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Fighting f-factors and implantation damage in emission Mössbauer spectroscopy

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The Mössbauer collaboration at ISOLDE/CERN applies short lived isotopes for emission Mössbauer spectroscopy (eMS) within material sciences. Mössbauer spectroscopy (MS) gives various detailed information on the probe atoms, through the hyperfine interactions. There are several benefits of eMS in particular we can perform measurements in the extremely dilute regime (~10^{-4} at. %) and make use of the chemical nature of the parent (implanted) atom.

In cases, where we want to study defect physics, the implantation damage is beneficial. In other cases it can impede investigations. Conventionally, we implant/measure at elevated temperatures to monitor the annealing of radiation damage, however, this can hamper the measurement due to the Debye Waller factor (probability of MS transition). In some cases, the interesting material physics are at low temperature, such as magnetic interactions.

For the first time since the 1980's we have applied so-called quenching experiments with short lived isotopes (~minutes), i.e. implantation at elevated temperatures (>300 K), while the measurement is performed at low temperature (77 K). In my presentation I will discuss some of the physics involved in connection with our new proposals. In addition, the data obtained from quenching experiments in the 1980's will be revisited. Finally some of the new data acquired at the 2014 beam-time will be presented followed by a discussion of future possibilities.

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