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A CONCEPTION OF THE PHOTON COLLIDER BEAM DUMP

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Photon beams at photon colliders are very narrow, powerful and can not be deflected. For the beam dump at the TESLA-like collider we suggest to use a long gas (Ar) spoiler in front of the water absorber, this solves the overheating and mechanical stress problems. The neutron background at the interaction point is estimated.

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. [1] 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.

Our scheme of the beam dump for the photon collider is depicted in Fig.1. In addition to the TESLA TDR solution we added the beam spoiler of 4–5 radiation length thickness, the cheapest solution is Ar at the pressure 3–5 atm ($X_{Ar} = 110$ m at P=1 atm). The deflecting (rotating) magnets are needed to decrease the stress in the entrance Al-Be window situated at the distance 100 m from the IP. The circle radius of $R = 0.5$–1 cm is sufficient. The thickness of the entrance window is small, therefore the density of electrons from the pair production by the narrow photon beam in the entrance window is acceptable. In the gas, photons and electrons produce showers and due to the multiple scattering the density of particle at the exit window of the gas vessel and entrance window of the water beam dump is also acceptable. A third critical place is the most dense point in the shower situated in the water beam dump between the entrance window and the shower maximum. In the chosen scheme the rise of the water temperature at this point is also acceptable.

The simulation using FLUKA code was done for the geometry shown in Fig.2. Some preliminary results are the following. The maximum ΔT at the entrance Be-Al window is about 40° for R=0.5 cm (sweeping radius). For the removal of the heat the thermal conductivity is sufficient, the gas cooling can be added, if necessary. The maximum local ΔT at the exit Be-Al window is small, about 10°. The maximum local ΔT in the water dump after passage of the train from 250 GeV photons is 75, 50, 25° at the Ar pressure 3, 4, 5 atm,

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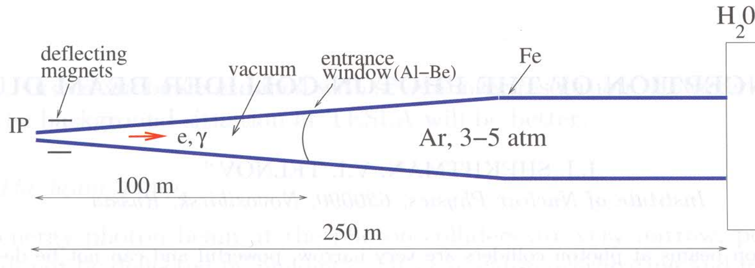

Figure 1: The scheme of the beam dump for TESLA.

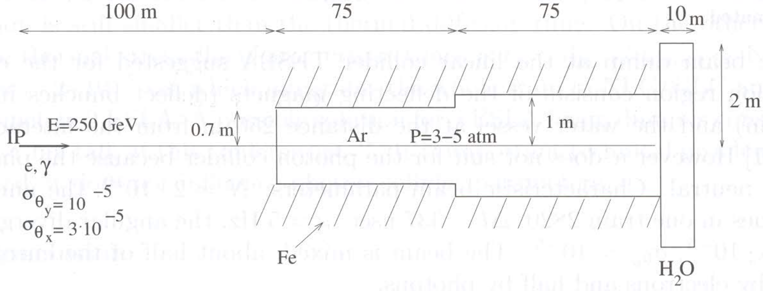

Figure 2: The scheme used in the simulation.

respectively, and by a factor of 2 lower for incident electrons.

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

The simulation gives also an estimate of the neutron flux at 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.

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!

References

1. B. Badelek et al, *TESLA Technical Design Report, Part VI, Ch.1 Photon collider at TESLA*, DESY 2001-011, ECFA 2001-209, hep-ex/0108012.