French ILC activities

Guy Wormser

LAL Orsay

January 10, 2008

LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

French ILC activities

- One project GDE/France (O. Napoly, G. Wormser co-chairs)
- 3 laboratories, 2 funding agencies: DAPNIA/CEA, LAPP/IN2P3, LAL/IN2P3
- 7 subgroups/activities
- ~30 FTE/year
- Multiples sources of funding (CEA, IN2P3, CARE, EUROTEV, HI-Grade, EUCARD, DESY)
- ~2.5 M€/year M&S

Strength of the French ILC Effort

- According to the official RD plan for the EDR,
  - France is third in GDE M&S investment just after US and Japan
  - France is fourth in FTE after US, UK and Germany
  - France has 0 official responsability in EDR!
- Totally unsane, especially after US and UK accidents

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The French ILC activities in a snapshot

- DAPNIA: Cavities, BDS
- LAPP : BDS
- LAL : BDS, Positron source, Coupler R&D, cryomodule transport

- In addition XFEL related work:
  - DAPNIA: Cryomodule integration
  - LAL: Coupler production

    (25% of the XFEL Linac!)

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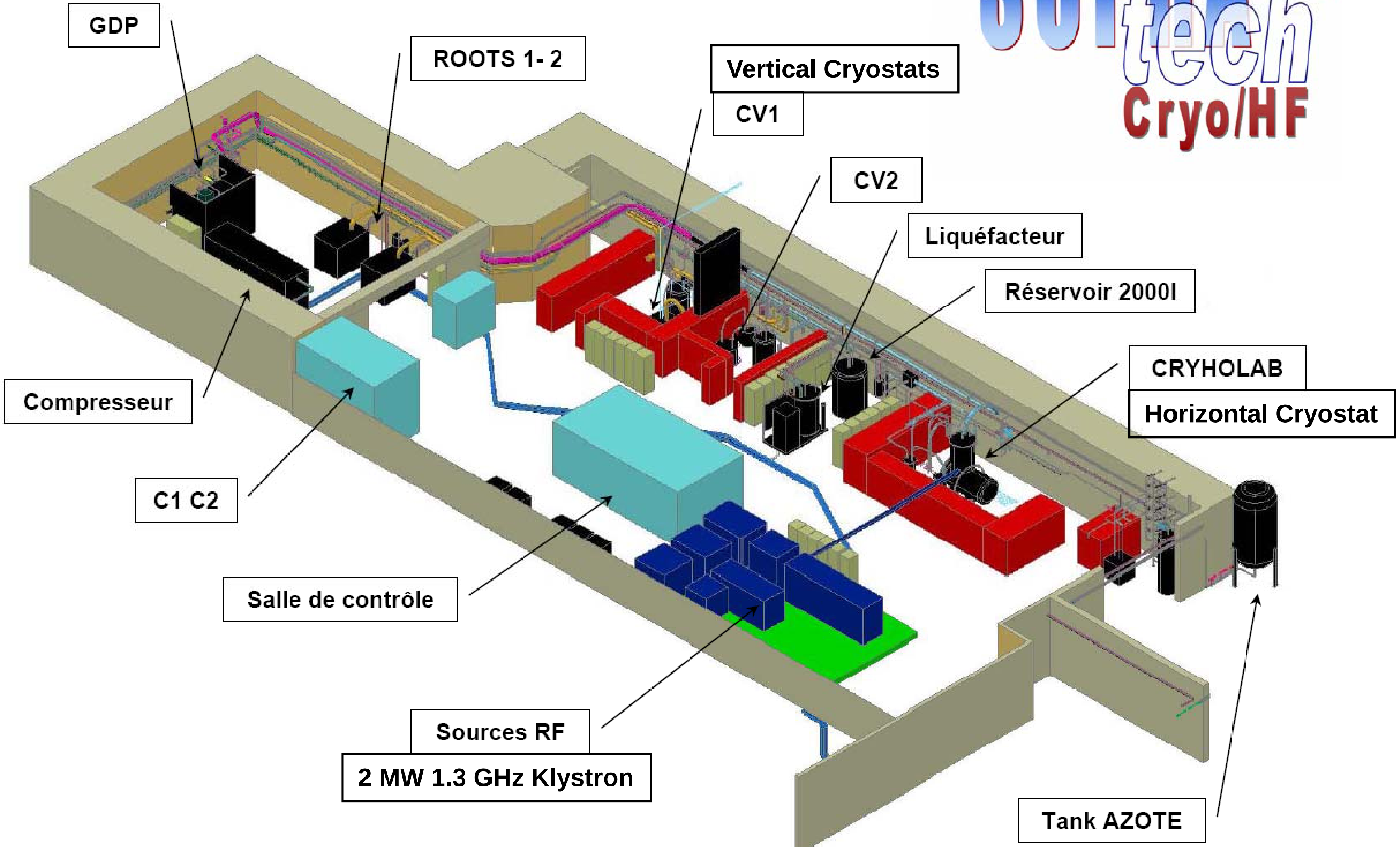
ILC Activities

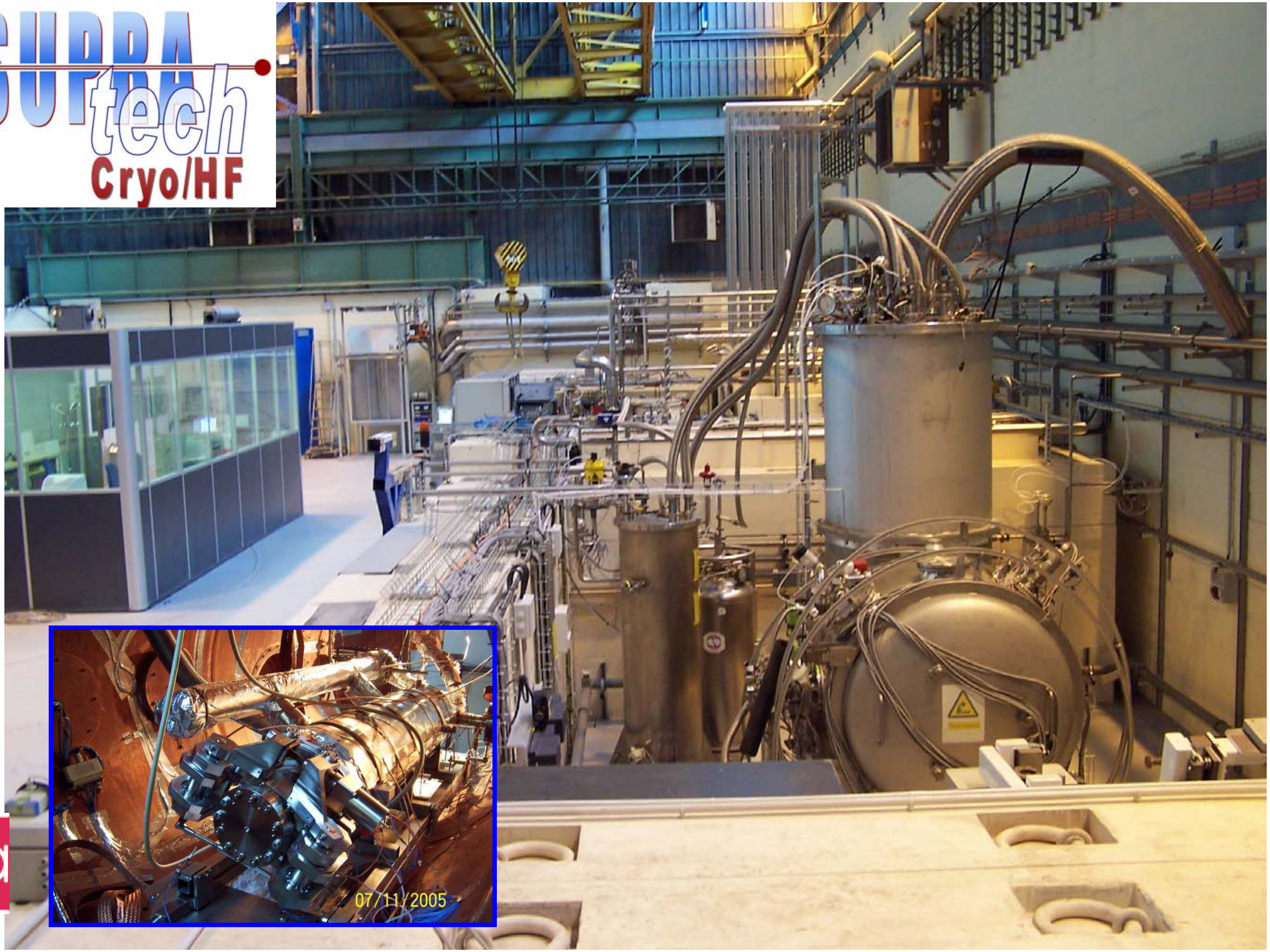
at CEA – Saclay

1. **Superconducting RF**
2. **Beam Delivery and IR**

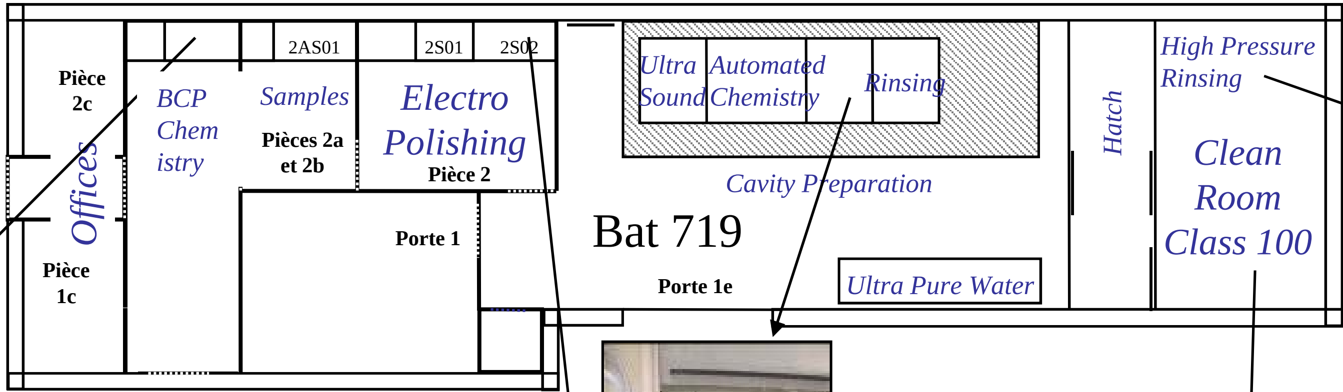
Layout of New RF Test Experimental Area (operational since mid'2007)



RF Test Flagship : CryHoLab



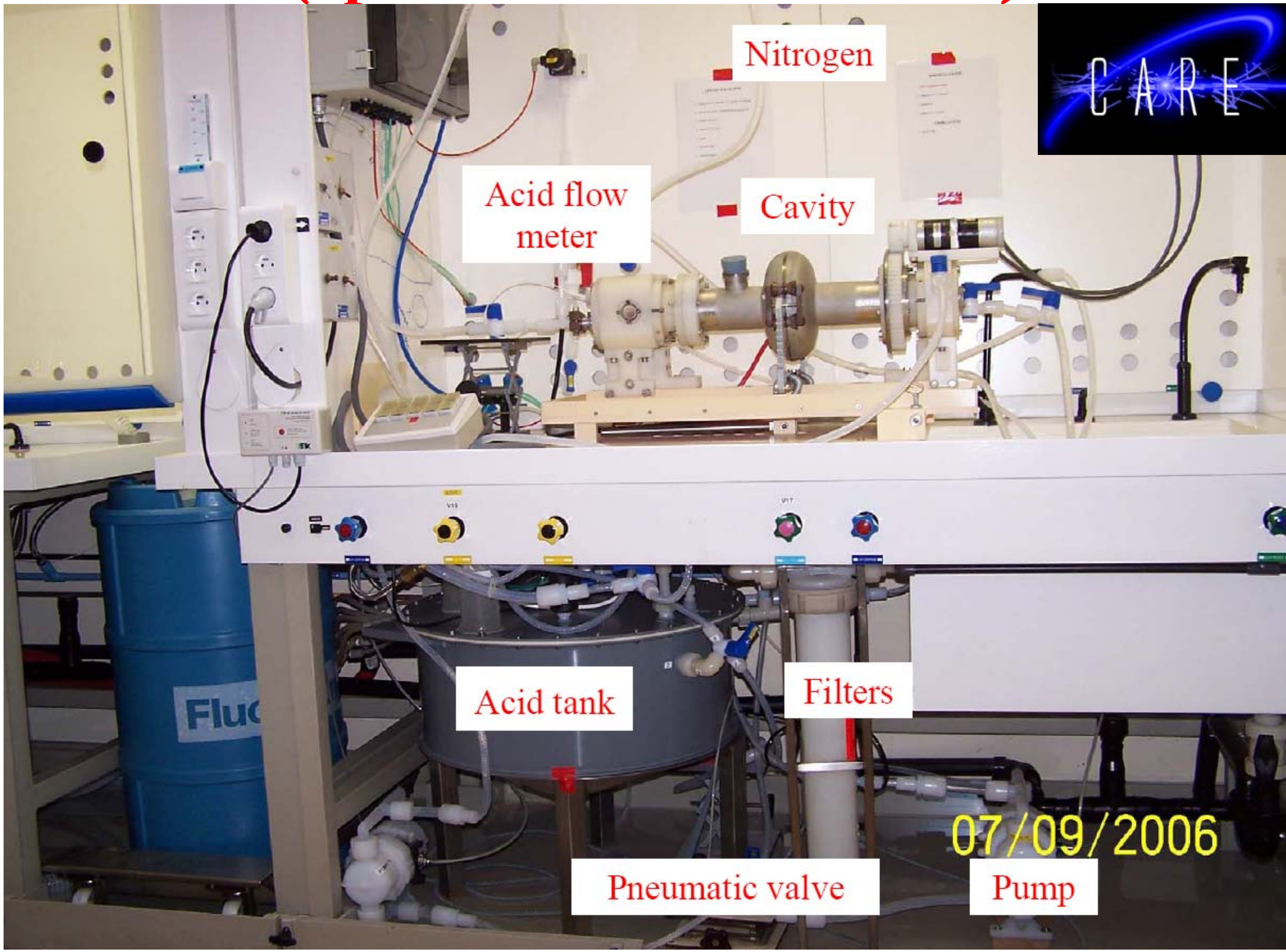
Cavity Preparation Area: Clean Room + Chemistry



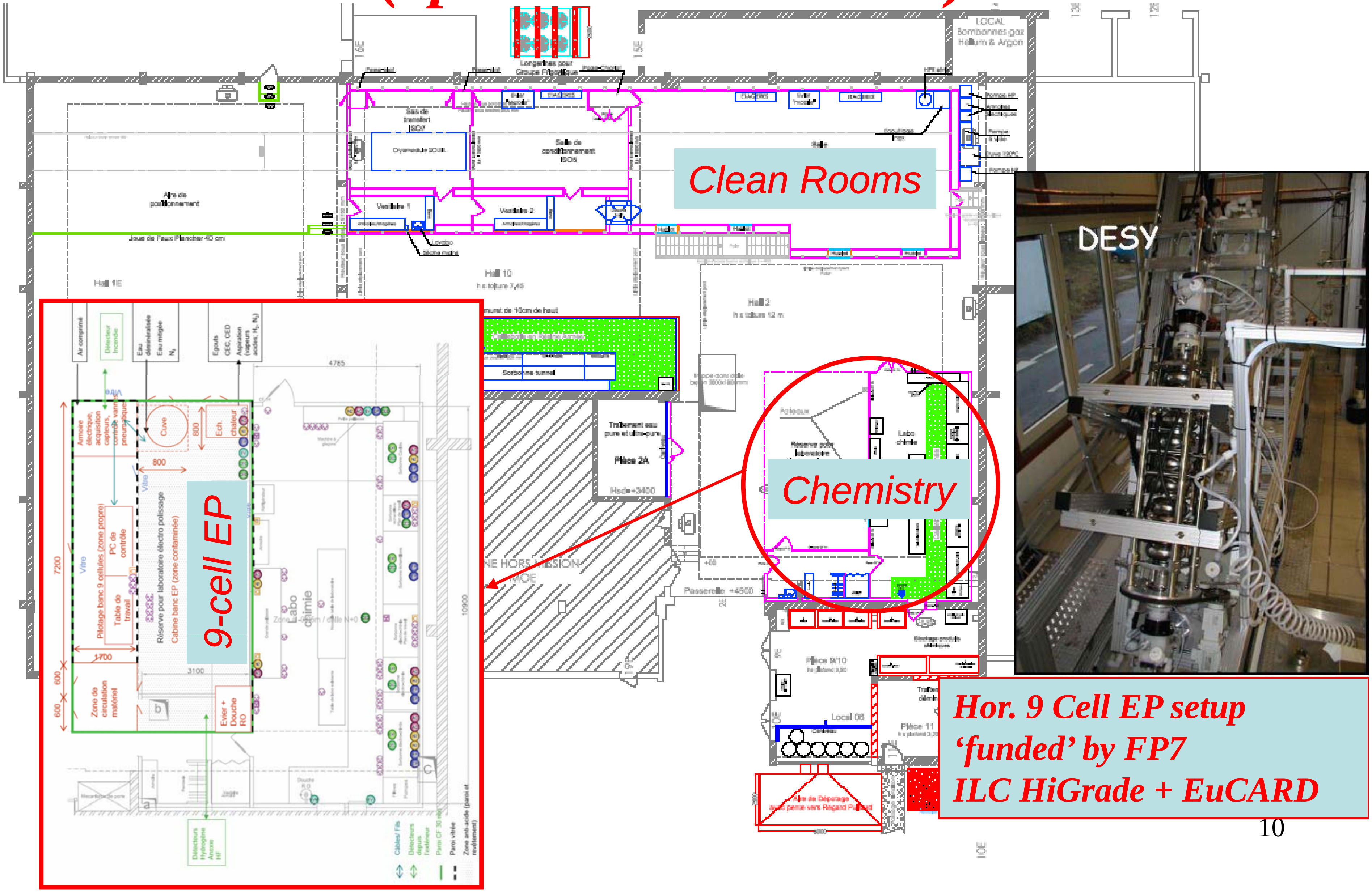
Installation initially designed to process CEBAF-like cavities (0.5 m, 5 cell, 1.5 GHz)

⇒ Upgrade for 1 m long ILC 9-cell (height), and SPIRAL2 cryomodule (weight)

Flag Ship : Single Cell EP Setup (operational since end'06)



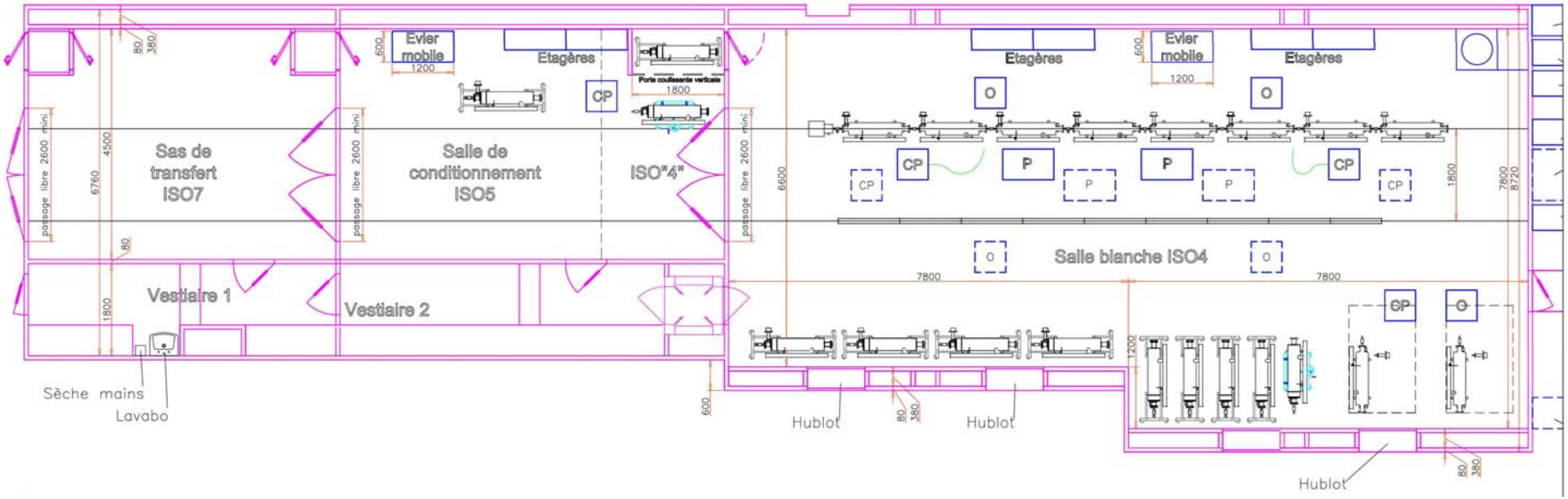
New Cavity Preparation Area (operational mid'2009)



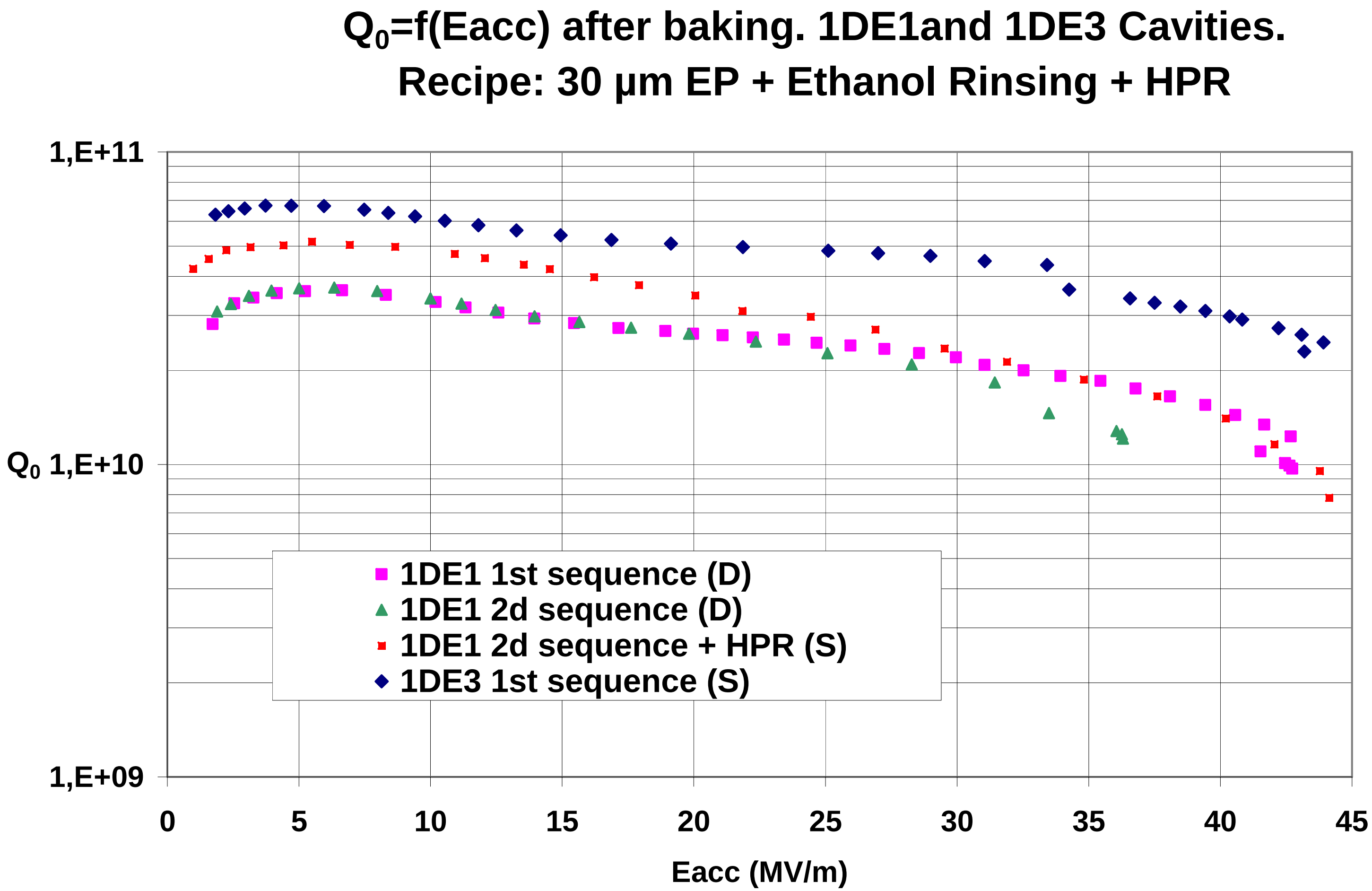
Hor. 9 Cell EP setup
'funded' by FP7
ILC HiGrade + EuCARD

XFEL Clean Room (cf. XFEL Talk)

Design finished
Installation June 2008
In operation beginning 2009

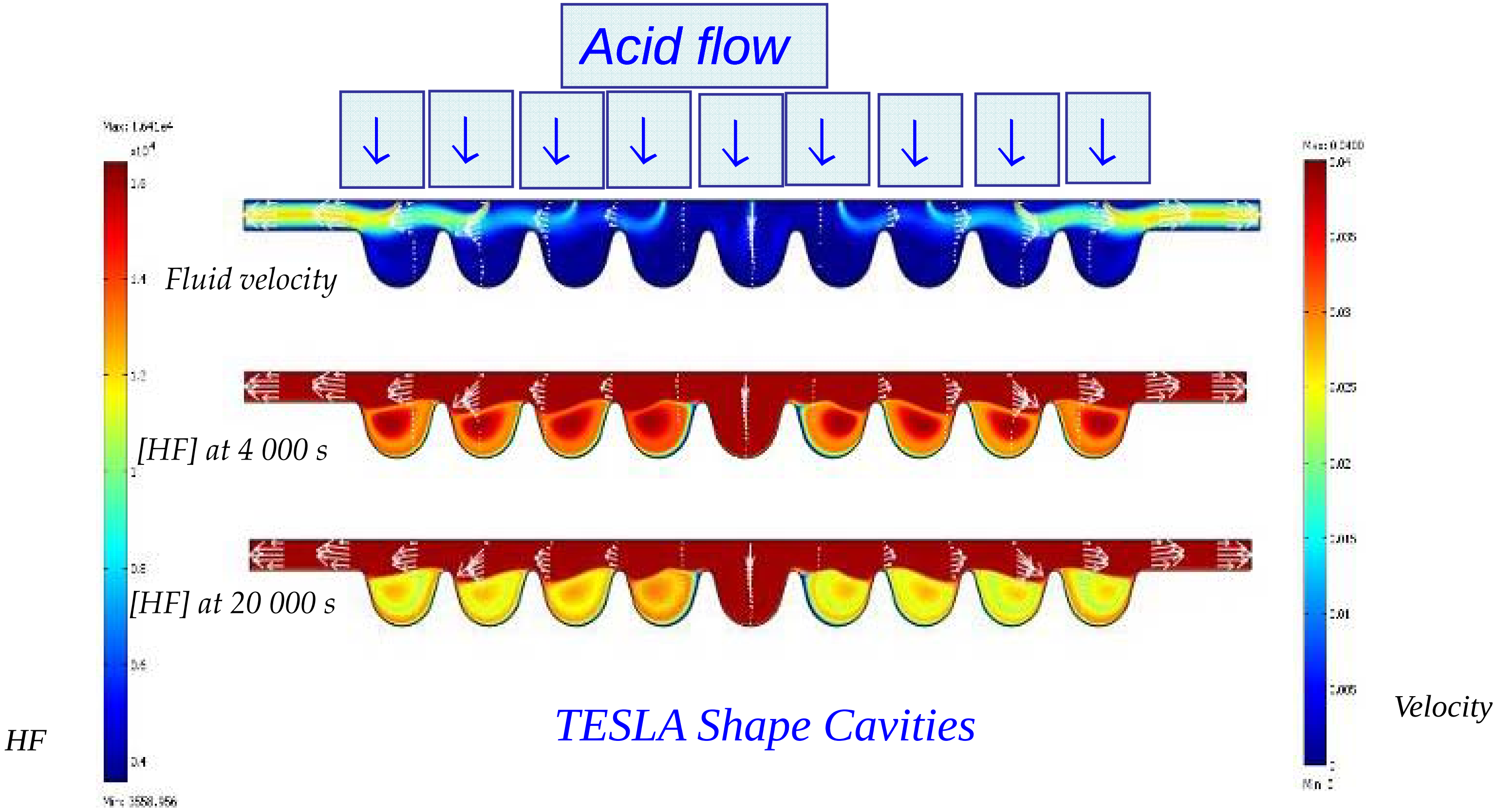


Participation to the RDB S0 Program (1 Cell EP + Alcohol Rinsing)



RESULTS FOR 1DE1 AND 1DE3 CAVITIES

EP Modeling with COMSOL

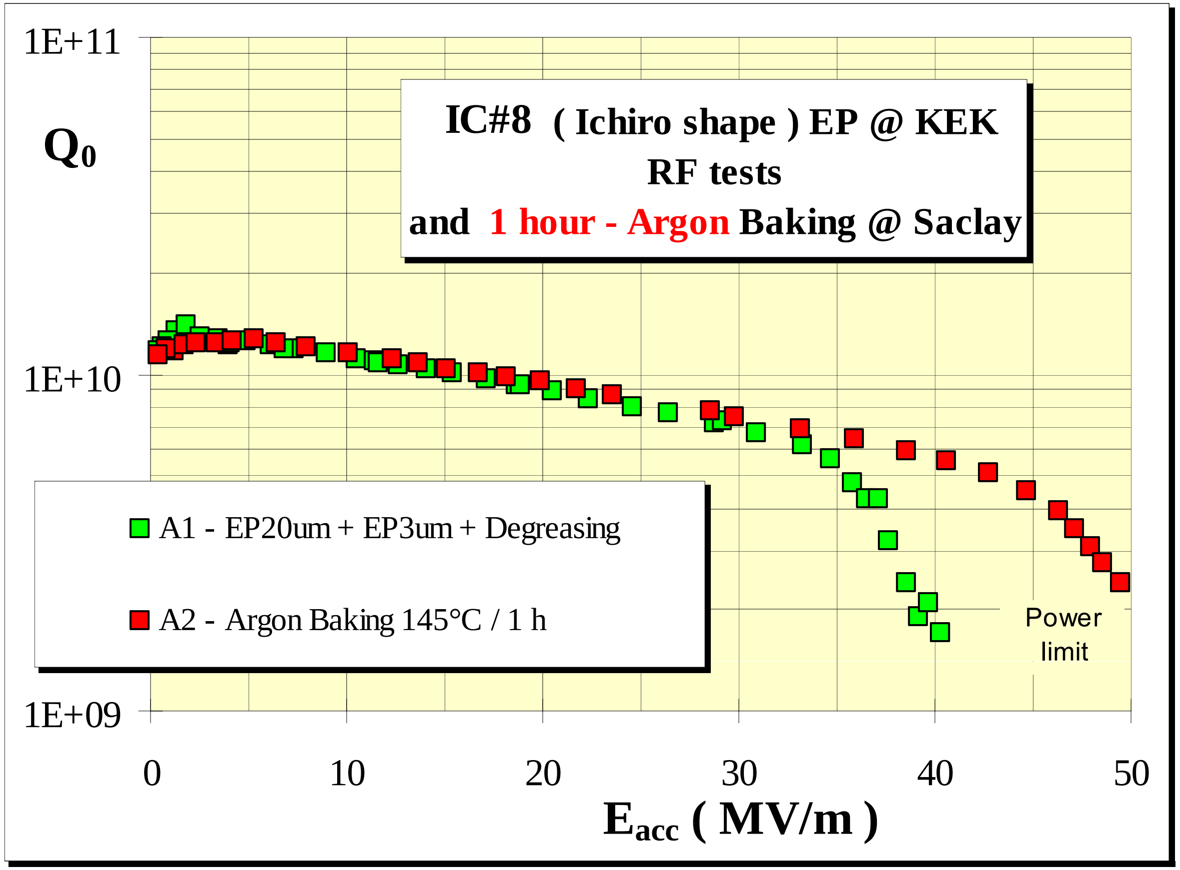


→ Good electropolishing of middle cell 5.
→ Electropolishing needs to be improved in the other cells.

Explanation of the different yields between 1-cell and 9-cell cavities ?
Explanation of the field flatness degradation observed at KEK after EP ?

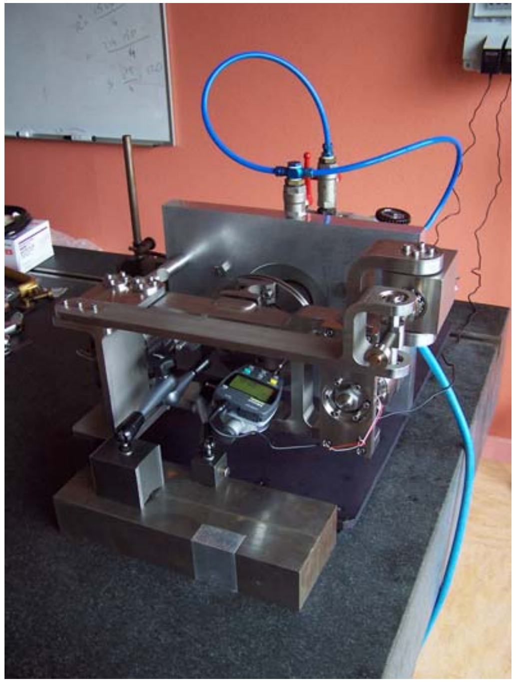
Fast Baking (145°C vs. time)

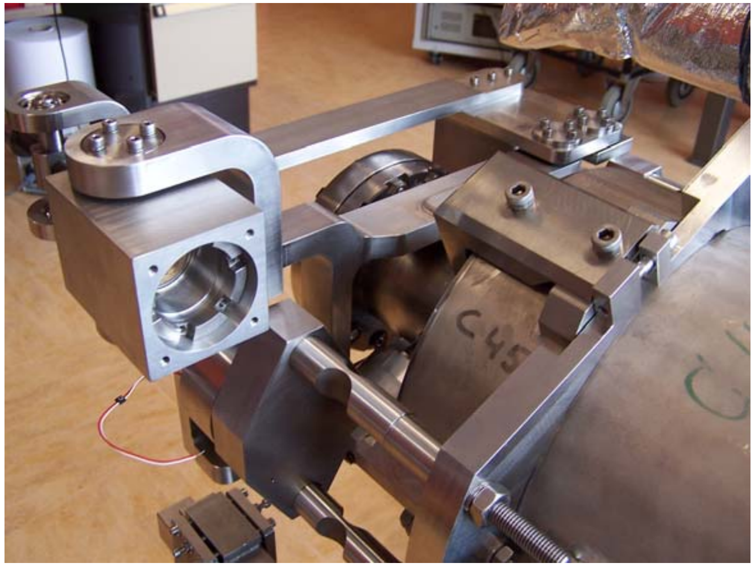
- Single Cell ICHIRO cavity electropolished at KEK
- *Fast 1 hour* Argon baking and RF tests at Saclay



ICHIRO IS#8

XFEL Saclay IV Tuner





Test planned in CHECHIA (DESY) next week

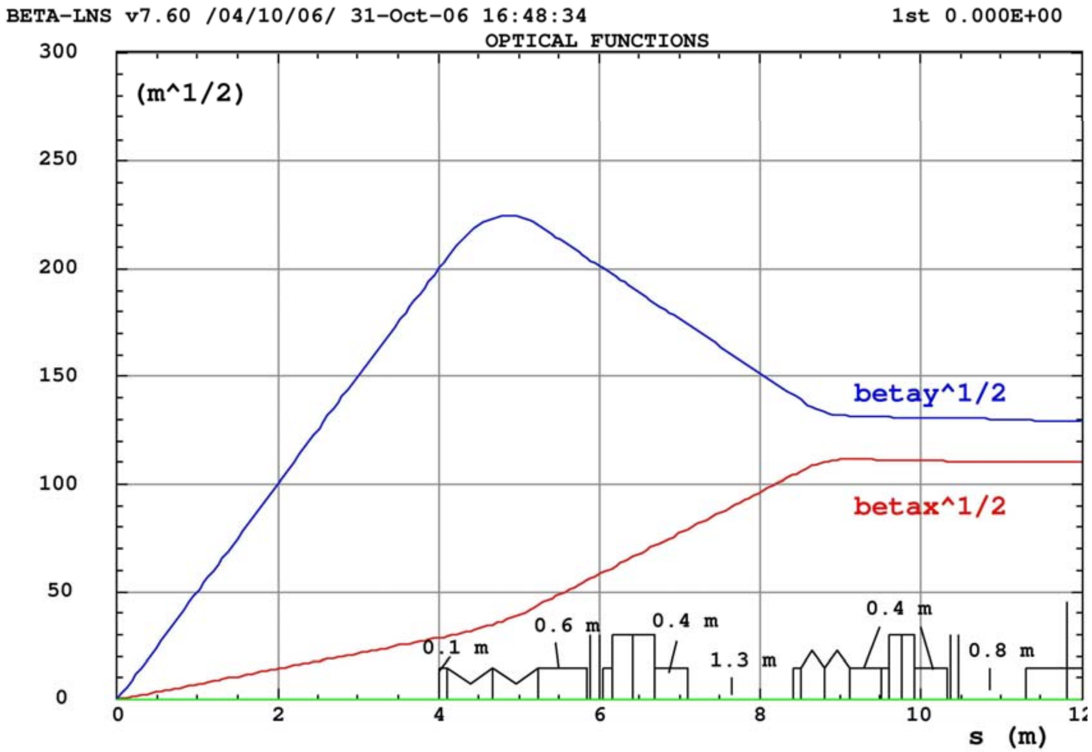
Beam Delivery and IR

Research Programmes

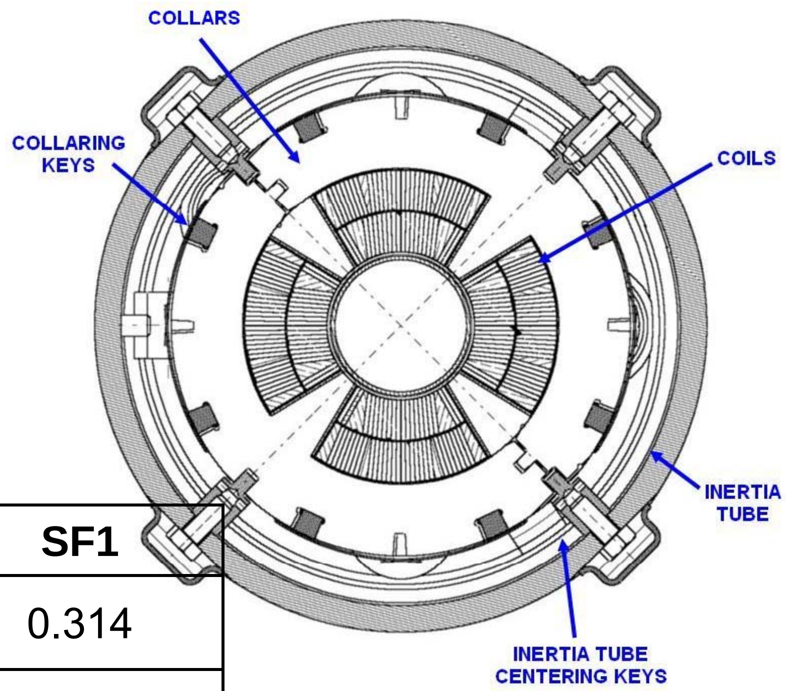
at CEA – Saclay:

1. **Head-on Interaction Region**
2. **High Field Nb3Sn Quadrupole**
3. **LDC Solenoid design**

Head-On Interaction Region and BDS Design



Final doublet design assumes engineered LHC arc superconducting Quadrupoles and Sextupoles with 56 mm bore diameter

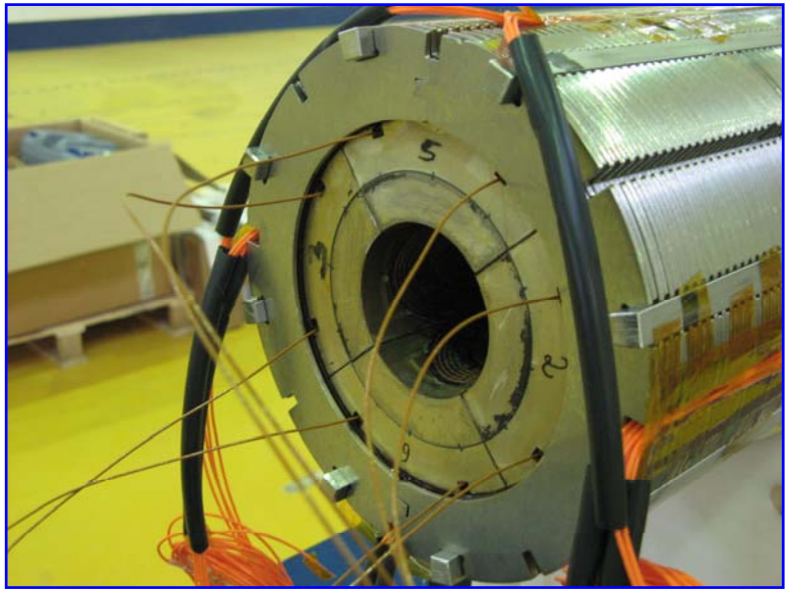


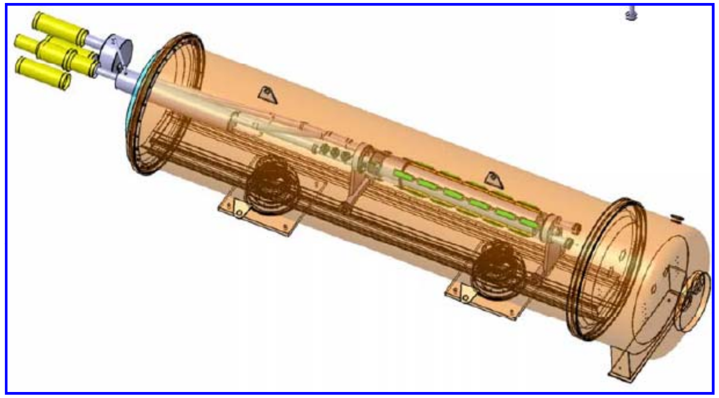
	QD0	QF1	SD0	SF1
Length [m]	1.146	0.593	0.548	0.314
Gradient	250 T/m	250 T/m	3880 T/m2	3662 T/m2
Field @ bore	7 T	7 T	3 T	2.9 T

Nb3Sn Quadrupole Program

- Main goals : Get an experience in the *Nb_3Sn technology* keeping in mind the industrialization process
  Build a 1-m-long model, 56-mm single aperture with no magnetic yoke
- Model design based on the design of LHC arc quadrupole magnets

Gradient	211 T/m
Current	11870 A
B_{peak}	8.3 T

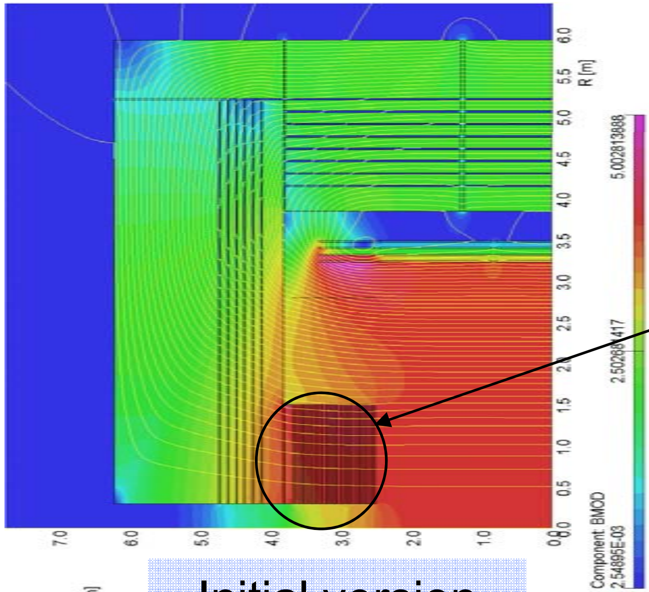




- 2 dummy coils and 6 certified coils have been manufactured between August 2004 and February 2007
- 2 coils with short circuit have been successfully repaired in April 2007
- *The four best coils have been assembled and collared in November 2007*
- Warm field measurements of the magnet are foreseen for the end of January 2008
- *Cold tests of the magnet are foreseen in the first half of 2008.*

LDC 4T Solenoid Design

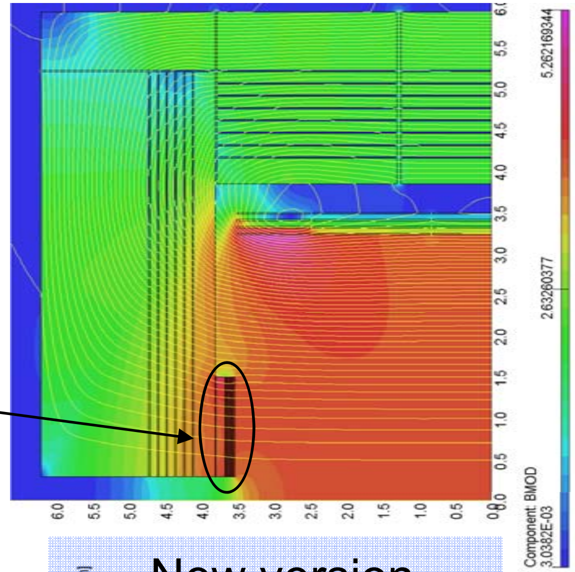
Optimisation of B-Field Homogeneity including the following modifications



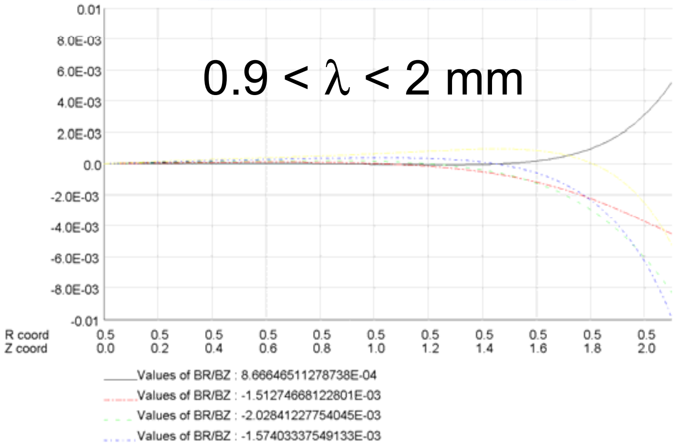
Initial version

Modifications :

1) *Coil Length*
   6.6 m ⇒ 7.0 m
2) *No ferromagnetic material in HCAL*
3) *200 mm Iron Plate in End Cap*



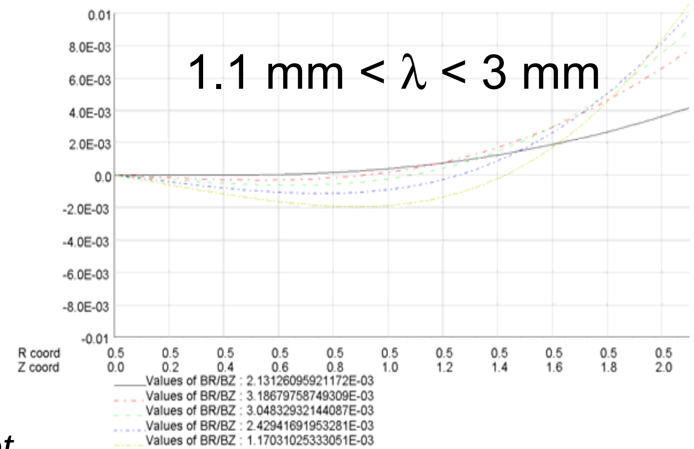
New version



Homogeneity in the TPC

$\lambda = \int (B_r/B_z)dz$ for

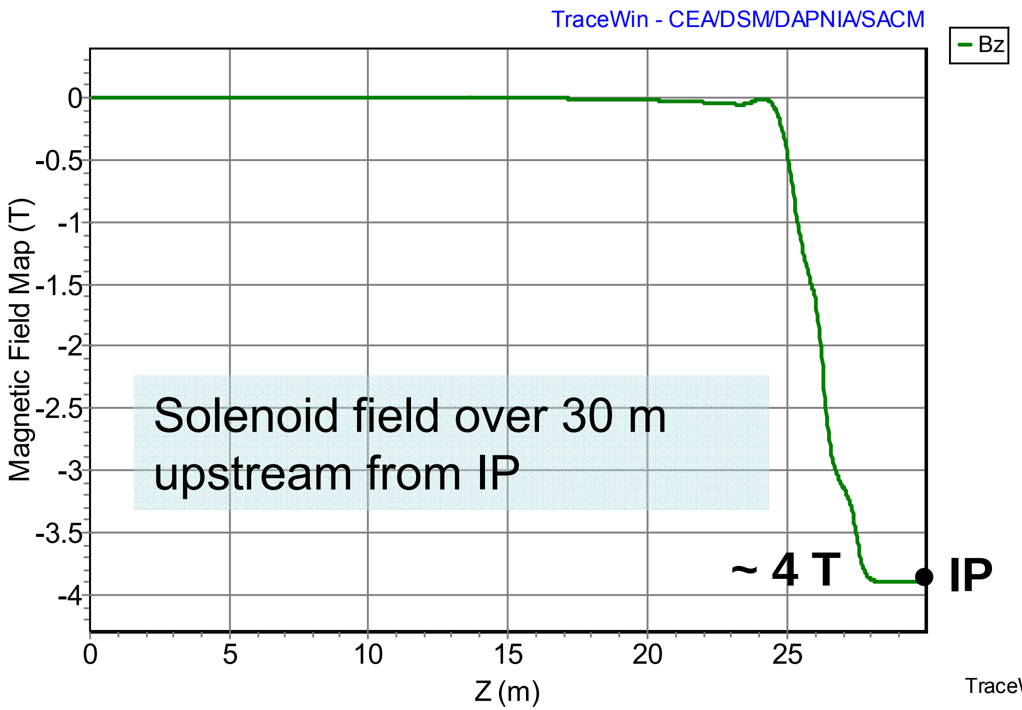
$0 < r < 1.6$ m

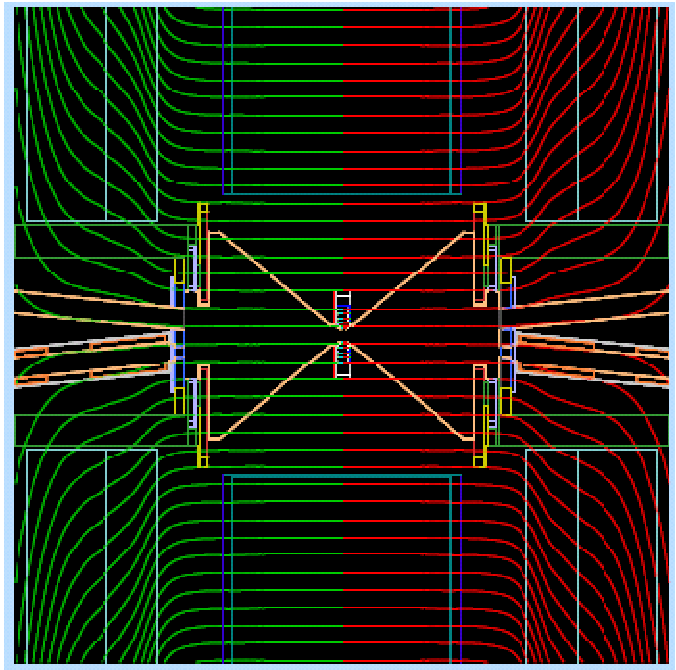


Laboratoire Leprince-Ringuet
Physique des Particules et Astrophysique

Collaboration with
Henry VIDEAU et Catherine CLERC du Laboratoire Leprince-Ringuet

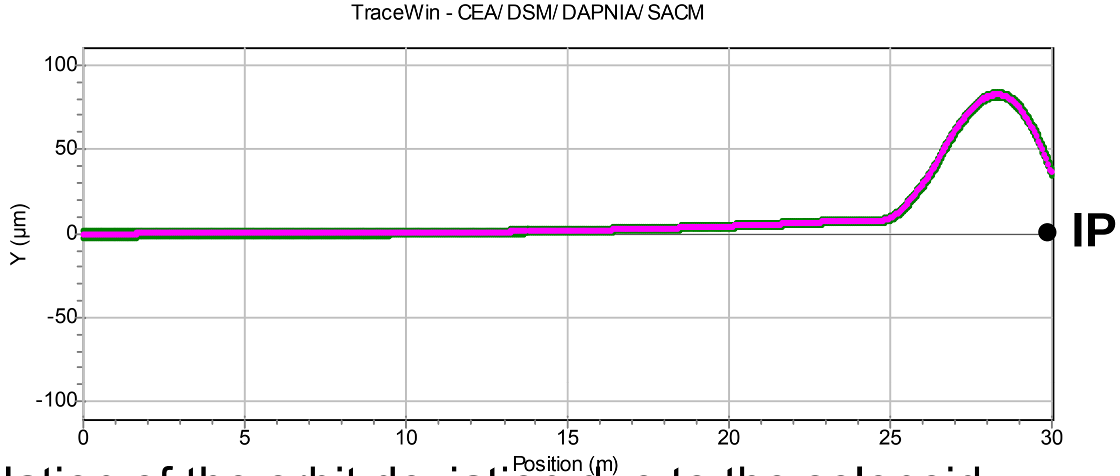
Tuning studies for 14 mrad scheme





Vertical trajectory for the starting coordinates :

x=0.21 m ,x'= 7 mrad,



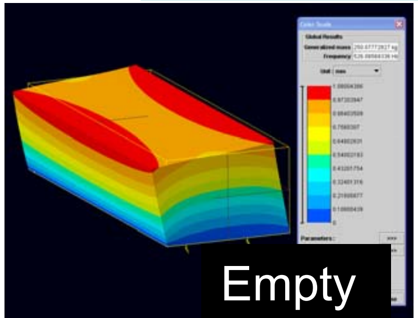
CEA-TRACEWIN calculation of the orbit deviation due to the solenoid

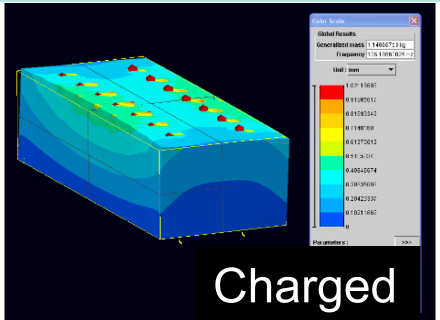
LAPP ILC related activities

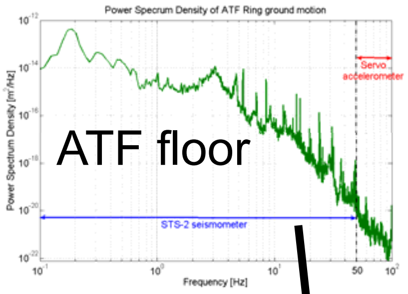
- ILC and ATF2
- ILC outside ATF2
- CLIC related activities

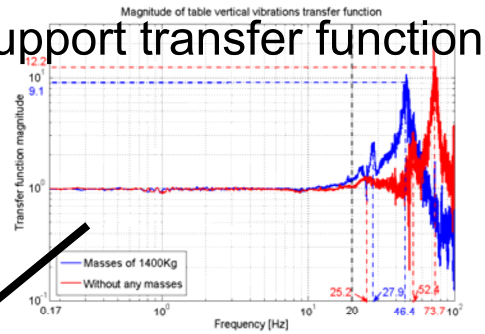
ATF2 at Annecy

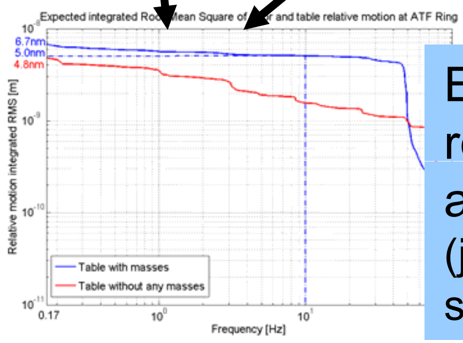
- Design, simulation and construction of FD support: honeycomb bloc; adapt movers to bloc; attach support to ATF2 floor
- Need compatibility with IP instrumentation supports
- Vibration measurements at Annecy complete with support and magnets
- Estimation of relative motion at ATF2 using transfer function from LAPP and ground motion measurements from ATF
- Installation at KEK in June 2008
- Open up to beam dynamics









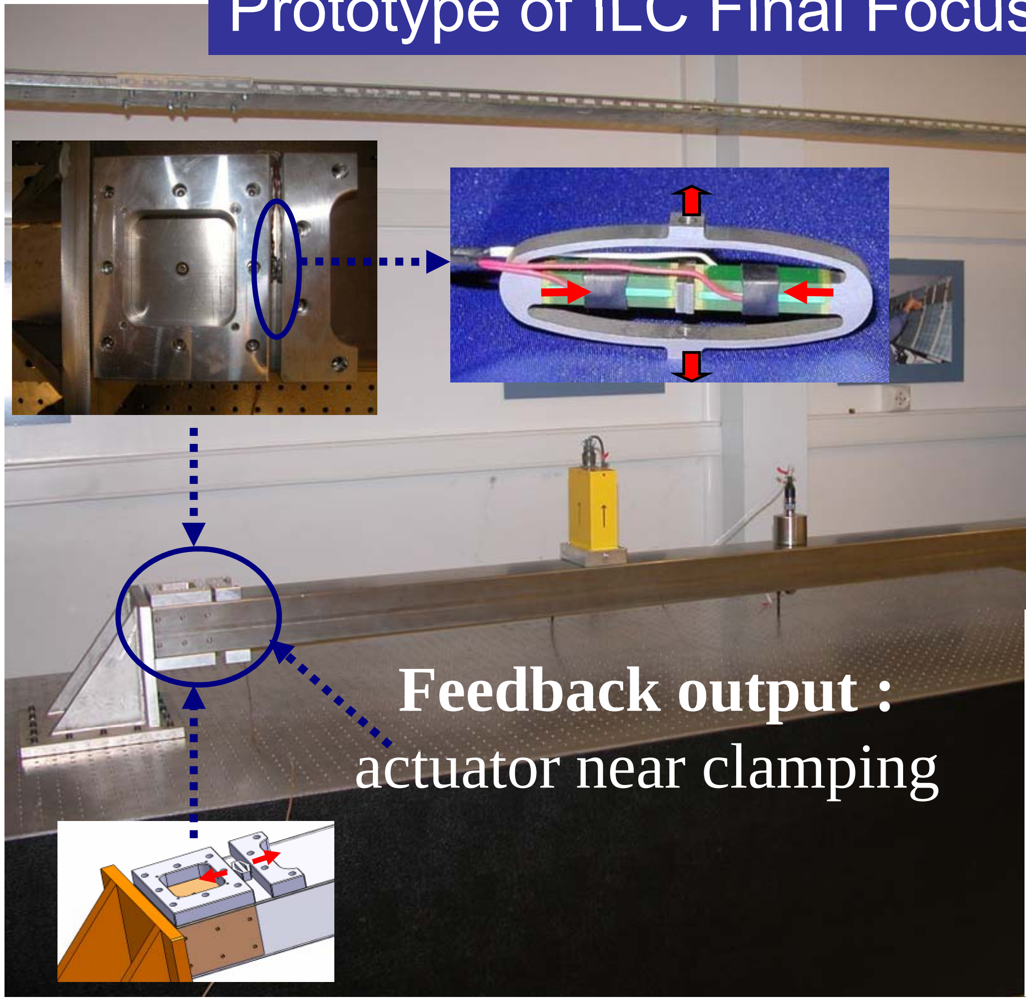


Estimation of relative motion at ATF2: 6nm (just about the specs)

Compensate the structure resonances (1/3 of beam size at f~frep/25 around 1-10Hz)

Prototype of ILC Final Focus magnet

Nanometre instrumentation exists



Feedback input :
sensor of free end

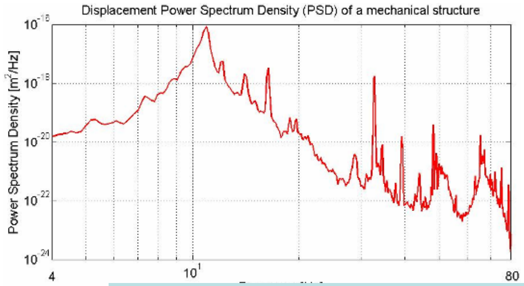
Feedback output :
actuator near clamping

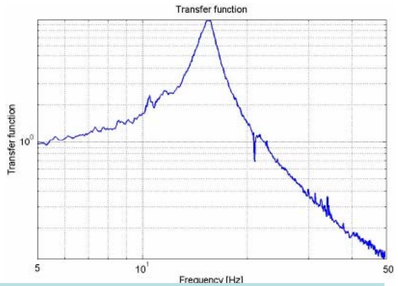
PCI6052 DAQ: Sensor acquisition and actuator control

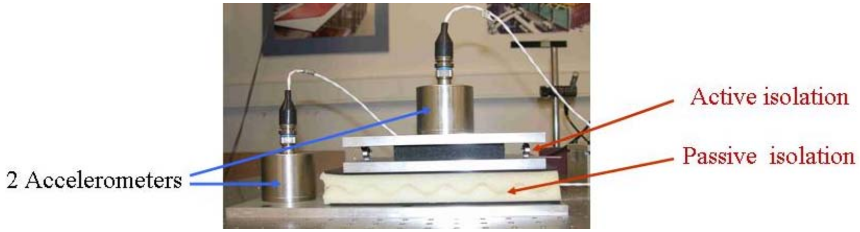
Discussion with A.Seryi and B.Parker for use of these actuators in ILC

Sub-Nanometre stabilisation

Combine passive (foam) and active isolation for ground motion isolation







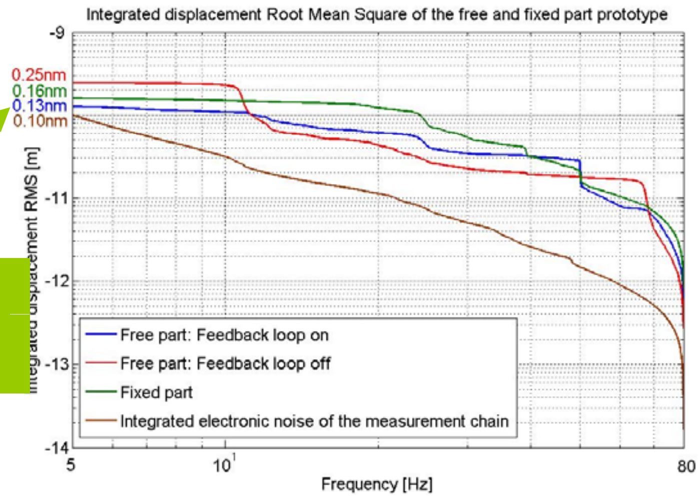
foam cuts high frequency vibrations but enhances at low freq.

active feedback cuts the resonance from passive isolation

Combine resonance compensation and isolation

Cuts ground motion vibrations (foam and feedback) and structure resonances (LAPP algorithm)

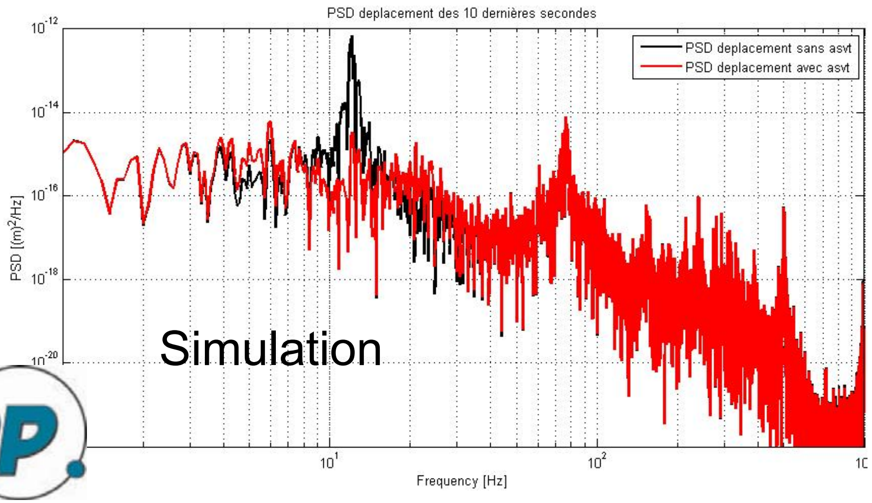
0.13nm at 5Hz at free end

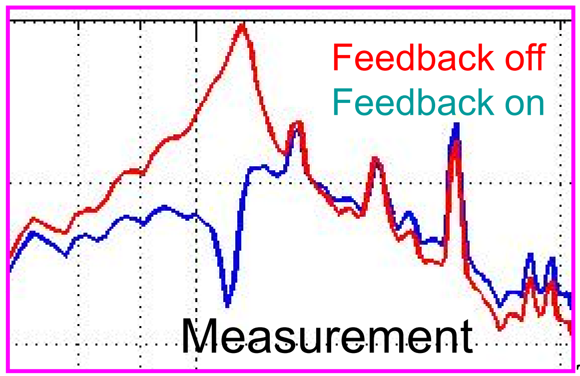


Dynamic response

Feedback algorithm development with the help of mechanical simulation

SAMCEF	***MATLAB***	***Simulink***
FE Model Creation →	**State-Space Model Creation** →	**State-Space Model Use**





CLIC/CTF3 stabilisation

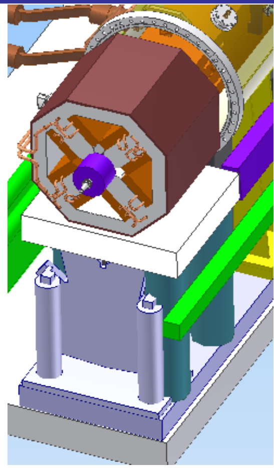
(European bid due February 2008)

Explore potential to achieve 0.1nm stability scale for the final doublet quadrupoles above a few Hz (by ~2012)

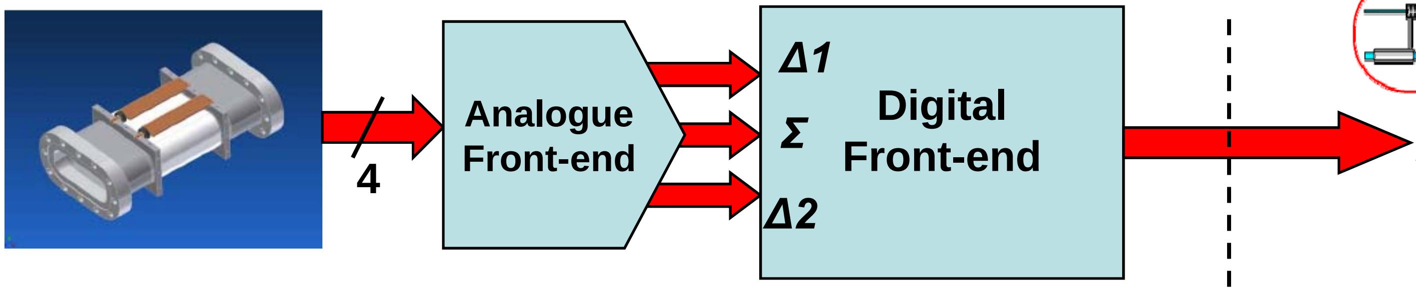
Final focus support: design, simulation, construction and installation of the support (final doublet mock-up, eigenmode analysis).
Feedback design: Adapt software to new configuration and boundary conditions.
Continue work to reduce costs.

Demonstrate better than 1nm stability of the main linac quadrupoles in an accelerator environment above frequencies of approximately 1Hz (by ~2010)

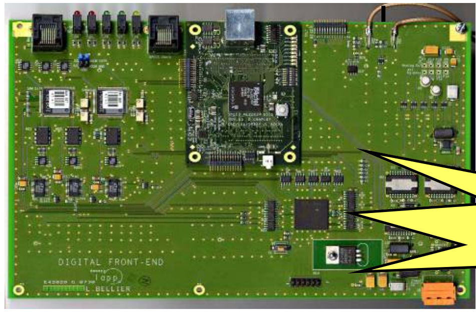
Inertial sensors: test and evaluate for accelerator environment (magnetic field, radiation, electrical and acoustic noise from accelerator components).
Integration with alignment beam feedback etc…



BPM electronics



Near the beam <10m



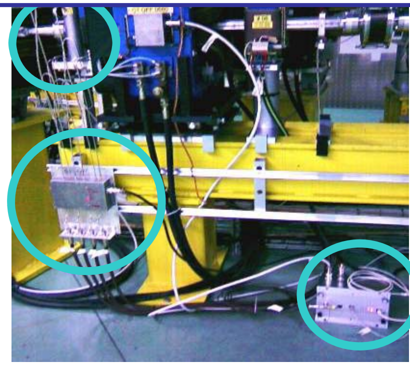
LAPP Digital front-end board

New solution ⇒ 3 TIMES CHEAPER!!!

Analogue Front-end

Specs PCI Board

On CTF3, under TL1



Tests continue spring 2008

LAL activities on ATF2

M.Alabau, S. Bai, P.Bambade, J. Brossard, Y. Rénier, C. Rimbault

Beam phase-space injected into ATF(2) EXT

Evaluation / improvement of vertical emittance measurement methods in presence of errors. Modeling of non-linearity in shared extraction channel and design of trajectory bumps for control. Stability. Dispersion matching, Commissioning and experimentation at KEK.

Pulse-to-pulse feedback at IP in ATF2

Ground motion modeling and analysis. Trajectory feedback algorithm. Beam correction modeling and tolerances. Feedback controller. Long term stability. Commissioning and experimentation at KEK.

Final focusing at ATF2 IP

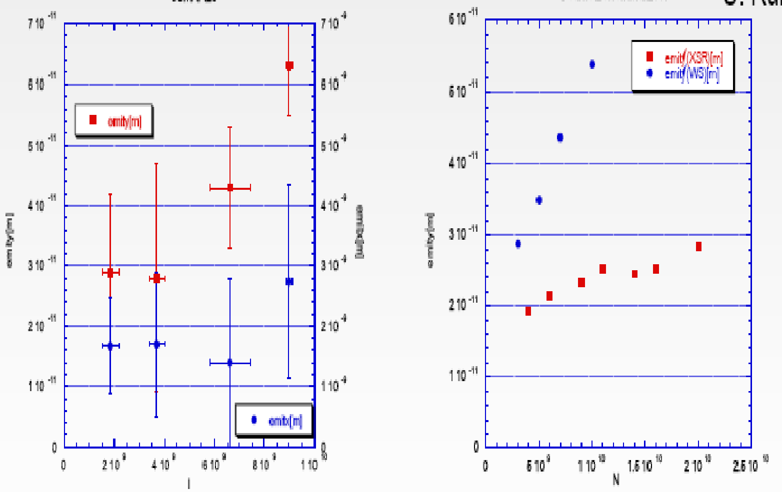
Spot optimisation with reduced tolerances for commissioning and varying IP locations. Limits and dependencies of final focus local chromaticity correction scheme. Control of optical aberrations. Static and dynamical optical tuning algorithm. Commissioning and experimentation at KEK.

ATF EXT emittance investigation

Vertical emittance growth in ATF Extraction Line

Measured vertical emittances are higher than expected, and there is a dependence with the beam current.

(Results from 2000) (Results from 2007) S. Kuroda et al.



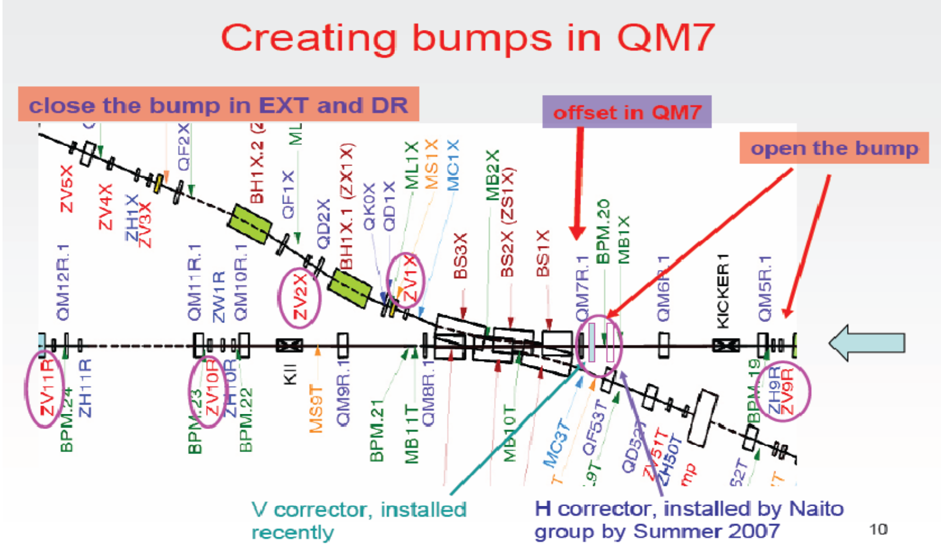
Hypotheses **mainly in shared quad QM7**

-Non-linearity (coupling)

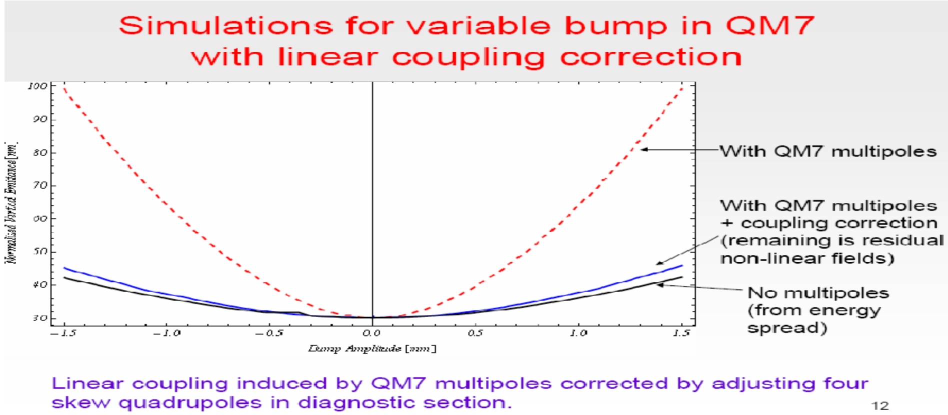
-Emittance measurement accuracy

-Intensity dependence: wakefields, orbit (BPM) ?

2



M.Alabau (collaboration with R. Appleby et al.)



→ Must make sure this won't limit ATF2 !

First results with bump in QM7

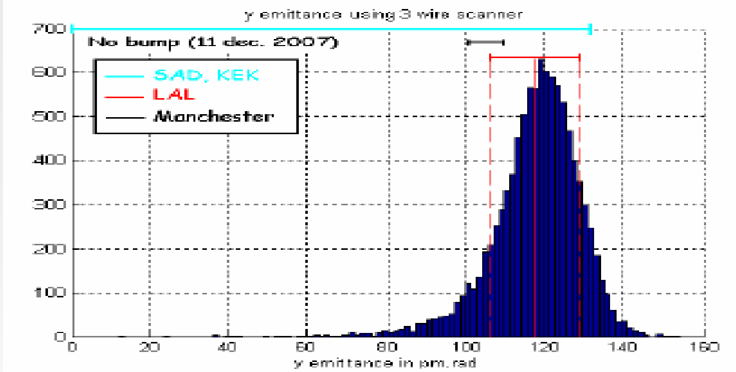
Reconstructed magnitude -0.81 mm

Emittance reconstruction

No bump

Vertical emittance =
118 +/- 11 pm.rad (J. Brossard, LAL)*
108 +/- 7 pm.rad (A. Scarfe, Manchester)
(52 +84 -52) pm.rad (SAD result)

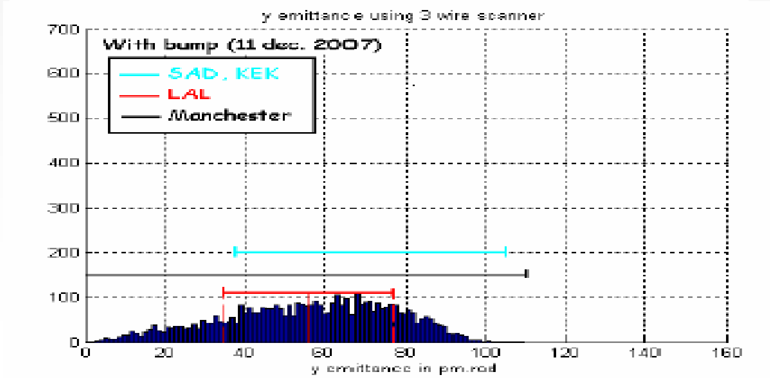
*Results based on 10 000 test within the error bar.
(rejection level of 0.02 %)



With bump

Vertical emittance =
56 +/- 21 pm.rad (J. Brossard, LAL)**
40 +/- 70 pm.rad (A. Scarfe, Manchester)
(47 +58 -9) pm.rad (SAD result)

**Results based on 10 000 test within the error bar.
(rejection level of 54.42 %)



ATF ring was not well tuned : mainly control room learning experience so far…

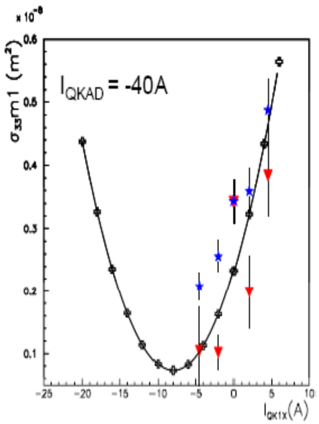
→ pursue more systematically in 2008 & 2009

Investigate emittance reconstruction methods:

1. Multiple wire scanners → χ^2 minimisation (constraints ?)
2. Combine normal + skew quad scans → reliable xy coupling ?

QK1X scan at MW1X wire scanner: coupling estimation using MAD8

• A "virtual" skew, QKAD, quad. of type QK1X is introduced at the beginning of the Ext line.
• Its strength varies until fitting with the measured points at MW1X with QK1X scan.
→the coupling is reproduced for I_{QKAD} : [-50; -35]A ≡ Ks[-0.258 ; -0.180]m^{-1}

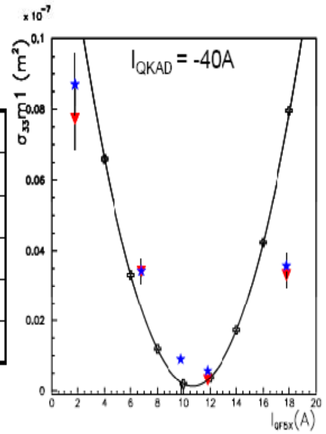


Fifth ATF2 Project Meeting , 19-21 dec. 2007, KEK, Japan

QK1X scan at MW1X wire scanner: coupling estimation using MAD8

• A scan of QF5X is simulated with different value of Ks_{QKAD}, and emittances are reconstructed.

I_{QKAD} (A)	Ks_{QKAD}(m^{-1})	ε_x (nm.rad)	ε_y(pm.rad)
0	0	1.12 ± 0.20	317 ± 73
-35	-0.1804	2.02 ± 0.09	248 ± 17
-40	-0.2062	2.02 ± 0.09	284 ± 21
-45	-0.2320	2.03 ± 0.09	319 ± 27
-50	-0.2578	2.02 ± 0.09	354 ± 33



Fifth ATF2 Project Meeting , 19-21 dec. 2007, KEK, Japan

C. Rimbault & J. Brossard

→ Dedicated schemes for flat beams (error analysis…)

velop practical tools for efficient control room work

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Contribution to "flight simulator" for ATF2

(collaboration with CERN, SLAC and KEK)

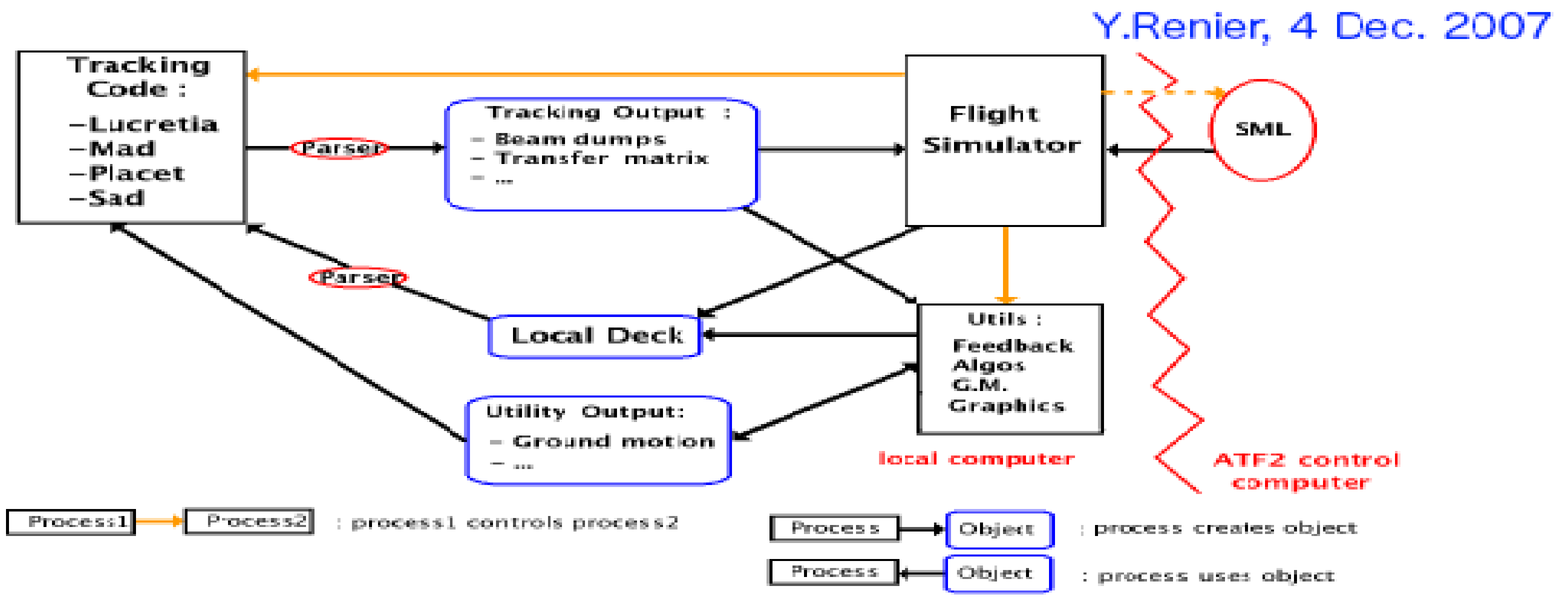


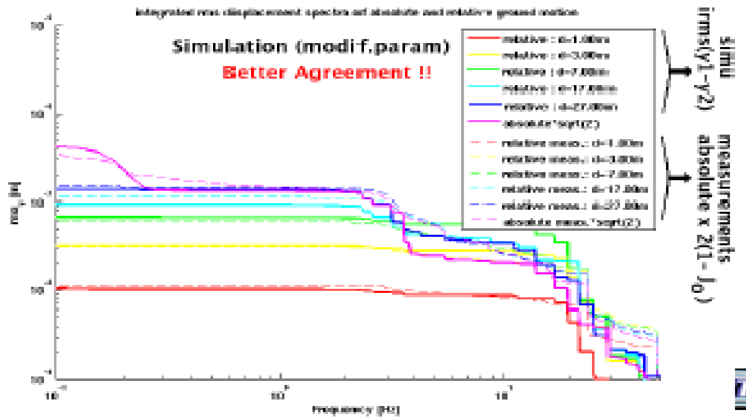
Figure 1 : Block diagram of changes induced by using several codes in the flight simulator

Possible action plan

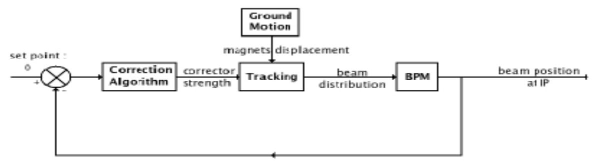
1) Identify optics codes to be supported.
2) Agree on format for the common optics deck (for instance AML ?)
3) Identify minimal set of utilities (feedback and tuning algorithms, GM, ...)
4) Identify required output and agree on common corresponding file formats.
5) Create command files for each optics code compatible with the common deck format (for instance AML ?)
6) Create parsers for the corresponding output files.
7) Create the defined minimal set of utilities, preferably in a given interpreted language e.g. Matlab and, for specific cases such as GM, adapt existing ones to satisfy 4)
8) Create parsers for the deck and output files for the other optics codes.

Ground motion generator and IP feedback design

Integrated RMS displacement



Description of the feedback

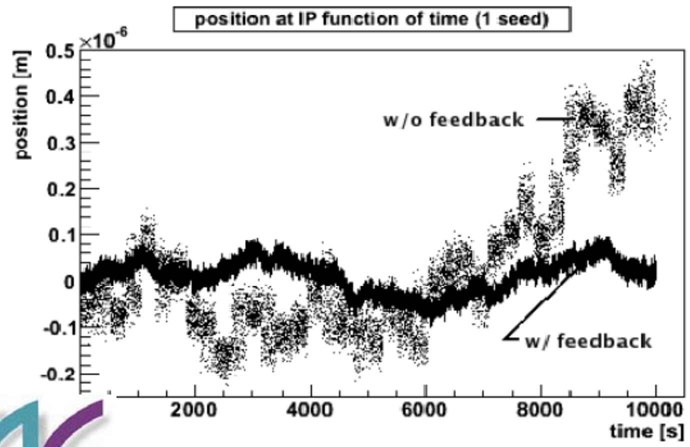


- For the moment, tracking (and GM modeling) is only done on FF ATF2 line.
- Corrector used is the sweeper magnet after FD used for SM.
- PID Correction Algorithm: $C(p) = k_p + \frac{k_i}{p} + k_d \cdot p$

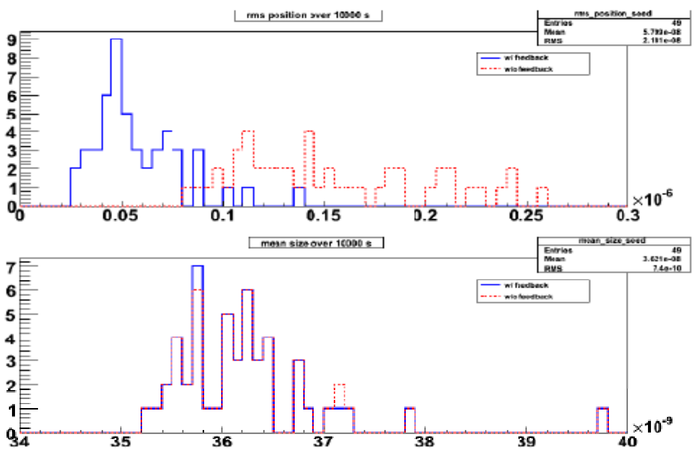
LAL/RT-0706,08

Y. Rénier

Displacement over 10000 s with feedback



IP position and size over 10000 s with feedback



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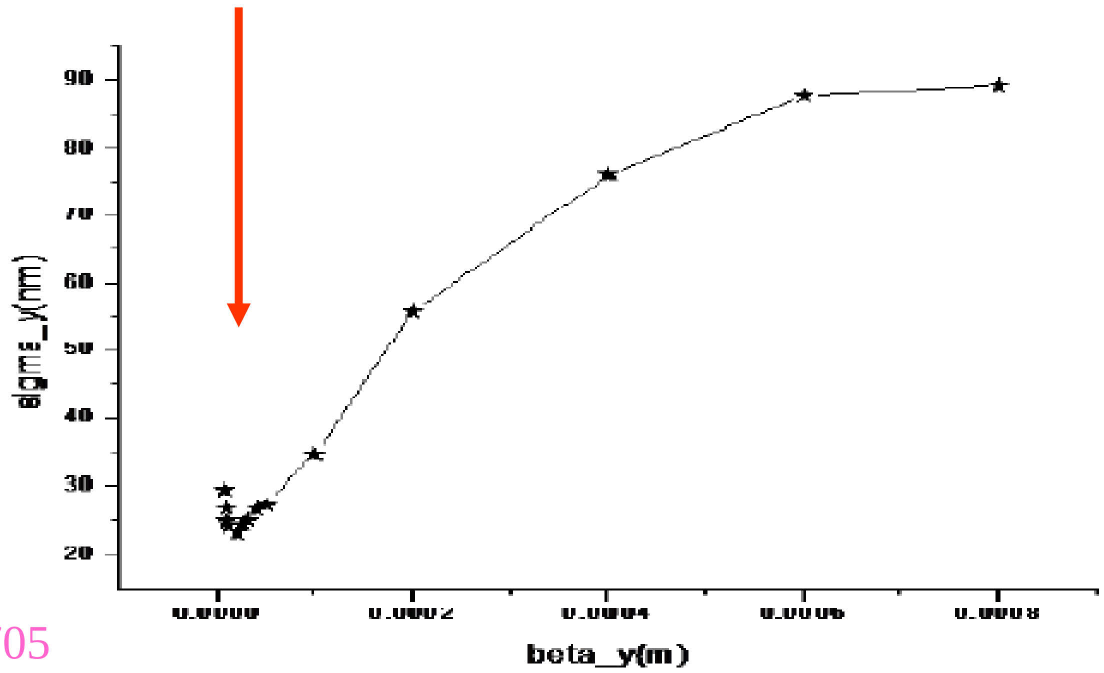
1. **Increasing β_y → gradual approach with looser tolerances**
2. **Reducing β_y → enhanced performance**
3. **Idem at Honda-monitor and wire-scanner locations**

Variable beam size at the interaction point (Gaussian fit to core)

Minimum with existing design and hardware : ~20 nm



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LAL/RT-0705

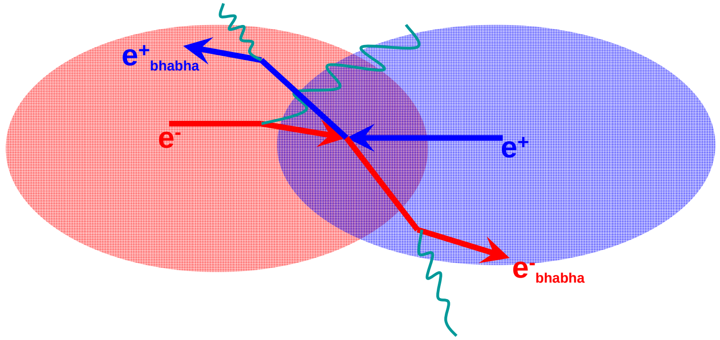
S. Bai

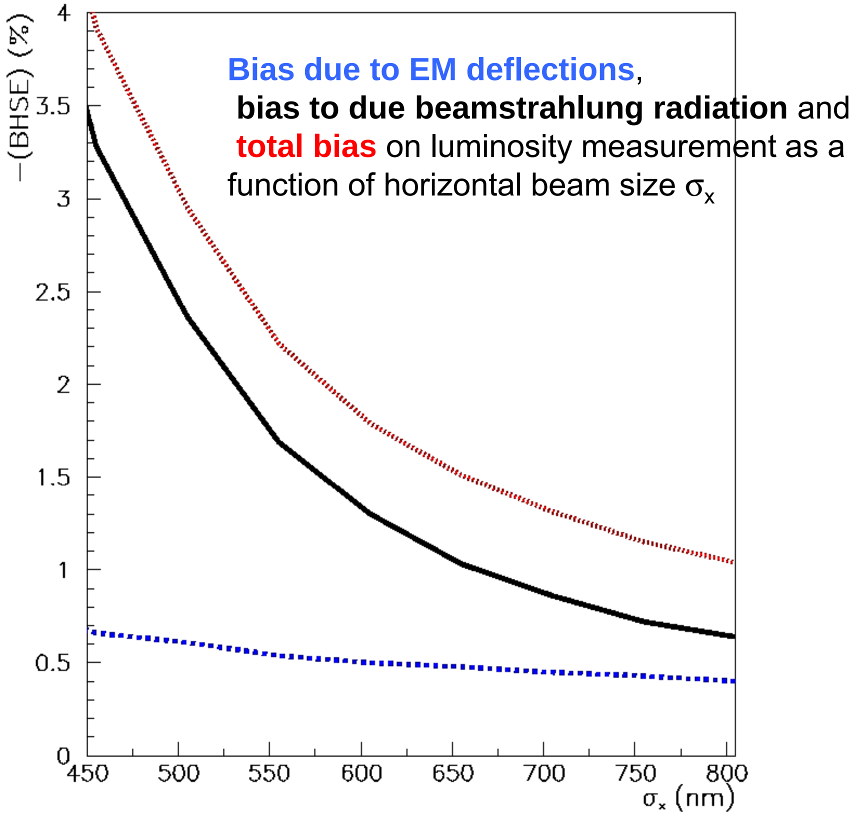
→ **Checking magnet variation ranges and designing orthogonal knobs**

BBSIM1 - Study of Impact of beam-beam effects on precision luminosity measurements using Bhabha scattering at ILC

C. Rimbault, P. Bambade, K. Mönig, D. Schulte

- **Kinematics of the Bhabha process is modified by the collective space charge effect (beamstrahlung + electromagnetic deflections) ➔ Number of detected Bhabha in a given angular acceptance is lower than the theoretical predictable one**
- **This leads to a bias of the order of 10^{-2} (for nominal case) in the luminosity measurement. But the bias depends on the parameters of the beams (energy, sizes, intensity)**
- **Beam parameters must be controlled at better than 20% to reach a precision of 10^{-3} on the luminosity measurement**





→ **EUROTeV-Report-2007-017, JINST 2 P09001**
Contribution to ILC Detector R&D Panel Report, FCAL Collaboration, 2007

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BBSIM2 - Status of GUINEA-PIG++ Simulation

G. Le Meur, F. Touze, P. Bambade, C. Rimbault

- GP++ use configuration management environment **CMT** → easy compilation
- GP++ versioning, updating and releasing achieved with **SVN**
- GP++ is distributed on the web software development tool **TRAC**:
  https://trac.lal.in2p3.fr/GuineaPig
- GP++ code can be run both on 32-bit and **64-bit** computers.
- New keyword **rndm_seed** allows to choose the random generation seed.
- Physics simulation improvement: easy interface to apply beam-beam effects on Bhabha event input files and associated photons. See documentation
  http://flc.web.lal.in2p3.fr/mdi/BBSIM/bbsim.html
- Automatic GRID sizing option: auto-computation of the grid sizes and number of cells based on the input beam parameters or loaded beams and disruption angle calculation (EuroTeV memo drafted) → very useful for feedback studies.
- All results are now in the main output file, with units and few comments.

Future of Beam-Beam SIMulation task

- Implement and study spin depolarization in GP++ (Spring 2008)
- Extend hadronic mini-jet phase space (Fall 2008)
- Time performance improvements:

  parallel computation is under development

  research on pair production optimization
- Technical paper on GP++ developments

Involved persons at LAL: P. Bambade, G. Le Meur, C. Rimbault, F. Touze, + ?

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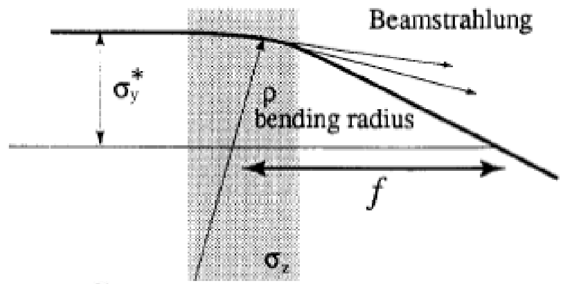
Beam-beam effects for e^+e^- and e^-e^- collisions

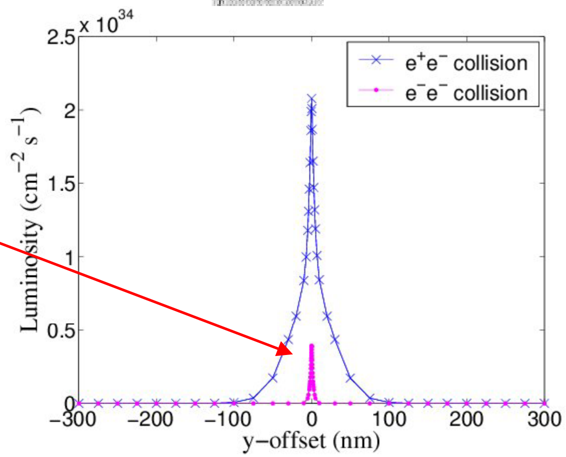
e^+e^-

Strong mutual focusing (pinch) that gives rise to luminosity enhancement H_D

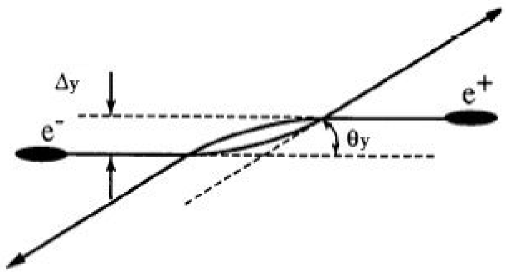


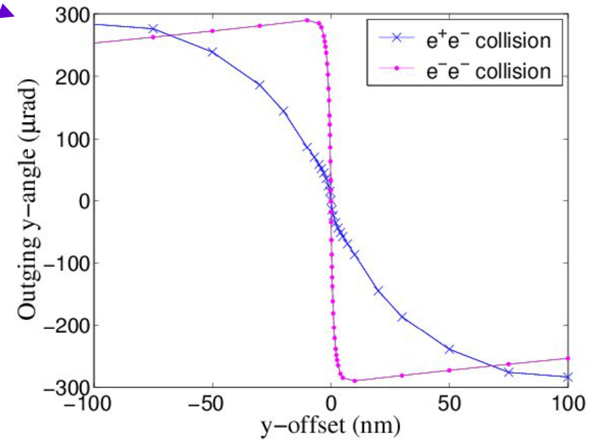
e^-e^-

Strong mutual defocusing (anti-pinch):
luminosity reduction
greater sensitivity to vertical offsets



If there is a vertical offset between the beams, deflects the trajectories





This deflection curve is the main signal to maintain aligned both beams into collision (fast IP position feedback system)

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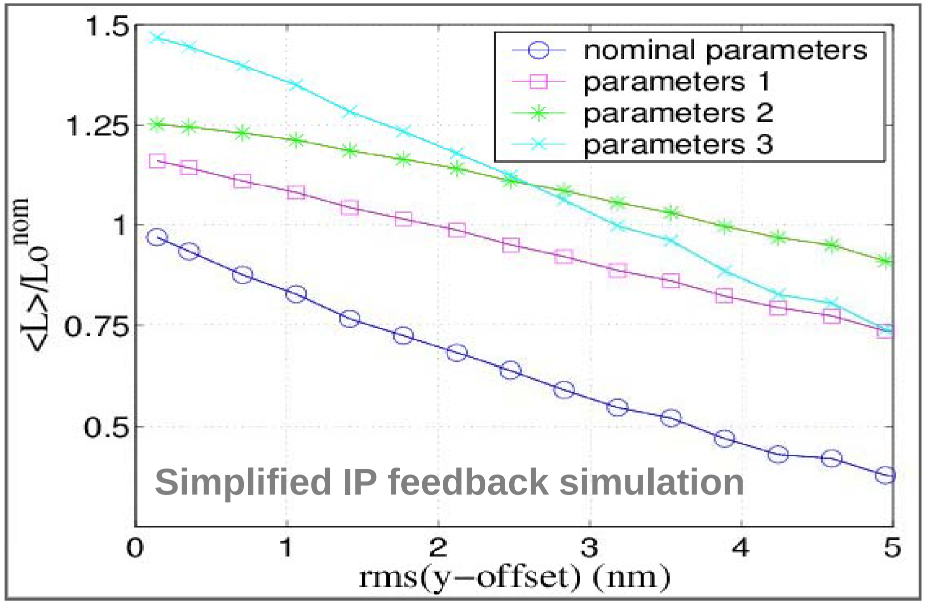
e^-e^- shows sharper deflection curves → different performance for feedback?

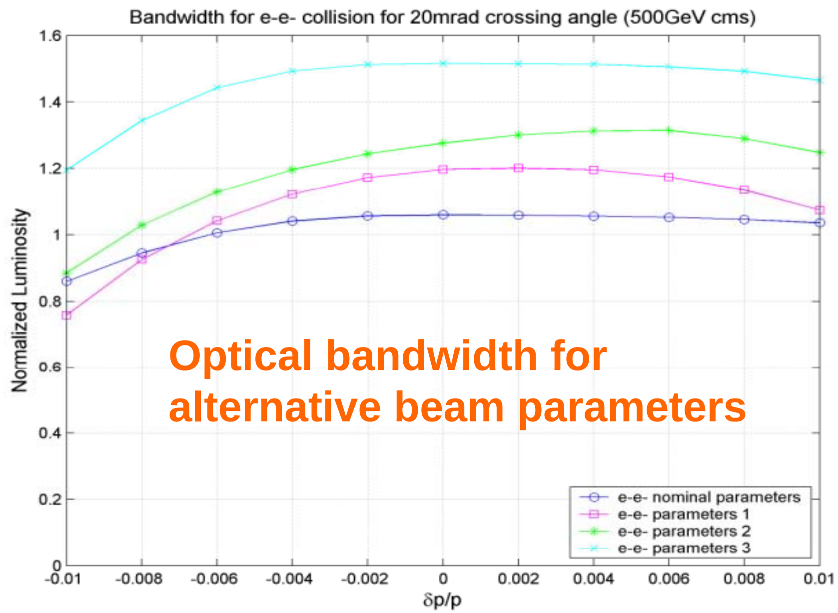
Beam parameters optimization for the e^-e^- option

Alternative beam parameters with smaller disruption by varying beam sizes allow to maximize the average train luminosity while maintaining the beamstrahlung energy loss below 5%

	nom.	set 1	set 2	set 3	low P
N/N_o	1	1	1	1	0.5
σ_z^*/σ_{zo}^*	1	0.7	0.5	0.5	0.5
σ_x^*/σ_{xo}^*	1	0.7	0.8	0.9	0.7
σ_y^*/σ_{yo}^*	1	1.5	1.5	1	0.6
$\epsilon_x^*(\mu m)$	10	10	10	10	9.6
$\epsilon_y^*(\mu m)$	0.04	0.04	0.04	0.04	0.03
$\beta_x^*(mm)$	21.0	10.3	13.4	17.0	10.0
$\beta_y^*(mm)$	0.4	0.9	0.9	0.4	0.2
$L\ (\times 10^{33})$ $(cm^{-2}s^{-1})$	3.9	4.6	4.9	5.8	3.0
$\delta_B\ (\%)$	2.24	4.9	5.0	4.3	2.2

Average train luminosity versus vertical jitter at IP after IP feedback has corrected for train-to-train variations





Feedback converges after ~100 bunches for e^-e^- compared to ~20 for e^+e^- → no major impact on average train luminosity

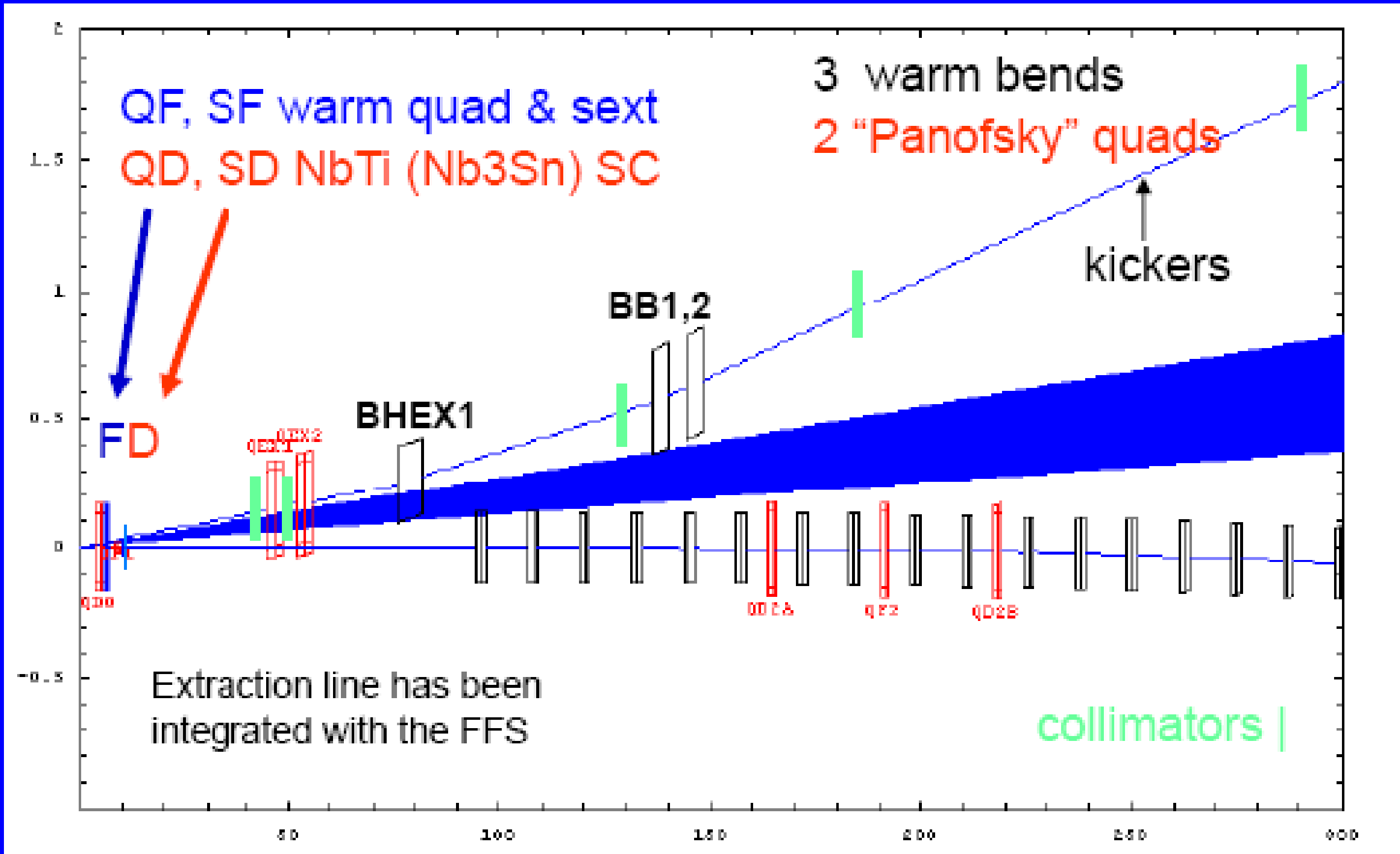
M.Alabau, LAL-RT-07-09

New "minimal" extraction line concept

D.Angal-Kalinin, R.Appleby, P.Bambade

➔ Explicit goals : short & economical, as few and feasible magnets as possible, more tolerant and flexible

EUROTEV-REPORT-2007-022
EUROTEV-MEMO-2007-1,4,5



dump(s): 0.5 m ↕ flexible 3 m

Beam rastering kickers can be placed to prevent water boiling and window damage

Length ~ 300 m

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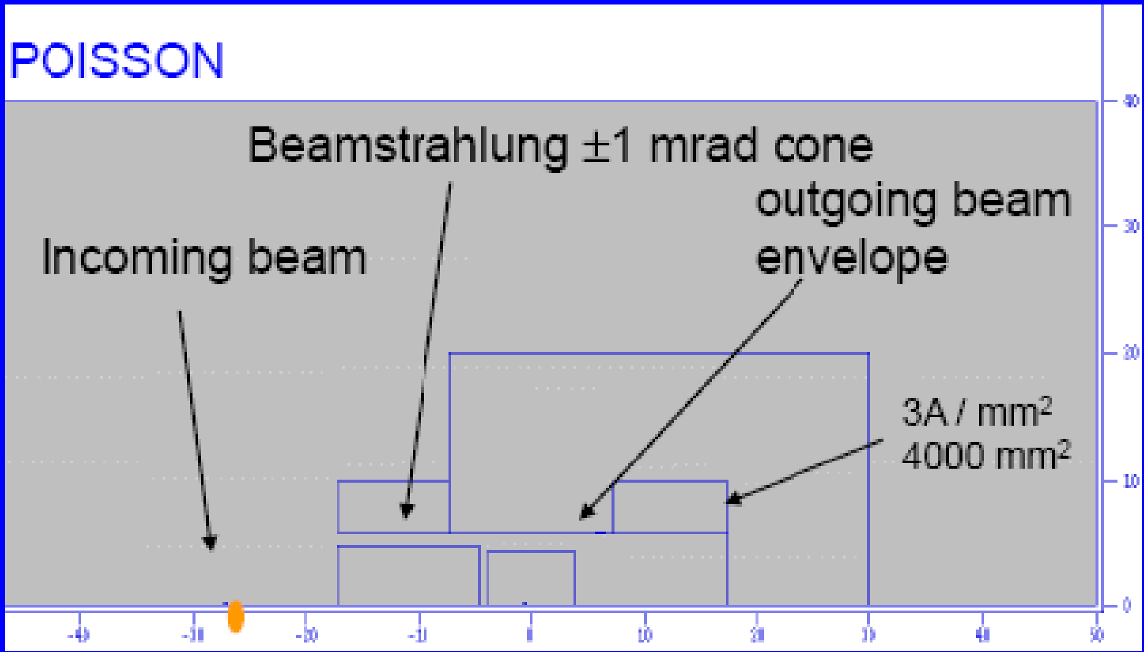
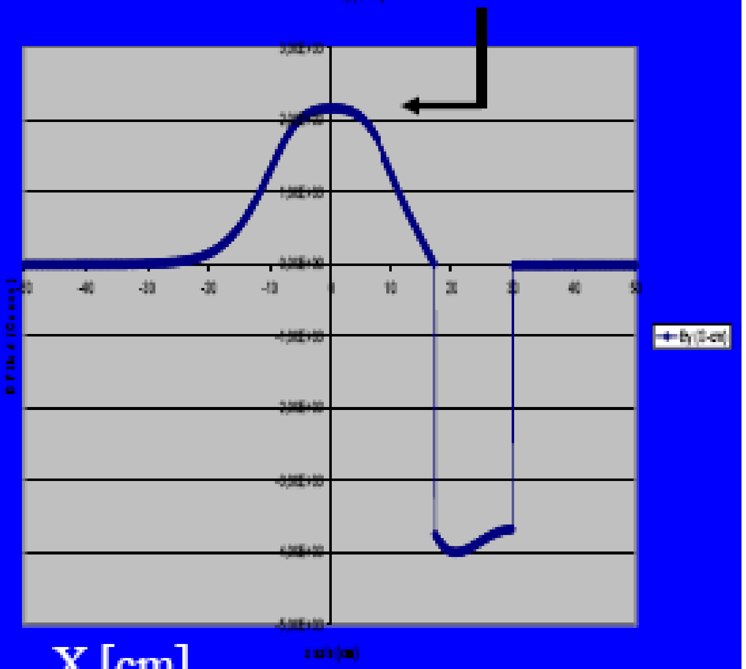
S.Cavalier → F.Touze
EUROTEV-MEMO-2008-xx

BHEX1 C-type bend

Accommodates the beamstrahlung, outgoing beam and proximity of incoming beam



$B_y = 0.215$ T



X [cm]

- $B_y(x)$ homogeneity < 4 % (with shims) within outgoing beam envelope → checked to be sufficient
- Residual B_y on incoming beam ~ 1% → 20 μrad (7.5 $\sigma_{x'}$)→use corrector
- Residual $B_x(y)$ dependence on incoming beam → only even powers
  [se]xtupole absorbed refitting SD / SF, decapole → negligible effects

Vertex detector backscattered photon hits from extraction line losses

• BDSIM model of extraction line constructed to assess photon flux towards VD from charged beam losses on the main extraction line collimators
• MOKKA model of the LDC detector to compute hit probability in VD → ~ 2.2%

	D [m]	X [cm]	P [kW]	#γ's/bx	**VD hits / BX**
QEX1COLL	45	20	0.2	1.3	**0.02**
QE2COLL	53	-	0	0	**0**
BHEX1COLL	76	41	0.1	0.2	**0.004**
COLL1	131	85	52.3	40	**0.8**
COLL2	183	115	207.5	82	**1.8**
COLL3	286	-	0	0	**0**

Conclusion : VD hits negligible from this contribution compared to rate from incoherent beam-beam pairs ~ 250 hits / BX

Notes: γ's reach VD layers via direct lines-of-sight from Cu collimator, passing through BeamCal hole with radius 12 mm, assuming no reflections on beam pipe

O.Dadoun, LAL-RT-07-07

EDR plans

2 mrad specific

general issue

D.Angal-Kalinin
R.Appleby
P.Bambade

Aim of proposed EDR-phase 2 mrad tasks is to bring the design to the level of a credible alternative to the 14mrad baseline

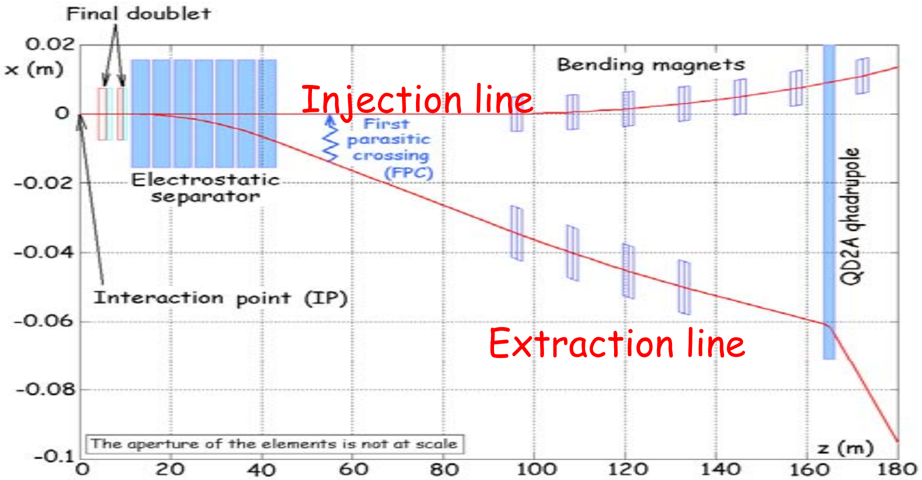
OK

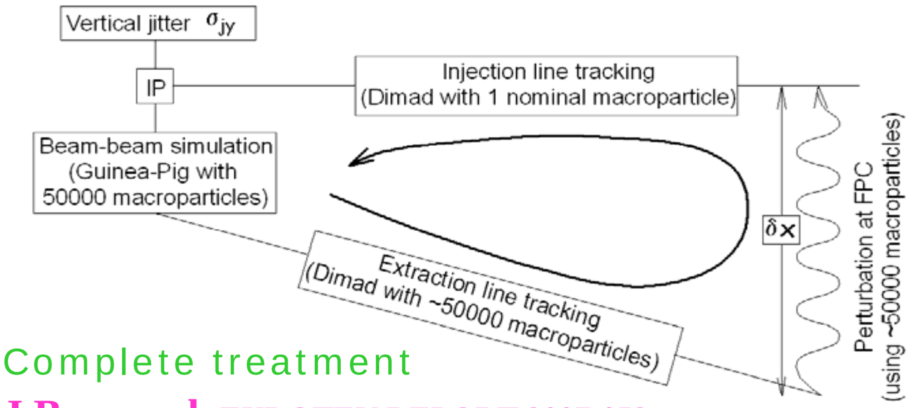
- Optics and beam transport
  - variable l* IR and extraction line layout (CI)
  - further study of extraction line aberrations on final focus beam(CI, LAL)
  - iteration of design and losses as magnet designs progress (LAL, CI)
  - iteration of integration of 2 mrad FD in final focus optics (CI)
- Magnet design studies
  - design of large aperture final horizontal bends BB1 and BB2 (LAL, CI)
  - design of standard warm FD magnets QF1 and SF1 (LAL)
  - design of a modified Panofsky quadruple magnets (exploring possibilities) [feasibility,cost]
  - engineering design of QD0 and SD0 [feasibility for compact SD0 size,cost]
- Other engineering and integration work
  - Integration of final doublet into detector, including
    - cryostat design and FD support / services
    - anti-solenoid or skew-quadrupoles for coupling correction, with appropriate integration
  - design of beam pipe in shared area (LAL) [detailed drawings critical]
  - design of beam pipe in extraction line (LAL) [detailed drawings critical]

Nov. 2007 : prel. design by Y. Iwashita (Kyoto) → seems OK

There is real flexibility in this scheme, with margins and adjustable parameters

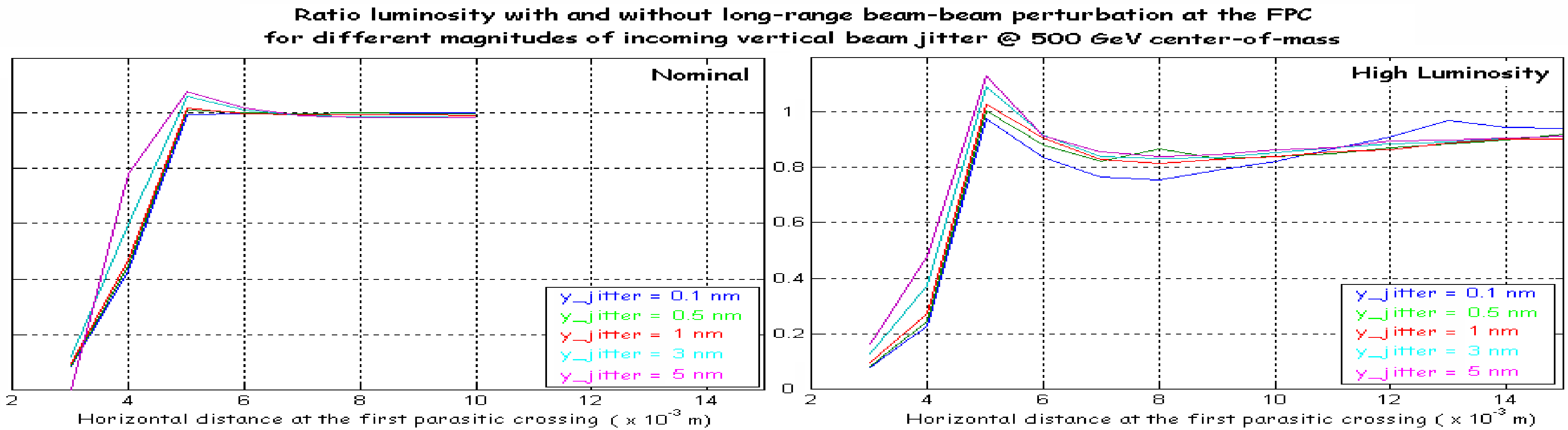
ILC head-on scheme : Luminosity reduction from amplification of vertical jitter due to long range beam-beam effect 60m after IP ?





Complete treatment

J.Brossard, EUROTEV-REPORT-2007-052



Nominal parameters → 6mm separation sufficient and OK with LEP E.S.

High Luminosity & Ecms ~ 200-350 GeV → further study under way

(Low Power → unfeasible due to reduced inter-bunch timing)

Compton polarised positron source studies including Laser/cavity R&D

CELIA(Laser Lab. In Bordeaux)
J. Boullet, E. Cormier, Y. Zaouter
IPN (Lyon)
X. Artrue, M.Chevallier, R. Chehab
LAL (Orsay)
J. Bonis, R. Chiche, R. Cizeron, Y. Fedala, G. Guilhem, D. Jehanno,
M. Lacroix, R. Marie, V. Soskov, C. Sylvia, A. Variola, A. Vivoli & F. Zomer
In very close collaboration with KEK & Novosibirsk

Outline

- Introduction
- e+ capture section sudies
- Optical resonator R&D
- Status & planning

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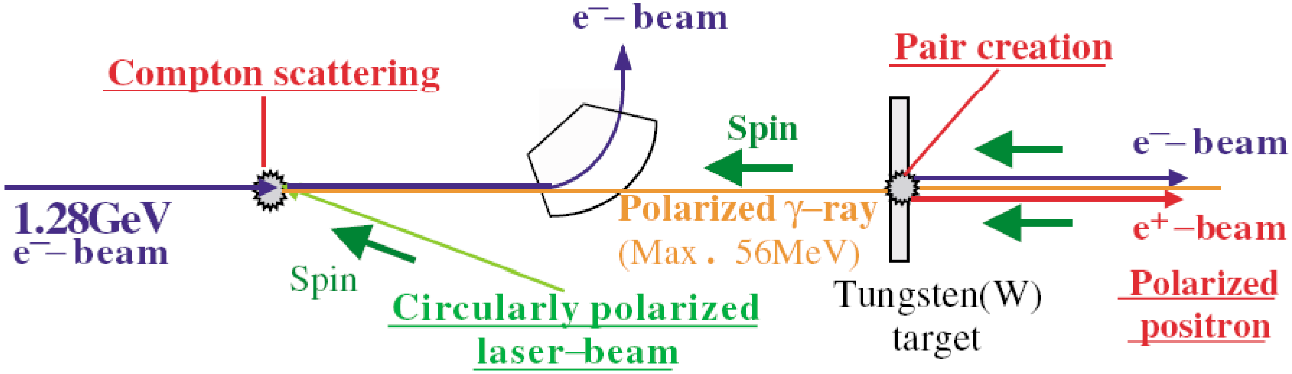
e+ polarised source for the ILC

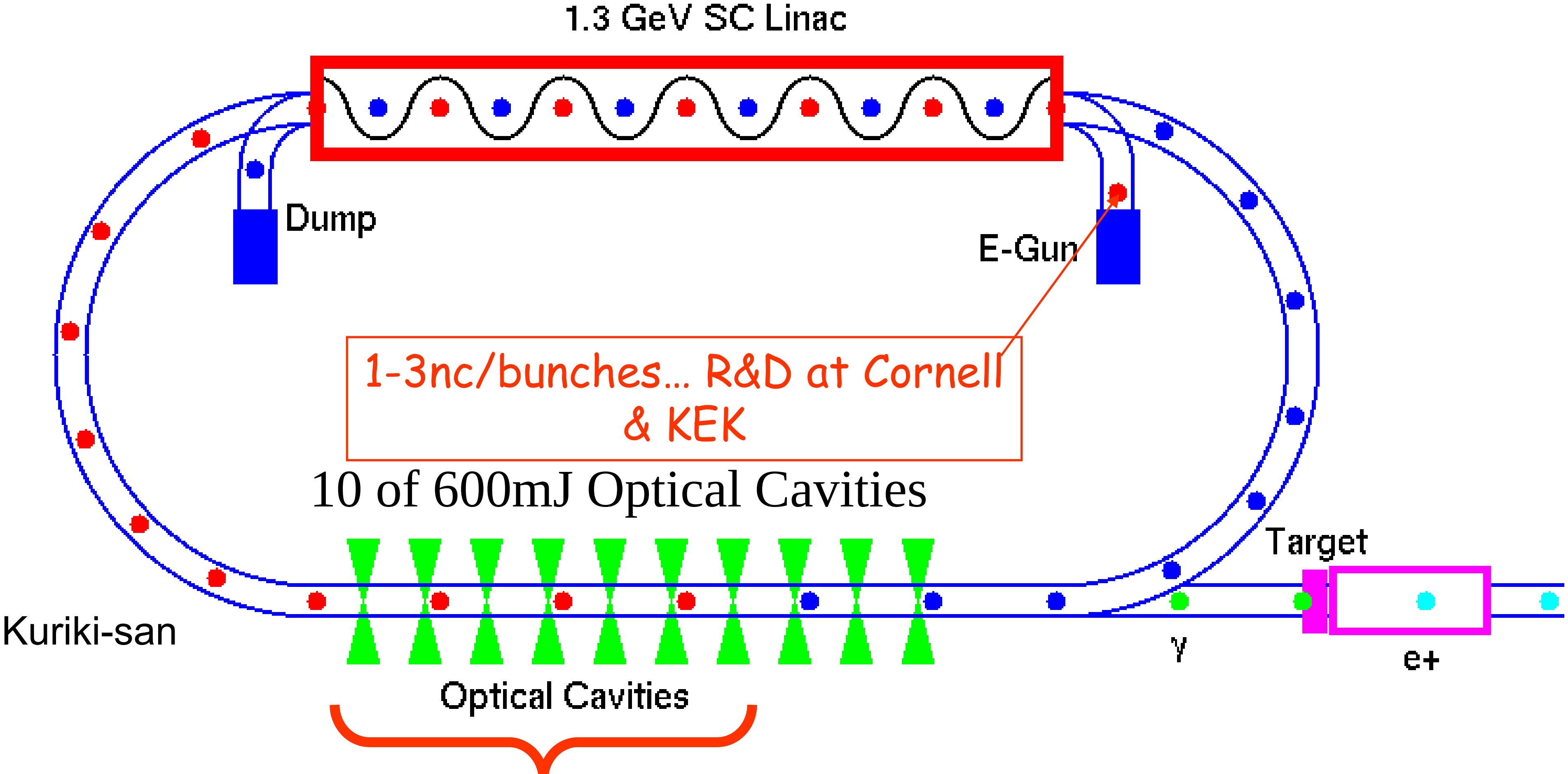
The original idea : the KEK scheme



K. Moenig idea to modify the KEK scheme
ILC beam = trains of~3000 bunchs
•AND Train frequency =5Hz

100ms to create & 100ms to cool the polarised e+

ERL scheme for the e+ polarised source
Variola's idea



0.6J/pulse@1ps@60MHz ➔ <P>=36MW !!!
For 1 cavity ➔ **R&D !** (KEK, LAL)

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POSITRON SOURCE FOR ILC USING PHOTONS FROM COMPTON PROCESS

- **PHOTON BEAM: the photons created in the 10 F-P cavities are transmitted through diaphragms to a thin [0.4 Xo thick W target]. Maximum incident angle is 0.4 mrad and γ spot size is 2.3 mm rms. The photons are circularly polarized.**
- **POSITRON BEAM: the positrons emitted by the target have a yield of ~8 % e+/γ. They are captured by an Adiabatic Matching Device (AMD) [solenoid with a field tapering from 6 to 0.5 Tesla on 50 cms] having a large momentum acceptance. The AMD is followed by warm accelerating sections imbedded in a solenoid with 0.5 Tesla. At the exit of this preaccelerator, the positrons, with an energy of 150 MeV are longitudinally compressed in magnetic chicanes in order to shorten the bunch length before injection in the Damping Ring where they are injected at 5 GeV after acceleration by a superconducting linac. RF frequency is 1.3 GHz for preaccelerator and the main one.**

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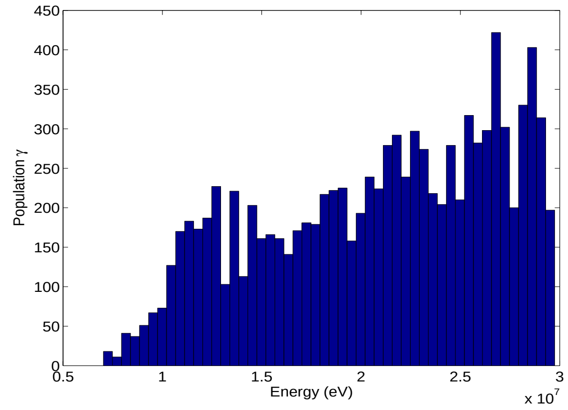
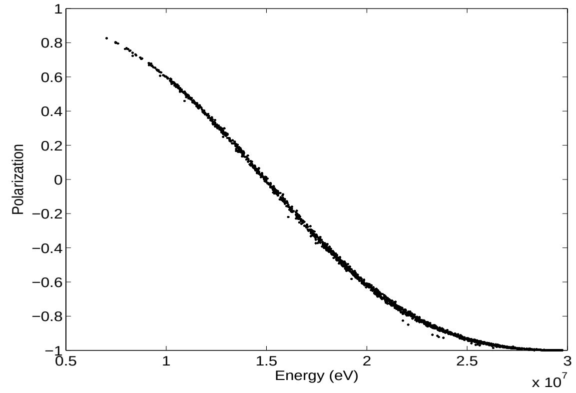
We are studying the design of:

- the Compton interaction region
- the conversion target
- the e+ capture section

- PHOTON BEAM
- (Simulations with CAIN)
- Photon spectrum: the γ
- Spectrum after collimation is
- Presented on upper figure
- Photon polarization (circular):
- The polarization vs Energy is
- Presented on bottom figure





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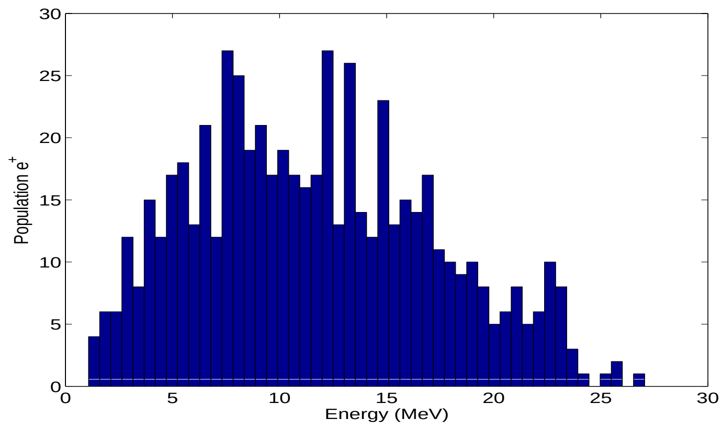
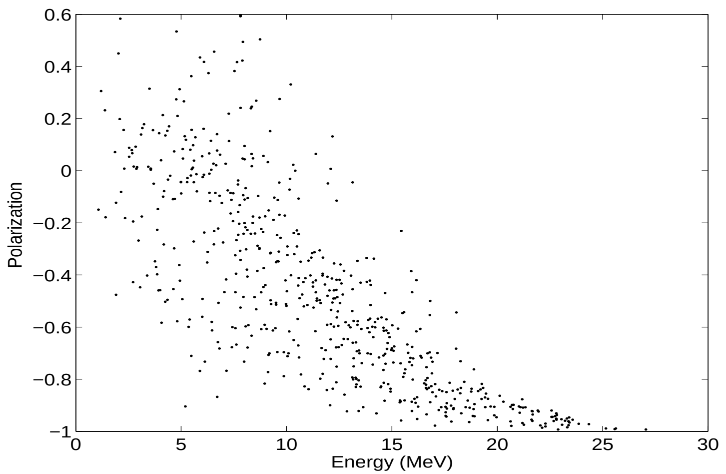
- **POSITRON BEAM**
- **(simulations with EGS4 with**
- **implemented polarization->K.F.)**
- **Positron spectrum at the target**
- **Spectrum is presented on upper**
- **figure; mean energy is ~12 MeV**
- **Positron polarization at the target**
- **The polarization vs Energy is**
- **presented on bottom figure**
- **Positron emittance at target**

$\varepsilon_x = \varepsilon_y = 1000\ \pi$mm mrad rms





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- **COLLABORATIONS FOR THE POSITRON SOURCE STUDY**
- **Simulation programmes:**
- **CAIN (from KEK)**
- **EGS4 with polarization: K.Floettmann (DESY)**
- **GEANT4 with polarization: A. Schaelicke(DESY/Zeuthen)**
- **PARMELA**
- **B.Mouton and O.Dadoun participation**
- **Optimization of the different parameters of the project**
- **Optimization of the positron emittance in 6-D and of the injection in the Damping Ring is subject of collaboration with KEK (Omori et al), CERN (Zimmermann et al), KIPT-Kharkov (Bulyak et al) and progresses are looked in regular video-conferences.**

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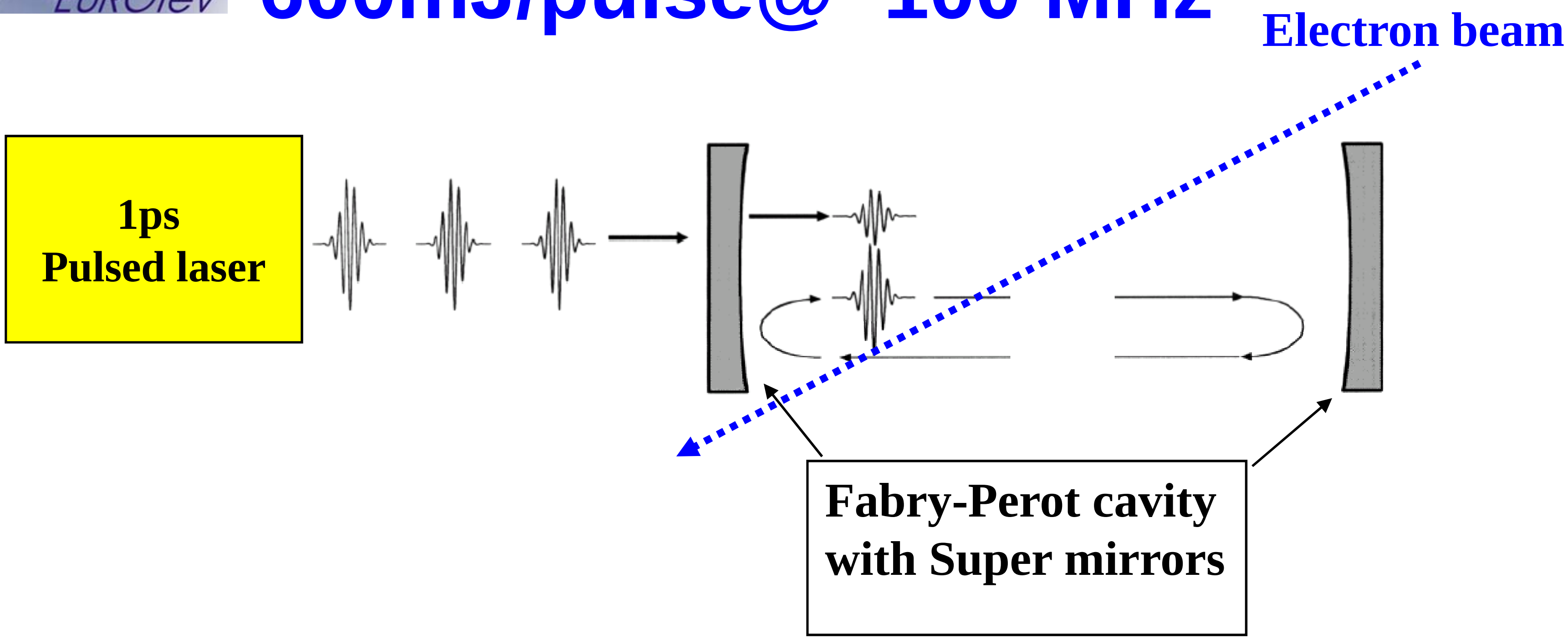
Laser/cavity R&D to reach 600mJ/pulse@~100 MHz

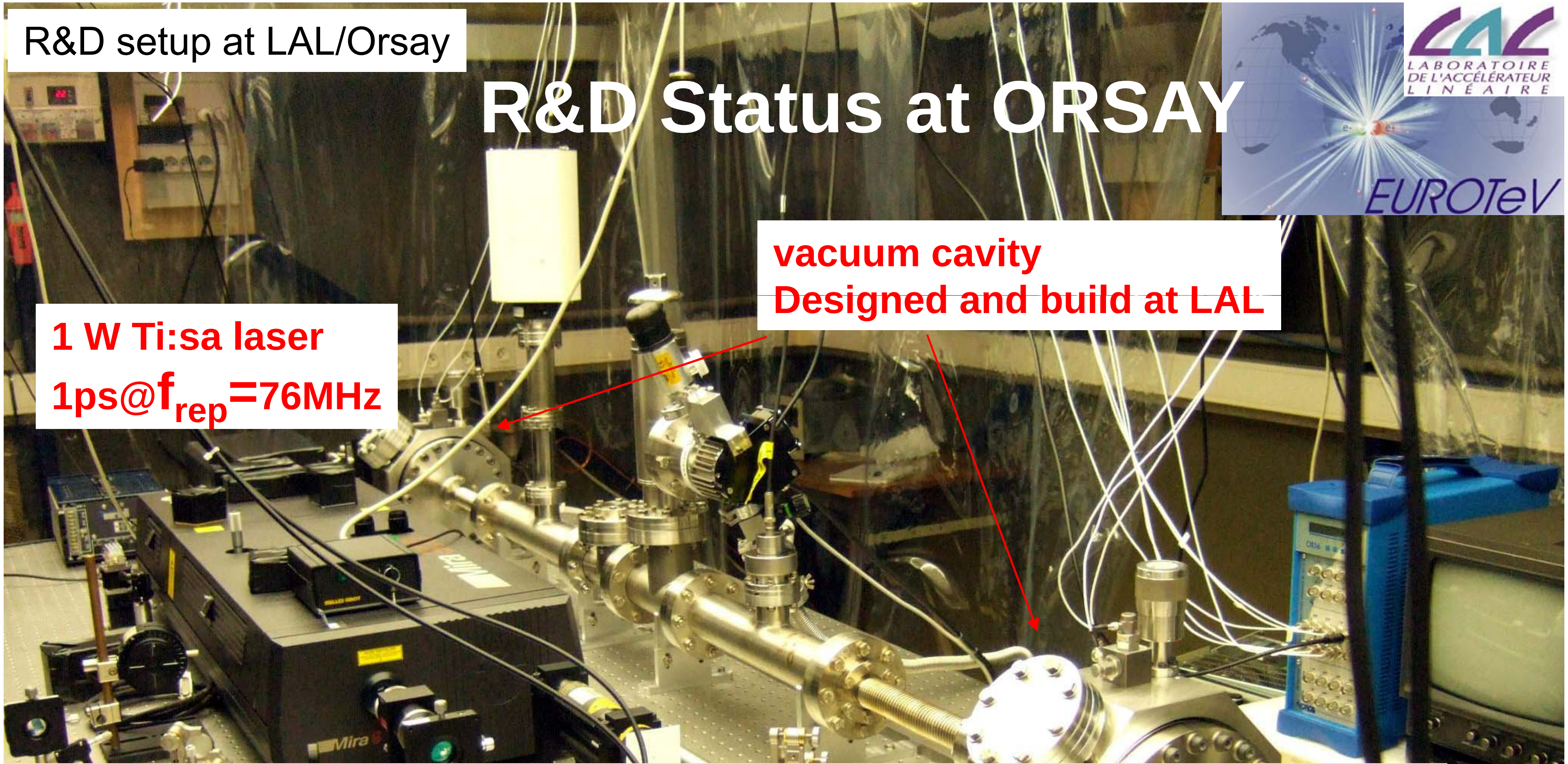


R&D tasks on Fabry-Perot in 1ps pulsed regime:

- **Feedback system to lock the pulsed laser on a cavity resonance**
- **Search for the max. power gain (=power enhancement factor) achievable** [published : gain 200/120fs in 2007 & gain 6000/30ps at SLAC]

This R&D has started in sept. 2005, funded by EUROTEV/IN2P3

R&D Status at ORSAY



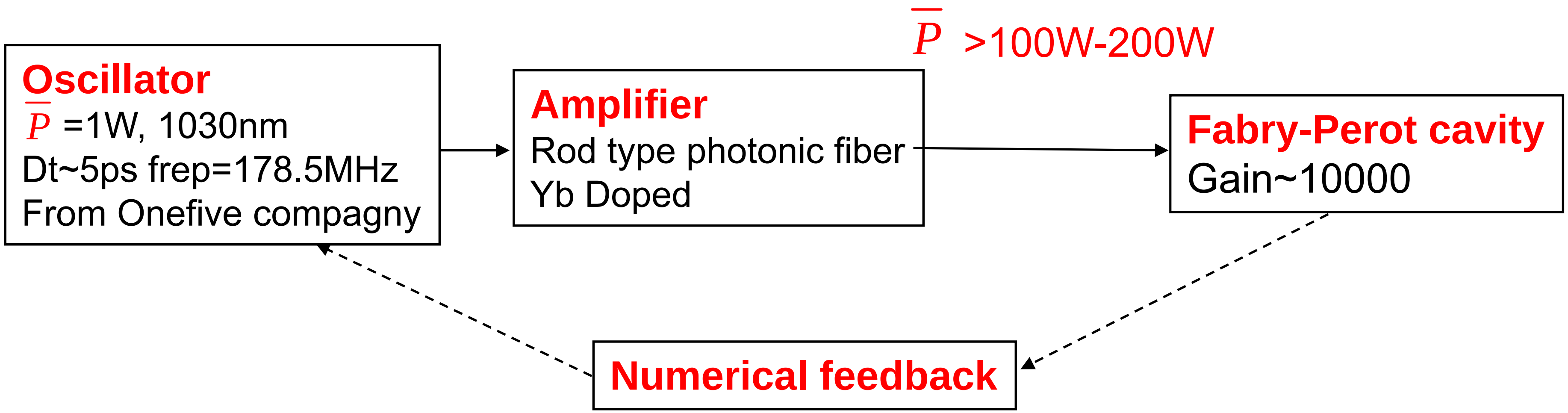
Status : Cavity locked with gain ~1200 since june 2007

- **Digital feedback (VHDL prog.) designed and build at LAL**
  - **Already $\Delta f_{rep}/f_{rep}=10^{-10}$ ➔ Δf_{rep}=30mHz for frep=76MHz**
- **New mirrors in january 2008➔ gains 10^4-10^5**

•End of the EUROTEV R&D : mid 2008

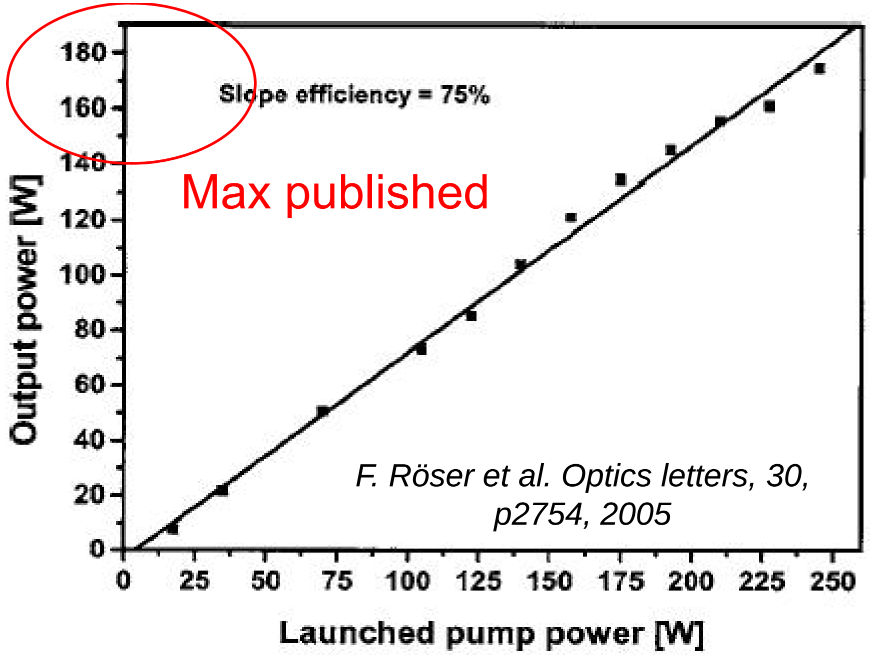
2008-2009: evolution of the R&D

Step 1. Setup the following system at Bordeaux/Orsay



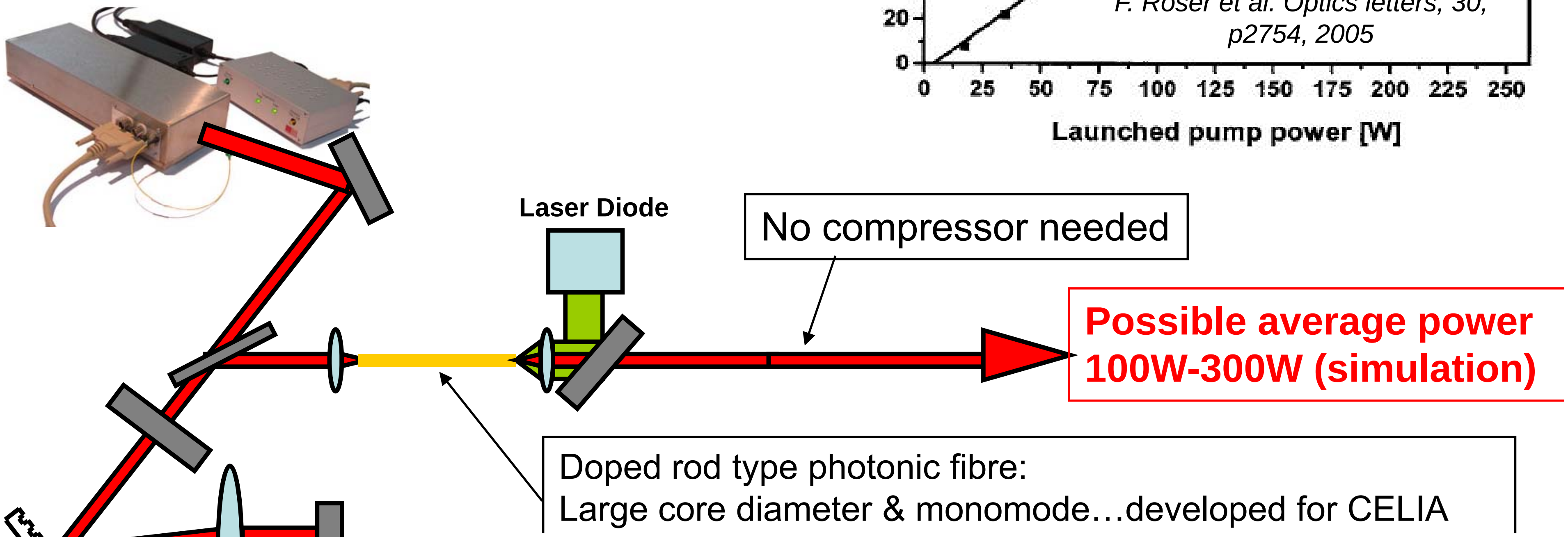
Step 2. Installation of the system at ATF/KEK

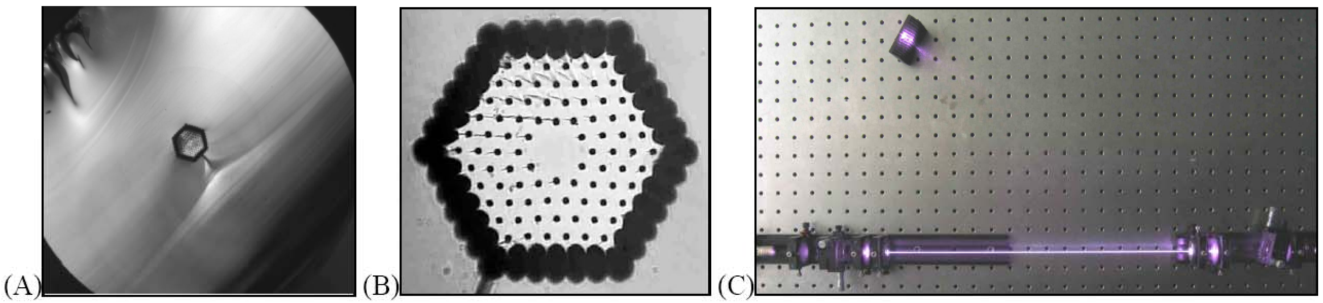
The laser amplification R&D with CELIA



OneFive laser

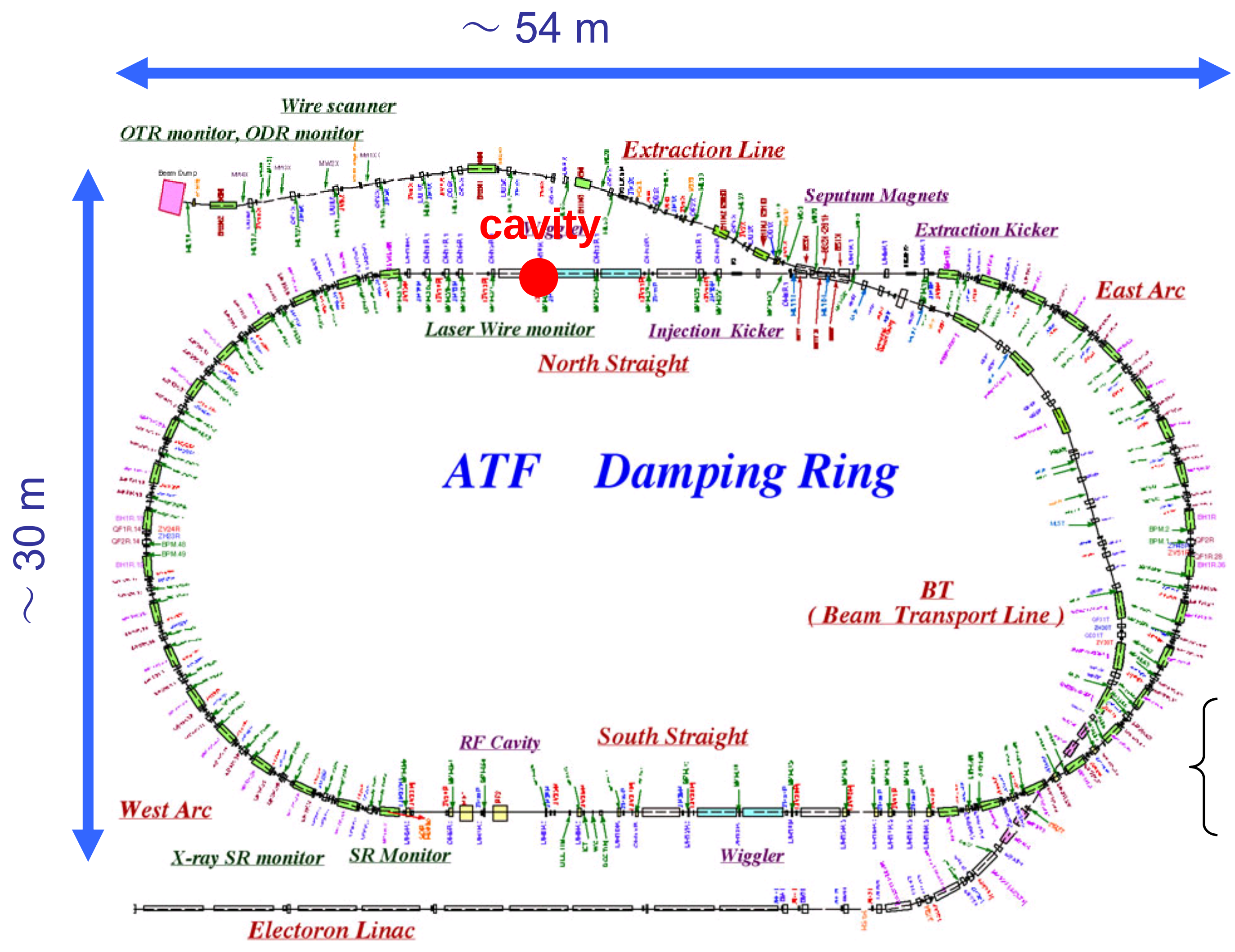
Δt=2-5ps, 178.5 MHz, 1W





Gold grating-based strectcher gives negative chirp for spectral compression

R&D at KEK : Cavity installation on the Accelerator Test Facility (ATF)



Beam Energy

→ 1.28GeV

Beam Size

→ 100μm × 10μm

Emittance →

1.0x10^{-9} rad.m

1.0x10^{-11} rad.m

(Ultra Low !!)

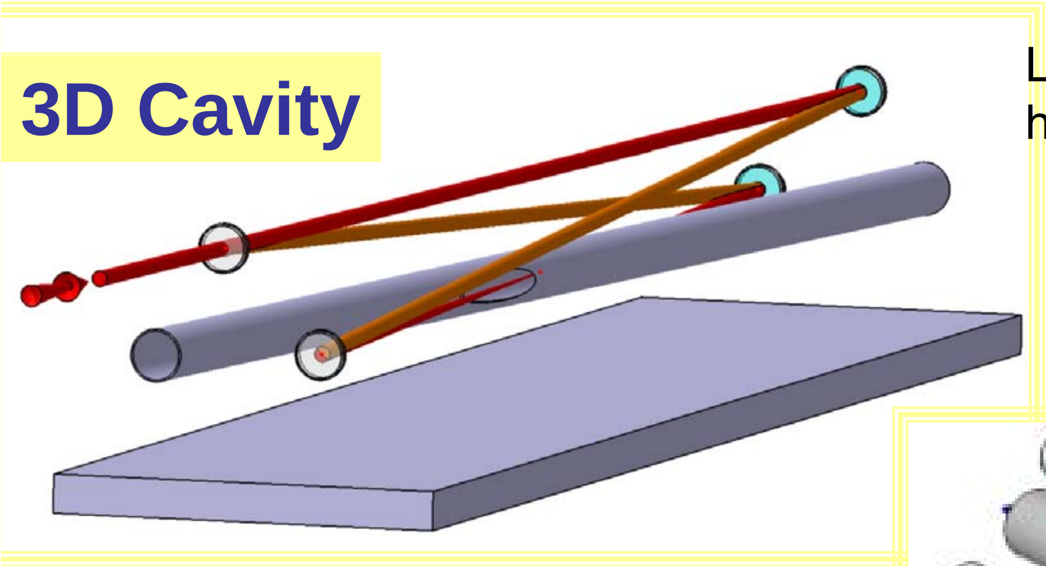
(H. Shimizu)

4 mirrors cavity design study for ATF

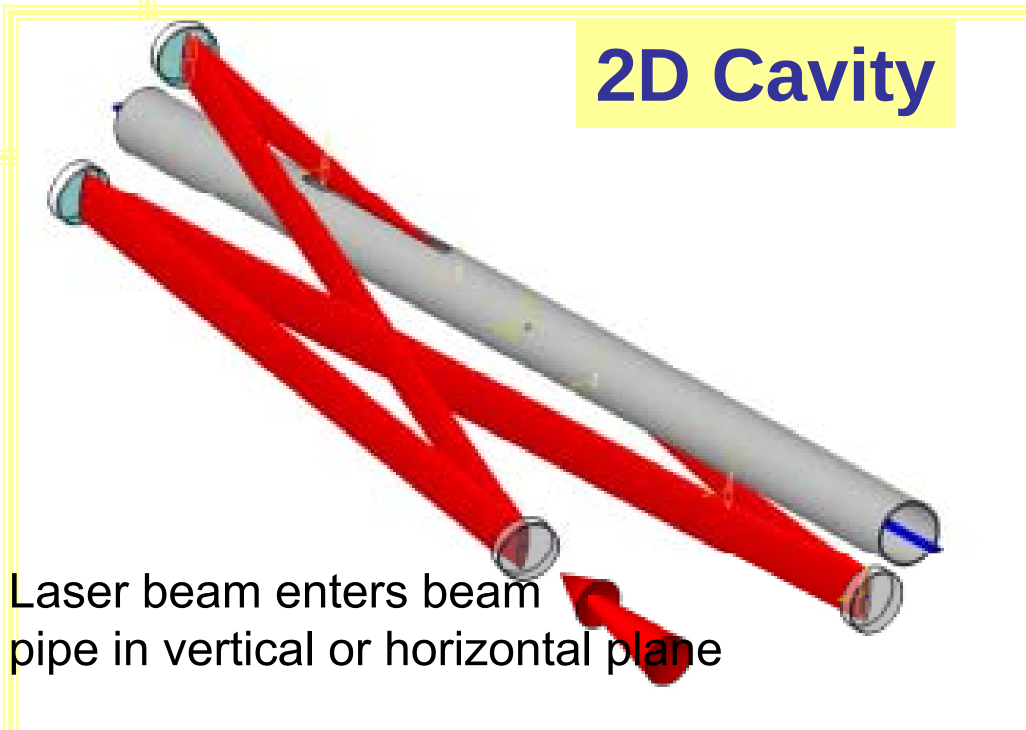
- Small laser beam size at the Compton IP
  - ➔mechanical instabilities with 2 mirrors cavity
  - ➔Mechanically stable with a 4 mirrors cavity
- Constraints from ATF
  - – ATF electron beam is elliptical: small vertical axis of 8µm and long horizontal axis of 160µm
  - – The laser beam enters the beam pipe by a 5mm horizontal slit…
  - ➔strongly constrained design of a 4 mirrors cavity

➔ Collaboration with KEK: regular video meetings & reciprocal visits thanks to the FJPPL IN2P3 programme

We are looking at 2 configurations



Laser beam enters beam pipe in horizontal plane



Laser beam enters beam pipe in vertical or horizontal plane

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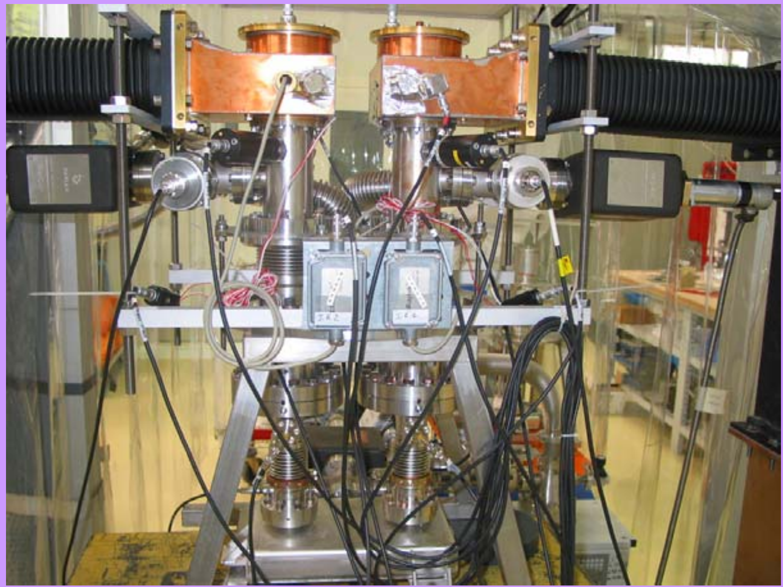
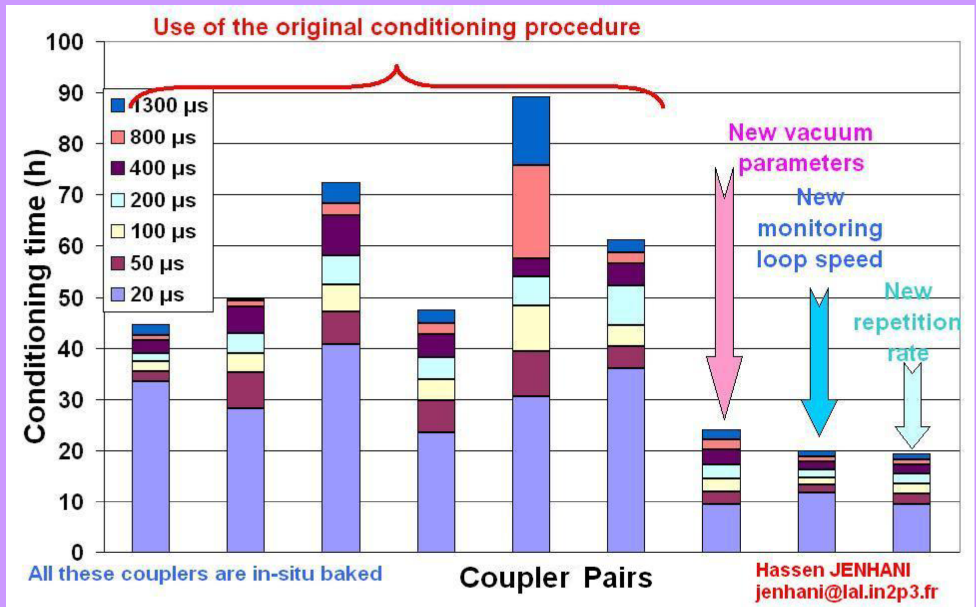
Summary

- e+ capture section design study in progress
- We are finishing the High Finesse cavity locking R&D (EUROTEV)
  - 700mW Ti:Sa 1ps @ 76MHz
  - Cavity locking with gain 1200 already achieved
  - Cavity gain of 10000 should be achieved beginning 2008
- New high average power laser source R&D started (CELIA)
  - 1W, 1030nm, 2-5ps @ 178.5MHz, cavity gain 10000
    - OneFive laser ➔reception in february /march 2008
  - Rod type photonic fiber amplification
    - ~1w average power inside cavity expected
    - ~20GW peak power, ~8mJ/pulse@178.5MHz
    - Studies start in January 2008 at CELIA (Bordeaux)
- Cavity design for ATF
  - 4 mirrors, 2D/3D geometry still to be chosen
  - Strong vacuum requirements ➔ difficult design of the cavity…

Conditioning tests



TTF-III coupler test stand



Optimisation of the TTF-III conditioning procedure

⇨ **Further optimisation still possible:**

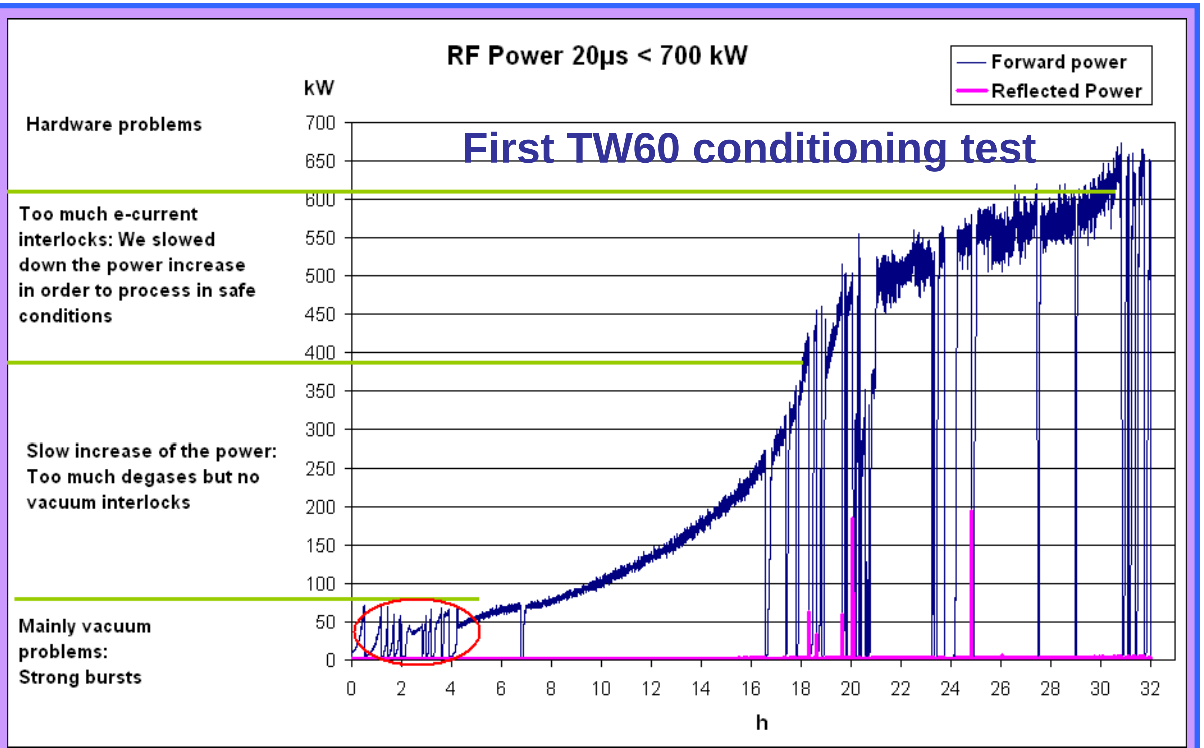
✓Less conditioning steps

✓New configuration : 2 coupler pairs conditioned at the same time (parallel or series)

✓Elimination of the coupler baking procedure (under vacuum) in the clean room

LAL coupler prototypes

TW60 coupler with coaxial disc window

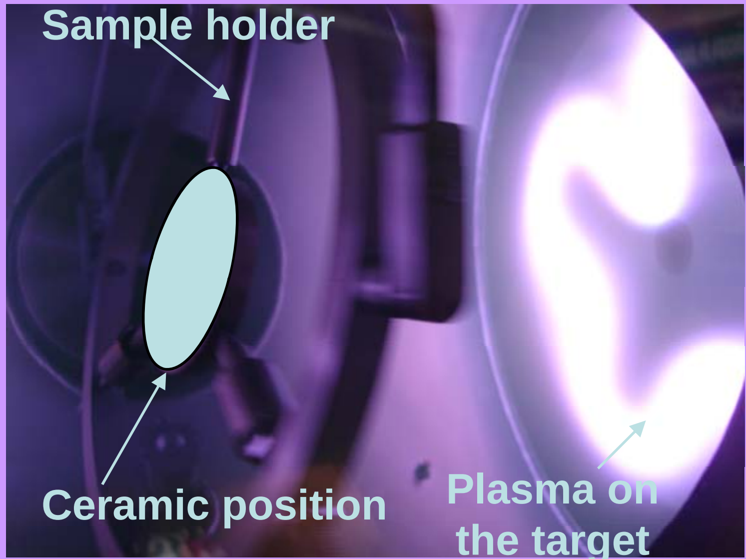


TTF-V coupler (similar to TTF-III but with larger cold part diameter)

TTF-V will be processed after a full conditioning test of TW60

TiN sputtering stand for ceramic windows

TiN sputtering stand at LAL for cylindrical and disc windows



TiN sputtering stand at LAL during operation

Existing related diagnostics

Scanning Electron Microscopy

Profilometer (thickness measurements)

Futur related diagnostics

Multipacting resonator (processing speed)

X-Ray Diffractometer (stochiometry and thickness determination)

Engineering study of the cryomodule in non-horizontal position

Christian Arnault

Sandry Wallon

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Topic: study of the cryomodule in non-horizontal position.

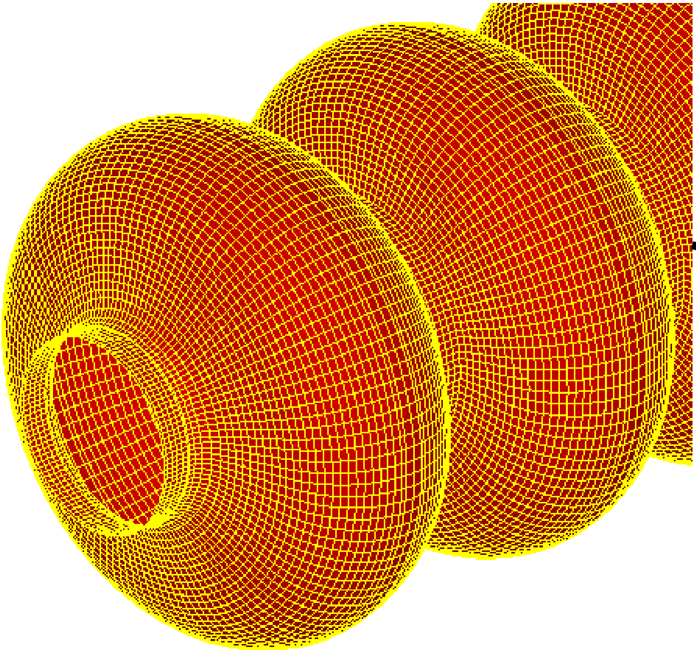
The goal is to understand whether it is possible to carry the cryomodule vertically into the pit, in order to reduce the pit diameter (5m expected) and thus to bring cost reduction.

We need to study the mechanical impacts of this transport method to this big structure, specially to the most critical components.

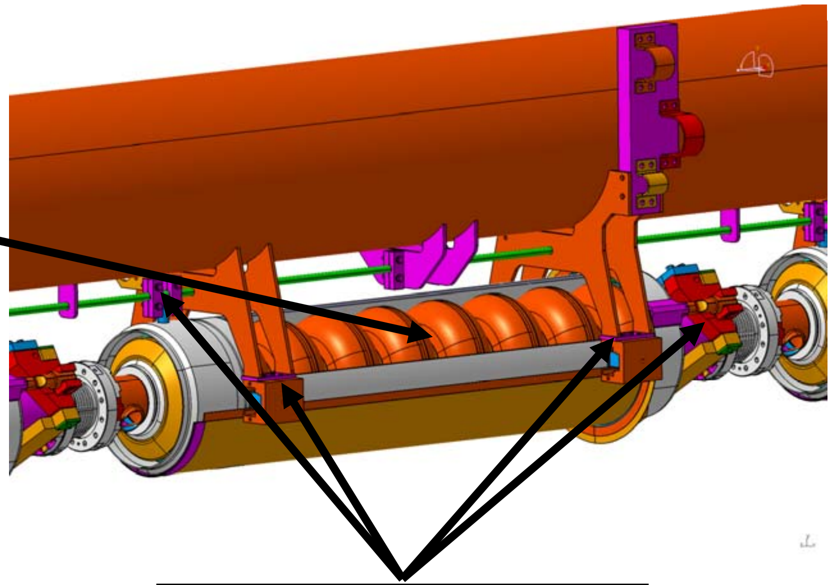
•Cavity positioning and deformation
•Moving and flexible parts
•Change of inertial forces
•Study of vibrations

Cavity strength and cavity fixings to set and maintain cavity alignment (problem of inertial phenomena during handling)

⇒ Action : Analytic and finite element calculations (dynamic)



Cavity mesh for FEM calculations



Parts involved in cavity aligment

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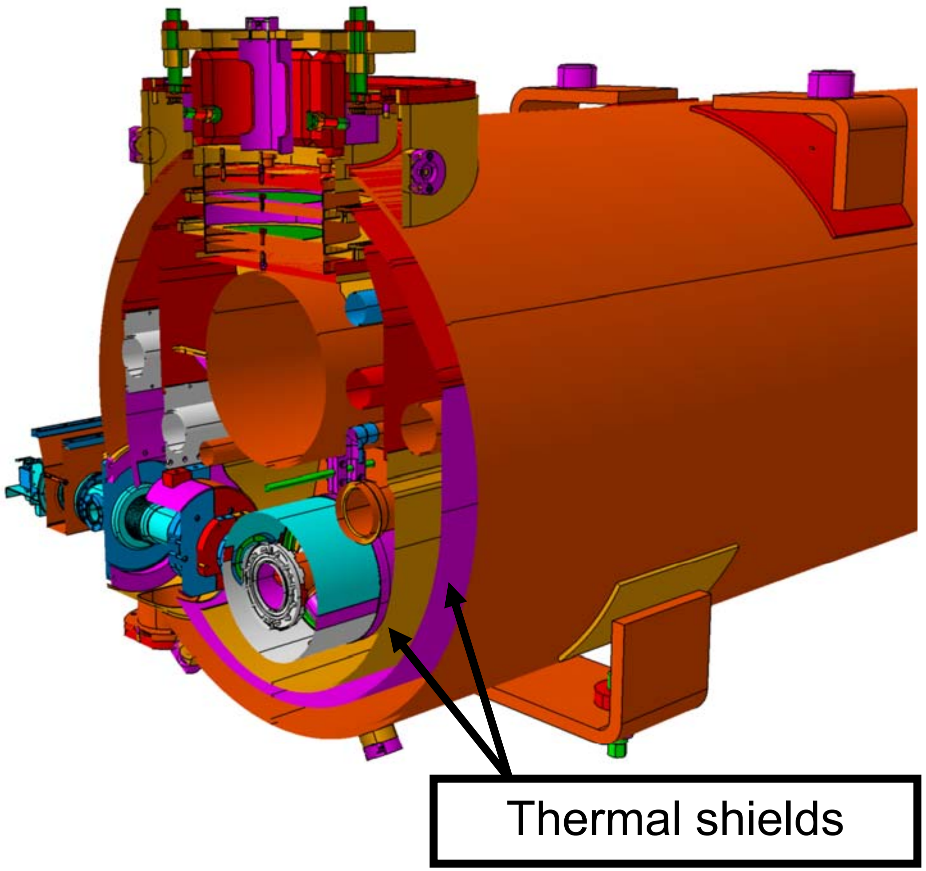
Thermal shields, large flexible parts with possible unexpected movements (and contacts) during handling

→ Fixing thermal shields at both ends will solve the problem

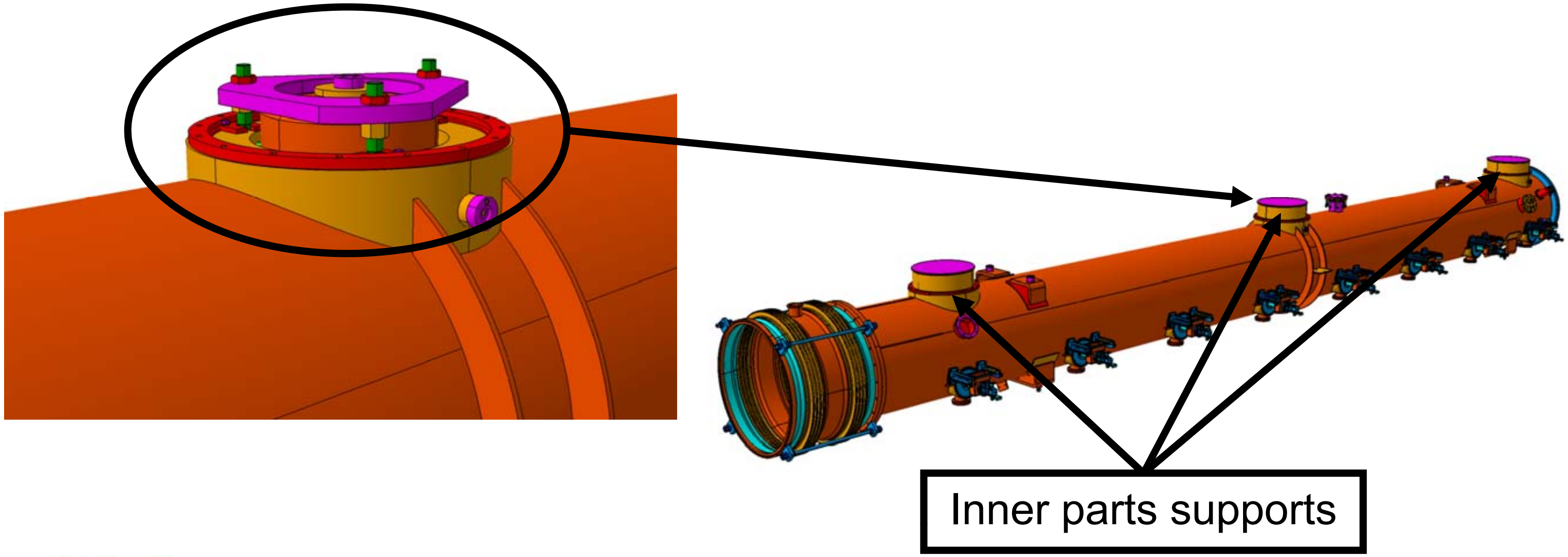
⇒ Action : Design of end caps



The cryomodule inner parts are not suitable for vertical position (inner parts are just “lean on” the outer vessel)

They have to be fixed at both ends to the stiffest inner parts of cryomodule, the Gas Return Pipe.

⇒ Action : Design of inner parts supports



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EDR Highlights in France

- High gradient cavities
- Robust, cheap input couplers
- Attractive alternative final focus design
- Exciting alternative new positron source
- Nanometer level stabilisation

- Lots of €€€€ saved thru smaller shafts if cryomodules can be lowered in a slanted way

Conclusions

- Very active participation to EDR phase in France, both in R&D and engineering (mostly thru XFEL): exciting results available on many fronts!
- Good collaboration in all subgroups with GDE teams in Europe, US and Japan
- Responsabilities inside EDR presently totally uncorrelated to the strength and quality of this effort