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Experimental determination of the energy dependence of the rate of negative muon transfer reaction $\mu^- p + O \rightarrow p + \mu^- O$

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We are reporting the results of the first experimental determination of the collision-energy dependence of the muon transfer rate from the ground state of muonic hydrogen to oxygen in the energy range below 100 meV. These results shed new light on the kinematics of the processes involving exotic atoms, and may serve as benchmark for the full-scale quantum-mechanical calculations of low-energy non-elastic scattering of atoms, including charge transfer. In the meantime, the accurate quantitative knowledge of the characteristics of the process of muon transfer to oxygen, which is used by the FAMU collaboration as signature of the resonance laser-induced excitations of the triplet spin state of the $\mu^- p$ atom, allows the precise modelling and fine-tuning of the ongoing FAMU experiment for the measurement of the hyperfine splitting in the ground state of muonic hydrogen and the determination of the electromagnetic Zemach radius of the proton.

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