A conception of the beam dump for the photon collider

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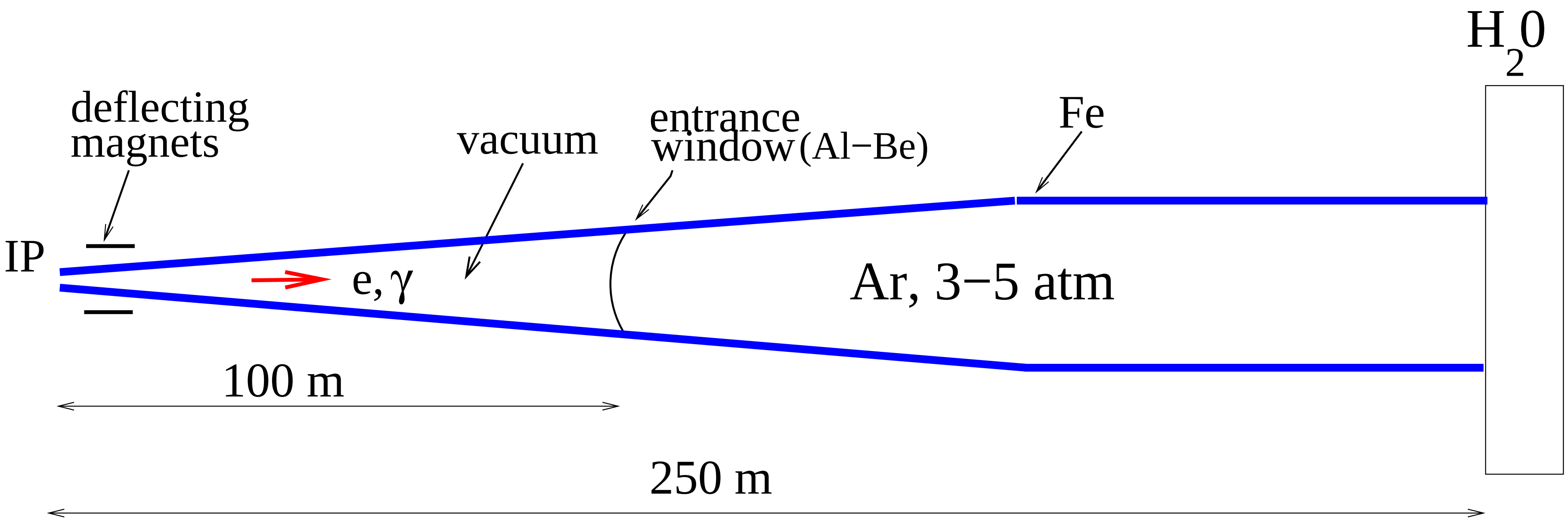
The beam dump at LC

The beam dump at the linear collider TESLA suggested for the e^+e^- interaction region consists of the deflecting magnets (deflect bunches inside one train) and the water vessel at the distance 250 m from the interaction point. However it does not suit for the photon collider because the photon beam is neutral.

Characteristic beam parameters: $N = 2 \cdot 10^{10}$, the number of bunches in one train 2820, $\Delta t = 337$ nsec, $\nu = 5$ Hz, the angular divergence $\sigma_{\theta_x} \sim 3 \cdot 10^{-5}$, $\sigma_{\theta_y} \sim 10^{-5}$. The beam is mixed, about half of the energy is carried by electrons and half by photons.

Below we present a scheme of the beam dump for the TESLA-like collider.

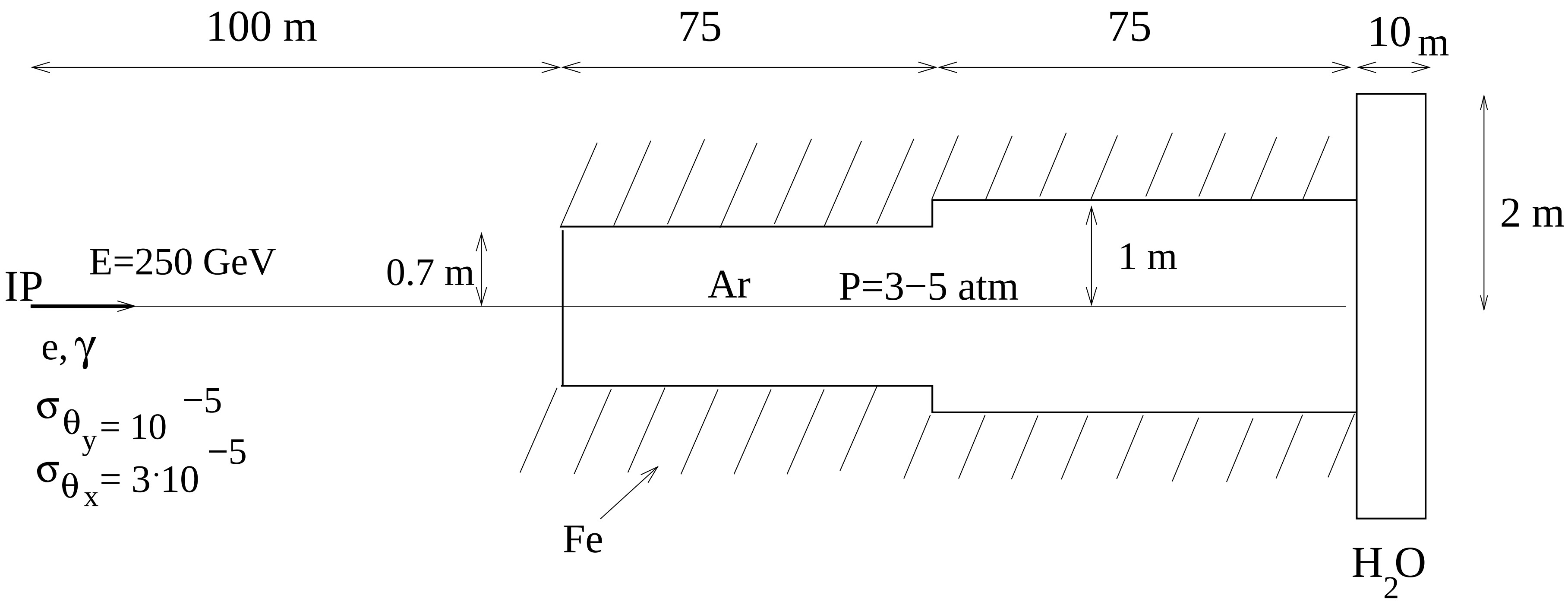
The beam dump for TESLA



The deflecting magnets rotate the electron beam (R=0.5-1cm at 100 m) in order to reduce local temperature at the entrance window. THe energy deposition by photons in the entrance window is small.

A gas volume (Ar at P=3-5 atm) of 4-5 X_0 rad. length thickness serves for conversion of photons and broadening of the shower before the water dump.

The scheme used in the simulation



Simulation results

Maximum local ΔT in the water dump after passage of the train from 250 GeV photons is 75, 50, 25° at 3, 4, 5 atm Ar, respectively and by a factor of 2 lower from electrons.

Maximum local ΔT at the exit Be-Ar (may be other material) window is small, $\sim 10^\circ$.

The maximum ΔT at the entrance Be-Al window is about 40° for $\sigma_{\theta_x} = 3 \times 10^{-5}, \sigma_{\theta_y} = 10^{-5}$ and R=0.5 cm (sweeping radius). For the removal of the heat the thermal conductivity is sufficient (gas cooling can be added if necessary).

Note, the problem of the stress in solid materials in cold-LC beam dump is not important because the train duration is much longer than the decay time of local stress ($r/v_{sound} \sim 1\ \mu s$). It is more serious for warm-LC with short train.

Neutron background at the IP

For 10^5 incident 250 GeV electrons and $P_{Ar} = 4$ atm there are 6 neutrons at the IP plain $z = 0$ with the radial coordinates $r = 1.5$, 2.5, 4.5, 14.5, 18.5 21.5 m. Due to the collimation by the Fe tube we do not expect the uniform density, the density per cm^2 should be larger near the axis. Assuming the uniform density for three neutrons closest to the axis we find the flux $5 \cdot 10^{-11}$ n/cm^2 per incident electron or about $1.5 \cdot 10^{11}$ n/cm^2 for 10^7 sec run time.

For comparison just the water dump at the distance 100 m gives 3×10^{11} n/cm^2 for the same time (quite similar).

It is remarkable that after the replacement of the first 20 m of Ar by H_2 at the same pressure there is only one neutron at $r = 1.5$ m for $8 \cdot 10^5$ incident electrons. With account of collimation by the tube it means the decrease of the neutron flux at least by a factor of ten!

Conclusions

The proposed scheme of the beam dump looks very attractive and can be used for all LC modes of operation.