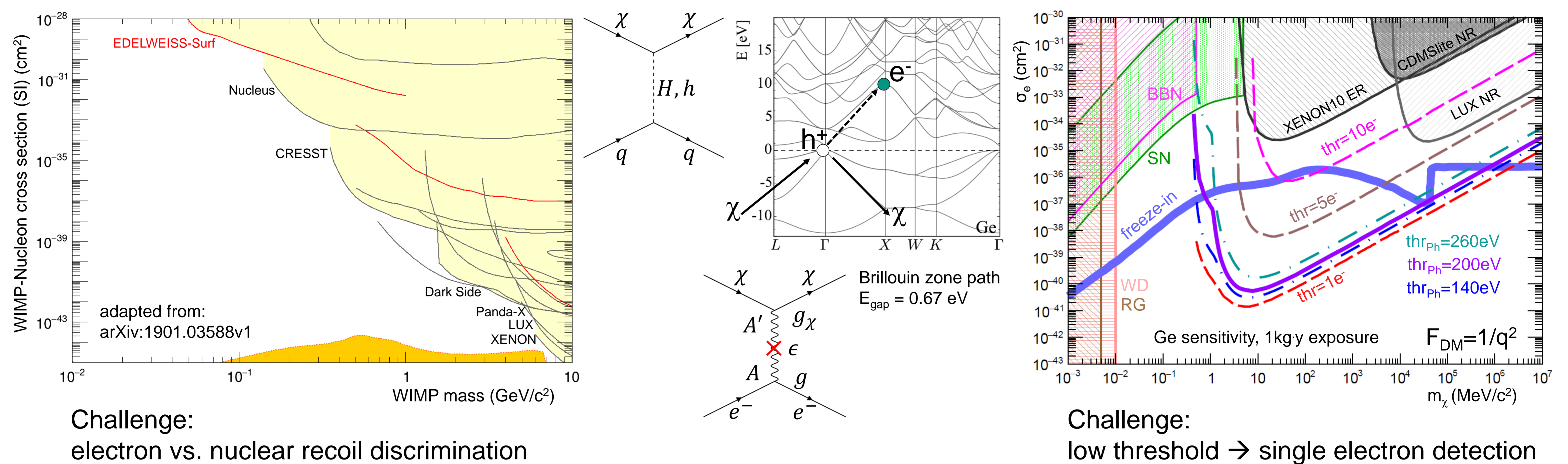




Instrumentation concepts for Neganov-Luke assisted cryogenic Ge detectors in Dark Matter search

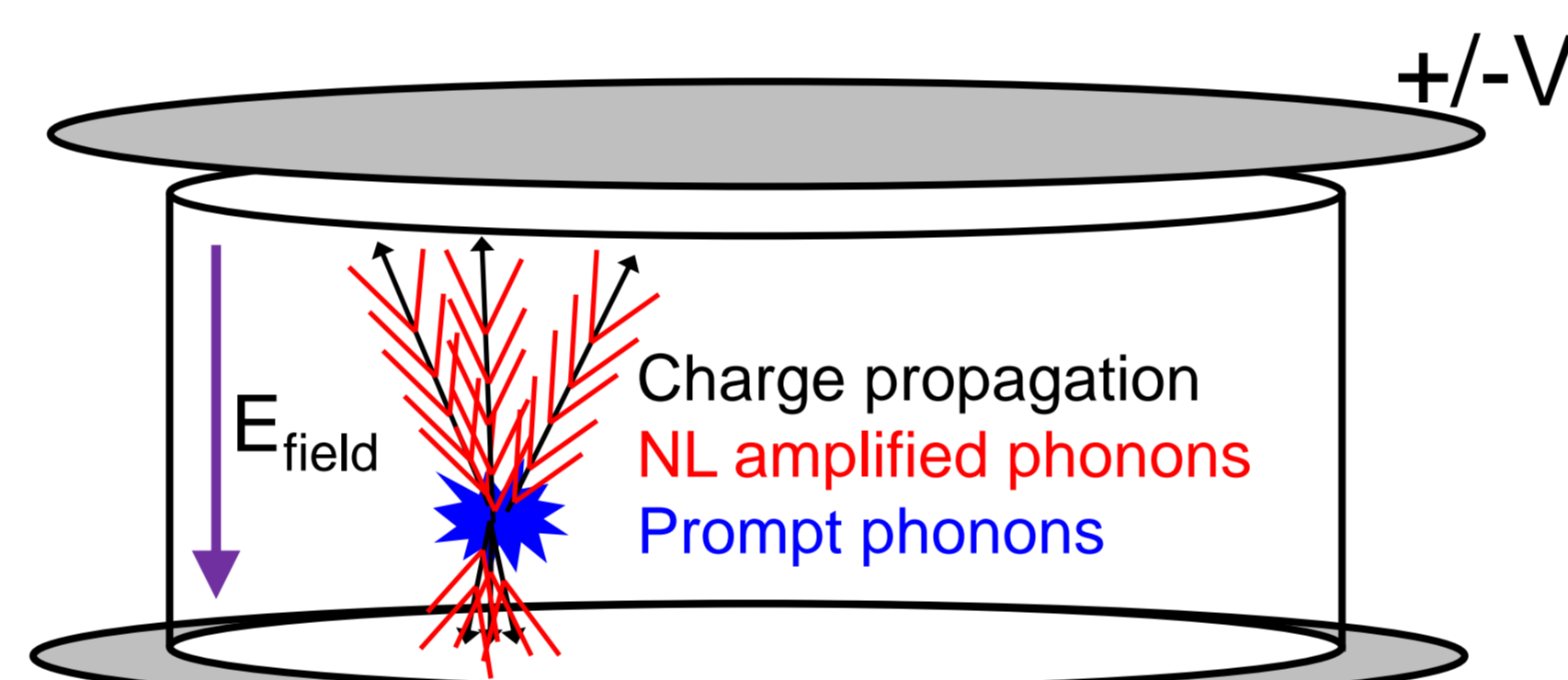
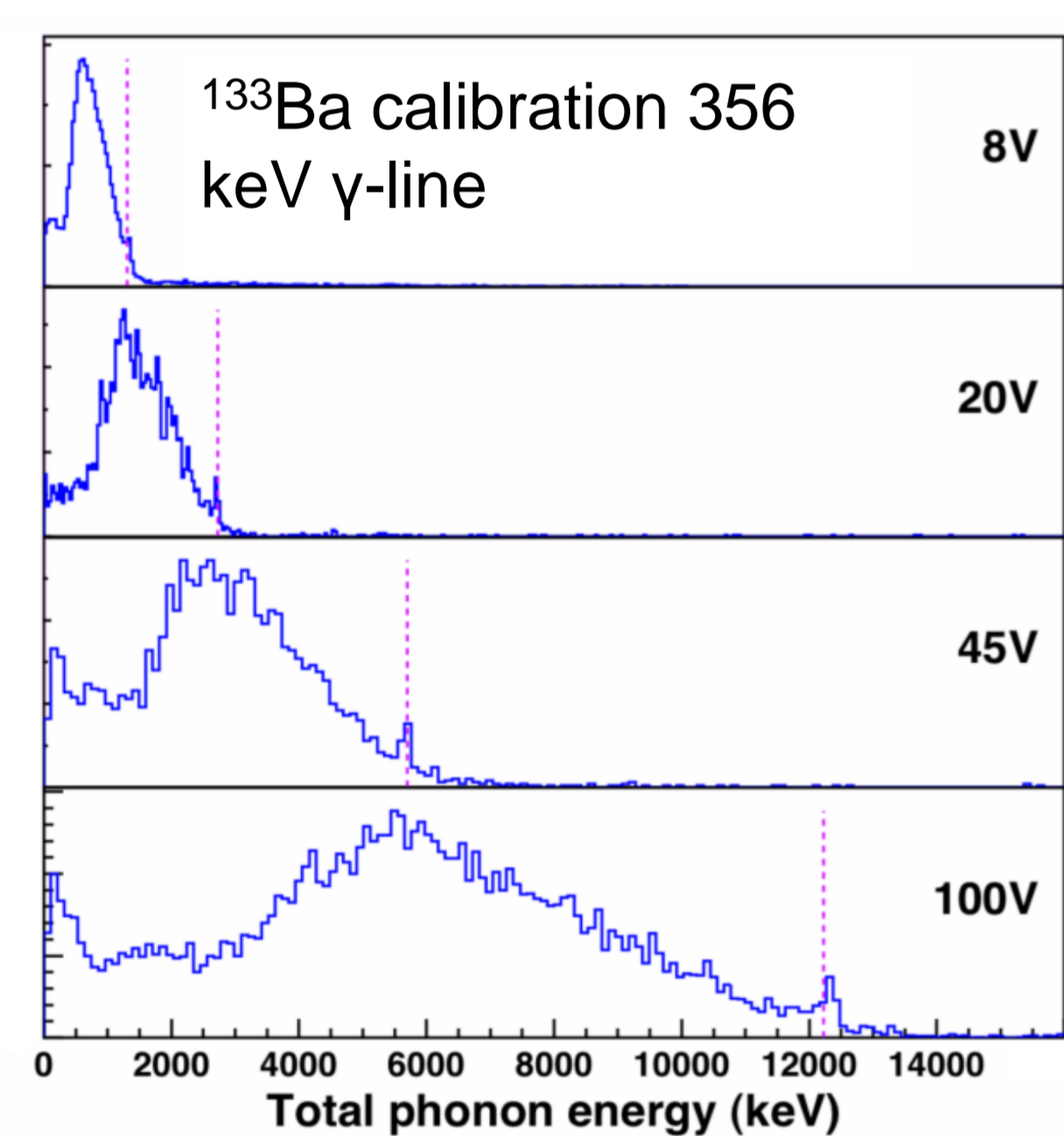
Bernhard Siebenborn

Direct search for Low Mass WIMPs with EDELWEISS and for Light Dark Matter with DELight



Neganov-Luke effect: measure ionization via an amplified thermal signal

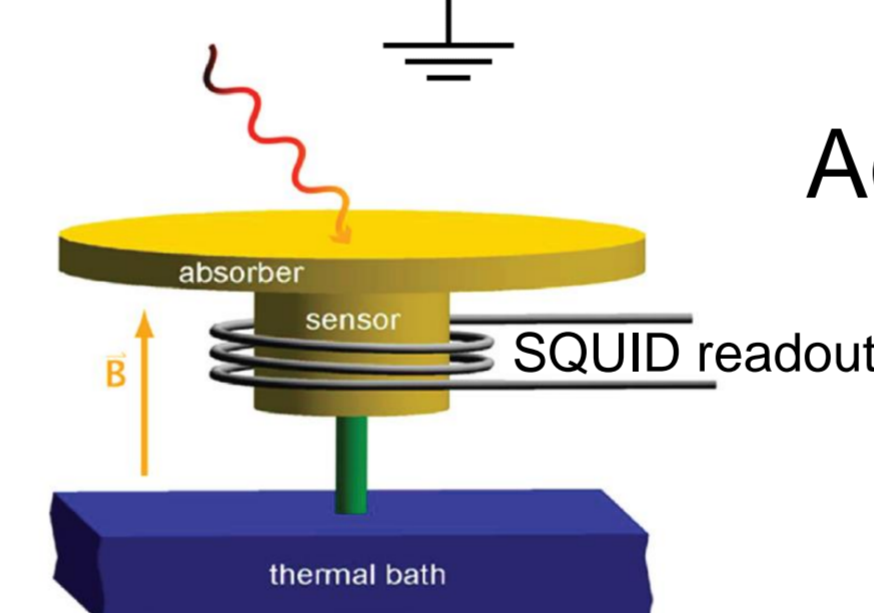
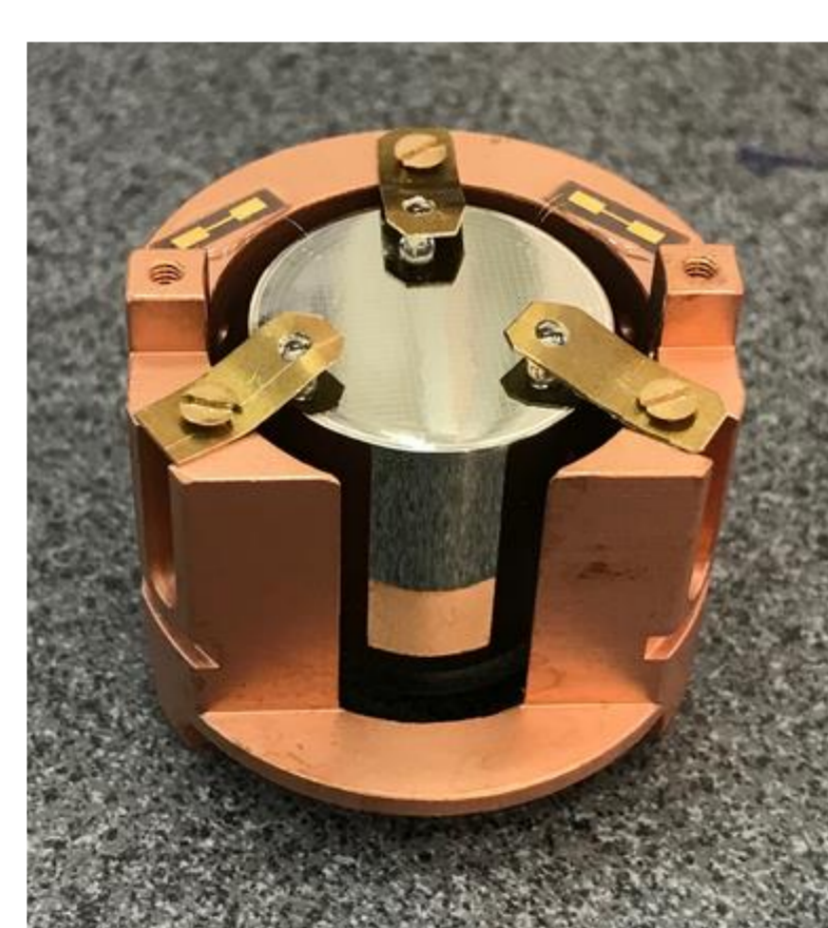
Monocrystalline HPGe crystals
 m ≈ 30...800 g
 T_{op} ≈ 18 mK
 E_{field} ≈ 2 - 100 V/cm
 ionisation + heat → ER discrimination



Neganov-Luke Energy E_{NL} proportional to

- number of produced e⁻ h⁺ pairs n_{e,h}
- applied voltage

$$E_{\text{phonon}} = E_{\text{dep}} - E_{\text{gap}} + E_{\text{NL}} \approx (n_{e,h} - 1)(\epsilon - \delta) + n_{e,h} q V$$



Achieved MMC resolution:

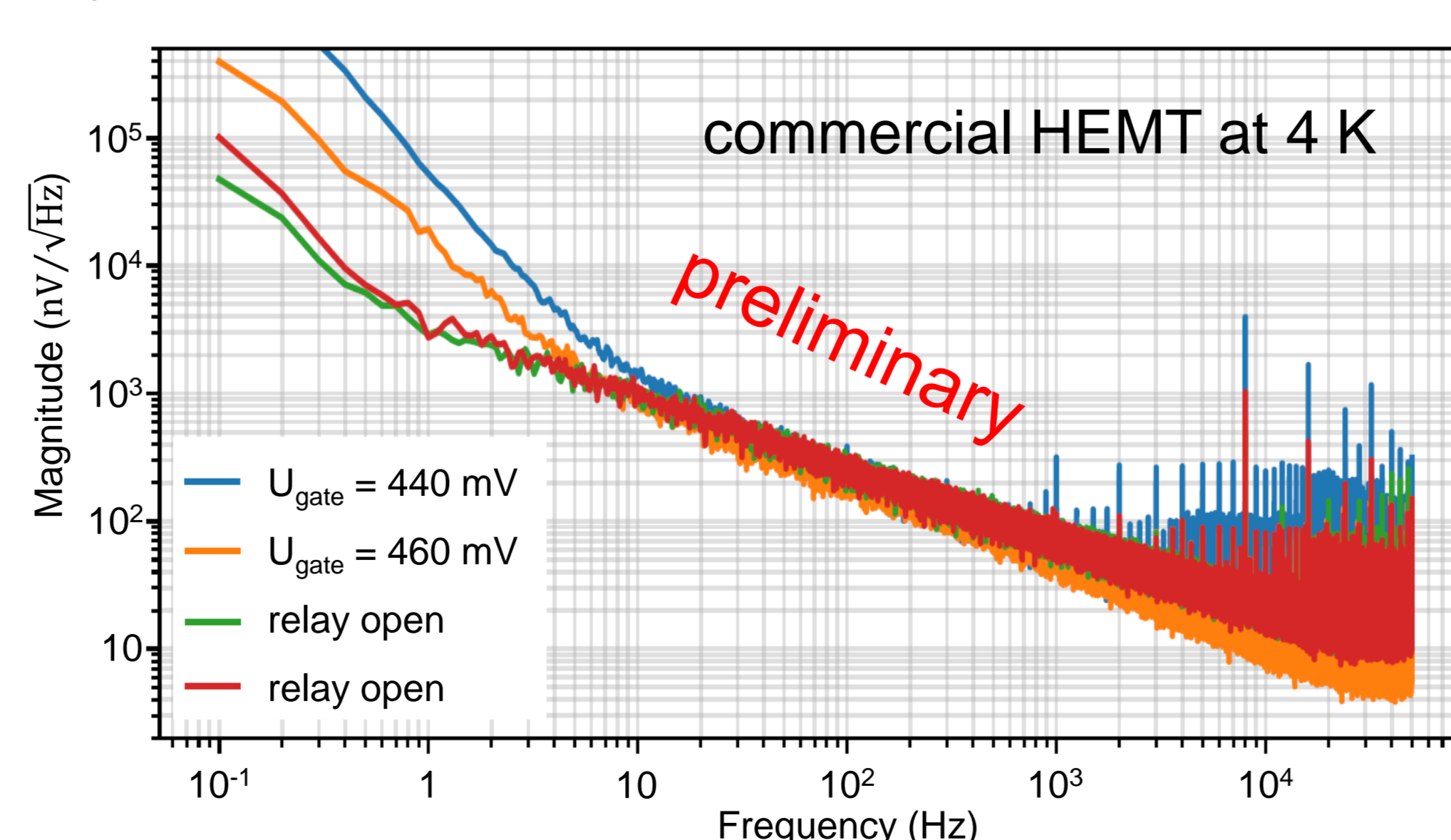
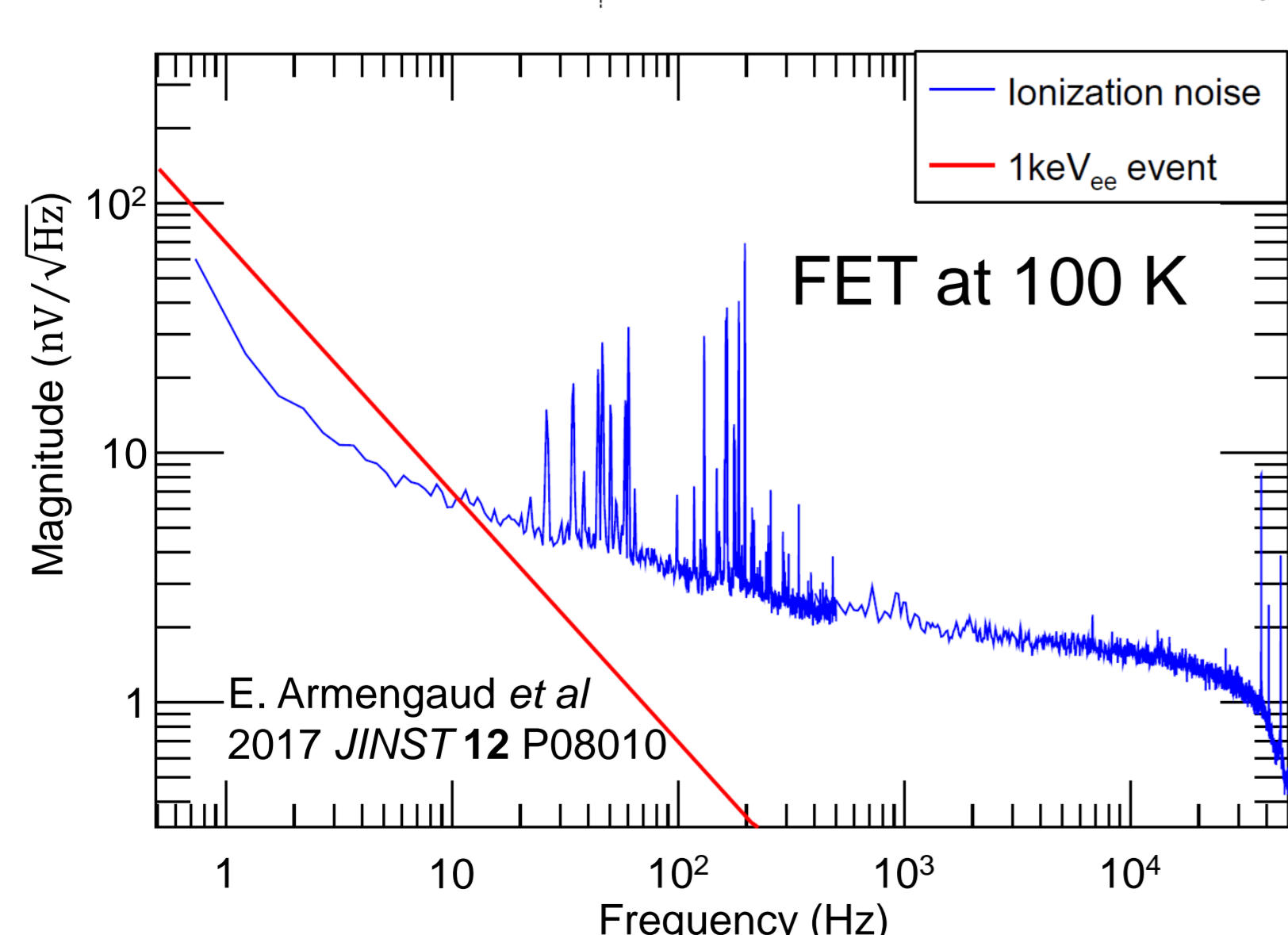
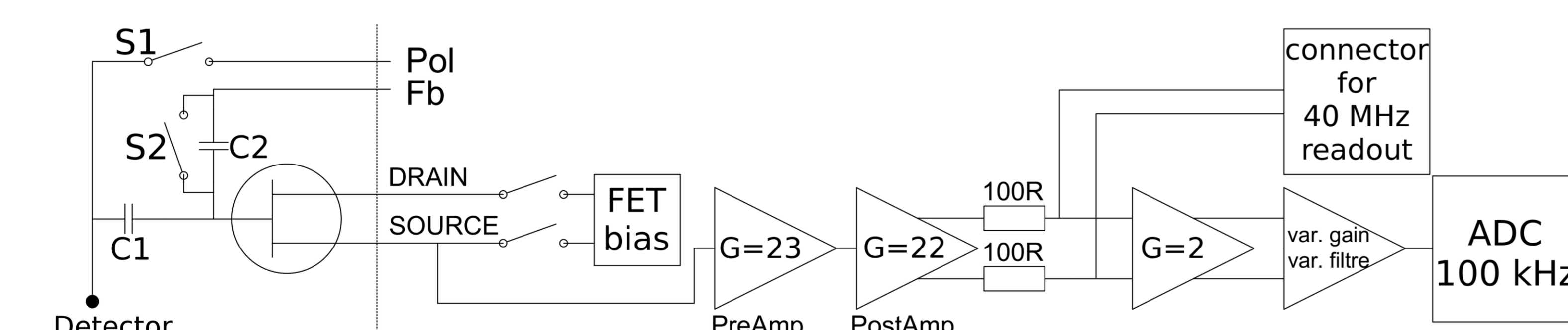
$$\Delta E_{\text{FWHM}} = 1.6 \text{ eV } (^{55}\text{Fe } 5.9 \text{ keV})$$

Kirchhoff-Institut, Universität Heidelberg
 A. Fleischmann et al.,
 AIP Conference Proceedings, 1185 (2009) 571

DELight: HPGe crystal + MMC heat sensors vacuum separated electrode to avoid

- additional heat capacitance
- leakage current from electrode
- surface treatment of Ge-detector

EDELWEISS ionization channel buffer amplifier: FET at 100 K



ionization channel with HEMT amplifier at 4 K

- diagnostics, energy scale cross-check

DELight ionization channel buffer amplifier: HEMT at 4 K

