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MULTI-COLOUR PHOTOMETRY OF THE UVn-TYPE VARIABLE, NS ORIONIS,
DURING AN EXCEPTIONALLY LONG-LIVED OUTBURST

The flare star, NS Ori (= Ton.157) is an H-alpha emission-line object in the Orion nebula aggregate (Haro 1953, 1968)^x. During a programme of photographic UBVR photometry (Andrews 1970) NS Ori was noted as exceptionally bright on a number of plates and the star appears to have undergone a major outburst lasting about two months. Classified by Parenago (1954) from the frequency function of random observations of magnitude the star is given as Class III (more frequently faint than bright) and the range is from $m_{pg} = 15.2$ to 17.6 (Rosino and Cian 1962). NS Ori is characterized by varying emission H-alpha strength and a conspicuous ultraviolet excess (Haro and Herbig 1955) and is of particular photometric interest in that it appears below the main sequence (Haro and Chavira 1969). The colorimetric behaviour of such objects is exceedingly complex (See e.g. Sinchetskul 1971) and they exhibit extreme departure from theoretical pre-main sequence evolutionary tracks. Interpreted as extremely young stars less massive than the sun and in the process of gravitational contraction these objects present considerable problems, but recent work suggests that they may be surrounded by infalling circumstellar dust shells.

The light curve, two-colour and colour-magnitude diagrams for NS Ori (Fig.1) illustrates the persistent nature of the blue and ultraviolet excesses over a wide range of apparent brightness. Seven nightly measures of UBVR are available which, apart from measure No.5, show $U-B = -1.4 \pm 0.3$ and $B-V = 0.4 \pm 0.1$, that is, approximately constant within the photoelectric accuracies. This places NS Ori well above the normal U-B/B-V relation for

^xA single flare of amplitude 1^m.5 (p.g.) has been detected on the first of two plates taken 2 hours apart (Rosino and Pigatto 1969) on 25/2/63, an event apparently mis-quoted in the Tonantzintla lists (Haro 1968) as an ultraviolet flare of 2 magnitudes. NS Ori is also stated elsewhere as varying by greater than 2 magnitudes in 19 hours (Haro 1953).

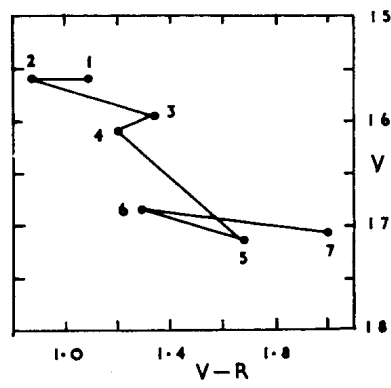
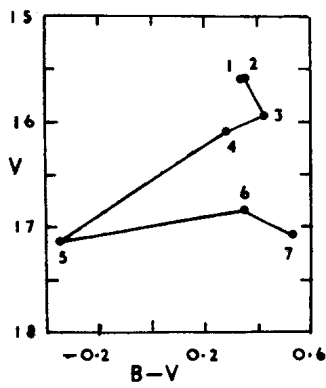
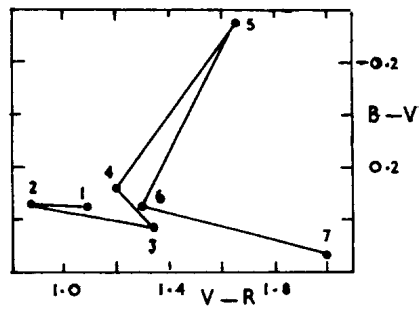
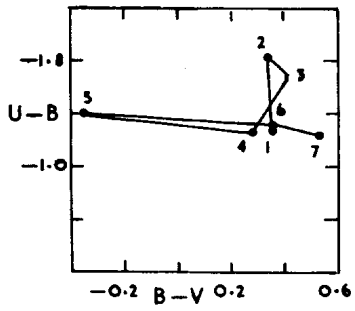
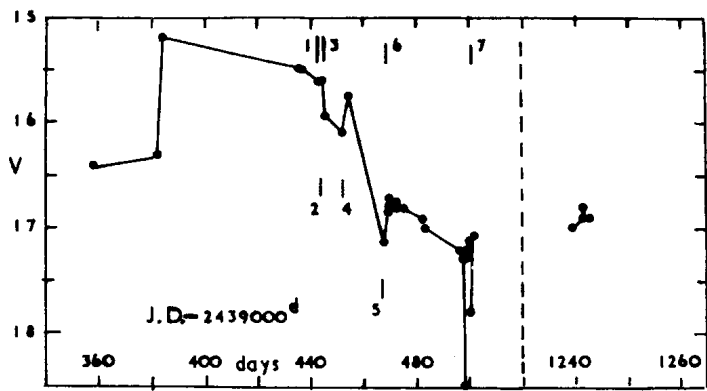


FIG. 1 Outburst of NS Ori

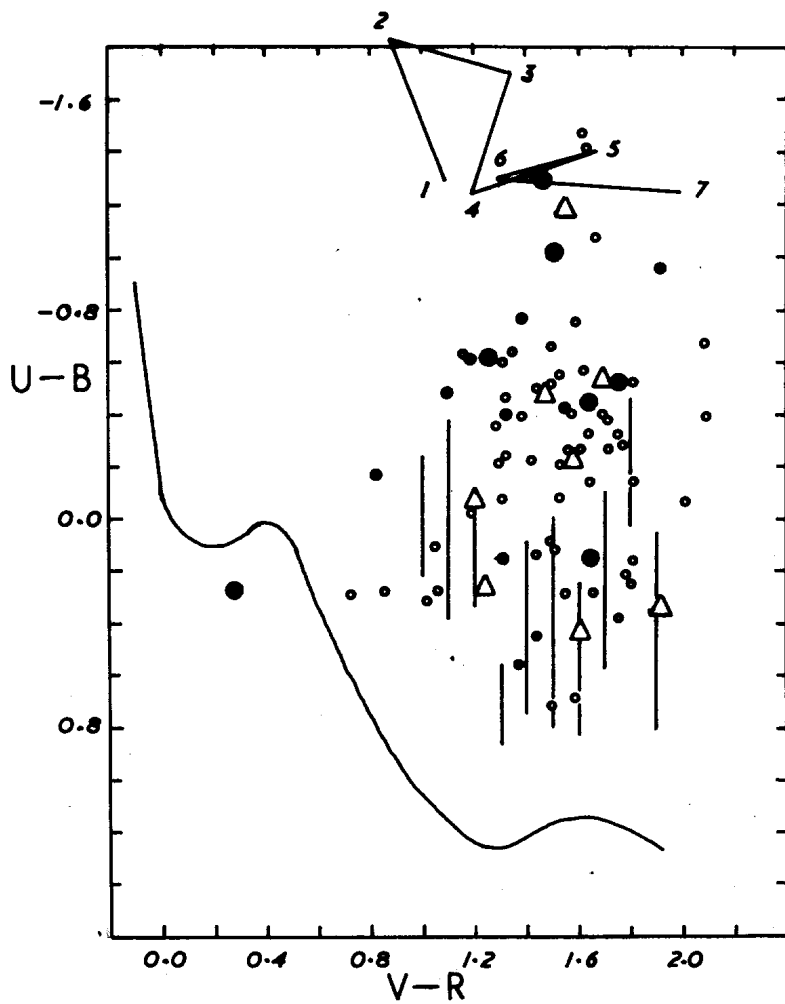


Fig.2

EXCURSION OF NS ORI IN U-B/V-R DIAGRAM COMPARED WITH MEAN DATA FOR 278 FLARE STARS (vertical lines - See Text) AND H-ALPHA EMISSION STARS IN ORION.

Emission Strength : Permanent, strong (filled circles); Variable, strong triangles ; Temporary or weak (open circles) according to Haro (1953).

main sequence stars, and indeed, shows this star as an extreme case as regards the colour anomalies of the flare stars and emission objects of the Orion aggregate (Andrews 1972). See Fig.2 in which the track of NS Ori is shown in relation to the U-B/V-R distribution of Orion flare and emission stars. The presence of emission H-alpha is seen to be an important spectroscopic criterion in establishing which stars present the most anomalous U-B colours. In Fig.2 the emission stars are designated with symbols according to their relative emission-line strength (Haro 1953), and the flare star distribution, excluding those in which emission H-alpha has been observed, is depicted as vertical lines representing the dispersion in U-B at constant V-R (in steps of $0^m.1$). In the colour-magnitude diagrams NS Ori remains well below the main sequence at both maximum and minimum in B-V/V but moves redward with decreasing brightness in V-R/V remaining essentially within the band defined by other flare and emission stars, at all times elevated above the main sequence. The variable exhibits the largest change in colour in V-R (about 1 magnitude) due to its much smaller amplitude in the red spectral region. The latter result emphasizes the importance of taking into consideration the variability of emission stars in the evolutionary interpretation of the V-R/V diagram of young aggregates (See e.g. Sedyakina 1971).

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15 June 1972

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