

Galileo's Account of Kepler's Supernova (SN 1604): A Copernican Assessment

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Abstract. The name of Kepler is inseparably associated with the supernova of 1604 (SN 1604; V843 Ophiuchi), but there are reasons why Galileo Galilei might also claim to leave his name on that phenomenon, given the assiduousness of his observations.

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Why is it that today the supernova of 1604 is known as “Kepler’s supernova” and not as Galileo’s? The simple answer is that, unlike the German astronomer, Galileo did not publish anything specific on it. However, that does not mean that he did not study it deeply, or that he did not publish anything at all on it. This note gave a summary of Galileo’s account of Kepler’s supernova, as recovered from surviving sources. The main challenge is that the surviving evidence is scattered, and in many texts of different types. The study of the “stella nova” was a life-long research objective for Galileo and he intended to utilize the observational opportunity offered by it for confirming the Copernican heliocentric hypothesis – his lifetime astronomical goal.

A few weeks after the supernova’s visible outburst, Galileo was asked to give some public lessons on the unexpected and unsettling celestial novelty. Galileo accomplished this well, even though it was the first time he had had to handle an issue of observational, rather than theoretical, astronomy. The texts of his lectures survive, though largely incomplete and fragmentary. The main aim of his teaching was to demonstrate that the nova was located beyond the distance of the Moon, as proved by his parallactic measurements. By itself it was a provocative result, since it was contrary to the dominant Aristotelian model, according to which no substantial change could take place in the superlunary region of the heavens. The interpretation of the fragments is aided by a recently discovered external report on Galileo’s lessons. Galileo’s assessment of the superlunary position of the nova, placed at the distance of the fixed stars, finds confirmation there.

The main reference which Galileo consulted for the interpretation of the nova was the *Progymnasmata* by Tycho Brahe. Galileo intended to offer a comparative study of the nova of 1572 with the one now visible. Brahe included some positional measures taken by the astronomer Elias Camerarius and which he disregarded as wrong, but they could have been right (Galileo noted) if the Earth were moving while the star stayed now.

Another important source of information for Galileo was Ilario Altobelli, one of the first observers of the new star. Galileo received many letters from him on the subject. The correspondent described openly his anti-Aristotelian interpretation of the appearance, and provided the observational data he collected. (At the same time Galileo also received observational notes from others). However, shortly afterwards Galileo was attacked by a pro-Aristotelian, Antonio Lorenzini, the point of contention being the alleged superlunary position and the presumed applicability of a geometrical method, i.e. parallax, to matters

within the domain of natural philosophy. Galileo pseudonymously replied *thrice*, also by the aid of one of his students, making plain the principles of parallax in an elementary way, defending the validity of its application for calculating relative astronomical distances, and cautiously sympathizing with Copernican heliocentrism.

18 months after its first appearance the nova had faded, and Kepler published his *De Stella nova*, hailed as the magnum opus on the subject. Galileo's only comment (written on a little slip of paper) was a consideration regarding the apparent centrality of the solar source of light as observed upon other heavenly bodies, stars included, an argument that he planned to discuss in his own account of the nova.

Another Aristotelian opponent, named Baldassar Capra, then attacked Galileo openly, discrediting his work because he did not attribute to him (Capra) the priority of having spotted the nova first – something that Galileo actually never pretended for himself. Galileo defended his professional respectability and his scientific results vigorously. From this dispute we learn that Galileo probably used a quadrant for his observations (the telescope had not then been invented), and that he provided precise alignment measures of the nova in respect to other surrounding stars in order to validate its fixity.

After the publication of his *Sidereus Nuncius*, Galileo was still reviewing the observations that he made in order to determine two unsettled key features of the nova: (1) whether it was in motion, and (2) what was its actual physical conformation. The observed decrease in luminosity suggested that the nova had an upward receding motion. From its progressive uniform fading he deduced that its estimated motion was constant, while from the lack of any detectable angular parallax he deduced that the motion occurred in a straight line. The “optical” nova was therefore considered to be in uniform rectilinear upward motion at constant velocity, far above the atmosphere.

In his *Dialogue Concerning the Two Chief World Systems* Galileo focused mainly on the earlier nova in Cassiopeia, but intended to extend his results to the one of 1604. He double-checked the measurements taken by others, and definitively corrected its position as superlunary (in opposition to the account provided earlier by Chiaramonti). He even took into account effects like atmospheric refraction and instrumental errors, but judged them irrelevant for the level of precision of the observations. Responding to his critics, he maintained that the “new star” had to be a sort of tailless, reflecting comet. 30 years later the nova was also a hot topic for discussion.

Among Galileo's papers we can also find a couple of undated sketches that turn out to be of paramount importance for assessing his interpretation of the object. One reveals how he intended to set his observations within a Copernican heliocentric framework. The other shows how he intended to use the expected parallactic shifts to confirm the Earth's revolution around the Sun: if the nova moved steadily on along a line, changes in the annual parallax could have falsified the geostatic hypothesis and confirmed the Copernican one. But no annual parallax could be detected (because of the nova's fading, and because of the insufficient measuring precision). Galileo later became fully aware that the actual distances to the stars were vastly greater than those commonly estimated. Nonetheless, even if the premises on which his hypothesis was built were wrong, his confirmation model was correct. Despite this, for almost 200 years after Galileo's death no-one was able to demonstrate the Earth's motion around the Sun by stellar parallax, as he brilliantly anticipated.

The cultural impact which the sudden appearance of the supernova had on the early-modern scientific mindset(s) was deep and unsettling, and proved key to the abandonment of the Aristotelian-Ptolemaic view of the world. Besides the distinguished contribution by Kepler, Galileo too (willing or not) played a star role in that historical transition.