Master thesis project

Generation of blue laser light (λ = 421 nm) by frequency doubling

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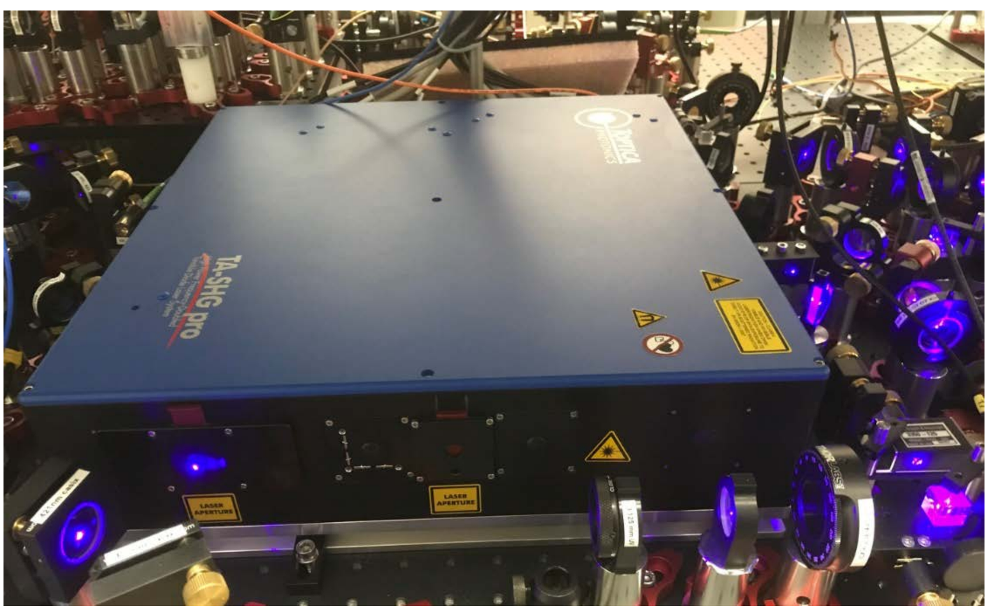
Scientific background: We work with ultracold dysprosium (Dy) atoms, which open up many exciting new avenues in quantum-gas research. In its electronic ground state, Dy possess the largest magnetic dipole moment of all atoms (10x the Bohr magneton), which makes it at promising system to explore for example quantum liquid-crystal physics. Highly magnetic fermions are also a useful system to study p-wave superfluidity. Another direction of research with fermionic Dy is the study of a topological superfluid phase utilizing spin-orbit coupling, and there are many other examples.

Why do we need laser light at 421 nm? As a first step to produce ultracold samples of Dy one needs to decelerate the atoms to reach the capture velocity of a magneto-optical trap. The strong transition at 421nm (linewidth 32 MHz) is ideal for this purpose. Commercially available systems to obtain sufficient power (>0.5W) at 421nm at a single frequency exist (see picture), but they are rather expensive due to the small pool of customers that would need such a tool. As a further drawback for the daily lab operation maintenance of a commercial system can only be done by the manufacturer.

The Master thesis project: The project will encompass the development of the key ingredients of a home-made system that can substitute the commercial one at 421nm. The main ingredients are a stable diode laser at 842nm, based on a cat-eye design, a tapered amplifier seeded by the former to produce about 2W of 842 light, and a bow-tie enhancement doubling cavity with a LBO crystal to achieve the desired >0.5W of the desired 421nm light.

What you get out: The project will provide excellent training in modern laser technologies and is directly connected to a state-of-the-art research project.



Commercial system (Toptica Photonics) to generate laser light at 421nm in our dysprosium laboratory.