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Short Communication

Evidences of the Earliest Supernova Observation in the Nebra Disk

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Abstract

One of the first man crafted objects dealing with the description of a celestial phenomenon or with an astronomical reference seems to be the Nebra disk. In the present paper we will discuss its morphology and give, through archeo-astronomical methods, a reasonable explanation of the depicted celestial phenomenon in agreement with well-known astrophysical properties of the Supernova explosion. We will therefore evaluate whether this hypothesis is reasonable in comparison with the age and positions of presently known Supernova remnants as well as comparing the present artefact with others available in the archeological community

Keywords: Archeoastronomy; Historical SN Observations; Supernovae Remnant

Abbreviations: SNR: Supernova Remnant

Introduction

The Nebra disk, found in Northern Germany, is one of the oldest concrete depiction of the cosmos yet known from anywhere in the world. It is represented in Figure 1 and the most striking features are, without any doubt, the Pleiades cluster, which shows up in the middle of the disk. It was found in a prehistoric enclosure in the Ziegelroda Forest, 60 km west of Leipzig. Together with it a number of bronze Age weapons were discovered. A large, circular disk, often interpreted as a solar disk and what is suggested to be a waning moon also appear in a starry background made of a green-blue patina. It was shown [11] that some other arcs were added later on, in a second phase, to the original figure on both sides of the disk. Presumably, from 14C dating recently performed on organic material which was buried together with the disk an approximate burial time is given around 1600-2000 BC. Nevertheless, its manufacturing has been possibly made generations before. It is, in fact, suggested by archaeological studies that the disk is an artifact of the Unetice culture in Central Europe which was active in several sites in the period 2300÷1600 BC.

The Disk was made during the Bronze Age, as it turns out from radiocarbon dating of objects buried together with it (swords, hatchets, bracelets and so on). In particular the radiocarbon method of a birchbark particle found on one of the swords confirmed this estimate to between 1600 and 1560 BC. As suggested before, this period only fixes its burial though its making was possibly happening several generations before. According to an initial analysis of trace elements by X-ray fluorescence [13], the copper originated at Bisch of shofen in Austria, while the gold was thought to be from the Carpathian Mountains. A more recent analysis found that the gold used in the first phase was from the Cornwall, United Kingdom [5], the same origin of the tin which constitutes the bronze used in the disk.

The most striking feature of the artefact is by far its representation of the sky with several objects which are present over a starry background as represented in Figure 1. It is clearly one of the first depiction of our Universe and of the night sky ever made by a prehistoric observer. Such an object quickly captures the attention of the observer which is usually focused in two points: the simultaneous depiction of the Moon and the Sun and a neighboring stellar cluster which is mostly resembling the Pleiades star cluster. It is clear that for some reason a lot of efforts, skill and resources were concentrated in the making of this object. Nevertheless, its real meaning is still unclear. Several studies have been performed to understand the eventual astronomical significance of the object [12]. From those ones it is assumed a first version of the disk was constructed without any reference to solar disks (the arcs which show up at the bottom and right side). Thus, the first version

of the Nebra disk was a blue starry sky with the Moon, Sun and Pleiades close to the center. In fact, it was shown in reference Ehser et al. [5] by means of the isotopic analysis of gold-contaminant, that the golden leaves which form the two arcs were made from material extracted from a different site than the one used for stars and the main objects. Therefore, in the first version of the disk its main patterns were the golden disk, the Moon as well as the Pleiades. This strange combination of celestial objects hardly finds a reasonable astronomical correlation with any particular known real phenomenon. Should the golden disk represent the Sun-disk, in fact, it is very unlikely to observe it, together and in the same portion of the sky, with the waning Moon and the Pleiades. Such objects, in fact it cannot clearly be the Sun and the Moon since, with such proximity to the Sun, the Moon would be in a partial phase around the new-moon and hence not visible in combination with the Sun. In that case it should be assumed that the artisan who made it was just displaying celestial symbols without any specific reason except symbolical ones.

Figure 1: The Nebra disk as it appears now (on display in Halle Museum of Prehistory). The Pleiades cluster shows up in the top part, amid the golden disk and the waning Moon. The solar arcs on the right and bottom of the picture were added in a post-construction phase (see text for details). The picture is courtesy of the State Museum of Prehistory in Halle, Saxony-Anhalt, Germany where the Nebra disk is now preserved.

On the other side our idea is trying to give a reasonable physical meaning to the celestial phenomenon we think it is described in the disk, gathering proofs and evidence which hint at this. In the present work, in particular, we reinterpret this artefact through the glasses of archeoastronomy, with a strong emphasis on the two extremely bright celestial bodies shown in the picture. There is clear indication that the two celestial objects drawn are very bright as one can assume for the visual appearance and size. We therefore investigate in this work the possibility that the observed disk-shaped object is not the Sun but a particularly brilliant star. It is clear in other prehistoric drawings from European caves that stars are never shown as large disks such the one in the Nebra disk [15]. Moreover, stars are plotted (e.g., the Pleiades or background stars) in this same studied artefact as smaller disks or even dots. Therefore, it seems the picture represented in the Nebra disk deals with a night starry background, in the sky region of the Pleiades and that a very luminous object is present close to the seven sisters and the crescent Moon. This object cannot be the Sun for the reasons explained above nor any other known object. The question is now, what were this primeval celestial observers trying to represent?

Methods and Results

Our idea is that the ancient people who made the disk did have an astronomical phenomenon to describe and, by portraying it, worship it for the ages to come. The singular phenomenon is a Supernova explosion (symbolized by the large golden disk) in the region of the sky, which is closer to the Pleiades, i.e., the Taurus/Auriga asterism. That area of the sky sits in a very active region for Stellar formation of our Galaxy and therefore in an area where several Supernovae events have occurred historically. The best known among them is the 1054 Supernova event which formed the so-called Crab nebula which is not far away. We underwent a search of any supernova remnant (SNR), i.e., the last relic which remains of a former massive star once it has exploded as a Supernova. Relics usually consist of a SNR and, depending on the kind of progenitor star and Supernova type, a pulsar in some cases. SNR are usually observed in several portions of the electromagnetic spectrum and many physical features are described including distance, composition, expansion speed and age (i.e., time passed since the SN explosion). At present we can even now the chemical

composition of the remnant and observations are getting more and more precise. In this survey, each SNR which is presently known in literature in that Galactic area and with an age which approximately matches the one expected for the Nebra disk itself is examined and investigated in this work. SNR ages, and consequently the amount of time passed since the explosion of the stellar progenitor (as well as the SN event) are usually measured by means of consolidated astrophysical techniques. The Auriga-Taurus asterism, laying within the Galactic plane is populated by freshly formed massive stars which are the typical progenitors of SN explosion. Those traces are maintained after thousands of years as a SNR and are usually visible even in the present times with appropriate diagnostics. In Table 1 the results of this search, conducted in recent literature, are reported. We have also reported the SNR approximate age and distance (which are measured in the bibliographical reference reported in column 4) while their relative position with respect to the Pleiades is drawn in Figure 2.

Figure 2: Position in the Taurus/Auriga region of the Supernova remnants reported in Table 1. IC443 is not reported, being in Gemini (upper left of the present stellar map).

Table 1: Supernova remnants which lay in the Auriga/Taurus asterism area. Ages and distances are also reported in the respective units as well as a bibliographical reference.

SN Remnant	Age (years)	Distance (kpc)	Reference
SH2 224	13000-24000	4.5	[2]
SH2 221 (HB9)	4000-6600	0.8 ±0.4	[1,10]
Simeis 147	30000 ÷40000	1.2÷1.5	[4,14]
Crab Nebula	966	2	[9]
IC443	3000-30000	1.5	[3]

Among those objects, five in particular are interesting for our purposes. It turns out that SH2-221, a supernova remnant which was recently object of intense study [10], The age of this SNR is about 4000 - 6600 years and is roughly comparable, in its lower part of the range, with the presumed fabrication period of the Nebra disk [11,12]. Being the explosion relatively close to the Sun neighborhood (distance 400-800 pc in the lower range) and assuming an absolute peak magnitude for a Typical type II supernova (which was probably at the origin of SH2-221 and the pulsar slightly off its center) M_V=-17÷19 (according to observations of other similar events, e.g. [6,7] and reference therein) we can easily calculate the apparent magnitude of the Supernova explosion at its peak by means of the equation

$$M_v = m_v - 5\log d + 5$$

(Where d is the distance in parsec).

This yelds, assuming 800 pc as distance thus assuming the average value for the distance (according to [1,10]), a brutal approximate value of -9≤mV≤-7.5 which is relatively close to the full Moon magnitude (mV =-12.7) or well above the crescent (about mV =-6.). Being this a celestial phenomenon of such striking power, it seems reasonable that it was taken as a possible herald of important events (as until recent years in several cultures for the comets) thus impressing the Bronze-Age society in North Europe which has produced such a fine artifact like the Nebra disk. Therefore, this stellar phenomenon (the SN explosion) was portrayed by those ancient star-gazers on the Nebra disk together with the most interesting objects nearby (the Moon and the Pleiades), making this artifact one of the oldest examples of an astronomical observation in prehistoric times. With time as the memory of the Supernova event slowly faded, generation after generation, maybe a new solar symbolism was found for the old object and solar arcs were carved and superimposed to the ancient representation as possible hints to astronomical phenomena like solstices as it is reported in Pasztor [12]. Therefore, the Nebra disk may be the first hint of a Supernova explosion observation ever made by mankind. Of course, it cannot be demonstrated although it might be reasonable in view of the arguments that were shown above. Even though the correctness of this assumption cannot be demonstrated it is striking that in other cultures of the same period a similar phenomenon was described. In fact, the assumed explanation for the Nebra disk seems in agreement with a similar origin of several stone carvings, made approximately in the same period in the Burzahama region (India) as reported in reference Hrishikesh et al. 2007 [8]. The carvings, investigated in that publication, shows a stick figure underneath two light-emitting objects that have previously been interpreted as either the sun and the moon or two stars in close proximity. But in Hrishikesh et al. [8] the authors make a case that the carving depicts the moon next to a supernova, most probably the same investigated in this paper which seems to have stricken those ancient observers' eye in two different parts of the globe [13-15].

Conclusions

As a part of archeo-astronomical research, possible and reasonable explanation of one of the most ancient and mysterious European Bronze-Age artefacts depicting cosmic objects (the Nebra disk) is given and its origin is reconnected to possibly the first documented observation of a Supernova event in prehistorical times. Hints are given as well as comparison with similar artefacts developed in the same period in different civil- isations worldwide. Quantitative details are given from the astronomical point of view, starting from presently known SNRs in the portion of the sky where the Pleiades cluster is located together with their physical characteristics, which might strengthen the given conclusions. If this is correct, we have evidence of the first, documented, observation of a SN explosion in human history, thus shedding lights on the important astronomical achievements reached by prehistorical societies. As many times in archeoastronomy no stronger evidence is available. Nevertheless, the discovery of stone carvings of similar age which depict a similar scene may be a hint, if not a proof, towards the possibility of the earliest SN observation and description already in prehistorical times. This study gives, once more, a taste of the importance that astronomical phenomena had for prehistoric populations (see also reference [15] for similar considerations). Rare and important phenomena like SN explosion were therefore observed and reported in special records not only in historical civilizations but also in prehistorical times. This gives a better understanding of the capacity of our ancestors to observe celestial phenomena and transmit their knowledge to other generations, marking a first and surprisingly important case of early astronomical observations.

Author Contributions

RGP has conceived the present paper, collected the data and has written the paper. RS has contributed to write the paper.

Data Availability Statement

Datasets are available upon request from the given references.

Conflicts of Interest:

The authors declare no conflict of interest.

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