INTERNATIONAL JOURNAL OF HIGH-ENERGY PHYSICS

CERN COURIER

VOLUME 46 NUMBER 9 NOVEMBER 2006

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BROOKHAVEN

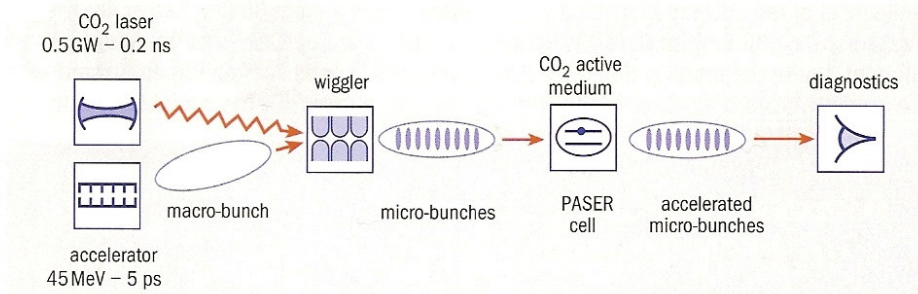
Researchers unveil the PASER: a novel acceleration scheme

Researchers from the Technion – Israel Institute of Technology have used the Accelerator Test Facility (ATF) at the US Department of Energy's Brookhaven National Laboratory to demonstrate the feasibility of particle acceleration by stimulated emission of radiation (PASER). This is in effect a particle analogue of the laser process.

Levi Schächter at Technion initially demonstrated theoretically the concept behind PASER. Its essence relies on the possibility of transferring energy stored in an active medium (with excited atoms) directly to electrons interacting with the medium, and thereby increasing their energy.

In lasers, photons traversing an active medium stimulate the atoms via collisions so that the atoms give up their excess energy as additional photons forming a coherent beam. In PASER, the atoms in the active medium transfer their energy directly to an electron beam in a coherent way.

To reach significant acceleration in a PASER, a macro-bunch of electrons injected into the PASER cavity should be modulated, forming a train of micro-bunches with a periodicity identical to the resonance frequency of the medium. In other words, coherent collisions of the second kind between the electrons in the train and the excited molecules should occur.



The PASER set-up. Electrons (macro-bunch) from a linear accelerator are modulated into a train of micro-bunches by interacting with a CO_2 laser in a wiggler. This train then gains energy through its interaction with the excited molecules of CO_2 in the PASER cell.

In the proof-of-principle experiment by Samer Banna, Valery Berezovsky and Schächter, electrons in a macro-bunch with an energy of 45 MeV were modulated by their interaction with a high-power CO_2 laser in a wiggler, to make a train consisting of about 150 micro-bunches, each several femtoseconds long. About 15% of the electrons in the train collected at the spectrometer at the end of the PASER cavity had absorbed energy stored in the cavity, increasing the total kinetic energy of the macro-bunch by about 0.15%.

Accelerating electrons in this way provides new opportunities as the effective quality factor of such a cavity may become comparable to that of macroscopic superconducting cavities. In particular it will be a challenge to try to use this technique to generate ultra-low-emittance beams.

Further reading

S Banna *et al.* 2006 *Phys. Rev. Lett.* **97** 134801.

S Banna *et al. Phys. Rev. E*, in press.

LHC NEWS

LHC prepares for cooling while magnets pass the 1000 mark

The first cryogenic feedbox designed to supply electricity to the superconducting magnets for one of eight arcs has been installed at Point 8 of the Large Hadron Collider (LHC). This milestone is the precursor to the cool-down of sector 7-8, scheduled for the coming months. Researchers will position a total of 16 such feedboxes at either end of the eight arcs, forming the ends of the continuous sections of cryostat. Each one weighs 12.7 t, is 10 m long and must withstand a pressure of 0.25 MPa.

Power leads, the lower extremities of which are immersed in liquid helium, bring the electrical power from room temperature to cryogenic temperature. Helium gas actively cools them and is injected at their base at 20 K and comes out at room temperature at the top. The power leads use ceramic high-temperature superconductor to limit the heat loads – the first time that these materials have been used on this scale.

Now that the first of the large feedboxes is in, sector 7-8 is preparing to cool down.

The 1000th cryomagnet during installation in the LHC tunnel on 5 September.

The power supply to the LHC's straight sections requires smaller electrical feedboxes. There will be 44 feedboxes around the LHC ring, equipped with 1200 current leads carrying 120–13 000 A.

Meanwhile, on 5 September the 1000th cryomagnet (superconducting magnet system) was installed between Point 3 and Point 4. During the same week, the final cryomagnet for sector 8-1 was also installed. There are 1746 cryomagnets, of which 1232 are the famous dipoles (*CERN Courier* October 2006 p28).