

SMALL SUMMARY OF THE FJPPL MEETING (1-2 DECEMBER 2008)



R.Chehab & F.Zomer

For LAL group (J.Bonis, R.Chiche,
R.Cizeron, O.Dadoun, D.Jehanno, M.Lacroix,
A.Variola, F.Zomer)

IPNL group (R.Chehab), KEK group (J.Urakawa,
Y.Funahashi, T.Kamitani, T.Suwada, T.Omori),
HIROSHIMA-U group (M.Kuriki, T.Takahashi)

FJPPL MEETING...

- **MEETING AT LAL ON 1st & 2d DECEMBER 2008**
- ***Proposed programme***
- ***Monday December 1st in the morning: the Compton source***
- * Stacking (F.Zimmermann)
- Status of the KEK 4 mirror cavity design and tests (R.Cizeron)
- Results of the Orsay 4 mirrors (1 inch) and Ti:Saphir cw laser: first results of the 2 inch mirrors and cw Nd:Yag laser (F.Zomer for V.Soskov)
- Simulations on Compton positron source: status (T.Omori & A.Variola)
- The « Quantum Beam Project » (J.Urakawa)
- ***Monday December 1st in the afternoon : the hybrid source***
- Operational performance on Positron Production from Tungsten Monocrystalline Target at the KEKB injector linac (T.Suwada)
- Studies on an hybrid target for ILC and CLIC (R.Chehab)
- The hybrid source for CLIC : some studies at CERN ? (L.Rinolfi)
- A test of the hybrid source at CERN ? (R.Chehab)
- ***Tuesday December 2d in the morning: Compton cavity***
- KEK & Hiroshima presentations
- Results of the 2 mirrors 30000 cavity finesse (R.Chiche)
- Round table discussion
- *Visit to the new optical lab*
- **Please visit the site: <http://indico.lal.in2p3.fr/conferenceDisplay.py?confId=625>**

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□ STACKING (F.ZIMMERMANN)

some conclusions

- CLIC/ILC Compton source w ERL or CR
- e+ emittance preservation after capture
- CLIC PDR & ILC DR parameters adapted for stability and stacking, $\alpha_2 \downarrow \downarrow$, $V_{RF} \uparrow$, $\tau_{||} \downarrow$
- stacking simulation: >90% efficiency with off-momentum off-phase injection
- (P)DR off-momentum dynamic aperture must be adequate (huge! >several %)
- quite some flexibility (# optical cavities vs. e- bunch charge)
- but a few challenges for PDR & DR design

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STACKING (Frank Z.)

stacking is helped by:

- short damping time
- small energy spread (which value is possible?)
- large ring momentum acceptance
(low α , low α_2 , large V_{RF} , higher harmonic rf)
- sufficient store time

simulation results:

95% for ILC-CR (300 inj's, $\sigma_\delta=3$ MeV spread)

94% for ILC-CERL (1020 inj's! $\sigma_\delta=0.5$ MeV)

95.5% for CLIC-CR/CERL (80 inj's, $\sigma_\delta=2$ MeV)

last 2 with energy pre-compression - **Compton version of ILC-DR acceptable? #e+ / pulse for CERL schemes?**

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STACKING (Frank Z.)

next steps & ideas:

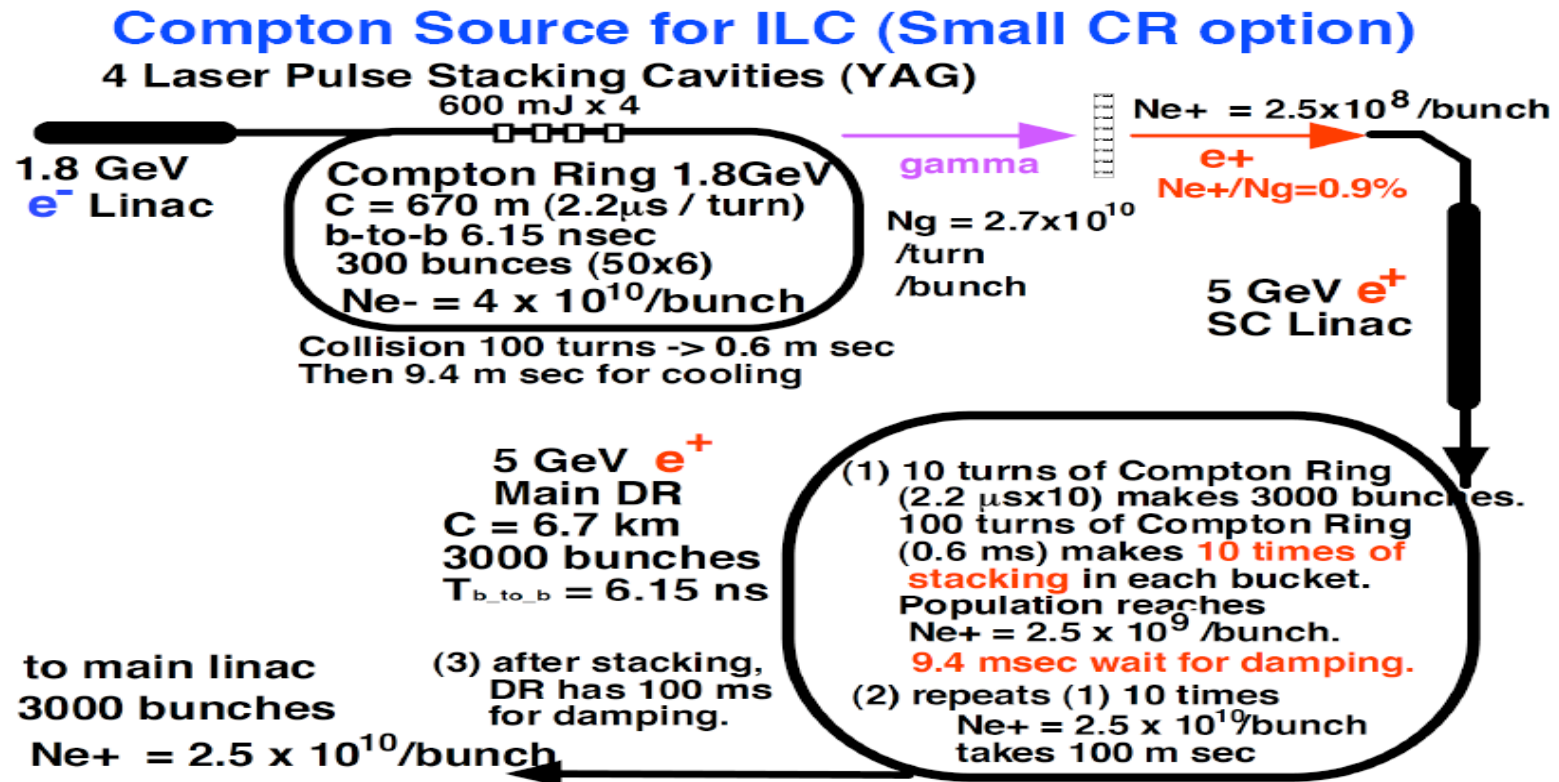
- determine “optimum” (pre-)DR parameters
- optimize **synchrotron tune, opt. α_1, α_2**
- **energy pre-compressor ; higher-harmonic rf**
- combined **longitudinal/transverse** stacking
- **off-momentum dynamic aperture**

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- ❑ **STATUS OF ORSAY CAVITIES (F.Zomer & R.Chiche & R.Cizeron)**
- ❑ **Results on:**
 - ❑ - 2 mirrors confocal cavity
 - ❑ - 4 mirror cavity prototype,
 - ❑ - 4 cavity design study for KEK (mounting, vacuum constraints,..)
 - ❑ - New laser and fiber amplification
- ❑ **Are available on the meeting site**
- ❑ **The main decisions were:**
 - ❑ - To test the 4-Mirror cavity in vacuum vessel at Orsay (by end 2009)
 - ❑ - To continue the development at KEK (with Didier Jehanno)
 - ❑ - Try to get a post-doc to work on the fiber laser
 - ❑ - Prove that the system works even with the no final laser (tests of vacuum chamber, test of collisions,..)
- ❑ **→ The system will be delivered in autumn 2009; the installation takes place during the shutdown (mid-december to 2d week of january 2010) or in 2010 summer shutdown.**
- ❑

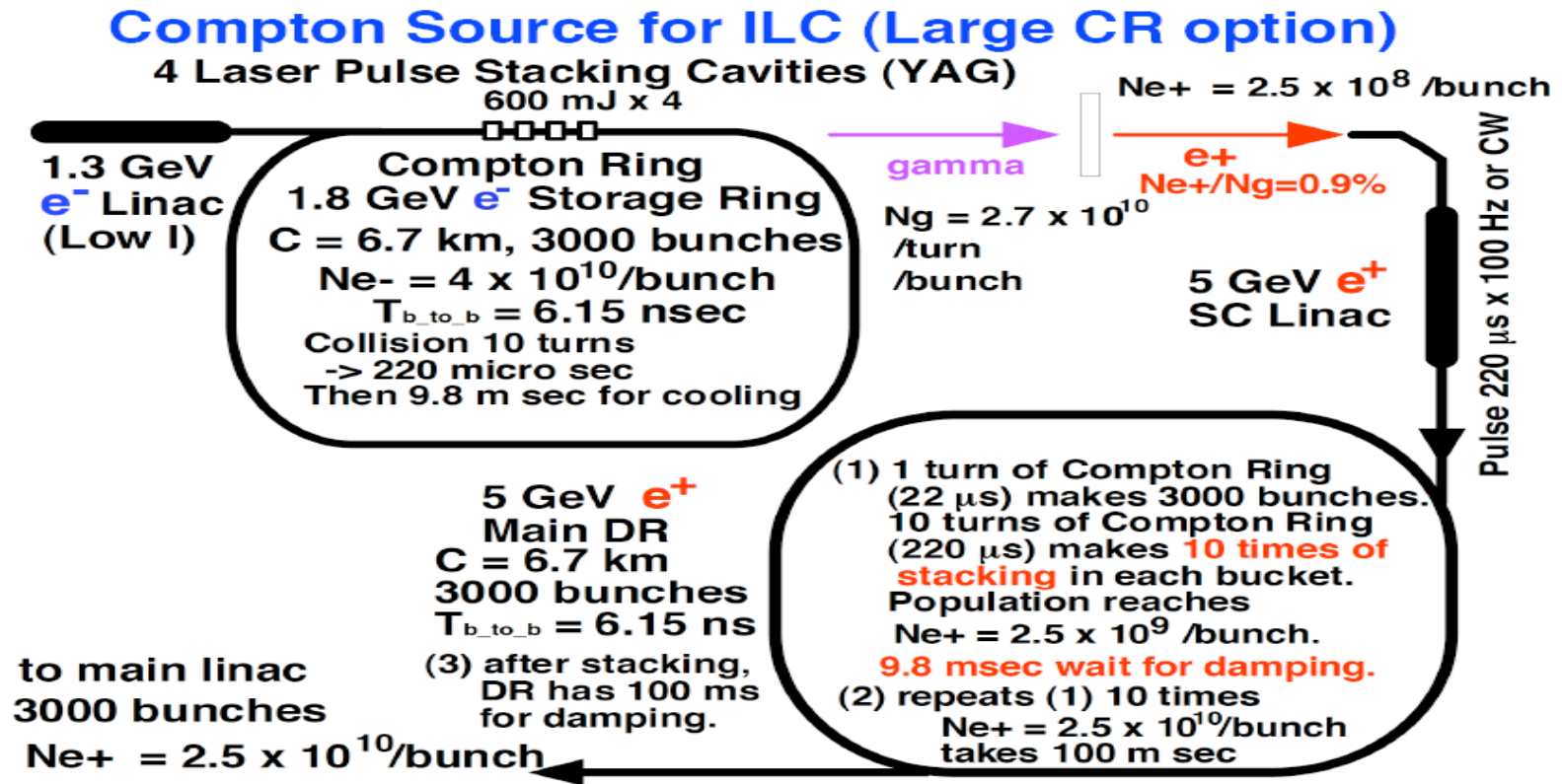
FJPPL MEETING...

□ SIMULATIONS ON COMPTON POSITRON SOURCE (T.OMORI)



FJPPL MEETING...

□ SIMULATIONS ON COMPTON POSITRON SOURCE (T.OMORI)



FJPPL MEETING...

- **QUANTUM BEAM PROJECT (J.Urakawa)**
- **This project is aiming to have a powerful X ray source using a laser stacking cavity and a superconducting accelerator.**
- **Different options are studied concerning the elements of the project.**
- **This project has:**
 - **- great compacity ($L < 10\text{m}$)**
 - **- High photon flux,**
 - **- High brilliance,**
 - **- Short pulses,**
 - **- Low losses in accelerator (superconducting)**
- **It has been approved in August 2008. Funding is 5 OkuYen/year. 3 young physicists are joining the project (2009-2012)**

3. Quantum beam project

Characteristic of proposed machine

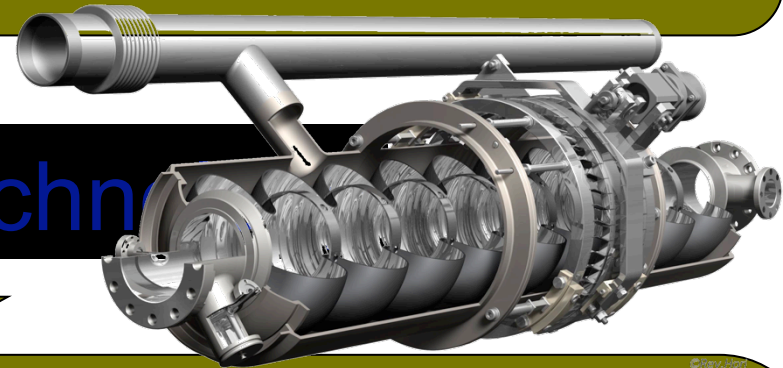
Compact (less than 10m) quasi-monochromatic (less than 1%)

High Flux (100 times than Compact normal Linac X-ray : 10^{11} photons/sec 1% b.w.)

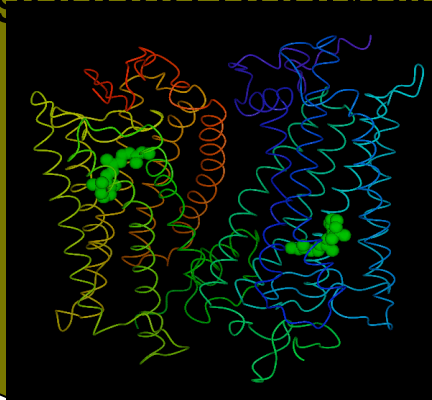
High Brightness (10^{17} photons/sec mrad² mm² 0.1% b.w.)

Ultra-short pulse X-ray (40 fs ~)

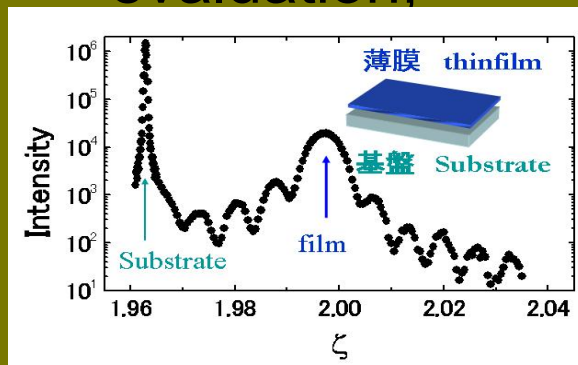
SCRF acceleration technology



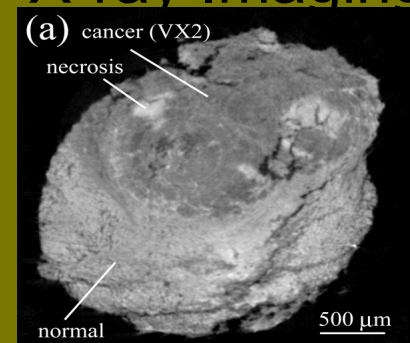
Structural genetic analysis,



Nano-material evaluation,



Highly fine X-ray Imaging



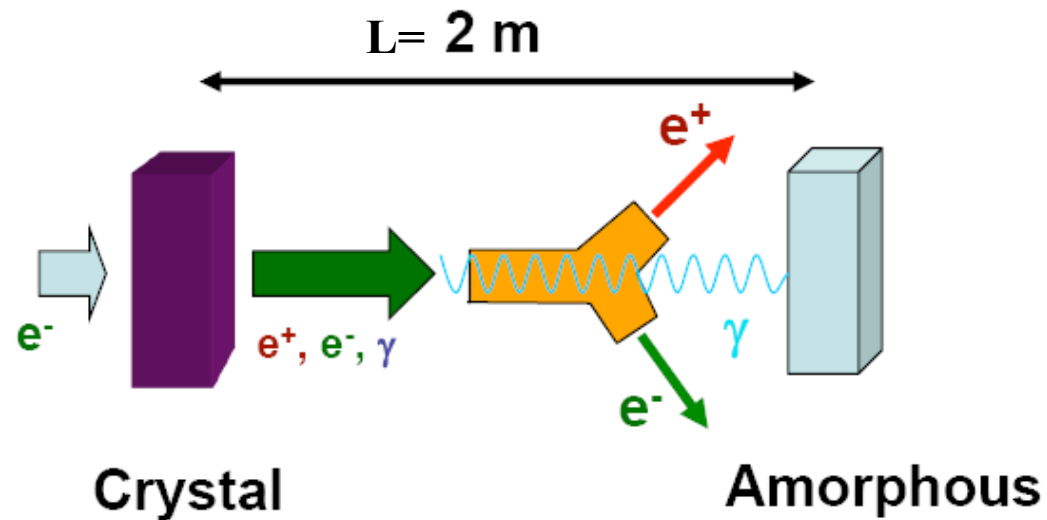
<http://mml.k.u-tokyo.ac.jp/>

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- ❑ **POSITRON PRODUCTION FROM TUNGSTEN MONOCRYSTALLINE TARGET AT KEKB (T.SUWADA)**
- ❑ **Suwada-san recalled the preliminary experiments on the KEKB injector linac with electron energies of 4 and 8 GeV on W crystals of different thicknesses. The installation of a W crystal on the positron source location of KEKB was reported: the crystal source worked well; the enhancement foreseen (25%) w.r.t. the previous amorphous target was verified. Using thermocouples a decrease of about 20% of the temperature of the crystal target w.r.t. amorphous was observed . No significant damages were observed; the crystal provided the same yield, in the same conditions, after 10 months working. Another crystal target is installed and started to deliver positrons (october 2008). This crystal is slightly thinner than the former (10 mm instead of 10.5 mm)**

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▣ STUDIES ON HYBRID TARGET FOR ILC & CLIC (R.Chehab)



The photons from the crystal are impinging on the amorphous target; the e^- and e^+ can be swept off or partially sent to the amorphous target. Distance L is taken 1.5 to 4 m

FJPPL MEETING...

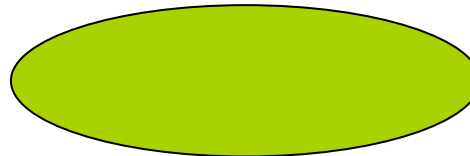
- **Hybrid Target (R.Chehab)**

- **ACCEPTANCE CONDITIONS**

- **The accepted e+ are contained in the transverse phase space defined by the acceptance ellipse at the target:**

- $[r/0.53]^2 + [p_T/11]^2 = 1$; r is in cm and p_T in MeV/c

-



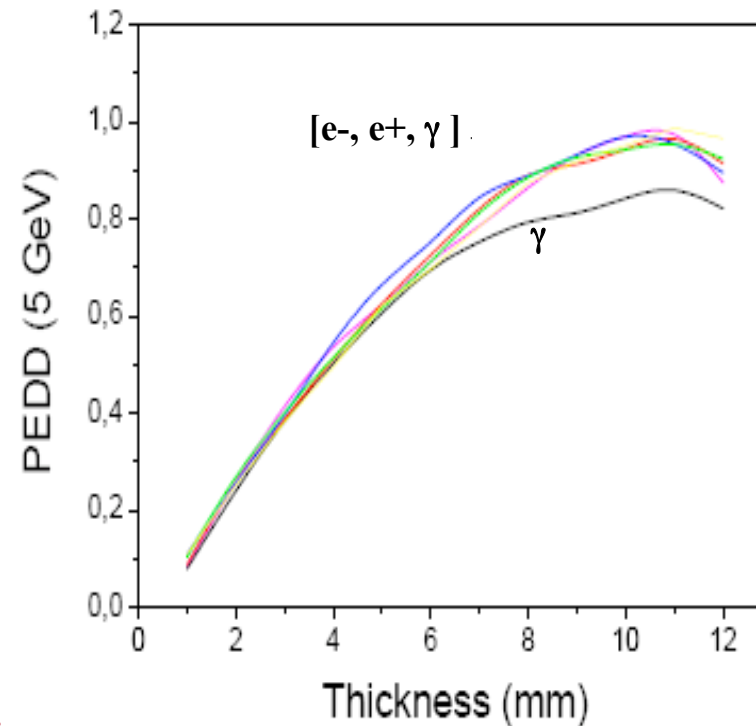
- **The longitudinal momentum p_L is taken between 1.3 MeV/c (debunching) and 17.3 MeV/c (adiabatic condition)**
- **The longitudinal and transverse momenta satisfy the relation:**
- **$p_T < 0.1875 \text{ MeV/c} + 0.625 p_L$; this relation corresponds to a maximum positron angle of emission of ~ 32 degrees which put a limit on the debunching (in an L-Band accelerator) with the focusing fields considered.**

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□ THE CASE OF CLIC: PEDD

- On the figure the PEDD is given in GeV/cm³/e⁻
- The PEDD is growing from 0.80 GeV/cm³/e⁻ to a mean value of 0.96 GeV/cm³/e⁻ when sending photons, e⁻ and e⁺ emitted at the crystal on a 10 mm thick amorphous target
- That brings the PEDD per CLIC Pulse to less than 18 J/g, well below the 35J/g limit. Threshold
- Energies are: 50 → 900 MeV

This figure shows the modest contribution of e⁻ and e⁺ from crystal when E > 50 MeV.



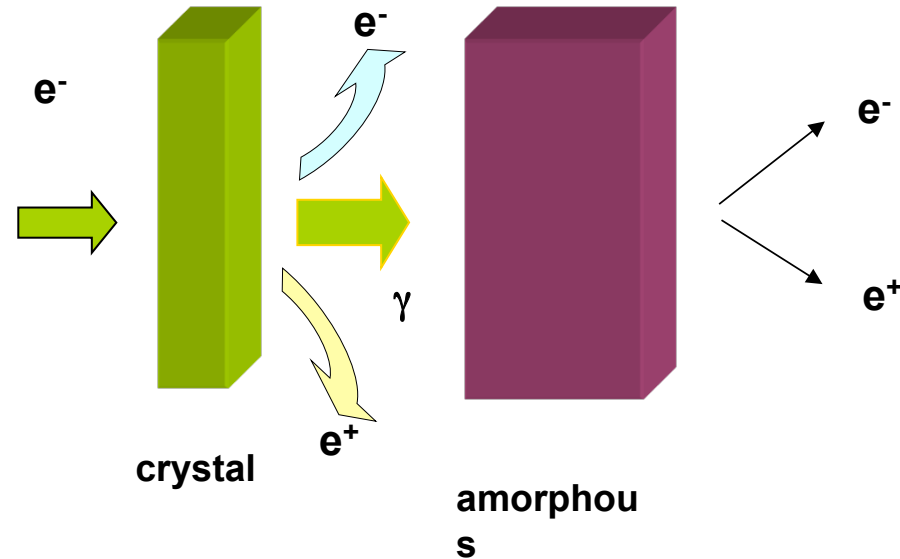
Unpolarized e^+ source by channelling

CLIC has now adopted this scheme for the base line configuration/

Talk of L.Rinolfi

A e^- beam impinges on the crystal:

- energy of 5 GeV
- beam size of 2.5 mm



- **A crystal e^+ source :**
 - - a 1.4 mm thick W crystal oriented along $\langle 111 \rangle$ axis
 - - a 10 mm thick W amorphous disk

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e⁺ by channeling from hybrid targets/CLIC

L.Rinolfi

Linac for Primary electron beam

Parameter	Unit	CLIC
Primary e⁻ Beam		
Energy	GeV	5
N e ⁻ /bunch	10 ⁹	7.5
N bunches / pulse	-	312
N e ⁻ / pulse	10 ¹²	2.34
Pulse length	ns	156
Repetition frequency	Hz	50
Beam power	kW	94
Linac frequency	GHz	2
Beam radius (rms)	mm	2.5
Bunch length (rms)	mm	0.5

Simulations performed by R. Chehab / IPNL-Lyon,
A. Variola, A. Vivoli / LAL, V.M.Strakhovenko /
BINP - Novosibirsk

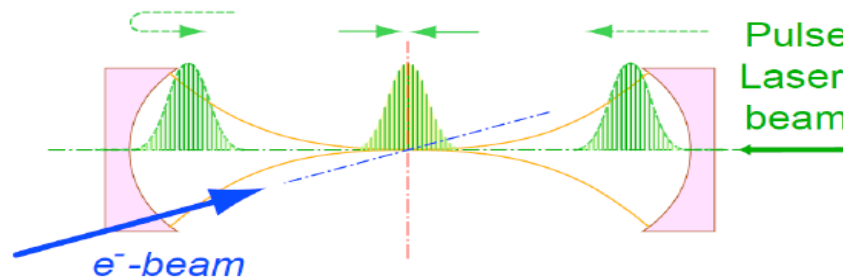
Parameter	Unit		
Target		Crystal	Amorph.
Material		W	W
Length	mm	1.4	10
Beam power deposited	kW	0.2	7.5
Deposited P / Beam Power	%	0.2	8
Energy lost per volume	10 ⁹ GeV/ mm ³	0.8	1.9
Peak energy deposition density (PEDD)	J/g	6.8	15.5

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Experiment at KEK

Experimental R/D in ATF

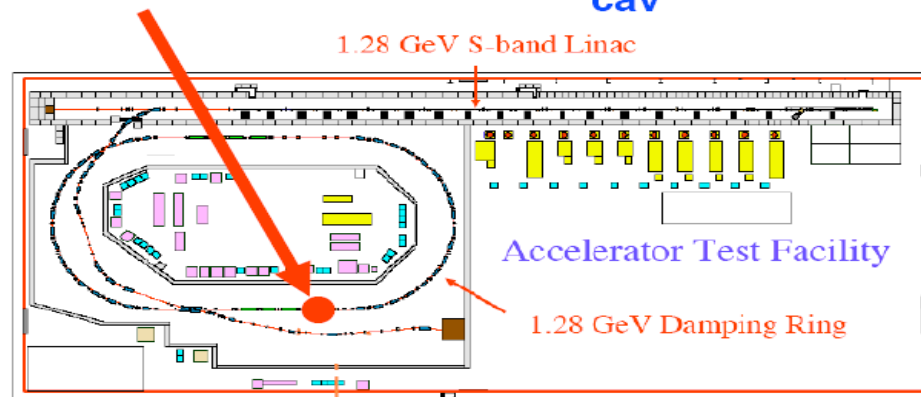
Hiroshima-Waseda-Kyoto-IHEP-KEK



Make a fist
prototype
2-mirror cavity

$$L_{\text{cav}} = 420 \text{ mm}$$

Put it in
ATF ring



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□ EXPERIMENT AT KEK

Summary

1. Success : Resonance Feedback + Phase Lock on Acc RF

Before Summer

No feedback

Trigger : Acc + Transmitted Light

Present

Normal Feedback ---> Cross-feedback

Resonance Feedback + Phase Lock on ACC RF

Trigger : Acc

2. Collision Experiment on going

5 gamma / crossing (single-bunch op.)

6 gamma / crossing (two-bunch op.)

Consistent: Experiment <--> CAIN simulation

Consistent: single-bunch <--> two-bunch

This week : collision in 10-bunch and 20-bunch op.