

A conception of the beam dump for the photon collideres

Valery Telnov
INP, Novosibirsk

(with L.Shekhtman)

ECFA workshop, Montpellier, November 13-16, 2003

Parameters of beams

Energy of electrons: $(0.02 - 1)E_0$; energy of photons $(0 - 1)E_0$.

Power: ~ 10 MW, 50 % electrons, 50 % photons.

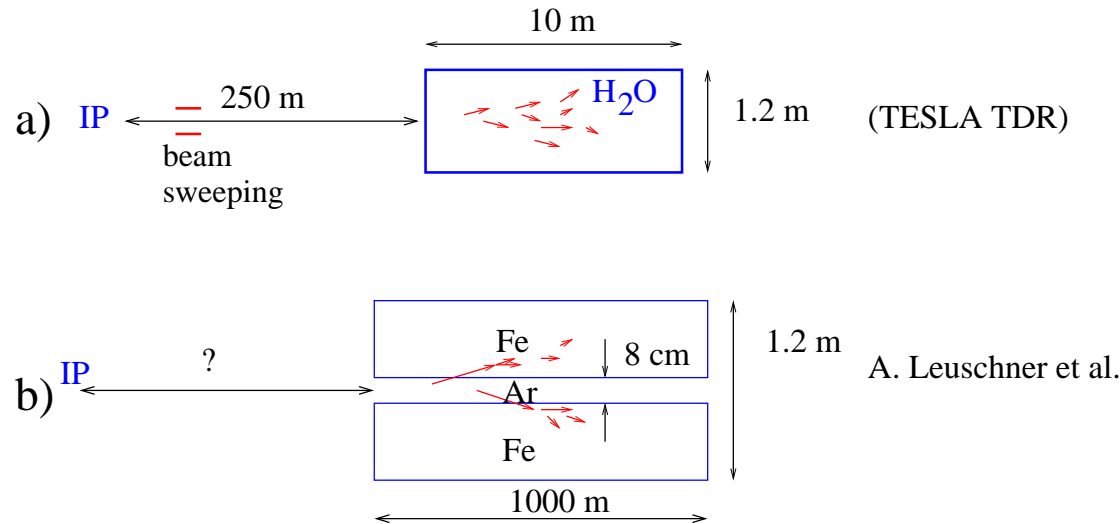
Beam diameter at the distance 100 m without beam collisions:
 $\sigma_x \sim 2 - 5$ mm, $\sigma_y \sim 1$ mm, determined by the electron beam emittancies.

Beam diameter at the distance 100 m with beam collisions(at $E_0 = 100$ GeV): $\sigma_x \sim \sigma_y \sim 35$ cm for 90%, and about 50 cm for 99%. Sizes are determined by repulsion of disrupted electron beams.

Problems

- The transverse size of the **electron** beam without disruption at the beam dump is **very small**, it can cause local overheating. Same problem for e^+e^- mode.
- The transverse size of the **photon** beam (photons after the Compton scattering) is **very small**, it can cause local overheating.
- Exit aperture for the disrupted beams at photon collider is large, **backward neutrons from the beam dump** can damage the vertex detector.
- Radiation problems, Tritium, etc, are very important, similar to e^+e^- .

Existing approaches



In the first scheme the problem of boiling water after hitting of the electron bunch train to the dump is solved by sweeping the beam during the bunch train by the deflector. The heat is removed from the beam dump by flowing of water in the transverse direction.

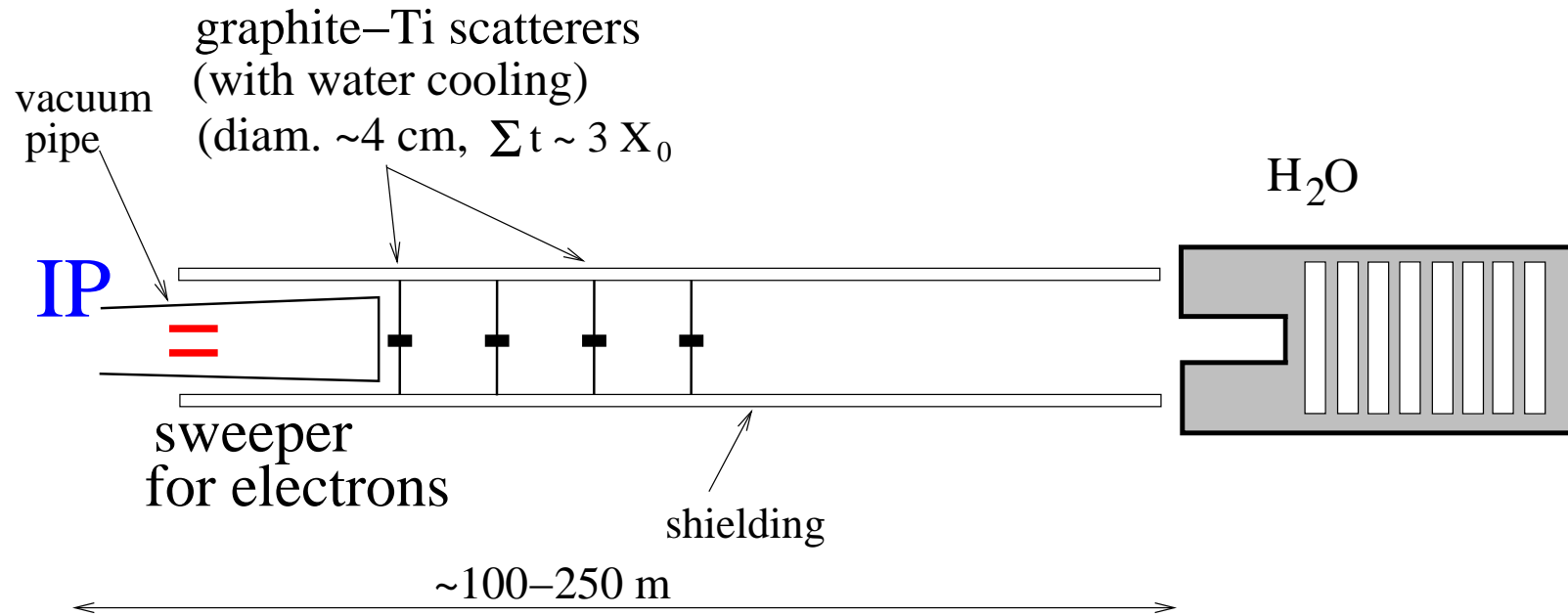
The main idea of the second scheme is the scattering of electrons on the noble gas Ar, but absorption of the energy in Fe, this solves Tritium problem. It was claimed that this scheme is suitable for the photon collider.

Problems

the scheme a): can not dump the narrow photon beam; neutron flux is larger than desired.

the scheme b) does not work for the beam with the large diameter. But even for narrow beams it is not good because the shower is developed at the Fe surface and neutrons can freely travel in the backward direction.

Possible scheme for the photon collider



Comments:

sweepers spread the electron beam;

scatterers spread the photon beam;

The important difference between the photon and electron beams: the photon beam is always on the the axis, the electron beam can be deflected by the opposing beam on about 2 mrad (20 cm at 100 m). The thermal conductivity of solid scatterers (C,Ti) is not sufficient for removal of the heat to outer (large) radius, one should use water pipes surrounding the central photon scatterer, but if the undisrupted electron beam hits the water it will boil, therefore the electron beam should be swept before crossing the scatterers planes.

The number of scatterers is about 15, to avoid boiling of water the r.m.s. size of the beam should be about 1.5-2 cm. By increasing the IP-dump distance one can avoid the scatterers, but the outer diameter of the disrupted beam becomes too large.

The water dump contains empty Ti boxes in order to increase the transverse size of the neutron source and absorb backscattered neutrons by the collimator. It helps without the scatterers, but not checked with the scatterers.

The scheme needs a detailed consideration and optimization.