# Atomic physics, quantum optics, and quantum information processing with trapped ions

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Atomic ions, confined and laser cooled in Paul traps have been the subject of intense research for decades now. Precision spectroscopy of single ions provides the basis for some of the best known optical frequency standards. Fundamental quantum optical experiments have been carried out with single laser cooled ions in Paul traps and continue to be an extremely valuable tool for an investigation of quantum feedback. Most notably, recent years have seen an increasing application of ion traps for quantum information processing. Basic quantum algorithms have been demonstrated with trapped ions and a number of quantum states have been created on demand. Such states are analyzed by state tomography, quantum procedures are characterized by process tomography and these elements provide a profound basis for the development of future quantum processors. In atomic physics, these newly developed quantum logic tools are applied for the new field of quantum metrology. Recent advances with trapped ions in the field of atomic physics, quantum optics and quantum information processing will be reviewed.