ILC positron Source meeting

Wednesday 27 - Friday 29 September 2006

Rutherford Appleton Laboratory

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For the L.A.L. Orsay group

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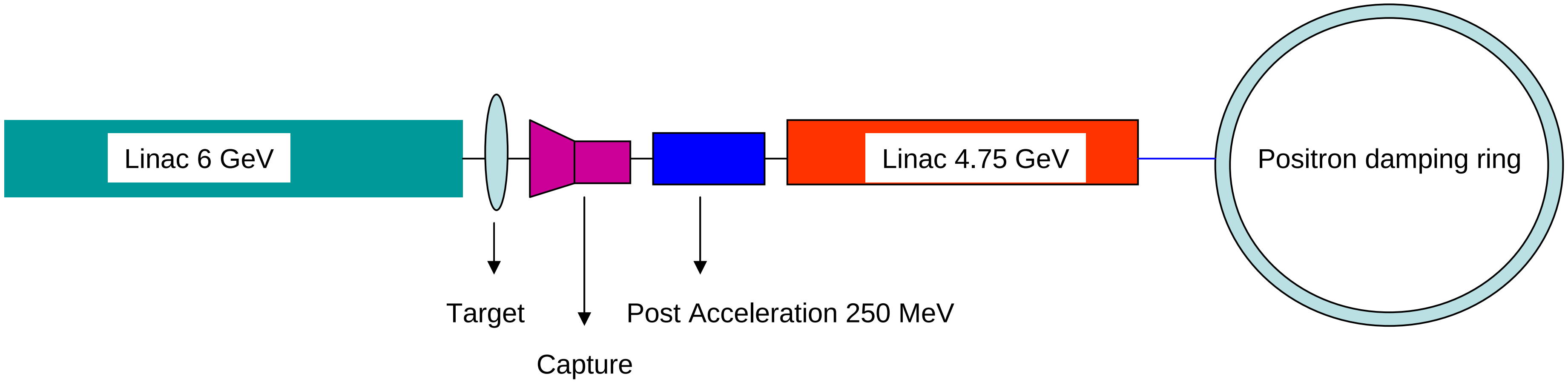
Posipol scheme: we are working on a proposal for a unique "lepton source" ERL based

Conventional positron source

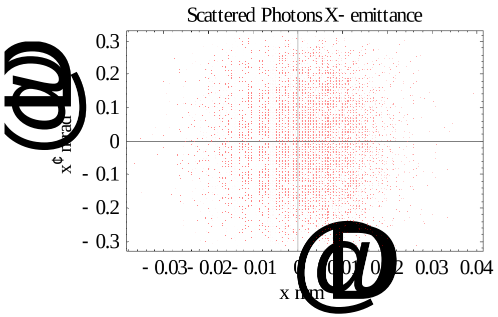


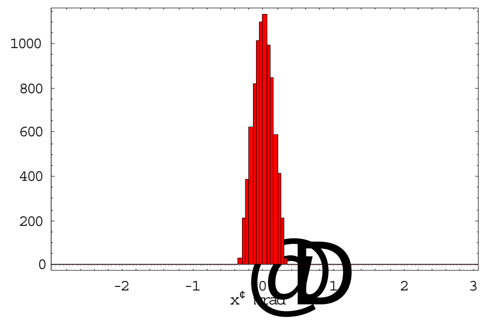
ERL solution
Can we compensate the charge reduction with bunch compression?

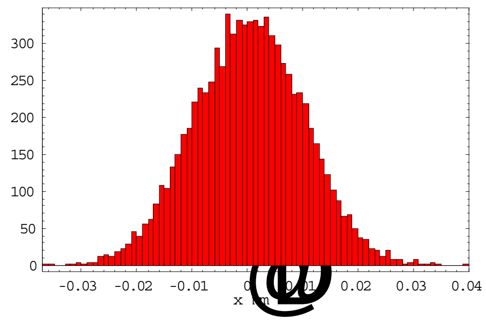
Beam STATISTICS

+++Right-going photon	25034 macro particles	1.562D+09 real		
Average (t,x,y,s)	4.000D-04	5.161D-08	1.431D-08	4.002D-04 m
R.m.s. (t,x,y,s)	1.138D-17	8.025D-06	4.693D-06	1.711D-04 m
Min (t,x,y,s)	4.000D-04	-3.212D-05	-2.013D-05	-2.618D-04 m
Max (t,x,y,s)	4.000D-04	3.005D-05	2.815D-05	1.070D-03 m
Average (En,Px,Py,Ps)	1.474D+07	1.699D+01	3.052D+01	1.474D+07 eV
R.m.s. (En,Px,Py,Ps)	9.279D+06	2.658D+03	2.672D+03	9.279D+06 eV
Min (En,Px,Py,Ps)	3.095D+02	-7.827D+03	-8.248D+03	3.082D+02 eV
Max (En,Px,Py,Ps)	2.987D+07	8.207D+03	8.557D+03	2.987D+07 eV
Stokes (|Xi|,Xi1,Xi2,Xi3)	0.00709	0.00128	0.00675	0.00175

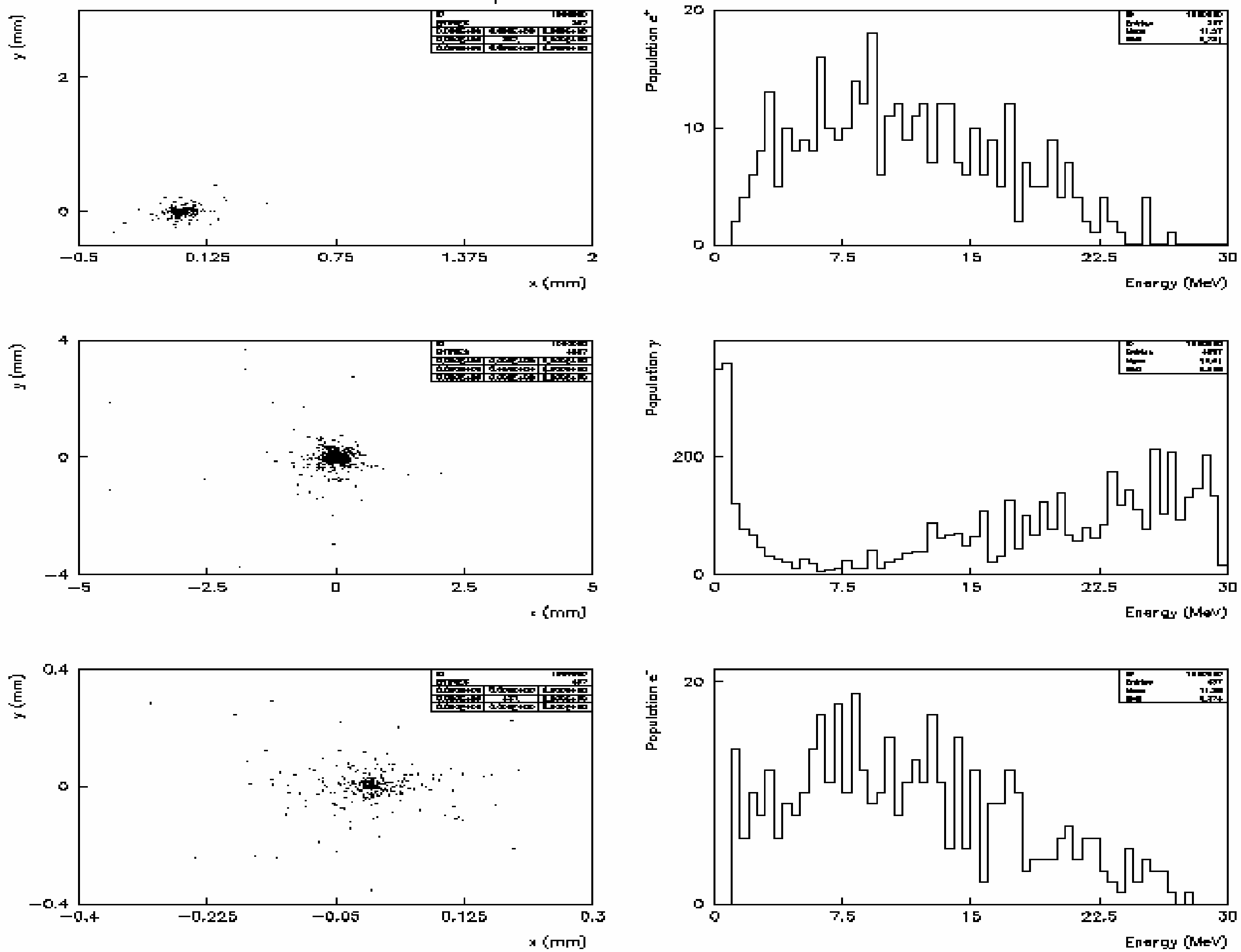
- Laser power density 1.90349132D+21
- Laser pulse Energy [Joule]= 6.00000000D-01
- Laser pulse length [m]= 2.40000000D-04
- Laser pulse wavelength [m= 1.06000000D-06
- Laser waist size [m]= 1.00000000D-05
- Laser Rayleigh length [m]= 2.96376665D-04
- Compton cut off [x beam energy]= 2.27627018D-02
- Beam Energy [eV]= 1.30000000D+09
- Particles per bunch9.36000000D+09
- Collision beta function x= 1.60000000D-01
- Collision beta function y= 1.60000000D-01
- Beam size sigma x [m] = 1.00000000D-05
- Beam size sigma y [m] = 1.00000000D-05
- Beam length sigma z [m] = 2.00000000D-04
- Emittance x= 6.25000000D-10
- Emittance y= 6.25000000D-10
- Energy Spread= 3.00000000D-03
- Collision angle [rad]= 8.72664626D-02
- ************************************
- ************************************



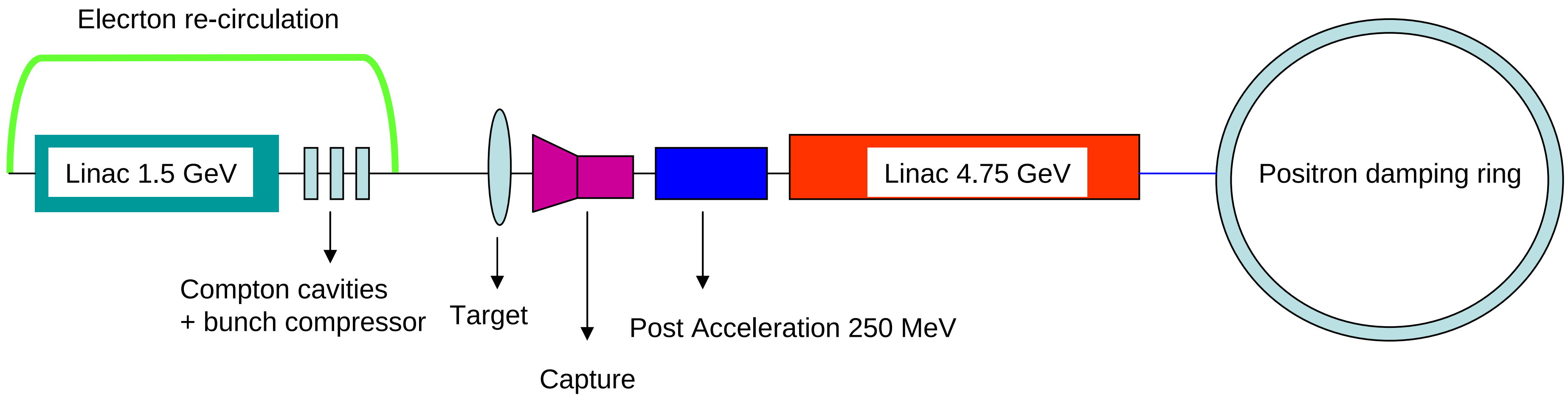




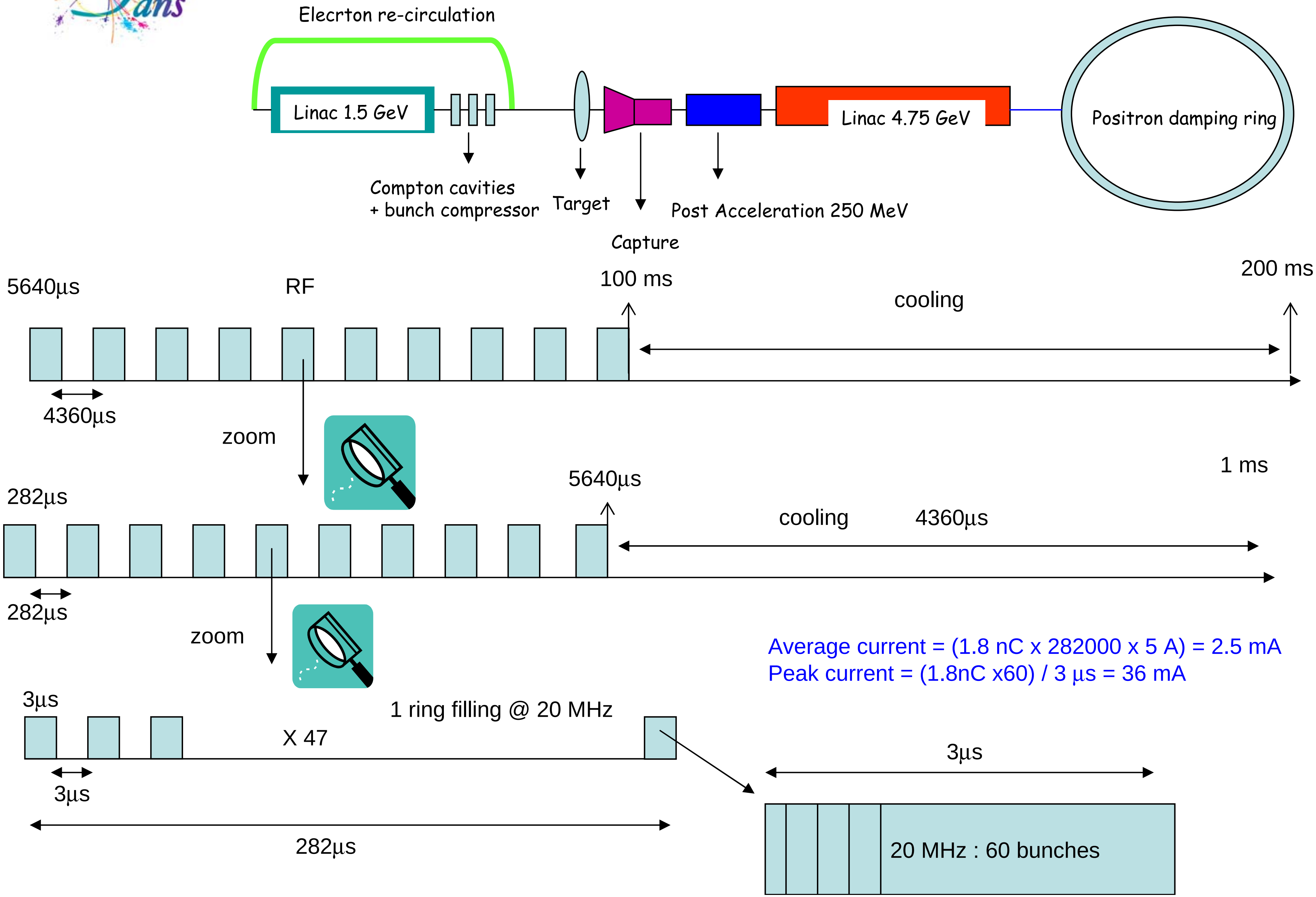
EGS 4270 photons incidents de 0 a 30 MeV



Polarised positron source – Compton cavities + ERL



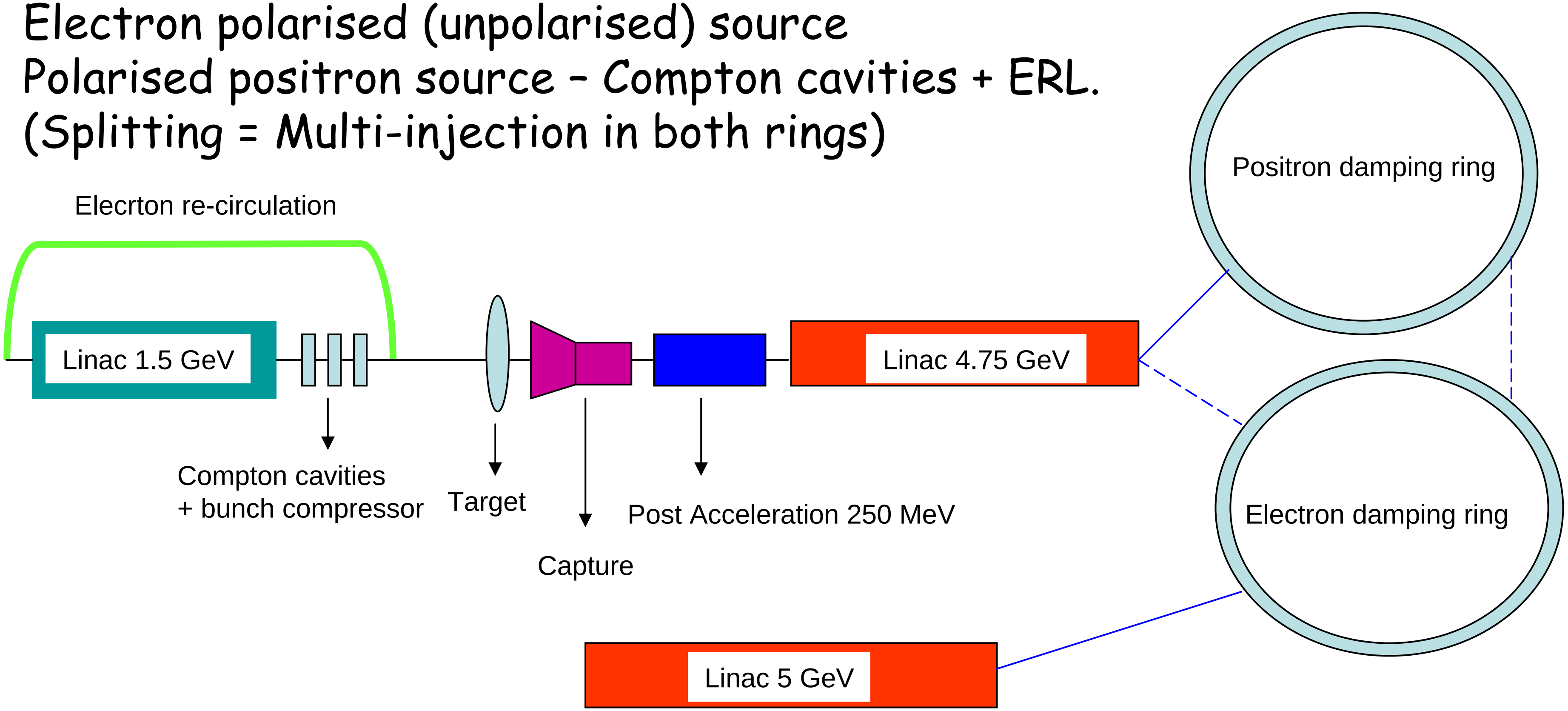
a possible example ERL : 100 re injection if 1 damping ring scheme. 50 if double damping ring scheme



Average current = (1.8 nC x 282000 x 5 A) = 2.5 mA
Peak current = (1.8nC x60) / 3 µs = 36 mA

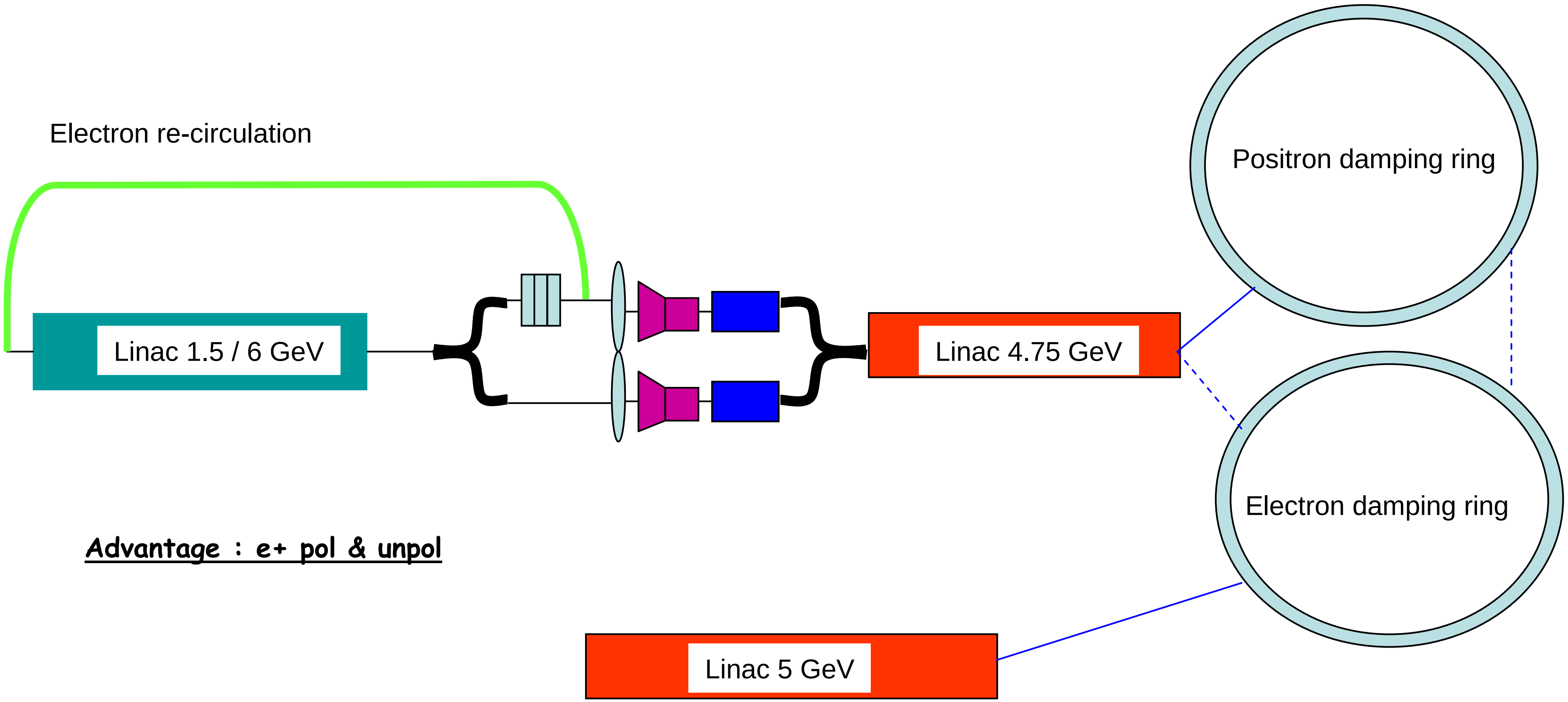
Two sources. One source every damping ring
If damping rings in the same location ……new scenarios:

Electron polarised (unpolarised) source
Polarised positron source – Compton cavities + ERL.
(Splitting = Multi-injection in both rings)



The first 1.5 GeV linac can be substituted with a 6 GeV one to have both sources

Electron polarised (unpolarised) source
Conventional & Polarised source – Compton cavities + ERL.
Damping rings in the same location (splitting)

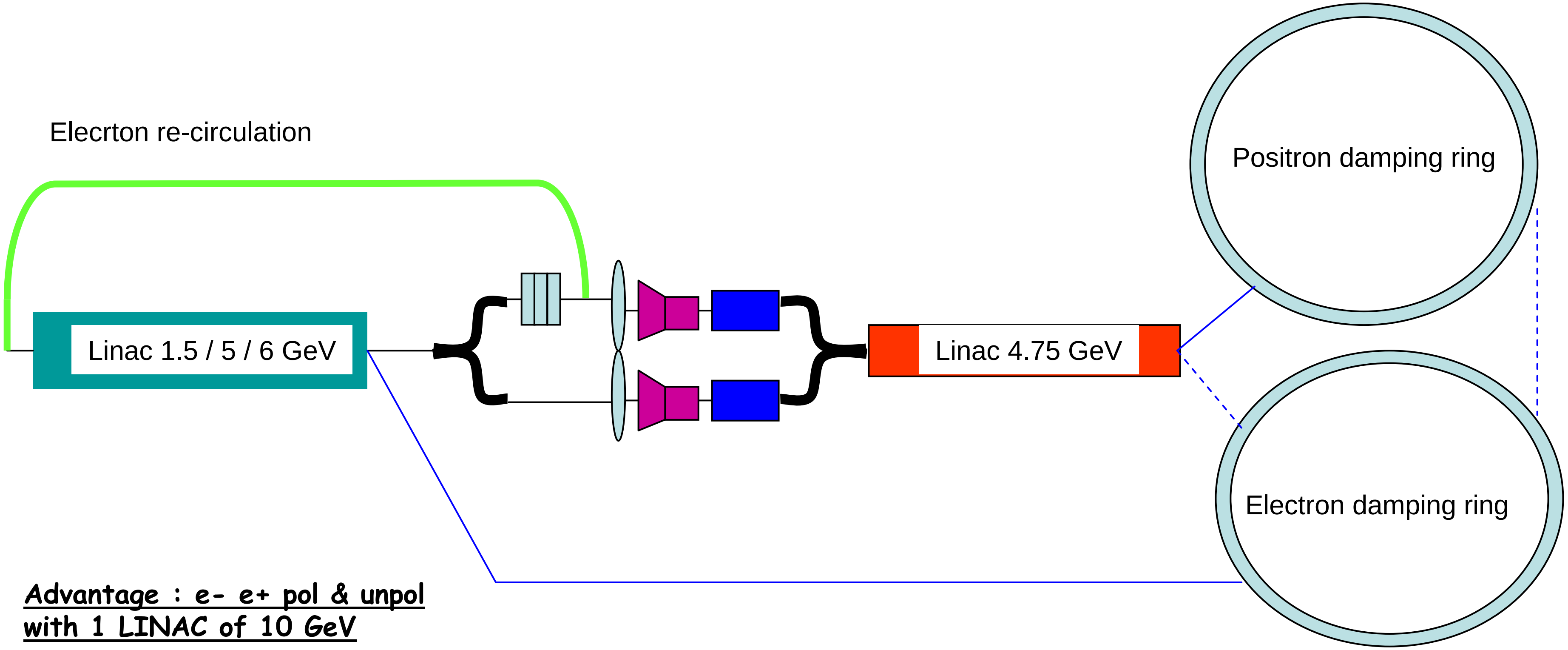


Advantage : e+ pol & unpol

But positron injection takes not more than 100 msec. The remaining 100 msec are enough for electron cooling, so we can split electron and positron injection in time and unify the electron and positron linacs :

IF DAMPING RINGS @ THE SAME LOCATION

Electron polarised (unpolarised) source
Conventional & Polarised source – Compton cavities + ERL.
Damping rings in the same location
(splitting…why not also for the conventional solution)

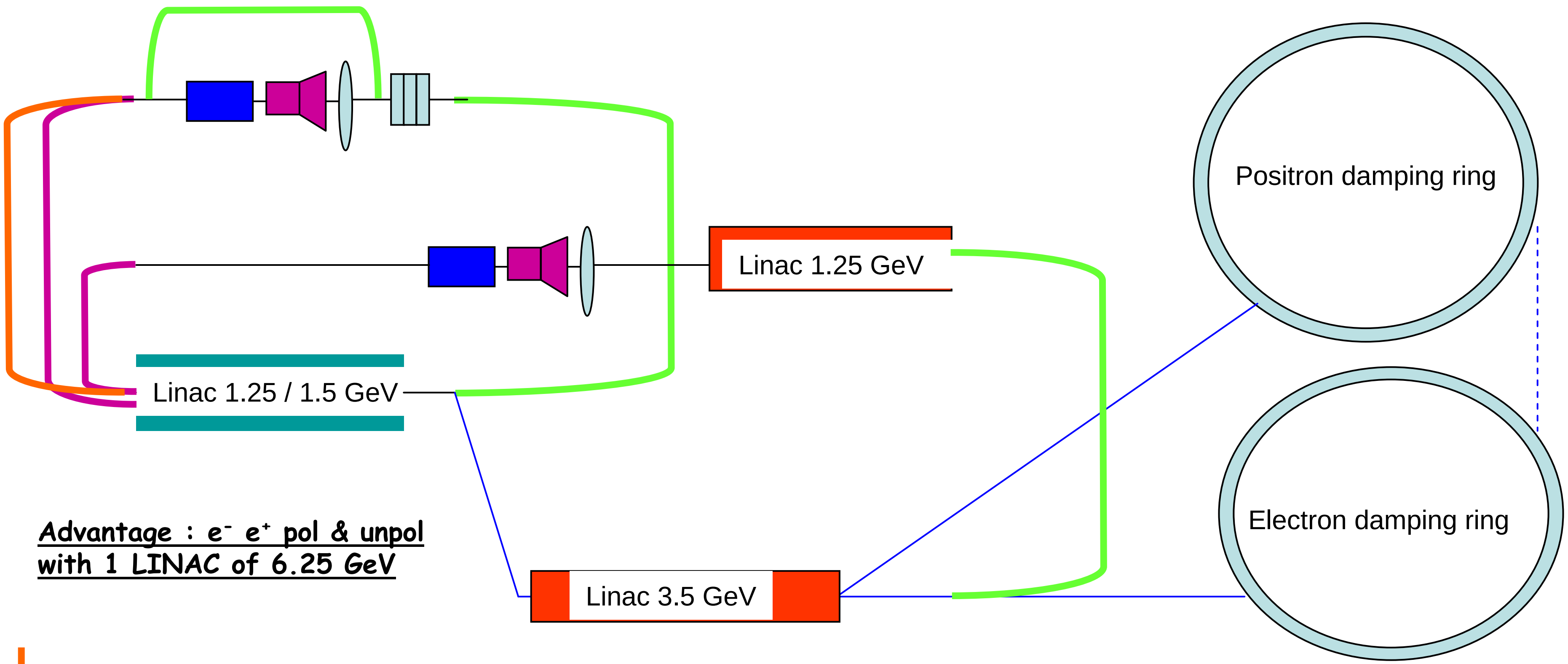


Advantage : e- e+ pol & unpol with 1 LINAC of 10 GeV

1 Complex !!!! Moreover, if we can re-circulate and split the first Linac we can avoid the second one

IF DAMPING RINGS @ THE SAME LOCATION

Electron polarised (unpolarised) source
Conventional & Polarised source – Compton cavities + ERL.
Damping rings in the same location (splitting)
=> e^+,e^- pol / non pol



Advantage : e^- e^+ pol & unpol with 1 LINAC of 6.25 GeV

Electron re-circulation

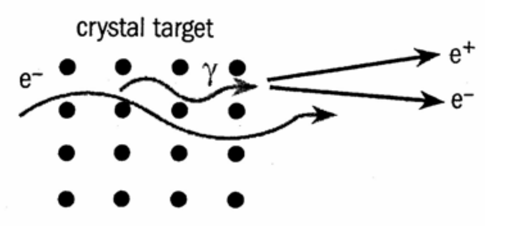
Positron re-circulation

Disrupted electrons and polarised positrons are re-circulated in the same train (deceleration for electrons and acceleration for positrons)

In the future : we would like to study the channeling option for the conventional source

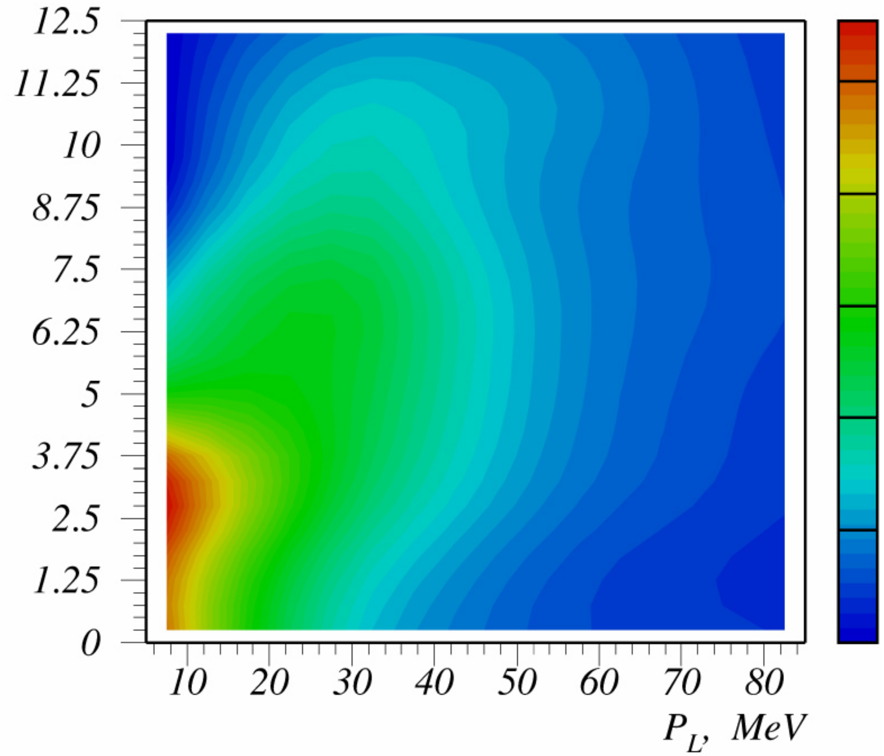
- UNPOLARIZED SOURCES
- - an amorphous target with high Z submitted to an unpolarized e- beam of high energy [conventional]
- - a crystal source made of a crystal aligned on one of its axes (radiator) and of an amorphous W disk (converter) placed after it. The crystal is submitted to a high energy e- beam; the incident energies are comparable for the both devices. = Hybrid

- THE Hybrid SOURCE



- Pair production in the same crystal or in an amorphous disk put after the crystal (preferably)
- The beam aligned on one of the crystal axes (where the potential is strong).
- Experiments made at CERN, KEK
- Simulations showed less deposited energy than in equivalent (e+ yield) amorphous target

- RESULTS OF WA 103 (10 GeV)
- With our large acceptance detector it was possible to measure the e+ yield in large momentum (150 MeV/c) and angular (30°) domains. We show the measured e+ yield in a (p_L,p_T) diagram; the case corresponds to a 8 mm crystal and a 10 GeV incident energy. Numbers are close to linear collider requirements.



In the case E-=10 GeV and a W crystal [<111> orientation], 8mm thick, the yields have been measured in (p_L,p_T) domains..

	$5 < p_l < 25$	$5 < p_l < 30$	$5 < p_l < 40$
$p_t < 4$	1.16 ± 0.04	1.28 ± 0.04	1.43 ± 0.04
$p_t < 6$	1.66 ± 0.05	1.85 ± 0.05	2.13 ± 0.05
$p_t < 8$	2.11 ± 0.07	2.46 ± 0.08	2.90 ± 0.08
$p_t < 10$	2.31 ± 0.08	2.75 ± 0.08	3.32 ± 0.08
$p_t < 12$	2.40 ± 0.08	2.94 ± 0.09	3.67 ± 0.10

For 6GeV : Yield plus ~ 15%
Energy loss (heating) minus ~40 %

Outlook

- We are progressing in parallel with R&D of 2-mirrors and 4-mirrors cavities.

 - 2mirrors = 1st error signal, low finesse.

 - 4mirrors = evaluation of the modes and polarisation. Plans for the mechanical set-up. 1st test with CW laser

- We are starting to evaluate a new scheme for the Compton source. The new idea seems promising
- In the future we would like to study the impact of the channeling for the conventional source