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A Practical Guide to the Use of QLCR in Muon Spectroscopy

Since the first measurements of muon quadrupolar level crossing resonance (QLCR) in Cu [1], the technique has been extended to various other quadrupolar atoms. For example, recent QLCR studies with N looked at a charge transfer salt [2] and the quantum delocalisation of the muon in solid N_2 [3]. Another recent study measured the kagome superconductor RbV_3Sb_5 and this has provided the first measurement of QLCR involving V atoms [4]. Although the muon is closer to Rb and Sb sites than the V, the QLCR signal with the V sites is stronger and more conveniently placed in field than that originating from the closer Rb and Sb sites. This rather counterintuitive result has prompted an assessment of the factors affecting the signal strength of particular quadrupolar nuclei within QLCR studies. Following this investigation, a figure of merit (FOM) is proposed, based on the ratio of dipolar to quadrupolar parameters, the natural abundance of the quadrupolar isotope and the degree of electronegativity for the quadrupolar atom. This FOM can provide some guidance towards answering the question of whether QLCR studies are likely to be experimentally successful in any given compound containing quadrupolar nuclei.

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