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The evolution of dust formation in SN2005ip from optical line profile models

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The source of the large masses of dust observed in some very early Universe galaxies at redshifts z $>$ 6 has been much debated. Core-collapse supernovae (CCSNe) have been predicted to be efficient producers of dust but the majority have only had small masses of warm dust ($< 10^{-3}$ $M_{\odot}$) detected in their ejecta during their early phases (t $<$ 3 years), based on fits to their near-IR and mid-IR SEDs. However, observations in the far-IR by Herschel and ALMA of a few CCSNe have yielded far higher cold dust masses (0.1 - 1.0 $M_{\odot}$), which, if representative of the wider CCSN population, could potentially account for the dust masses seen in the early Universe. Unfortunately, there are now few instruments capable of detecting CCSN dust emission outside the local group at far-IR and sub-mm wavelengths, so other techniques must be exploited.

The late-time optical and near-IR line profiles of many CCSNe exhibit a red-blue asymmetry caused by red-shifted emission from the receding parts of the ejecta, which must traverse the dusty interior of the ejecta, experiencing greater extinction than the blue-shifted emission. I present Monte Carlo line transfer models of asymmetric optical line profiles of the interesting Type IIn interacting supernova SN2005ip from ∼40 d post-discovery to ∼4000 d. Dust has been predicted to form in two phases in this object, first in the ejecta and also in the post-shock region that develops following interaction of the ejecta with a dense circumstellar medium (Smith et al. 2009). I present models of the progressively blueshifted, broad Hα line that arises in the ejecta at early times ($<$ 200 d) along with models of the evolving intermediate width Hα and HeI λ7065A lines that arise in a post-shock region at later times (∼400 d - ∼4000 d). I determine the dust masses that have formed and discuss the location of the dust and the clumpy structure of the post-shock region. I compare my SN2005ip dust mass estimates to dust mass estimates for other CCSNe that have been derived from both optical line profile modelling and SED fitting, and consider the evolution of dust formation in these objects.

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Yes

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