

Gradignan, June,22 2020

**Report on Proposal for opening a new project: "Muon ordinary capture for the nuclear matrix elements in  $2\beta$  decays (project MONUMENT)"**

The MONUMENT project addresses the important problem of the determination of the nuclear matrix elements for the neutrinoless double beta decay ( $\beta\beta 0\nu$ ). Indeed, despite the progress made during the last 20 years in this domain, it still remains a discrepancy of a factor 2 -3 between the different models of nuclear matrix calculation. This project aims to populate the states of the intermediate nucleus in a double beta decay by ordinary muons capture in the daughter nucleus. It will be focused on the  $^{136}\text{Ba}$ ,  $^{76}\text{Se}$  and  $^{96}\text{Mo}$  corresponding to the double  $^{136}\text{Xe}$ ,  $^{76}\text{Ge}$  and  $^{96}\text{Zr}$  double beta decay emitters, respectively. These isotopes will be used in the next generation of double beta decay experiments

MONUMENT will be performed at the meson-factory of the Paul Scherrer Institute (PSI) in Switzerland by an international collaboration experienced in such measurements. This program is in line with a previous one, interrupted by the lack of available accelerators with the required beam performance in the world. With the new negative muon beamline pE1 (with a moment of 20-28 MeV/c) at PSI, it is possible again to conduct OMC program for double beta decay nuclear matrix calculation purposes.

The JINR Dubna has a long-standing experience in the domain of nuclear spectroscopy or neutrino physics using OMC. Up to recently, this JINR activity was led by V.G. Egorov and has international recognition.

The contribution of JINR concerns hardware, integration and data analysis. The group will be in charge to procure isotopically enriched targets of high chemical purities of  $^{\text{nat}}\text{Ba}$  (2g),  $^{76}\text{Se}$  (2g),  $^{96}\text{Mo}$  (2g),  $^{40}\text{Ca}$  (1g),  $^{56}\text{Fe}$  (2g),  $^{32}\text{S}$  (2g) and produce suitable solid target source. It will include also a modernization of the trigger system and beam-profile monitor refurbished from the previous program. The JINR will provide 2 of the germanium detectors used for detection of X and gamma-rays following OMC as well as a 16-channel digitizer for DAQ system. The group will be also involved in the integration for hardware.

JINR Dubna has very visible and essential contributions in the experimental hardware corresponding also to their expertise in such experiment. The strong experience in the data analysis of the Dubna group is a guarantee of capability of the collaboration to achieve the goals. The collaboration includes also the theoretical group of Jyväskylä University (Finland) allowing a complete synergy from the OMC data measurement to the interpretation of the data and the improvements of nuclear matrix element calculation.



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The Dubna group is a key member of this collaboration to measure OMC for the double beta decay Nuclear Matrix Element. It has clear objectives and relevant contributions. The total number of FTE and the requested budget is in adequation with the objectives.

In conclusion, I recommend strongly to fully support the new project Monument.

A handwritten signature in black ink, appearing to read 'Fabrice Piquemal', written over a horizontal line.

Fabrice Piquemal

Director of CENBG