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SN 1997ab and its progenitor's wind

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Abstract. SN 1997ab belongs to a class of luminous type II SNe which are thought to be powered by the interaction of the shock wave with a dense circumstellar medium. We report the discovery of narrow P-Cygni profiles atop broad Balmer emission lines, an unambiguous signature of a dense and slow circumstellar wind due to mass loss in the final stages of the progenitor's life.

1. What was SN 1997ab?

SN 1997ab is a new member of a growing list of peculiar type II SNe which are characterized by a high luminosity, slow decay, strong broad emission lines with no P-Cygni absorptions, and sometimes large radio and X-ray luminosities. SN 1997ab was first detected on April 11, 1996 in a QSO survey, showing broad (FWHM $\simeq 3000$ km s^{-1}) Balmer emission lines (Hagen *et al.* 1997), and was still bright *one year after its discovery*, with $M_B = -17.5$. The standard explanation for these sources (Chugai 1991; Terlevich *et al.* 1992) demands the interaction of the SN shock with a dense circumstellar medium ($n_{\rm CSM} \geq 10^6$ cm^{-3}). The dense medium promotes the early entry into the radiative phase, with cooling causing the collapse of the swept up gas into a thin shell while still moving at several thousands of km s^{-1}, producing an outburst capable of ionizing the cooling shell, the unshocked ejecta and the surrounding gas. This causes the most luminous and fast evolving remnants, although they only acquire sizes of $\sim$ a few 10^{16} cm, and hence have been termed "compact" SN remnants (cSNRs).

2. P-Cygni lines and the progenitor's wind

SN 1997ab surprised us when we detected narrow (FWZI $\simeq 180$ km s^{-1}) P-Cygni profiles *atop* the much broader Hα and Hβ emission lines (Figure 1). The P-Cygni line most likely originates in the slowly expanding, dense medium into which the cSNR shock evolves. From the analysis of the broad lines one can derive the physical conditions of the SN ejecta and its main shock, while the narrow P-Cygni lines tell us about the velocity, mass loss rate and radial extent of the progenitor's wind (Salamanca *et al.* 1998). The detection of such a pre-SN wind wind thus opens a window possibility to study mass loss in the very

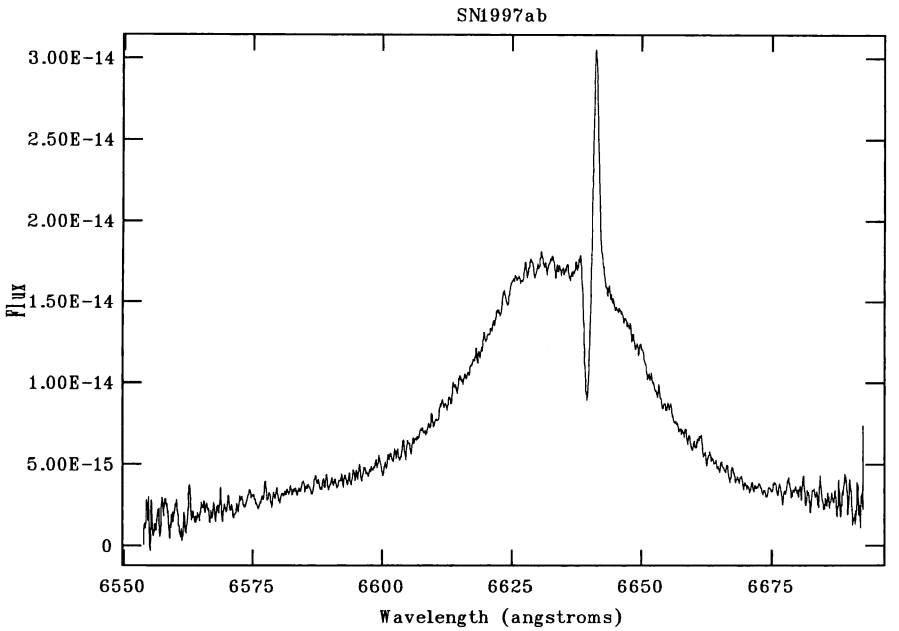

Figure 1. Hα echelle spectrum of SN 1997ab obtained at the *WHT*.

final stages of stellar evolution! Furthermore, the complex line profiles observed in SN 1997ab offer an interesting problem to radiative transfer theory. The formation of the P-Cygni lines in SN 1997ab differs from the classical case (*e.g.*, WR stars) where an expanding wind draws photons from an inner photosphere. Here, the absorbed photons come mostly from the inner fast moving region which produces the broad lines, thus introducing modifications in the line transfer problem due to radiative coupling between the "broad line region" and the outer slow wind (Cid Fernandes 1999).

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