**Table 7.** JD and magnitude of last-non detection, discovery, and confirmation epochs and estimated explosion epoch for 33 CSP-I SE SNe.

| SN | Discovery telegram | Last non-detection (JD–2 450 000) | Discovery (JD–2 450 000) | Confirmation (JD–2 450 000) | Last non-detection (mag) | Discovery (mag) | Confirmation (mag) | Explosion date (JD–2 450 000) |
|---|---|---|---|---|---|---|---|---|
| 2004ex | IAUC 8418 | 3272.77 | 3289.84 | 3291.83 | >19.0 | 17.7 | 17.7 | $3288.40^{0.33}_{-0.33}$ [R] |
| 2004ff | IAUC 8425 | 3291.91 | 3308.90 | 3309.91 | >19.0 | 18.0 | 18.0 | $3298.16^{8.22}_{-6.25}$ [R] |
| 2004gq | IAUC 8452 | 3343.88 | 3350.86 | 3351.43 | >19.5 | 15.5 | 15.9 | $3347.37^{3.49}_{-3.49}$ [L] |
| 2004gt | IAUC 8454 | 3136.75 | 3351.58 | 3355.51 | >15.7 | 14.9 | 14.6 | $3343.33^{4.08}_{-4.08}$ [R] |
| 2004gv | IAUC 8454 | 3338.24 | 3353.17 | 3354.07 | >18.6 | 17.6 | 17.4 | $3345.77^{1.54}_{-1.54}$ [R] |
| 2005aw | CBET 127 | 3436.82 | 3453.77 | 3454.75 | >17.9 | 15.3 | 15.3 | $3446.17^{3.00}_{-3.00}$ [R] |
| 2005em | IAUC 8604 | 3615.93 | 3640.94 | 3641.88 | >19.5 | 18.1 | 18.0 | $3638.66^{2.28}_{-3.00}$ [T] |
| 2006T | CBET 385 | 3752.45 | 3766.49 | 3767.35 | >18.0 | 17.2 | 17.4 | $3758.14^{0.92}_{-0.92}$ [R] |
| 2006ba | CBET 443 | 3771.54 | 3814.31 | 3820.35 | >18.8 | 18.4 | 17.7 | $3801.61^{3.00}_{-3.00}$ [T] |
| 2006bf | IAUC 8693 | 3741.50 | 3821.85 | 3822.62 | >19.3 | 17.7 | 17.7 | $3798.15^{3.35}_{-3.35}$ [T] |
| 2006ep | CBET 609 | 3974.14 | 3977.85 | 3979.10 | >19 | 17.8 | 17.8 | $3975.99^{1.86}_{-1.86}$ [L] |
| 2006ir | CBET 658 | … | 4001.80 | … | … | 16.9 | … | $3988.76^{3.35}_{-3.35}$ [T] |
| 2006lc | CBET 688 | … | 4029.50 | … | … | 20.2 | … | $4015.24^{1.97}_{-1.97}$ [b] |
| 2007C | CBET 798 | 4093.37 | 4108.36 | 4109.20 | >18.5 | 15.9 | 16.0 | $4095.94^{3.30}_{-2.57}$ [T] |
| 2007Y | CBET 845 | 4083.35 | 4147.27 | 4148.24 | >18.0 | 17.5 | 17.1 | $4145.50^{2.00}_{-2.00}$ [a] |
| 2007ag | CBET 868 | 4155.50 | 4166.79 | 4167.62 | >19.4 | 18.0 | 17.5 | $4155.50^{3.32}_{-0.00}$ [T] |
| 2007hn | CBET 1050 | … | 4343.70 | … | … | 18.6 | … | $4341.32^{2.38}_{-3.02}$ [T] |
| 2007kj | CBET 1092 | 4364.11 | 4376.10 | 4376.95 | >19.0 | 17.4 | 17.3 | $4364.11^{3.00}_{-0.00}$ [T] |
| 2007rz | CBET 1158 | 4423.91 | 4442.90 | 4443.92 | >19.5 | 16.9 | 16.9 | $4427.00^{3.35}_{-3.09}$ [T] |
| 2008aq | CBET 1271 | 4506.97 | 4523.94 | 4524.90 | >19.1 | 16.3 | 16.2 | $4511.29^{3.00}_{-3.00}$ [T] |
| 2008gc | CBET 1529 | 4651.78 | 4742.66 | 4743.65 | >18.0 | 17.4 | 17.3 | $4724.95^{3.29}_{-3.29}$ [T] |
| 2009bb | CBET 1731 | 4909.70 | 4911.61 | 4913.51 | >18 | 17.0 | 16.6 | $4909.60^{0.60}_{-0.60}$ [c] |
| 2009K | CBET 1663 | 4842.58 | 4845.57 | 4846.56 | >18.0 | 14.9 | 15.0 | $4844.07^{1.49}_{-1.49}$ [L] |
| 2009Z | CBET 1685 | 4617-67** | 4865.03 | 4866.97 | >19.4 | 18.1 | 17.8 | $4860.54^{0.56}_{-0.56}$ [R] |
| 2009ca | CBET 1750 | 4766.69 | 4920.87 | 4924.86* | >18.5 | 17.1 | 17.1 | $4915.86^{3.35}_{-3.35}$ [T] |
| 2009dt | CBET 1785 | 4942.86 | 4949.83 | 4950.82 | >19.0 | 17.2 | 16.6 | $4946.34^{3.49}_{-3.48}$ [L] |
| 2004ew | CBET 96 | 3260.71 | 3288.42 | 3289.26 | >18.1 | 17.5 | 17.5 | $3260.71^{3.35}_{-0.00}$ [T] |
| 2004fe | IAUC 8425 | 3300.78 | 3308.79 | 3309.80 | >19.0 | 18.1 | 17.7 | $3307.24^{1.55}_{-3.00}$ [T] |
| 2005Q | CBET 106 | 3370.31 | 3399.30 | 3400.26 | >20.5 | 17.2 | 17.1 | $3386.20^{3.00}_{-3.00}$ [T] |
| 2005bj | CBET 137 | 3191.50 | 3471.60 | 3472.51 | >19.5 | 17.7 | 17.7 | $3452.58^{3.00}_{-3.00}$ [T] |
| 2006fo | CBET 624 | … | 3994.50 | … | … | 18.2 | … | $3983.86^{3.00}_{-3.00}$ [T] |
| 2008hh | CBET 1575 | 4759.50 | 4789.62 | 4790.65 | >19.2 | 16.6 | 16.6 | $4781.19^{3.35}_{-3.35}$ [T] |
| 2009dp | CBET 1779 | 4923.60 | 4944.60 | 4945.62 | >18.5 | 17.7 | 17.7 | $4939.50^{3.35}_{-3.35}$ [T] |

**Notes.** A horizontal line separates the objects observed in both optical and NIR from those observed only in the optical. [(a)] From Stritzinger et al. (2009). [(b)] From Taddia et al. (2015). [(c)] From Pignata et al. (2011). [(L)] From good pre-explosion limits. [(R)] From the fit of the photospheric radius before $r_{\rm max}$. [(T)] From the rise time.

photospheric velocity ($v_{\rm ph}$). Measured as the Doppler velocity at maximum absorption, $v_{\rm ph}$ serves as an important constraint on the ratio between the $E_K$ and $M_{\rm ej}$. In the following, $v_{\rm ph}$ values are adopted from Doppler velocity measurements of the Fe II $\lambda$5169 feature (cf. Branch et al. 2002; Richardson et al. 2006), which are presented in a companion paper by Holmbo et al. (in prep.). Plotted in Fig. 16 are the resulting $v_{\rm ph}$ values versus days relative to explosion epoch, with the associated uncertainties being on the order of 500 km s$^{-1}$. Inspection of the $v_{\rm ph}$ measurements reveals similar values for each of the SE SN subtypes over the same epochs, and the evolution of $v_{\rm ph}$ is found to be well-represented by a PL function characterized by an index $\alpha = -0.41$ (dashed line in Fig. 16). As expected, the Type Ic-BL SN 2009bb and SN 2009ca exhibit significantly higher $v_{\rm ph}$ values, several thousand of km s$^{-1}$ higher than the rest of the sample over the same epochs. These two objects are omitted when computing the PL fit.

For the semi-analytic models we use the value of $v_{\rm ph}$ at peak luminosity [$v_{\rm ph}(t_{\rm max})$] to constrain $E_K/M_{\rm ej}$. These are computed by fitting a PL to the measured Fe II $\lambda$5169 velocities for each