Search for keV-scale dark matter candidates with the Gerda experiment

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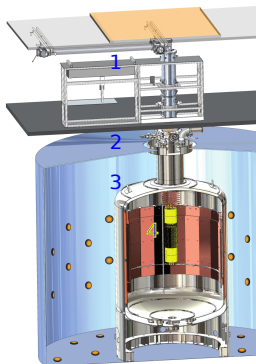
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June 15th 2017

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The concept of the GERDA experiment
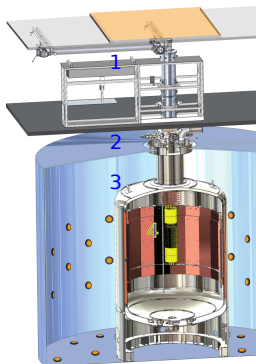

1 *Clean room*

2 *Cherenkov Muon Veto*

3 *Liquid argon cryostat*

4 *Germanium detectors array*

- Located at underground laboratory LNGS, Italy
- Utilizes high pure germanium detectors, operated in liquid argon
- **The main physics goal**: search for $0\nu\beta\beta$ decay
- Aims to contribute to **bosonic super-WIMPs** search

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The bosonic super-WIMPs

- Cold or warm DM particles, depending on their mass
- Has super-weak coupling to the baryonic matter
- Can exist in form of two possible candidate types:
    - Pseudo-scalar (ALP)
    - Vector (hidden photon)
- Can be detected via **absorbtion** by the atom, due to **axioelectric effect**
- The signature in the energy spectra: gaussian peak with the mean at the mass of the absorbed super-WIMP
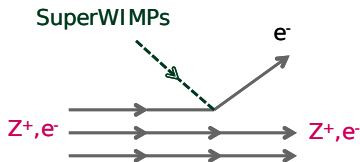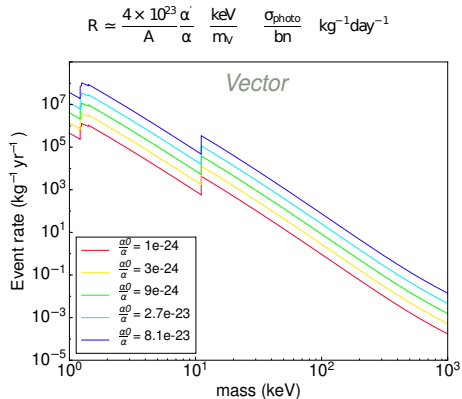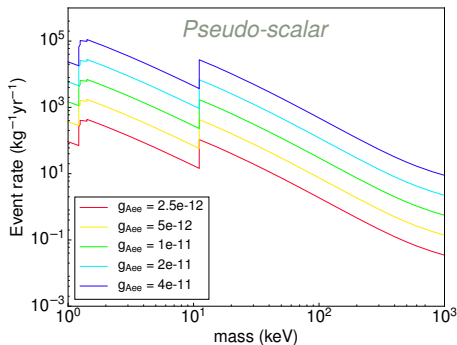

Pospelov et. al. Phys. Rev. D 78, 115012
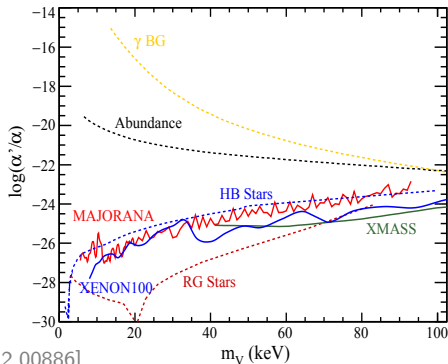
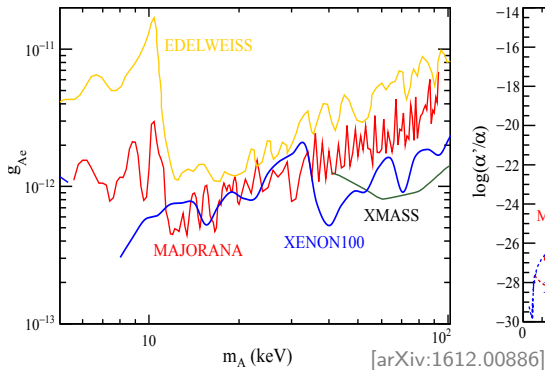# The expected signal rate in ^{76}Ge

- Depends on the σ_{photo}/A
- Decreases with the mass

$$R \simeq \frac{1.2 \times 10^{19}}{A} g^2_{Aee} \frac{m_a}{keV} \frac{\sigma_{photo}}{bn} \quad kg^{-1}day^{-1}$$

$$R \simeq \frac{4 \times 10^{23}}{A} \frac{\alpha'}{\alpha} \frac{keV}{m_V} \frac{\sigma_{photo}}{bn} \quad kg^{-1}day^{-1}$$

Current status of the experimental search

- Astrophysical constrains
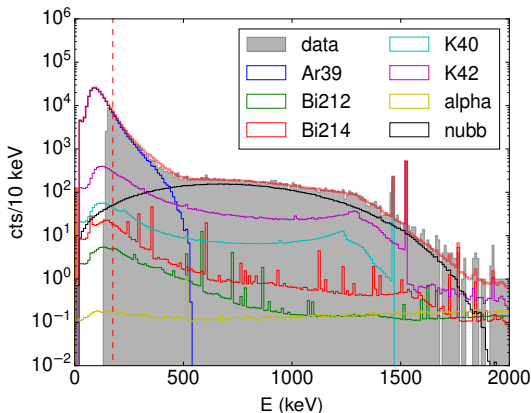- Direct detection constrains

[arXiv:1612.00886]

- **The aim of GERDA:** to extend the direct search range for bosonic Super-WIMPs to 1 MeV

Background for the super-WIMP search

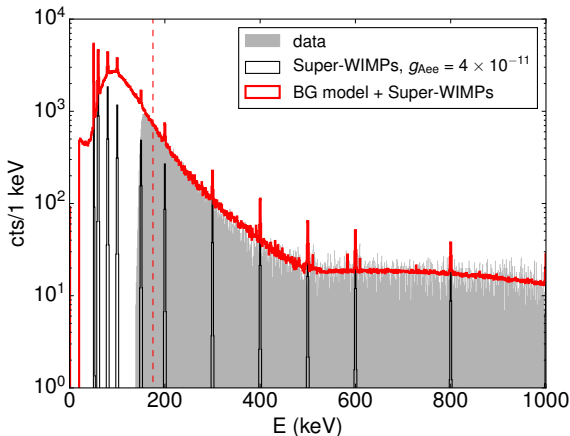**2νββ:** topology is similar to the super-WIMP (SSE)

³⁹Ar: can be distinguished due to different pulse shape (MSE)

The expected signature

- For the pseudo-scalar with the coupling $g_{Aee} = 4 \cdot 10^{-11}$

- We need to discriminate background and peform statistical analysis to set the exclusion limit

Conclusion and outlook

- Bosonic super-WIMP is theoretically motivated for warm/cold DM candidate

- With its high efficient background rejection technique GERDA is sensitive to pseuso scalar and vector super-WIMPs

- The mass region upto 1MeV for existed limits can be extended

- The profile likelihood analysis is under development

- The results for the total exposure of 40 kg*yr will come soon :)