

Particle Acceleration by Stimulated Emission of Radiation (PASER)



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1. Motivation

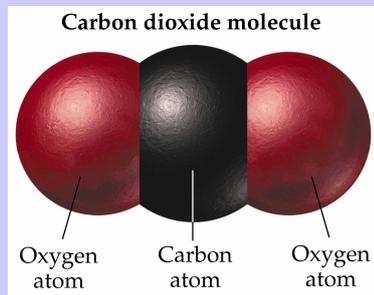
Nowadays, electrons are accelerated to high energies by their passage through cavities that store electromagnetic energy. Each cavity is of a few cm's length containing about 5×10^{24} photons.



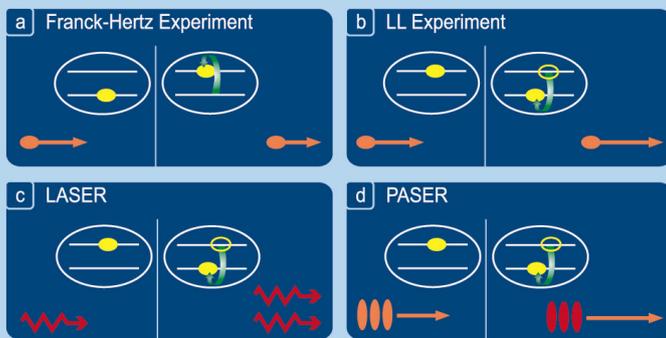
400 cells, each of 1cm long

Question:

can we accelerate electrons using energy stored in individual atoms or molecules?

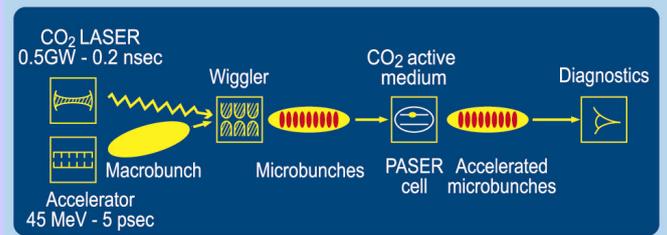


2. Historical Context



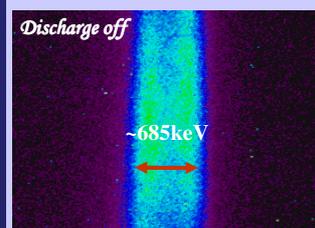
- Franck-Hertz Exp.:** Energy transferred from a free electron to a bound electron – deceleration.
- LL Exp.:** Inverse Franck-Hertz – acceleration.
- LASER:** Multiple collisions of a wave with atoms.
- PASER:** Inverse LASER, coherent collisions of the 2nd kind – acceleration.

3. Experimental Setup

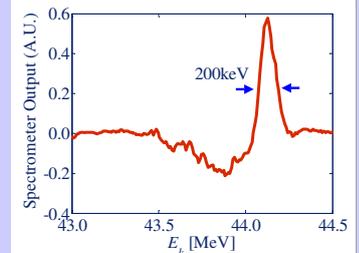
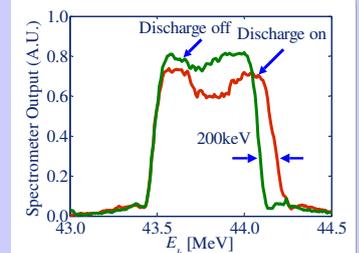
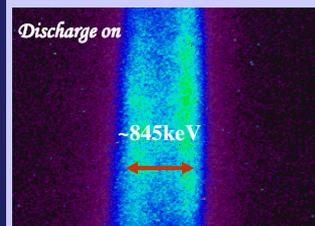


- 45MeV-5psec electron beam is modulated in a wiggler by interacting with 0.5GW-200psec CO₂ laser pulse.
- The bunch enters an active medium – its resonant frequency is identical to that of the train of micro bunches.
- The bunch is monitored both when the discharge circuit is on and when it is off.

4. Experimental Results



increasing energy



200keV energy gain

~2,000,000 collisions of the second kind between the acc. electron and the excited molecules of the CO₂ mixture