Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Normal Modes, Rotational Inertia, and Thermal Fluctuations of Trapped Ion Crystals[1] DANIEL DUBIN, University of California, San Diego

— Trapped ion crystals are employed in a variety of applications ranging from N-body quantum simulations to studies of strongly-coupled plasmas. Here the normal modes of an ion crystal are derived using an approach based on the Hermitian properties of the system dynamical matrix. This approach is equivalent to the standard Bogoliubov method, but for classical systems it is arguably simpler and more general in that canonical coordinates are not required. The general theory is developed for stable, unstable, and neutrally-stable systems. The method is then applied to develop reduced eigenvalue problems for the large magnetic field limit, where the spectrum breaks into ExB drift modes, axial modes, and cyclotron modes. Thermal fluctuation levels in these modes are analyzed and shown to be consistent with the Bohr-van-Leeuwen theorem. Rotational as well as vibrational motions are considered, and an expression for the rotational inertia of the crystal is derived. A magnetic contribution to this inertia which dominates in large magnetic fields is described, and an unusual limit is discovered for the special case of spherically-symmetric confinement, in which the rotational inertia does not exist.

[1]Supported by NSF grant PHY-1805764, DOE grant DE-SC0018236, and AFOSR grant FA9550-19-1-0099

Daniel Dubin
University of California, San Diego

Date submitted: 26 Jun 2020 Electronic form version 1.4