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A cw-OPO seeded pulsed OPA system towards High-Resolution Laser Spectroscopy

Friday 29 March 2024 10:00 (30 minutes)

Resonant laser excitation in atomic spectrum studies unveils nuclear structures. Interactions of the nuclear ground state with the electronic shell induce hyperfine structure (HFS) and isotope shift (IS), enabling precise measurement of nuclear properties such as spin (I), magnetic dipole moment ($_I$), electric quadrupole moment (Q_s), and changes in mean square charge radii (r^2). Accessible with lasers, atomic transitions of valence electrons in the range of a few eV necessitate an optimal optical linewidth for high-resolution laser spectroscopy. Techniques like collinear resonance ionization spectroscopy employ a resonance peak linewidth of 40-70 MHz to resolve the HFS in most elements. Pulsed laser light with a full width at half maximum (FWHM) of less than 50 MHz has been achieved through various methods, including the seeding of a pulsed dye amplifier and injection-locking a titanium:sapphire (Ti:Sa) laser. As exotic nuclides demand hard to access wavelengths, new laser techniques are essential. While dye lasers and Ti:Sa-based systems prevail, an optical parametric oscillator (OPO) seeded dye amplifier system demonstrates comparable performance near 330 nm. This proposed setup aims to generate high-energy pulses (in the range of 1000 nm to 1530 nm) using a narrow-band cw-OPO seeded optical parametric amplifier (OPA) towards high-resolution spectroscopy of Actinides. Preliminary characterization of the pulse length and optical linewidth were done to meet specific experimental requirements, including mode-hope-free tuning suitability.

Workshop Themes

Laser design/performance

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