

Time-dependent ionization in the envelope of supernovae of type II during the photosphere phase

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The importance of allowance for the time-dependent effect in the kinetics at the photospheric phase during a supernova explosion has been confirmed by several independent research groups [1, 2]. The time-dependent effect provides a higher degree of hydrogen ionization in comparison with the steady-state solutions and strengthens the H α line in the resulting simulated spectrum, with the intensity of the effect increasing with time. However, some researchers [3] argue that the time-dependent ionization effect is unimportant. Its allowance leads to an insignificant strengthening of H α in their modeling only in the first days after explosion. We have demonstrated the importance of the time-dependent effect with the models of SN 1999em as an example using the new original LEVELS software package [4]. The role of a number of factors that can weaken the time-dependent effect has been checked. We have confirmed that the intensity of the effect is affected by the abundance of metal admixtures in the envelope, while the addition of extra levels to the model hydrogen atom weakens the time-dependent effect to a lesser degree and never removes it completely. Accounting for the fine structure of hydrogen also does not cancel time-dependent effect.

References

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