Chelsea Harris – Astronomy seminar – 10/2/2017

Title: Modeling Supernova Interaction with Circumstellar Material

Abstract:
Supernova progenitors -- the star systems that result in a terminal explosion -- are largely unknown across all supernova types. A rare subset of supernovae (SNe) from both the core-collapse and thermonuclear explosion mechanisms have been observed to collide with circumstellar mass (CSM) -- material that was expelled by the progenitor in the millennia before explosion and thus constrains its identity. I simulate these collisions and calculate radiation signatures, creating tools for data interpretation.

This talk will focus on thermonuclear or type Ia supernovae (SNe Ia). In the case of core-collapse supernovae, interaction spans a range of CSM densities; but, perplexingly, SNe Ia seem to be dichotomous, having either the densest CSM observed for any star system, or none at all (with none being the typical case). However, the derivation of CSM properties from observations is model-dependent; so perhaps part of the apparent dichotomy is not physical but rather because we interpret observations with models that do not apply to SN Ia progenitors. For this talk, I will focus my simulations of SN Ia interaction that address whether, in the majority case where no interaction is observed, it is possible that the interaction wasn't too dim (low density) to see but rather too short duration to see. I ran one-dimensional hydrodynamic simulations of ejecta hitting a detached, geometrically thin shell of material, and presented a new way to place upper limits on CSM density from data at radio frequencies that is simple for anyone to use. [1]

I continue to work on delayed and long-duration interaction, and I will also outline some of these projects: How extended is the CSM of PTF 11kx [2]? How could a disk of CSM change the timescales of emission? And, what can we do with the improved sample size the Large Synoptic Survey Telescope is going to give us?

[1] Harris, Nugent, and Kasen (2016)

[2] Graham, Harris, Fox, et al. (2017)