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NS 1987A in SN 1987A

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The possible detection of a compact object in the remnant of SN 1987A presents an unprecedented opportunity to follow its early evolution. The suspected detection stems from an excess of infrared emission from a dust blob near the compact object's predicted position. The infrared excess could be due to the decay of isotopes like 44Ti, accretion luminosity from a neutron star or black hole, magnetospheric emission or a wind originating from the spindown of a pulsar, or thermal emission from an embedded, cooling neutron star (NS 1987A). It is shown that the last possibility is the most plausible as the other explanations are disfavored by other observations and/or require fine-tuning of parameters.
Not only are there indications the dust blob overlaps the predicted location of a kicked compact remnant, but its excess luminosity also matches the expected thermal power of a 30 year old neutron star. Furthermore, models of cooling neutron stars within the Minimal Cooling paradigm readily fit both NS 1987A and Cas A, the next-youngest known neutron star. If correct, a long heat transport timescale in the crust and a large effective stellar temperature are favored, implying relatively limited crustal n-1S0 superfluidity and an envelope with a thick layer of light elements, respectively. If the locations do not overlap, then pulsar spindown or accretion might be more likely, but the pulsar's period and magnetic field or the accretion rate must be rather finely tuned. In this case, NS 1987A may have enhanced cooling and/or a heavy-element envelope.

Author: PAGE, Dany (Universidad Nacional Autonoma de Mexico)

Presenter: PAGE, Dany (Universidad Nacional Autonoma de Mexico)

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