Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias, 60, 179-180, (2026)

OPEN ACCESS https://doi.org/10.22201/ia.14052059p.2026.60.161

Radio spectra of the classical nova V5668 Sgr

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Keywords: *stars: binarie, stars: novae: V5668Sgr, stars: radio continuum*

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The classical nova V5668 Sgr erupted on 2015, March 15. It was observed with ALMA on 2017 (Diaz et al., 2018) 927 days after eruption, showing for the first time, that the nova shell is formed by clumps of sizes $\sim 10^{15}$ cm (Fig.1a). V5668 Sgr was observed with the VLA, although not resolved, at frequencies ranging from 1.3 to 35 GHz (Chomiuk et al., 2021), between days 2 and 1774 after eruption (Fig.1b). In this work we show that it is possible to reproduce all the VLA spectra, assuming that the clumps were formed early in the nova evolution.

A nova eruption is the result of a thermonuclear explosion at the surface of a white dwarf (WD) in a close binary system. The companion star transfers matter to the WD, an accretion disk is formed around the WD and when enough matter is transferred, thermonuclear reactions occur at the base of the disk. The disk is ejected at velocities of $\sim$ 1000 km s^{-1}. The ejecta expands and forms a shell, while nuclear reactions continue at the surface of the WD. The fastest wind from the WD interacts with the slower ejecta, producing radiative shocks, clumps, and γ-ray emission. As the shell expands, soft and hard X-ray emission is detected.

In our model, the shell is formed by a number $N_{\rm cl}$ of identical spherical, homogeneous clumps, although the model is also valid if the clumps have a power law distribution of sizes (Abraham et al., 2024). The clumps emit free-free radiation and the observed spectrum is the sum of the individual spectra of the clumps. The parameters of the model are electron temperature $T_{\rm e}$, number density $n_{\rm H}$, and radius $R_{\rm cl}$. We verified that models with constant temperature (1.21×10^4 K, as obtained from models of optical and infrared line emission) fit the VLA spectra after day t = 635 after eruption; before, the temperatures necessary to fit the data were higher. After day 635, the density of the clumps decreased as $n_{\rm H} \propto t^{-3}$. Based on this result we propose that the clumps are in pressure equilibrium with a hotter and thinner plasma which fills and expands with the shell, which at earlier epochs was responsible for the observed X-ray emission. In fact, the X-ray emission calculated from this model coincided with the observed hard X-ray flux. The total mass of the clumps

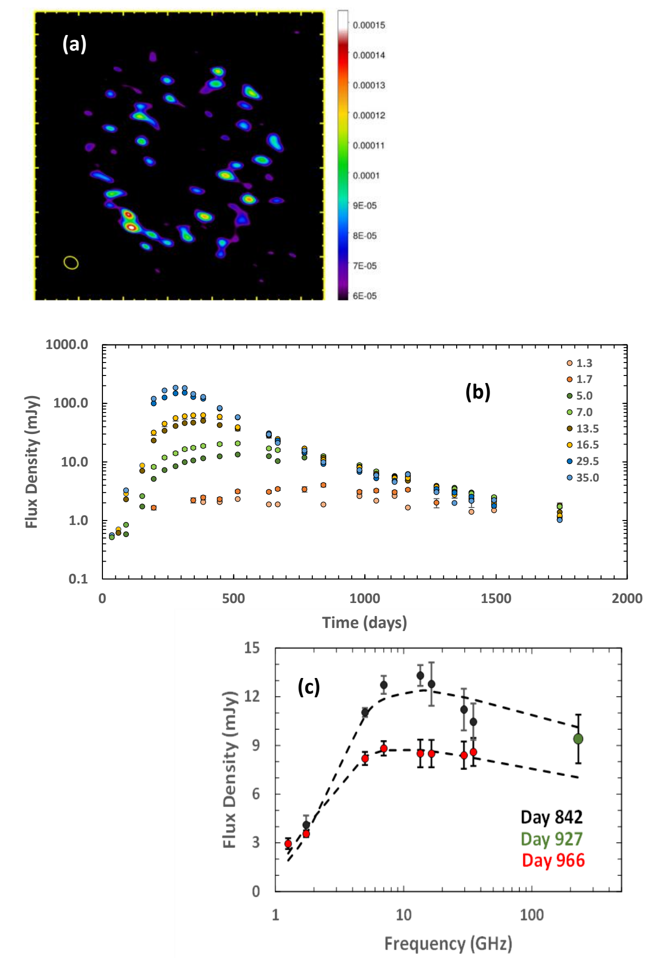

Figure 1. (a) 230 GHz continuum image of V5668 Sgr, (b) VLA light curves, (c) VLA spectra at two epochs (points), with adjusted model (lines) and 230 GHz ALMA data.

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was 1.9×10^{-5} $M_\odot$, for $N_{cl} = 40$ while the mass of the hot material was 3.5×10^{-7} $M_\odot$.

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