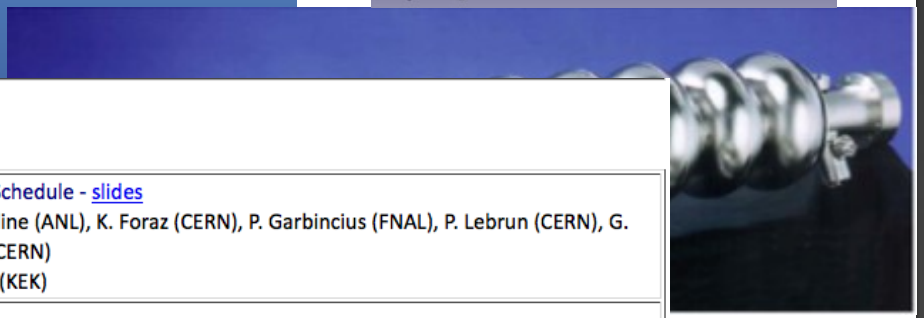
KEK/Japan – CERN collaboration on Collider studies

- Substantial act
  accelerator wo
  detectors
- Based on CERN-KEK ag
  and CLIC – ILC commo
  groups
- Plans at CERN the common years

- Experimental particle physics, including both collider and fixed-target experiments;

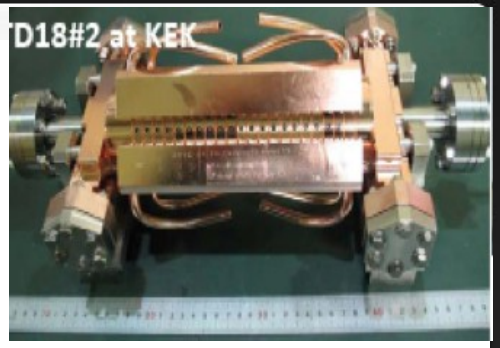
- Research and development on accelerator physics and technology, including:
  - Damping rings and Beam Delivery Systems for advanced accelerator technology, using the Accelerator Test Facility (ATF, including the ATF2 project) at KEK;
  - Design, fabrication and tests of high-gradient X-band accelerating structures.



Working groups and Presentation of Mandate and Action Plan:

Civil Engineering and Conventional Facilities (CFS) - slides C. Hauviller (CERN, J. Osborne (CERN), V. Kuchler (FNAL)	Cost and Schedule - slides J. Carwardine (ANL), K. Foraz (CERN), P. Garbincius (FNAL), P. Lebrun (CERN), G. Riddone (CERN) T. Shidara (KEK)
Beam Delivery Systems and Machine Detector Interface - slides D. Schulte (CERN), L. Gatignon (CERN), B. Parker (BNL), A. Seryi (SLAC), R. Tomas Garcia (CERN)	Beam Dynamics - slides A. Latina (FNAL), K. Kubo (KEK), D. Schulte (CERN), N. Walker (DESY)
Detector and Physics - slides L. Linssen (CERN), F. Richard (LAL), D. Schlatter (CERN), S. Yamada (KEK)	Positron Generation - slides J. Clarke (Daresbury), L. Rinolfi (CERN)
Damping Rings - slides M. Palmer (Cornell), Y. Papaphilippou (CERN)	

Accelerator collaborations



- Key topics:
  - X-band structure development and testing (previous talk)
    - ✓ Tests of X-band accelerating structures at KEK are vital f
    - ✓ We also profit from the experience in building structure
    - ✓ We profit from X-band klystron expertise of Japanese in
  - ATF2-3 activities (J. Urakawa, T. Tauchi)
- Collaborations within the CLIC- ILC working group fram
  - Sources (T. Omori et al.)
  - Damping ring beam dynamics (K. Kubo et al.)
  - Beam dynamics from damping ring to IP (K. Kubo et al.)
- Generic (often informal) collaborations on many funda
  - Electron cloud (K. Ohmi et al.)
  - Two-stream instabilities (K. Ohmi, K. Oide et al.)
  - Coherent synchrotron radiation (K. Oide et al.)
    - ✓ Super-KEKB and CLIC damping ring have similar (potent
  - BDS + Collision Point (T.Tauchi)

ATF + ATF2 Past and Current Profits

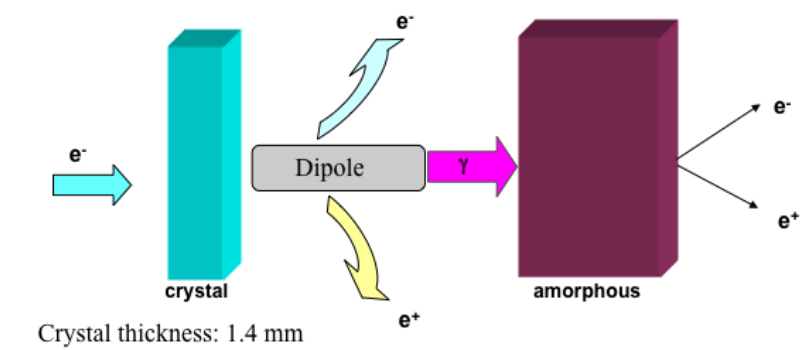
- A most important test facility for damping ring and bea
  - BDS tuning is a critical issue for CLIC and ILC, we learn eno experience
  - Test of FONT (Feedback On Nano-second Timescales)
  - World leading BPM resolution
  - Extraction kickers
  - Operation of ATF
- We contributed in the past
  - E.g. optimisation code (MAPCLASS)
  - CSR calculations for ATF (F. Zimmermann)
  - A CERN/Spanish PhD student work on ATF2 (Eduardo Mari
- Very important is training of young people at ATF/ATF2
  - This year CERN hired two former PhD students from ATF2 Benoît Bolzon)
  - Example above – CERN PhD student working on ATF2

ATF3

- We are considering a number of topics for increased fu and ATF3
  - Very small beta-function to match CLIC chromaticity
    - Limited by QF1, consider providing one with larger aper
  - Ground motion feedback/feed-forward
    - Install ground motion sensors on each relevant magnet
  - Test of quadrupole stabilisation in ATF extraction
    - Could be best way to verify stabilisation performance w
  - We will develop damping ring extraction kickers systems
    - Would need ATF3 to verify kicker performance
  - Superconducting wiggler for ATF
  - Coherent synchrotron radiation induced beam instability
    - Experiments would allow to distinguish between differe
  - BPM tests
    - CLIC main linac BPMs developed by FNAL could be teste
    - More BPMs should follow in the future
  - We would like to contribute to ATF2/3 operation to gain m

Positron Source (Hybrid Target)

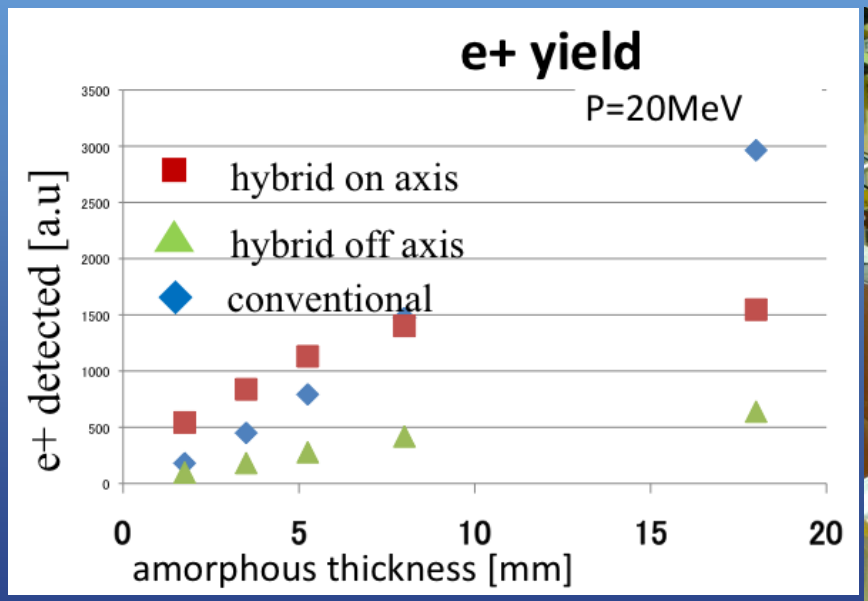
- Hybrid target
  - The CLIC baseline
  - Alternative source for ILC
  - Test at KEKB linac are crucial

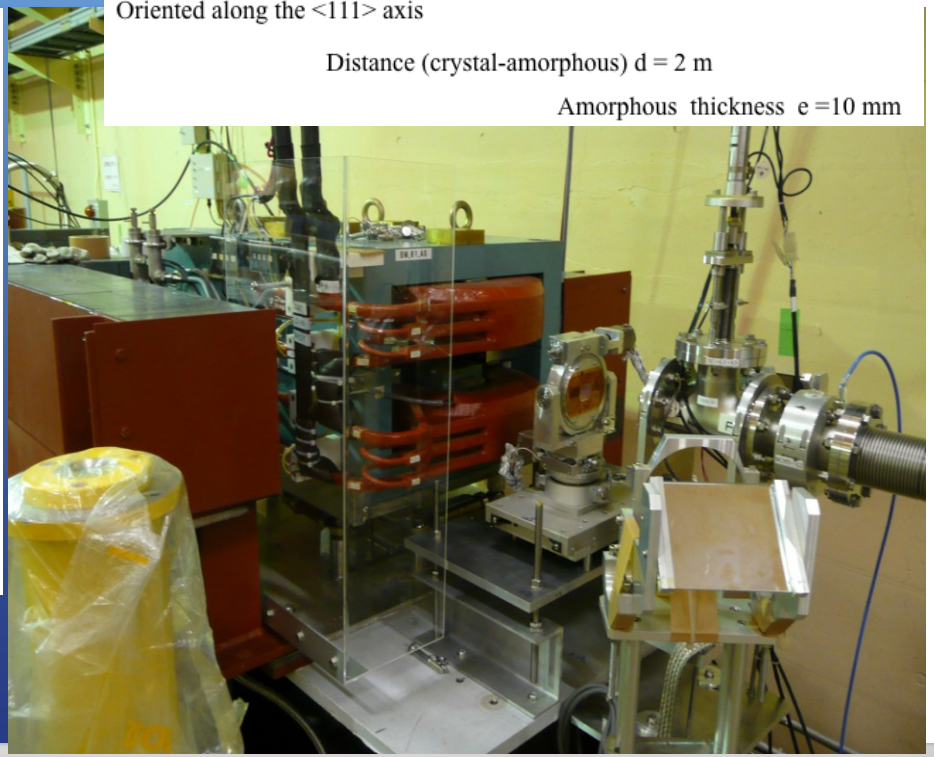


Crystal thickness: 1.4 mm
Oriented along the <111> axis

Distance (crystal-amorphous) d = 2 m

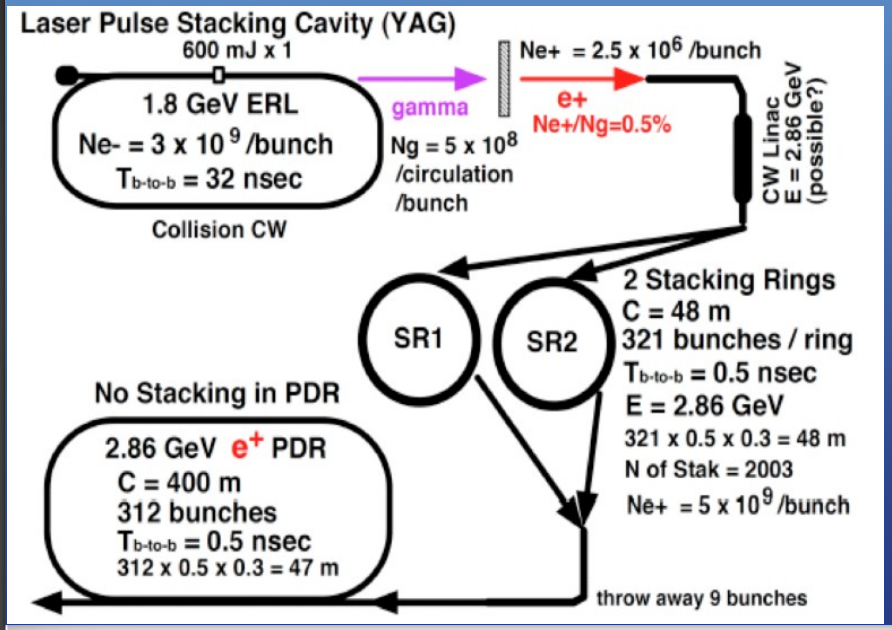
Amorphous thickness e =10 mm





Positron Source (Compton Source)

- At CLIC serious alternative source
  - Polarized positrons will be increasingly more important
  - But feasibility needs to be established
- Optical cavity work at KEK is fundamental
  - CERN is involved via French collaboration

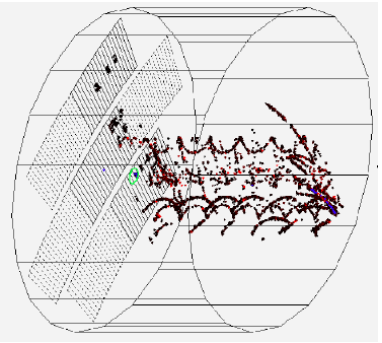


T. Omori (KEK) et al

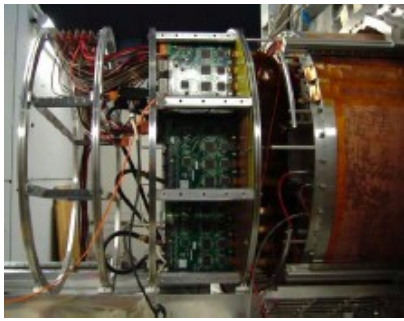
CERN-Japan collaboration on Linear Collider Detector studies

http://lcd.web.cern.ch/LCD/

Collaboration is uniquely based on areas of
synergy between ILC and CLIC detector studies,
such as:



ILD detector concept studies
Event generation and grid production
Flavour tagging for LC
Detector magnet system R&D
LC-TPC studies with GEMs and S-Altro electronics



ILD detector concept studies

Event generation and production

LCFI flavour tagging for LC

Until now, Japanese participation to CLIC detector study has been on a voluntary basis. Expert knowledge transfer and contributions from Japan are essential for the CLIC detector studies and physics simulations.

Particular mention:

Contributions to CLIC physics/detector CDR editing:
A. Miyamoto (KEK), T. Takeshita (Shinsu Univ.), T. Matsuda (KEK+DESY), Y. Makida (KEK)

Expert advice on event generation, and contact for grid production at KEK:
A. Miyamoto (KEK)

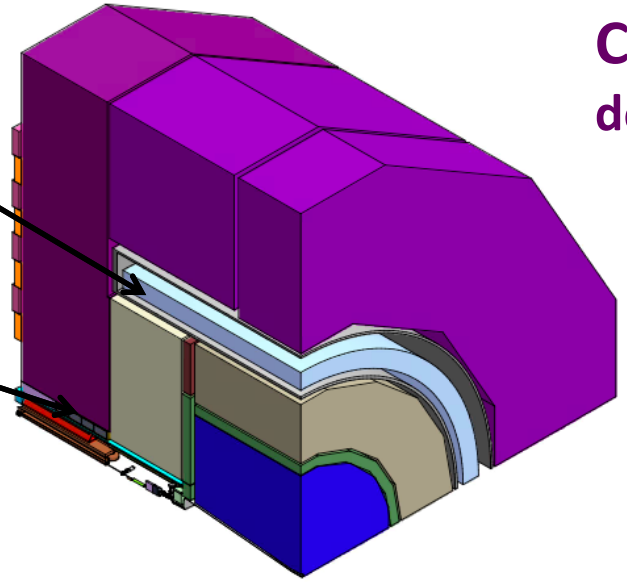
Common LCFI flavour tagging package for LC:
Maintained and developed by Univ. of Tokyo, KEK, Tohoku Univ., and Nippon Dental Univ.

R&D on Linear Collider TPC with GEMs and Pad readout (SALTRO electronics):
K. Fujii (KEK), T. Matsuda (KEK+DESY) et al.

Detector magnet system R&D

Detector solenoid
4 Tesla, 3.4 m inner bore

Anti-solenoid
1.4 Tesla, 0.5 m radius



CLIC_ILD
detector concept

Collaboration with KEK on:

- Common R&D on **reinforced conductor** for ILC and CLIC detector solenoid
  - Development of materials for conductor reinforcement
  - Extrusion test of a large reinforced conductor, based on Rutherford cable and Ni-reinforced aluminium from ATLAS solenoid. Test performed in Switzerland. Expert contribution from KEK highly desirable (A. Yamamoto, Y. Makida)

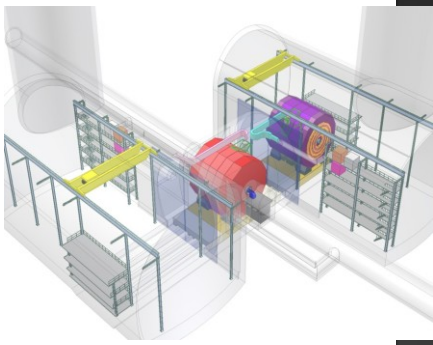
- Design of **anti-solenoid**, surrounding the final-focus quadrupole in the CLIC detector. This project has synergy with COMET pion capture magnet. Technology solutions overlapping with BESS balloon magnets.

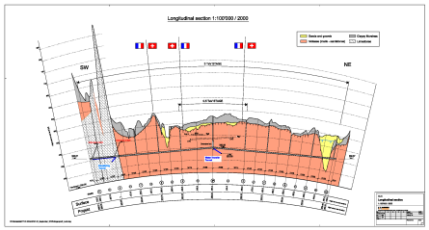
CERN LC programme 2011-2016

- **Before 2011**
  CDR (2011), CLIC feasibility

- **2011-2016 – Project Preparation phase, some specifical some generally for a LC**
  - Review of the CLIC baseline design, taking into account and including:
    - ✓ cost & power consumption optimization
    - ✓ energy staging
    - ✓ technical risks and performance risks
  - Technical developments and test of critical comp prototypes, using several facilities across the collaboratio
  - Exploitation and upgrade of CTF3 to CTF3+, constr commissioning of CLIC drive beam injector

  - Machine/Detector interface (in a wide sense – including p
  - Detector R&D and studies
  - Physics studies including guidance from LHC and Tevatron
  - Site studies
  - Organization and Governance





Summary

Two main messages:

- A very significant number of collaborative efforts in the implemented in the frameworks of the current CERN-KEK ag working groups, or in some cases purely scientific contacts similar problems.

- Many (most) of the LC activities at CERN and Japan wil strengthened collaboration, including more exchange of peop
  - ✓ The possibility to involve Japanese scientists being placed activities here – machine studies or detector studies – w coming years