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Search for neutron disappearance into sterile states

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The origin of matter and dark matter might be explained by models invoking copies of the Standard Model, e.g. mirror matter, which are sterile under ordinary Standard Model forces. Previous experiments constrained neutron to mirror neutron (n-n') oscillations by searching for anomalous neutron losses during the storage of ultracold neutrons (UCN). However, the presence of a mirror magnetic field or a mass splitting between neutron and sterile state would suppress the oscillation probability. We installed a new experiment at the PSI UCN source to search for resonant n-n'oscillations in magnetic fields between $5\ \mu$T and $360\ \mu$T and oscillation times on the order of 100 s. We present our setup and a preliminary analysis of our first measurements.

The experiment features a large $1.47\ \mathrm{m}^3$ stainless steel storage volume with a storage-time constant for UCN of 202 s and a mean time between subsequent collisions of the neutron with the vessel walls of 0.17 s. After a storage time of 180 s we detect on average 10^6 UCN. A monitoring phase after filling of the storage volume compensates drifts and fluctuations of the UCN output of the source. We achieved a statistical sensitivity on the asymmetry observable of the normalized neutron counts after storage in a vertical up and down magnetic field of 10^{-4} per measurement day.

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