Matter-antimatter gigaelectron volt gamma ray laser rocket propulsion

F. Winterberg 2012

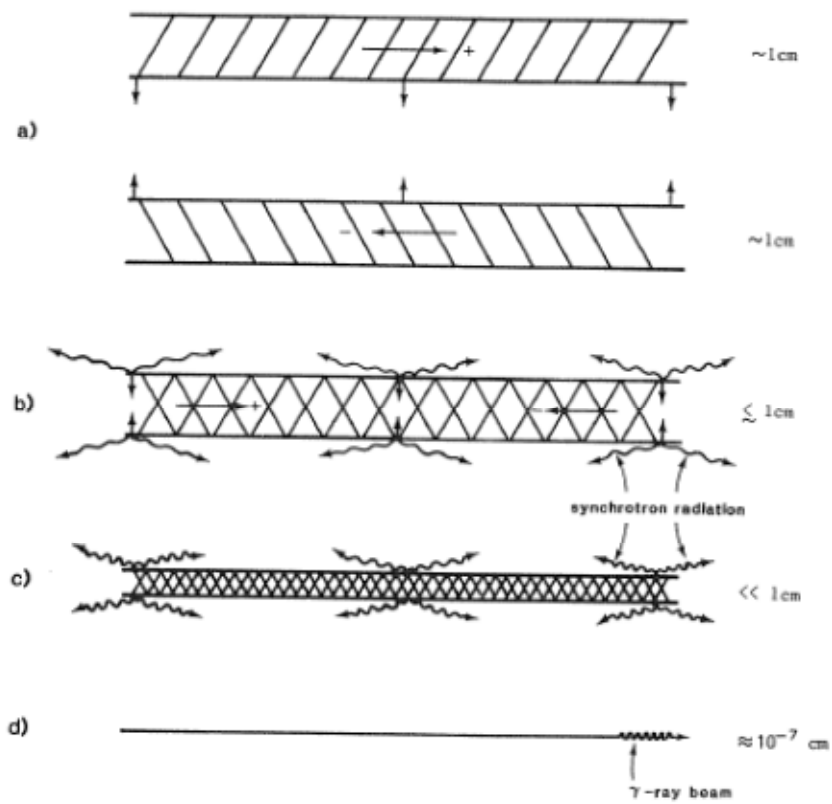

Figure 1: Coalescence and radiative collapse of two counterstreaming relativistic electron and positron beams to form an electron-positron gamma ray laser with a high inversion density.
(F. Winterberg, Phys. Rev. A **19**, 1356 (1979))

1. Electron-positron ambiplasma pinch is stable for relativistic electron and positron energies.

2. With the plasma frequency ω_p equal to the electron and positron radial oscillation frequency ω, the plasma is transparent for every radius of the pinch discharge channel.

3. Hence, for $\frac{dE}{dt}(radiation\ loss) > \frac{dE}{dt}(Coulomb\ collision\ gain)$, a condition which can be met for $\gamma \gg 1$, the pinch discharge radiatively collapses down to a radius r_{min} given by Heisenberg's uncertainty principle,

$$\gamma m r_{min} c = \hbar \qquad\qquad (\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}})$$

thereby reaching nuclear densities in the pinch discharge.

4. With the electron-positron annihilation cross section

$$\sigma = \frac{\sigma_0}{\gamma^2}, \qquad \sigma_0 = r_0^2, \qquad r_0 = \frac{e^2}{mc^2}$$

the ambiplasma has a sufficiently long lifetime.

Four electron and positron rings are now being proposed to form a GeV proton-antiproton laser:

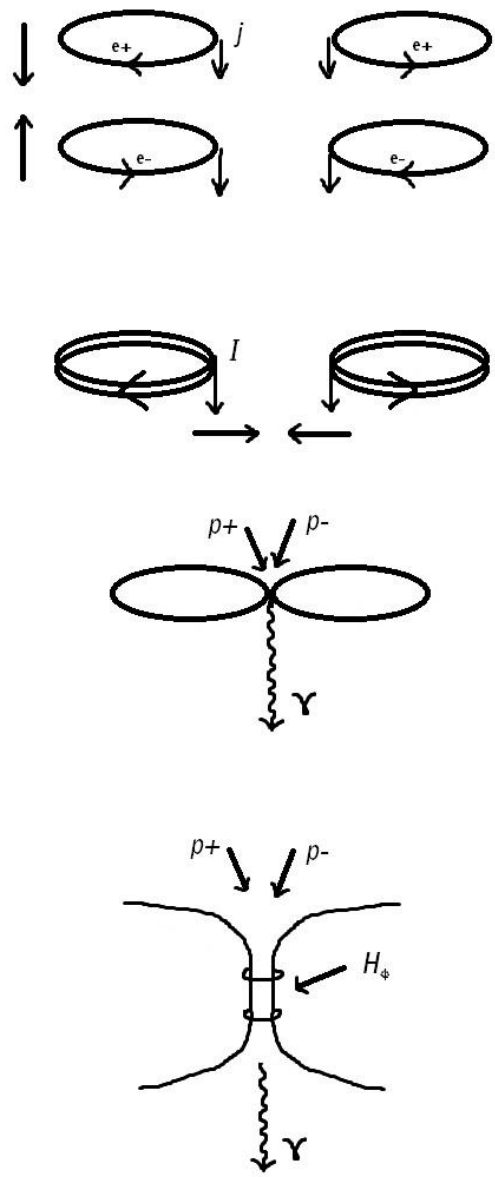

Figure 2

5. Cold hydrogen and antihydrogen injected into the collapsing electron-positron plasma remain cold long enough to form an upper proton-antiproton GeV laser level for the launching of a proton-antiproton GeV laser avalanche with the recoil transmitted to return current conductor by the Mössbauer effect.

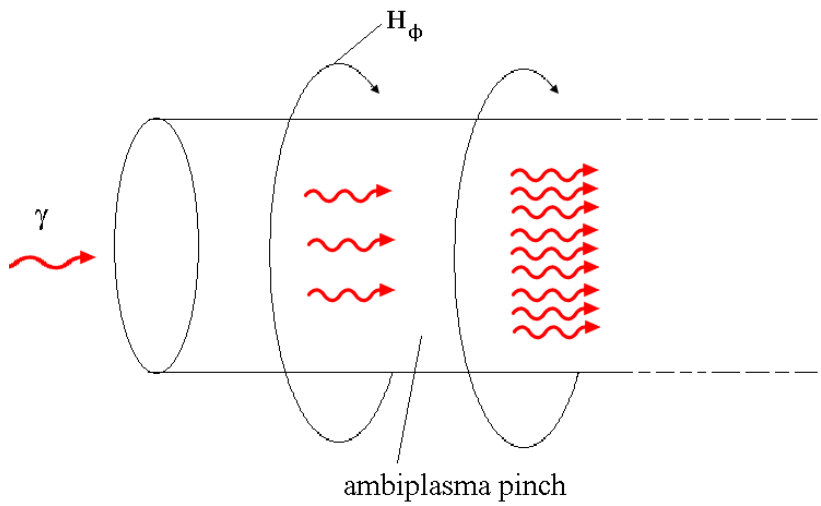

Figure 3: Ambiplasma pinch with laser avalanche

6. For the realization of this configuration, we start from two positron and two electron rings made in two ring accelerators, obtaining two electron-positron ambiplasma rings by their coalescence (see figure). Furthermore, when these two rings intersect, as shown in the figure, they form a linear segment of a hydrogen-antihydrogen ambiplasma, from which the GeV laser avalanche is launched.

7. The GeV laser beam can be used for rocket propulsion to reach relativistic spacecraft velocities, and at the same time it can make a tunnel through the cosmic dust by periodically and for a short time directing the laser beam into the opposite direction from the direction for propulsion.

8. The antihydrogen can be produced in robotic factories in the vacuum on the surface of the planet Mercury, obtaining their energy from huge solar collectors.

For details, see Acta Astronautica **81** (2012) 34-39, “Matter-antimatter gigaelectron volt gamma ray laser rocket propulsion,” by F. Winterberg.

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