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## An ultimate single-ion source using a Coulomb crystal in a Paul trap

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An ion cloud confined in a Paul trap eventually reaches a Coulomb crystalline state when strongly cooled toward absolute zero. The normalized emittance of the Coulomb crystal can be in the sub-femtometer range. The trap is thus usable as a unique ion source for nano-beam production, though the available beam intensity is limited. This new concept was first discussed nearly 20 years ago *and later experimentally demonstrated by several research groups* (\*, \*\*). In this paper, we report on the result of a recent experiment where an attempt was made to extract Ca<sup>+</sup> or N<sub>2</sub><sup>+</sup> ions one by one from a compact linear Paul trap. In addition to the regular extraction scheme based on a string Coulomb crystal, the possibility of using a multi-shell crystalline structure is explored in detail.

### Footnotes

- M. Kano et al., J. Phys. Soc. Jpn. 73, 760(2004). \*\* W. Schnitzler et al., Phys. Rev. Lett. 102, 070501 (2009). \*\*\* K. Izawa et al., J. Phys. Soc. Jpn. 79, 124502 (2010).

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