Pramana — journal of physics Vol. xx, No. x
xxxxx 2007
pp. 1–4

Gamma gamma technology group

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Abstract. The results presented at this conference in the $\gamma\gamma$ technology group are described.

Keywords. Laser cavity; photon linear collider; compton scattering; emmittance; beam dump.

PACS Nos

1. Introduction

This report briefly describes the results presented at this conference on work to develop the technology required to build the proposed gamma gamma option, also known as the photon linear collider (PLC) [1]. Before describing the work presented at this conference I would like to put it in context. At the International Workshop on High Energy Photon Linear Colliders, 5–8 September 2005, Kazimierz Dolny, Poland, the first meeting of the Gamma Gamma Planners Group was held, chaired by David Miller. The purpose of the meeting was to form a group of people who would work on studying the technical aspects of the photon linear collider. Various tasks were assigned, for example, A F Zarnecki agreed to look at the crossing angle and I agreed to study beam monitoring and feedback issues. A meeting was planned for October 2005 to study issues around the laser cavity design. Unfortunately one month after this David Miller suffered a major stroke which disrupted our efforts considerably. The organisation of the Laser Cavity meeting was taken over by myself and was postponed to January 10th 2006. I presented the outcome of this meeting at this conference [2]. I am happy to report that David continues to make a steady recovery and we look forward to seeing him again at future meetings.

2. Laser cavity

Klemz, Moenig and Will [3] have worked out a detailed design proposal for the laser cavity for use at the PLC. An overview of the layout is shown in figure 1. A number of people have provided written comments on the design, and a meeting was held in January 2006 to draw these people together, together with experts from outside the accelerator community to discuss the feasibility of the proposed design [2]. It

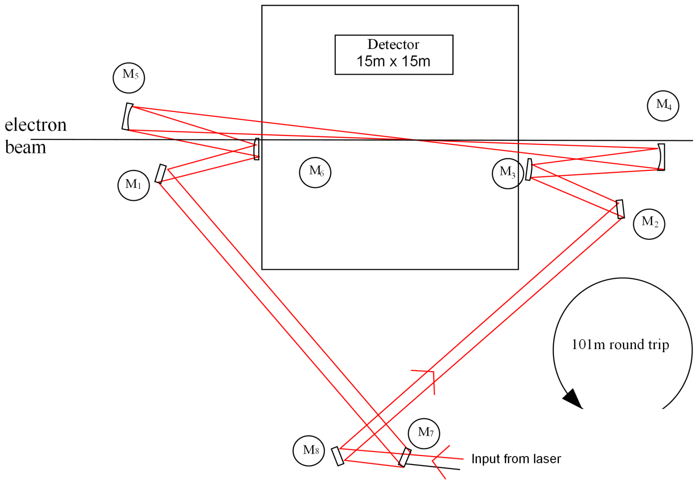

Figure 1. Proposed design for the laser cavity.

was very successful and helped to clarify what further studies need to be done, as well as emphasising the usefulness of making these contacts with laser and optics experts from other communities.

3. Compton-based polarized positrons source for ILC

Another community with whom we hope to have fruitful collaboration are those people working on laser cavity for use in a polarized positron source. At this meeting we heard about such activity from Roychowdhury [4], on behalf of V Yakmenko, D Cline, I V Pogorelsky, and V.N.Litvinenko. They propose a polarized positron source based on Compton backscattering inside an optical cavity fed by a CO_2 laser beam focused on a 6 GeV e^- beam produced by a Linac. The proposal utilizes commercially available units for the laser and accelerator systems. It requires a high power picosecond CO_2 laser mode of operation developed at ATF. A three year laser R&D program is needed to verify the laser operation in this non standard regime.

4. Simulation of background using CAIN

Zarnecki [5] described his studies of the background at a PLC using CAIN. He studied whether backgrounds using the 20 mrad crossing angle option were acceptable by looking at the energy deposited at the face of the final dipole, 4.5 m from

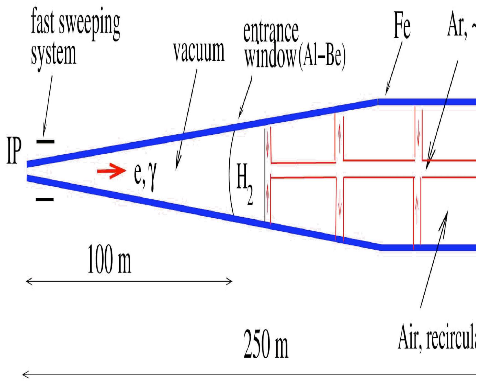

Figure 2. Proposed design for beam dump.

the interaction point. A large number of low-energy electrons are produced in the collision which are strongly deflected by the opposing beams and the detector magnetic field. An outgoing beam opening of at least 12 mrad is needed to avoid power dissipation greater than 10 W. A new design has been proposed for the dipole which reduces its outer radius to 39 mm, combining this with an elliptical beam pipe for removing the spent beams which results in acceptable background levels for a 20 mrad crossing angle.

5. Damping ring

Telnov [6] described how the damping rings might be modified to obtain smaller emittances and thus higher luminosity at the PLC. The luminostiy of the ILC is limited by beam–beam interactions and so there is no advantage in making the beams smaller than the current design. These effects are absent when one or both beams has been converted to a photon beam, so there is a large potential gain in reducing the electron beam size. The minimum size of the beam is determined by the emittances and it might be possible to reduce these by adding more wigglers into the damping ring. This proposal needs input from damping ring experts so that the baseline configuration does not exclude this upgrade option.

6. Beam dump

A possible scheme of the beam dump for the photon collider was presented by Telnov. Having put in great efforts to produce an intense beam of high energy photons it is then a challenge to dispose them off. In the design proposed here (figure 2 the long argon gas target ensures that the photon beam produces a shower so that its density at the beam dump becomes acceptable. Approximately 10% of the electrons from the original beam are not converted into photons, and they also produce a very narrow beam. However in this case the density can be reduced by a fast sweeping system. As a result, the thermal load is acceptable everywhere in the beam dump. A volume containing hydrogen is positioned in front of the gas converter in order to reduce flux of backward neutrons from the dump. According to a simulation gives the flux is reduced by at least a factor of 10. In order to reduce the angular spread of the disrupted low energy electrons, some focusing after the exit from the detector is also necessary. This design now needs to undergo a detailed technical analysis.

7. Future directions

A F Zarnkecki has made a good start on background studies, V.Telnov has proposed a possible beam dump design and a start has been made on checking the feasibility of the laser cavity. Future plan is to arrange for BDSIM to be able to take the output from CAIN to enable studies of detector backgrounds, beam dumps and feedback systems to be pursued. In fact, since progress has already been made in this direction, we will also pursue the possiblity of simulating the dynamics of the laser cavity to test its feasibility.

8. Final thoughts

A quick look at the agenda of this conference reveals that 25% of the ILC-related physics talks related to the gamma gamma option. However there was no mention of the gamma gamma option in the detector concepts or DCR talks. Clearly the design of the baseline accelerator needs to take into account all the possible upgrade options. The gamma gamma community are concerned that in the rush to prepare for the e^+e^- machine, allowance is not being made for a future upgrade of the photon linear collider.

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