Contribution ID: **189** Type: **Talk (17 + 3 min)**

Weak and Which-Way Measurements in Neutron Interferometry

Wednesday, 22 March 2023 15:10 (20 minutes)

Neutron interferometry [1], where an interference effects of matter waves passing through a perfect silicon-crystal interferometer is observed, has established a powerful tool for investigation of fundamental quantum mechanical concepts with massive particles [2]. In this talk I will give an overview of our recent work on weak measurements [3], a new type of quantum variable introduced by Yakir Aharonov in 1988. Our neutron optical approach is realized by utilizing neutron interferometry, where the spin of the neutron is coupled weakly to its spatial degree of freedom [4] allowing to study a new counter-intuitive phenomenon, the so-called quantum Cheshire [5], or a direct experimental verification of the canonical commutation relation [6]. In a recent experiment, we experimentally demonstrate that an individual neutron moving through a two-path interferometer is actually physically distributed between the two paths where the weak value of the path projector and is not a statistical average but applies to every individual neutron [6].

[1] H. Rauch, W. Treimer, and U. Bonse, Phys. Lett. A 47, 369 –371 (1974).
[2] S. Sponar, *et al.*, Nat. Rev. Phys. 3, 309 –327 (2021).
[3] Y. Aharonov, D. Z. Albert, and L. Vaidman, Phys. Rev. Lett. 60, 1351 –1354 (1988).
[4] S. Sponar, *et al.*, Phys. Rev. A 92, 062121 (2015).
[5] T. Denkmayr, *et al.*, Nat. Commun. 5, 4492 (2014).
6] R. Wagner, *et al.*, Phys. Rev. Research 3, 023243 (2021).
[7] H. Lemmel, *et al.*, Phys. Rev. Research 4, 023075 (2022).

Primary author: Dr SPONAR, Stephan (TU Wien - Atominstitut)

Presenter: Dr SPONAR, Stephan (TU Wien - Atominstitut)

Session Classification: Fundamental Physics

Track Classification: Fundamental Science