CFEL SCIENCE

SEMINAR

09th April 2013 - 11:00 a.m.
Building 99, seminar room II

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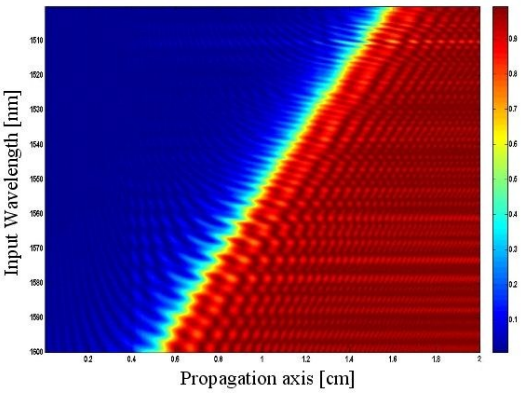
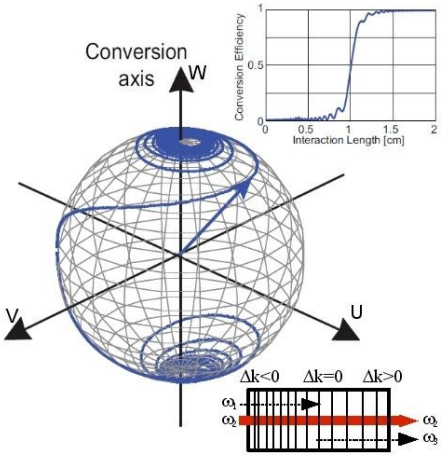
Adiabatic frequency conversion

Conversion of one laser frequency to another is one of the oldest and most useful effects in nonlinear optics. However, in wavelength conversion devices, there is usually a trade-off between the efficiency of the conversion and the bandwidth over which the device functions. The introduction of adiabatic frequency conversion, a concept which utilizes an analogy between coherently excited two-level quantum system and the propagation of two electromagnetic waves in a nonlinear crystal, allowed the achievement of efficient scalable broadband frequency conversion. The concept was applied successfully to the upconversion and downconversion of ultrashort pulses, where conversion of Ti:S oscillator pulses with near-100% efficiency for ultrabroadband spectrum has been achieved. The method is allowing the generation of high-energy, multi-octave-spanning IR pulsed sources in the 2-5 μm range and is expected to become a powerful seeding source for coherent wavelength multiplexers based on optical parametric amplifiers.
In my talk, I will review the mathematical background behind two level system and rapid adiabatic passage dynamics in frequency conversion realm. Then, I will show experimental demonstrations of the concept using tunable quasi-CW laser and ultrashort pulses, and discuss the robustness, tunability and scalability of the scheme. Last, I will present shortly, a follow-up research that shows the extensions of the adiabatic dynamics into multi-level quantum systems, predicting new phenomena and concepts in frequency conversion, such as efficient conversion through an opaque medium, and the prediction of 'Stark shift' in the realm of frequency conversion.





Host: Franz X. Kärtner, CFEL UX Seminar