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Recent laser developments at the IGISOL facility

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The quest for efficient and selective laser ionization and spectroscopy of new elements and isotopes requires advances of the currently used laser systems in terms of several key parameters including power, wavelength coverage and resolution. To enhance the specifications of the currently employed Ti:sapphire laser systems at IGISOL and other international facilities, several new techniques have been employed. For each technique a short review as well as an application will be presented.

• A grating-based Ti:sapphire laser for wide range wavelength scanning has been built and used for ionization scheme development in samarium.
• The power of the second and fourth harmonic was greatly improved using intra-cavity frequency doubling, a technique which is now routinely used in experiments.
• A first test of difference frequency mixing has been carried out to check the viability of filling in the "wavelength gap"between the fundamental and the second harmonic for the Ti:sapphire laser in the range of 500-700 nm.
• Fiber transport for high power pulsed lasers is currently under investigation and may be used for convenient optical distribution to different ion sources, reducing the need for tedious alignment procedures.
• The intrinsic resolution of the Ti:sapphire laser has been improved from 5 GHz to below 1 GHz by introducing a second thick etalon into the cavity. First measurements with this system have been carried out on the stable isotopes of copper in a collimated atomic beam reference cell as well as inside the gas cell and gas jet of the IGISOL laser ion source.
• An even further reduction of the laser linewidth is possible using the technique of injection locking. Currently, such a system is being set up at IGISOL using a continuous wave master laser to seed a pulsed pumped bow-tie ring cavity. In optimal conditions the linewidth of such a laser is only determined by the Fourier-transform limit and the stabilization performance and can reach to below 20 MHz.

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