Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Colloquium

Cooling of trapped ions with a tiny cloud of ultracold atoms

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Trapping and cooling of ions have been instrumental in advancing numerous fields including precision measurements, quantum computing, quantum simulations and cold chemistry. Demonstration of new ion cooling methods is therefore of paramount importance in the advancement and expansion of these research areas. Optically dark ions such as Na^+, Rb^+, Cs^+ cannot be laser cooled, leaving cooling by collisions with cold atoms as the next most viable option. Indeed, experiments have time and again verified that an ion trapped in a Paul trap can be cooled by *elastic collisions* with cold atoms when the ion is heavier than the atom. However, there is a long-standing debate on whether the reverse, cooling of low-mass ions by higher-mass atoms, is possible. In the first part of my talk, I shall discuss our experiments which demonstrate, for the first time, cooling of low-mass ions by ultracold atoms of higher mass. The ions are cooled because the ultracold atoms are localized and placed precisely at the centre of the ion trap, where the ion's secular speed is the maximum. Therefore, elastic collisions with ultracold atoms always reduce the speed, and hence the temperature, of the ion. In the second part of the talk, I shall discuss our experiments which demonstrate, for the first time, a novel ion cooling mechanism based on inelastic, *resonant charge exchange collisions* between the trapped ion and the parent neutral atom.

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04:00 PM (Tea/Coffee at 03:30 PM)

Auditorium, TIFR-H