

## Development of HPGe detectors for (n,xn) measurements at n\_TOF

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## Subtask 1.2.2 in a nutshell


- Neutron inelastic scattering measurements can be employed for the advancement of both nuclear applications and basic research
- Such reactions can be studied through high-resolution  $\gamma$ -spectroscopy
- Reaction cross-sections are needed typically in the neutron energy range 100 keV - 100 MeV
- Thanks to high instantaneous, wide spectrum and high resolution neutron fluxes, the n\_TOF facility can further expand its experimental program and boost the production of high-quality neutron inelastic scattering data
- A suited detection system has to be available:
  - the response of the detection system to the so called  $\gamma$ -flash and beam induced background
  - an high spectroscopic energy resolution, fundamental for high accuracy measurements

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Lead and financed institut	collaboration	deliverables	deliverable date & responsible	Milestones	Milestones date & responsible
CERN	Univ. Manch., NTUA, Univ. Ion., IFIN-HH	D.1.6 "Report on the performance of the HPGe equipped with newly developed electronics"	M48 CERN	MS.8 Completion of the commissioning of the HPGe equipped with newly developed electronics at CERN	M24 CERN

## Road to milestone MS.8 (09/21) in Covid19 era

- 1) Perform detailed GEANT4 simulations of the prototype detectors tested + electronic (also with radioactive sources), with the aim of characterizing them in terms of efficiency and energy resolution
  - 2) Benchmark the performance of PSA code using the existing data taken with beam and specifically designed/developed electronic, as well as offline data.
  - 3) Extended Geant4 and FLUKA simulations in harsh neutron/gamma field for different crystal configurations as to optimize the final order (e.g. planar or coaxial or Clover at larger distance from the beam)
  - 4) Design and fabrication of a proper mechanic hosting the setup according to the detection needs. In addition, switch to electrical cooling for the prototype if possible
  - 5) Order, test and characterise in laboratory in the new electrically cooled HPGe according to the afore-mentioned studies
- **Milestone 8** - Commissioning of the HPGe detector with n\_TOF neutron beam (M24) 

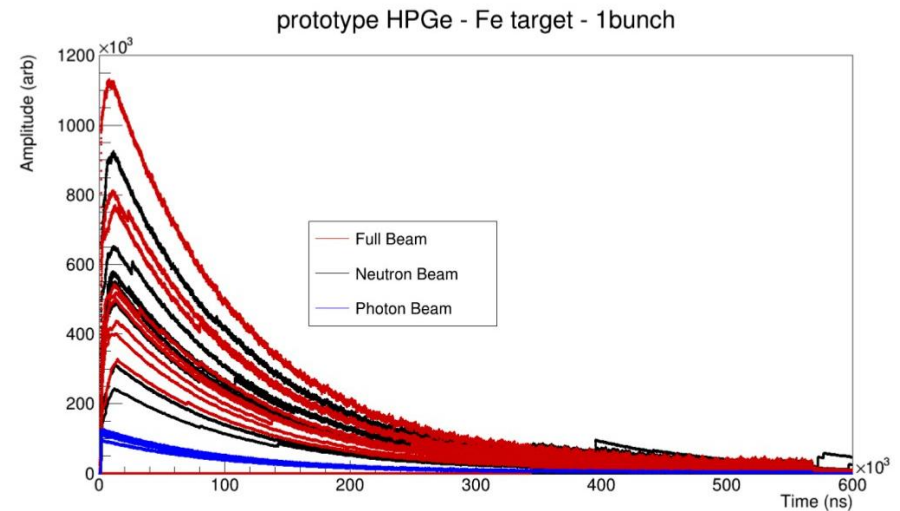
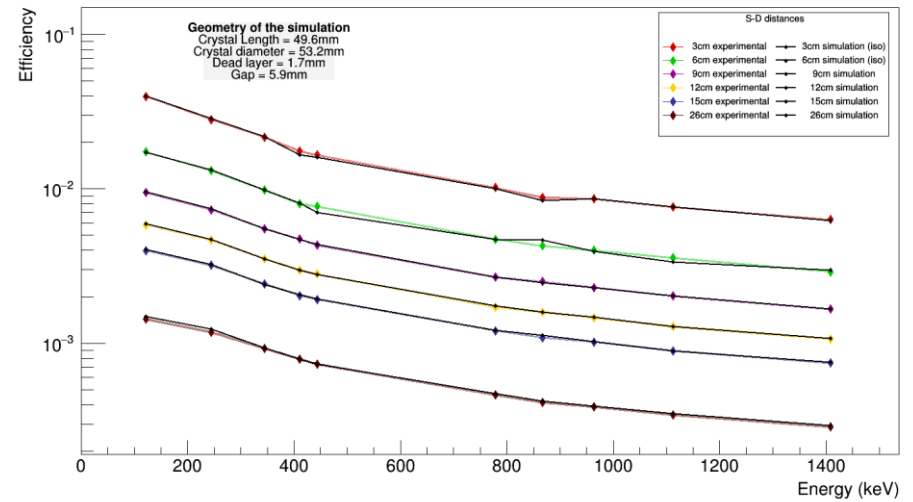
# Road to milestone MS.8 (09/21) in Covid19 era

1) Characterization of the prototype detector in terms of efficiency (fully modelled through Geant4, efficiency curves for different geometries) and resolution.

Successfully performed in Fall 2019/Winter 2020

2-3) Understanding of the detector response to g-flash, mitigating it with on purpose developed electronic and suited pulse shape routine for signals recognition.

Final stages



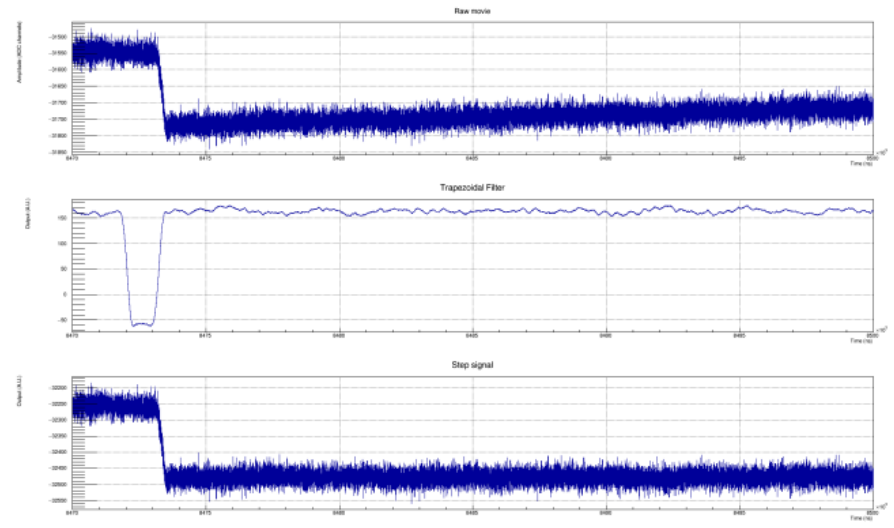
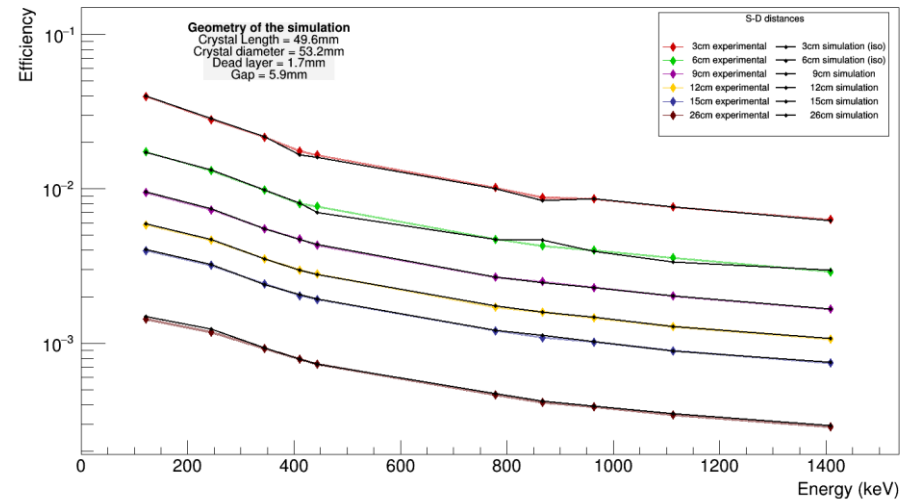
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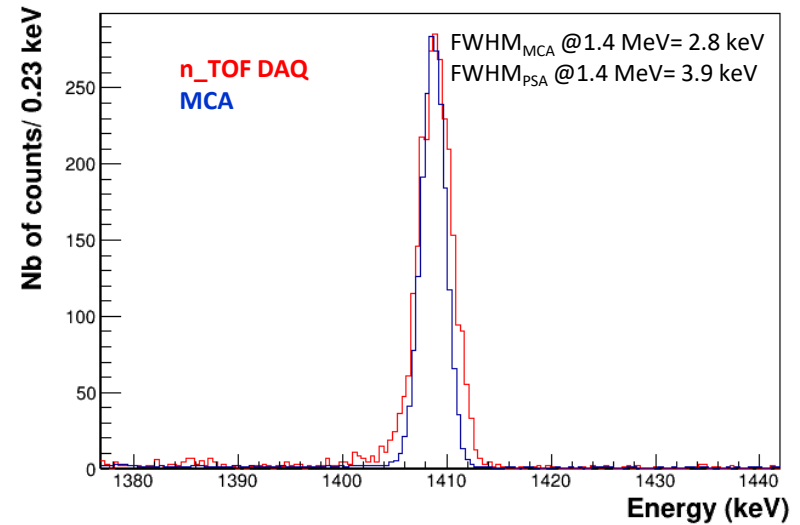
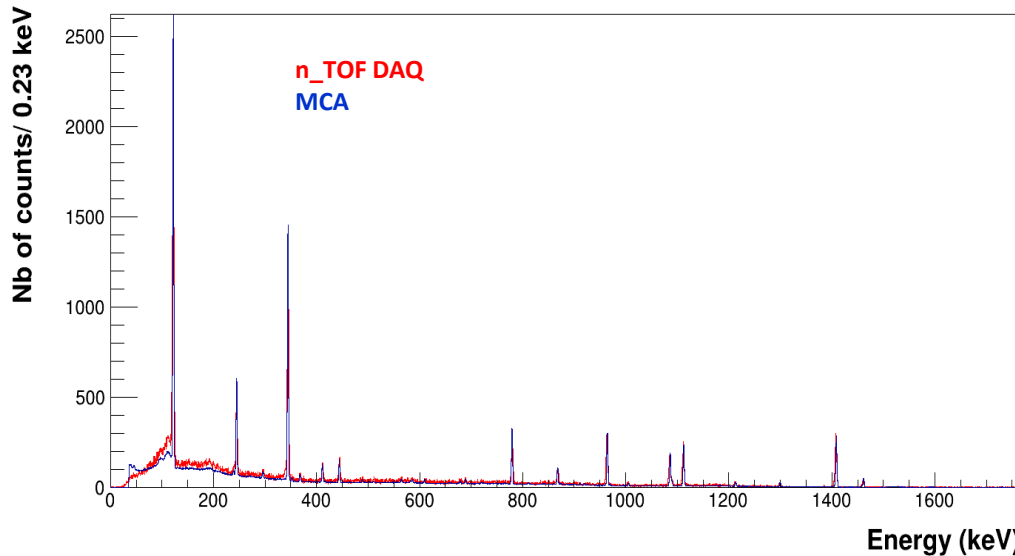
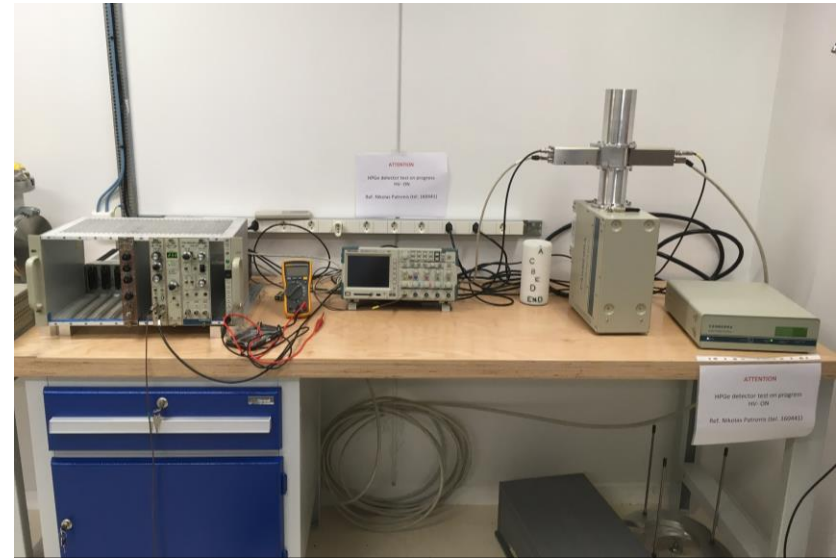


# Road to milestone MS.8 (09/21) in Covid19 era

4-5) Switch to electronic cooling, mechanical assembly, in lab test and coupling to n\_TOF DAQ

Successfully performed in Fall 2020, respecting Covid19 measures taken by CERN

Very good energy resolution

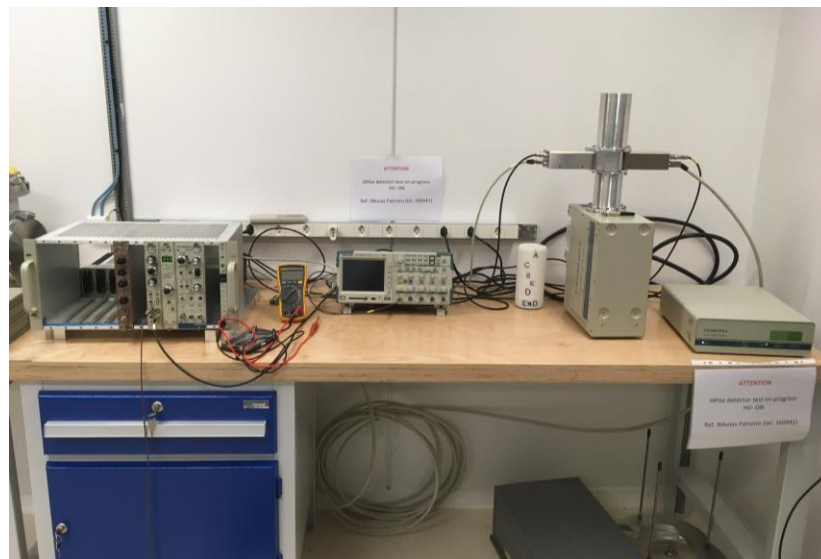


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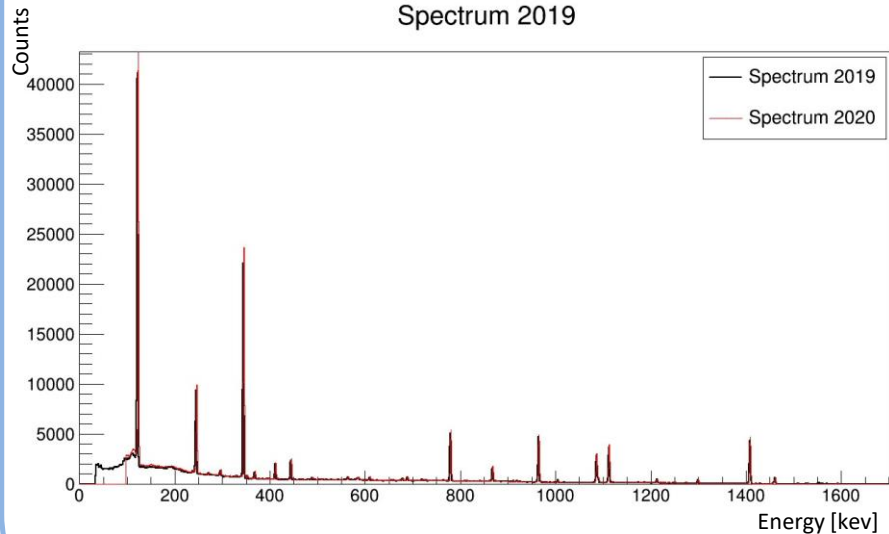
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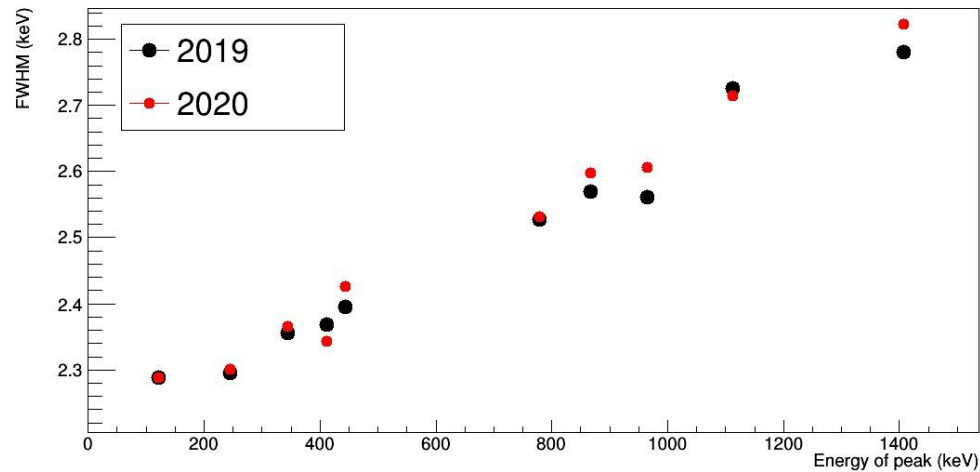
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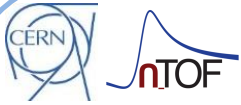
Spectrum 2019



FWHM comparison







# Road to milestone MS.8 (09/21) in Covid19 era

- Letter of Intent to perform the commissioning of the detector prepared and ready to be submitted to INTC for beam time approval
- The commissioning of the detector is subject to the availability of the n\_TOF neutron beam. Sample and detectors ready
- During Covid19 era n\_TOF underwent major changes, with a new spallation target being installed
- First beam expect by April 2021 had to be rescheduled to July 2021 (4 months delay)
- A similar delay is then expected for milestone MS.8

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Letter of Intent to the ISOLDE and Neutron Time-of-Flight Committee

Measurement of neutron inelastic scattering cross-sections at n\_TOF through  $\gamma$  spectroscopy

December 29, 2020

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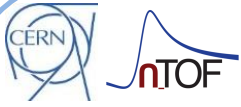
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**Technical coordinator:** O. Aberle (Oliver.Aberle@cern.ch)



## Road to deliverable D.1.6

Due to advanced status of the work performed so far, and in the current scenario, no delays are foreseen on the deliverable of the project (M48)