Luminosity estimate of SN 2023ixf via amateur astrophotography

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SN 2023ixf

A long time ago in a galaxy far, far away —20.87 million light years to be precise —a star exploded. The supernova was in an outer spiral arm of M101 right next to NGC 5461. SN 2023ixf was first observed May 19th and subsequent observations have cataloged the absolute magnitude for a variety of wavelengths [1]. In this study we use amateur astrophotography equipment to estimate the absolute magnitude of SN 2023ixf on June 11th and compare our results with previous measurements. We are able to estimate the luminosity within an order of magnitude without accounting for atmospheric or galactic extinction.

Measurement methodology

200 frames of 13s each were taken using the following hardware:

- Sensor: Canon 6D mark II
- Optics: Celestron 8 Schmidt-Cassegrain telescope with focal reducer and flattener (1260mm f/6.3)
- Software: SiriL for image extraction, python for analysis

The frames were collected at the South rim of the Grand Canyon which had occasional cloud cover and considerable skyglow.

Absolute magnitude estimate

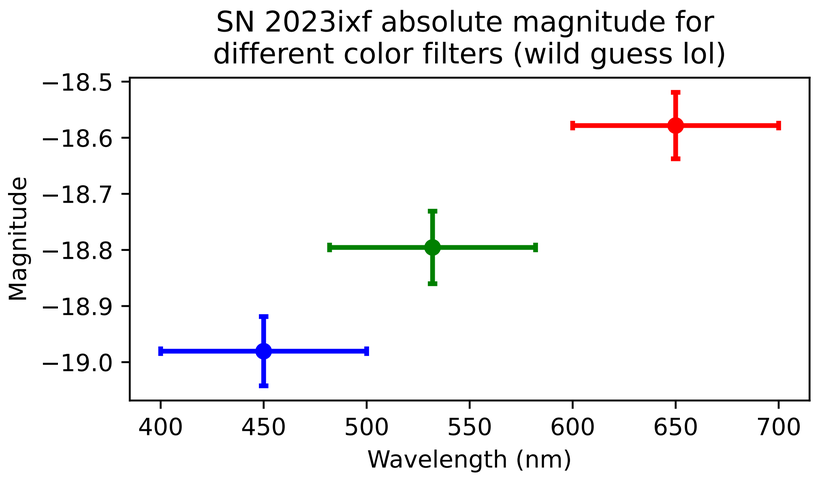

Fig. 1: Magnitude for different wavelengths based on a wild guess of the range of accepted wavelengths for the color filter array (Bayer pattern) on the 6D mk II sensor.

About me

Hi! I am a 6th year graduate student in plasma physics studying turbulence and transport in magnetic mirrors, which are a class of potential fusion devices. I love dogs, space and do some astrophotography as a hobby. Half of my personality is that I drive a blue Bolt and the other half is that I was born and raised in Tokyo.

[1] W. V. Jacobson-Galan et al. *SN 2023ixf in Messier 101: Photo-ionization of Dense, Close-in Circumstellar Material in a Nearby Type II Supernova*. 2023. arXiv: 2306.04721 [astro-ph.HE].

Analysis and results

Out of 200 frames, approximately half of the least blurry frames were analyzed The images were aligned, cropped , and split into red, green, and blue channels, which were analyzed separately. The average read and amplification noise was then subtracted. The peak wavelengths of the color filter array were assumed to be 630, 532, and 430 nm for red, green, and blue, respectively. The collected photon power was estimated and extrapolated to a sphere with a radius of the distance to M101. The estimated absolute magnitude are red, green, and blue are -18.6, -18.8, and -19, respectively, which is roughly consistent of the values gathered by others (-18 for green [1]). Plots with error bars can be seen in fig. 1.
Future work is outside the scope of this study.

Please enjoy this pretty picture.

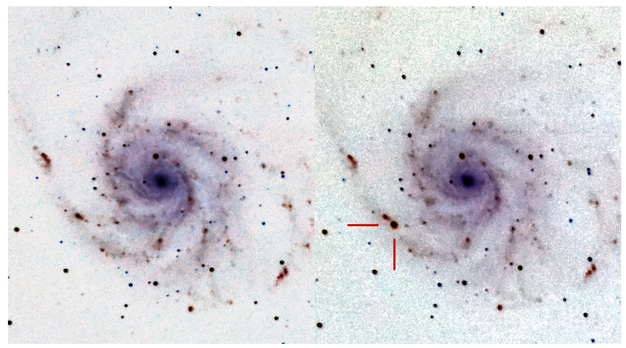

Fig. 2: M101 a few days before and 20 days after the supernova