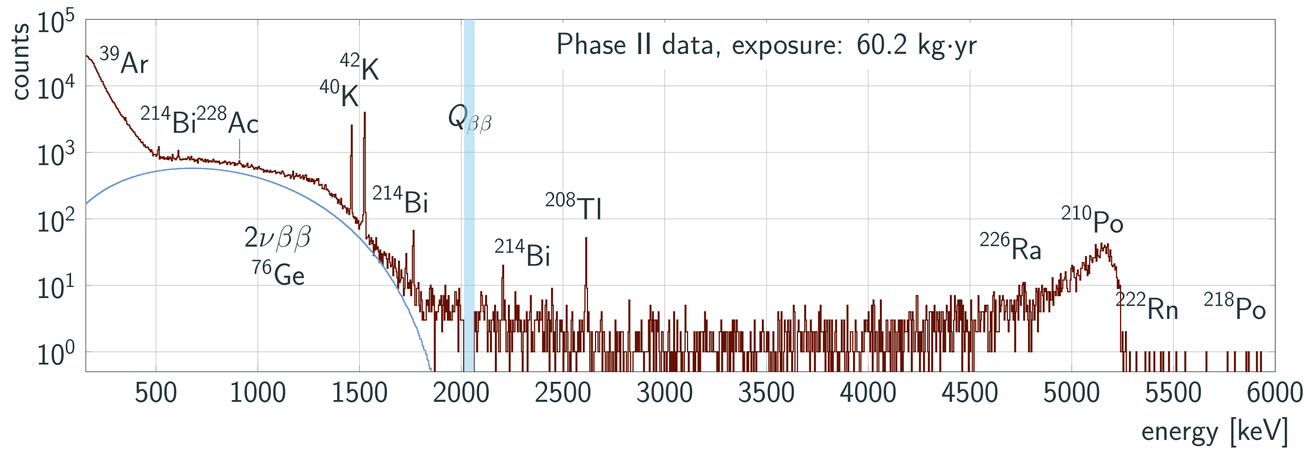
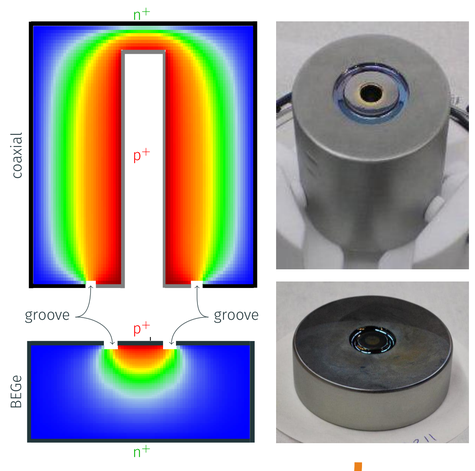
Tools and methodologies for GERDA Phase II background modeling

Luigi Pertoldi [pertoldi@pd.infn.it] on behalf of the GERDA collaboration
Università degli Studi di Padova
INFN – Sezione di Padova

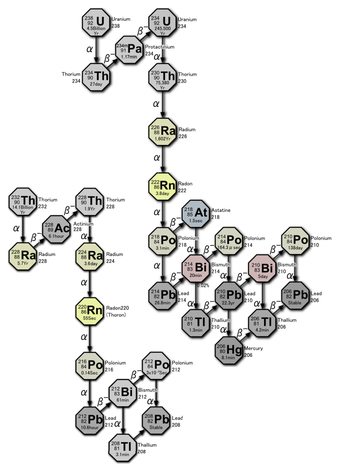
DATA



The background model is a fundamental tool to analyse in detail the composition of the background around $Q_{\beta\beta}$ and to study the shape of the $2\nu\beta\beta$ distribution → new physics (Majorons, Lorentz violation...)



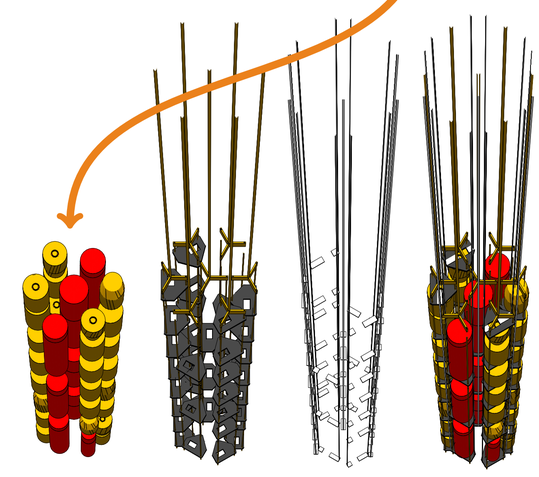
SIMULATIONS



The full GERDA experimental setup is reproduced in a GEANT4 framework to simulate background contaminations:

- $2\nu\beta\beta$ in ^{76}Ge (detectors)
- ^{42}K in liquid argon (LAr)
- ^{40}K, ^{232}Th and ^{238}U decay chains, ^{60}Co in detector holders, cables, electronic components, LAr instrumentation...

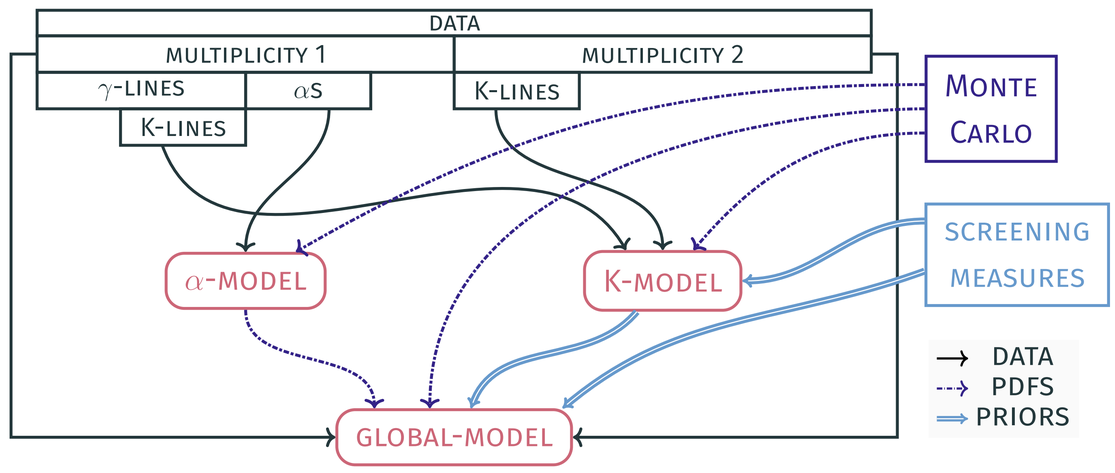
Probability Density Distributions (PDFs), used to fit data, are built from the Monte Carlo output. Runtime ON/OFF detectors and run live-times are taken into account.



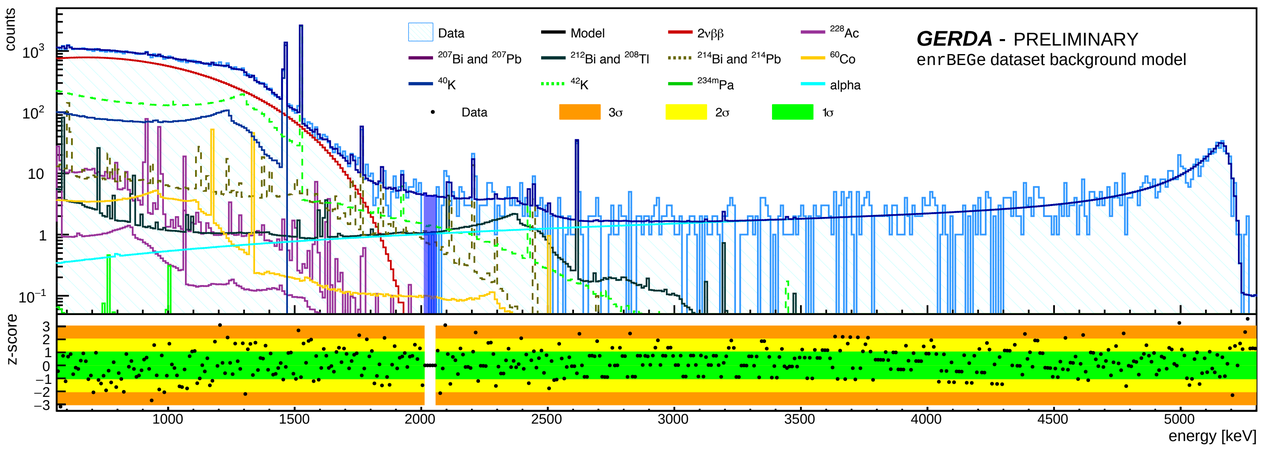
MODELS

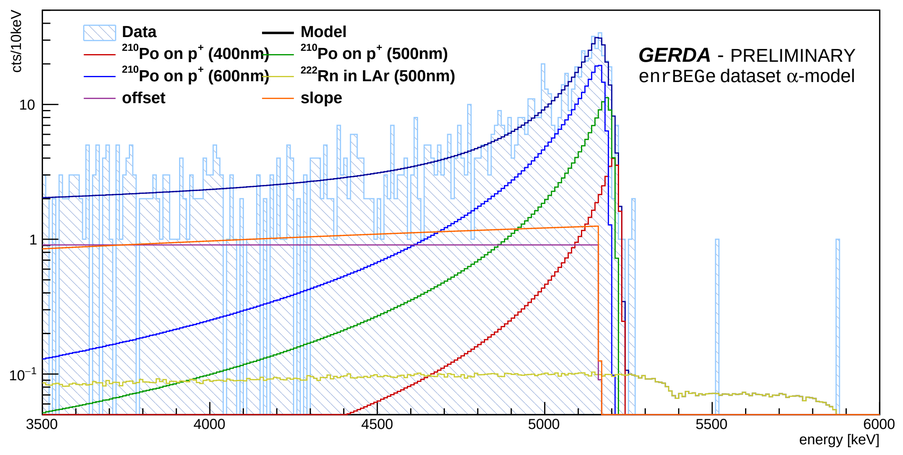
Different bayesian statistical models targeted to tackle different features, studying both single- and two- detector events

- **α-model** analysis of the high-energy part of the spectrum, dominated by α events from isotopes on detectors surface
- **K-model** per detector analysis of the intensity of the two potassium lines (^{40}K and ^{42}K). Powerful *potassium "source tracking analysis"*
- **global model** full-range analysis of single- and two-detector events, uses results from the other two models, *over 40 fit parameters!*



PRELIMINARY RESULTS





The whole fitting machinery is applied to all the Phase II data collected up to now (60.2 kg yr of enriched germanium). *Screening measures of radioactive contaminations in building materials are injected as bayesian prior information.*

α-model

- The high energy events are interpreted as decaying ^{210}Po, ^{222}Rn chain, ^{226}Ra on the p$^+$ contact and ^{222}Rn chain in LAr
- A linear component is needed to model ^{210}Po α events originating in the detector's groove
- A combination of different dead layer's thicknesses must be considered

Potassium model

- Upper detectors (in the array) see more ^{42}K
- In addition to what expected from the screening measures, a far and a near ^{40}K sources are identified

Global model

- $T^{2\nu}_{1/2} = (1.97 \pm 0.2\ \text{stat}) \cdot 10^{21}$ yr
- good agreement with data (p = 0.3) and screening measures