New infrastructures for ultracold neutron production at the ILL

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Conversion of cold to ultracold neutrons (UCN) via single-phonon emission in superfluid helium provides a viable mechanism to achieve high densities of UCN at the end of a neutron guide. In a current development at the ILL new sources based on this mechanism have been implemented at two monochromatic neutron beam lines. The first beam hosts an upgraded prototype source which will be used for neutron gravity experiments. Studies with a second, more modular source cryostat are underway at the second beam with the goal to further improve UCN accumulation and extraction from the converter. A first application of this source will be the neutron lifetime experiment HOPE which employs a magneto-gravitational UCN trap made of a vertical array of Halbach octupole permanent magnets with superconducting axial-field coils. While our second prototype source has recently demonstrated a UCN density beyond 100 per ccm, a large improvement is expected using a magnetic reflector around the helium converter. This technique will be employed in the project SuperSUN, a powerful UCN source to be installed in an intense, white neutron beam at the ILL, with projected saturated UCN densities beyond 1000 UCN per ccm.