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Wavelength-selected neutron pulses formed by a spatial magnetic neutron spin resonator

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Abstract

We present a novel type of spatial magnetic neutron spin resonator for precise wavelength selection and definition of the time structure of white thermal and cold neutron beams from continuous and pulsed sources [1,2]. This device exploits the fact that upon passage of polarised neutrons through a spatially alternating transverse static magnetic field each neutron in its rest frame experiences an alternating field with a frequency depending on the neutron velocity and the spatial period of the resonator. If this frequency equals the *Larmor* precession frequency - which can be tuned by the strength of an orthogonally oriented static magnetic field - a resonant spin flip will take place. This result is used to pick out a desired wavelength band of adjustable width from an initially polychromatic polarised neutron beam. The time structure of the selected neutron beam can be tailored from continuous operation to ultra-short pulses in the microsecond regime by application of a travelling magnetic wave mode. Thus, this new type of pulsed neutron magnetic spin resonator could be useful for polarised neutron beamlines at both, continuous neutron sources and short- and long-pulse spallation sources. It will be of clear advantage that the time structure, of in such a way precisely wavelength-selected neutron pulses (continuous sources) and sub-pulses (e.g. chopped out of the 2.6 ms ESS neutron pulse), will be almost arbitrarily adjustable by purely electronic means. To demonstrate the feasibility of this technique, we designed and engineered a first prototype of such a resonator consisting of ten individually switchable stages. They were made of individual aluminium loops driven by microcontroller based current sources with high-performance MOSFET switches to allow for ultra-fast electronic switching for the generation of microsecond pulses. This resonator was installed at a polarised neutron beamline at the 250 kW TRIGA reactor of the Vienna University of Technology at the Atominstitut. First measurements and performance tests of this resonator are indeed very promising [3].

[1] G. Badurek, C. Gösselsberger, E. Jericha, Physica B **406** (2011) 2458.

[2] C. Gösselsberger et al., Physics Procedia **17** (2011) 62.

[3] C. Gösselsberger et al., J. Phys.: Conf. Ser. (2011), in print.