VLT-CRIRES Observations of Eta Carinae’s Ejecta: Weigelt Condensations and Strontium Filament

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5 Sveneric and Vladilen tragically passed away during the past year.

Introduction

We have obtained Very Large Telescope-CRIRES observations of Eta Carinae, focused on the Weigelt condensations (WC) and the Strontium Filament (SrF). These are nebular regions, in the close vicinity to Eta Car, with complex emission line spectra. The two regions show, however, strikingly different physical conditions and abundances. The WC are driven by far-UV radiation from the hot companion (Eta Car B). The radiation is internally redistributed to hydrogen emission which enables exotic atomic photo processes, such as Resonance Enhanced Two-Photon Ionization (RETPI) and stimulated emission (LASER). The lines proposed for the stimulated emission are the 1.68 and 1.74 µm transitions from the cF7/2 level in FeII (i.e. the spectrum of Fe	extsuperscript{+}).

The Strontium Filament received its name from the initial discovery of forbidden [SrII] lines from singly ionized strontium. The analysis have revealed strange abundances (see separate poster by Bautista et al. at this meeting), and spectral lines with complex line profiles. The main emission component is consistent with a creation of the ejecta in the 1890s.

We present a preliminary analysis of the ejecta in the NIR, using high spectral (R=90,000) and spatial resolution (~0.3") spectra obtained with CRIRES in April 2007. The data allow us to study the individual ejecta in detail, at a spectroscopic phase where

Spatial structure

The high spectral and spatial resolution provided by VLT-CRIRES clearly separates out spectral features of WC and the SrF from the stellar components. In Figure 1 the difference is seen, where the forbidden [SrII] line at 10326 Å is very weak compared to the [SII] line at 10285 Å, which originates from the SrF. The stellar contribution is removed.

The position angle was chosen to include the star, the WB located 0.2" NW of the star and the SrF located 1-2" in the same direction (Figure 3). It was thus possible to observe all these three spatial locations, using a single slit orientation.

CRIRES can only observe a limited wavelength range in a single exposure. The wavelength ranges were chosen to especially cover 1041 Å lines (max. FeII for WC) and [TIII]/SrII (SrF). The blue shifted Hubble law structure of the SrF can be seen in the 10300 Å line. A spatial extrapolation to the star (zero offset) results in zero radial velocity, which is consistent with a single ejection scenario around year 1890, with a velocity dispersion producing the present structure.

Figure 1: The [SII] lines at 10287 and 10321 Å come from the Weigelt blobs, whereas the [TIII] at 10306 Å and the weaker SrII at 10326 Å are emitted from the Strontium filament. The spectrum is normalized to the stellar continuum, to enhance the visibility of the weaker emission lines. (The 10312 line is from the star)

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Figure 2: Extractions at different angular offsets from the star, corresponding to slices in the 2D spectrum above. The angular difference between two adjacent slices is 0.17", ranging from 0.8-2.5" offset. The stellar background is not subtracted in these spectra, which is the case for Figure 1 to enhance the weak features.

Figure 3: HST image of Eta Carinae (left) and an NIR image showing the central part with the Weigelt blobs (WB) and Strontium Filament (SrF) marked. The brightest lines in the central object.