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REDISCUSSION OF NOVA CrA 1981 DISTANCE

Caldwell (1981) estimated the distance to Nova CrA 1981 (ℓ = 358°, b = -14.4°) but several developments have since indicated that a re-evaluation of its probable distance is called for. These are, firstly, that the author misconstrued how to apply the nova t_2 calibration to begin with, secondly, that Honda has revised his discovery m_V by half a magnitude (Kozai, private communication), thirdly, that Duerbeck (1981) has recalibrated the nova (M_V : log $t_{3,V}$) relation, and fourthly, that Brosch (1981a-c) has also estimated the nova distance, using probably too large an intrinsic maximum brightness.

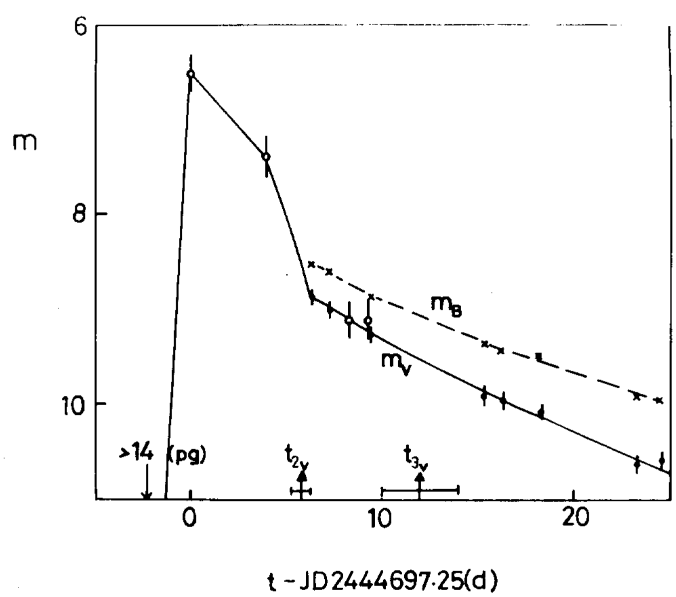

Figure 1
Light curve of Nova CrA 1981

Figure 1. gives the V (and partial B) light curve, with revised $m_{V,MAX}$ of 6.5, from the sources Gilmore (1981), Kozai and Kosai (1981, revised in private comm.), Cragg (1981, confirmed in private comm.), Mattei (1981), Vrba and Rydgren (1981), and Caldwell. The error bars shown are ± 0.2 for visual and ± 0.1 for photoelectric photometry; the latter arises principally from the system transformation uncertainty, while the former is intended to cover the scale uncertainty but not the transformation error, which may well be larger.

Brosch estimated the local Galactic extinction in the direction toward the nova as A_V (at 0.5 ± 0.12 kpc) = 0.32 ± 0.13 from Klare and Neckel's (1977) work. It may be noted that this extinction is slightly lower than that implied by the global absorption model used earlier by Caldwell, namely A_V (at 0.5 kpc) = 0.44. Rescaling that model to fit Brosch's information then yields A_V (at nova)= 0.45 ± 0.16 for the full path length through the disk towards the nova.

In the most recent treatments of the nova absolute magnitude calibration, three methods appear, namely the Duerbeck (M_V : log $t_{3,V}$) plot, the Pfau(1976) (M_B : log $t_{3,B}$) regression, and the Pfau $M_{15,B}$ standard magnitude. In Duerbeck's plot, Nova CrA, with log $t_{3,V}$ = 1.08 ± 0.08 would fall securely into the Group I (very fast or fast novae), which is characterized by log $t_{3,V}$ = 1.08 ± 0.28 (disp.) From his tables one further obtains that M_V (Group I) = -9.2 ± 0.5 (disp.), excluding the two most extreme "outriders," or -9.2 ± 1.0 including them. The result follows that $m_V - M_V - A_V$ = 15.25 ± 0.55 (from M_V : log $t_{3,V}$).

Pfau's work leads to two rather smaller modulus estimates, but not significantly so given the errors. His (M_B : log $t_{3,B}$) regression, combined with Duerbeck's $B-V_{MAX}$ = 0.35 ± 0.15 and our derived log $t_{3,B}$ = 1.36 ± 0.07, implies $m_B - M_B - A_B$ = 14.5 ± 0.55 (from M_B : log $t_{3,B}$). His $M_{15,B}$ figure of -5.74 ± 0.60, combined with our derived $m_{15,B}$ = 9.3 ± 0.1, implies $m_B - M_B - A_B$ = 14.45 ± 0.65 (from $M_{15,B}$). Combining the three results and using the dispersion as a conservative estimate of the uncertainty, one obtains m - M - A = 14.8 ± 0.5, along with the further results for Nova CrA 1981 given in Table I.

TABLE I: PARAMETERS OF NOVA CrA 1981

t_o	JD2444697.25
$t_{2,V}$	5.8 ± 0.5 d
$t_{3,V}$	12 ± 2 d
$m_{V,MAX}$	6.5 ± 0.2
$M_{V,MAX}$	-8.75 ± 0.5
A_V	0.45 ± 0.16
r	9 ± 2 kpc

The almost exact agreement between this distance, 9 ± 2 kpc, and the Brosch result of 9.1 kpc (when $m_{V,MAX}$ is updated to 6.5), is deceptive because he has adopted estimates for the nova intrinsic brightness and for the total interstellar extinction which we think are large overestimates that happen to cancel. Brosch adopted a total A_V (at nova) of 1.7 magnitudes, as inferred from the Hα:Hβ Balmer decrement, and attributed the extra 1.4 magnitudes (beyond the .3 in the local disk) to absorption by interstellar matter within the central bulge of the Galaxy (z~ -2.3 kpc). High absorption arising in circumstellar dust was not favored (Kunkel and Rydgren). One may object to Brosch's high extinction figure, firstly, because the Hα:Hβ decrement may well not yield a valid A_V for reasons discussed in Walker et al. (1979), Feast and Glass (1980), and Grinin (1980), and, secondly, because there is reason to believe the spheroidal population II to be nearly free from obscuring material.

On the other hand Brosch adopted an absolute magnitude for the nova at maximum of M_V = -10, on the basis of the spectral similarity of Nova CrA to Nova Cygni 1975; Duerbeck had obtained M_V = -10.1 for the latter. Nova Cygni 1975, by all accounts the most extreme example of its class (fast novae) yet observed in the Galaxy, had $t_{2,V}$ and $t_{3,V}$ of 2.5 and 3.6 ± 0.1 d, respectively. This is to be compared to $t_{2,V}$ = 5.8 ± 0.5 and $t_{3,V}$ = 12 ± 2 d for Nova CrA (Figure 1.), which suggests that Nova CrA is more plausibly an "average" Group I nova or about 1 fainter than Nova Cygni 1975 at maximum.

In summary, the similarity between our estimate and Brosch's, both placing Nova CrA in the central bulge of the Galaxy, comes down to the fortuitous circumstance that $(M_V + A_V)_{Cald}=(-8.75 + .45)=(-10 + 1.7) = (M_V + A_V)_{Brosch}$. We hope it has been useful to rediscuss the determination of a distance for Nova CrA 1981, firstly, to point out that it need not have been exceptionally luminous for its decay time, and, secondly, to give some indication of the uncertainties that can arise in a specific practical case of finding a nova distance.

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