RES-NOVA

A revolutionary archaeological Pb observatory for astrophysical neutrino sources

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European Research Council
Established by the European Commission

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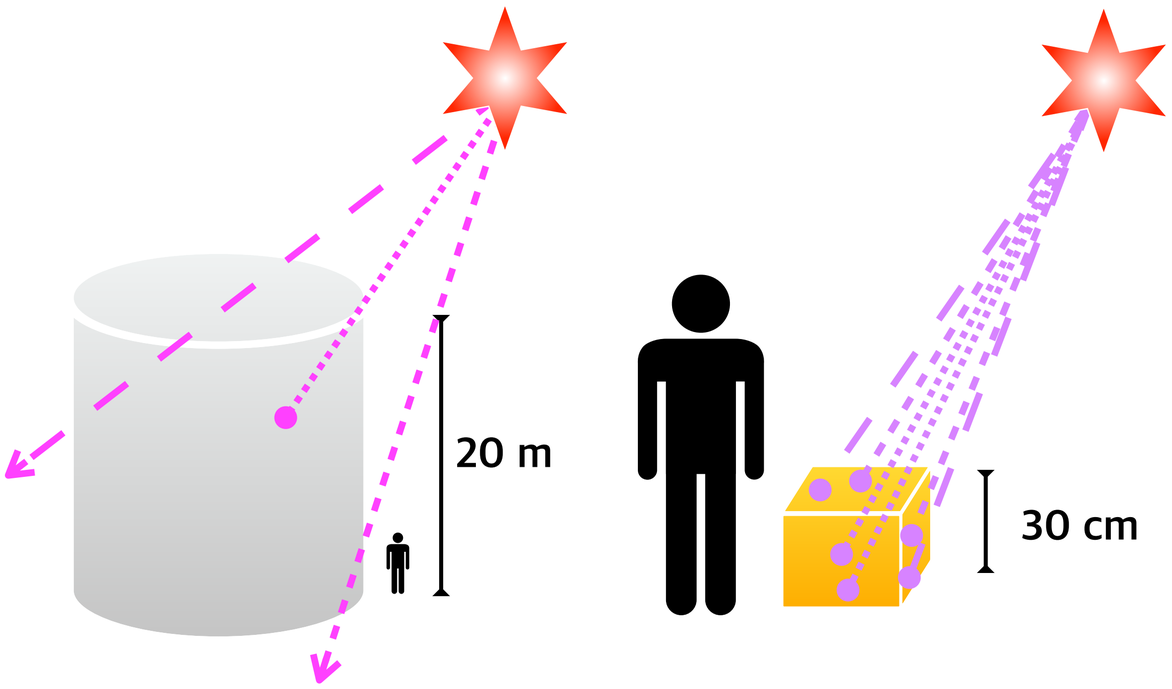
Consiglio di Sezione Pavia 05.07.2023

RES-NOVA IN ONE SLIDE

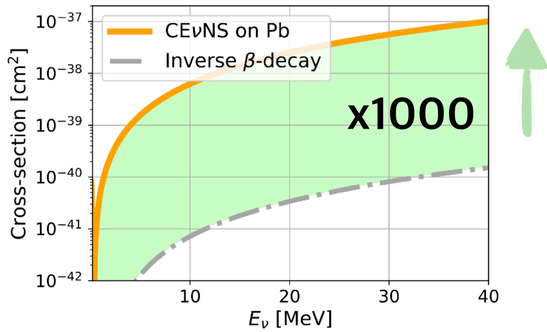
Detecting SuperNova neutrinos

1 SN / 50 years



using an innovative technology for high-statistic and flavor independent studies

Coherent neutrino-nucleus scattering on Pb



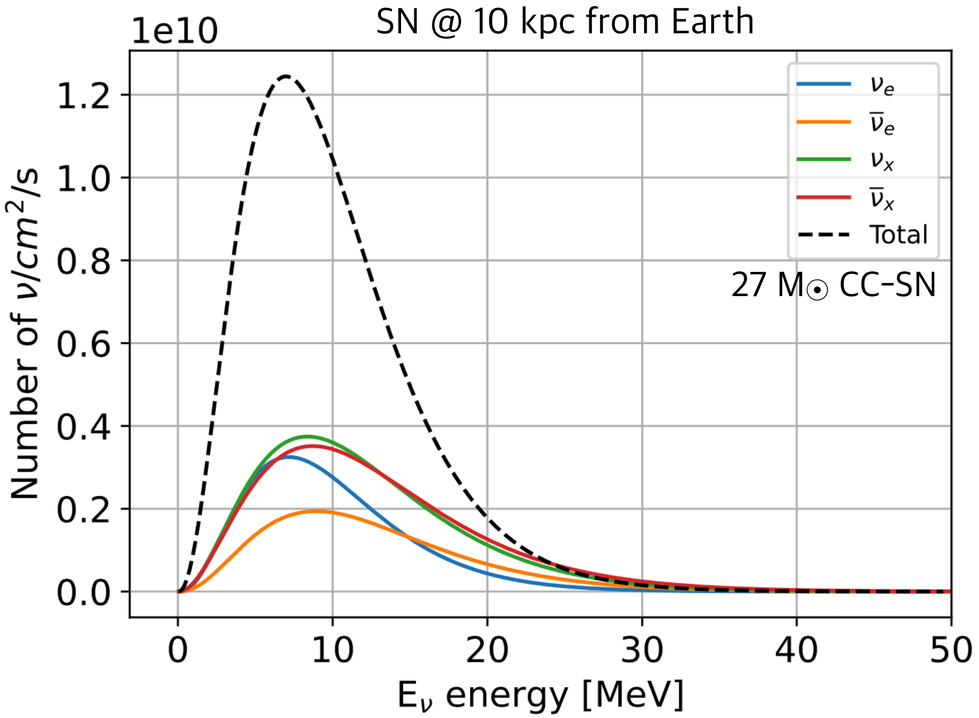
Archaeo-Pb-based neutrino telescope

Total detector volume (30 cm)³

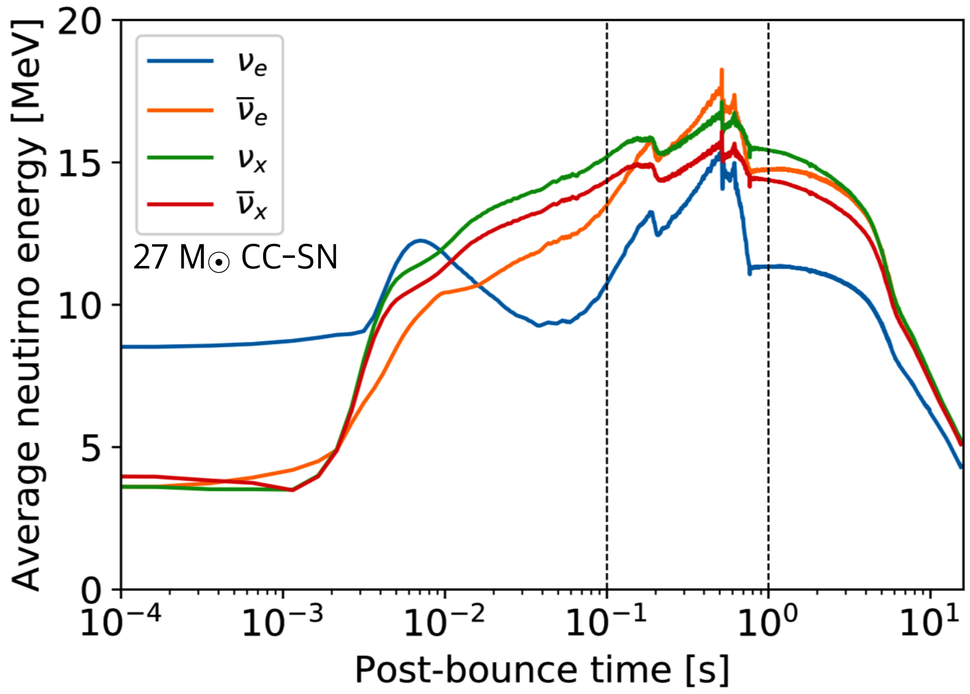
Survey 90% of SN in Milky Way

Supernova Neutrino signal

What is the average neutrino energy?



v_x is the most **intense** component of the flux



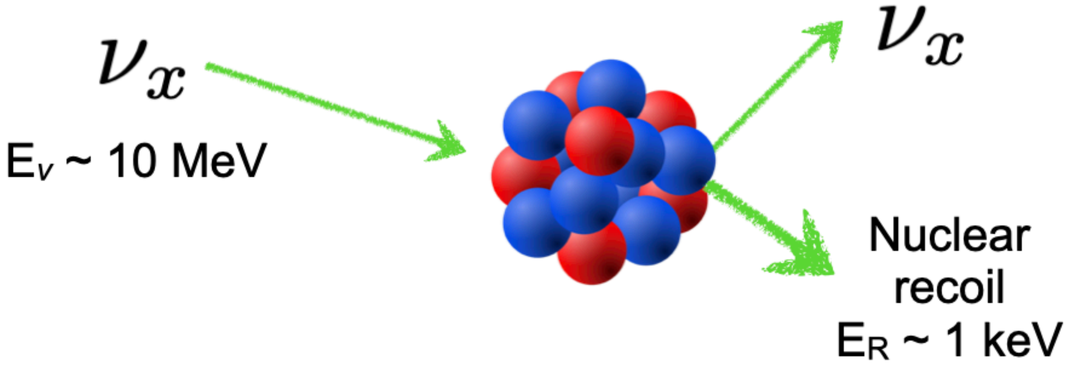
v_x is the most **energetic** component of the flux

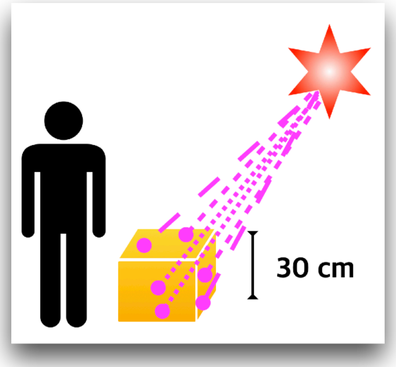
Current SN neutrino detectors are mostly sensitive to anti-v_e/v_e

MPA Supernova Archive, https://wwwmpa.mpa-garching.mpg.de/ccsnarchive

All neutrino flavors are detected

Coherent neutrino-nucleus scattering





> Equally sensitive to all ν-flavors

> High interaction cross-section

$$\sigma_{CE\nu NS} = \frac{G_F^2}{4\pi} F^2(q^2) E_\nu^2 Q_W^2$$

cross-section

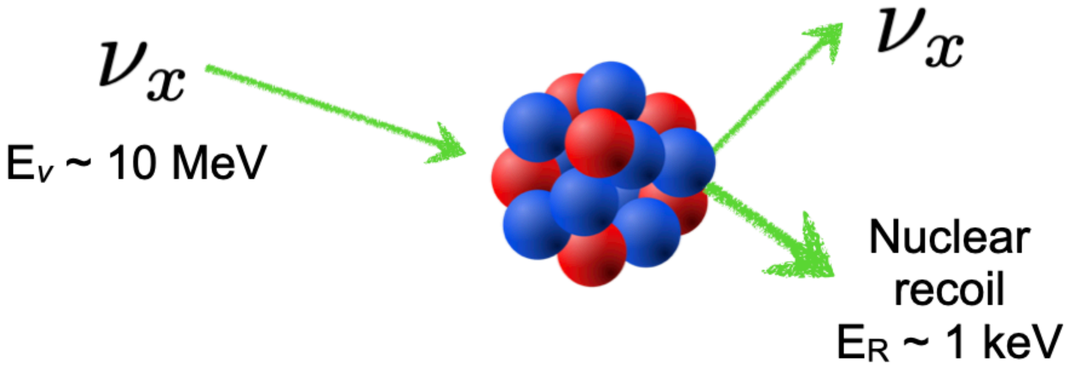
Nuclear Form factor

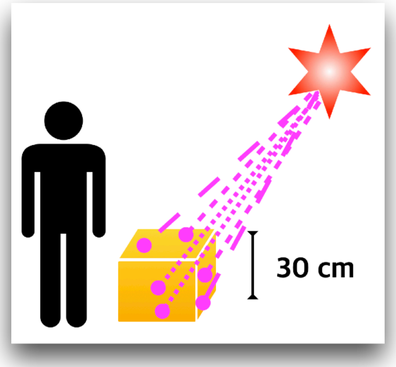
Neutrino energy

Weak nuclear charge

All neutrino flavors are detected

Coherent neutrino-nucleus scattering





> Equally sensitive to all ν-flavors

> High interaction cross-section

$$\sigma_{CE\nu NS} \propto N^2$$

cross-section

Neutron number

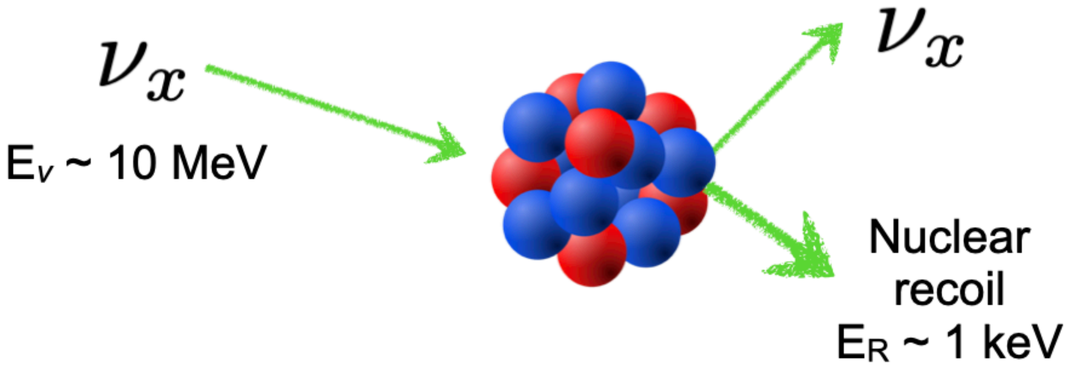
Pb ideal target

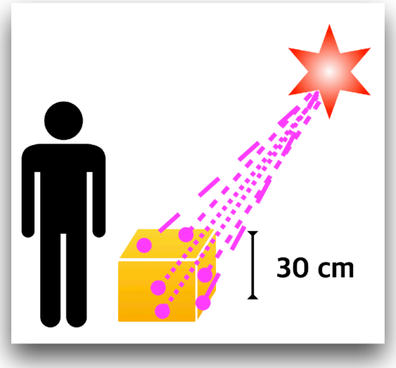
Highest neutron number

Highest nuclear stability

All neutrino flavors are detected

Coherent neutrino-nucleus scattering





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cross-section

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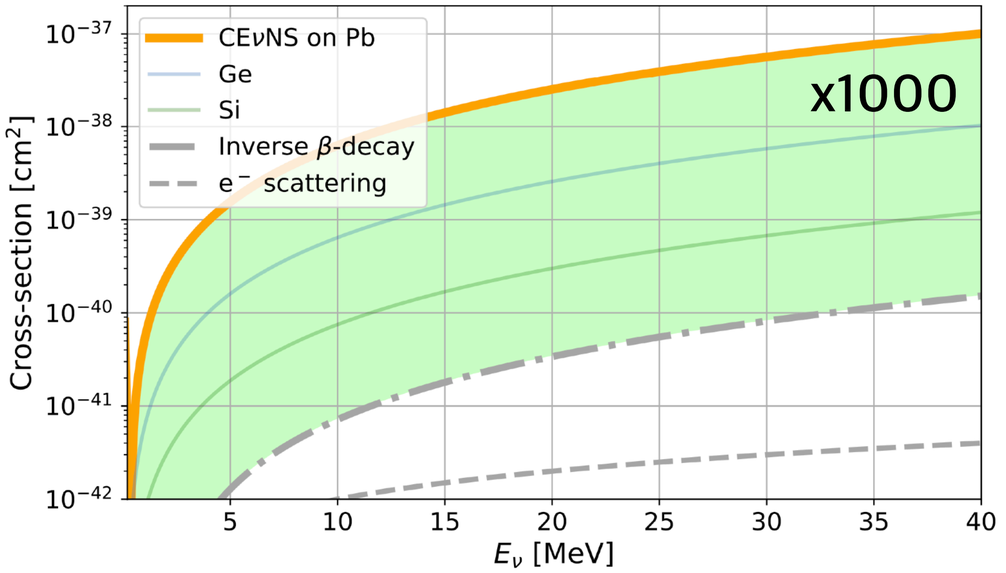
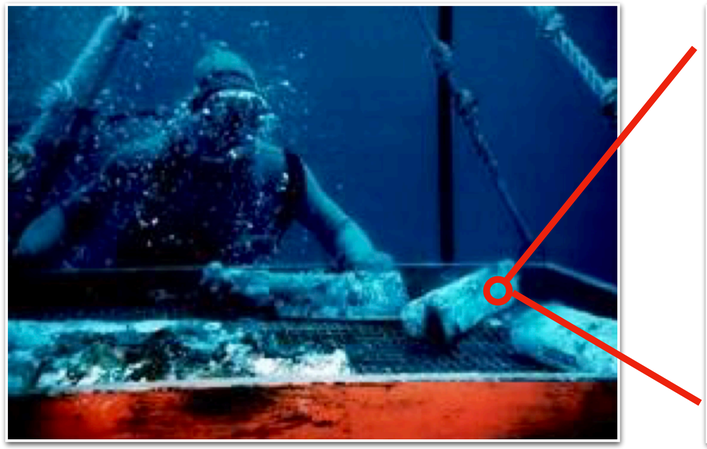
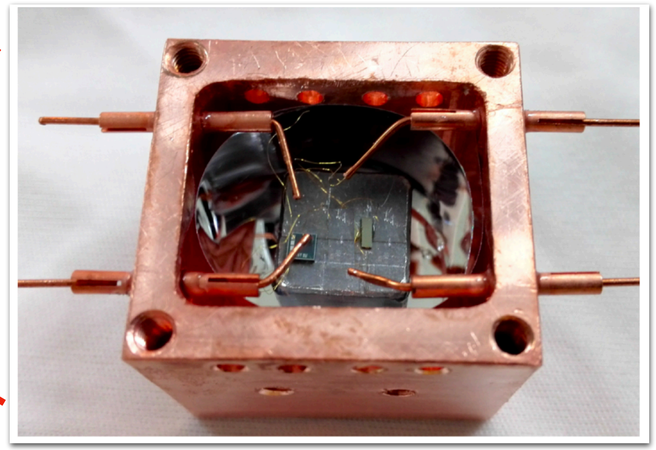


Cryogenic detectors built from Archaeological Pb

taken from N. Nosengo (2010)





Archaeological Roman Pb:

- ★ from underwater shipwreck
- ★ 2000 years old

Archaeo-Pb cryogenic detector

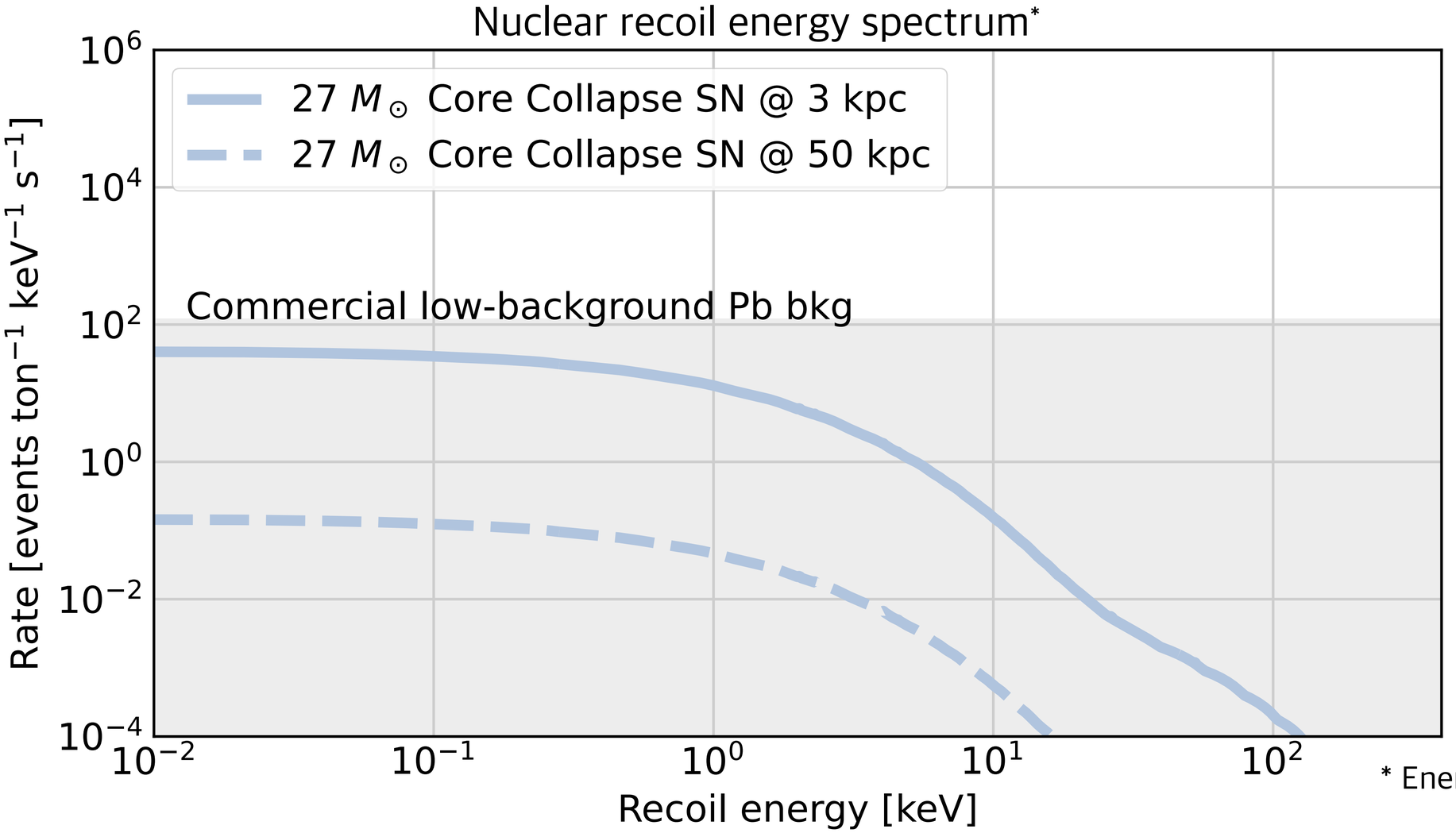
High radiopurity: < 1 mBq/kg

x10⁴ better than commercial low-background Pb

Several tons of Archaeo-Pb @ INFN

L. Pattavina et al., Eur. Phys. J. A 55, 127 (2019)

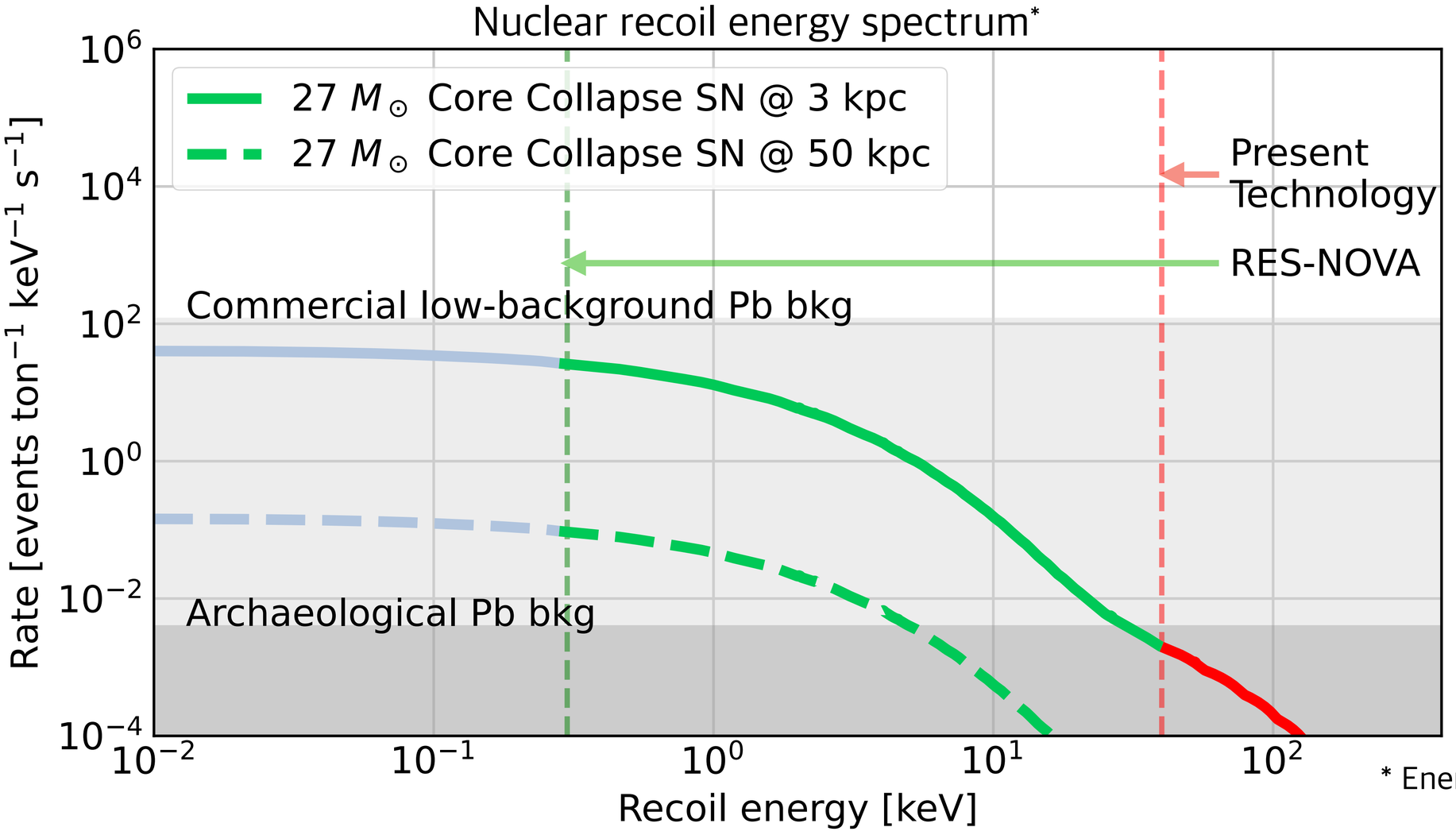
RES-NOVA DETECTS SN NEUTRINOS



* Energy resolution 0.2 keV

L. Pattavina et al., *Phys. Rev. D* 102, 063001 (2020)

RES-NOVA detects SN neutrinos



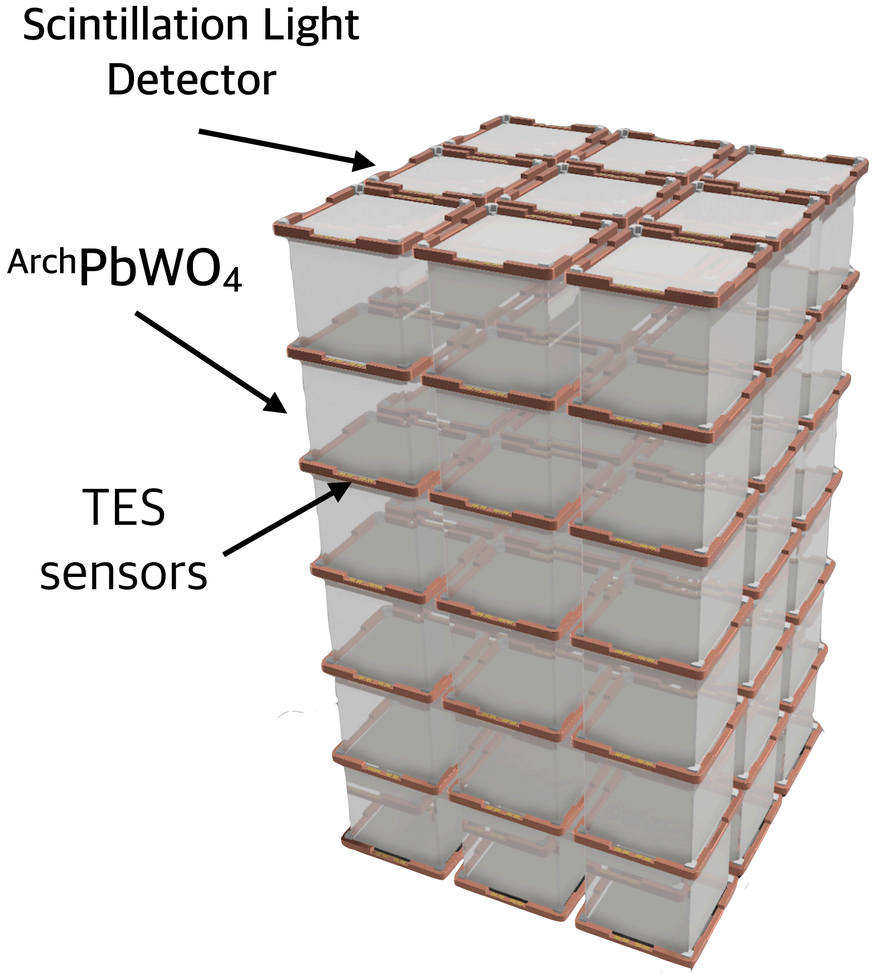
* Energy resolution 0.2 keV

L. Pattavina et al., *Phys. Rev. D* 102, 063001 (2020)

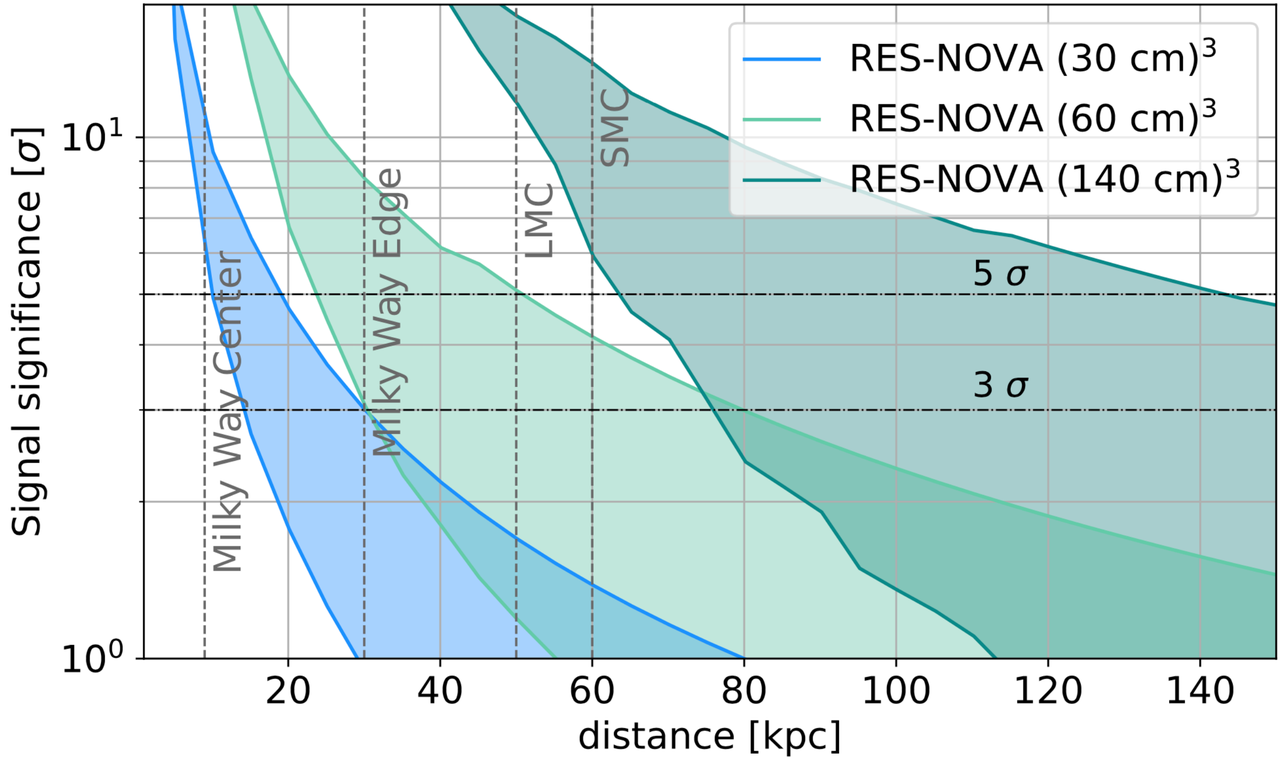
RES-NOVA Group of Interest, *Eur. Phys. J. C* 82, 692 (2022)

N. Ferreiro, L. Pattavina et al., J. Low Temp. Phys. 11, 184 (2022)

RESNOVA TECHNOLOGY DEMONSTRATOR



Total mass 150 kg
Total volume $(30\ cm)^3$
Threshold 1 keV
Bkg in RoI 10^{-3} c/keV/ton/s



<15 kpc from the Sun

90% of Galactic SNe are included

L. Pattavina et al., *JCAP* 10 (2021) 064
S. M. Adams et al., Astrophys. J. 778, 164 (2013)

Group of Interest

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