SAN DIEGO STATE UNIVERSITY DEPARTMENT OF ASTRONOMY MASTER'S THESIS TALK

Speaker: Kelsi Flatland

Topic: SN 2014cx: A Case Study of a Normal Type II-Plateau Supernova

Time: 1:00 PM, Friday, August 5, 2016

Place: Room 215, Physics-Astronomy Building (PA-215)

Abstract:

The type II-plateau (II-P) class of supernovae (SNe) is characterized by hydrogen in the spectrum and an enduring period of nearly constant optical brightness. This photometric plateau is likely due to the progenitor having a large, intact hydrogen envelope, as seen in red supergiants; the energy of the explosion is deposited into this envelope, ionizing the hydrogen and making the ejecta opaque. The hydrogen takes about 100 days to recombine from the outer layers inward, causing the SN to stay at a relatively constant brightness for that time. SNe II-P are the most commonly observed type of core-collapse event, and yet the basic characteristics of this class are still being defined.

Here we add to the growing sample of type II-P events with well-sampled data from observations of SN 2014cx. This SN was independently discovered on September 2, 2014 UT by Nakano et al. (2014) and Holoien et al. (2014) in the SBd galaxy NGC 337, which has a Tully-Fisher distance of 20.7 +/- 1.7 Mpc. SN 2014cx was classified as a young type II SN through spectra taken within a day of discovery at both optical (Nakano et al. 2014) and near-infrared (Morrell et al. 2014) wavelengths. Later, Andrews et al. (2015) proposed the classification of type II-P based on an initial photometric analysis. We initiated a photometric and spectropolarimetric campaign to follow SN 2014cx; over a five month period following the SN's discovery, we obtained optical BVRI images using the 40-inch telescope at Mount Laguna Observatory as part of the MOunt LAguna SUpernova Survey (MOLASUS) and spectropolarimetry as part of the SuperNova SpectroPOLarimetry project (SNSPOL).

In this thesis, I present an analysis of the photometry and spectroscopy obtained as part of this campaign. From the photometric light- and color-curves, I securely establish the type II-P classification, measuring a plateau decline-rate in V to be 0.0039 +/- 0.0005 mag/day, well within the normal bounds for SNe II-P. To better investigate the photometric behavior, I employ several techniques that convincingly establish that SN 2014cx's light suffers little to no reddening due to dust in the host galaxy. I demonstrate that SN 2014cx's light- and color-curves exhibit shapes typical of SNe II-P, aside from a few minor peculiarities. From the spectropolarimetry, I analyze the extremely high signal-to-noise flux ratio spectra. Using the FeII 5169 absorption feature, I find that the photospheric velocity shows temporal evolution typical of the SNe II-P class: declining steadily during the plateau as the photosphere recedes back through the ejecta. Finally, I apply the the standardized candle method of Hamuy & Pinto (2002), and determine a distance to SN 2014cx of 21.0 +/- 1.7 Mpc, consistent with the Tully-Fisher distance. I conclude with a brief discussion of the net polarization of SN 2014cx derived from the spectropolarimetry, finding that its polarimetric behavior falls within the normal range for SNe II-P. All of these results point to SN 2014cx being a typical SN II-P.