NLTE CALCULATIONS OF HYDROGEN LINE PROFILES FOR SN1987A

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The synthetic line profiles presented here are the result of a series of models:

- Woosley's (1988) calculation of the stellar explosion yield the **luminosity**, the **density** and the **velocity** structure of the expanding SN as a function of time (Woosley's model 10HM was used)
- subsequent Monte Carlo simulations of the radiation transport in the expanding photosphere are based on the atmosphere structure given by the model above for a given time. The calculations take into account tens of thousands of lines and yield the line blanketed continuum flux and the **temperature** structure.
- The previous two models specify the physical condition of the expanding shell. With a third model the NLTE populations of 10 H and 12 He levels are determined and the emergent hydrogen lines profiles are obtained. The method of solving the NLTE problem is described by Wessolowski et al. (1988) and references therein.

The resulting hydrogen line profiles are given in Fig. 1. They are the result of essentially **ad initio** calculations: the free parameters are already determined by Woosley's calculations. The agreement of the theoretical profiles with the observed ones has to be called not too bad, keeping in mind how they are obtained: the ad initio modeling. But certainly, the synthetic profiles do not reproduce the observed ones. The question is, why not? In order to get an answer, several model parameters have been varied:

- the number of levels of the atomic hydrogen model
- the helium abundance
- the temperature outside the continuum formation region
- the luminosity (i.e. temperature structure in deeper layers)
- the treatment of line blanketing in the NLTE calculations
- the density structure

With the exception of the last point, all these variations resulted only in negligible to moderate changes of the line profiles, which were clearly not able to explain the observed discrepancy. However, the variation of the density structure caused a change of the desired order of magnitude. This might be the explanation why Höflich (1988)

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is able to reproduce the observed hydrogen line profiles. However, Höflich's calculations are based on a completely different density structure than the one resulting from Woosley's model-calculation.

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References

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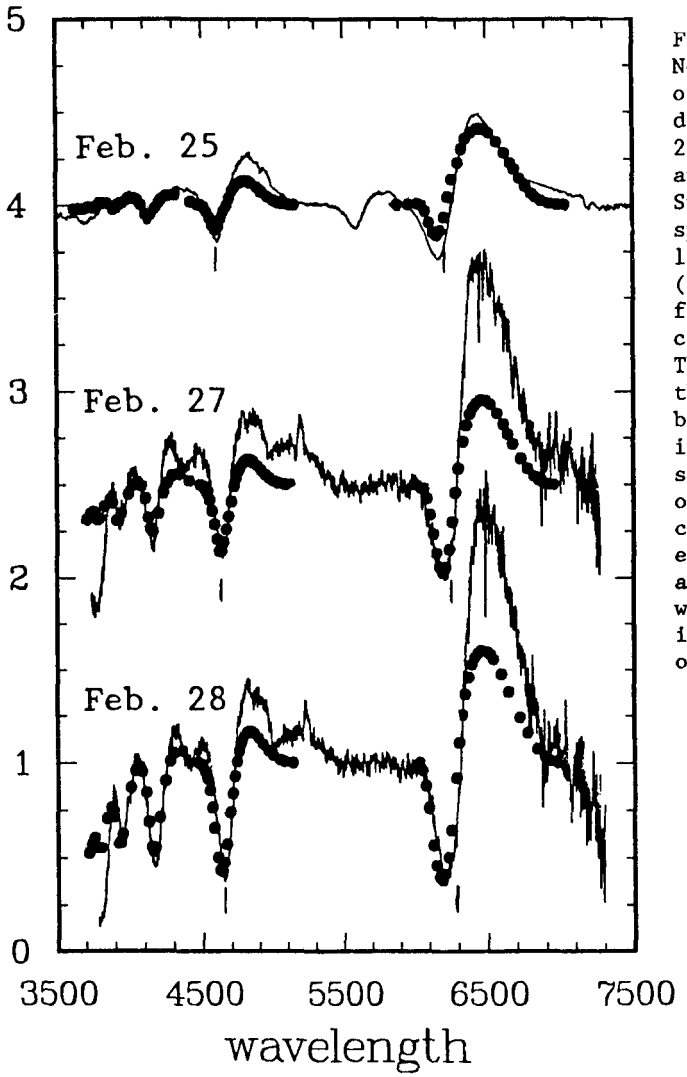

Figure 1. Normalized spectra of SN1987A for three dates: 4:00 UT Feb. 25, 0:40 UT Feb. 27. and 0:30 UT Feb. 28. Superimposed are the synthetic hydrogen line profiles (dots), calculated for the corresponding dates. The tick-marks below the H alpha and H beta profiles indicate the blue-shifted wavelength of the line corresponding to the expansion velocity at the location where the continuum is formed (Rosseland optical depth 2/3).

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