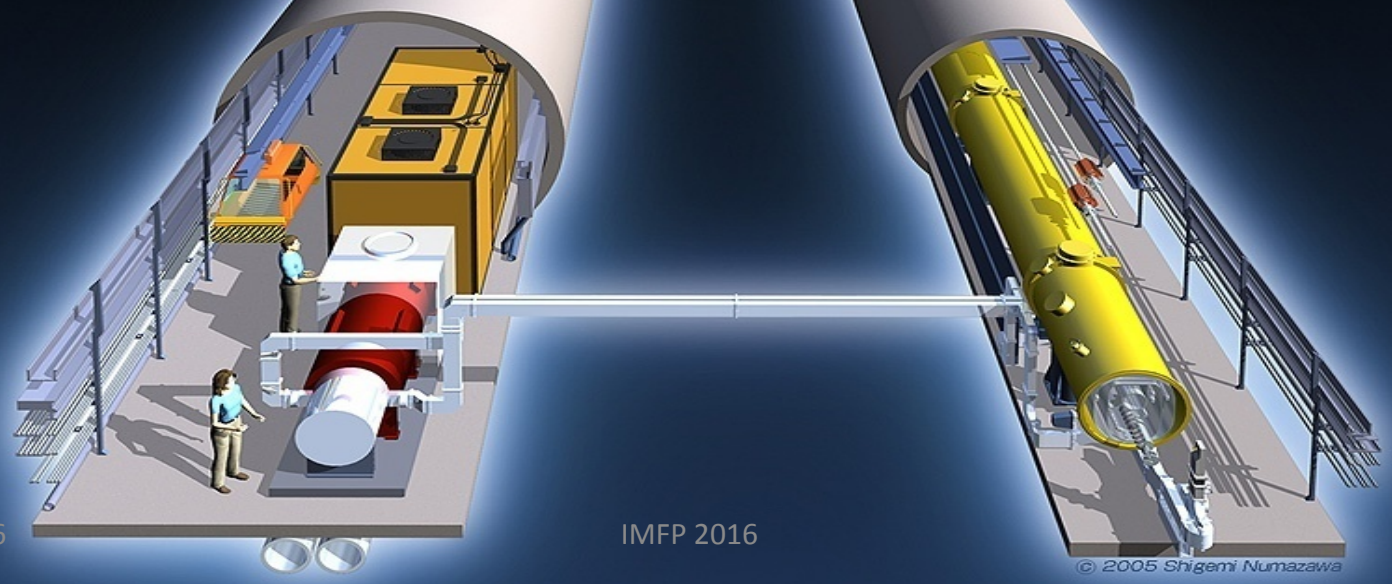
XLIV International Meeting on Fundamental Physics
Madrid
4-8 April 2016

Accelerator R&D activities at IFIC



Contents

- The IFIC and the Group of Accelerators Physics
- R&D Accelerators in Circular Colliders HL-LHC
- R&D Accelerators at ILC-ATF2
  - Optical transition radiation monitors for ATF2 and ILC
  - Beam halo collimation and wakefields in ATF2 and ILC
- R&D Accelerators at CLIC
  - Stripline kickers for beam injection and extraction in CLIC-DR
  - Stripline BPM development for the CLIC drive beam
  - Direct alignment of Accelerating Structures
  - High-gradient RF structure studies for medical accelerators
- Future Perspectives
- Participation in Research Projects and Contracts
- Academic Training

The **Consejo Superior de Investigaciones Científicas** CSIC is the largest public multidisciplinary research organization in Spain. It has 116 institutes or centres distributed throughout Spain. There is also a delegation in Brussels.

The Instituto de Física Corpuscular is a joint centre between the Spanish Research Council **CSIC** and the **University of Valencia** devoted to research in Nuclear, Particle and Astroparticle Physics and its applications to Medical Physics and to other fields of Science and Technology.

The **IFIC** has been participating in leading particle physics experiments since 1950 when it was founded. In the institute converged experimental and theoretical physicists and, in addition to the lecturers and professors of the University of Valencia, this institute was joined in the following years by Spanish and foreign researchers who worked in several institutions from abroad.

Recently has been awarded with the "**Severo Ochoa**" label of excellence.

http://webific.ific.uv.es/web

Accelerator R&D: GAP at IFIC

RESEARCH ACTIVITIES

- Collimation systems studies for Circular Colliders (HL-LHC) and Future Linear Colliders (ILC-ATF2, CLIC).
- Optics Design and Beam Instrumentation studies for the Beam Delivery System of Future Linear Colliders ILC-ATF2 and CLIC
- Design and Construction of Beam Instrumentation:
  - Inductive Beam Position Monitors for CTF3;
  - Stripline Beam Position Monitors for the CLIC Drive Beam.
  - Optical Transition Radiation Monitors for ATF-ATF2;
  - Beam Position Tunning for Hadrontherapy Facilities;
  - Stripline Kickers for CLIC Damping and Pre-Damping Rings;
  - Collimator sytem for ATF2
- HG Linacs for Hadrontherapy applications

http://gap.ific.uv.es/

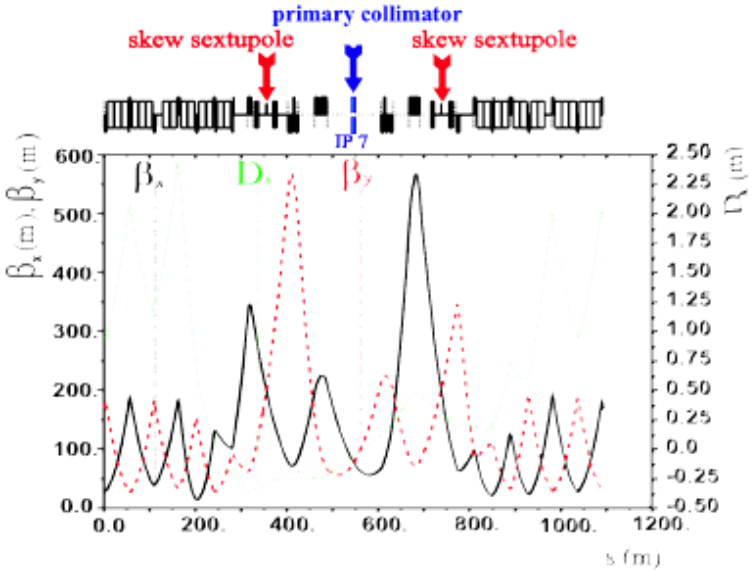
COLLABORATORS

PEOPLE

- **Dr. Angeles Faus-Golfe** (CSIC researcher)
- **César Blanch Gutiérrez** (Mechanical engineer)
- **Dr. Alfonso Benot Morell (**Electromagnetic engineer)
- **Dr. Daniel Esperante Pere**ira (Electromagnetic engineer)
- **Dr.Theodoros Argyropoulos** (Postdoc researcher)
- **Núria F. Martínez** (PhD Student UV)
- **Jorge Giner Navarro** (PhD Student, CERN-UV)
- **Natalia Galindo Muñoz** (PhD Student PACMAN)

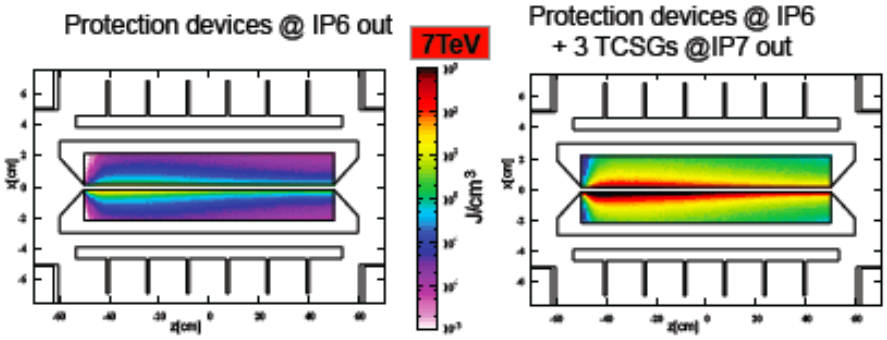
R&D activities at HL-LHC

CIRCULAR COLLIDER COLLIMATION STUDIES

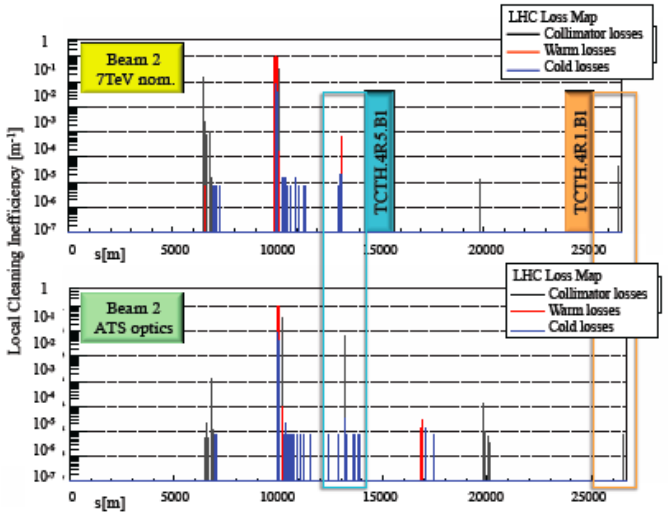


Optics studies for non-linear collimation system in IR7

- Alternatives **non-linear collimation** schemes
- Studies of **thermal loads** on collimators for **HL-LHC** optics in the case of fast losses
- Studies on the **effects** from **asynchronous beam dump** onto LHC collimators



2D energy deposition maps at the jaws cut at the beam height by 7TeV protons.

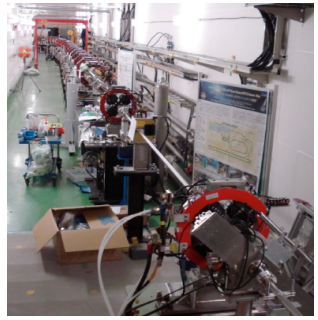


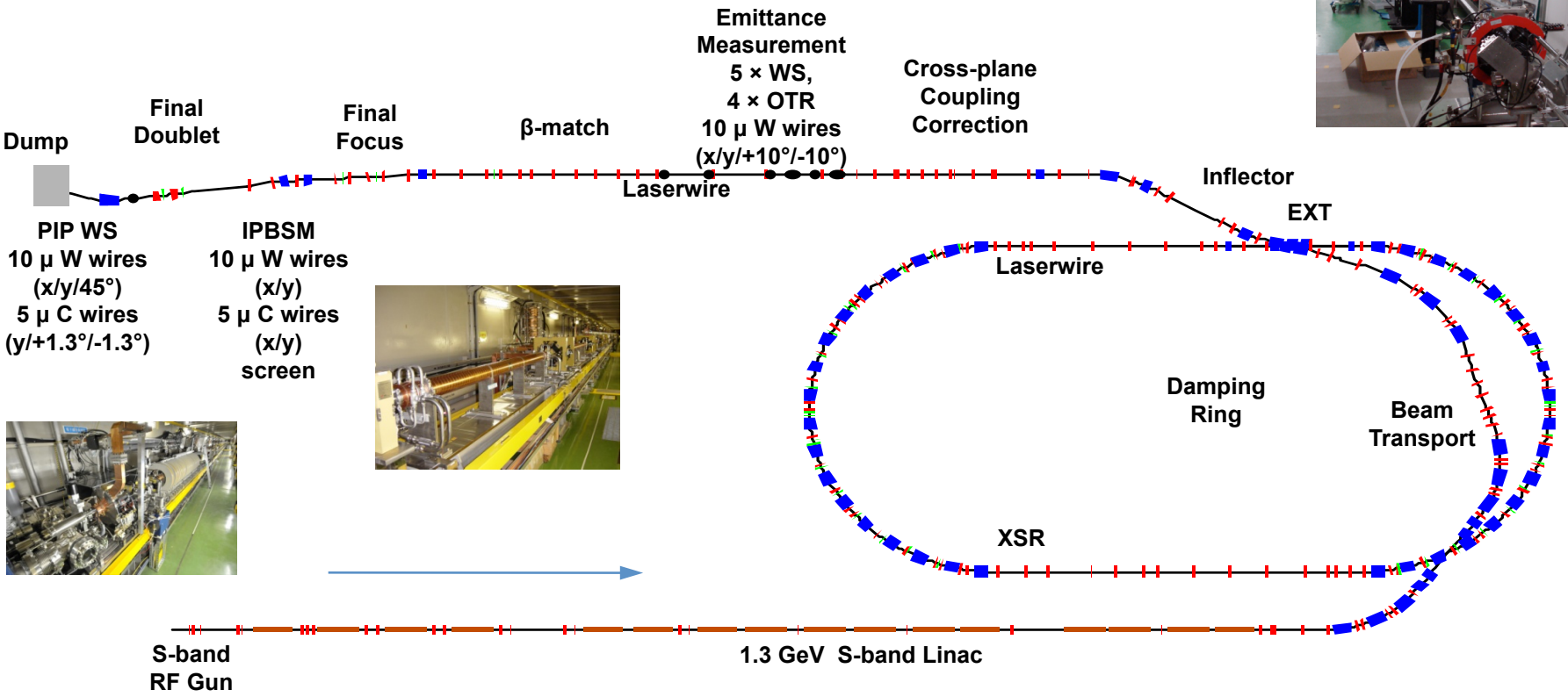
Local Cleaning inefficiency loss map for beam 2 with errors

R&D activities at ILC-ATF2

ATF-ATF2 OVERVIEW

- The Accelerator Test Facility (**ATF**) was built in KEK (Japan) to create small emittance beams. The Damping Ring (DR) of ATF has a world record of **the emittance: 12 pm rad**
- **ATF2** studies the feasibility of focusing the beam into a nanometer spot in a future linear collider (σ_y**=37nm with nm level stability**)

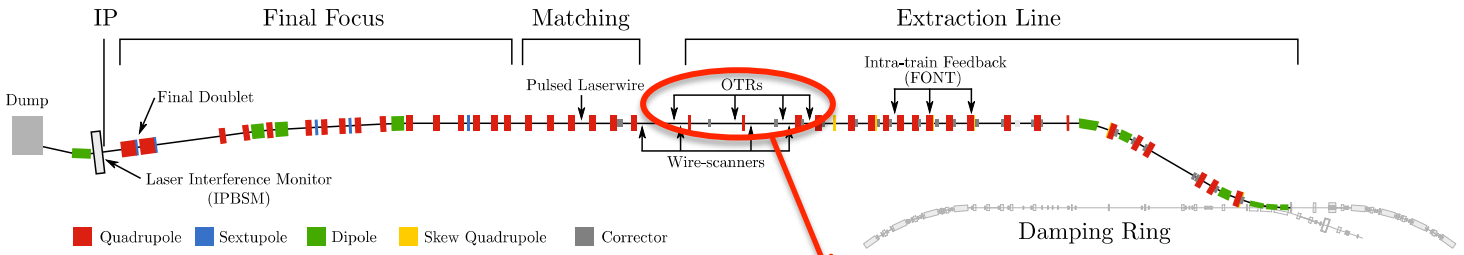




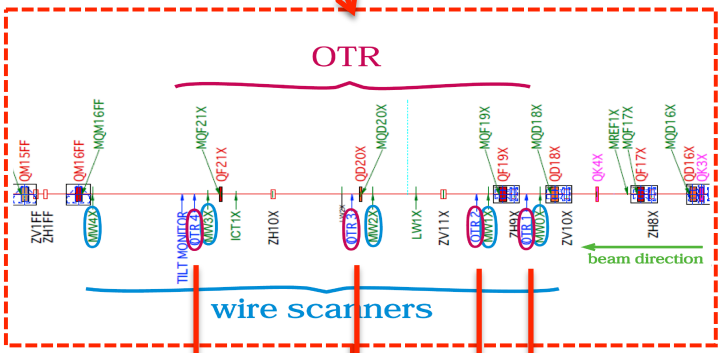
R&D activities at ILC-ATF2

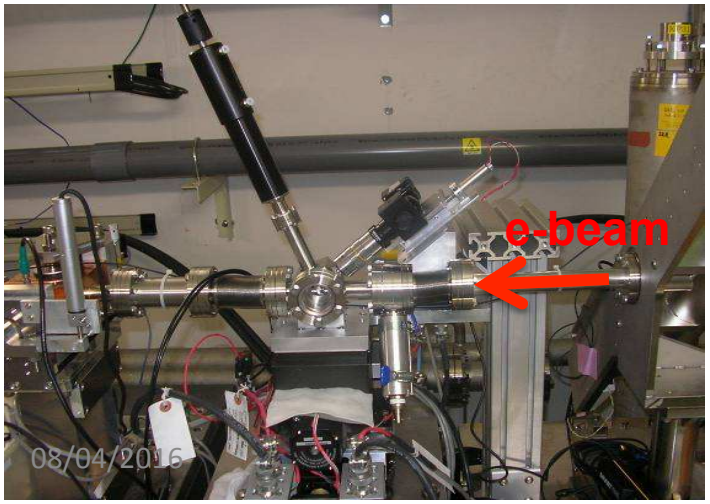
OPTICAL TRANSITION RADIATION MONITORS FOR ATF2

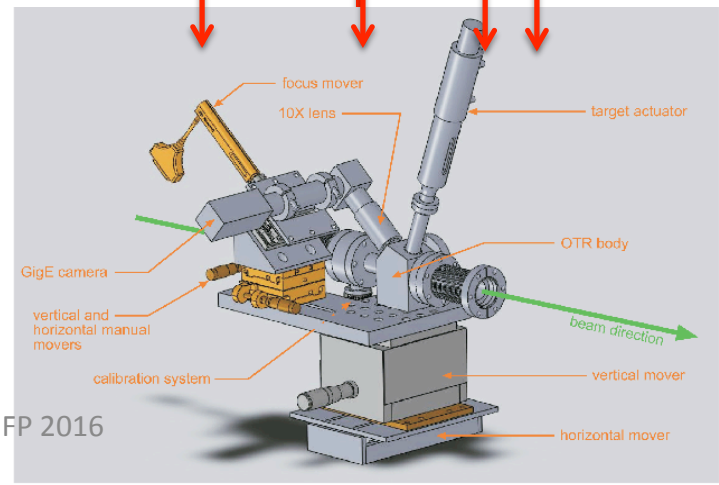
ATF2 layout



4-OTR system





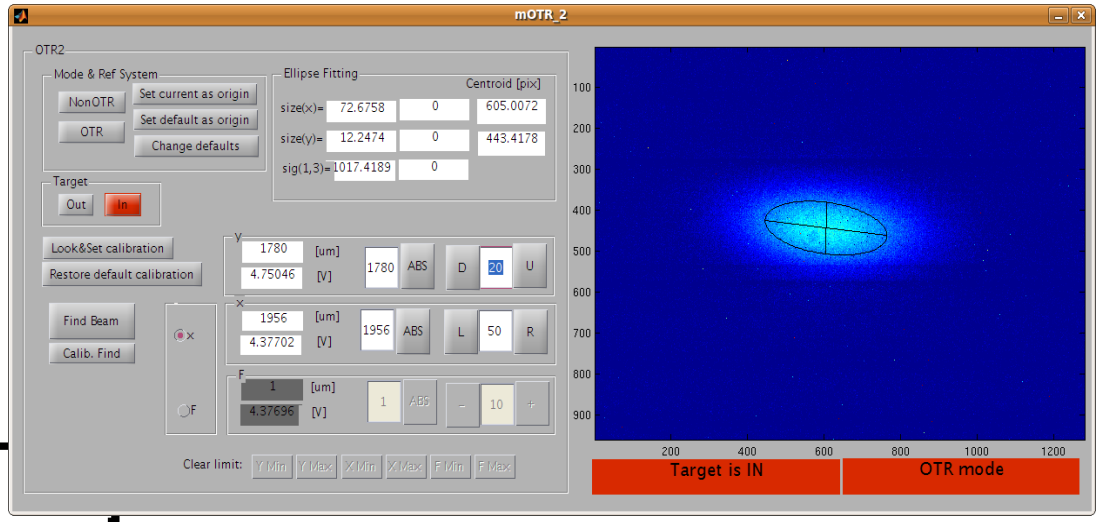


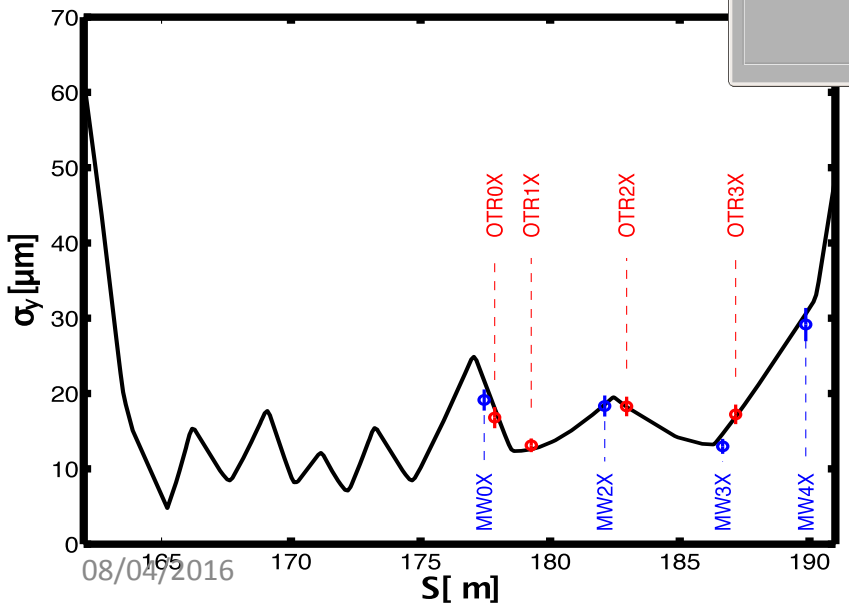
R&D activities at ILC-ATF2

OPTICAL TRANSITION RADIATION MONITORS FOR ATF2

Beam size measurements and emittance reconstrcution

- The ATF2 multi-OTR system has demonstrated to be very reliable
- Fast beam size measurement and emittance reconstruction
- Diagnostic tool very helpful for the tuning of the machine



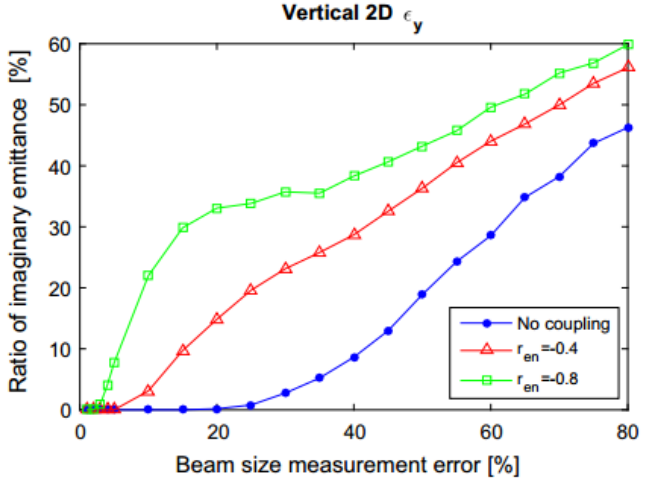


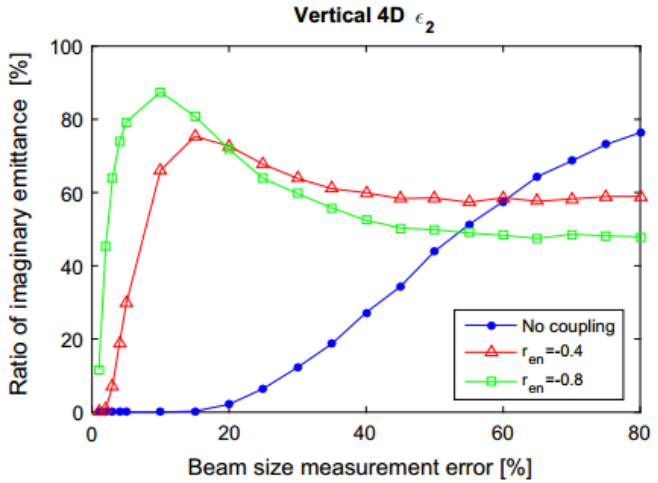
Example of vertical beam size measurements by the 4 OTRs and the wire scanners compared with the ATF2 model

R&D activities at ILC-ATF2

OPTICAL TRANSITION RADIATION MONITORS FOR ATF-ATF2

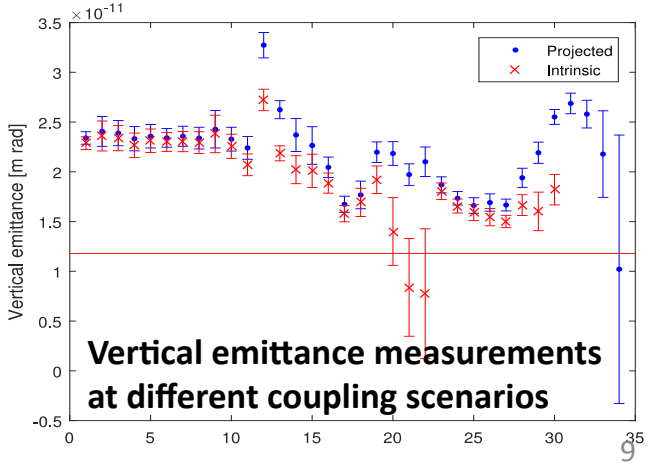
Simulations has been made to test the robustness of the emittance reconstruction in high coupling scenarios and its sensitivity to measurement errors.





Emittance reconstruction was also tested with data of real **measurements** taken with the m-OTR system of ATF2, during the tune-up of the machine.

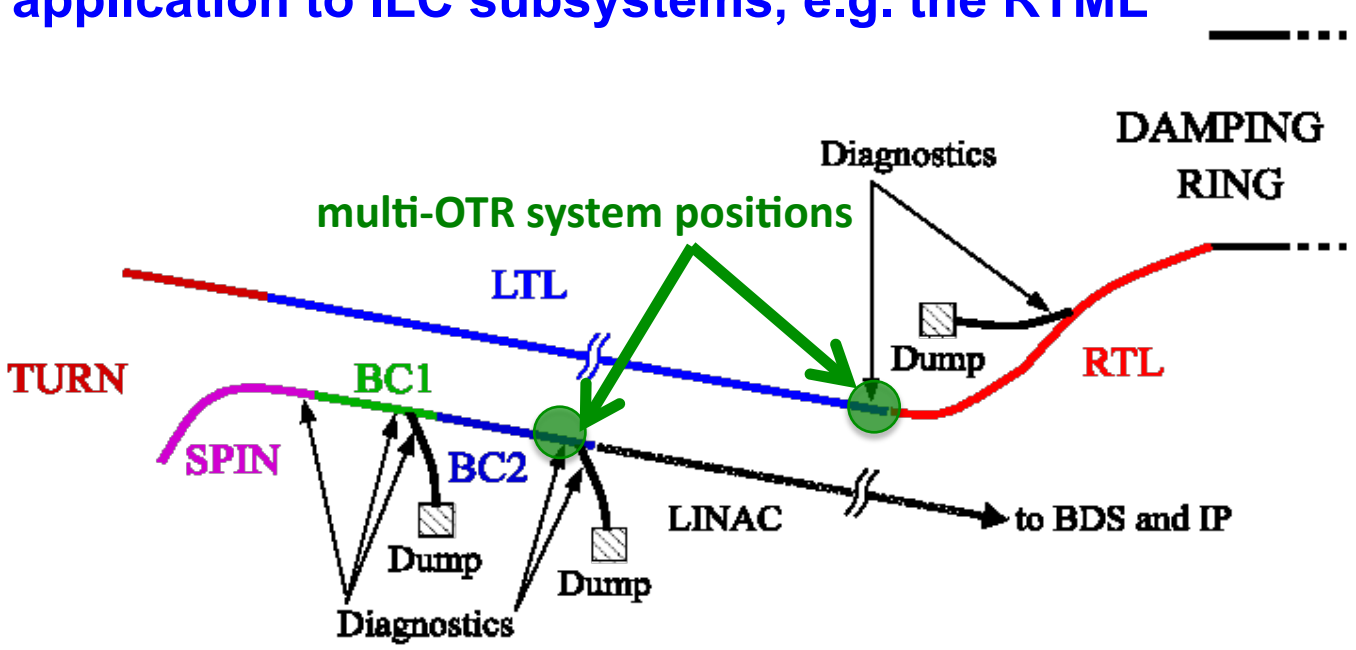
The cases for which the system of equations can not be solved are compatible with the analysis of the conditions of solvability.



R&D activities at ILC-ATF2

OPTICAL TRANSITION RADIATION MONITORS FOR ILC

Potential application to ILC subsystems, e.g. the RTML



- OTR monitors are mature and reliable diagnostic tools that could be very suitable for the setup **and tuning** of the machine **in single-bunch mode**
- It can be very useful during **startup and commissioning phases of the RTML**
- When operating with high charge and multi-bunch train the OTRs would be in non-measurement mode, i.e. they would be retracted from the beam path

R&D activities at ILC-ATF2

OPTICAL TRANSITION RADIATION MONITORS FOR ATF-ATF2

- The **multi-OTR system** of the ATF2 EXT has demonstrated its performances as a **fast** (~1 min) and **reliable** system for measuring the beam size and the emittance.

- **Totally integrated** in the **online model** and **crucial** for beam **tuning procedures**: coupling correction, beta matching, energy spread measurements

- We have **studied analytically** the **conditions of solvability** of the systems of equations involved in the process of emittance reconstruction and we have obtained some rules about the **locations** of the **measurement stations** to avoid unphysical results.

- **Simulations** has been made to test the robustness with high coupling scenarios and measurement errors. The results of these studies will be very **useful** to better determine the location of the emittance measurement stations in the **diagnostic sections** of **FLCs**.

- OTR monitors are **mature** and **reliable** diagnostic tools that could be **very suitable** for the setup and tuning of the machine in single-bunch mode. It can be very useful during **start up** and **commissioning** phases of the **RTML**. The **feasibility study** of using a m-OTR system in **transfer lines** of the **ILC RTML** has been made.

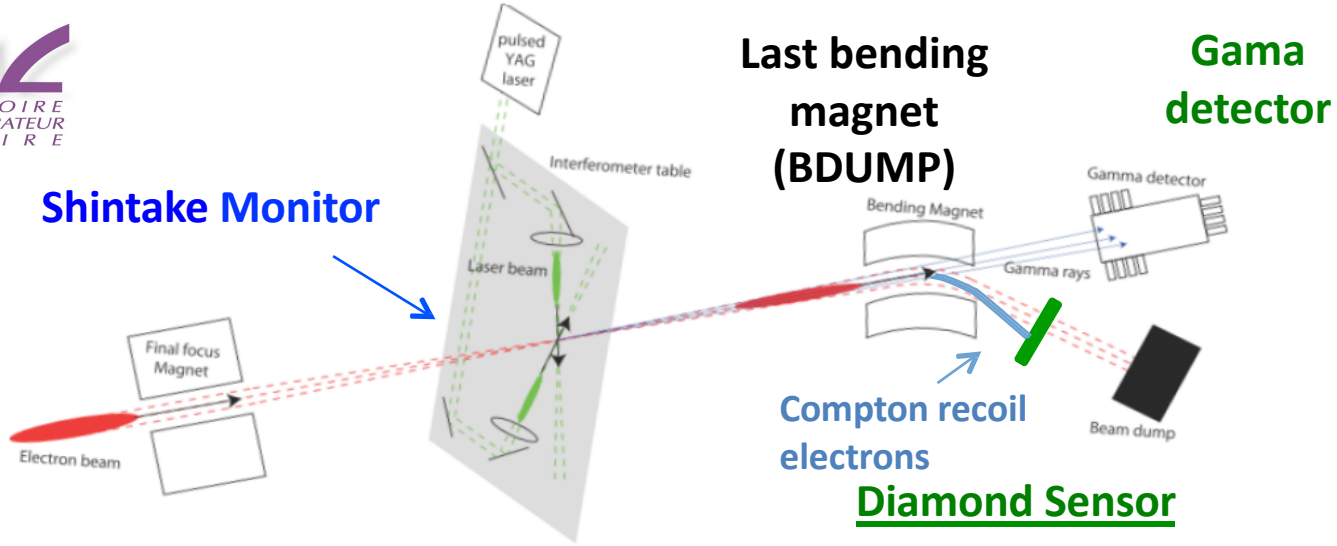
Published in NIMA58627 (March 2016)

R&D activities at ILC-ATF2

BEAM HALO COLLIMATION AND WAKEFIELD STUDIES

Motivation of the study

- ***Beam halo control and study*** in the vertical and horizontal plane
- ***Beam halo reduction*** to reduce the bremsstrahlung background that could be created at the **last bending magnet (BDUMP)**
- ***Beam halo reduction, especially in the horizontal plane,*** to enable Compton electron measurements at the **horizontal DS**



R&D activities at ILC-ATF2

BEAM HALO COLLIMATION AND WAKEFIELDS

1. **Beam dynamics simulation and realistic tracking studies** in ATF2 to evaluate the efficiency of a retractable halo collimation system (IFIC-LAL-KEK)

2. **Design** of a retractable halo collimation device: mechanical and material study (IFIC-LAL)

3. **Construction and calibration** of the halo collimation device (IFIC-LAL)

4. **Software design** of the halo collimation device control system (IFIC-LAL)

5. **Installation and commissioning** of the halo collimation device in ATF2 (IFIC-KEK-LAL)

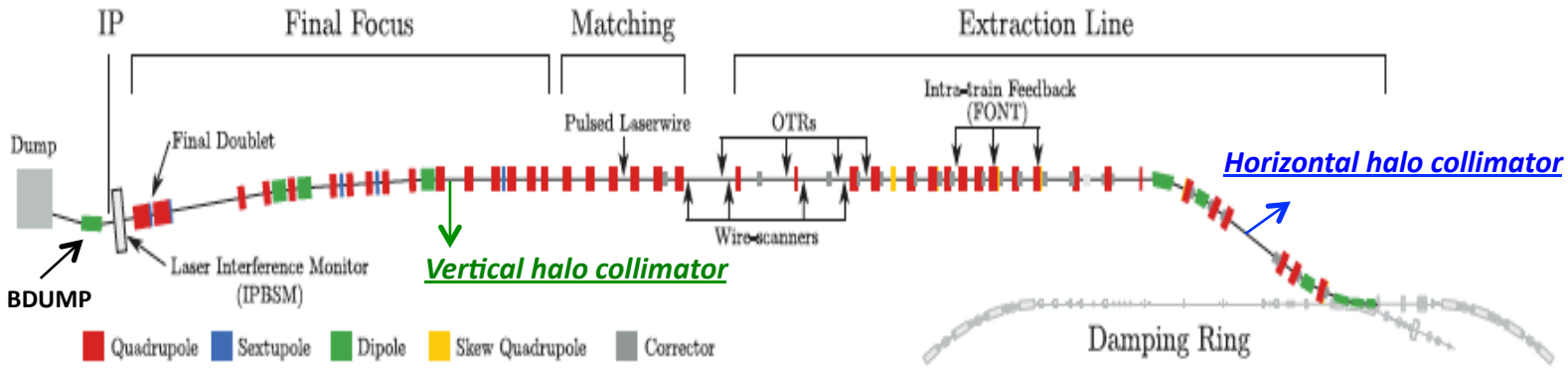
6. **Halo control, background reduction and collimator wakefield studies** using the ATF2 halo collimator (IFIC-KEK-LAL)

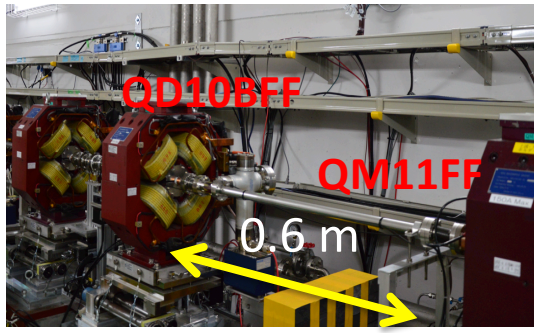
R&D activities at ILC-ATF2

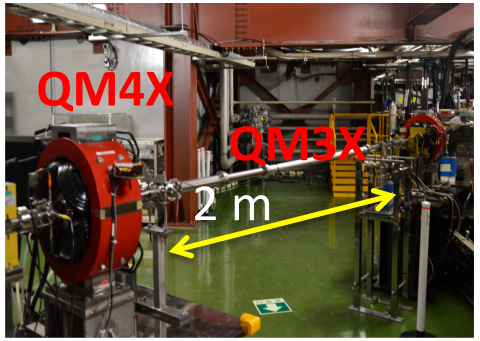
BEAM HALO COLLIMATION AND WAKEFIELDS

Beam dynamics simulation and realistic tracking studies:

- Optimized location for a betatron beam halo collimation system (vertical and horizontal)







Vertical halo collimator

- Between **QD10BFF-QM11FF**
- β_y=7126.51 m
- 0.6 m available free space length

Horizontal halo collimator

- Between **QD4FX-QD3FX**
- β_x=157.02 m
- 2 m available free space length

R&D Actvities at ILC-ATF2

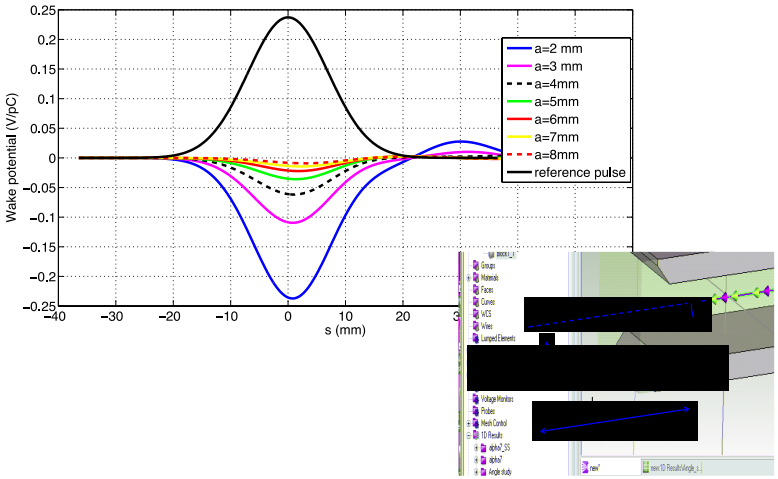
BEAM HALO COLLIMATION AND WAKEFIELDS

Design of a retractable halo collimation device: mechanical and material study:

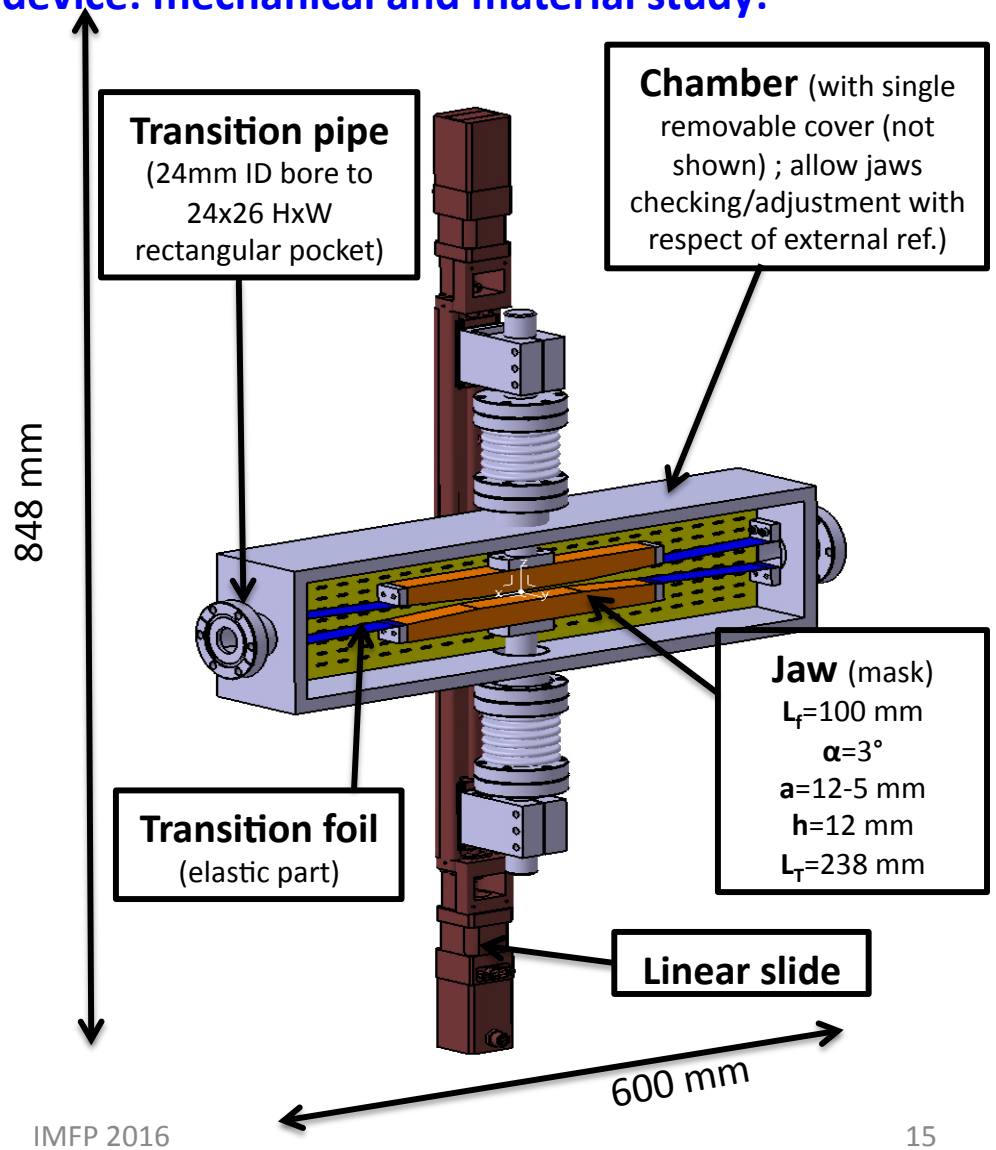
A retractable halo collimation type has been considered because of its flexibility in terms of operational aspects

Collimator wakefield study

Analytical and **Numerical simulations** using **CST PS**



This study has given the geometrical parameters to do a first 3D design



R&D activities at ILC-ATF2

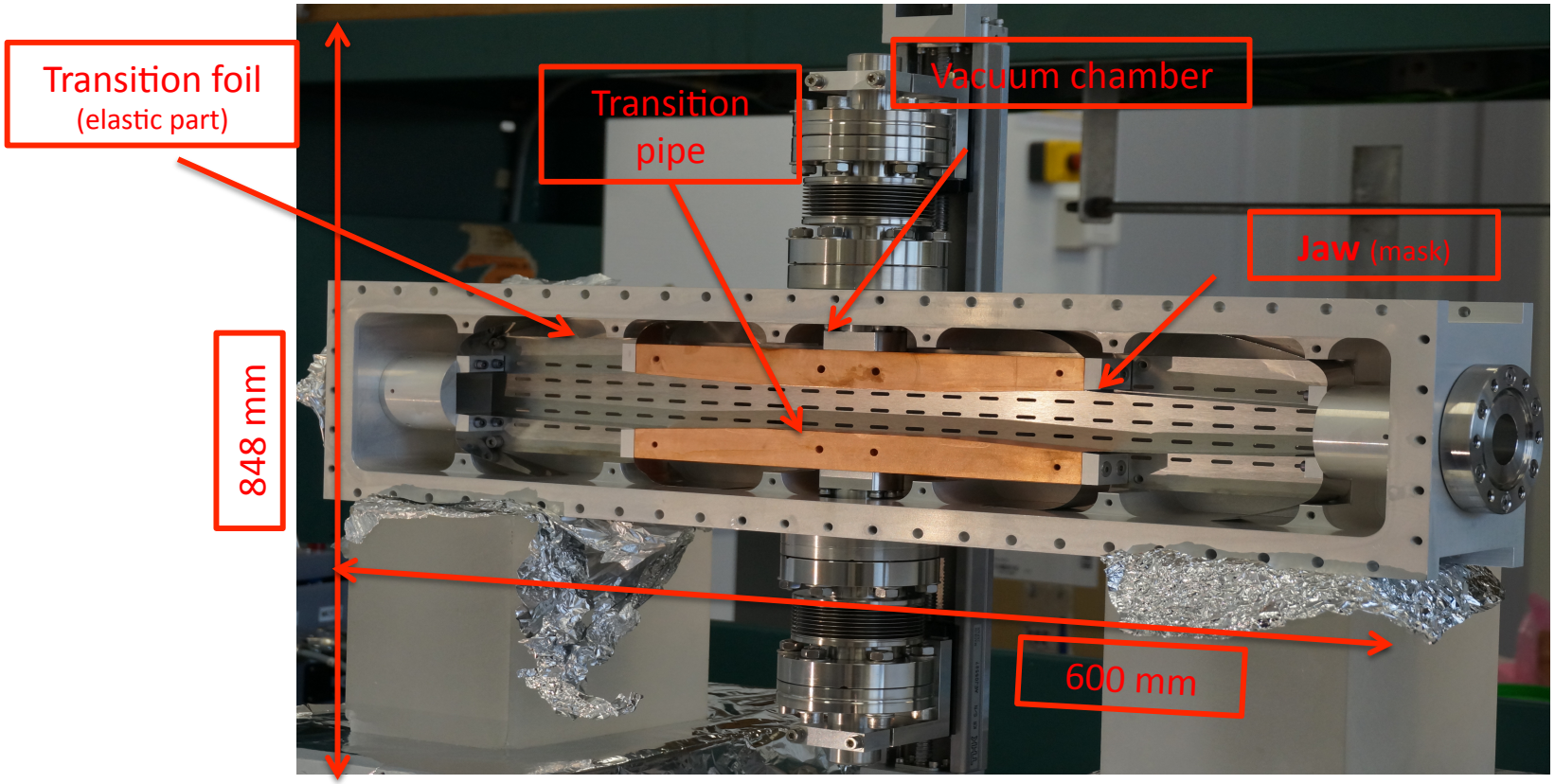
BEAM HALO COLLIMATION AND WAKEFIELDS

Installation and commissioning at ATF2 - 29/02 to 4/03 (IFIC-KEK-LAL)

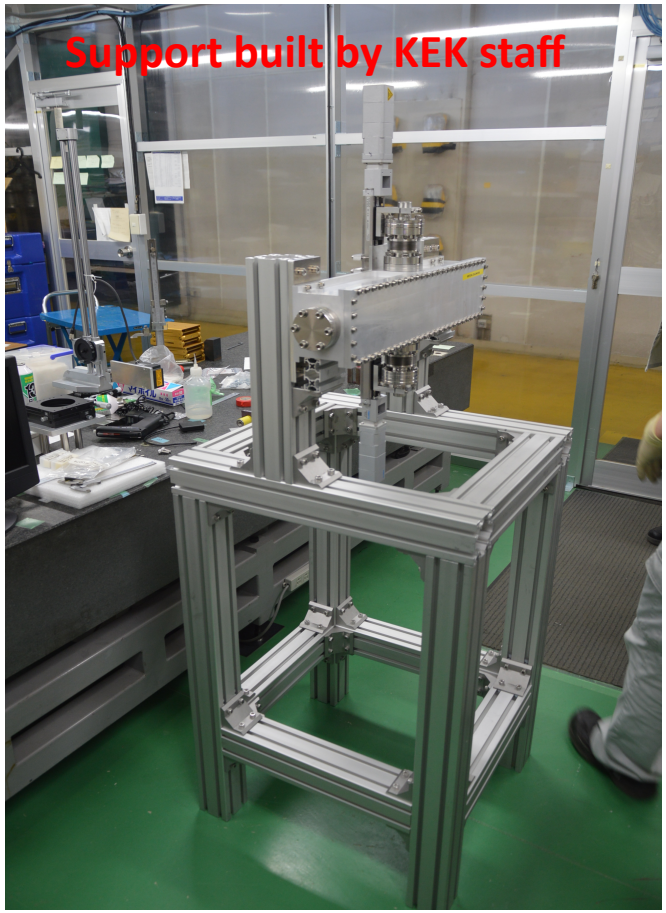
People working on the installation and commissioning:

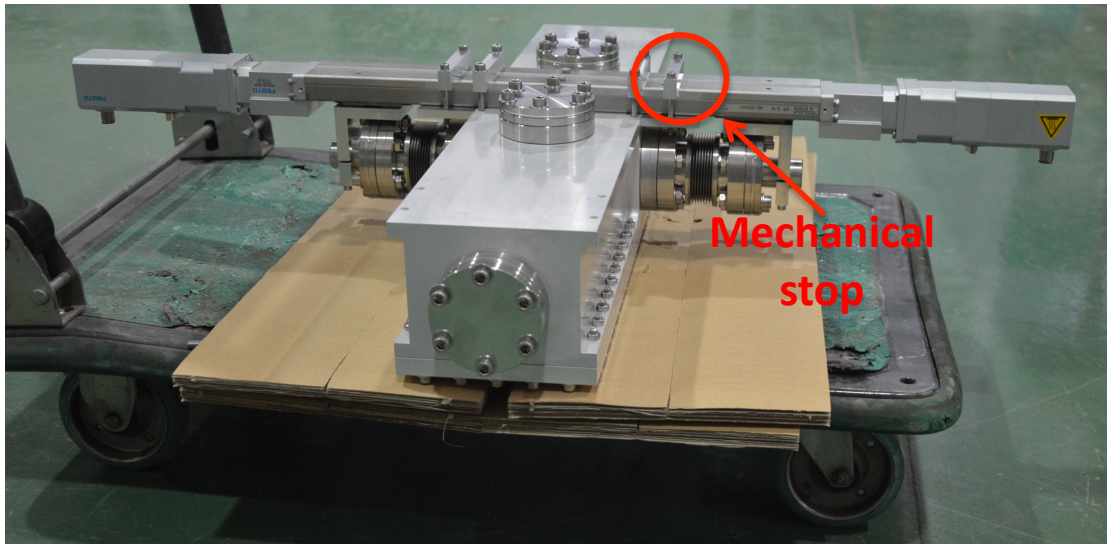
S. Wallon, P. Cornebise , P. Bambade, R. Yang, V. Kubytskyi (LAL)

N. Fuster- Martínez (IFIC) A. Schuetz (DESY)

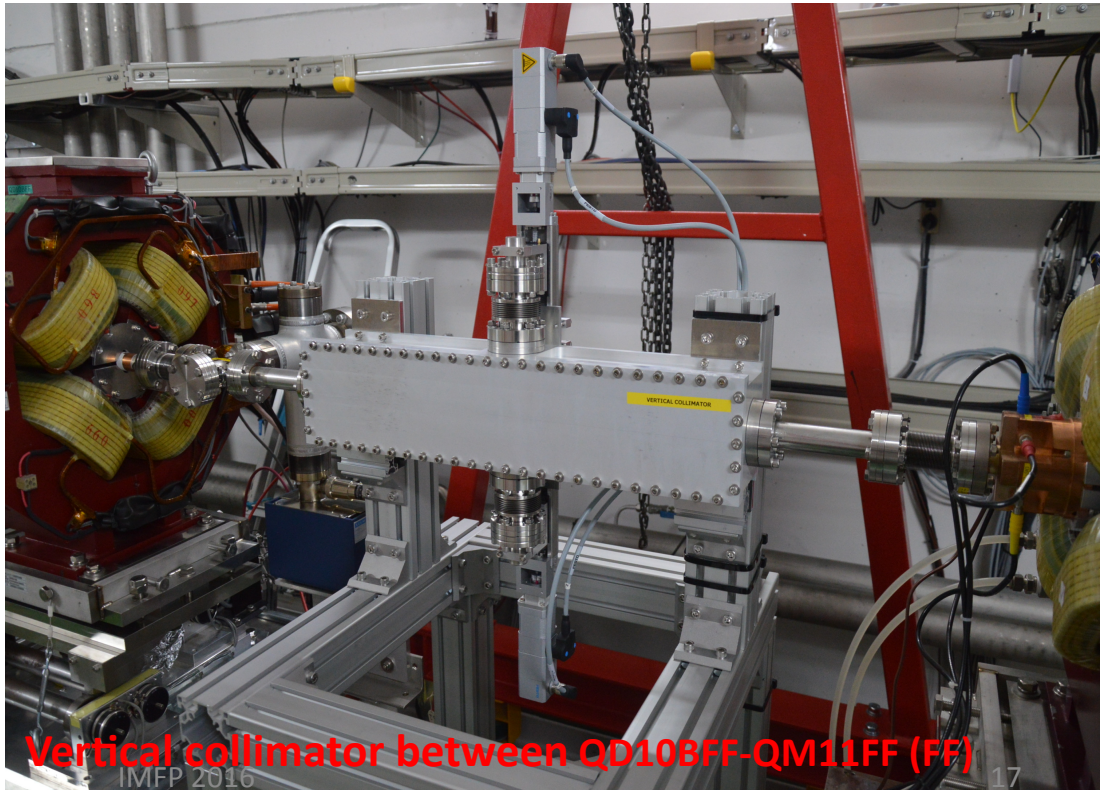


*Based on preliminary design for the ILC collimators, Full structure simulations of **ILC collimators**" J.D. A. Smith, Lancaster University/Cockcroft Institute, Warrington, UK, Proceedings of PAC09*


Support built by KEK staff


Mechanical
stop


Control box


Vertical collimator between QD10BFF-QM11FF (FF)

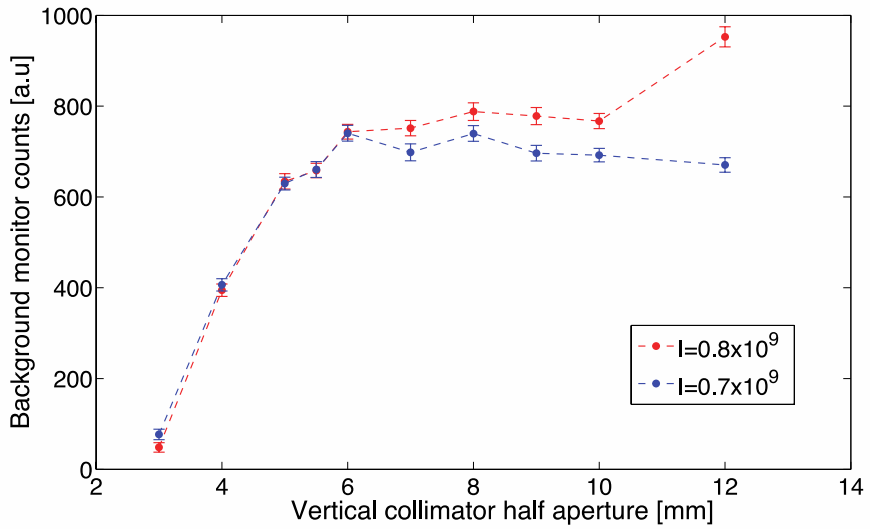
R&D activities at ATF-ATF2

BEAM HALO COLLIMATION AND WAKEFIELDS

Collimator performance studies (March 2016)

Background close to the IP

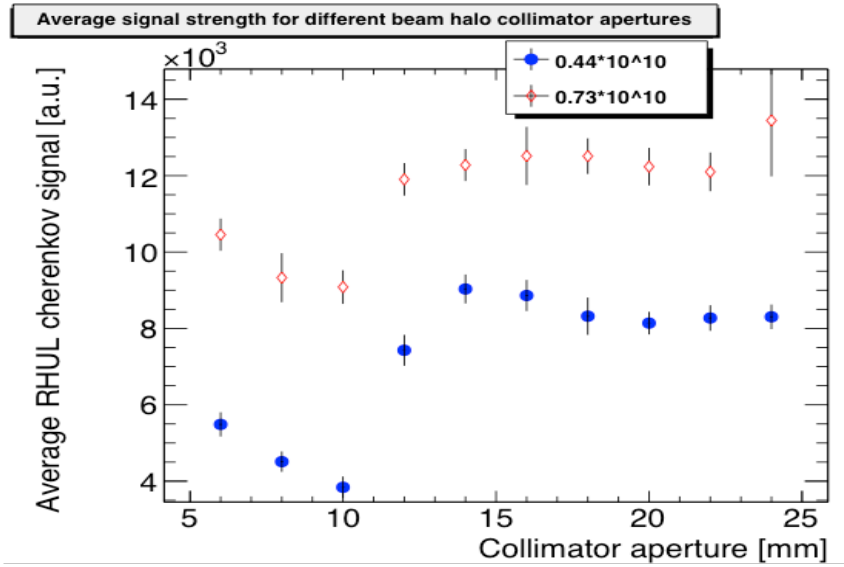
- Background study using the post-IP background monitor to investigate the efficiency of the collimation system



Background measurements close to the collimator

- Background study using the RHUL Cherenkov detector (B5FF-QD6FF) next to the collimator to investigate the background generated by the collimator

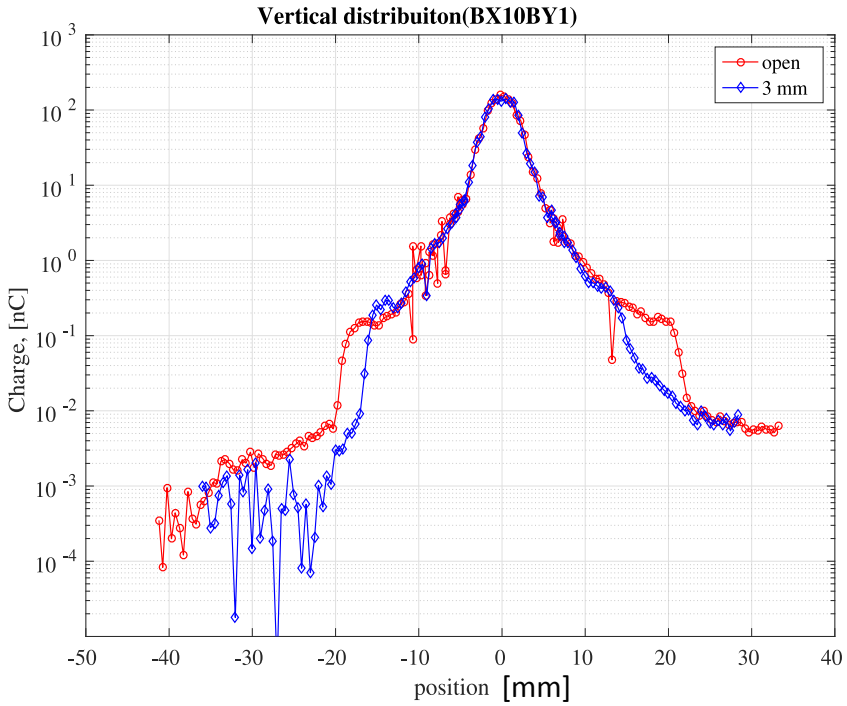
Detailed simulation to be done

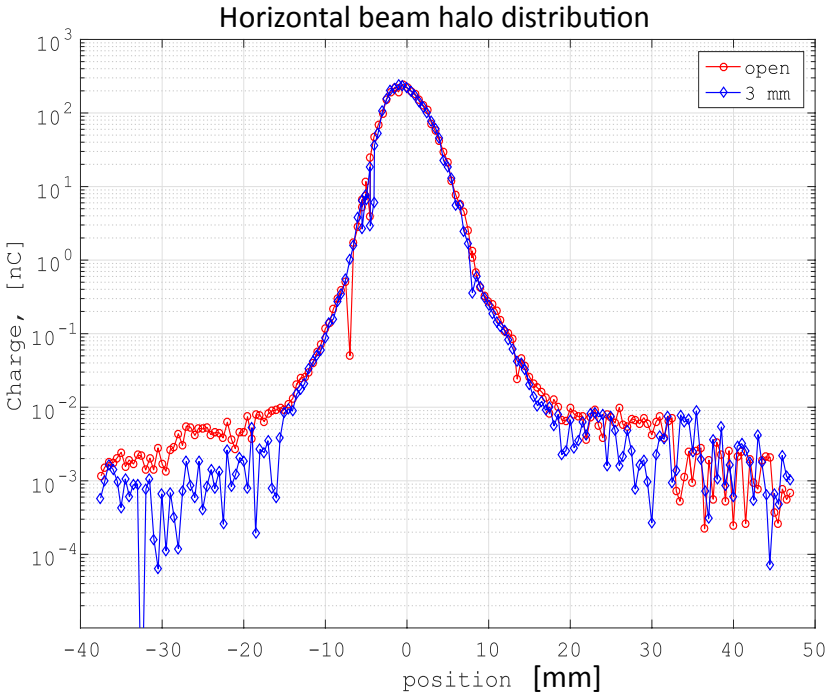


R&D activities at ILC-ATF2

BEAM HALO COLLIMATION AND WAKEFIELDS

- Beam **halo measurements** were taken with both horizontal and **vertical Diamond sensor**, with the **collimator** closed to 3 mm half aperture



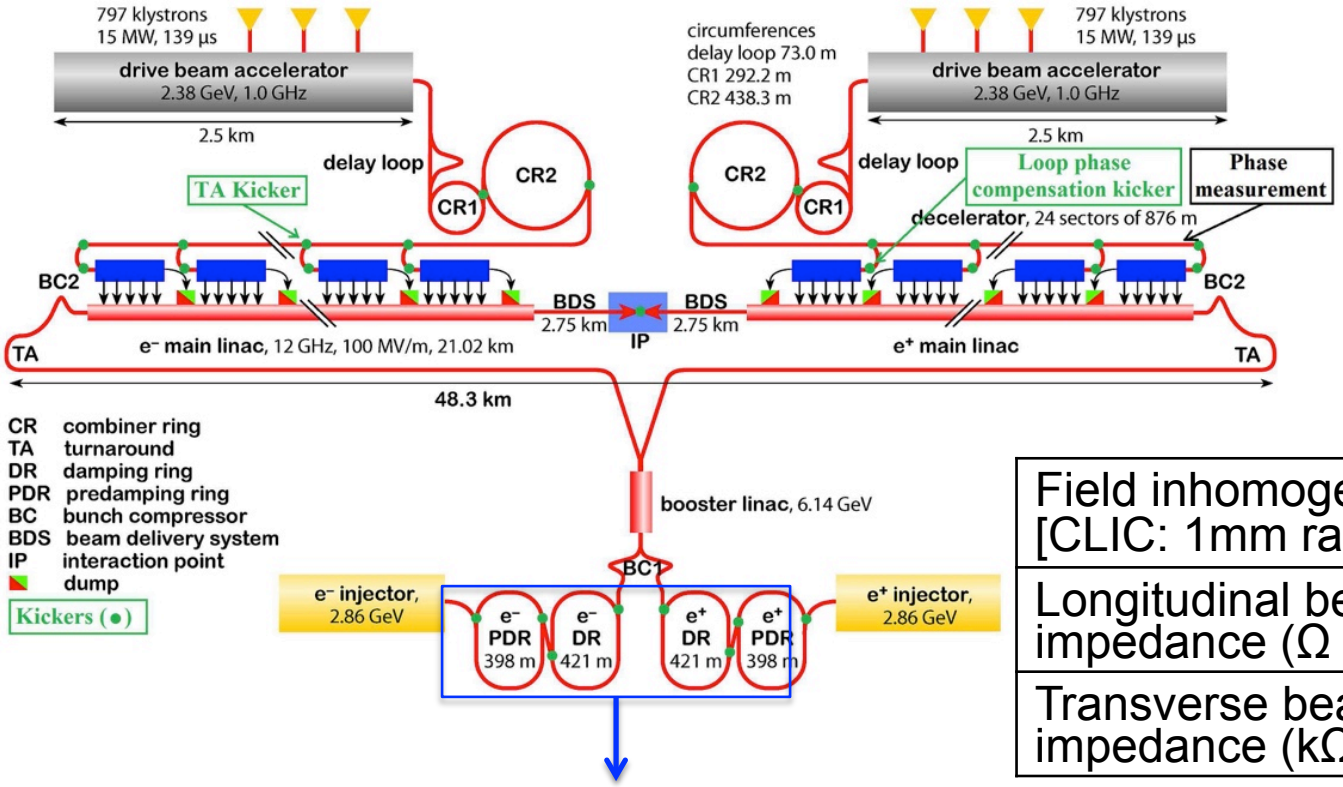


- **Symmetric cut** is observed in the **vertical plane** and **halo signal level reduced** on the left side
- In the **horizontal** beam halo distribution we also observed a **reduction of signal** in the left side

R&D activities at CLIC

STRIPLINE KICKERS FOR BEAM INJECTION AND EXTRACTION IN FUTURE LINEAR COLLIDERS

Striplines design, construction and test for the extraction kicker of CLIC Damping Rings

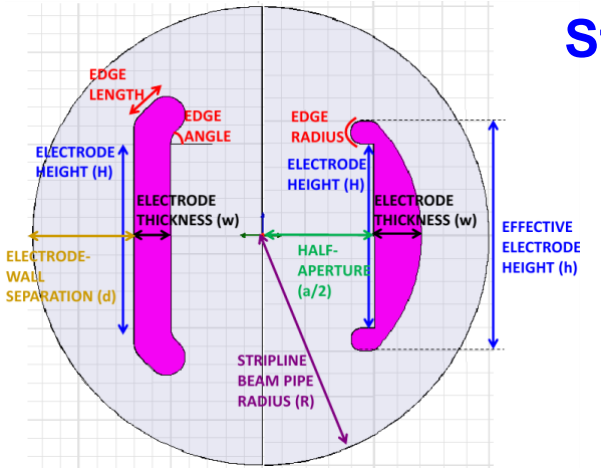


Field inhomogeneity (%) [CLIC: 1mm radius]	± 0.01
Longitudinal beam coupling impedance (Ω per turn)	< 0.05
Transverse beam coupling impedance (kΩ/m)	< 200

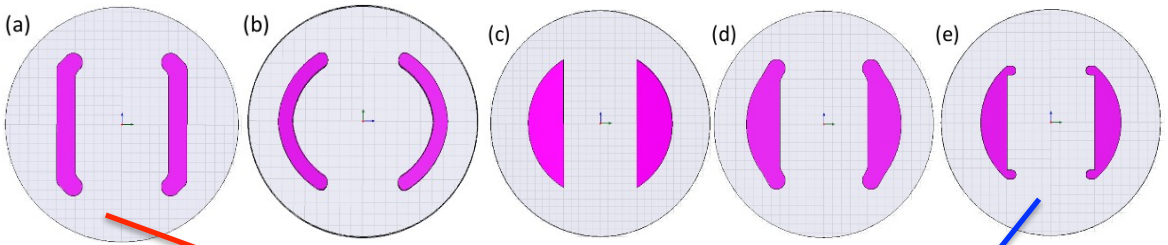
8 challenging kicker systems for beam injection and extraction from CLIC PDRs and DRs

R&D activities at CLIC

STRIPLINE KICKERS FOR BEAM INJECTION AND EXTRACTION IN FUTURE LINEAR COLLIDERS



Striplines geometry choices

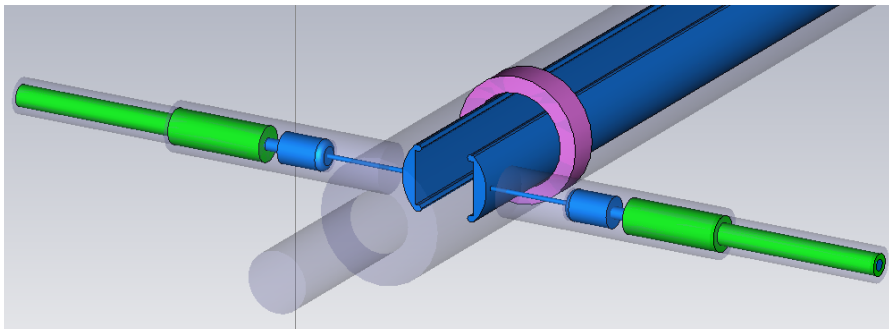


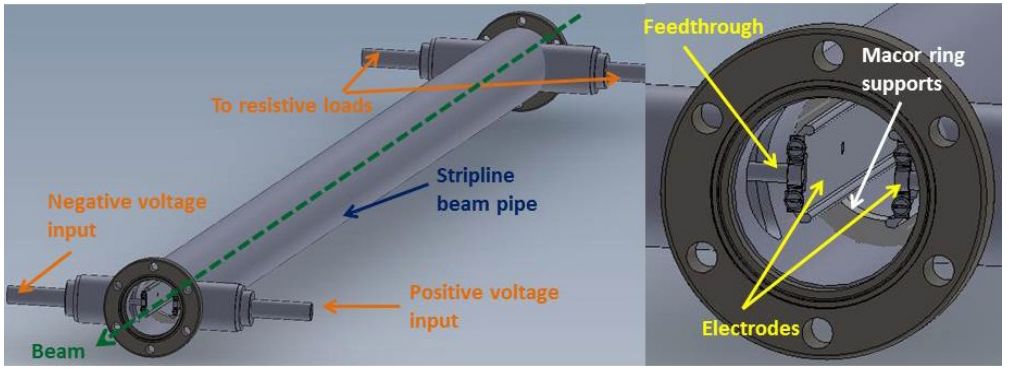
	FLAT ELECTRODE	HALFMOON ELECTRODE
Matching characteristic impedances		✓
Field homogeneity	✓	✓
Signal transmission		✓
Settling time		✓
Untapered longitudinal beam coupling impedance		✓
Untapered transverse beam coupling impedance	✓	

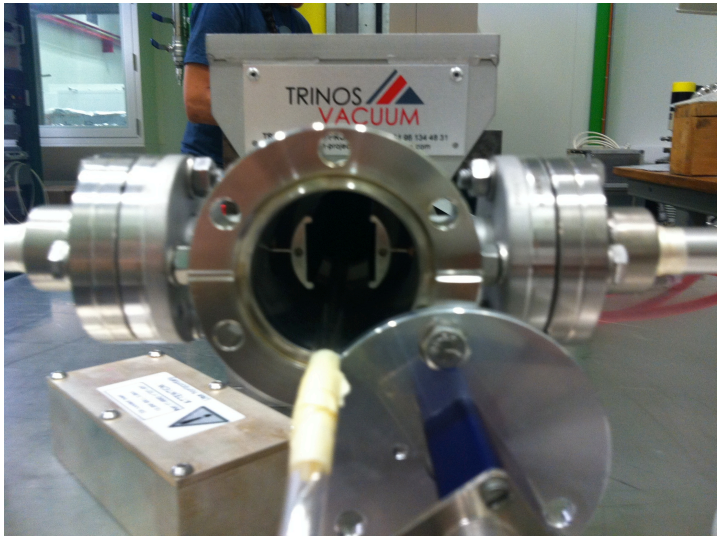
R&D activities at CLIC

STRIPLINE KICKERS FOR BEAM INJECTION AND EXTRACTION IN FUTURE LINEAR COLLIDERS

Fabrication of the striplines and their components





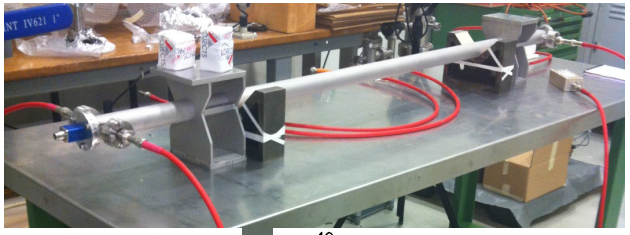


- The design of the striplines and their components, such as feedthroughs and electrode suports, has been published in the PRSTAB 17, 071003 (July 2014).
- The fabrication of the striplines has been carried out by the Spanish company Trinos **Vacuum Projects**, under the Spanish program **"Science for Industry"**.

R&D activities at CLIC

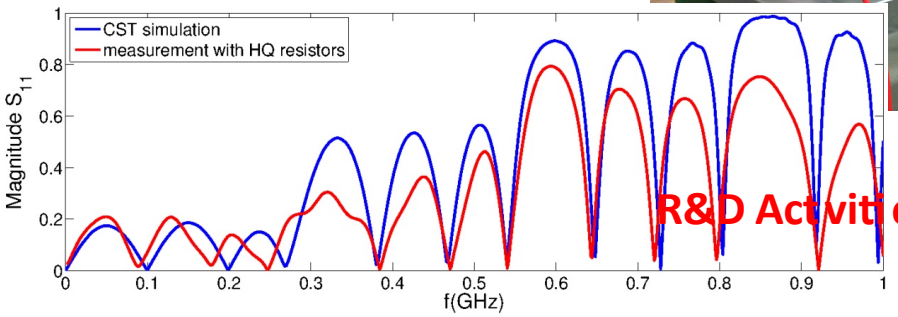
STRIPLINE KICKERS FOR BEAM INJECTION AND EXTRACTION IN FUTURE LINEAR COLLIDERS

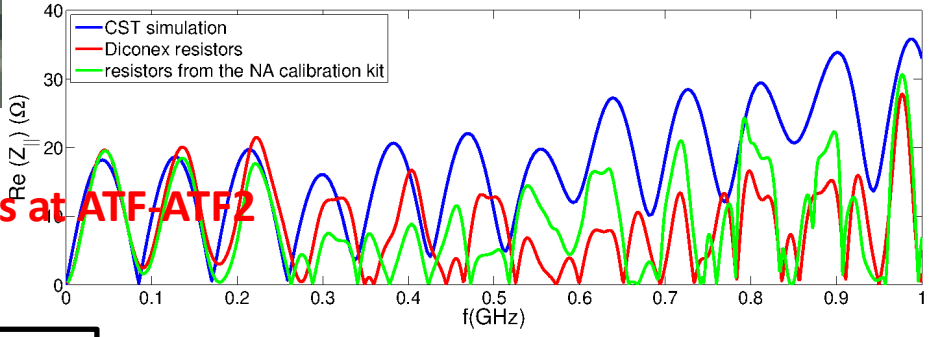
Laboratory tests at CERN:



S_{11} parameter

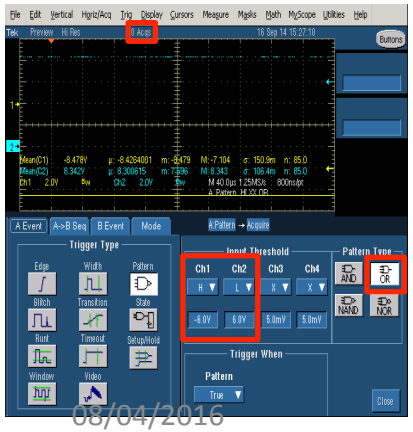
Longitudinal beam impedance

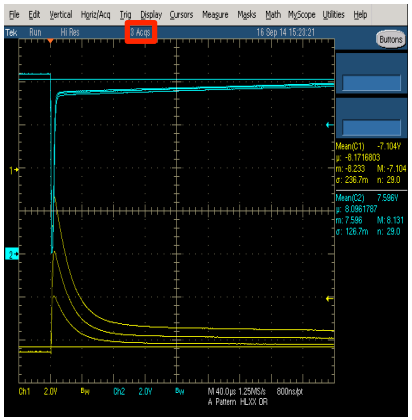


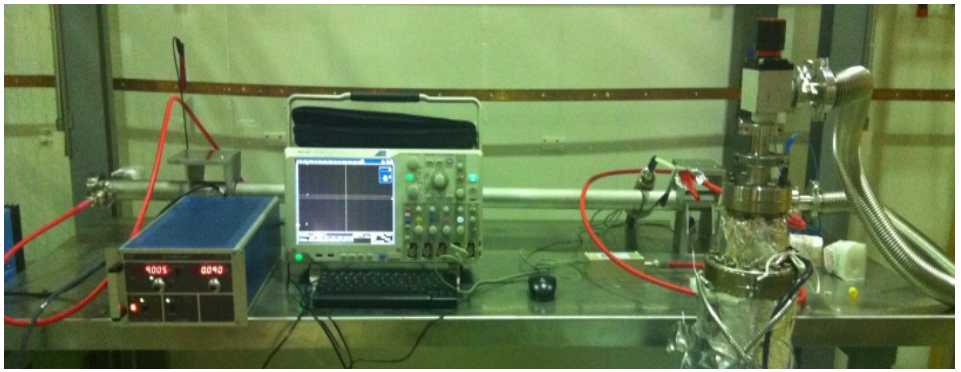


R&D Activities at ATF-ATF2

HV tests

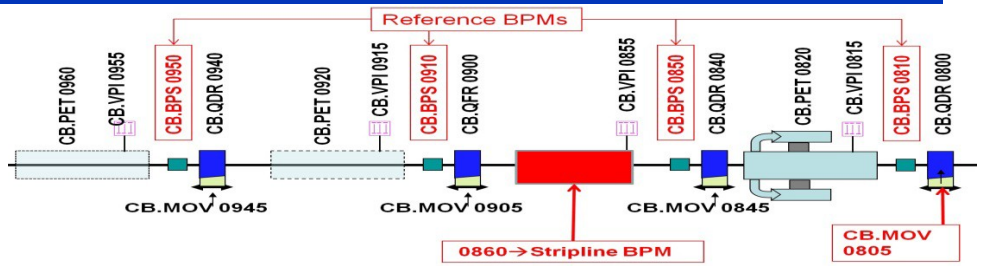






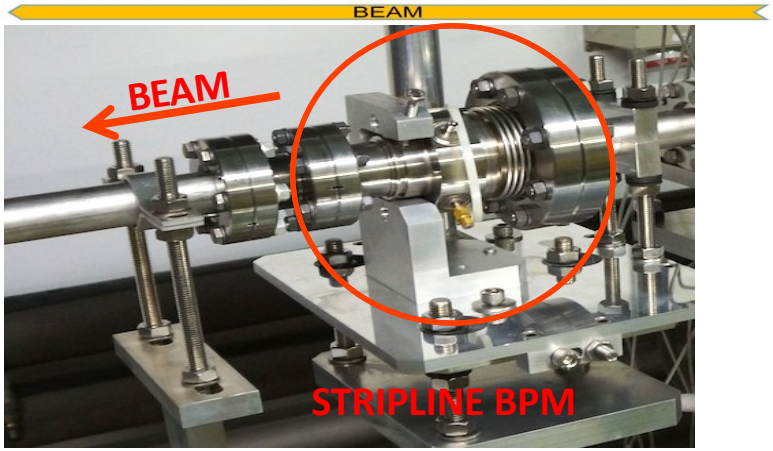
R&D activities at CLIC

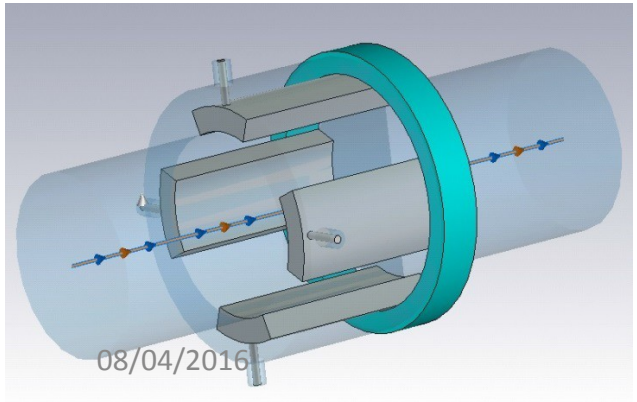
STRIPLINE BPM DEVELOPMENT FOR THE CLIC DRIVE BEAM



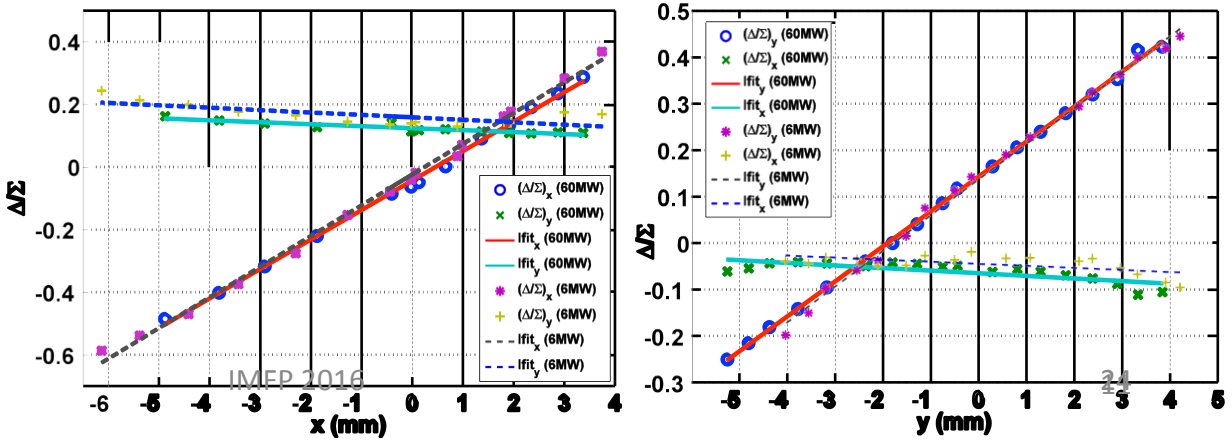
- **Stripline prototype** with **short-circuited** electrodes installed in TBL at CTF3.

- Linearity and Sensitivity parameters successfully tested with beam for 6 MW and 60 MW of extracted PETS power.
- Resolution tests performed using Singular Value Decomposition (SVD) analysis: **10 µm** (H and V planes) for a 3A beam current → Requirement not met (**2 µm**).
- **Poor rejection** of the PETS interference at **12 GHz** (next slide)





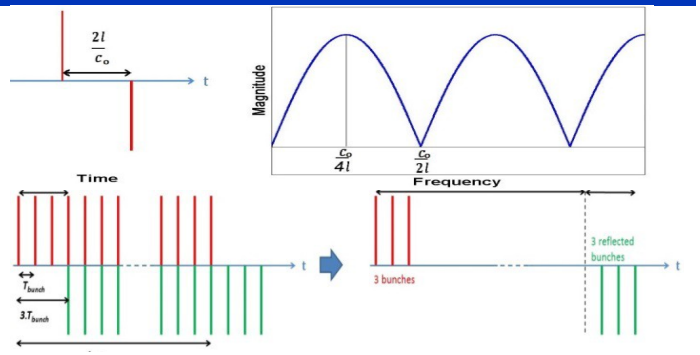
TBL Beam sweep in horizontal and vertical planes



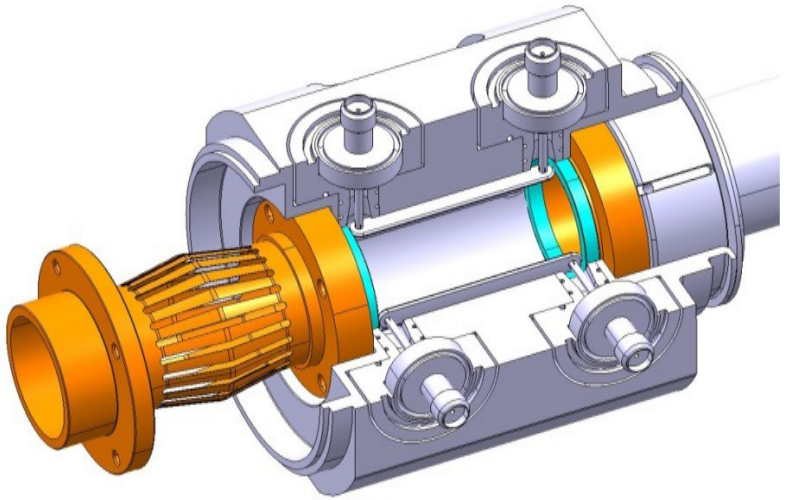
R&D activities at CLIC

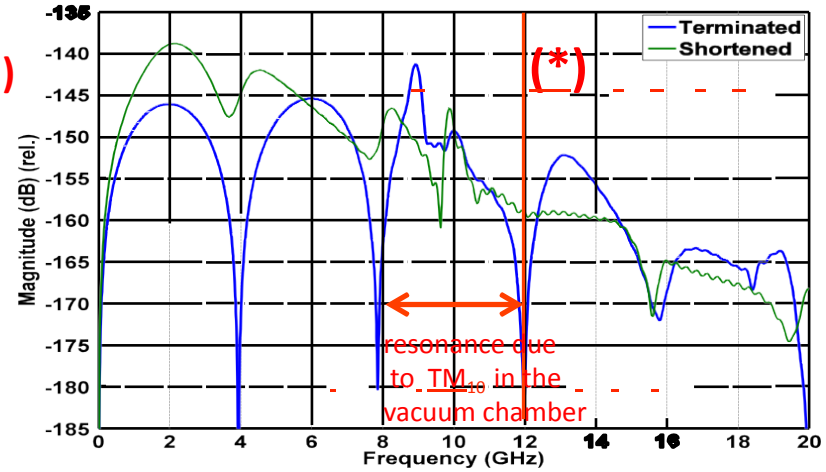
STRIPLINE BPM DEVELOPMENT FOR THE CLIC DRIVE BEAM

- **2 Stripline prototypes** with 50Ω-**terminated electrodes** developed for CLIC Module.
- 8-port design for increased notch tunability and loop-through calibration.



- **Enhanced PETS interference suppression at 12 GHz (*)** (blue trace) compared to the first prototype (green trace).

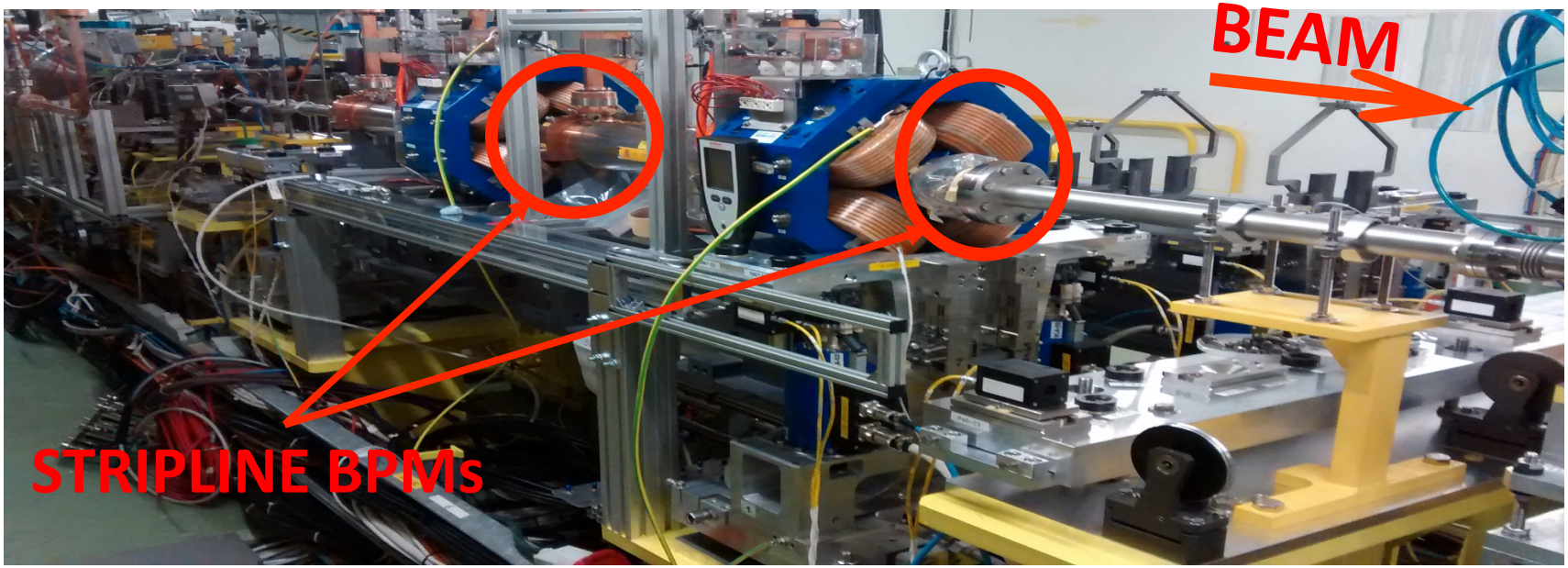




Parameter	Shortened BPM	Terminated BPM
Stripline length	25 mm	37.5 mm
Angular coverage	12.5% (45°)	5.55% (20°)
Electrode thickness	3.1 mm	1 mm
Outer radius	17 mm	13.54 mm
Ch. Impedance	37 Ω	50 Ω
Duct aperture	23 mm	23 mm
Resolution	2 µm	2 µm
Accuracy	20 µm	20 µm
Time Resolution	10 ns	10 ns

R&D activities at CLIC

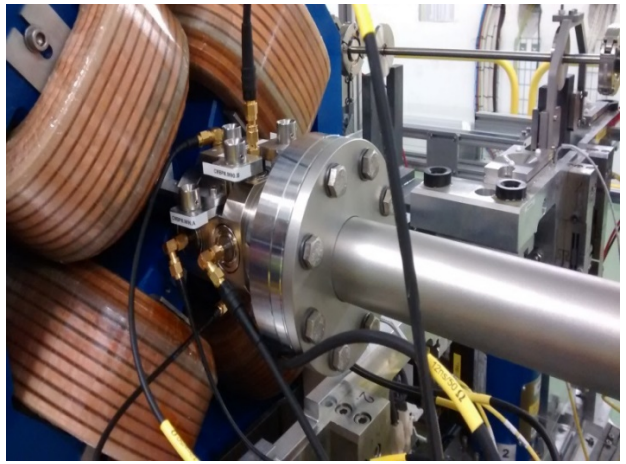
STRIPLINE BPM DEVELOPMENT FOR THE CLIC DRIVE BEAM



CLIC Two-Beam-Module (TBM) Installation

- Two installed units:
  - CM.BPL0645
  - CM.BPL0685

- Beam tests in progress:
  - Linearity/Sensitivity
  - Resolution

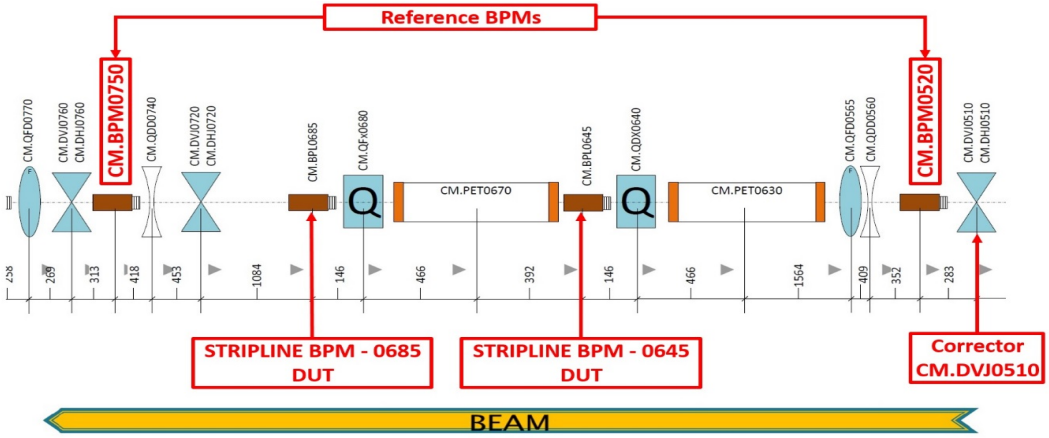


R&D activities at CLIC

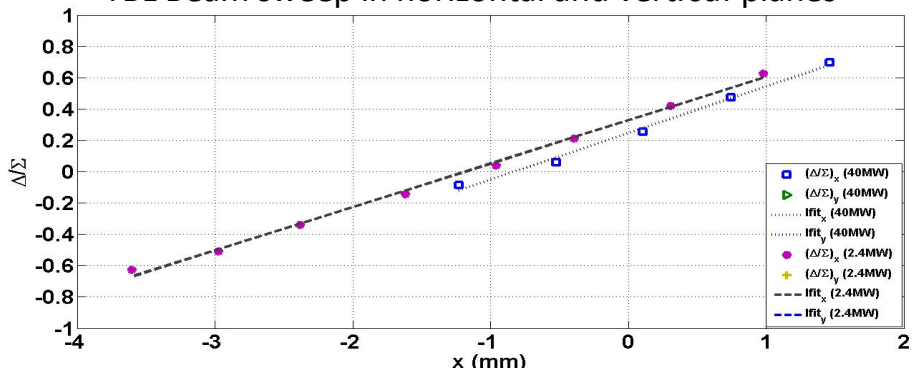
STRIPLINE BPM DEVELOPMENT FOR THE CLIC DRIVE BEAM

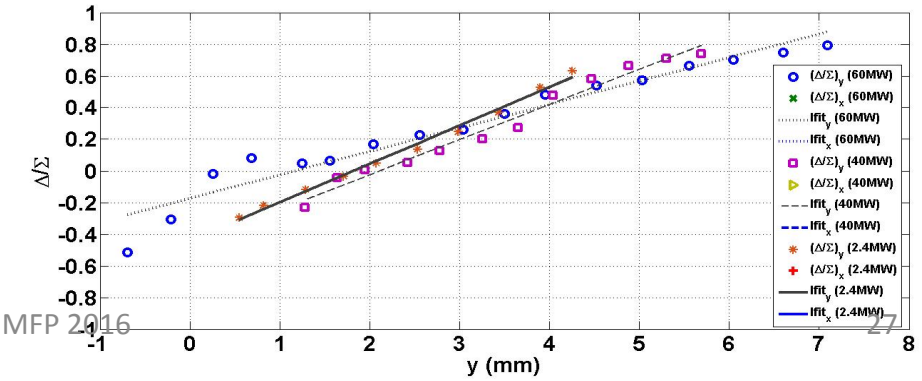
Linearity/Sensitivity Tests

- CTBM, pos. 0645 and 0685
- Evaluate the influence of 12 GHz PETS interference (130 MW in CLIC) in the linearity of the device.
- Beam steered by corrector 0510.
- Reference BPMs: Inductive BPMs 0520 and 0750
- Three test scenarios: 2.4 MW, 40 MW and 60 MW PETS power interference at 12 GHz



TBL Beam sweep in horizontal and vertical planes



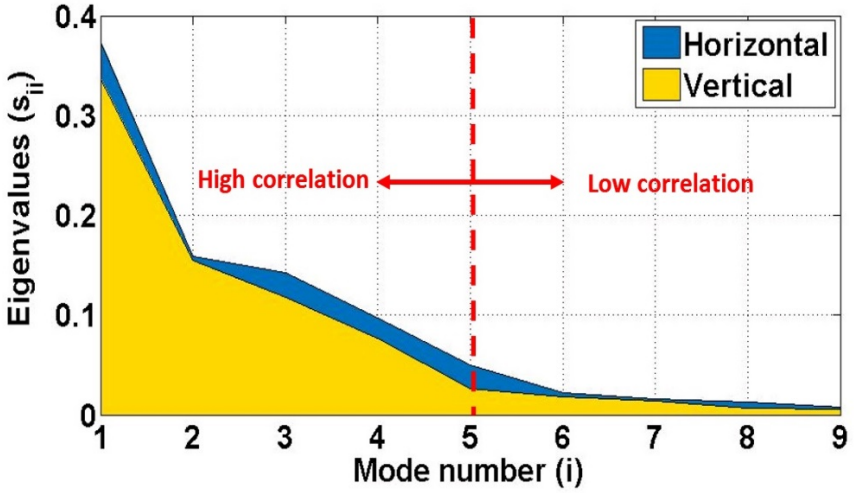


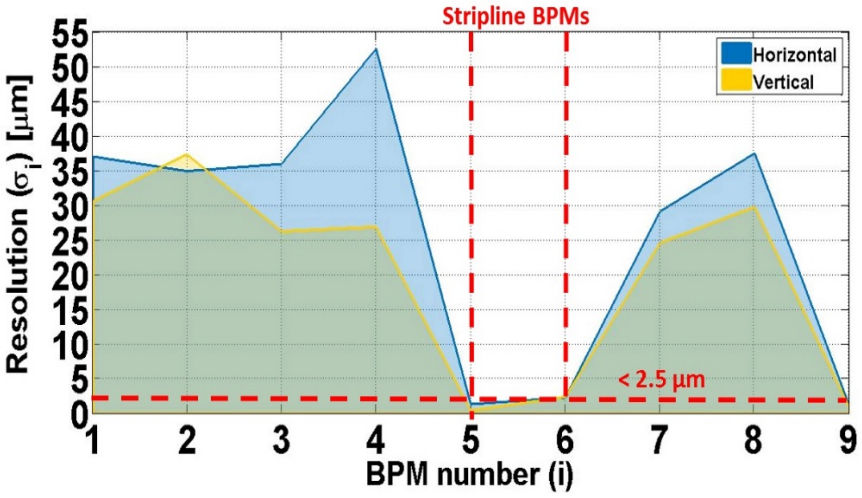
R&D activities at CLIC

STRIPLINE BPM DEVELOPMENT FOR THE CLIC DRIVE BEAM

Resolution Tests

- Singular Value Decomposition (SVD) analysis used to separate highly-correlated, systematic beam effects from uncorrelated BPM noise floor.
- Analysis performed for 1000 shots acquired from a centered 22 A beam.
- Position data are recorded for all 9 BPMs in the Drive Beam line of TBM and decomposed.
- Eigenvalues corresponding to high correlation region (first 5 in this case) are set to zero and the position data matrix is recomputed.
- The standard deviation of the recomputed matrix columns gives the measured resolution for our prototypes:
  - BPM0645 (#5): **1.4 µm (H) , 0.5 µm (V)**
  - BPM0685 (#6): **2.4 µm (H) , 2.5 µm (V)**



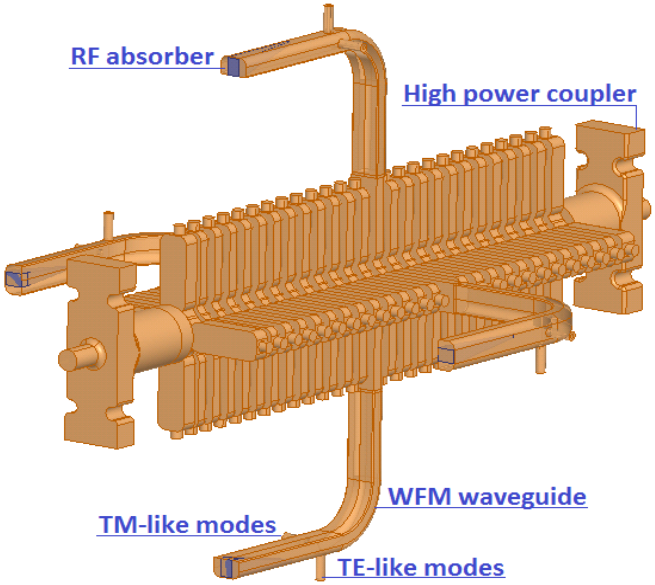


R&D activities at CLIC

DIRECT ALIGNEMENT OF ACCELERATING STRUCTURES

PACMAN is a Marie-Curie project (grant PITN-GA-2013-606839) consisting of 10 ESR PhD students for a development of new methods and tools to improve the pre-alignment accuracy of the CLIC components.

The objective involves the pre-alignment of a 23 cm long traveling wave Accelerating Structure (AS) operating at 12 GHz. It consists of 26 tapered cells with iris mean aperture of 5.5 mm.



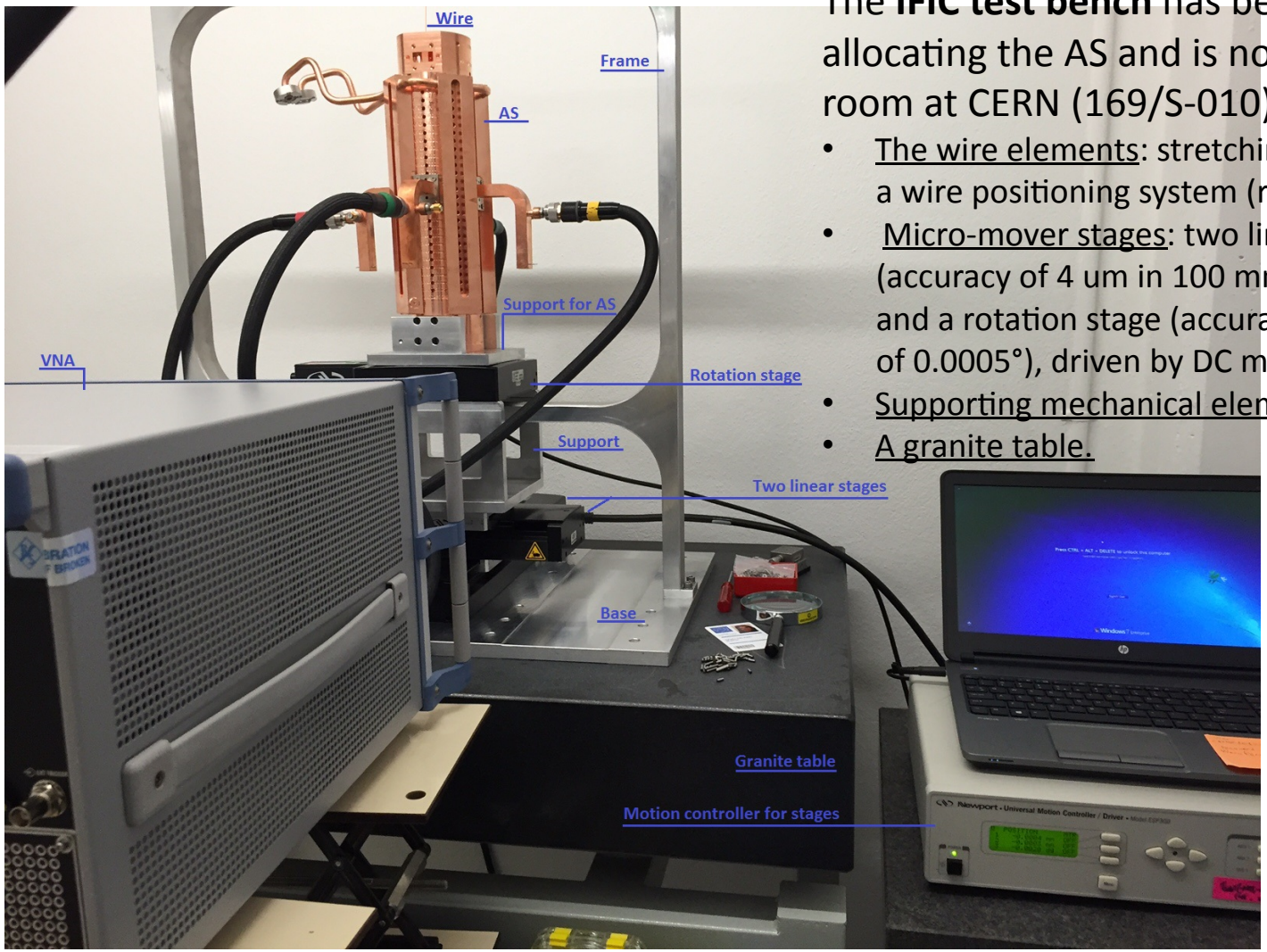
The in-situ internal **alignment of the AS** can be done in a laboratory environment using a Vector Network Analyser (VNA) and a dedicated experimental set up that has been developed for this purpose.

A **stretched wire** is used to materialize the electromagnetic axis in the AS and serves as a reference to fiducialise the structure in the environment of a 3D Coordinate Measuring Machine (CMM). The required precision is 7 um with an uncertainty of ±0.3 um.

Transmission and reflection coefficients are measured at the WFM ports while changing the position of the wire. The perturbation created by the wire is minimised when it lays in the centre of the AS.

R&D activities at CLIC

DIRECT ALIGNEMENT OF ACCELERATING STRUCTURES: Experimental set-up



The **IFIC test bench** has been adapted for allocating the AS and is now placed at the RF-room at CERN (169/S-010). It consists of:

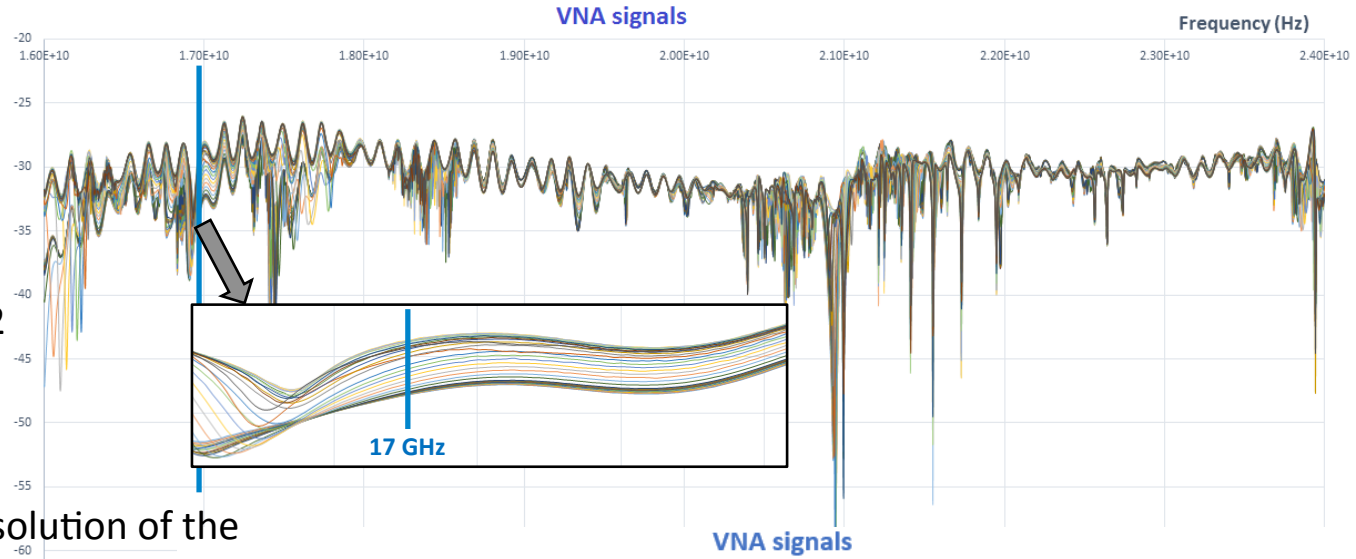
- The wire elements: stretching wire tools, fiducials and a wire positioning system (reproducibility of 1.5 um).
- Micro-mover stages: two linear translation stages (accuracy of 4 um in 100 mm with 0.1 um resolution) and a rotation stage (accuracy of 0.012° and resolution of 0.0005°), driven by DC motos.
- Supporting mechanical elements.
- A granite table.

A **development environment** (LabVIEW) allows the performance of automatic measurements. The movement of the stages are controlled based on the acquisition from the VNA and the signal processing done by the program.

R&D activities at CLIC

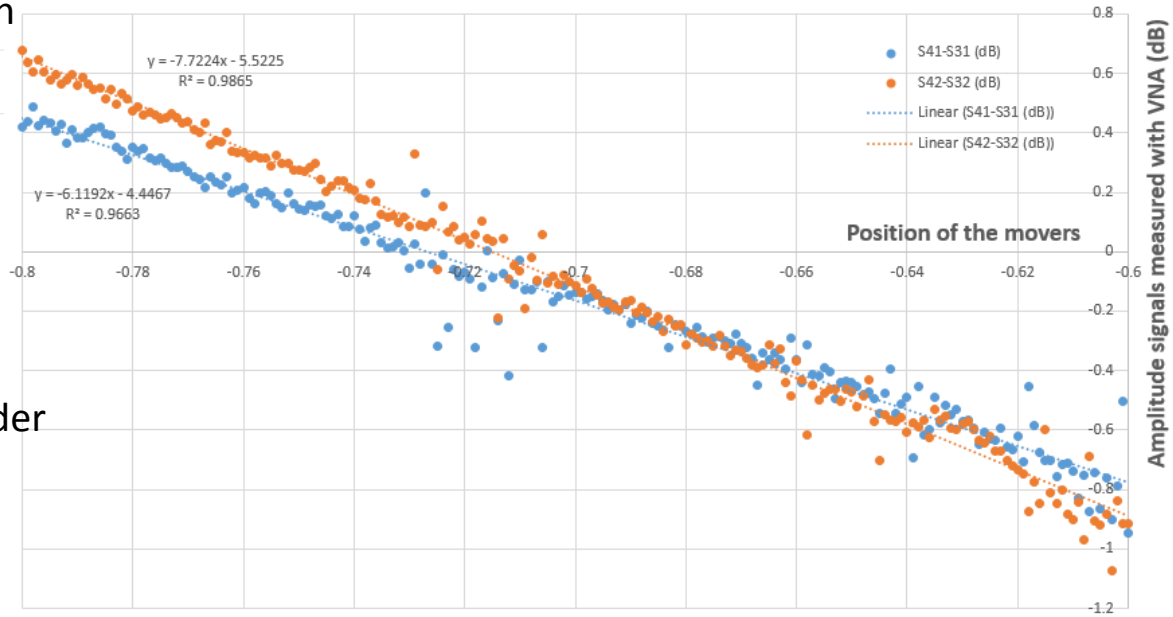
DIRECT ALIGNEMENT OF ACCELERATING STRUCTURES: Results

<u>Selection of the frequency:</u>
The most sensitive frequency to the position of the wire around the centre of the AS is at 17 GHz. The dependence is linear and the sensibility is 3.2 dB/mm.



<u>Current results:</u>
We have demonstrated a resolution of the measurements of 1.5 um and 0.8 um in the X and Y axis respectively with a repeatability of 10 um and 5 um .

<u>Future work</u>:
will look at the reproducibility of the measurements and will implement mechanical improvements in the test bench with the help of the CMM in order to look for 1 um accuracy.



R&D activities at CLIC

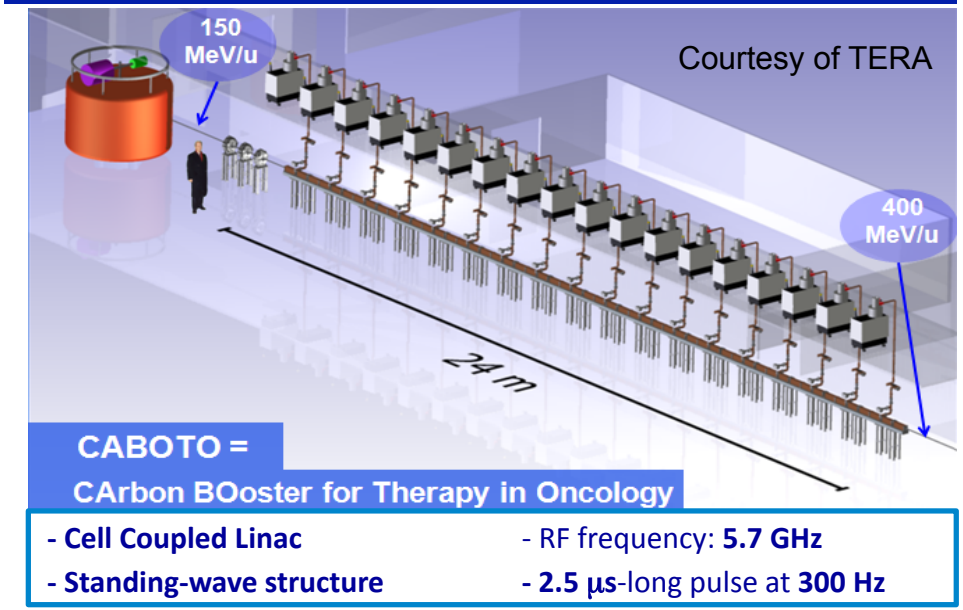
HIGH-GRADIENT RF STRUCTURE STUDIES FOR MEDICAL ACCELERATORS

Motivation

Compact, energy-efficient accelerators for tumour treatment with hadrons (**hadrontherapy**)

Compactness ⟷ **high-gradient RF technology**
(about 24-m long) *(E_S ~ 200 MV/m)*

but RF breakdowns?



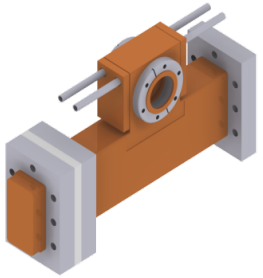
CABOTO =
CArbon BOoster for Therapy in Oncology

- **Cell Coupled Linac**
- **Standing-wave structure**
- RF frequency: **5.7 GHz**
- **2.5 μs**-long pulse at **300 Hz**

S-band: 3 GHz

One 3 GHz TERA **Single-Cell** Cavity

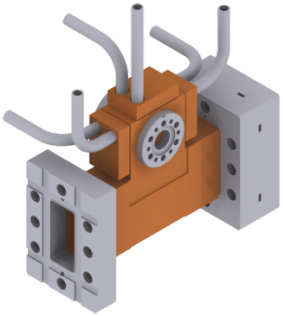
Low-power at CERN and high-power (CTF3) **tested**



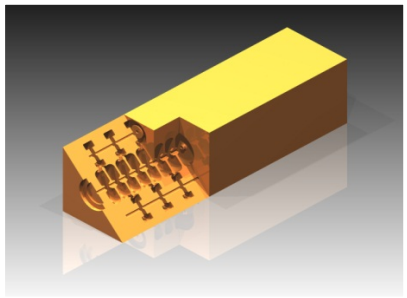
C-band: 5.7 GHz

Three 5.7 GHz TERA **Single-Cell** Cavities

Low-power at CERN and high-power (ADAM S.A.)



❖**Multi-Cell** Structure (either S-band **or** C-band)

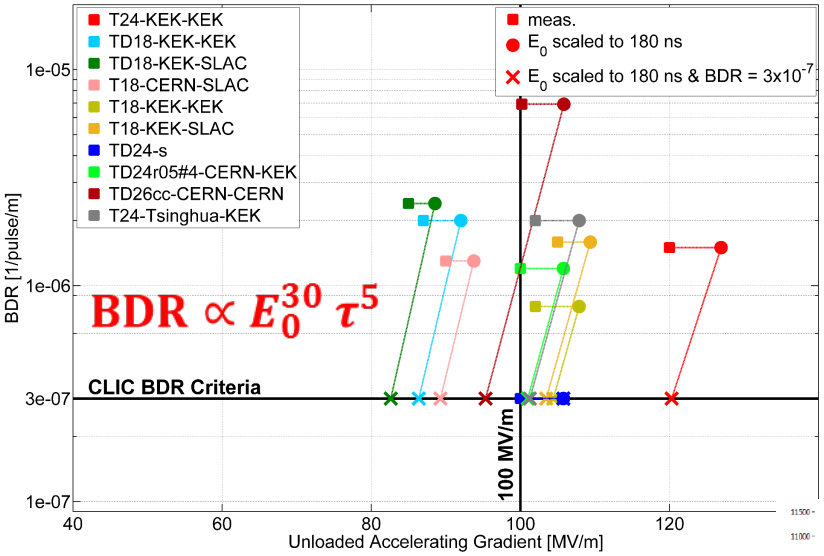


S. Verdu-Andres, "High-gradient accelerating structure studies and their application in hadrontherapy", Ph.D. Thesis, Universitat de Valencia

R&D activities at CLIC

XBOX: X-BAND HIGH-POWER TEST STAND AT CERN

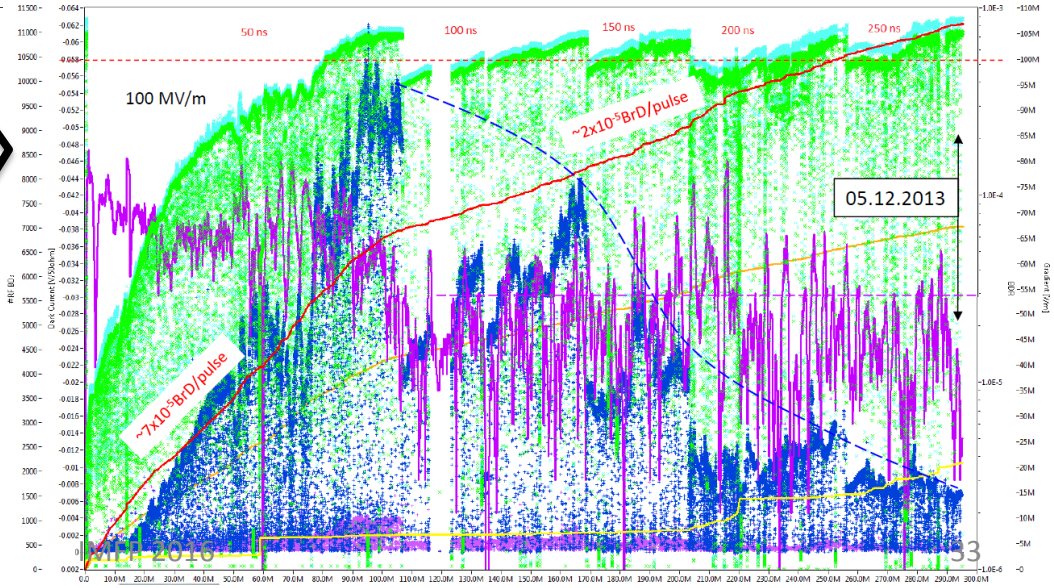
High-gradient in CLIC (Compact Linear Collider)



The performance of **new designs** of accelerating structures have been **tested**, based on the CLIC main requirements of **100 MV/m** gradient and **breakdown rate** below **3e-7 bpp/m.**

New X-band (12 GHz) test stands are operative at CERN: Xbox-1 and Xbox-2. The 3rd generation Xbox-3 is on commissioning phase.

Conditioning and test of the TD26CC structure from July to December 2013 at Xbox-1



R&D activities at CLIC

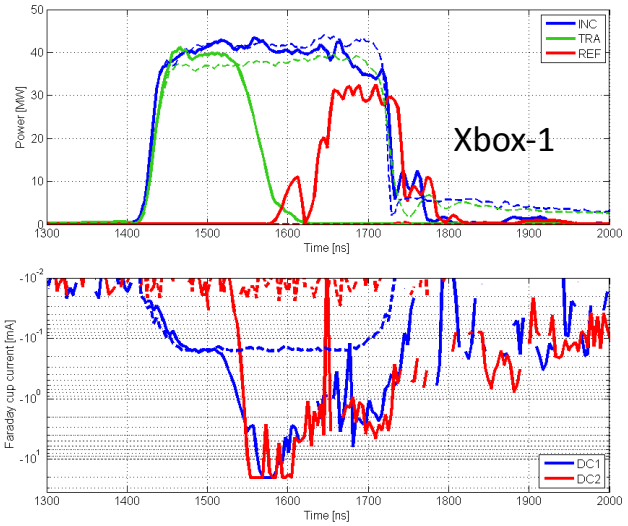
XBOX: X-BAND HIGH-POWER TEST STAND AT CERN

Breakdown studies in high gradient accelerating structures

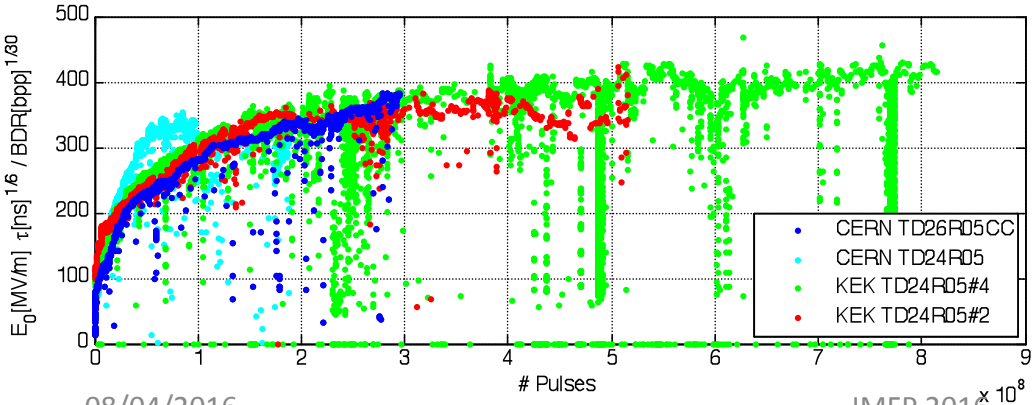
Data acquired in Xbox-1 and Xbox-2 is analysed to understand the nature of breakdown phenomena:

- **Breakdown localization**
- **Dark current** and **field emission** measurements
- Breakdown **statistics** and measurement of the BDR-gradient dependence
- **Conditioning process** and test optimisation

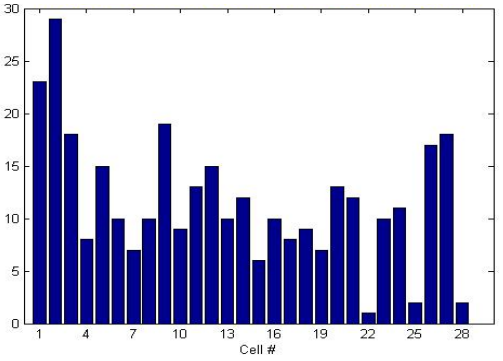
RF power and Dark Current signal analysis



Comparative analysis of RF conditioning with the cumulative pulses



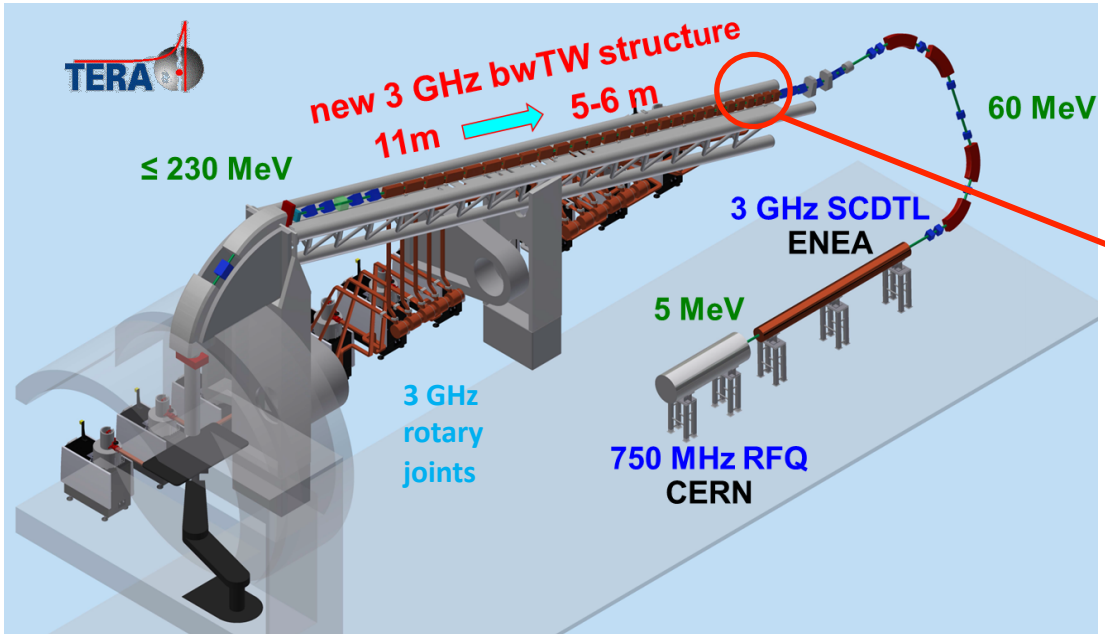
Cell location of breakdowns during TD26CC test

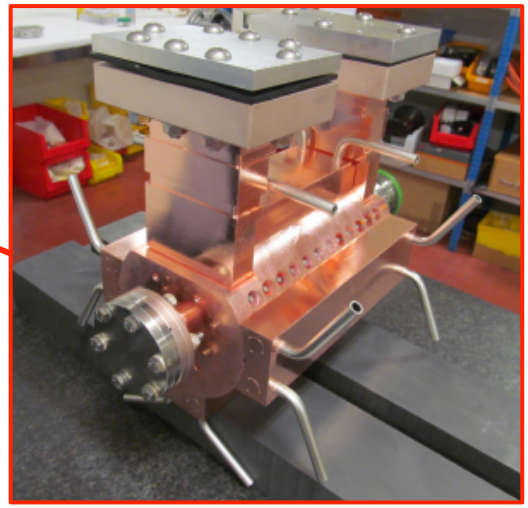


R&D activities at CLIC

HIGH GRADIENT RF STRUCTURE STUDIES FOR MEDICAL ACCELERATORS

Test of an S-band high gradient proton accelerating structure





A prototype of a high gradient **3 GHz proton accelerator** operating in backward TW mode has been designed in the framework of the TULIP project. High-Gradient **up to 50 MV/m** allows to install the **compact linac directly on the gantry**.

First prototype was manufactured at CERN following same CLIC design and production procedure. High-power test is foreseen to be done in 2016 in CTF3 (CLIC Test Facility, CERN), based on the experience of the operative X-band test stands at CERN, and later in the future **IFIC-IFIMED RF laboratory (Valencia).**

R&D activities at CLIC

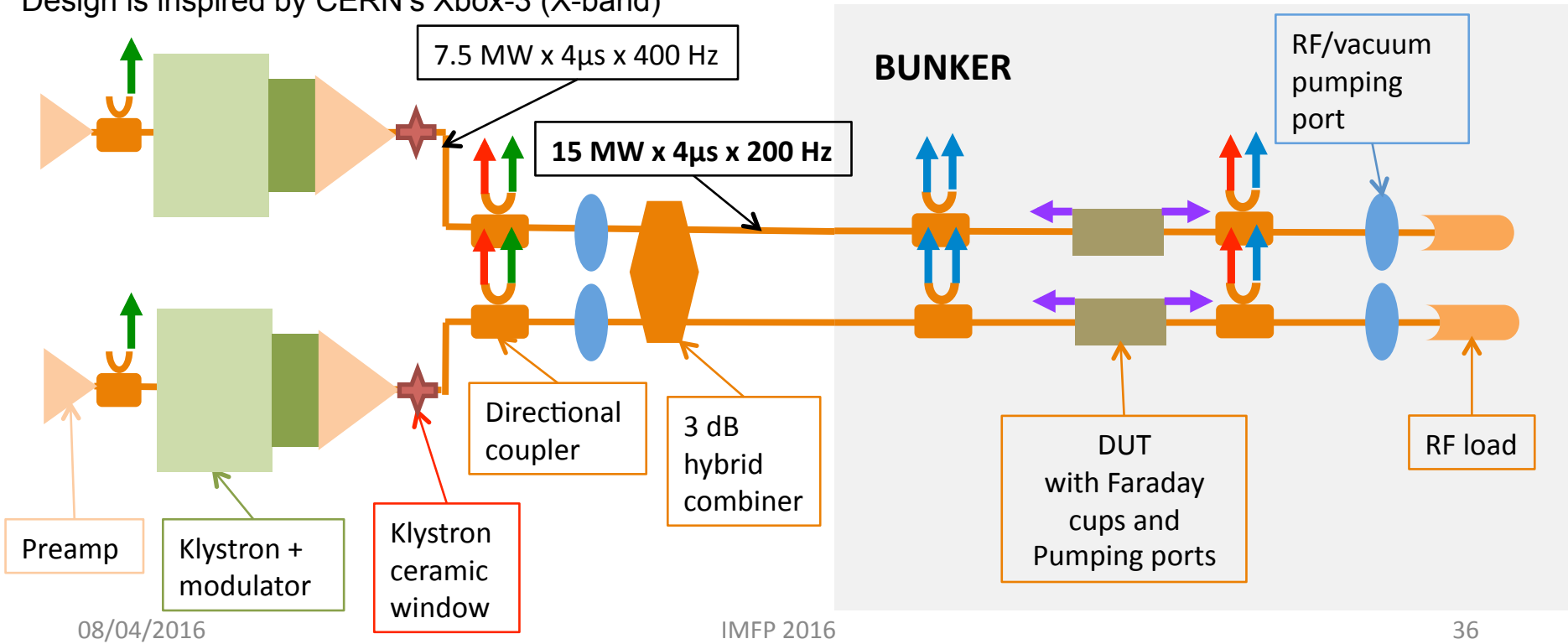
HIGH-GRADIENT RF STRUCTURE STUDIES FOR MEDICAL ACCELERATORS

IFIMED RF Test Infrastructure

- Creation and operation of a **S-band (3 GHz) high-power testing facility**
- Test stand for **High-Gradient RF structures**

Available equipment: LLRF, electronics and cables, high-power components, ultra-high vacuum equipment, cooling circuits.

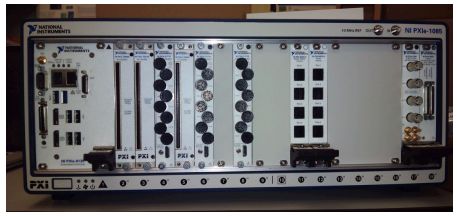
Design is inspired by CERN's Xbox-3 (X-band)



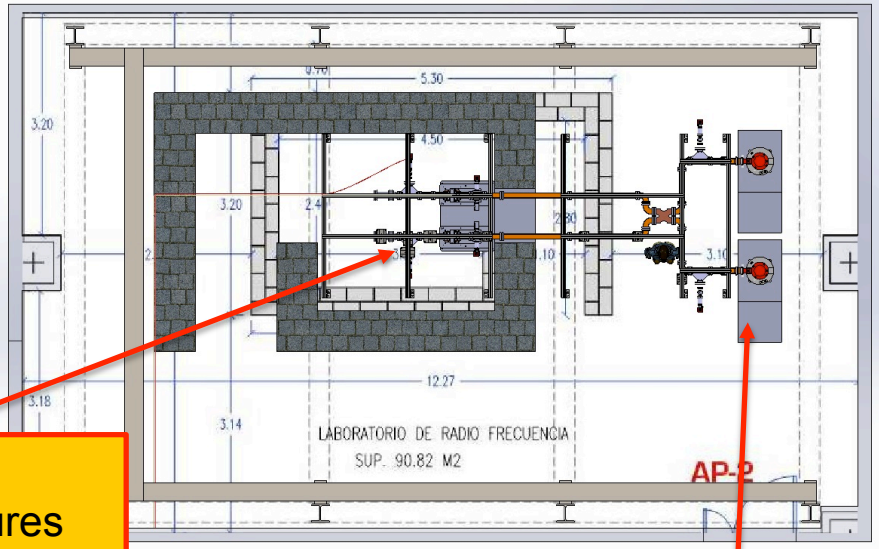
R&D activities at CLIC

HIGH-GRADIENT RF STRUCTURE STUDIES FOR MEDICAL ACCELERATORS

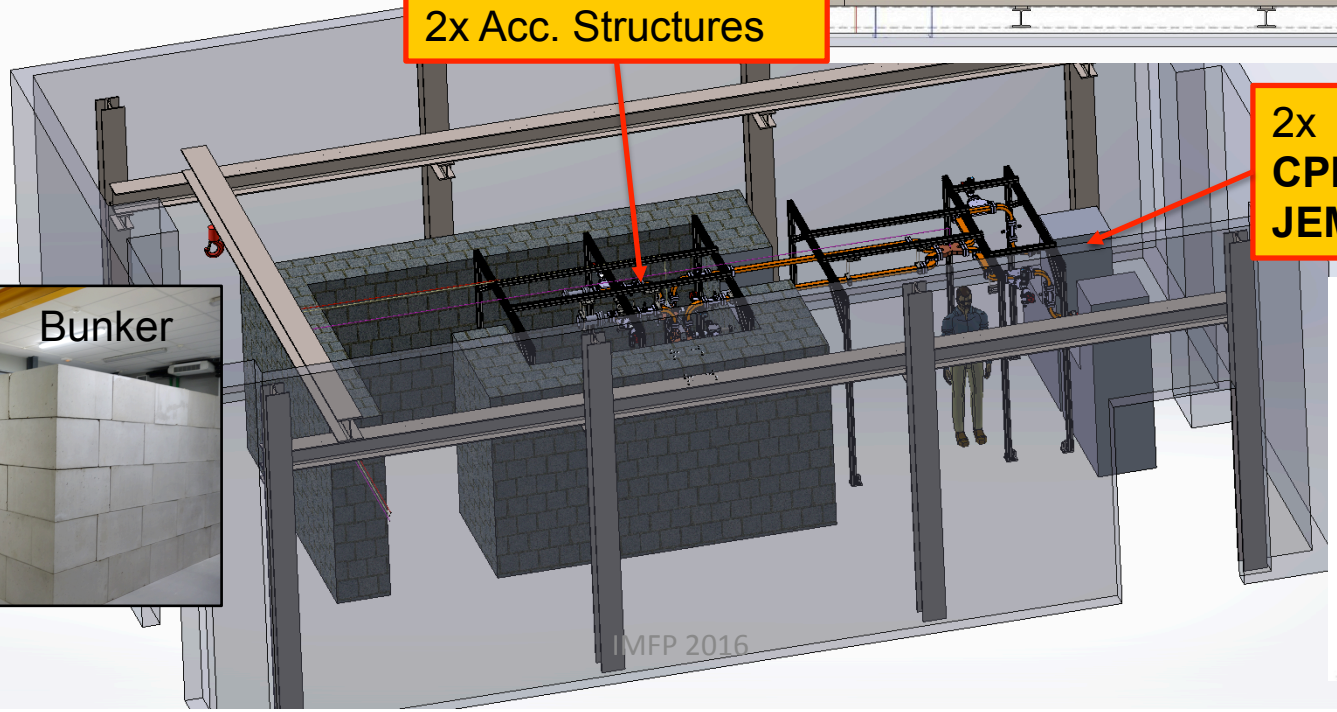
IFIMED RF Test Infrastructure



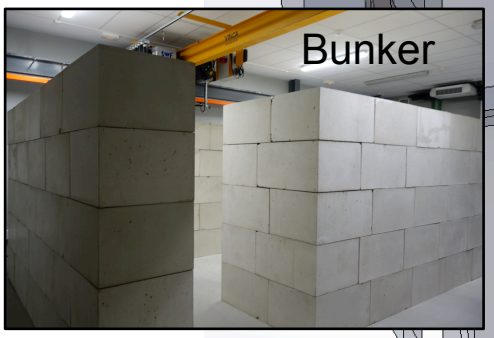
LLRF controlled by National Instruments electronics and LabVIEW



Bunker:
2x Acc. Structures

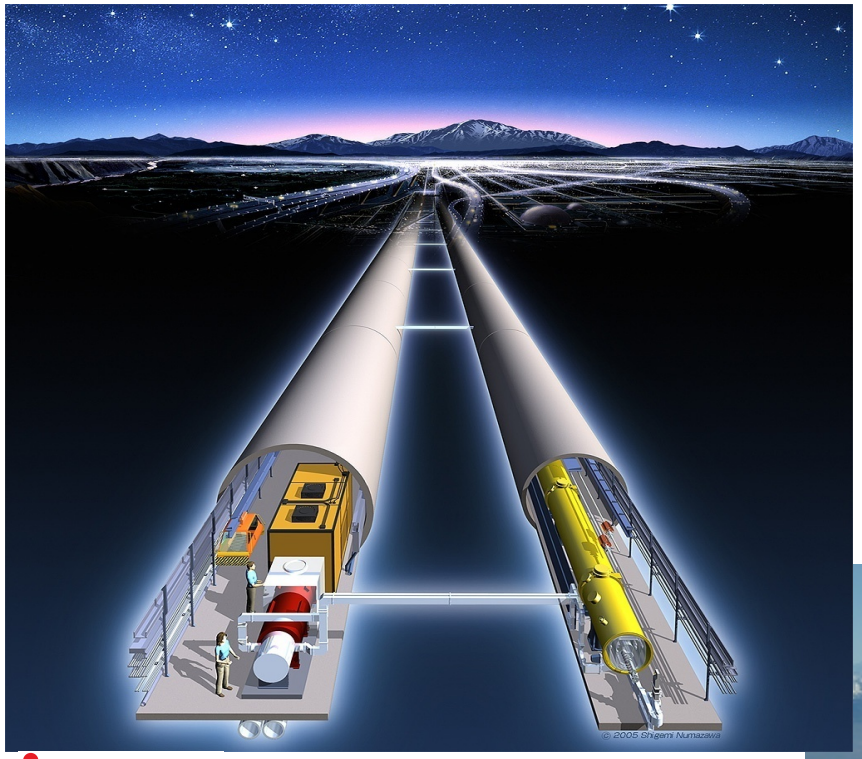


2x
CPI Klystron+
JEMA Modulator



Future perspectives

R&D ACCELERATORS AT FUTURE COLLIDERS



- **Beam dynamics and Instrumentation R&D for LC:** ATF2 collimation and wakefields impact
- **Collimation studies at FCC**: optics and inefficiency studies

Future perspectives

HIGH-GRADIENT RF STRUCTURE STUDIES FOR MEDICAL ACCELERATORS

Design and Optimization of RF structures for hadrontherapy linacs

ESR13 will participate in the **design, construction** and **powering test** of two novel high-power prototype 3 GHz accelerating structures at **76 MeV** (low energy) and **213 MeV** (high energy) which corresponds to the to the lowest and highest energy of commonly used proton linac. Tests of these two new structures will then be made in the **HG-RF test stand at IFIC-IFIMED labs** of the University of Valencia.

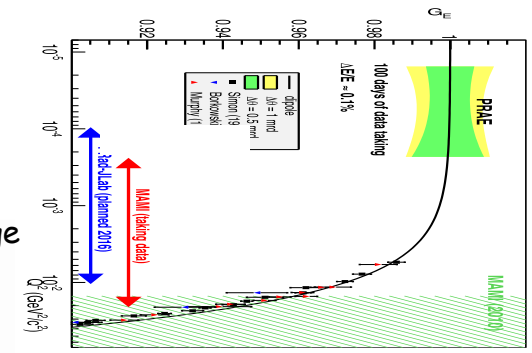
PRAE

Platform for Research and Applications with Electrons

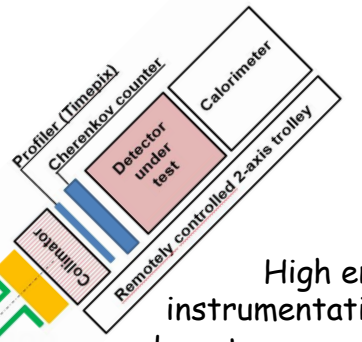
S. Barsuk, A. Faus-Golfe, B. Genolini, Y. Prezado, E. Voutier et al.

➢ Multidisciplinary facility for R&D&A in Physics, Instrumentation, Radiotherapy.

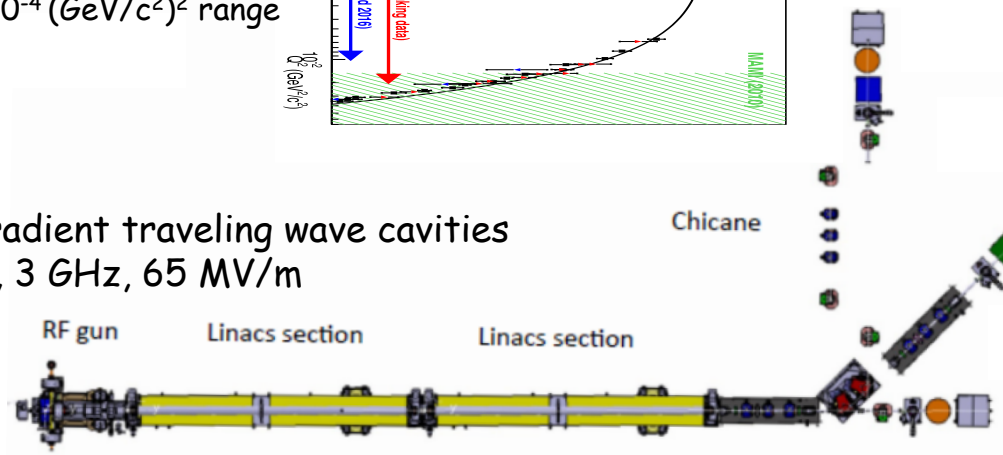
High precision measurement of $G_E(p)$ in the 10^{-5}-10^{-4} $(GeV/c^2)^2$ range



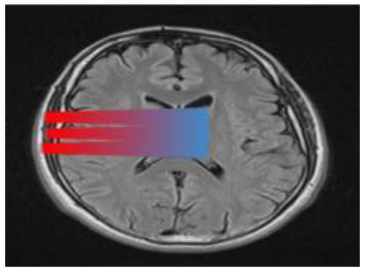
High energy instrumentation platform down to mono-electron beam



High-gradient traveling wave cavities
S-band, 3 GHz, 65 MV/m



eHGRT



High energy electron grid therapy

10 ps bunch, 50 Hz
Q ≤ 2 nC/bunch (polarized)
E ≤ 140 (300) MeV

P2IO emblematic project (www.labex-p2io.fr)

Participation in Research Projects and Contracts

- ***Spanish National and Local GV Project (36) 10 as IP***
  some of them was in coordination with other Spanish Institutes as the CIEMAT
- ***International Projects***
  bi-lateral actions with LAL and LLR and 7 EU projects related to Coordination of the Accelerator Research as CARE, EUROTeV, EUCARD, HL-Lumi, EUCARD2, Medical Physics as PARTNER and Training as PACMAN and OMA
- ***Research Contracts***
  special contract with industry: Trinos Vacuum Projects and collaboration agreement with CERN to contribute to the LHC consolidation work and CLIC activities mainly Instrumentation and HG-RF R&D

Academic Training

- ***PhD Thesis***
  - *Direct Measurement of Resonance Driving Terms in the Super Proton Synchrotron (SPS) of CERN using Beam Position Monitors, R. Tomás García, Univ.Valencia, January 2003 staff at CERN*
  - *Design and Performance Evaluation of Nonlinear Collimation Systems for CLIC and LHC, J. Resta López, Univ. Valencia, October 2007, Researcher at Cockcroft*
  - *Optics Studies and Performance Optimization for a Future Linear Collider: Final Focus System for the e-e- Option (ILC) and Damping Ring Extraction Line (ATF), C. Alabau Pons, Univ.Valencia, February 2010 Industry*
  - *High-Gradient Accelerating Structures Studies and their Applications in Hadrontherapy, S. Verdu Andres, Univ. Valencia, January 2013, Researcher at BNL*
  - *Beam size and very low emittance with a Multi-OTR system in ATF2, J. Alabau-Gonzalvo, Univ. Valenci, February 2013 Industry*
  - *Development of the Beam Position Monitors for the Diagnostics of the Test Beam Line in the CTF3 at CERN, J.J. Garcia Garrigos, Univ. Politecnica de Valencia, November 2013, Industry*
  - *Striplines Kickers for CLIC Damping Ring, C. Belver Aguilar, Univ. Valencia, October 2015, fellow at CERN*
  - *BPM system for the Drive Beam of CTF3, A. Benot Morell, Univ. Politecnica de Valencia, February 2016, Postdoc Researcher at IFIC*

- ***PhD Thesis under supervision***
  - *Collimation wakefield studies for Future Linear Colliders, N. F. Martinez, Univ.Valencia, Started in July 2012*
  - *Application of High Gradient RF technology for Hadrontherapy Accelerators, J. Giner Navarro, Univ. Valencia, Started in July 2013*
  - *New Measurement Techniques, for finding the Electromagnetic Center of Microwave Cavities with Nanometer Accuracy, N. Galindo Muñoz, University: Politecnica de Valencia, Started in May 2014*


Thanks for you attention
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R&D activities at CLIC

RESEARCH ACTIVITIES:
DESIGN AND CONSTRUCTION OF BEAM INSTRUMENTATION

Inductive Beam Position Monitors for CTF3

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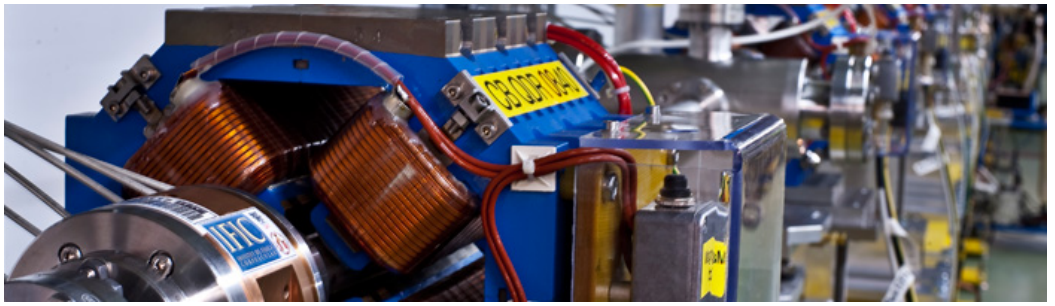

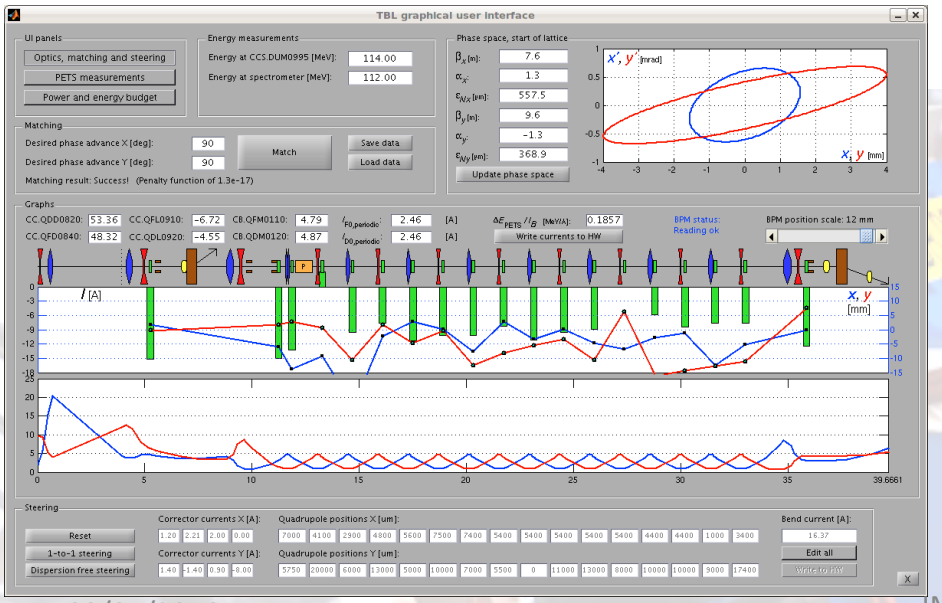

MEASUREMENT OF THE POSITION WITH THE BPS's IN THE TBL OF CTF3-CLIC

R&D activities at CLIC

RESEARCH ACTIVITIES: DESIGN AND CONSTRUCTION OF BEAM INSTRUMENTATION

Smith-Purcell radiation monitor for the ESTB at SLAC

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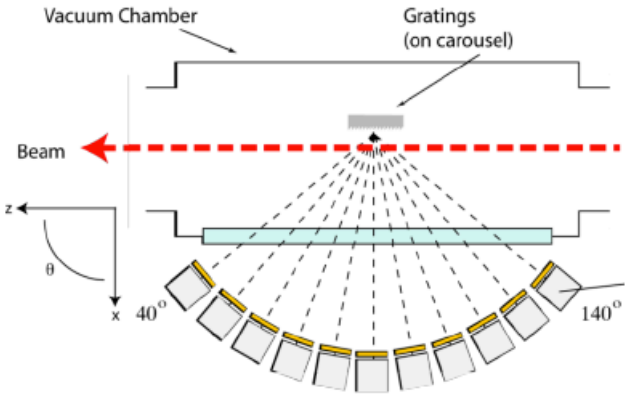
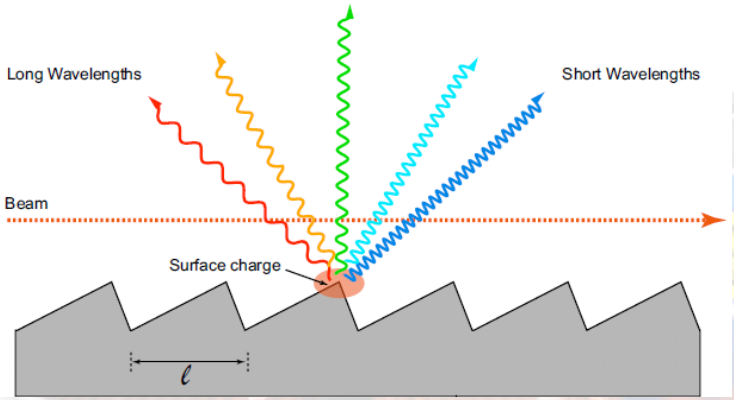
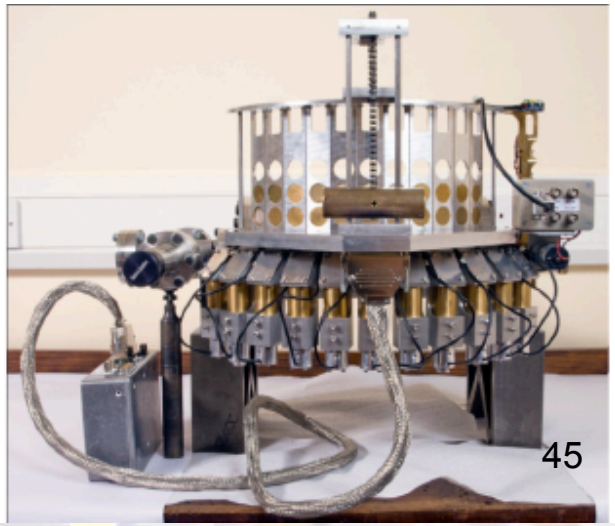
SMITH-PURCELL RADIATION PROCESS





MEASUREMENT OF THE TIME PROFILE OF RELATIVISTIC ELECTRON BUNCHES IN THE FEMTOSECOND REGIME



R&D activities at CLIC

RESEARCH ACTIVITIES: DESIGN AND CONSTRUCTION OF BEAM INSTRUMENTATION

Beam Position Tuning for Hadrontherapy Facilities

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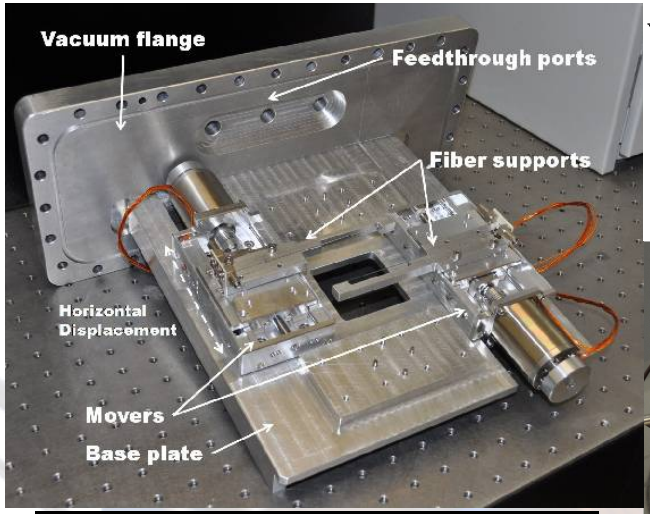
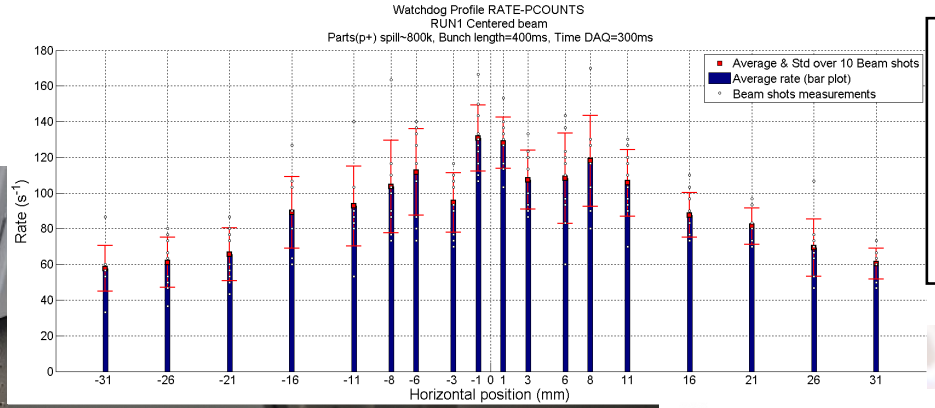


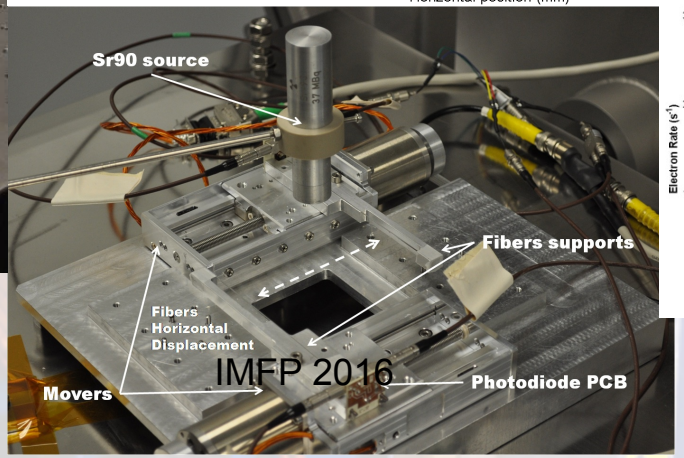
WATCHDOG PROTOTYPE

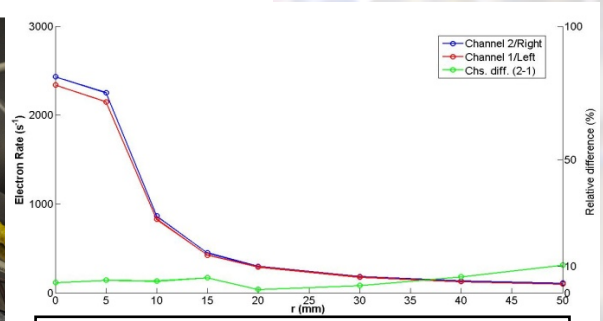
CALIBRATION SETUP with source Sr-90

FIRST CALIBRATION TESTS IN THE VSC AND PS CERN



T10 PS CERN Beam tests:
Horizontal profile of a centered beam measured by sweeping the fibers left/right (-/+ in plot).





VSC Cal test with Sr-90 source:
Horizontal profile with centered source measured by sweeping the fibers left/right (red/blue in the plot).