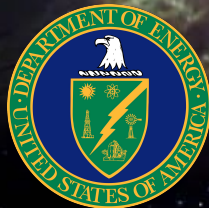


Pre-Supernova Neutrinos in Large Dark Matter Experiments

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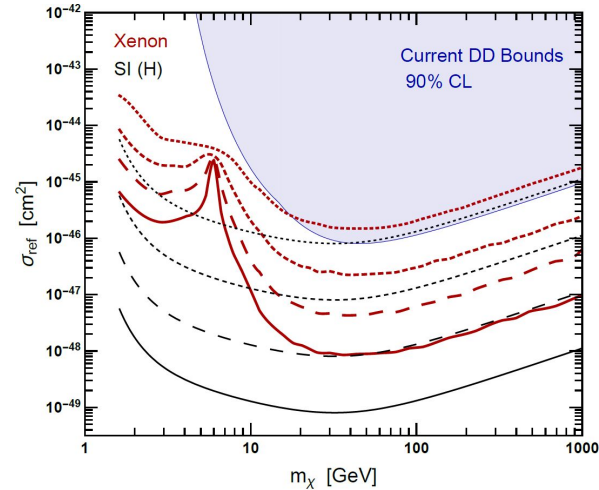
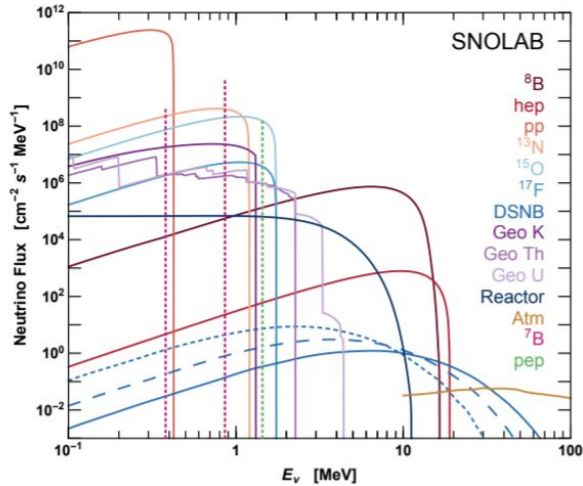


Direct detection DM experiments

- Look for particle DM interactions in detector → nuclear (and electron) recoils
- Typical setup:
 - heavy target material ($A \sim 30-130$)
 - low threshold ($\sim \text{keV}$)
 - potentially scalable (Argon, Xenon)
- Upcoming (Gen-2): ton-scale → future (Gen-3): multi-ton scale

Neutrino floor

- No convincing signs of DM \rightarrow probe further
- Eventually will encounter irreducible neutrino-background: “neutrino floor”



DM experiments as neutrino telescopes

- Neutrinos will be seen in big DM experiments → effective “DM neutrino detectors”
- Complementarity to dedicated neutrino experiments
 - enhanced coherent scattering (Scholberg’s talk, [Akimov+ (COHERENT), Science, 2017])
 - bypass IBD threshold
 - probe all ν ’s flavors
 - very low energy threshold

Example: geo-neutrinos [Gelmini, VT, Witte, PRD, 2018]

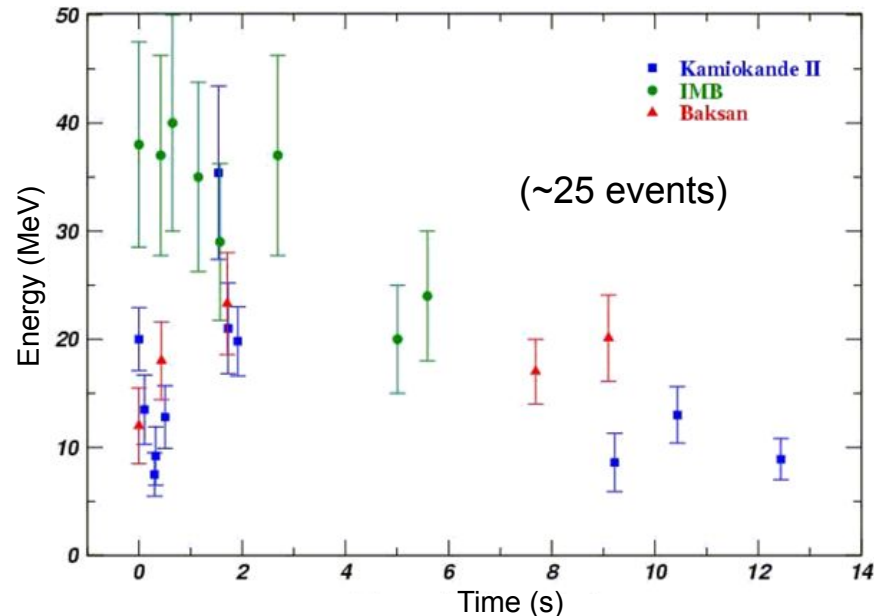
Historic neutrino astronomy breakthrough: SN 1987a

- Core-collapse SN: most energy released as neutrinos → mechanism confirmed by SN1987a

Optical



Neutrinos

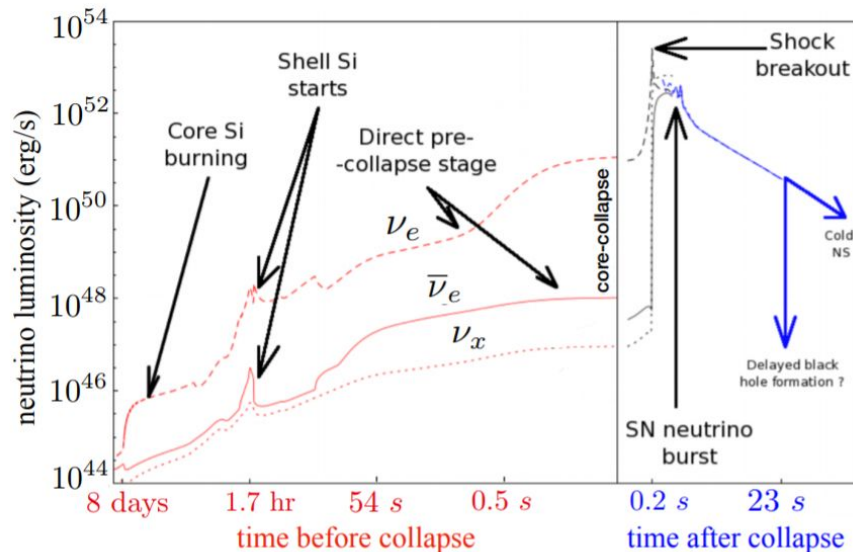


- Many unknowns → hunt for ν 's from next Galactic SN (rate $\sim 1/30$ yrs) a major target

Forecasting SN: pre-SN neutrinos

- Next Galactic SN → easily see in Super-K, big exp. (M. Nakahata's, R. Lang's talk)
- Pre-SN neutrinos: probe final star evolution stages, supernova alarm (Kato's talk)

Super-K-GD (~2020), besides likely first DSNB observation, will see hundreds pre-SN ν 's within ~day before SN explosion @ Betelgeuse (0.2 kpc)



[Odrzywolek+, 2010]

Pre-SN neutrinos in big DM experiments?

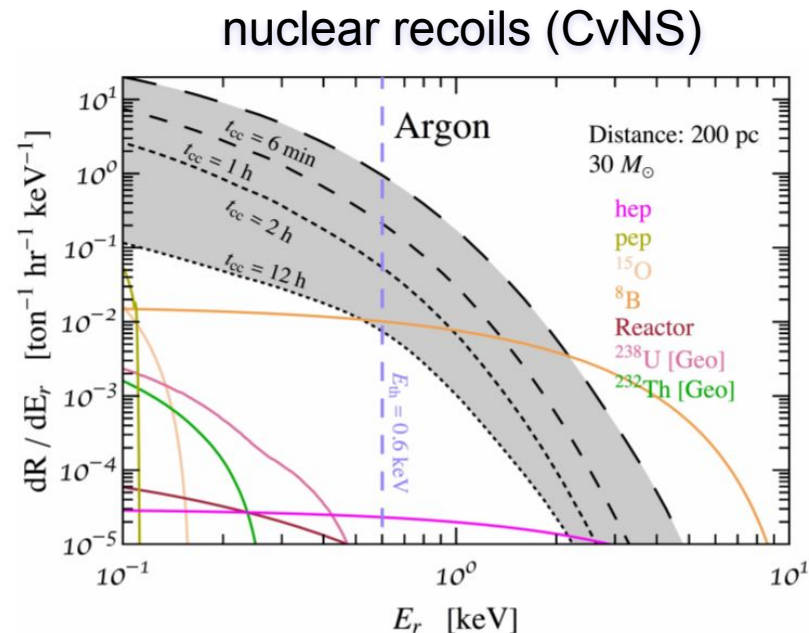
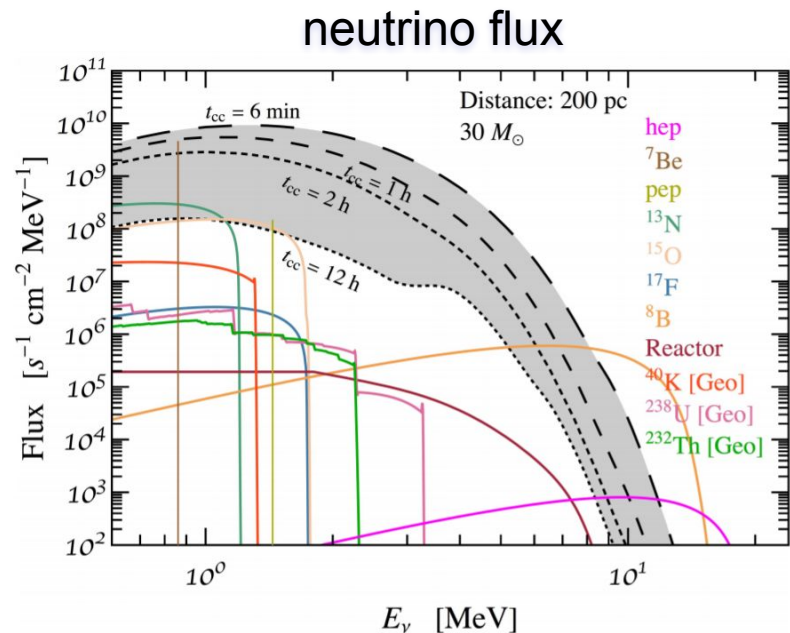
Pre-SN ν 's in DM experiments: benchmark

- Configurations (\sim Gen-3)

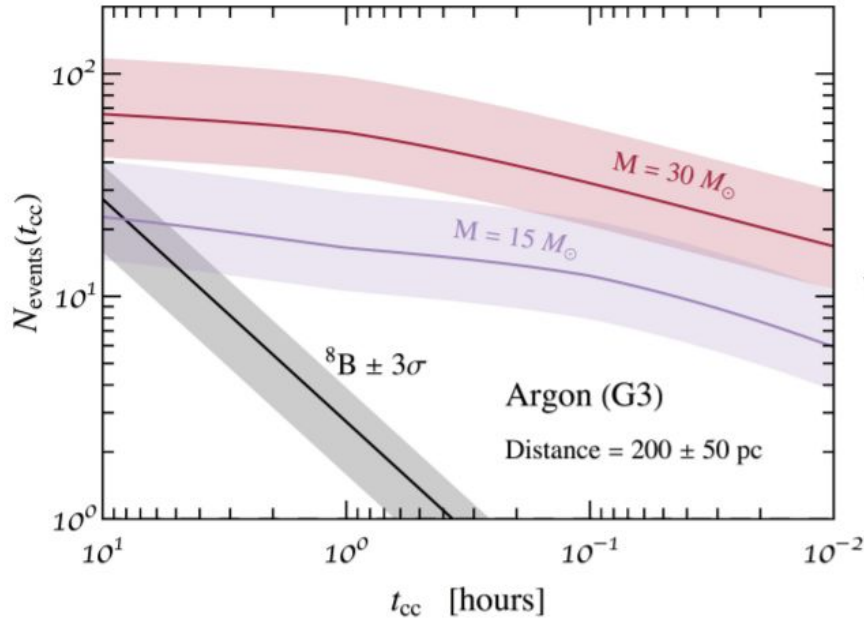
Target	Mass [tonnes]	Threshold [keV]
argon	300	0.6
xenon	50	1.0
germanium	0.05	0.04
silicon	0.05	0.08

- Source: Betelgeuse (200 pc)

Pre-SN v's in DM experiments: signal

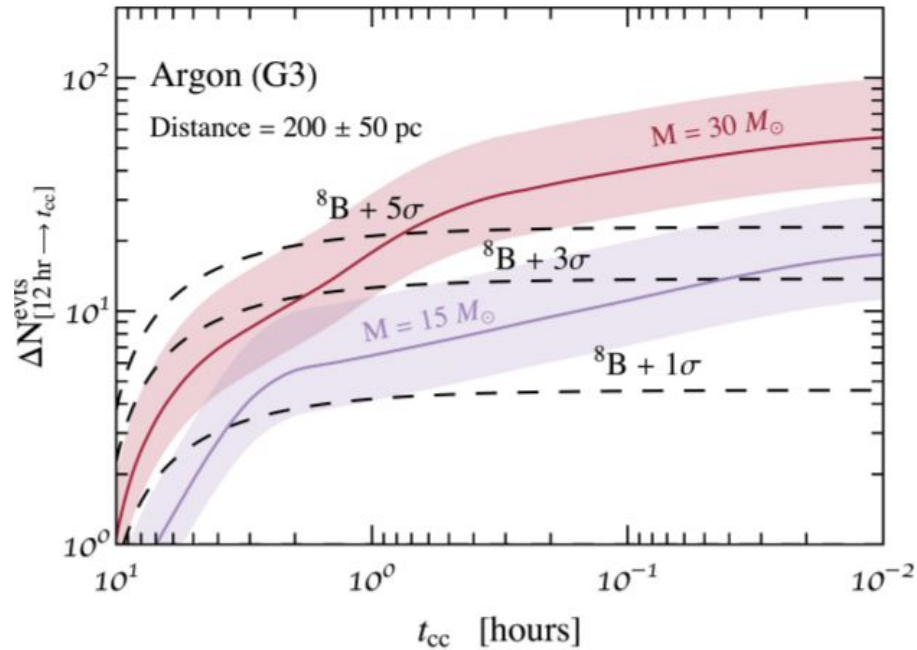


Pre-SN v's in DM experiments: detection



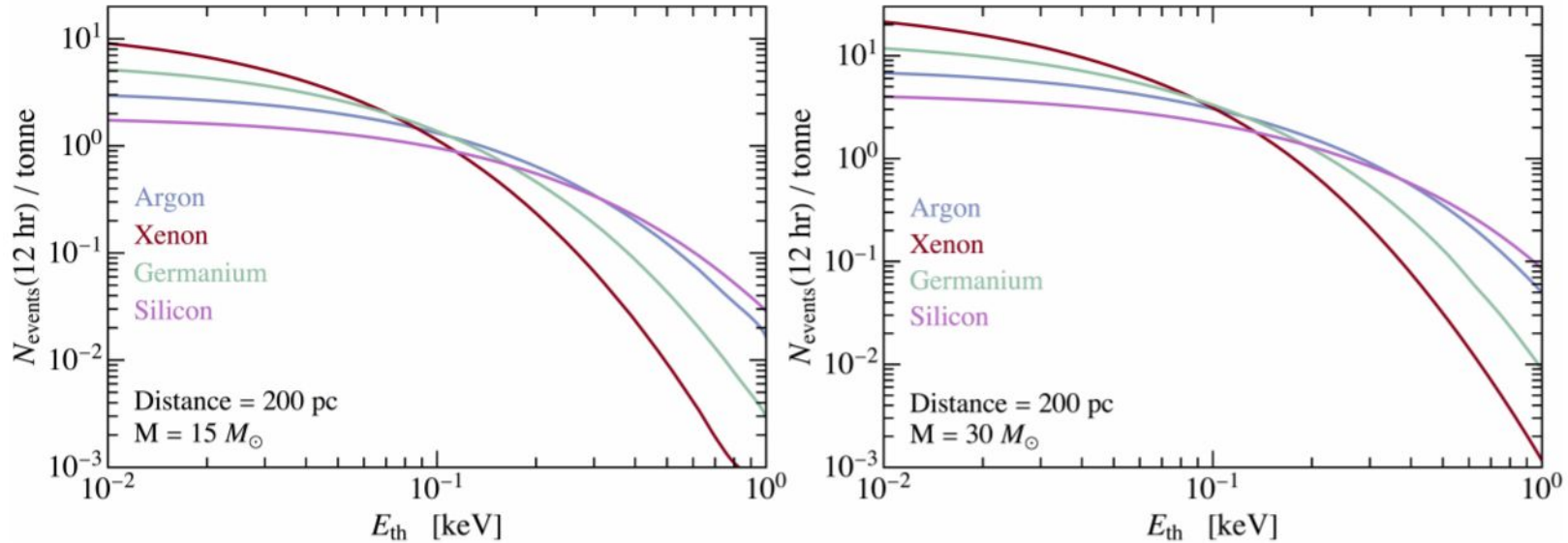
[Raj, VT, Witte, 2019]

Pre-SN v's in DM experiments: detection



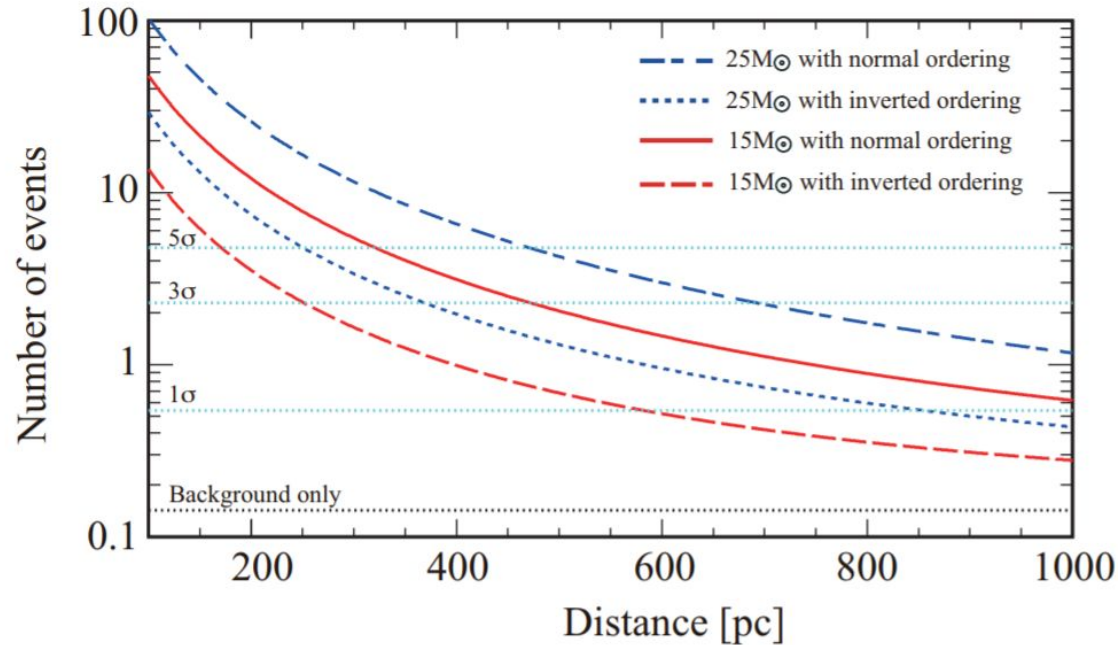
*** can implement software trigger

Pre-SN v's in DM experiments: thresholds



- Lower threshold \rightarrow lower required exp. size (great for Xenon, also Lang's talk)

Inensitivity to oscillation effects



[Asakura+
(KamLAND), 2015]

Summary

- Start thinking about big DM experiments as “effective neutrino telescopes”
 - opportunities, complementarity with dedicated neutrino-telescopes
- Argon and Xenon detectors can combine size and low threshold
 - great for SN, pre-SN sirens
 - all flavor observation