HYBRID SCHEME FOR ILC & CLIC

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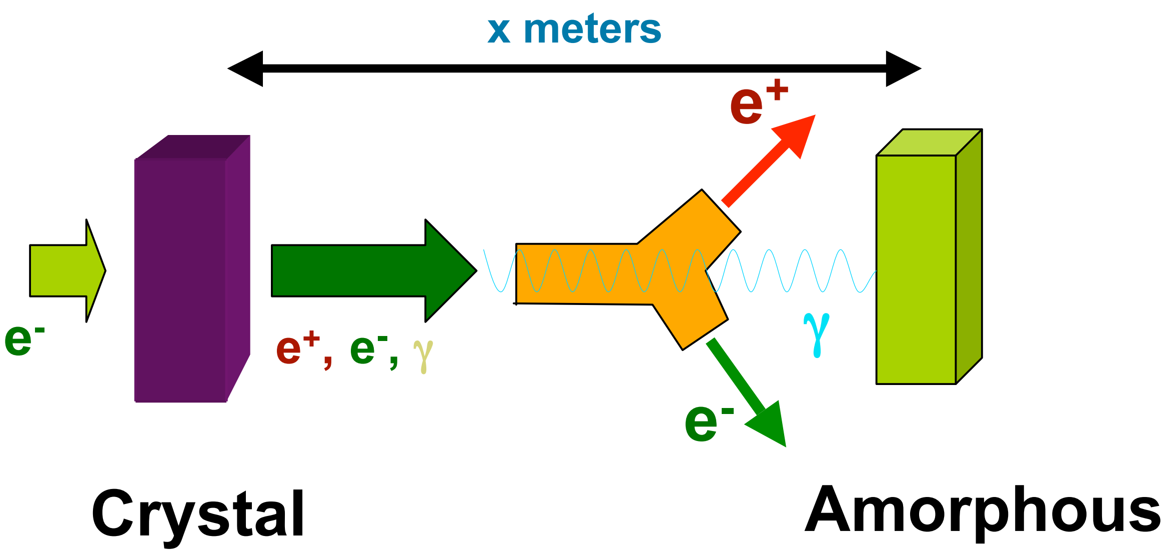
- **RECALL:** an hybrid scheme using a crystal to produce the photons and an amorphous target to convert the photons in e+e- pairs was presented at POSIPOL2008. The scheme:



The charged particles are swept off before the amorphous target: only the γ are impinging

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- **RECALL: Such a solution was found convenient for CLIC as, minimizing the PEDD (Peak Energy Deposition Density) in both targets, it led to the use of a unique hybrid target.**
  - **1-CLIC: the distance between the 2 targets is 2 meters**
  - **ACCEPTED POSITRON YIELD**
  - *** For an incident e- beam with σ = 1 mm => η = 1 e+/e-**
  - *** For an incident e- beam with σ = 2.5 mm => η = 0.9 e+/e-**
  - **PEDD**
  - **Assuming an incident e- pulse of 2.34 10^{12} e-, we have :**

	CRYSTAL		AMORPHOUS	
	PEDD/e- (GeV/cm3/e-)	PEDD/total J/g	PEDD/e- (GeV/cm3/e-)	PEDD/total J/g
σ=1mm	2	38	2.5	48.5
σ=2.5mm	0.35	6.8	0.8	15.5

  - **An entirely amorphous target, 9 mm thick, with the same incident e- beam would have provided the same accepted yield and a PEDD of 150 J/g (σ=1mm) or 40 J/g (σ=2.5 mm). This shows the advantages of an hybrid scheme leading to a unique target with a PEDD < 35 J/g using an e- beam with σ= 2.5 mm.**

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- **RECALL:** **it might be interesting to remind a comparison made in the case of CLIC between purely amorphous, purely crystal and hybrid targets in the case of an incident beam with σ=1mm [CLIC WORKSHOP OCTOBER 2007]**
  - **COMPARISON WITH PURELY AMORPHOUS AND CRYSTAL TARGETS GIVING THE SAME YIELD (at E- = 5 GeV)**
  - **If we consider an amorphous target giving almost the same total positron yield η_+ [~8 e+/e-], the target thickness is: 9 mm**
  - **A purely crystal source giving the same total e+ yield is 4 mm thick**
  - **Comparison of the 3 kinds of e+ sources for CLIC conditions [3.4×10^{12}e-/pulse]: we compare for same total η+ :**

	Total Dep. En.(%)	PEDD(Gev/cm3/e-)	PEDD (J/g)[pulse]
Purely amorp.	4.5%	7	200
Purely crystal	2.4%	7.2	204
Hybrid	6%	1.5	42

  - **We recall that these results correspond to an incident e- beam with σ= 1mm**
  - **We can see the interesting advantage of the hybrid source on the others for the PEDD. If we consider the maximum limit of 35 J/g for W, we are led to multiple targetting: 6 for the to first cases and 1-2 for the third. (see discussion later). Comparisons related to accepted yields instead of total yields lead to analog conclusions.**
  - **The intensity in this table is larger (3.4×10^{12}e-) than in the former (2.34×10^{12})**

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- **THE CASE OF ILC**
- **The time structure in ILC with ms pulses having almost 3000 bunches of 2.10^{10} electrons (more than 5.10^{13} e-) does not allow putting any solid target in the beam. That led the TESLA (and ILC) designers to propose a planar undulator followed by a thin target for the unpolarized positron source. If we want to use the advantages of the hybrid source (low PEDD) we have to use a different time structure to produce the positrons and after to reconstruct the nominal ILC time structure with a damping ring. That has been proposed by T.Omori and represented on the figure below.**

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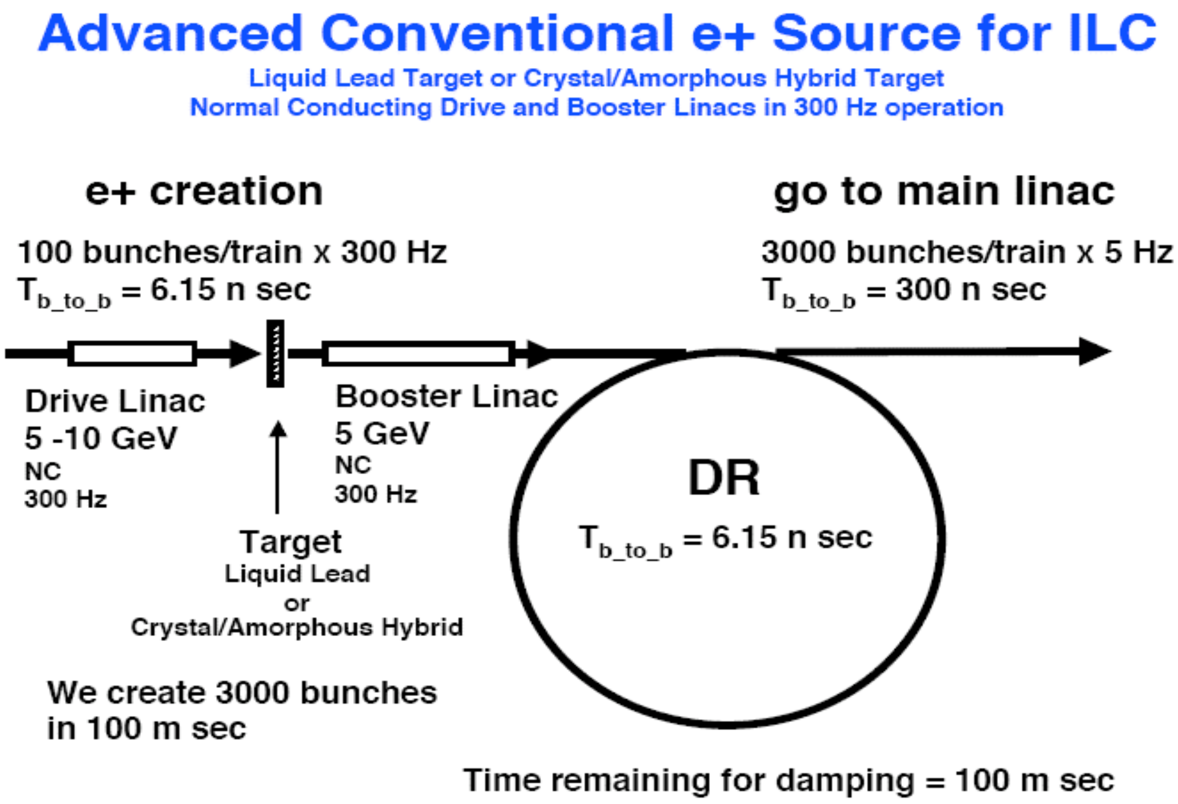
- **THE SCHEME FOR ILC [courtesy of T.Omori]**



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PEDD PER BUNCH FOR ILC

- **INCIDENT BEAM:** an incident electron beam of 10 GeV
- **TARGETS:**
- **CRYSTAL:** a 1 mm thick W crystal <111> orientation
- **AMORPHOUS:** a 8 mm thick amorphous target
- The distance between the 2 targets is of 2 meters.
- **CAPTURE SYSTEM:** AMD with decreasing field from 6 to 0.5 Tesla on 50 cms Accelerating field is 18 MeV/m, peak [SW]
- **RESULTS:** accepted yield: 1.8 e+/e- (σ^-=1mm)
- 1.5 e+/e- (σ^-= 2.5 mm)
- **PEDD:** assuming an incident e- bunch of 2. 10^{10} e-

	crystal		amorphous	
	PEDD/e-	PEDD/bunch	PEDD/e-	PEDD/bunch
σ^-=1mm	2 GeV/cm3	0.33 J/g/bunch	7.5 GeV/cm3	1.25 J/g/bunch
σ^-=2.5mm	0.35 GeV/cm3	0.058 J/g/bunch	2 GeV/cm3	0.33 J/g/bunch

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- **PEDD PER PULSE FOR ILC**
- **The "new" ILC incident pulse is made of 100 bunches; pulse period is of 3.3 ms. That allows 30 pulses in a 100 ms duration. After the pulses are injected in the DR there is a 100 ms damping time.**
- **The PEDD per pulse are given below:**

	crystal		amorphous	
	PEDD/e-	PEDD/pulse	PEDD/e-	PEDD/pulse
σ= 1mm	2Gev/cm3	33 J/g/pulse	7.5 GeV/cm3	125 J/g/pulse
σ=2.5mm	0.35GeV/cm3	5.8J/g/pulse	2 GeV/cm3	33J/g/pulse

- ***With an incident electron beam of 2.5 mm rms radius, the limit of 35J/g is not reached. A unique hybrid target may be considered.***

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- **WHAT IS NEEDED, NOW:**
- **Concerning the beam time structure: precisions about the accelerator scheme [slide 5]: accelerator gradient, kind of structures, …**
- **Concerning the hybrid scheme: optimization w.r.t. the distance between the two targets, the minimum energy above which the charged particles coming from the crystal are accepted on the amorphous target, the incident beam dimensions on the crystal, the heating in both targets,…**
- **Finally, a figure of merit presenting the yield, the total power deposited and the PEDD in both targets must be provided.**