CFEL SCIENCE

SEMINAR

29th May 2013 - 14:00 a.m.

CFEL-bldg. 99, seminar room I

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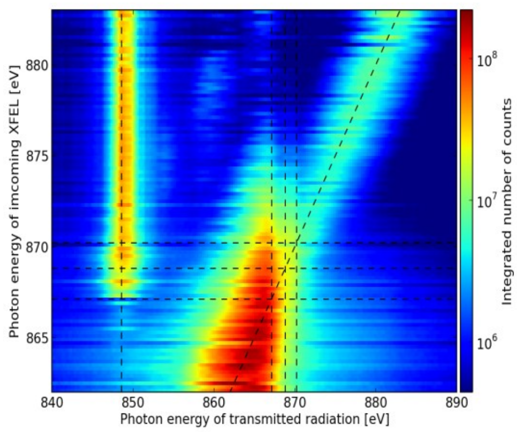
Stimulated processes in x-ray pumped atomic gases

With the advent of x-ray free electron lasers (XFEL) it is possible to explore the area of quantum optics in the x-ray regime. Recently stimulated emission has been observed after inner-shell ionization of neon [1]. By focusing the XFEL beam into a gas cell core holes are created producing a transient population inversion. A few spontaneous photons at the beginning of the medium can now drive a series of stimulated emission processes. I will present a generalized Maxwell-Bloch approach to model the stimulated emission. This semi-classical model treats the electric field classically, while the atomic system is treated quantum mechanically in the density matrix formalism.

Another interesting process to study is Stimulated Electronic X-ray Raman Scattering. This method allows for non-linear all x-ray spectroscopy to explore electronic and vibrational excitations in solids, liquids, gases and interfaces. The stimulation of the process is essential for detecting the scattered radiation since the spontaneous scattering cross section is extremely low. I will present first calculations along with experimental data for stimulated x-ray Raman scattering in neon [2]. The analysis shows that the stimulated scattering signal is amplified by several orders of magnitude compared to the spontaneous signal. This might make single shot scattering experiments feasible at present XFEL sources. Despite the incoherent spectral properties of XFELs, high resolution of the scattering process can be obtained with statistical methods such as covariance mapping [3].



[1] N. Rohringer et al., Nature 481, 488 (2012).

[2] C. Weninger, M. Purvis, D. Ryan, R. A. London, J. D. Bozek, C. Bostedt, A. Graf, G. Brown, J. J. Rocca and N. Rohringer. Submitted (2013)

[3] L. J. Frasinski, K. Codling, P.A. Hatherly. Science 246 , 1029 (1989).

Host: Nina Rohringer – MPG-ASG