SNe 2012A and 2012aw: two recent nearby type II supernovae

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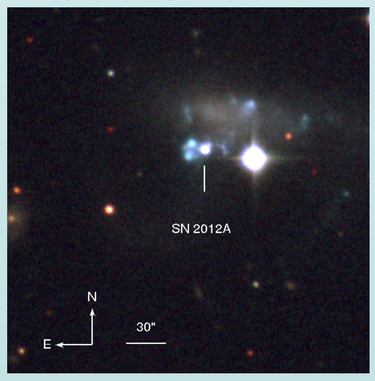
Type II supernovae are promising distance indicators. We present follow-up observations of two nearby SNe, 2012A and 2012aw. We model the spectra with SYNOW and use them to determine the photospheric velocities. These velocities, along with the photometric data are then used to calculate distances via the expanding photosphere method. We get D = 11.2 ± 2.0 Mpc and D = 8.4 ± 0.8 Mpc for SNe 2012A and 2012aw, respectively.

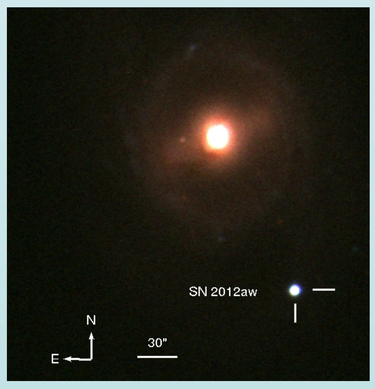
Introduction

SN 2012A in NGC 3239 was discovered on January 7.4 UT by Moore, Newton and Puckett and was classified as a young type II SNe on January 10.15 UT (Luppi et al. 2012).

SN 2012aw in M95 was discovered on March 16.9 UT by amateur astronomers (Fagotti et al., 2012). On March 15.3 UT there was a non-detection (lim. mag., Poznanski et al., 2012). We adopt the time of explosion as March 16.1 ± 0.8 UT. Both the light curve and the spectral evolution are typical for a normal Type II-P SN.

Fig.1: *BVI* color images of SN 2012A (left) and SN 2012aw (right). The images were taken at Piszkéstető Mountain Station, Hungary on days +28 and +9 after explosion, respectively.



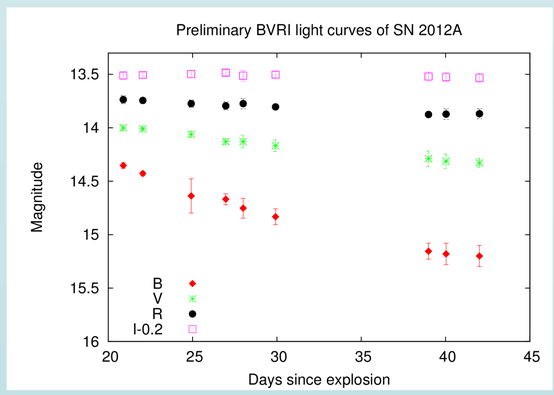


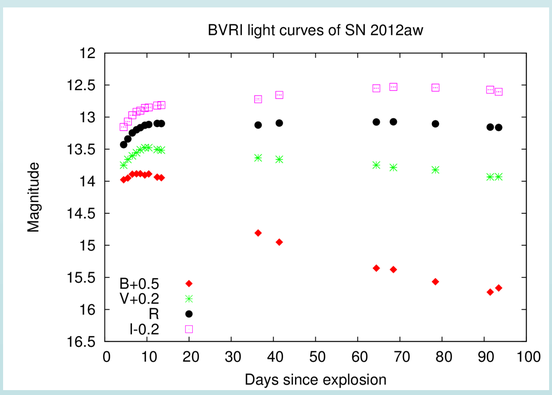
Photometry

The photometric follow-up was carried out from Piszkéstető Mountain Station of Konkoly Observatory, Hungary using the 60/90 cm Schmidt telescope, equipped with Bessel *BVRI* filters.

In the case of SN 2012aw we used aperture photometry to measure the brightness of the SN, while for SN 2012A PSF-photometry was performed. Note, that in the latter case the background arount the SN is complicated, so the light curve presented here is only preliminary, further measurements using image subtraction will be done after the disappearence of the SN.

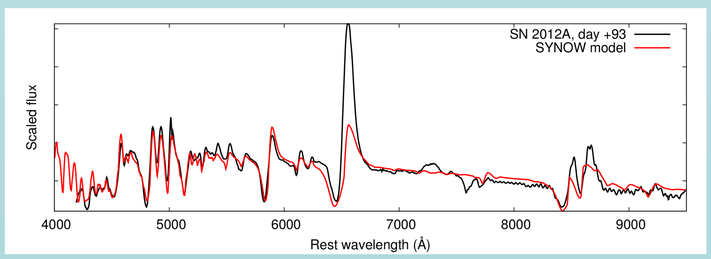
Fig.2: *BVRI* light curves of SN 2012A (left) and SN 2012aw (right). Note, that in the case of SN 2012A only preliminary results are presented.





Spectral modeling and the velocity curves

Fig. 3.: We created SYNOW models of several spectra of both SNe, taken with the FAST spectrograph mounted on the 1.5m Tillinghast telescope at FLWO, Arizona and with the Marcario Low Resolution Spectrograph on the 9.2m Hobby-Eberly Telescope at McDonald Obs., Texas. An example of the modeling in the case of SN 2012A is shown below.

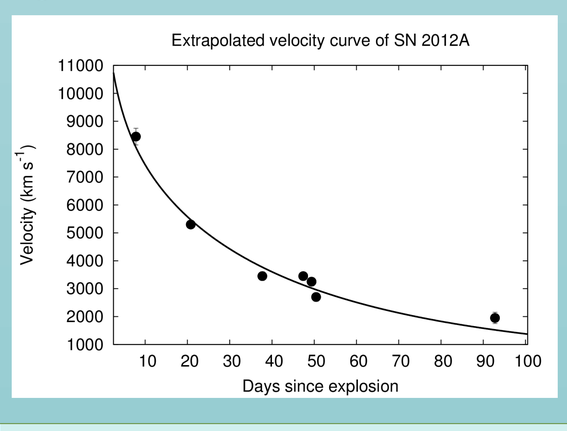


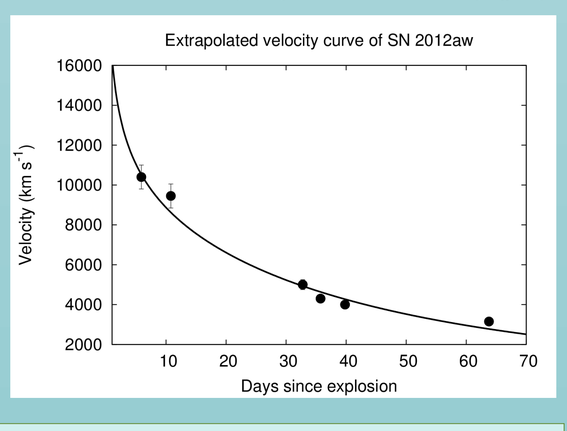
The expansion velocities (v) were measured using these SYNOW models and were extrapolated to the epochs of photometry using the equation of Takáts & Vinkó (2012):

$$v(\Delta t)/v(50\mathrm{d}) = \frac{(\Delta t/50\mathrm{d})^{a}}{\Sigma_{j=0}^{2} b_j (\Delta t/50\mathrm{d})^{j}} \qquad (1)$$

where Δt is the elapsed time since the explosion (t_0), and both v(50d) and t_0 were fitted simultaneously.

Fig.4: Measured and extrapolated velocities of SNe 2012A (left) and 2012aw (right).





Distance measurements

We applied the expanding photosphere method (EPM, Kirschner & Kwan, 1974) to measure the distances. We used the minimization technique of Hamuy et al. (2001):

$$\sum_{\lambda \in S} \frac{(m_\lambda + 5\log(\theta\zeta) - b_\lambda(T_S))^2}{\sigma_m^2} = min. \qquad (2)$$

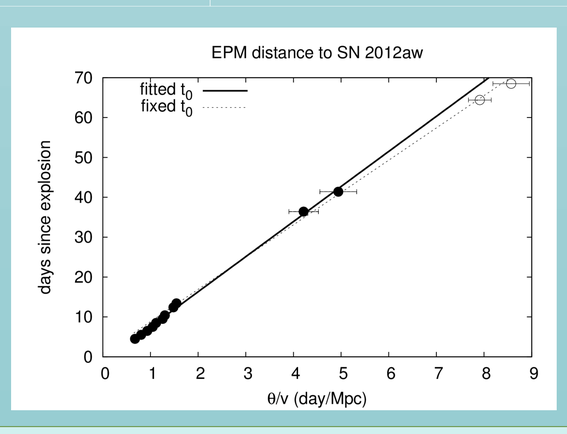
$$t = D\frac{\Theta}{v} + t_0 \qquad (3)$$

where: D - distance, θ - angular size, v - velocity, t - time, t_0 - explosion time, ζ - korrection factor, m_λ - magnitude, σ_m - the photometric error, T_S - temperature, $b_\lambda(T_S)$ - blackbody flux expressed in magnitude, S - filter set.

Table 1.: The resulted distance (D) and time of explosion (t_0) of SNe 2012A and 2012aw determined via EPM. Since the time of explosion of SN 2012aw is well-known, we repeated the fitting of eq. 3 with t_0 fixed at the mid-point between the last non-detection and the discovery (2456002.6 ± 0.8 JD).

		D (Mpc)	t_0 (JD-2400000)	Distance in literature
SN 2012A		**11.2 ± 2.0**	55929.5 ± 4.6	8.1 ± 1.5 (Tully, 1988)
SN 2012aw	Fitted t_0	8.8 ± 0.6	56000.6 ± 0.4	
	Fixed t_0	8.1 ± 0.5	56002.6	10.1 ± 1.0 (8.1-12.9, NED)
	average	**8.4 ± 0.8**		

Fig. 5: Distance measurements of SN 2012aw using t_0 as a fitting parameter (solid line) or keeping it fixed (dashed line).



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Acknowledgements

This project is supported by the European Union and co-funded by the European Social Fund through TÁMOP 4.2.2/B-10/1-2010-0012 grant, by the Hungarian OTKA grant K76816 and NSF grant AST11-09881. KS acknowledges support from the “Lendület” Program of the Hungarian Academy of Sciences. GHM is supported by NSF grant AST09-07903. AP has been supported by the ESA grant PECS 98073 and by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.