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OBSERVATIONS OF THE SUPERNOVA SN2023IXF

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Abstract: Residing in a spiral arm of the Pinwheel Galaxy (M101), Supernova SN2023ixf was distinguished as one of the most intrinsically luminous objects visible in the 2023 summer night sky. Its astronomical significance is further highlighted by its relative proximity, situated at 6.64 Mpc. Over a span of 22 days, photometric observations were meticulously conducted by the GTRI team to analyze this supernova.

1 Introduction

On 19 May 2023, Koichi Itagaki discovered a Type II supernova, assigned as SN2023ixf via the Transient Name Server (2023), in a spiral arm of the Pinwheel Galaxy (M101), located ∼6.64 Mpc (∼21 million light-years) away NED (2023). This supernova, the closest observed in nearly a decade (Latest Supernovae, 2023), originated from a previously unobserved massive supergiant star. SN2023ixf peaked at V = 10.8 mag on 22 May 2023 and began fading on 10 June 2023 (Latest Supernovae, 2023), making it a prime observational candidate. Hiramatsu et al. (2023) and Hosseinzadeh et al. (2023) present numerous observations and detailed analyses of SN2023ixf during its first two months.

2 Observations and Data Reduction

The 11-inch Celestron "Aloha" Telescope, situated in Kihei (Maui), HI, USA, is a collaborative facility between the Georgia Institute of Technology (GA Tech) and the US Air Force Research Lab (AFRL). Primarily providing streaming views of celestial objects to K-12 students during school hours, the telescope also supports photometric observations for selected projects. The telescope has a field of view (FOV) of ∼15 arcmin and a focal length of 2800 mm. Using its ZWO ASI147MM-cooled camera, which features a Sony 1/1.2-inch Monochrome CMOS sensor with a resolution of 1920 x 1200 pixels (2.3 Megapixels), we captured images of the supernova using a Johnson R filter.

Astrometry.net, an astrometric calibration program, facilitated the identification of the objects in the image and, through plate solving, confirmed the location of the prominently visible supernova shown in Figure 1, highlighted with a circle. TYC 3852-1108-1 = 2MASS J14034985+5409062 served as the comparison star, marked with a square in Figure 1, and has an apparent R magnitude of 11.2 as noted on the ADS site. The comparison star coordinates are presented in Table 1.

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Table 1: Characteristics of Comparison star. Magnitudes are taken from SIMBAD (2023).

Star	ID	RA [h:m:s]	DEC [°:m:s]	R [mag]
Comp	TYC 3852-1108-1	14:03:49.8	+54:09:06.0	11.2(20)

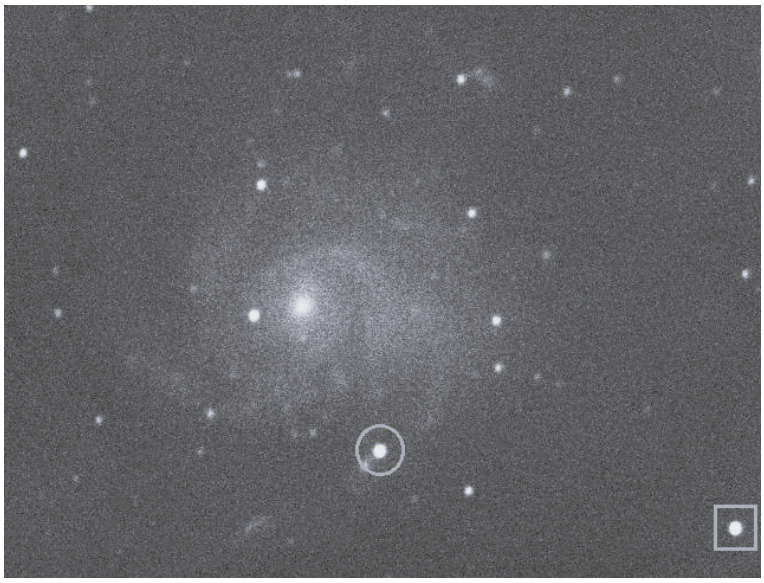

Figure 1: Image of the Spiral Galaxy displaying the location of the observed supernova; circle – SN2023ixf, and the comparison star; square – TYC 3852-1108-1.

SN2023ixf was observed between 12:00 a.m. and 4:00 a.m. HST from 26 June to 18 July 2023. The mid-point of the nightly observations (2:00 am HST = 7:00 am EDT = 12:00 UT) are presented in Table 2, along with the observational results.

Table 2: Apparent and Absolute Magnitudes of SN2023ixf.

Date	R (mag)	M_R (mag)
26 June 2023, 12:00 UT	11.60(09)	-17.51(09)
29 June 2023, 12:00 UT	11.58(14)	-17.53(14)
14 July 2023, 12:00 UT	11.67(11)	-17.44(11)
15 July 2023, 12:00 UT	11.85(16)	-17.26(16)
18 July 2023, 12:00 UT	11.90(09)	-17.21(09)

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3 Data Analysis and Results

Multiple supernova images were taken during each observing session, stacked with the program Siril, and reduced via DeepSkyStacker. Using AstroImageJ, the fluxes of the two objects were determined via the mean intensity values of the supernova and the comparison star. Next, the known visual R magnitude of the comparison star (11.2 mag) was used to compute the supernova's apparent R magnitude for each observation. A distance of 6.64 Mpc, from the large range of distances for M101 listed in NED (2023), was used to compute the absolute magnitude M_R values of the supernova, indicated in Table 2.

Over the 22-day range, starting 34 days after the supernova reached its peak intensity, the nightly observations of SN2023ixf ranged from a M_R of $-17.53(09)$ to $-17.21(09)$ mag. The observations in Table 2 show, within our photometric error bars, a decrease in magnitude over this time, with some subtle fluctuations; commonly seen in supernova light curves (Zhang et al., 2016). Nevertheless, the general trend displays a decrease in brightness, as displayed in Figure 2.

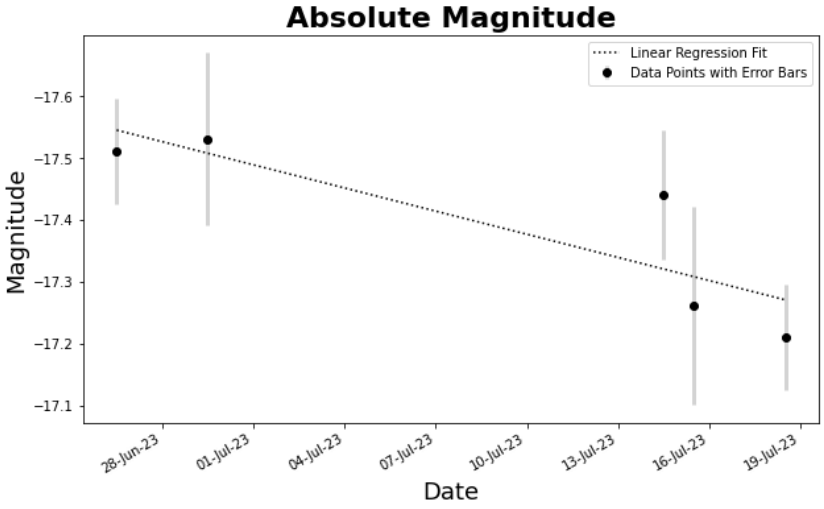

Figure 2: Light curve of SN2023ixf with five magnitude observations showing a gradual decline.

The magnitudes of SN2023ixf indicate a gradual dimming from its peak brightness, as the luminous after-effects of the explosion continue to wane. After attaining its maximum brightness, the fading of a supernova can unfold over the course of a few years (Dimitriadis et al., 2017); a process reflected in the slight decreases in magnitude measured over the three-week period.

4 Summary

The decay of SN2023ixf's luminosity over the 22-day range of observations matches what is expected in the behavior of a supernova several weeks past its maximum (Filippenko, 1997). The brightness changes are apparent but minimal.

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