $0^m.12$ . However, the variations in  $v$  and  $y$  are in the opposite sense, as shown by the scatter in  $y + v/2$ , which is only  $0^m.019$ . As a consequence of the described variations, the indices  $(b-y)$  and  $m_1$  vary together, with ranges  $0^m.12$  and  $0^m.16$  respectively, while the Balmer discontinuity index  $c_1$  varies in the opposite sense with the range  $0^m.45$ . When the star is brightest, it is also reddest, has the largest  $m_1$  value, and the smallest  $c_1$  value. In the  $([m_1], [c_1])$  diagram the star jumps back and forth in a narrow band between the two extremes: the point  $(0^m.20, 0^m.90)$  corresponding approximately to an A7 type star near the ZAMS, and the point  $(0^m.39, 0^m.43)$ , which lies in a region populated by composite stars and cepheids, and on the red border of the region of cool Ap stars (cf. Figs. 3 and 5 in Cameron 1967).

Thackeray (1966) has obtained four spectra of CPD -55° 5216 (=HD 110956f) in order to determine the radial velocity, which is -4 km/s. Thackeray classifies the spectrum A3p and comments: "CaII weak. Some signs of spectral variation with mild features of a Cr star". Later, Andrews and Thackeray (1973) have published UB<sub>V</sub> photometry for CPD -55° 5216, but they do not refer to any photometric variability.

Andersen (1977, private communication) has obtained a  $20\text{\AA}/\text{mm}$  coude spectrogram (ESO 1.5 m telescope, HJD = 2443271.695). He gives the following description: "The spectrogram shows a late A type spectrum, but with the CaII K line far too weak. Several CrII lines are considerably strengthened, as are possibly also MnI  $\lambda\lambda$  4030-33 and EuII  $\lambda\lambda$  4205, 4129. The SiII and SrII lines do not appear enhanced, and the ScII lines not abnormally weak. There is a noticeable broadening of the lines, with  $v \cdot \sin i$  about 30 km/s. A rough measurement yields a radial velocity of -3 km/s, in good agreement with the value by Thackeray (1966). There is thus no indication of appreciable variation of the radial velocity".

There is no doubt that CPD -55° 5216 is a cool Ap star with very large photometric variations. It is very reminiscent of Osawa's star HD 221568, which has a smaller range in  $m_1$  and  $c_1$ , but a similar range in  $V$  and  $(b-y)$  (cf. Osawa 1967). Somewhat

smaller variations in the v band relative to neighbouring bands have also been found in HD 71866 and 125248, and, to an even lesser degree, in several other stars (cf. Adelman et al. 1976 and references therein). Adelman et al. explain this as partly due to two EuII bound-free discontinuities at  $4200\text{\AA}$ . The periods of the three stars just mentioned range from 7 to 159 days, while the period for CPD -55° 5216 (if it has a period) is considerably shorter, probably about 2 days. The star thus seems to be the most extreme in this group of Ap stars.

HR 7575 has also been found to show variations in the v band. In Cameron's (1967) investigation it was the Ap star with the largest  $m_1$  value, and his photometry was confirmed by Grønbech and Olsen (1976). However, a single measurement in August 1976 has yielded  $(V, (b-y), m_1, c_1) = (5^m.66, 0^m.051, 0^m.370, 0^m.665)$ . The u, b, and y magnitude thus show no changes, while v has changed by  $0^m.06$ . In this connection attention is drawn to Grønbech and Olsen's (1976) Table 4 and their notes to Table 2, which contain many variable Ap stars.

Since no further observations of CPD -55° 5216 are being planned at this observatory, we strongly recommend this noteworthy object to other observers. Simultaneous spectrographic and photometric observations should prove particularly valuable in investigations of the sources of the observed variations.

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HJD	V	b	v	u	b-y	m <sub>1</sub>	c <sub>1</sub>
2440000+							
1367.79664	8. <sup>m</sup> 716	8. <sup>m</sup> 895	9. <sup>m</sup> 408	10. <sup>m</sup> 387	0. <sup>m</sup> 179	0. <sup>m</sup> 334	0. <sup>m</sup> 466
1368.80087	8.778	8.871	9.163	10.328	0.093	0.199	0.873
2831.85748	8.792	8.889	9.171	10.331	0.097	0.185	0.878
2832.80867	8.704	8.889	9.369	10.373	0.185	0.295	0.524
3220.77962	8.712	8.894	9.406	10.400	0.182	0.330	0.482
3222.81860	8.794	8.890	9.204	10.355	0.096	0.218	0.837
3226.71967	8.704	8.901	9.398	10.383	0.197	0.300	0.488
3228.81928	8.773	8.906	9.267	10.376	0.133	0.228	0.748
3230.76144	8.806	8.903	9.174	10.365	0.097	0.174	0.920
3232.70323	8.732	8.914	9.358	10.385	0.182	0.262	0.583
3233.72544	8.821	8.920	9.201	10.389	0.099	0.182	0.907
3234.79941	8.755	8.914	9.354	10.411	0.159	0.281	0.617
3236.64818	8.802	8.884	9.176	10.347	0.082	0.210	0.879
3237.71561	8.720	8.894	9.339	10.391	0.174	0.271	0.607
3238.56246	8.757	8.922	9.320	10.372	0.165	0.233	0.654
3238.64723	8.767	8.925	9.300	10.377	0.158	0.217	0.702