

# Spectropolarimetry of the BL-Ic SN 2014ad

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**Abstract.** Over the past two decades a clear relation between Gamma-Ray Bursts (GRBs) and some broad-lined Type Ic Supernovae (SNe) has been observed. The use of spectropolarimetry allows us to directly probe the 3D geometry of the unresolved ejecta of SNe, which can help us better understand the physics of their explosion and the SN-GRB connection. We present 7 epochs of spectropolarimetry of the broad-lined Type Ic SN 2014ad and highlight its similarities with SN 1998bw.

## 1. Introduction

Massive stars that have been stripped of their outer hydrogen and helium layers end their lives as Type Ic SNe. Some of these SNe exhibit very broad spectral features caused by high ejecta velocities (as high as 30,000 km/s): they are called broad-lined Type Ic (BL-Ic). A number of BL-Ic have been connected to LGRBs and X-ray Flashes: e.g. SN 1998bw, SN 2003dh and SN 2006aj (Patat *et al.* 2001, Stanek *et al.* 2003, Sollerman *et al.* 2006). The question of the differences in the explosion mechanism between normal Type Ic SNe and BL-Ic SNe has not yet been fully answered.

## 2. Overview

The spectropolarimetric data obtained for SN 2014ad consists of 7 epochs spanning 68 days, starting 2 days before V-band maximum, which is the best spectropolarimetric data set ever obtained for a BL-Ic SN. Additionally we also acquired 8 epochs of spectroscopy, ranging from 2 days before to 107 after V-band maximum. The spectroscopic data revealed that SN 2014ad closely resembles SN 1998bw. The similar levels of broadening suggest similar photospheric velocities. The spectra of SN 2014ad are dominated by blended Fe II features in the blue and the Ca II IR P-Cygni profile in the red. Additionally a strong Si II feature appears by 5 days after V-band maximum. The degree of polarisation of SN 2014ad shows the most structure at the first epoch, with polarised Si II, O I and Ca II features. By +5 days there are only 3 visible peaks, associated with O I, Si II and a blend of Ca II and O I. The  $q-u$  plots of the first 3 epochs show a strong dominant axis suggesting an axial symmetry, as well as O I and Ca II IR loops indicating departures from axial symmetry. The evolution of the O I and Ca II loops is also reminiscent of the other BL-Ic SN 2002ap (Patat *et al.* 2003).

Further results and figures will be published in Stevance *et al.* (2017).

## References

- Patat *et al.* 2001, *ApJ*, 55:900-917
- Patat *et al.* 2003, *ApJ*, 592:457-466
- Sollerman *et al.* 2006, *A&A*, 454:503-509
- Stanek *et al.* 2003, *ApJ*, 591:L17-L20