

## The 1989 and 2015 outbursts of V404 Cygni: a global study of optical features.

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### Abstract

The black hole transient V404 Cygni exhibited a bright outburst in June 2015 that was intensively followed over a wide range of wavelengths. Our team obtained high time resolution optical spectroscopy ( $\sim 90$  s), which included a detailed coverage of the most active phase of the event. We present a database consisting of 651 optical spectra obtained during this event, that we combine with 58 spectra gathered during the fainter December 2015 sequel outburst, as well as with 57 spectra from the 1989 event. We previously reported the discovery of wind-related features (P-Cygni and broad-wing line profiles) during both 2015 outbursts. Here, we build diagnostic diagrams that enable us to study the evolution of typical emission line parameters, such as line fluxes and equivalent widths, and develop a technique to systematically detect outflow signatures. We find that these are present throughout the outburst, even at very low optical fluxes, and that both types of outflow features are observed simultaneously in some spectra, confirming the idea of a common origin. We also show that the nebular phases depict loop patterns in many diagnostic diagrams, while P-Cygni profiles are highly variable on time-scales of minutes. The comparison between the three outbursts reveals that the spectra obtained during June and December 2015 share many similarities, while those from 1989 exhibit narrower emission lines and lower wind terminal velocities. The diagnostic diagrams presented in this work have been produced using standard measurement techniques and thus may be applied to other active low-mass X-ray binaries. (See poster).