have still not been experimentally demonstrated yet.

In this paper we report an experimental study of effects of the linewidths of the coupling field and the probe field on the EIT in a three-level A-type atomic system of rubidium. This A-type three-level system consists of Rb\(^{87}\) atoms in a Doppler-broadened vapor cell. The two hyperfine levels \(F_2 = 1\) and \(F_2 = 2\), spaced by 6.8 GHz, of the ground state \(5S_{1/2}\), serve as the two lower states of the lambda system. The excited state \(5P_{1/2}, F_2 = 1\) is 814 MHz away, outside the Doppler-broadening linewidth and its effect can be neglected. The coupling field is provided by a diode laser (output power of about 30 mW) with a free running linewidth of about 5 MHz in few ms time scale when operating under current stabilization and temperature stabilization. The probe field is also provided by a diode laser (few \(\mu\)W power) with a linewidth of about 5 MHz in free-running current stabilization and temperature stabilization. The coupling laser beam and the probe laser beam copropagate through the vapor cell to achieve the two-photon Doppler-free condition. By using a random noise generator, we were able to increase the linewidth of either the coupling field or the probe field from 5 MHz to above 100 MHz continuously. In the first experiment, the linewidth of the probe field was kept at the same (about 5 MHz) while the linewidth of the coupling field was increased from 5 MHz to be more than 100 MHz. As the linewidth of the coupling field increases, the absorption reduction at the line center reduces rapidly depending on the strength of the coupling Rabi frequency. We measured the dependence of the EIT on the coupling Rabi frequency and on the linewidth of the coupling laser. Detailed experimental studies were made and the experimental results were compared with theoretical predictions. In the second experiment, we kept the linewidth of the coupling field unchanged (about 5 MHz) and varied the linewidth of the probe laser. As the linewidth increases, only the central part of the frequency components of the probe field passes through the medium as a result of EIT and the frequency components that are out of the EIT window are absorbed. This effect is related to the frequency matching between the coupling field and the probe field and has implication in the noise correlation between the coupling field and the probe field through the atomic coherence effect in multilevel atomic system. Detailed study of this experiment and comparison with theoretical calculation will be given and possible applications of these frequency filtering effect will be discussed.

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5. B. Liu, W. H. Burnett, M. Xiao, to be published.

**High Field Interactions**

Louis B. DaSilva, Lawrence Livermore National Laboratory, President

**TUcC** 9:00 am–10:00 am

**Room 341**

**Observation of electron positron pair production and nonlinear Compton scattering in laser-electron interactions**


We report the observation of the production of electron positron pairs and evidence for nonlinear Compton scattering in the interaction of a high intensity (\(10^{19}\) W/cm\(^2\)) laser pulse with an ultra-relativistic (50 GeV) electron beam.

**TUc2** 9:30 am

**Relativistic laser-plasma interaction above \(10^{19}\) W/cm\(^2\) by 2D and 3D PIC simulations: Single channel, hole piercing, MeV electrons, 100 MG magnetic fields**

Alexander Pukhov, Jürgen Meyer-ter-Vehn, Max-Planck-Institute for Quantum Optics, Garching, Germany

We present, we believe, the first fully explicit three-dimensional (3D) particle-in-cell (PIC) simulations of ultrashort, high-intensity, laser-pulse interaction with slightly underdense plasmas. We show that relativistic filamentation and self-focusing is accompanied by acceleration of background electrons to multi-MeV energies in the forward direction. The relativistic electrons are pinched by self-generated 100 MGauss magnetic fields and channel light into a single filament 1–2 wavelengths wide. This superchannel contains most of the incident laser power. Recent experiments at the Rutherford Appleton Laboratory (M. Borghesi et al) confirm the PIC simulations. We also simulate a ponderomotive trapping of overdense plasma layers by ultraintense laser pulses in 2D slab geometry. We show that the relativistic electrons propagate deeply in the overdense plasma in the form of magnetically collimated jets. These are key issues for the Fast Ignitor concept in Inertial Confinement Fusion (ICF). The direct fully electromagnetic 3D PIC simulations of actual short pulse laser-plasma experiments are based on the code VLPL (Virtual Laser Plasma Laboratory) developed at MPQ Garching. Being designed for massively parallel processing (MPP) computers like CRAY-T3E, the code VLPL exists in 2D and 3D versions, is highly portable, and can be run on high-performance work stations as well.