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Quantum information processing and quantum-limited metrology using trapped ions at NIST.[1]

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With the use of atomic ions confined in a multi-zone array, we implement simple quantum algorithms and study the problems in scaling such a device to tens of qubits [1]. Current work is devoted to better control of classical parameters such as laser intensity, suppression of heating from ambient fluctuating electric fields, and studying limitations caused by more fundamental sources of decoherence, such as spontaneous emission. Along with other groups, we are studying ways to increase the number of trap zones; in particular, we concentrate on a surface-electrode multi-zone geometry. Although a general purpose quantum computer appears to be a distant goal, simple applications of quantum information processing methods enable new techniques for spectroscopy and efficient quantum detection. [1] Current research in collaboration with D. Leibfried, J. Amini, J. C. Bergquist, R. B. Blakestad, J. J. Bollinger, J. Britton, K. Brown, R. J. Epstein, D. B. Hume, W. M. Itano, J. D. Jost, E. Knill, C. Langer, R. Ozeri, T. Rosenband, S. Seidelin, N. Shiga, and J. H. Wesenberg.

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