

## **Ion Trapping in Quadrupole Fields; a Modern Saga**

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The quadrupole ion trap, QIT, was surely the most atypical mass spectrometer to be introduced in the twentieth century. In a world of large sector instruments, the QIT was small; ion paths within the QIT were torturous rather than linear; ion/neutral collisions were said to be desirable rather than an anathema; and the pressure within the QIT was some three orders of magnitude higher than in a sector instrument. Yet the QIT is now placed securely within the arsenal of sophisticated analytical instruments of high versatility and sensitivity. The pace of instrument development of the QIT has been meteoric and the degree of acceptance of this instrument has been extraordinarily high. It is estimated that some 6,000 QIT instruments have been purchased at an average cost of k\$150; thus, some  $\$9 \times 10^8$ , a substantial fraction of the funds allocated to the purchase of mass spectrometers, has been directed to the purchase of QIT instruments.

The largely personal review of the history and development of the quadrupole ion trap during the past 30 years that will be presented emphasizes the ion trapping action of a quadrupole field and the roles of ion/neutral collisions within such a field. This review will highlight those discoveries and instrument developments that have resulted in the highly-charged ion trap (HCT), the linear ion trap (LIT), the mini-cylindrical ion trap (CIT), arrays of mini-CITs, the digital ion trap (DIT), and the rectangular ion trap (RIT).