

# In search of Indian records of Supernovae<sup>1</sup>

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## Abstract:

One of the unexplained items of ancient Indian astronomical traditions is an apparent absence of records of supernovae, which are the last moments of dying stars when they become several orders of magnitude brighter than usual and may often be visible in daytime sky. In the present paper, we make a list of about 12 supernovae that should have been visible during the periods of prehistory and history.

## 1. Introduction

Supernova is an extremely violent explosion that marks end of stellar life. Supernovae are among the brightest events in the Universe. Some supernovae are so bright that they can outshine the entire galaxy. There are two basic types of supernovae. Type Ia happens when a white dwarf star draws large amounts of matter from a nearby star, until it can no longer support itself, and collapses. The second better-known kind of supernova, type IIa, is the result of the collapse of a massive star. These two types of supernovae can be uniquely identified by their intensity curves. At the time of supernova, brightness of star can instantaneously increase to more than a million times its original brightness. It can remain in such a state for a few hours and after that it fades away slowly over next few months.

Hence, if a supernova occurs in our vicinity, it can appear so bright that it will outshine most of the objects in the night sky. In rare cases it can even outshine the moon and be visible in daylight. However, supernovae are among the rarest events to observe. Last two millennia may have seen only fifteen supernovae. Supernovae sightings have been recorded throughout history although the distinction of true supernovae from novae is sometimes ambiguous. Probable supernovae are listed in Table 1.

Observation of supernova by a civilization gives some hints about the level of their sophistication. As seen from Table 1, Chinese civilization reported many supernovae with their approximate positions in the sky. In eleventh century, Arabians noted two of the most important supernovae, confirming Chinese records. Further, even Japanese, Korean, Native American and European civilisations have reported supernovae sightings. In India, astronomy was flourishing in the golden era that had started with *Aryabhatta* in the 5th Century and was to continue till 14th Century or even later in case of the sothern states like Kerala. Such a brilliant event must have been observed by many people in India and it is hard to imagine that no records of these sightings were maintained. Traditionally, astronomers and astrologers were consulted when such unusual event was seen. They must have therefore recorded some events. However, Indian method of recording is far more complex with an insistence on brevity and mysticism.

In the present paper we list out some of the major supernova in the background of Indian history. The purpose is to help focus the research for supernova records in future. We give the details of Indian environment during the most prominent of the supernovae amongst the ones listed in Table 1. The first two columns give the year and date of the event as described in the contemporary records, “Con” denotes the stellar constellation, thus indicating its position in the sky, “Mag” is the apparent magnitude

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of the supernova, where brighter events have more negative magnitude (The magnitude of the full moon is about -12.5 or that of the Venus is -4.4 and difference of 1 magnitude translates into roughly brightness ratio of 2.5). The “Remnant” column gives names of the known supernova remnant (SNR) in the sky which are thought to be at the same location as the recorded supernova. Next column say which civilisation has recorded the event. Lastly, RA / DEC gives astronomical position co-ordinates of the SNR.

Table 1: List of historical supernovae that should have been visible unaided eyes

	Year	Date	Con	Mag	Remnant	Observed/Comments	RA	Dec
1	2241 BC			-10		Dubiously listed in some source		
2	352 BC					Chinese; "first such record"		
3	185 AD		Cen	-2	G315.4-2.3	Chinese	14:43.1	-62:28
4	369 AD					Chinese		
5	386 AD		Sgr		G11.2-0.3?	Chinese		
6	393/ 396 AD		Sco	-3	SNR 393	Chinese	17:14	-39.8
7	1006 AD		Lup	-10	SNR 1006	Arabic; also Chinese, Japanese, European	15:02.8	-41:57
8	1054 AD	4-Jul	Tau	-6	M1	Chinese, North American (?); also Arab, Japan	05:34.5	+22:01
9	1181 AD	6-Aug	Cas	-1	3C 58	Chinese and Japanese	02:05.6	+64:49
10	1572 AD	6-Nov	Cas	-4	Tycho SNR	Tycho Brahe's SN	00:25.3	+64:09
11	1592 AD		Cas			Korean; probably Nova		
12	1604 AD	9-Oct	Oph	-3	Kepler SNR	Johannes Kepler's SN	17:30.6	-21:29
13	1680 / 1667 AD		Cas		Cas A	Flamsteed ? not seen ?	23:23.4	+58:50

## 2. Indian environment during the best known supernovae

In India, mainly two calendar systems were followed i.e. *vikram samvat* and *shalivahan shaka*. *Vikram samvat* was initiated on the day of *Kartik Pratipada* of year 57BC. There are few ambiguities about King Vikram who started the calendar. But, the calendar system in itself is unambiguous. Second of the major calendar systems was initiated by *Satavahan* Dynasty (also known as *Andhra* Dynasty or *Shalivahan* Dynasty), known as *Shalivahan Shaka*. *Shatakarni* Kings started *Shalivahan Shaka* in the year 78AD. After Islamic invasions, people also got acquainted to the Islamic calendar called Hijri Calendar. The Islamic Calendar was introduced by a close companion of the Prophet.

We will review seven bright supernovae in the last two millennia that were prominently recorded by other civilizations. We also provide details about different kingdoms that existed in India at the time of the occurrence of supernovae. Most of the kingdoms had their own court astronomer(s). We also give the political map of India during the period. Sometimes such events are acknowledged in the folklore or legends of the contemporary kings make mention of them as good / bad omens or literary works composed in that era make use of the observed unusual events in their manuscripts to make them more

interesting. Thus, the supernova sightings need to be searched in wide range of sources. We also give famous personalities in the era to facilitate the future researchers.

### 2.1 Supernova 185AD (Vikram Samvat 242, Shalivahan Shaka 108)

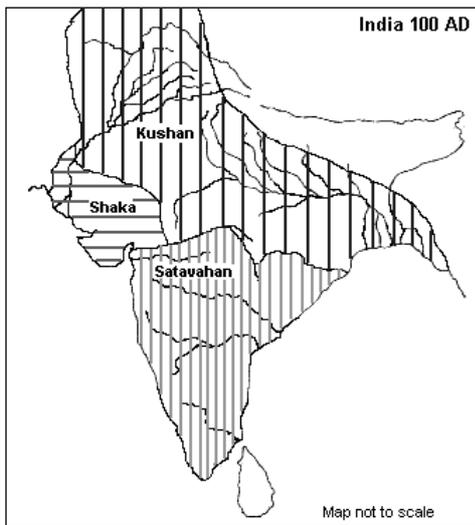


Figure 1: Indian Political scenario in 100 AD

Supernova exploded in the constellation of Centaurus, roughly between  $\alpha$  Centauri and  $\beta$  Centauri. The peak brightness of supernova is estimated to be brighter than Sirius (*Vyadh*). As per Chinese records, this supernova was visible for more than 8 months. Centaurus lies in the southern skies, westward of the constellation Scorpius. In Indian mythology, stars  $\alpha$  Centauri and beta Centauri are known as *Mitra* and *Mitrak*, respectively. We can see a shell of radio emission called G315.4-2.3, which is likely to be the remnant of this supernova.

*Satavahan* Dynasty was a prominent dynasty at that time. They ruled from *Paithan* on the banks of *Godavari*. *Prakrit* was the court language. They were lovers of architecture. Carle caves and some part of Ajanta Caves were built during this period. Last of the prominent *Satavahan* Kings, *Sri Yajna Satkarni*, was reigning at the time of the supernova. *Kushans* ruled in northern India. Emporor *Huvishka* or his son *Vasudeva I* – grandson of

*Kanishka I* – ruled the empire during this period. The decline of this empire started around the middle of 3<sup>rd</sup> century with the death of *Vasudeva I*. Philosopher *Nagarjuna* was contemporary of this period. The Amitabh (“cosmic”) buddha statues were first created in roughly this period (28<sup>th</sup> year of *Huvishka's* reign). This Mudra signifying a “Buddha with infinite merits” can also be inspired from some celestial signal like a supernova.

### 2.2. Supernova 393AD (Vikram Samvat 450, Shalivahan Shaka 316)

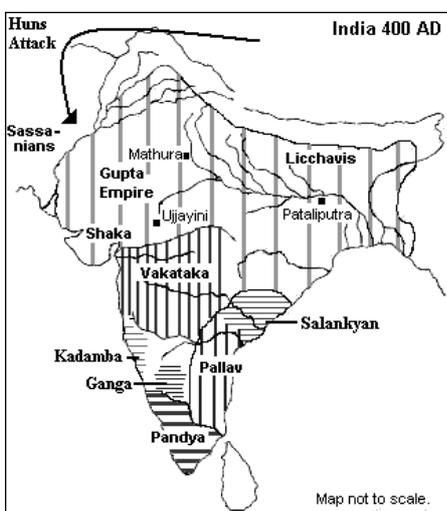


Figure 2: Indian Political scenario in 400 AD

The supernova appeared in the tail of Scorpius according to two different Chinese texts. However, the exact date is difficult to estimate. The supernova was between Jupiter and Venus in brightness and later faded away in the next 7 months. (Political scenario during the period is indicated in figure 2). Three radio emission sources had been identified in this region, but none of them is conclusive enough to be identified as supernova remnant.

After the downfall of *Kushans* in north and *Satavanahas* in south, no great power arose in India. *Chandragupta I* laid the foundation of the great *Gupta* dynasty. *Vikramaditya Chandragupta II* (380-425AD) was the legendary emperor of India. It is speculated that *mahakavi Kalidas* was a courtier in his court. The great mathematician *Aryabhatta I* was born 83 years after this supernova. So it is quite possible that knowledge was passed to him and he

mentioned it somewhere in his works. Famous drama *Mudra-rakshasa* was written in this period.

After the fall of *Satavahan* Empire, many dynasties built their empire on the ruins; *Vakatakas* being prominent among them. They paid tributes to *Guptas* for 30 years between 380AD and 410 AD. The famous poem *Harivijay* was composed during this period. Few Ajanta caves belong to the *Vakataka* period. Further south in Kanchipuram, King Viravarman was the ruler of Pallava dynasty.

2.3 Supernova 1006AD (Vikram Samvat 1063, Shalivahan Shaka 929, Hijri San 428)

SN1006 is undoubtedly the brightest of all recorded supernovae. It was noted across most of the civilizations in the world - Europe, China, Japan, Korea, Egypt and Iraq. Supernova blazed at a magnitude of -9 (100 times brighter than Venus). The supernova was seen near  $\delta$  Lupi; probably seen first on April 30, 1006. Lupus lies westward of the constellation scorpius. In 1960s, radio astronomers identified remnant of SN1006, technically called as G327.6+14.6.

In 973AD, *Tailap Chalukya* of the *Kalyani* branch gained power by defeating *Rashtrakuta* Dynasty and restored the *Chalukyan* rule. They ruled for next 200 years. *Satyasrya Chalukya* ruled from *Kalyani* in *Karnataka* in this period. *Chola* Kingdom was the prominent kingdom in southern India. The most important ruler of *Chola* was *Rajaraja I*. He was one of the greatest kings of the South India. The famous Shiva temple at Tanjavur was completed in 1009AD i.e. just 3 years after this supernova. *Hottur* inscriptions of *Satyasraya Chalukya* were carved in 1007-1008 and they describe the battle between *Cholas* and *Chalukyias*. Second *Solanki* King *Chamundraj* was on the throne of Gujrat. The Buddhist king *Mahipala I* one of the most prominent rulers of the *Pala* dynasty ruled in Bihar and Bangal.



Figure 3: Indian Political scenario in 1000

Mahmud of Gazni defeated the *Hindushahi* kings of Peshawar and the Muslim ruler of Multan in year 1000AD. He raided India 17 times in 25 years. It was a period of political instability and chaos. There could have been cases that court astronomers' records were destroyed during destruction.

In Nanded district, Maharashtra, there are more than 40 stone inscriptions inscribed by *Kalyani Chalukya*.

2.4. Supernova 1054AD (Vikram Samvat 1111, Shalivahan Shaka 977, Hijri San 476)

The most popular historical supernovae exploded on July 4, 1054, in the constellation of Taurus. References to this supernova can be found in well-documented Chinese records to inscriptions of Native Americans. It is probably the nearest supernova among seven candidates. The Supernova was visible in early morning skies when it exploded. Crescent of the moon was very close to the supernova. The guest star was visible in the daylight for about 23 days. It was visible for the next 20 months in the night skies before it faded out. The nebulous remnant was discovered by John Bevis in 1731 and was discovered independently by Charles Messier. This remnant is known as M1, being the first object in Messier's list.

The remnant is also known as crab nebula.

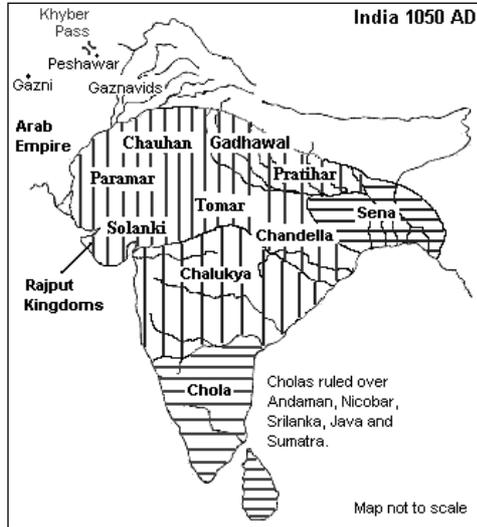


Figure 4: Indian Political scenario in 1050 AD

*Rashtrakutas* had probably established a satellite state in *Kanauj* around 1050AD. *Bhimdev I* of the *Solanki* dynasty ruled Gujrat. *Vigraha Pala III* was the ruler of the *Pala* dynasty.

In year 1052, King *Somesvara I* (also known as *Ahamavalla*) of *Chalukya* dynasty defeated *cholan* King *Rajadhiraj*. Later *Rajendra II* ascended the throne of the weakened *Chola* dynasty. Glory of *Chola* dynasty declined in the years to follow. Yet it served as great patron to intellectuals. Historian *Jayamkondar* was separated from this supernova by only a generation and may have seen or heard about it. The *Gadag* art style originated during the period of King *Somesvara*. *Gadag* art style is known for ornate pillars with intricate sculpture. About 50 temples were built during *Somesvara's* rule. It is quite possible that sighting of the supernova may have been inscribed on the pillars of some temple. In the South East India, *Rajaja Narendra* of the eastern *Chalukya* branch had great poet *Nannaya Bhatta* in his court. His translations of all famous

sanskrit texts are masterpieces of the Telugu literature. Famous King *Bhoj* ruled from *Ujjain* between 1010AD and 1052AD. *Narsingh* was the ruler in *Delhi* around the time of this

Narlikar and Bhate (2001) did an extensive search for finding records about possible sighting of

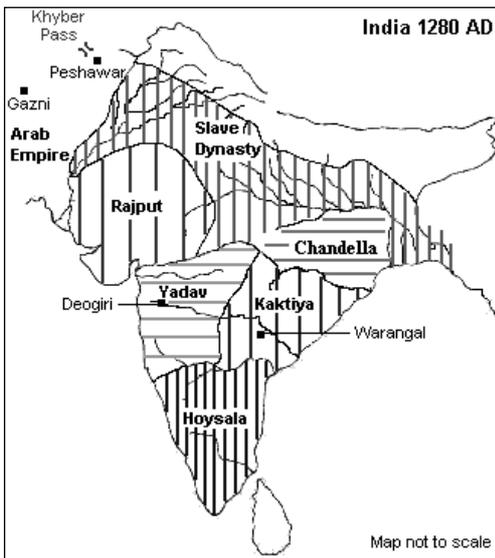


Figure 5: Indian Political scenario in 1280 AD

supernova. However, searches had not led to anything definitive that can stand alongside the Chinese or Japanese notings of the Crab Supernova, nor are they even broadly confirmatory as in the case of Native American records.

We have a speculation about the supernova. In Indian mythology,  $\delta$  Tauri is given the name *Agni* (The god of Fire).  $\delta$  Tauri is a very ordinary star and it is difficult to imagine why such an aggressive name is given to an ordinary star. In fact,  $\sigma$  Tauri (*Rohinee*) could have been a very close candidate for a name *agni* due to its red colour. We speculate that the name was originally given to the 'new star' that was shining with brightness 5 times greater than that of *Venus*. After supernova faded away, name got stuck with  $\delta$  Tauri being brighter than  $\alpha$  Tauri. However, this speculation needs to be cross-checked by searching for a possible reference to the star  $\delta$  Tauri being designated as *Agni* before 1054AD.

### 2.5. Supernova 1181AD (Vikram Samvat 1238, Shalivahan Shaka 1104, Hijri San 603)

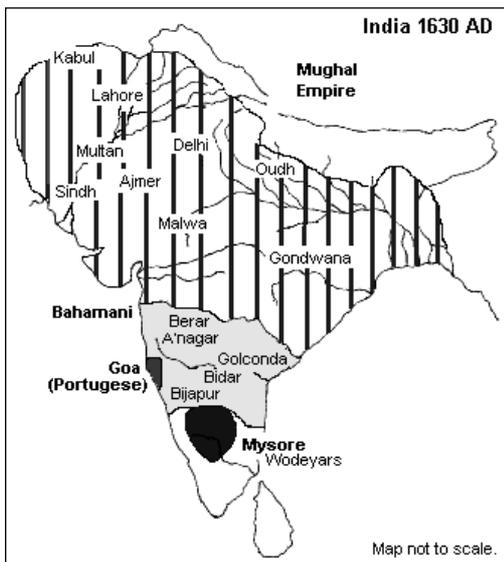
SN1193 exploded in northern skies on August 6, 1193. Its peak magnitude is estimated to be  $-1$  (slightly dimmer than *Sirius*). It was mainly observed by Japanese and Chinese civilization. Supernova was visible in constellation of *Cassiopeia* (*Sharmishtha*) for 185 days.

The last quarter of 12<sup>th</sup> century was the most unstable period in the history of India. Firstly, Muhammad Ghori invaded India seven times. Though *Prithviraj Chauhan* defeated Ghori in the first battle (1191AD), Ghori returned next year and defeated *Prithviraj*. Secondly, the great *Chalukyan* Dynasty disintegrated in 1187AD. There was chaotic period in the south until *Yadavs* of Deogiri, *Kaktiyas* of Warangal and *Hoysalas* of Belur divided the empire among themselves. Thirdly, in 1161AD, *Pala* Empire of Eastern India was defeated and taken over by the *Sena* dynasty. In 1197AD, *Tughan Khan* defeated the *Sena* king, *Laxman*. After this defeat, the *Nalanda* University was destroyed. Millions of books and records were burnt away.

Mohammad Ghori left Qutab-ud-din Aibek who was a slave from Turkistan in charge of the Indian affairs. He formed Slave Dynasty in 1206AD. He conquered most of the kingdoms like Malwa, Sind, Ranthambor, Ajmer, Jalor, Nagor, Gwalior, Kannauj, Banaras and Badaun. Qutab Minar was erected during his period.

*Yadavas* of Deogiri were prominent in southern India. Marathi language received the status of a court language in *Yadava* rule. The great mathematician astronomer *Bhaskaracharya II* (1114AD-1193AD) might have seen supernova in 1181.

2.6. Supernova 1572AD (Vikram Samvat 1629, Shalivahan Shaka 1495, Hijri San 994)



The supernova exploded in the constellation of Cassiopeia on November 11, 1572. Its peak magnitude is approximated to  $-4$  making it third brightest object in the night sky next to moon, and Venus. The supernova was spotted by the Chinese, Koreans and Europeans, but it is famously known as Tycho's Supernova. Remnant of the supernova was identified in 1960s as a radio source 3C10. The supernova was visible for almost 15 months.

*Akbar* became ruler at the age of 14. He re-established Mughal rule in Delhi in year 1556. Mughal Empire reached the pinnacle of its glory during *Akbar's* reign. *Akbar* had a court astronomer in his court. We feel, prosperity and stability of the time makes SN1572 the best candidate for searching records of sighting of supernova. In 1572, *Rana Pratap* defeated *Akbar* in the first battle of HaldiGhati. We might also find some reference to the supernova in historian's note.

Figure 6: Indian Political scenario in 1630 AD

Fall of *Vijaynagar* Empire in 1565, by the joint efforts of *bahamani* kings i.e. Adilshahi, Nizamshahi, Qutubshahi and Baridshahi, is a disappointing event. Sant *Eknath* is another hope for the supernova records. Sant *Eknath* was in his fifties at the time of the supernova. He took *jal-samadhi* in 1599AD.

2.7. Supernova 1604AD (Vikram Samvat 1661, Shalivahan Shaka 1527, Hijri San 1026)

Famously known Kepler's Supernova exploded near the misty band of milkyway, northward of the tail of Scorpius. The supernova was visible for 1 year. The supernova exploded on October 9, 1604. It was nearly as bright as Jupiter at peak.

Interestingly, when the supernova exploded, the planets Jupiter, Saturn and Mars were within 5 degrees from supernova. It would have been the greatest sighting of the time. The planet trio and the supernova were visible in the western sky in the month of October.

*Jahangir*, the successor of *Akbar*, became the ruler of Mughal Empire in 1605. The last years of Akbar's life were marred by ill-healths and constant rebellions. The supernova may have been mentioned in some chronicles as a possible omen.

### 3. Summary

In Table 2 we have given a brief summary of the various periods of the constellations in which the 7 most prominent supernovae should have been seen.

Year	Vikram Sanvat	Shalivahan Shak	Hijri San	Constellation	Brightness	Prominent Indians
185 AD	242 ±1	108±1		Centaurus	Brighter than Venus	Satavahan Dynasty, King Vasudeva (Kushan)
393 AD	450±1	316±1		Scorpius	Brighter than Mars or Jupiter	Vikramaditya Chandragupta-II, Vakataka Dynasty
1006 AD	1063±1	929±1	428±1	Lupus	Brighter than Venus	Kalyani Chalukyas
1054 AD	1111±1	977±1	476±1	Taurus	Brighter than Venus	King Somesvara-I, King Bhoj, Nayanna
1181 AD	1238±1	1104±1	603±1	Cassiopeia	Between Sirius and Saturn in brightness	Yadavas, Bhaskaracharya-II
1572 AD	1629±1	1495±1	994±1	Cassiopeia	Nearly as bright as Venus	Emperor Akbar, Rana Pratap, Sant Eknath
1604 AD	1661±1	1527±1	1026±1	Ophiuchus	Between Sirius and Jupiter in brightness	Jahangir

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