THE 1987 OUTBURST OF THE RECURRENT NOVA U SCO

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ABSTRACT. Spectral observations obtained soon after the 1987 brightening of U Sco support a thermonuclear runaway model for outbursts of this object. Spectra later in the decline are, however, more characteristic of a hot accretion disc. These observations are reconciled in a model where the low-mass high-velocity shell ejected from the surface of the white dwarf collides with the accretion disc causing it to brighten.

1 INTRODUCTION

The recurrent nova U Sco, has the fastest decline rate of all known novae and one of the shortest documented recurrence times amongst recurrent novae. Its outbursts have been modelled as thermonuclear runaways (TNRs) on a white dwarf with a mass near the Chandrasekhar limit (Starrfield et al. 1985, Webbink et al. 1987). It is therefore seen as a likely precursor of a type I supernova. We have obtained observations in May 1987 during the fifth recorded outburst. Of particular interest is an optical spectrum obtained closer to visual maximum than any previous spectra.

2 THE 1987 OUTBURST

Overbeek, who regularly monitors U Sco, found it to be at $m_V = 10.8$ on 1987 May 16.09. It appears that maximum light must have occurred around May 12/13 when U Sco was unobservable due to its close proximity to the moon. This highlights the possibility of missing completely such a rapidly evolving outburst. Subsequent photometry and spectroscopy suggest that this was in all respects a normal maximum. The recurrence time of previous recorded outbursts of U Sco averaged 39 yr. Theoretical models of TNRs were able to match this time scale only by assuming the mass of the white dwarf was at the Chandrasekhar limit. The last interval of only 8 yr between outbursts obviously presents a challenge to these models.

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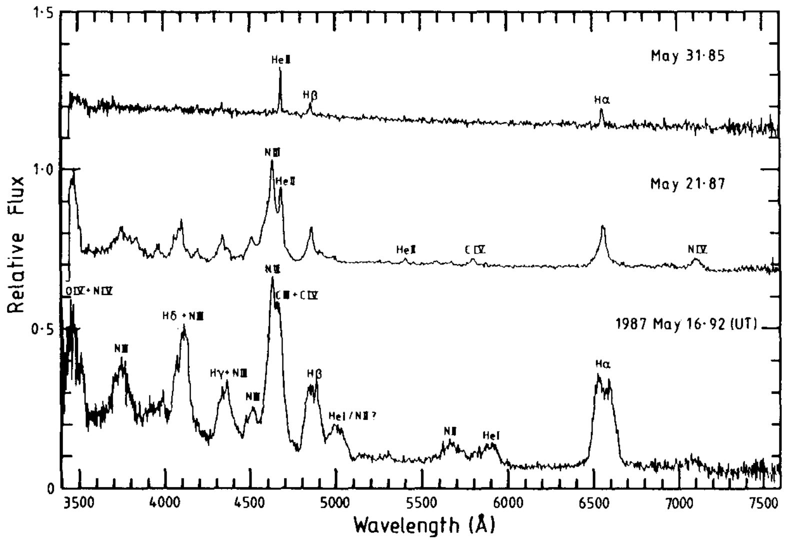

Fig. 1. Spectra of U Sco obtained approximately 4, 9 and 16 day after the estimated time of visual maximum.

3 SPECTRA

The spectra shown in Figure 1 were obtained at SAAO at approximately 4, 9 and 16 day after the estimated time of maximum light. They can be compared with spectra obtained during the 1979 outburst and discussed by Barlow et al. (1981).

The earliest spectrum shows the broad (FWZI ~ 10000 km s^{-1}) flat-topped emission lines indicative of an optically thin shell expanding at constant velocity. Presumably the result of a low-mass shell ejected at high velocity (~5000 km s^{-1}) following the TNR. In contrast the last spectrum shows only narrow (FWZI ~ 1500 km s^{-1}) emission lines of HI and HeII. It is similar to that seen in U Sco during quiescence (Hanes 1985) which has been interpreted as originating from an accretion disc (Webbink et al. 1987). We therefore suggest that although the outburst on U Sco originates as a TNR its later development is due to brightening of the disc caused by the impact of TNR ejecta.

A paper presenting the detailed observations and discussion summarized here has been submitted to Monthly Notices of the Royal Astronomical Society.

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