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Diamond-based Raman laser technology for RILIS operation and high-resolution spectroscopy

The Raman nonlinear process consists in a scattering interaction between light and a crystal. Through the process, a photon losses energy to a phonon of the crystal, leading to an up-shift in the laser wavelength. This wavelength shift can be used to extend the laser frequency coverage of the RILIS laser systems, for operation and high-resolution spectroscopy experiments.

During the past years, different Raman laser designs have been developed, characterized, and tested for resonant ionization.

Particularly, a Z-fold diamond laser resonator, conserving the pump laser's linewidth, has been implemented, making it suitable for regular RILIS operation. Recently, the use of this design has been validated in MEDICIS with the ionization of Radium, for which the first step frequency of the laser scheme (482nm) is difficult to achieve using an intra-cavity doubled TiSa lasers.

A different design based on a monolithic diamond Raman resonator, provides narrow linewidth, suitable for high-resolution spectroscopy, for example with PI-LIST. The characterization of the first and second Stokes output, emitted by such Raman laser, has been performed. The measured efficiency (up to 40%), linewidth (down to 150MHz) and tunability well satisfy the requirements for high-resolution spectroscopy experiments.

The design of both types of diamond Raman lasers, alongside performances characteristics will be presented, as well as the preliminary results of applications for ion beam production and high-resolution spectroscopy.

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