THE KOREAN 1592–1593 RECORD OF A GUEST STAR: AN ‘IMPOSTOR’ OF THE CASSIOPEIA A SUPERNOVA?

CHANGBOM PARK1, SUNG-CHUL YOON2, and BON-CHUL KOO2,3

1Korea Institute for Advanced Study, 85 Hoegi-ro, Dongdaemun-gu, Seoul 02455, Korea; cbp@kias.re.kr
2Department of Physics and Astronomy, Seoul National University, Gwanak-gu, Seoul 08826, Korea yoon@astro.snu.ac.kr, koo@astro.snu.ac.kr
3Visiting Professor, Korea Institute for Advanced Study, Dongdaemun-gu, Seoul 02455, Korea

Received —; accepted —

Abstract: The missing historical record of the Cassiopeia A (Cas A) supernova (SN) event implies a large extinction to the SN, possibly greater than the interstellar extinction to the current SN remnant. Here we investigate the possibility that the guest star that appeared near Cas A in 1592–1593 in Korean history books could have been an ‘impostor’ of the Cas A SN, i.e., a luminous transient that appeared to be a SN but did not destroy the progenitor star, with strong mass loss to have provided extra circumstellar extinction. We first review the Korean records and show that a spatial coincidence between the guest star and Cas A cannot be ruled out, as opposed to previous studies. Based on modern astrophysical findings on core-collapse SN, we argue that Cas A could have had an impostor and derive its anticipated properties.

It turned out that the Cas A SN impostor must have been bright ($M_V = -14.7 \pm 2.2$ mag) and an amount of dust with visual extinction of $\geq 2.8 \pm 2.2$ mag should have formed in the ejected envelope and/or in a strong wind afterwards. The mass loss needs to have been spherically asymmetric in order to see the light echo from the SN event but not the one from the impostor event.

Key words: history and philosophy of astronomy — supernovae: individual (Cassiopeia A)

1. INTRODUCTION

During the last thousand years, five supernova (SN) events in the Milky Way have been witnessed and recorded in history books of East Asian and/or European countries: SN 1006, 1054, 1181, 1572, and 1604 (Stephenson & Green 2002). Each of them was visible to the naked eye in the night sky over a period longer than six months, and their supernova remnants (SNRs) are now observable as beautiful nebulae with modern telescopes. The SN event that produced the SNR Cassiopeia A (hereafter Cas A), however, was an exception.

Cas A is a small, spherical remnant expanding rapidly ($\sim 5000$ km s$^{-1}$) at a distance 3.4 kpc (see Figure 1). It was discovered in 1940s as a bright radio source (Ryle & Smith 1948), and since then it has been extensively studied over all wavebands. In particular, the SN flash light at the time of explosion was detected in 2008 as the SN light 'echo', which confirmed that Cas A is a remnant of core-collapse SN (CCSN) with a massive (15–20 $M_\odot$) progenitor, i.e., SN Ib (Krause et al. 2008). The material that we see in Figure 1 is mostly heavy elements synthesized in the innermost region of the progenitor star and expelled by the explosion. The proper motion studies of almost freely-expanding dense SN material have yielded an accurate date of the SN event, i.e., AD 1671.3 $\pm$ 0.9 and 1680.5 $\pm$ 18.7 (Thorstensen et al. 2001; Fesen et al. 2006), implying that the Cas A SN event was in the telescope era.

It is, therefore, surprising that there is no controversial historical record on the Cas A SN event. It has been suggested that the 6-th magnitude star ‘3 Cas’ recorded by John Flamsteed on August 16 in 1680 corresponds to the Cas A SN event (Ashworth 1980). But this object is most likely a non-existing star resulting from combining measurements of two different stars by mistake (Broughton 1979; Stephenson & Green 2002). An extensive search using the historical astronomical records of three East Asian countries has also failed to find any record matching the Cas A SN event (e.g.,

![Figure 1. Three-color composite optical/near-infrared image of the Cas A SNR produced from HST ACS F775W and F850LP (B and G) and Palomar WIRC [Fe II] 1.64 µm (R) image (Hammell & Fesen 2008; Lee et al. 2015). The emission in HST ACS F775W and F850LP filters are dominated by [O II] and [S III] emission lines, respectively.](image-url)
The only records of a guest star that appeared very close to Cas A were made by Korean astronomers in 1592–1593, for which Brosche (1967) and Chu (1968) independently proposed that it might have been the Cas A SN event. On the other hand, Stephenson & Yau (1987) (see also Stephenson & Green 2002 for a summary), who studied this Korean record in detail, concluded that not only the date but also the positional agreement between the guest star and Cas A was poor, so that this Korean record was attributed to a nova.

Modern astrophysical studies suggest that the Cas A SN might have been a normal CCSN with absolute magnitude of about $-17.5$ (Young et al. 2006; Krause et al. 2008 see also Section 4), so that at a distance of 3.4 kpc, it should have been visible if the interstellar extinction were ‘typical’. The extinction to Cas A is indeed large ($A_V = 4–8$ mag), which may or may not be enough to explain the missing historical records (Koo & Park 2016 see also Section 4). An interesting hypothesis is that there was an extra extinction at the time of SN explosion, possibly due to mass loss from the progenitor star (Predehl & Schmitt 1995 [Hartmann et al. 1997]). This raises the question if the guest star in 1592–1593 could have been such a mass loss event of Cas A. It is known that some CCSNe experience luminous transients, sometimes as bright as $M_B = -17.8$ mag (Kochanek et al. 2012), and ejection of mass without destruction of the stars. Such ‘SN impostor’ phenomena have been observed mostly in SNe of type Ib, but their nature is poorly known. A significant fraction of SN impostor progenitors are indeed relatively low mass ($15–25 M_{⊙}$) stars (Kochanek et al. 2012 [Adams & Kochanek 2015 and references therein]). Therefore, although the reported years are too early to be directly responsible for Cas A, there could be a possibility that the Korean records of the guest star in 1592–1593 was an impostor that provided extra circumstellar extinction to the Cas A SN in 1670s. In Section 2, we review the Korean records and show that the spatial coincidence between the guest star and Cas A cannot be ruled out, as opposed to previous studies. In Section 3, we discuss the possibility that the guest star was an impostor of the Cas A SN based on modern astrophysical findings on CCSN. And in Section 4, we derive the properties of the Cas A SN impostor that can explain the observations and conclude our paper.

2. Korean Records of the 1592-1593 Guest Star

Korean astronomical records during Joseon dynasty (1639–1910) are to be found in the official history books of Joseon dynasty: Joseon Wangjo Sillok 朝鮮王朝實錄 (the Annals of the Joseon Dynasty) and Jeungbo Munheon Bigo 增補文獻備考(Enlarged Official Encyclopedia). In addition to them, there are other historical books that contain astronomical records, such as Seunjeongjeon Ilgi 承政院日記 (Diary of the Royal Secretariat) and Iseongryok 日省錄 (Cords of Daily Reflection). The contents of these books are available in the Internet (http://db.history.go.kr and http://www.minchu.or.kr). We inspected all these books to search for records that can match the Cas A event. The only records possibly associated with Cas A were the sightings of a guest star near Cas A in 1592-1593 in the Annals of the Joseon Dynasty that had been already reported in previous studies [Brosche 1967 [Chu 1968, Stephenson & Green 2002]. In the following, we discuss these records.

The first record appears on December 4, 1592 (November 1 in lunisolar calendar) in Seonjo Sillok 朝鮮王朝實錄 of the Annals of the Joseon Dynasty, which reports that a guest star appeared “at the first star in the west of Wangyang 王良”. After this first record the location of the guest star was consistently described as "inside (Fig. 2)" the first star in the west of Wangyang (Fig. 2). The total duration of the sightings of the guest star in the record is 91 days. The west-most star in the constellation of Wangyang is β Cassiopeia (β Cas). The angular distance between β Cas and the expansion center of Cas A determined from the proper motion of SN ejecta knots (Thorstensen et al. 2001) is 5.9 degrees.

Stephenson & Yau (1987) (see also Stephenson & Green 2002) studied these Korean records in detail, and...
concluded that these guest star records were probably observations of a nova rather than sightings of Cas A supernova. Stephenson & Yau (1987) tried to find the meaning of “inside (内)” by examining the distance between objects whose separation was described with the same expression. They noted that there are records of another guest star appearing in the constellation Cheonchang 天倉 from November 23, 1592 to September 15, 1594, which describe the position of the guest star to be “inside the third star at the east of Cheonchang and about 3 chon ⊦ away”. They estimated 3 chon to be about 0.45 degree and concluded that the expression “inside (内)” was used when a separation was much less than one degree. This led them to conclude that the separation of 5.9 degrees between β Cas and Cas A was too large to be described by the expression that “the guest star was inside the star β Cas”.

Since the meaning of “inside (内)” was critically important in their rejection of the records of the guest star near β Cas as the sightings of Cas A SN, we investigated other usages of the same expression in the same history book, Seonjo Sillok. We found another record on October 21, 1585, 7 years before the above records, saying that “A comet appeared inside the first star at the west of Cheonchang. It was separated by 7 degrees from Byeokseong 壁星 and by 101.5 degrees from the north pole star.” Here Byeokseong and the first star at the west of Cheonchang correspond to γ Peg and τ Cet, respectively (Park 1998). Note that, in this record, the angular separation of γ degrees is in right ascension and that the angles were still measured in the traditional system where the angle of a full circle was 365.25 degrees instead of 360 degrees. Precession calculation of γ Peg and τ Cet to the year of 1585 gives angular distance between this comet and τ Cet of 5.4 degrees, which is much larger than one degree.

In the above calculation, however, we find that the comet would be located within the lunar mansion of Gyu 奎 instead of Byeok 壁. If this were the case, the record would have reckoned angular separation from the constellation Gyu instead of Byeok. A possible explanation would be that they measured the right ascension of the comet from the old royal Korean constellation map, Cheonsang Yeolcha Bungyajido 天象列次分野之圖, presented in Figure 3 (left panel). In this map, τ Cet is 1 degree east of the boundary between the Gyu and Byeok lunar mansions and since the comet was 7 degrees from Byeok (or 2 degrees west of the Gyu-Byeok lunar mansion boundary) according to the record, the difference between the comet and τ Cet in right ascension is

Figure 3. Left: A part of Cheonsang Yeolcha Bungyajido 天象列次分野之圖, the old Korean constellation map of Joseon dynasty made in 1395, showing the constellations Wangyang 王良, pink dots), Byeok (壁, right two dark blue points), Gyu (奎, left 16 dark blue points), and Cheonchang (天倉, yellow dots at bottom left). The right most star of Wangyang is β Cas, and the right-most star of Cheonchang is ι Cet. The epoch of this map is around 1st century A.D (Park 1998). Right: Position of the stars near Cassiopeia and Cetus brighter than 5.5 in visual magnitude in 1592. The expansion center of Cas A is marked with a small cross near AR Cassiopeia. The angular distance between β Cas and the expansion center is 5.9 degrees.
about 3 degrees in the traditional angle-measuring system. If the north polar distance is used as recorded, the total angular separation between the comet and ι Cet is 3.1 degrees. In either case, the separation intended by the expression “inside a star” was much larger than one degree, as large as 3.1 or 5.4 degrees. Stephenson & Yau (1987)’s understanding of the expression was only based on one record for which the separation happened to be less than one degree. The fact that the expression “inside a star” was used for separations up to a few degrees allows one to keep the records of the guest star near β Cas in 1592–1593 as an event possibly associated with Cas A.

Before closing this section, it is worthwhile to comment on one false guest star and two other guest stars recorded in Seonjo Sillok during the same period. The false one is the above mentioned guest star in Cheon-chang, for which Stephenson & Yau (1987) studied the meaning of “inside”. On September 15, 1594, however, the court astronomers requested that its identification as a guest star be canceled after reporting to King Seonjo that the guest star must be a fixed star because it had been visible for more than three years. This implies that they made self-inspection of their reports on guest stars. The second one is the guest star between the first and second eastern stars of Wanyang, which appeared from November 30, 1592 to March 28, 1593 for 119 days. This may be a nova event as argued by Stephenson & Green (2002). There are only two mentions of the third guest star separated by 37 days first appearing on December 12, 1592 above the constellation Gyuseong 奎星. This could have been a nova event too as suggested by Stephenson & Green (2002).

3. IMPOSTOR OF THE CAS A SUPERNOVA?

The discussion in the previous section suggests that the guest star in the Korea 1592–1593 records could be spatially coincident with the Cas A SN. The observation date of this guest star, however, is ~80 years before the estimated date of the Cas A SN, which makes the Korean records in 1592–1593 unlikely to be the sightings of the SN event responsible for the Cas A SNR observed today.

We may still consider the possibility that the guest star was related to a strong eruption of the progenitor star of the Cas A SN. It is well known that some massive stars undergo an outburst of the envelope during the course of their evolution, which would appear as a supernova impostor (see Smartt 2009, Kuchner et al. 2012 for a review). A notable example is the Great Eruption of η Carinae that occurred in the 19th century. Most of SN impostors appear less bright than a supernova, typically having visual magnitudes of $-15 \lesssim M_V \lesssim -11$. The duration of their optical transients ranges from about 20 days to 4400 days.

Steady, line-driven winds cannot explain this phenomenon and the physical mechanisms of these outbursts have not been well understood yet. For very massive stars close to the Eddington limit, various hydrodynamic instabilities like the strange-mode instability may occur in the envelope, which can trigger non-steady mass outflows on a short timescale (Owocki 2015). This may explain eruptions from luminous blue variables (LBVs). However, not all SN impostors would originate from very massive stars. Binary interactions that lead to a common envelope ejection or a merger may also produce an event that resembles a SN impostor (e.g., Ivanova et al. 2013). Nuclear shell flashes during the late stages of massive star evolution may also trigger an outburst of the outer envelope from a massive star (Woosley & Heger 2015). Binary interactions do not necessarily involve very massive stars, and the latter mechanism strongly favors the low-mass end of CC progenitors ($9 - 11 \ M_\odot$).

Observations indicate that a strong outburst of the envelope can occur shortly before the real SN explosion. For example, SN 2009ip was a SN impostor from a LBV, and turned into a true SN three years later, which appeared as a SN IIn (Mauerhan et al. 2013). Could the guest star in 1592–1593 have been a SN impostor as a precursor of the Cas A SN as well? The time span of about 80 years between the appearance of this guest star and the Cas A SN is very long compared to the case of SN 2009ip for which the real SN explosion in 2012 occurred 3 yrs later than its precursor. However, such an outburst can occur at anytime before the SN explosion in principle, in particular if binary interactions are responsible for it.

The case of SN 2014C is particularly relevant in this regard. The recent study on SN 2014C, which appeared as a SN Ib initially and evolved into a SN IIn over one year, indicates that the progenitor experienced a mass eruption about 100 years before the SN explosion (Milisavljevic et al. 2015; Margutti et al. 2016). A situation similar to this case may have occurred with Cas A. The fact that the Cas A SN is type Ib instead of IIn does not necessarily contradict this scenario. The light echo spectra of the Case A SN by Krause et al. (2008) are believed to reflect rather an early stage of the SN, i.e., near the optical peak. We cannot exclude the possibility that the Cas A SN would have evolved into type IIn in later stages as in the case of SN 2014C. Alternatively, it would not have turned into a SN IIn if the mass of the ejected material during the outburst in 1592 had been sufficiently small. This issue deserves future work with numerical simulations.

4. DISCUSSION AND CONCLUSION

In this section, we discuss the properties of the Cas A SN impostor anticipated if the guest star in the Korean 1592–1593 records had been an impostor of the Cas A SN and had provided necessary extra extinction to hide the SN event.

We first consider the brightness of the impostor. There is no record about the brightness of the guest star. Considering that the stars in the old Korean

\footnote{Stephenson & Yau (1987) in their paper said “The only brightness estimate for 1592C is that it rivalled Praesepe (i.e., 5th mag) soon after discovery.” where 1592C is the guest star in this paper, but we could not confirm this. There is a record on November 4, 1592, i.e., four days after the discovery of the guest star.}
constellation map Cheonsang Yeolcha Banyajido are mostly brighter than 5 mag, however, the guest star might have been brighter than \( \sim 5 \) mag to be witnessed as a ‘guest’ star. On the other hand, it was probably not very bright (\( \geq 3 \) mag) because otherwise its brightness would have been compared to the known bright stars or planets, e.g., the brightness of the Kepler SN on April 23, 1605 was compared to the 2.8 mag star \( \tau \) Scopi in Sesojo Sillok. Therefore, we may assume that the brightness of the guest star was \( M_{V, \text{guest}} = 4 \pm 1 \) mag. At the distance of Cas A (3.4 kpc), which implies that the absolute magnitude of the impostor should be

\[
M_{V, \text{impostor}} = m_{V, \text{guest}} - 5 \log d + 5 - A_V \\
= -8.7 \pm 1.0 - A_V,
\]

where \( A_V \) is the extinction to the impostor. There have been considerable efforts to estimate the extinction to the explosion center of Cas A \( (\text{Troland et al. 1985}) \); Keohane et al. \((1996)\); Reynoso & Goss \((2002)\); Erikson et al. \((2009)\), and excluding the results from X-ray studies (see below), the derived extinction ranges 6–8 mag \( (\text{see also Table 3 of Koo & Park 2016}) \). These numerical values, however, are partly on the high side, and, considering various uncertainties in converting the observed physical parameters to the extinction, we adopt \( A_{V, \text{ISM}} = 6 \pm 2 \) mag for the interstellar extinction to the expansion center of Cas A. Therefore, assuming that the extinction to the impostor in Equation \((1)\) is given by \( A_{V, \text{ISM}} \), we obtain \( M_{V, \text{impostor}} = -14.7 \pm 2.2 \) mag, which is comparable to the brightest SN impostors.

We next consider the magnitude of the circumstellar extinction to be provided by the impostor \( (\Delta M_{V, \text{circum}}) \) for the Cas A SN event to be missed by ‘contemporary’ observers. The peak brightness of a hydrogen-deficient SN is directly proportional to the mass of synthesized \( ^{56}\text{Ni} \) mass \( (\text{Arnett 1982}) \). For Cas A, the total \( ^{56}\text{Ni} \) mass inferred from the observed \( ^{56}\text{Fe} \) and \( ^{44}\text{Ti} \) masses is \( \sim 0.2 M_\odot \) \( (\text{Hwang & Laming 2012}) \); \( \text{Young et al. 2006}) \), which is comparable to the average \( ^{56}\text{Ni} \) mass of SN Ib \( (\text{Drout et al. 2011}) \), so that the peak brightness of Cas A is believed to have been close to the mean \( M_1 \) \( \approx -17.6 \pm 0.9 \) mag of SN Ib. We adopt \( M_{V, \text{SN}} = -17.5 \) mag, which was the peak brightness of SN 1993J, as the characteristic absolute brightness of the Cas A SN. If we assume that the apparent peak brightness of Cas A was fainter than 4 mag to be missed by the 17th-century observers \( (\text{e.g., Shklovsky 1968}) \), although we cannot exclude the possibility that the SN was brighter but overlooked \((\text{see Koo & Park 2016 for a summary})\), we obtain

\[
\Delta M_{V, \text{circum}} = m_{V, \text{SN}} - M_{V, \text{SN}} - 5 \log d + 5 - A_V \\
\geq 2.8 \pm 2.2 \text{ mag}.
\]

This appears to be a large extinction for an expanding dusty shell, although \( \eta \) Carina might have had produced a large amount of dust in its Great Eruption (1837–1856) which made its second eruption in 1890s fainter by \( \sim 4.3 \) mag \( (\text{Humphreys et al. 1999}) \). The outburst, however, is thought to be a signal that the star is entering a high-mass loss rate phase for some SN impostors \((\text{Kochanek et al. 2012}) \); \( \text{Adams & Kochanek 2015}) \), and the Cas A progenitor, survived from the eruption, could have had a strong, steady dusty wind.

In conclusion, in order for the guest star in the Korean 1592–1593 historical records to be an impostor of the Cas A SN that had provided extra circumstellar extinction to hide the SN event, the impostor must have been bright \( (M_{V, \text{impostor}} = -14.7 \pm 2.2 \) mag) and an amount of dust with \( \Delta M_{V, \text{circum}} \geq 2.8 \pm 2.2 \) mag should have formed in the ejected envelope and/or in the strong wind afterwards. It is not likely that we can see a footprint of such mass loss in the \( \sim 340 \) yr-old SNR, although X-ray studies suggested a cavity of 0.2–0.3 pc radius which was attributed to fast Wolf-Rayet wind \( (\text{Hwang & Laming 2009}) \). The larger extinction implied from X-ray absorbing gas columns, i.e., 9–11 mag \( (\text{Willingale et al. 2002}) \); \( \text{Hwang & Laming 2012}) \) has been suggested as evidence for the circumstellar gas where dust grains had been present but destroyed by SN shock, but the extinction measurements are uncertain and the evidence is circumstantial.

In the impostor hypothesis, it is likely that the impostor in 1592 AD was brighter than the Cas A SN in the 1670s in apparent magnitude. This raises a question: do we or can we see the light echo of the impostor? The spectra of infrared (IR) light echos of Cas A SN have been shown to be consistent with thermal emission from interstellar dust heated by an intense and short burst EUV-UV radiation from the SN shock breakout \( (\text{Dwek & Arendt 2008}) \). On the other hand, the optical spectra of the light echo obtained at three different positions all look similar and consistent with SN Ib \( (\text{Rest et al. 2011}) \). Therefore, all the detected IR/optical light echos appear to be associated with the SN event, and there is no evidence for the light echo of the impostor event. It is not impossible that there is one to be detected, but perhaps a more plausible conjecture is that the mass loss of the impostor was not spherically symmetric so that its circumstellar extinction affected only some limited directions, and we may only see the echo of the SN event. Considering that the jet axis in the Cas A SNR is almost perpendicular to the line-of-sight, if the mass loss was preferentially along the equatorial plane that happens to coincide with our line-of-sight, this does not seem to be unphysical.

**Acknowledgments**

We wish to thank Jae-Joon Lee, Dave Green, and Dan Milisavljevic for their helpful comments on the manuscript. We also thank the anonymous referee for his/her comments on the presentation of Korean historical records. We gratefully acknowledge the support
from the JKAS Editorial Office on using Chinese characters in the paper and the latex help by Sascha Trippe. BCK was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning (2014R1A2A2A01002811).

REFERENCES

Adams, S. M., & Kochanek, C. S. 2015, LOSS’s First Supernova? New Limits on the ‘Impostor’ SN 1997bs. MNRAS, 458, 2094

Arnett, W. D. 1982, Type I Supernovae. I – Analytic Solutions for the Early Part of the Light Curve. ApJ, 253, 785

Ashworth, W. B., Jr. 1980, A Probable Flamsteed Observation of the Cassiopeia-A Supernova. J. Hist. Astron., 11, 1

Brosche, P. 1967, A Historical Record Possibly Related to the Radio Source Cas A. Inf. Bull. Variable Stars, 192, 1

Broughton, R. P. 1979, Flamsteed’s 3 Cassiopeia = Ar-Cassiopeia + SAO35386. J. R. Astron. Soc. Can., 73, 381

Chu, S.-I. 1968, Supernovae from Ancient Korean Observational Records. JKAS, 1, 29

Dessart, L., Hillier, D. J., Audit, E., Livne, E., & Waldman, R. 2016, Models of Interacting Supernovae and their Spectral Diversity. MNRAS, 458, 2094

Drout, M. R., Soderberg, A. M., Gal-Yam, A., Cenko, S. B., Fox, D. B., Leonard, D. C., et al. 2011, The First Systematic Study of Type Ibc Supernova Multi-band Light Curves. ApJ, 741, 97

Dwek, E., & Arendt, R. G. 2008, Infrared Echoes Reveal the Shock Breakout of the Cas A Supernova. ApJ, 685, 976

Eriksen, K. A., Arnett, D., McCarthy, D. W., Young, P. 2009, The Reddening Toward Cassiopeia A’s Supernova: Constraining the $^{56}$Ni Yield. ApJ, 697, 29

Fesen, R. A., Hammel, M. C., Morse, J., Chevalier, R. A., Borkowski, K. J., Dopita, M. A., et al. 2006, The Expansion Asymmetry and Age of the Cassiopeia A Supernova Remnant. ApJ, 645, 283

Hammel, M. C., Fesen, R. A. 2008, A Catalog of Outer Ejecta Knots in the Cassiopeia A Supernova Remnant. ApJS, 179, 196

Hartmann, D. H., Predehl, P., Greiner, J., Egger, R., Trumper, J., Aschenbach, B. et al. 1997, On Flamsteed’s supernova Cas A. Nucl. Phys. A, 621, 83

Humphreys, R. M., Davidson, K., & Smith, N. 1999, $\eta$ Carinae’s Second Eruption and the Light Curves of the $\eta$ Carinae Variables. PASP, 111, 1124

Hwang, U., Laming, J. M 2009, The Circumstellar Medium of Cassiopeia inferred from the Outer Ejecta Knot Properties. ApJ, 793, 883

Hwang, U., Laming, J. M. 2012, A Chandra X-Ray Survey of Ejecta in the Cassiopeia A Supernova Remnant. ApJ, 746, 130

Ivanova, N., Justham, S., Avendano Nandez, J. L., & Lombardi, J. C. 2013, Identification of the Long-Sought Common-Envelope Events, Science, 339, 433

Keohane, J. W., Rudnick, L., Anderson, M. C. 1996, A Comparison of X-Ray and Radio Emission from the Supernova Remnant Cassiopeia A. ApJ, 466, 309

Kochanek, C. S., Szczygieł, D. M., & Stanek, K. Z. 2012, Unmasking the Supernova Impostors. ApJ, 758, 142

Koo, B.-C. & Park, C. 2016, Supernova Remnant Cassiopeia A, in: Handbook of Supernovae (Springer)

Krause, O., Birkmann, S. M., Usuda, T., Hattori, T., Goto, M., Rieke, G. H., Misselt, K. A. 2008, The Cassiopeia A Supernova Was of Type I Ib. Science, 320, 1195

Lee, Y.-H., Koo, B.-C., Moon, D.-S., & Lee, J.-J. 2015, Near-infrared Extinction due to Cool Supernova Dust in Cassiopeia A. ApJ, 808, 98

Margutti, R., Kamble, A., Milisavljevic, D., et al. 2016, Ejection of the Massive Hydrogen-rich Envelope Timed with the Collapse of the Stripped SN2014C, arXiv:1601.06806

Mauерhan, J. C., Smith, N., Filippenko, A. V., et al. 2013, The Unprecedented 2012 Outburst of SN 2009ip: A Luminous Blue Variable Star Becomes a True Supernova, MNRAS, 430, 1801

Milisavljevic, D., Margutti, R., Kamble, A., et al. 2015, Metamorphosis of SN 2014C: Delayed interaction between a Hydrogen Poor Core-collapse Supernova and a Nearby Circumstellar Shell, ApJ, 815, 120

Owocki, S. P. 2015, Instabilities in the envelopes and Winds of Very Massive Stars, in: Very Massive Stars in the Local Universe, Ap&SS Library, 412 (Springer), 113

Park, C. 1998, Analysis of the Star Map in Chun Sang Yul Cha Boon Ya Ji Do, J. Korean Hist. Sci. Soc., 20, 113

Predehl, P., Schmitt, J. H. M. M. 1995, X-raying the Interstellar Medium: ROSAT Observations of Dust Scattering Halos. A&A, 293, 889

Reed, J. E., Hester, J. J., Fabian, A. C., Winkler, P. F. 1995, The Three-dimensional Structure of the Cassiopeia A Supernova Remnant. I. The Spherical Shell. ApJ, 440, 706

Rest, A., Foley, R. J., Sinnott, B., et al. 2011, Direct Confirmation of the Asymmetry of the Cas A Supernova with Light Echoes ApJ, 732, 3

Reynoso, E. M. & Goss, W. M. 2002, Very Large Array Observations of 6 Centimeter H$_2$CO in the Direction of Cassiopeia A. ApJ, 575, 871

Ryle, M. & Smith, F. G. 1948, A New Intense Source of Radio-Frequency Radiation in the Constellation of Cassiopeia. Nature, 162, 462

Shklovsky, J. S. 1968, Supernovae. (London: Wiley)

Smartt, S. J. 2009, Progenitors of Core-Collapse Supernovae. ARAA, 47, 63

Smartt, S. J. 2015, Observational Constraints on the Progenitors of Core-Collapse Supernovae: The Case for Missing High-Mass Stars. PASA, 32, e016

Stephenson, F. R. & Green, D. A. 2002, Historical Supernovae and Their Remnants. (Clarendon: Oxford)

Stephenson, F. R., & Yau, K. C. C. 1987, Four Korean Guest Stars Observed in 1592AD. Q. J. R. Astron. Soc., 28, 431

Thorsten, J. R., Pesen, R. A., & van den Bergh, S, 2001, The Expansion Center and Dynamical Age of the Galactic Supernova Remnant Cassiopeia A. AJ, 122, 297

Troland, T. H., Crutcher, R. M., & Heiles, C. 1985, Molecules and Dust toward Cassiopeia A. ApJ, 298, 808

Young, P. A., Fryer, C. L., Hungerford, A., Arnett, D., Meakin, C., Eriksen, K. A. 2006, Constraints on the Progenitor of Cassiopeia A. ApJ, 640, 891

Willingale, R., Bleeker, J. A. M., van der Heyden, K. J., Rieke, G. H., Misselt, K. A. 2008, The Cassiopeia A Supernova Was of Type I Ib. Science, 320, 1195

Woosley, S. E. & Heger, A. 2015, The Remarkable Deaths of 9–11 Solar Mass Stars, ApJ, 810, 34