Spring 2013

Spectral Transformations of Novae in Andromeda Galaxy

Amanpreet Kaur

Dieter H. Hartmann

Spectral Transformations of Novae in Andromeda Galaxy (M31)

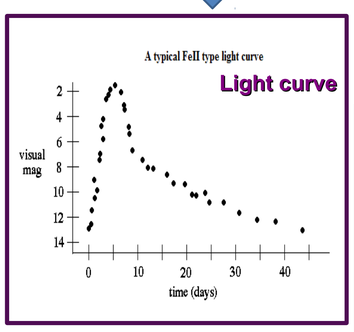
"The Bulge/Disk bimodal population was called in question by hybrid novae"
Addressing this question with global population studies

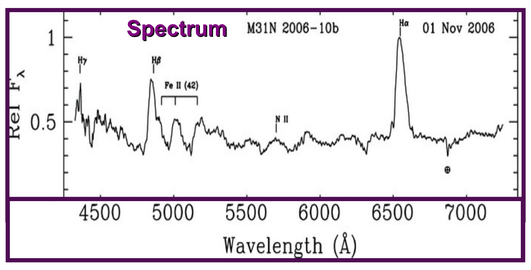
Amanpreet Kaur (akaur@clemson.edu), Dieter H. Hartmann
Department of Physics and Astronomy, Clemson University, Clemson, SC - U.S.A.

Abstract

Nova outburst is the nuclear explosion on the surface of a white dwarf, which is caused by mass accretion from its companion star in the binary system. It is commonly believed that novae in Andromeda Galaxy (M31) separate into two distinct populations: bulge and disk in the galaxy. These spatial distinctions in the galaxy appear to correlate with the two spectral types of novae (FeII type and He/N). However, recent observations of novae in our own galaxy, Milky Way has demonstrated spectral transformations from FeII to He/N and vice-versa, which calls the spectral distinction between two source classes into question. However, for M31 only one such case is known. Multi epoch spectroscopy is needed to address the questions whether novae in M31 also undergo spectral transformations and whether spatial distinction in the galaxy has any correlation with the spectral type of novae. We construct a spatial distribution model of the stars in M31 and its disk/bulge nova population in order to investigate possible selection effects during observations, that could play a role in spectral - spatial correlations.

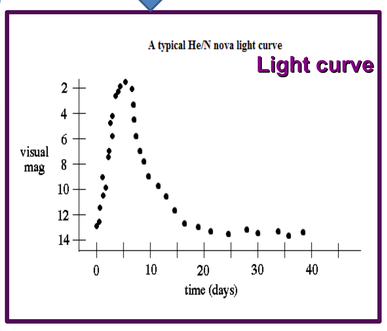
"Bulge" novae Fe II type Slow

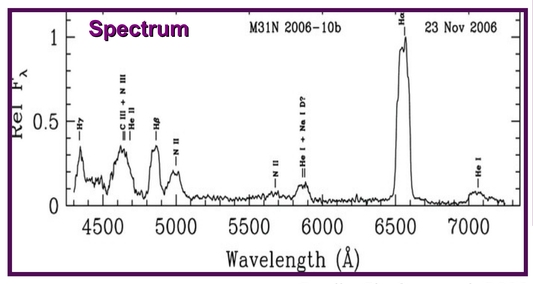




Credit: Shafter et al. 2011

"Disk" novae He/N type Fast





Credit: Shafter et al. 2011

Spectral class Transformation

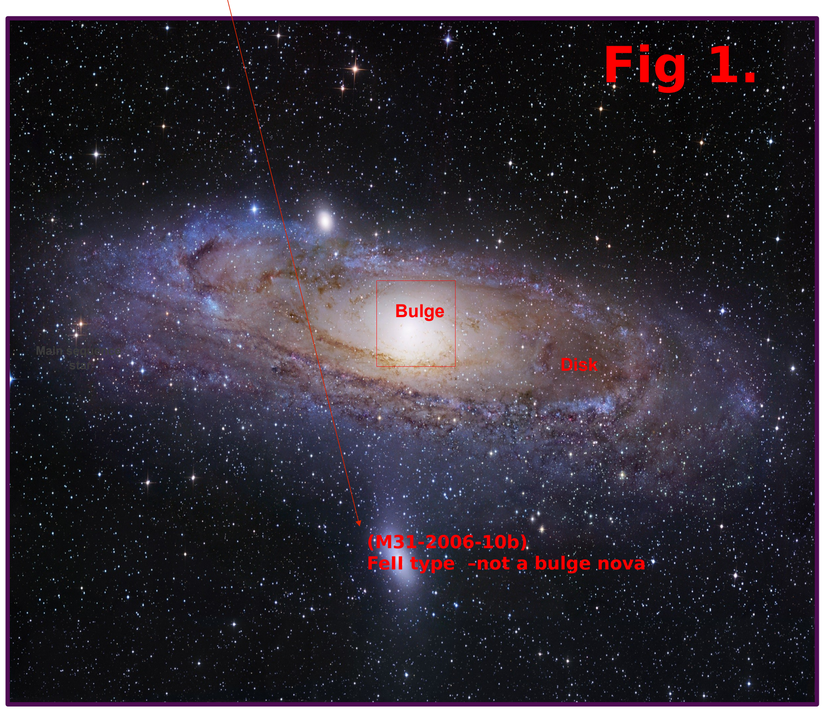
Hybrid nova in M31

Novae

- Thermonuclear explosion on the surface of a white dwarf, in a binary system.

In Andromeda galaxy

- Occurrence Rate: 50 per year (Shafter et al. 2011).
- Spectroscopic "bimodal" population ? i.e. bulge vs disk novae. See **Fig. 3b**.
- More FeII (~82%) than He/N type. (Shafter et al. 2011). See **Fig. 2b.**



Credit: http://apod.nasa.gov/apod/ap080124.html

Spatial Distribution Model of Novae in M31

Nova distribution:

- Exponential disk with scale length, 5.3 kpc and scale height equal 0.1 kpc
- Sersic bulge with scale length equal 1.0 kpc and sersic index, n=2.3 (Courteau et al. 2011).
- Bulge to Disk ratio = 41 :141
- Follow disk plus bulge light distribution. See **Fig. 3A**

Hybrid Novae

- Transition from one spectroscopic class to another
- 5% of the total Milky way classical novae. (Williams, R. 2012)
  observational selection ?
- Transition from FeII to He/N, but one (TPyX).
- Only **one case in M31** (M31-2006-10b). See **Fig. 1.**

Results

Comparison of model and observations of 89 novae

Observations : More novae in the bulge
See Fig. 2a and 2b

Model :More novae in outer disk region
See Fig. 3a and 3b

Reason *: extinction in the disk ?*

Spectroscopic follow up required

Observations:
Proposal submission for 4 meter Kitt Peak telescope

Work in Progress

Global Modeling:

- Line of sight extinction model
- Do novae follow light precisely ?
  Nova rate : light ratio to be determined
- Environment : wind, interstellar medium

References :
- Courteau et al. 2011 ApJ 739 20
- Shafter, A. W. & Irby, B. K. 2001, ApJ, 563, 749
- Shafter, A. W., Darnley, M. J., & Hornoch, K. et al. 2011, ApJ, 734, 12
- Williams, R. E. 1992, AJ, 104, 725
- Williams, R. E. 2012, AJ, 144, 98