Contribution ID: **3**   Type: **Oral**

On quantum trapping of cold neutrons in nano-scaled Fabry-Perot resonating cavities & neutron lifetime considerations

Abstract:

Relatively to the atomic constituents'counterparts, the neutron is singular as it is sensitive to the four fundamental interactions: strong, weak, electromagnetic, and gravitational. This multi-sensitivity makes neutron wave-matter optics a particularly versatile tool for testing quantum mechanics specifically and fundamental physics concepts in general.

The lifetime of a free neutron defined via its beta-decay $\langle \tau n \rangle$ is of a pivotal importance within the standard model & cosmology.

Indeed, the precision on the neutron lifetime is paramount as it regulates the precision of the 1st element of the Cabibbo–Kobayashi–Maskawa matrix, central to the standard

model. The two major methods used to measure $\langle \tau n \rangle$ while trapping free neutrons, namely, the beam and the bottle methods give different neutron lifetime values; $\langle \tau n \rangle$Beam ~ 888.0 ± 2.0 s , that obtained by the bottle technique is smaller; of about $\langle \tau n \rangle$Bottle ~ 879.4 ± 0.6 s. In

addition of the persistent difference of ~10 s persists for years, even if the two methods have been modified to enhance the experimental accuracy. This latter was shown to be enhanced if one could trap cold neutrons in nanostructured Fabry-Perot resonators.

The de Broglie wave-particle duality coupled to the Fermi total reflection phenomenon in addition to the tunneling & trapping of cold neutrons in such nano-resonating cavities,

allow trapping times with a precision governed by the Heisenberg uncertainty of 10-12 s [1-2].

[1]. M. Maaza, Journal of Neutron Research -1 (2023) 1–16 1 DOI 10.3233/JNR-220015,

[2]Nano-structured Fabry-Pérot resonators in neutron optics & tunneling of neutron wave-particles, Maaza, M., Hamidi, D., Physics Reports 2012, 514(5), pp. 177–198

Author: MAAZA, Malik (iThemba LABS/National Research Foundation of South Africa (ITLABS/NRF) & University of South Africa (UNISA))

Presenter: MAAZA, Malik (iThemba LABS/National Research Foundation of South Africa (ITLABS/NRF) & University of South Africa (UNISA))