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Systematic vibration studies on a cryogen-free ^3He/^4He dilution refrigerator for X-ray spectroscopy at storage rings

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The precise determination of transition energies in highly-charged heavy ions in the X-ray regime provides a sensitive test of quantum electrodynamics. Such experiments are commonly performed at storage ring facilities. [1,2]
To minimize interruptions of long time measurements during beam times due to maintenance, a cryogen-free cryostat for such experiments is currently under commissioning. The design is based on a "wet" cryostat (operated with liquid nitrogen and helium) which was used in past experiments [3] and features a long side arm to bring the detectors as close to the x-ray emitting interaction zone of the storage ring as possible.
The system is equipped with a pulse tube cooler. This device replaces the coolant liquid helium by cooling the system with a compressor. However, this compressor operation introduces mechanical vibration into the system which will contribute significantly to the overall signal noise by means of microphonic noise generation. The long side arm makes the system particularly sensitive to such microphonic noise contributions. This will decrease a signal to noise ratio which is directly connected to the energy resolution of the X-ray signals.
Therefore, systematic vibration studies at different positions within the cryogenic system have been conducted. Special focus was set onto the vibrations of the side arm and the cables leading to the detectors to identify the optimal mechanical and electronic setup. The measurements and conclusions will be presented in this poster.

[1] V. A. Andrianov et al., Journal of Low Temperature Physics 151 (2008) 1049
[2] S. Kraft-Bermuth et al., Journal of Low Temperature Physics 167 (2012) 765
[3] A. Bleile et al., AIP Conf. Proc. 605 (2002) 409