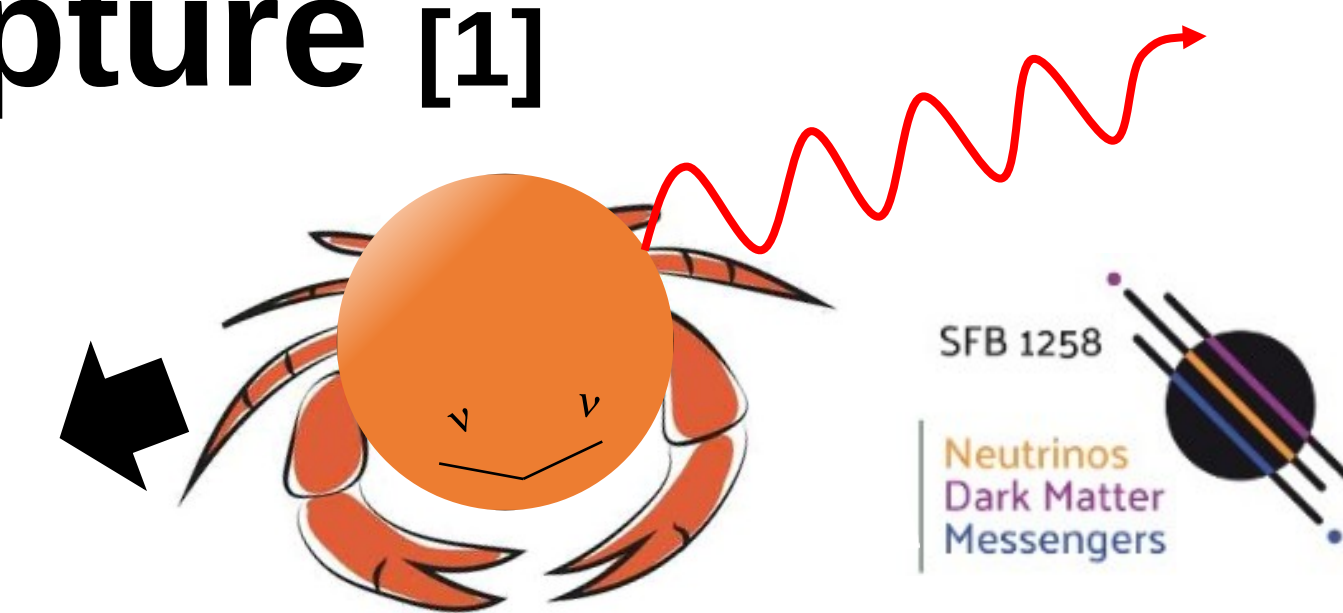


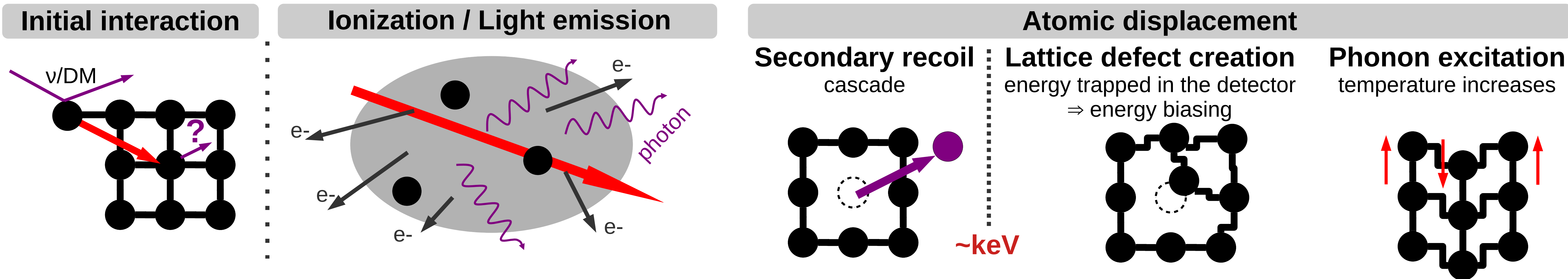
CRAB : Calibrated Recoils for Accurate Bolometry at the 100 eV scale using neutron capture [1]

L. Thulliez on behalf of the CRAB collaboration
 Email: loic.thulliez@cea.fr



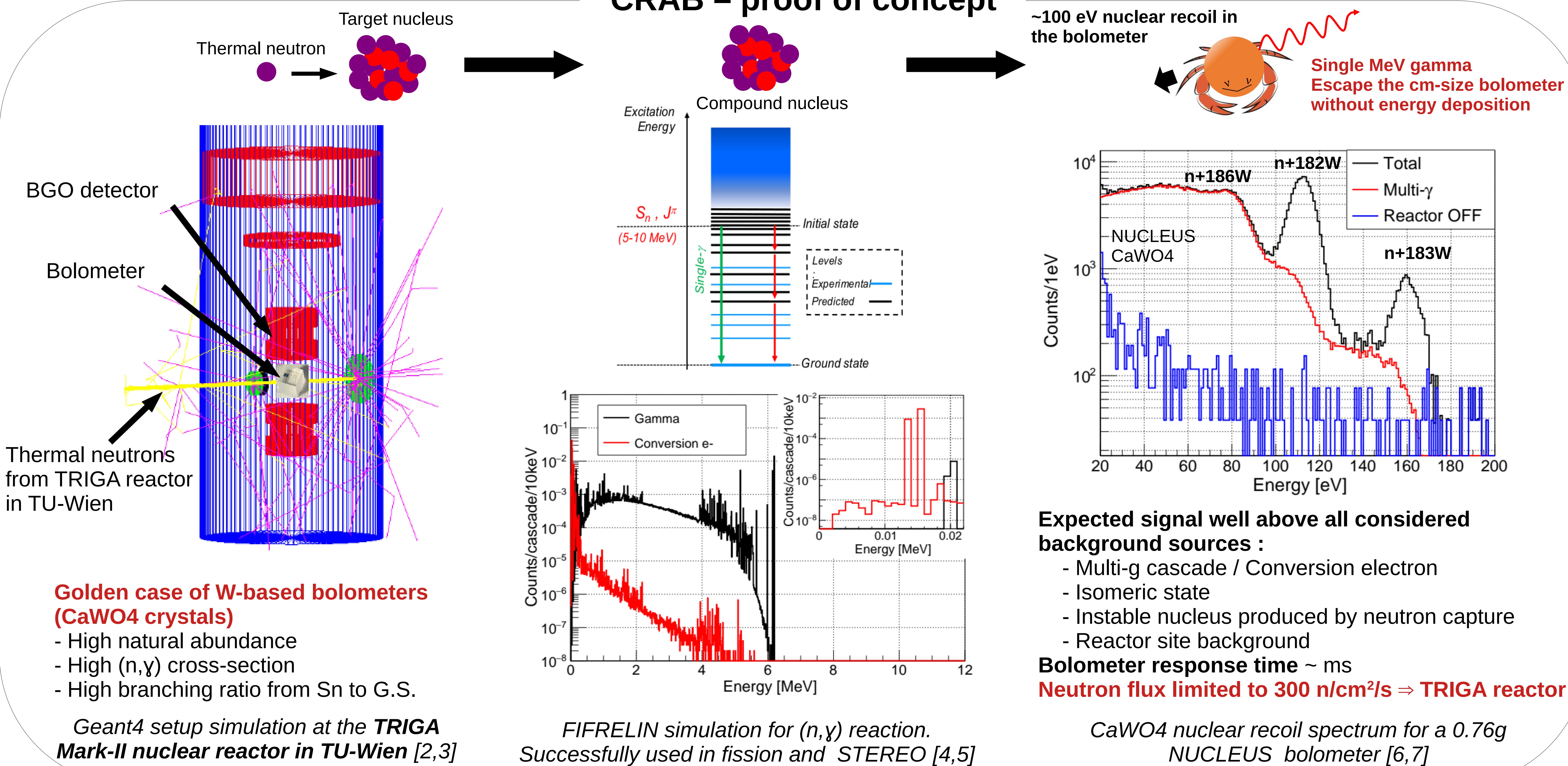
A bottle into the sea

Searches for light dark matter or coherent scattering of reactor neutrinos require to detect sub-keV nuclear recoils. Gram scale bolometers are used to achieve energy threshold of ~10 eV. There is currently no method to calibrate nuclear recoils in the sub-keV regime : CRAB proposes to fill this gap.



Direct methods to calibrate detector to sub-keV nuclear recoil, i.e. to disentangle the different processes, are then needed. **How to produce a nuclear recoil with a known energy to calibrate detector responses at sub-keV?**

CRAB – proof of concept



Golden case of W-based bolometers (CaWO₄ crystals)

- High natural abundance
- High (n,γ) cross-section
- High branching ratio from Sn to G.S.

Geant4 setup simulation at the TRIGA Mark-II nuclear reactor in TU-Wien [2,3]

FIFRELIN simulation for (n,γ) reaction. Successfully used in fission and STEREO [4,5]

CaWO₄ nuclear recoil spectrum for a 0.76g NUCLEUS bolometer [6,7]

Expected signal well above all considered background sources :

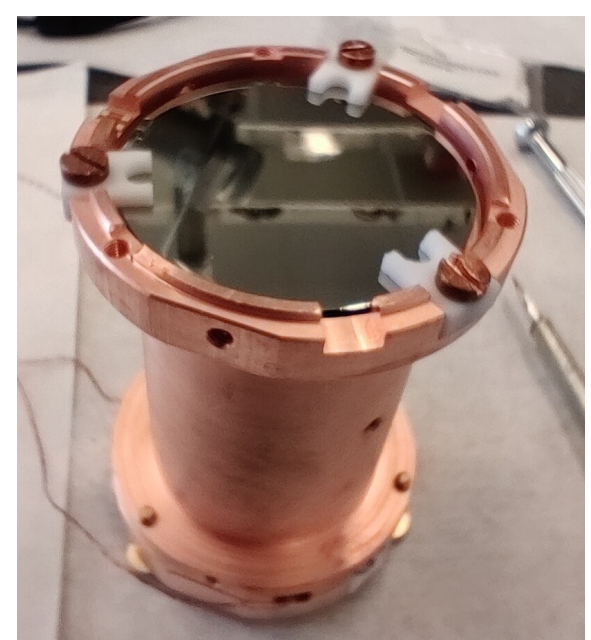
- Multi-g cascade / Conversion electron
- Isomeric state
- Instable nucleus produced by neutron capture
- Reactor site background

Bolometer response time ~ ms
Neutron flux limited to 300 n/cm²/s ⇒ TRIGA reactor

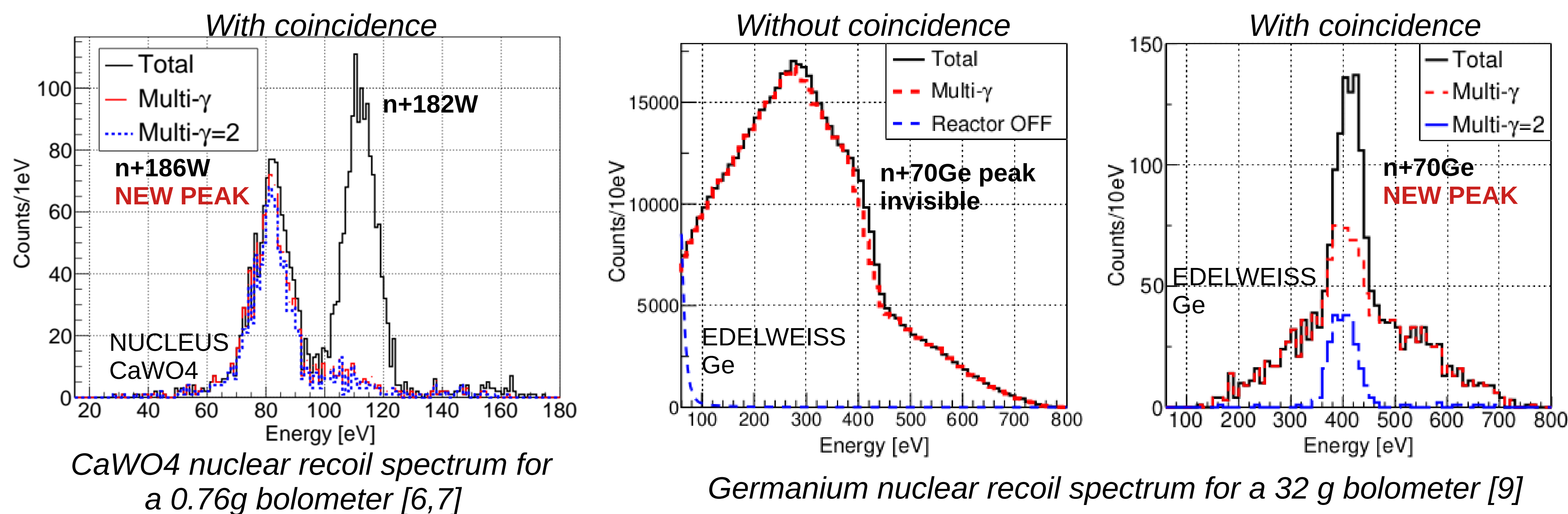
CRAB++ with gamma tagging

Improving multi-γ background rejection

- ⇒ extends the operation range:
- linearity study (3 peaks vs 2 for CaWO₄)
- new bolometer material : Ge case !
- larger crystals with lower resolution



3"x3" BGO (σ(E)~2% @7MeV)
 High energy gamma detection [8]



CRAB – a pinch of perspectives

- * Reaction kinematic reconstruction with multiple BGOs
 - access to lower energy recoil with multi-gamma tagging
- * CRAB + electronic recoil measurement
 - cross-calibration
 - quenching factor measurement at sub-keV energies
 - lattice damage study
- * First CRAB measurement in 2023 at the TRIGA Mark-II reactor in Wien

References

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