Minutes of the 1st "ILC-CLIC e+ studies" meeting

Date: February 5th 17:00(JST)  9:00 (CET), 2009

A part of Attendees (whom Omori was able to hear the voices):
Louis(CERN), Vivoli(CERN), Variola (LAL), Dadoun(LAL),
Eugene(NSC-KIPT), Andreas(DESY), Sabine(DESY), Andy(CI),
Andriy(), Gudi(Durham), Clarke(CI), Stefan(),
Kuriki(Hiroshima), Takahashi(Hiroshima), Kamitani(KEK),
Urakawa(KEK), and Omori(KEK)

Agenda:

1. ILC-CLIC e+ studies : Louis-san
2. Update of Low E e- driven source : Kuriki-san
3. Optimal Compton Ring : Eugene-san

Presentations:

http://www-jlc.kek.jp/~omori/ILC-CLIC-e+Studies/20090205/
20090205-Louis_ILC_CLIC_meeting_1.pdf

http://www-jlc.kek.jp/~omori/ILC-CLIC-e+Studies/20090205/
20090205-Kuriki_LowE_Conv.pdf

http://www-jlc.kek.jp/~omori/ILC-CLIC-e+Studies/20090205/
20090205-Eugene_optRing.pdf

1. ILC-CLIC e+ studies:

   Louis-san described the background/motivation/aim of
   this new meeting "ILC-CLIC e+ studies".

   Please see "20090205-Louis_ILC_CLIC_meeting_1.pdf"

   (a) ILC-CLIC e+ generation working group:

       A new ILC/CLIC working group called "e+ generation"
       has been officially set-up at University of Illinois
       Chicago - UIC during ILC08 workshop: 15th - 20th
       November 2008.

   (b) Mandate of the working group:

       The ILC study considers the Undulator option as the base
       line while the Compton schemes are alternative options.
       The CLIC study considers the Compton schemes as the base
       line while the Undulator is an alternative option.

Additionally, both projects are interested in the development of conventional sources (ILC as an auxiliary source and CLIC as an alternative baseline).

The working group should:

* Develop the synergy between the ILC and CLIC $e^+$ studies.

* Evaluate the common technical issues related to both options for the production of polarized positrons.

* Prioritize R&D.

* Consider other alternatives such as ERL, Linac-Compton and conventional sources.

* Review the existing technical and tests facilities where further tests could be performed.

* Evaluate where cost savings could be obtained.

* Promote common meetings and workshops.

(c) Test facilities (Alphabetic order):

* BINP: Li lens, liquid Li and Pb targets
* CERN: NA63 experiment
* CesrTA: Li lens for positron beam
* Cockcroft Institute (Daresbury): Positron target tests
* KEK: ATF and KEKB e+ source
* LAL: Optical cavity

(d) List of institutes (Alphabetic order):

ANL, BINP, BNL, CERN, CI, Cornell, DESY, Durham, Hiroshima U, IPNL, KEK, LAL, LLNL, LNF, NSC-KIPT, STFC

This list is not exhaustive and needs to be completed.

(e) Communication:

Upcoming meeting/Workshops in 2009

* GDE meeting 17th -21st April 2009 at KEK
* POSIPOL workshop 22nd - 25th June 2009 in Lyon
* CLIC workshop 12th -16th October 2009 at CERN

Online communication:

* A common ILC-CLIC mailing list is now established
* Regular Webex meetings (<--- This meeting)
  First (or second) Thursday of the month

2. Low E e- driven e+ source:

Kuriki-san explained the update of the "Low E e- driven e+ source".

Please see "20090205-Kuriki_LowE_Conv.pdf".

(a) The low E e- driven e+ source:

The low E e- driven e+ source has been proposed by Kuriki-san at ILC08.

* You can get Kuriki-san's original proposal from; http://www-jlc.kek.jp/~omori/EuroJapanMeeting/20081127/081119_MM_v03.pdf.
  In the proposal, the drive beam energy was 0.7 GeV.

The study was updated by considering DR acceptance, and presented in the ILC e+ meeting on 13-Jan-2009. In the meeting, Kiriki-san presented the updated version of the proposal in which the drive beam energy was 2.2 GeV.

Critical and constructive investigation was made by Wanming-san and Wei-san (ANL group).

Two studies are compared in this ILC-CLIC meeting by Kuriki-san.

(b) Positron Yield study:

Positron yield (Ne+/Ne-/GeV) was studied by Kamitani-san and Kuriki-san (KEK, Hiroshima), and by Wanming-san and Wei-san (ANL).

Both results were consistent at various beam energy.

Then Kurik-san studied necessary number of electrons in the drive beam as a function of the beam energy.

(c) Configuration of the Low E e- driven e+ source:

An example of the configuration was shown by Kuriki-san.

* L-band RF gun (FLASH type) generates ILC format (2625 bunches in 1 m sec) beam with 4.5nC bunch intensity.

* Three RF section (2 klystron for high beam power drives 3 cryomodules, 24 cavities) accelerate it up to 2.2 GeV.

* Liquid lead target + Liquid Lithium lens for high capture efficiency.

(d) Target vitality (Kuriki and ANL):

Kuriki-san estimated both instantaneous energy and average power passing through the BN window. It seemed that the BN window can stand a 2.2GeV 4.5nC/bunch beam with ILC format (369ns spacing, 2625 bunches, 5Hz).

Wanming-san and Wei-san studied the heating of the liquid lead by the beam. The results clearly showed that the boiling of the lead could be a serious problem.

If the spot size is small (1 mm rms) and the speed of the lead flow is 10 m/s, the lead will be boiled in any case of the drive beam energy.

(e) Detailed simulation (ANL):

In addition, Wanming-san and Wei-san made detailed study of the effect of Li-lens, and energy deposit on the target as a function of beam energy and target thickness.

(f) Target thickness:

Kuriki-san choose the target thickness of 3 to 3.5 X0, which is thinner than the maximum yield thickness. This choice gave slightly smaller yield but significantly smaller energy deposit.

(g) Summary:

* Two independent studies on the e- driven positron source were compared.

* The positron yield calculations were consistent to each other.

* Yield enhancement by Lithium lens comparing to AMD was shown by ANL's study.

* Kriki-san's study shows 2.2 GeV drive beam is a solution, but no enhancement by LL is assumed.

* ANL's study shows that Pb boiling is a serious issue. Larger spot size and higher flow speed avoid the boiling.

* Accounting both yield and energy deposition, low X0 point is another optimum.

* By assuming 2.2GeV drive beam, 30 m/s flow speed is required to avoid the boiling.

* 10 m/s speed is acceptable for LowP set.

* According the newest result of ANL party, to avoid the Pb boiling, 1.4 and 2.2 GeV driver requires 20 and 30 m/s flow speed for LowP and nominal sets, respectively.

After Kuriki-san's presentation, we made discussions.

Comment by Variola-san:

The point is temperature rise, not energy deposit. If we employ thicker target, energy deposit goes up, but target mass goes up as well. Therefore temperature may not goes up so much. We need check.

Question by Variola-san.
Does simulation include window material?
Answer by Kuriki-san:
No.

Question by Variola-san.
What is the thickness of the window?
Answer by Kuriki-san:
The thickness of the window is about 5 mm.

Question by Louis-san.
What 180 kW means?
Answer by Kuriki-san:
It is the average power passing through the window, not deposited power.

Question by Louis-san:
What 1.5 sigma means? Is it in longitudinal phase space?
Answer by Kuriki-san:
Transverse phase space.

Question by Louis-san:
Is 30 m/s realistic?
Answer by Kuriki-san:
10 m/s is already achieved by BNL prototype.
They have experience of long time operation.
30 m/s requires R/D.

Question by Louis-san:
Why 1.4 GeV? Way not 1 GeV, not 2 GeV, not 1.5 GeV.
Answer by Kuriki-san:
The acceleration of the one ILC section is 0.72 GeV.
So the solutions are 0.7 GeV (0.72 GeV), 1.4 GeV (1.44 GeV) and 2.2 GeV (2.16 GeV).

Question by Clarke-san:
Do you take x1.5 overhead of the number of positrons?
Answer by Kuriki-san:
No.

3. Optimal Compton Ring:

Eugene-san presented his study about "Optimal Compton ring length and performance.

Please see "20090205-Eugene_optRing.pdf".

Following is the summary of the Eugene-san's presentation written by himself.

Summary (by Eugene-san)

(a) Energy spread in electron bunches, induced by
electron-to-laser photons interactions, is the main
obstacle limiting performance of Compton rings as
sources of polarized gammas. Analytical study on the
beam dynamics is rather difficult in this cases,
simulations were used instead.

(b) Simulations were done to compare performance of the
long ring (proposed by P.Gladkikh, 2008) and short
ring (with circumference 10 times shorter).

Results:
* the short ring yields on average 0.225 gammas/(electron turn)
in 100 turn train (maximal rms spread = 3.2%),
* the long ring 0.3 gammas/(electron turn)
in 10 turn train (maximal spread = 2.3%).
* Spans of 'tails' in distribution are about the same,
therefore about equal beam losses.

Conclusion:
Performance of Compton ring gamma sources weakly depends
on the circumference lengths.

(c) Simulation of yield dependence upon the laser pulse
length (duration) in resonators was done. The yield
weakly depends on the duration:

| length(mm) | yield/2500 turns |
|---|---|
| 1.92 | 100 |
| 0.96 | 126 |
| 0.48 | 145 |
| 0.24 | 150 |

(d) Optimal Compton ring proposed:
(d-1) Double-chicane scheme (idea J.Urakawa, 2006)
(d-2) 2-micrometer laser enables increase energy of
gammas (40 MeV vs. 20 MeV) at the same spread or
reduced spread by sqrt(2) at the same energy of
gammas.
(d-3) Long train of gammas - a few thousand turns at
reduced power stored in resonators (CLIC-like).

He made this study in order to answer Omori's questions
in the Euro-Japan meeting in last December.
http://www-jlc.kek.jp/~omori/EuroJapanMeeting/20081212/
20081212-Omori_SmallCR_LargeCR.pdf

Eugene-san's presentation in the Euro-Japan meeting
in the last summer also gives some answers.
http://www-jlc.kek.jp/~omori/EuroJapanMeeting/20080825/
20080825-Eugene_Spr-pres.pdf

After Eugene-san's presentation, we made discussions.

Question by Omori.
Why you say "Span about the same"? (page 5)

Electrons distribute from -0.16 to zero in the left plot,
but electrons distribute from -0.16 to 0.16 in the right
plot. So, there is about x2 difference.

Answer by Eugene-san:
The plots shows the distributions just after gamma
generation. Distribution in the left plot will flip
in several turns after finishing gamma generation
(flip to zero to 0.16).

The date of the next meeting will be on March 5th.

Reported by T. OMORI

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Note 1: Network trouble in the meeting:
During the meeting, we had the network trouble in KEK.
Due to the trouble, we stopped the meeting in the middle.
So we did not have the scheduled presentations of Dadoun-san
and Urakawa-san. They will give the presentations in the
next meeting.

Note 2: Network trouble and this minutes:
Due to the network trouble, Omori did not catch the
discussions in the last part of Eugene-san's presentation.
Some discussions are not in this minutes. Sorry for your
inconvenience.

Note 3: Old minutes:
You can get the materials of the old "Euro-Japan meeting"
from the address shown below.
http://www-jlc.kek.jp/~omori/EuroJapanMeeting/