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High-Q room-temperature electron-ion Paul traps

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While Paul traps are commonly used in ion trapping, electron trapping with Paul traps is a new line of advance, done only by few laboratories in the world [1–2]. It requires comparably high (GHz range) frequency, which creates a challenge for efficient power supply. Low input power, decreasing device heating, can be achieved by designing the trap as part of a resonator. We have developed a coaxial trap, designed for two signals at different frequencies to trap both electrons and ions. The high-frequency signal is delivered and amplified by a half-wave resonator. The trap is 3D-printed and shows a relatively good quality factor, more than 1 000.
Having a corresponding planar trap design, connected with resonating transmission lines, could improve optical access and make the trap possible to manufacture in standard CMOS methods [3] or direct laser inscription method on metal-plated glass substrate, developed by us [4]. We have filed a patent application for such trap design with a segmented ring electrode and resonating lines coupled with Marchand baluns. While there are still some challenges in having an efficient planar design, the development of both designs forwards using trapped electrons both in research and various quantum technological applications.

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Author: LAUSTI, Niklas Vilhelm (Charles University (Czech Republic))

Co-authors: HEJDUK, Michal (Charles University (Czech Republic)); KUMAR, Vineet (Charles University (Czech Republic))

Presenter: LAUSTI, Niklas Vilhelm (Charles University (Czech Republic))

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