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Polarizability shifts and body-frame electric-dipole moments of molecular ions in a Penning trap

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In a Penning trap the cyclotron frequency of a polarizable ion is perturbed by the Stark interaction of the ion with the motional electric field. For polar molecular ions, which have adjacent rotational levels of opposite parity, these state-dependent cyclotron frequency shifts can be particularly large - especially for the lowest rotational levels, which are occupied in a Penning trap at 4.2K. These polarizability shifts complicate precision atomic mass measurement, but can also be used to measure body-frame dipole moments of molecular ions, which are difficult to measure by other means.