

The Photon Collider in the LC project

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To: International Steering Committee on Linear Colliders

CC: Worldwide Study Organizing Committee

From: Conveners of the Photon Collider working groups

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Subject: The Photon Collider in the LC project

Dear colleagues,

As you know the photon collider ($\gamma\gamma, \gamma e$) is considered as an option at LC. This means that it is not the first priority but we are going to foresee the possibility to conduct such experiments at one of the interaction regions several years after beginning of the LC operation. In this letter we would like to remind you that **in order to have the photon collider in future it should be planned from the very beginning and its specific requirements should be taken into account in designs of practically all LC systems and one of detectors.** This is mentioned also in the document "Understanding matter: ...the case for the Linear Collider" signed by 2695 LC supporters: "...two collision points could allow the optimization of the detectors for different studies. For example the conditions around the $\gamma\gamma$ collision point are different than those at the e^+e^- interaction region and suggest differences in detectors."

Below we give a short list of these specific requirements and suggest how to proceed.

Special requirements for photon colliders:

- for removal of the disrupted beams **the crossing angle** at one of the interaction regions should be about 30 mrad (the exact number depends on the final quad design);
- the $\gamma\gamma$ luminosity is almost proportional to the geometric ee luminosity, therefore the product of **horizontal and vertical emittances should be as small as possible** (requirements to damping rings and beam transport lines);
- the final focus system should provide a **spot size at the interaction point as small as possible** (the horizontal β -functions can be smaller by one order of magnitude than that in the e^+e^- case);

- the beam dump should withstand absorption of narrow photon beams and follow a straight line from the interaction point (deflectors are not possible);
- the detector design should allow replacement of elements in the forward region (≤ 100 mrad), including the vacuum pipe and the vertex detector;
- a space is needed for laser beam lines and housing.

We suggest that the second interaction region should be designed and optimized for the photon collider from the very beginning. In this case it will be good for all LC modes. May be the crossing angle is somewhat larger than the optimum one for e^+e^- but this is unavoidable. For full compatibility the final focus system should be tunable in the full range of possible horizontal β functions. The detector for this interaction region should be designed as the detector for all modes of operation allowing rather easy transition between modes.

It is very natural that the people working on the photon collider are members of the “second” detector collaboration, participate in initial e^+e^- and then in $\gamma\gamma, \gamma e$ experiments and carry responsibility on the development of the photon collider physics program and specific photon collider elements (incl. the laser system). They also keep contact with the designers of the LC systems important for the photon collider performance.

Development of the laser system needs a special attention. The laser scheme depends on the choice of the LC technology, but certainly this is a state-of-art laser system which can be built only with participation of leading laser laboratories. This needs intellectual efforts, money and sufficient time.

The photon collider will add significant extra physics value to the LC programme for small additional cost on the scale of the whole project. It is important to make design decisions in the baseline project which are not prohibitive or unnecessarily difficult for the photon collider, allow to reach its ultimate performance and rather easy transition between modes.

Taking into account organization aspects and cost optimization it would be rational to develop the photon collider as an inherent part of the whole LC project.

We hope that our remarks and suggestions will be taken into account in the further plans for the linear collider.

On behalf of the photon collider community,
Worldwide Study contact persons and conveners

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