

Referee Report to the 52nd N.P. PAC at JINR (June 25, 2020)

Concerning: 6. Proposal for opening a new project

“Muon ordinary capture for nuclear matrix elements in 2β decays (project MONUMENT)”

Ordinary Muon Capture (OMC) is a fundamental weak interaction process that takes place after a negative muon is captured in atomic orbit. The gamma radiation from excited states of the daughter nuclei produced by OMC can be well identified and distinguished from prompt radiation like muonic X-rays, since the capture process is delayed in time. OMC is thus a very powerful tool to study nuclear structures and matrix elements of transitions.

The MONUMENT proposal aims at an OMC study of special isotopes which are important to a more precise understanding of the neutrino-less double-beta decay (DBD). The nuclei of highest interest are Ba-136, Se-76, Mo-96 and others, which can provide more precise information for calculations of nuclear matrix elements of the DBD candidates Xe-136, Ge-76, Zr-96, etc.

The Dubna group, led by D. Zinatulina, has a high reputation in this field. It started this activity in experiments at PSI's low energy muon beams already in the 90's and more recently in 2006. The results presented in many publications demonstrate the great expertise of this group. In 2019 they joined a major collaboration specialized in Germanium gamma spectroscopy of muonic atoms (muX collaboration at PSI). First OMC measurements were performed in 2019 on selected nuclei like Mg-24.

In January 2020 the proposal (called OMC4BDB experiment, a 3-years program) was accepted by the PSI scientific advisory committee and received a first 3-weeks beam time allocation for Nov/Dec 2020). The goals of the experimental program include many more physics topics of importance, e.g. OMC on Mo-100 (candidate for measuring Supernova explosions), total and partial OMC rates on Ca-40, Fe-56, S-32 for testing nuclear shell model calculations), study of giant resonances, collecting X-ray energies of the muonic cascades, etc.

The requested expenses (378 k\$/3y) are quite reasonable, since expensive equipment like HPGe detectors is shared among the collaboration partners.

Recommendation: The MONUMENT proposal is a highest valued experimental program in the field of OMC and neutrino-less Double-beta-decay. I recommend acceptance of the entire project and full financial support by JINR.

Villigen-PSI, June-22-2020

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