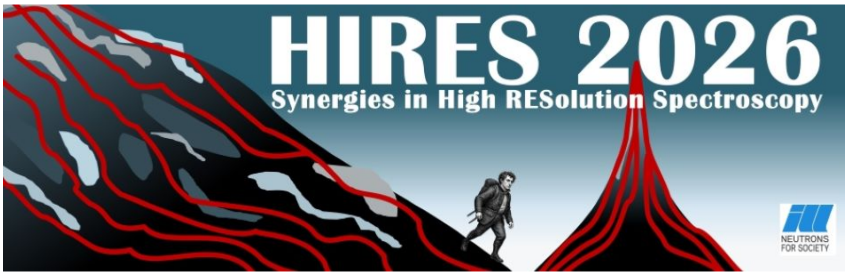

Contribution ID: **64** Type: **Oral**

The influence of dipolar interactions on the critical dynamics in nickel

The study of critical phenomena has always been deeply connected with magnetism in solid state materials. Nickel, one of the three archetypical room temperature ferromagnets, is understood to be an itinerant system with a high degree of localization regarding its magnetically active electron states. We report a high-resolution neutron spectroscopy investigation of nickel (Ni) near its Curie temperature T_C, extending measurements to unprecedentedly small wavevectors $q_\mathrm{min} = 6.6 \cdot 10^{-3}$
$unicode0x212B^{-1}$ and achieving an energy resolution of $\Delta E = 4.9\,\mu\mathrm{eV}$. This was achievable using the RESEDA spectrometer in MIEZE mode, a variant of the neutron resonant spin-echo technique.

Our analysis of the spin-wave dispersion reveals that the dipolar wavevector $q_\mathrm{D} = 6.4 \cdot 10^{-3}$
$unicode0x212B^{-1}$ is approximately half of the previously reported value, but strictly non-zero to rationalize the observed excitations. The spin wave stiffness $D(T)$ is in good agreement with literature, but most importantly, we uncover evidence that the linewidth of the spin waves follows the dynamical scaling characteristic of a dipolar ferromagnet rather than an isotropic one. In contrast, the linewidth of the fluctuations above T_C exhibit scaling consistent with the Resibois–Piette function and renormalization-group predictions, despite the itinerant ferromagnetic nature of Ni. This observation suggests a pronounced localization of the $3d$-electrons responsible for magnetic scattering.

Session

Magnetism

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Session Classification: Magnetism