Binary Paths to Type Ia Supernovae Explosions
Proceedings IAU Symposium No. 281, 2011
R. Di Stefano, M. Orio, & M. Moe, eds.

doi:10.1017/S1743921312014974

The Helium Abundance in the Ejecta of U Scorpii

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Abstract. U Scorpii was observed in outburst for the tenth time in January 2010. We obtained optical and near-infrared spectroscopy from which we derive a helium abundance of $N(\mathrm{He})/N(\mathrm{H}) = 0.056 \pm 0.020$ from the most reliable lines available; this is lower than most other estimates and indicates that the secondary is not helium-rich, as previous studies have suggested. Velocities are found to be up to 14,000 km s^{-1} in broad components and up to 1,800 km s^{-1} in narrow line components. The reddening of U Sco is found to be $E(B-V) = 0.14 \pm 0.12$.

Keywords. stars: novae, cataclysmic variables, abundances, individual (U Scorpii)

1. Introduction

U Scorpii is a recurrent nova which has been observed in outburst on 10 occasions, most recently on 2010 January 28.19±0.17 (Schaefer *et al.* 2010). The system consists of a white dwarf primary with a mass close to the Chandrasekhar limit (Thoroughgood *et al.* 2001) and a probable subgiant secondary (Anupama & Dewangan 2000; Hanes 1985). U Sco is an eclipsing system with an orbital period of 1.23 days (Schaefer & Ringwald 1995). The system is at a distance of 12 ± 2 kpc and is far out of the galactic plane at a height of 4.5 kpc (Schaefer 2010). We present optical and near-infrared spectroscopy covering the first 13 days of the 2010 outburst, which can be seen in Figures 1-3.

2. Results

From these spectra we determine the abundance of He I in the ejecta to be 0.012 ± 0.015 from the line at 6678Å. We determine the abundance of He II in the ejecta to be 0.061 ± 0.010 from the line at 1.163 μm and 0.027 ± 0.009 from the line at 4686Å.

We find velocities in the ejecta to be up to 14,000 km/s in broad components and up to 1,800 km/s in narrow components. We derive the reddening to be E(B-V) = 0.14 ± 0.09 from hydrogen lines on days 8.81 and 9.43; our result is consistent with previous studies.

The helium abundances determined here are lower than most previous estimates (Anupama & Dewangan 2000; Evans *et al.* 2001); this suggests that the system does not have an over-abundance of helium and that the white dwarf is not accreting helium-rich material. Further details can be found in Maxwell *et al.* (2011).

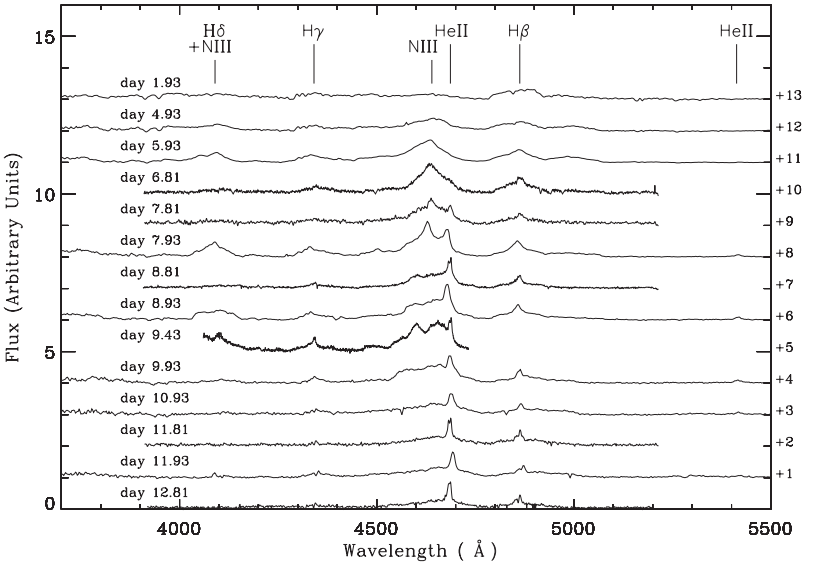

Figure 1: Spectra of U Sco from Liverpool Telescope (LT; days ending .81), Cerro Tololo Inter-American Observatory (day 9.43), and South African Astronomical Observatory (SAAO; days ending .93). Spectra are offset; flux is in arbitrary units. LT spectra are smoothed with a Gaussian profile.

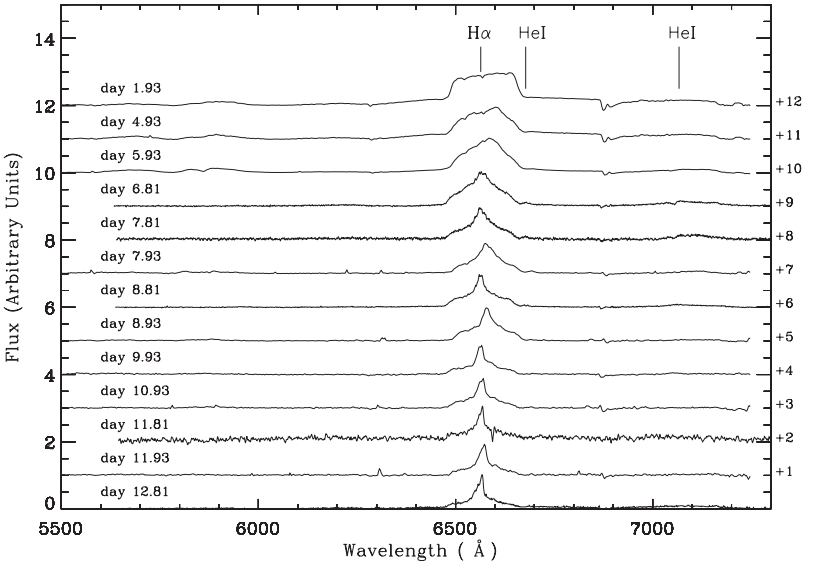

Figure 2: Spectra of U Sco taken from day 1.93 to 12.81 at LT (days ending .81) and SAAO (days ending .93). The spectra are offset as indicated and the flux is in arbitrary units. LT spectra are smoothed with a Gaussian profile.

https://doi.org/10.1017/S1743921312014974 Published online by Cambridge University Press

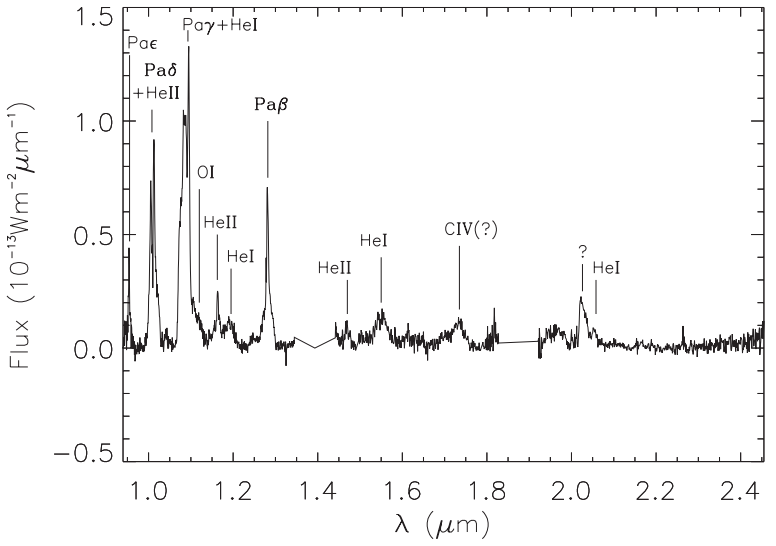

Figure 3: IR spectrum of U Sco taken at the New Technology Telescope on day 9.43 of 2010 outburst.

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