

# STATUS OF THE PROJECT

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CLIC Project Meeting  
09/06/2015



# Summary

PACMAN = a study on Particle Accelerator Components' Metrology and Alignment to the Nanometre scale

It is an Innovative Doctoral Program, hosted by CERN, funded by EU, providing training to 10 Early Stage Researchers (ESRs).

- Start date: 01/09/2013
- Duration: 4 years
- 10 ESRs, working towards a PhD thesis
- 16 academic & industrial partners
- First students started in February 2014, last one in September 2014.

Presentation of the project

Subjects & first results



## Beam off

Mechanical pre-alignment

~0.2 - 0.3 mm over 200 m

Active pre-alignment

14 - 17  $\mu\text{m}$  over 200 m

## Beam on

Beam based Alignment & Beam based feedbacks

One to one steering

Make the beam pass through

Dispersion Free Steering

Optimize the position of BPM & quads by varying the beam energy

Minimization of AS offsets

Using wakefield monitors & girders actuators

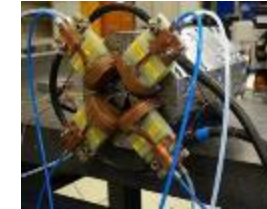
Minimization of the emittance growth

# Scientific aspects

## Why PACMAN?



### Components to be aligned:



Number of components

~  
4000

~  
4000

~ 140 000

Budget of error

14  $\mu\text{m}$

17  $\mu\text{m}$

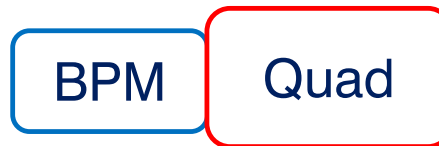
17  $\mu\text{m}$

BPM

Quad

AS

### Strategy:



### 3 steps:

- Fiducialisation of the components and their support
- Initial alignment of the components on their support
- Transfer in tunnel and alignment in tunnel

# Scientific aspects

## Why PACMAN?



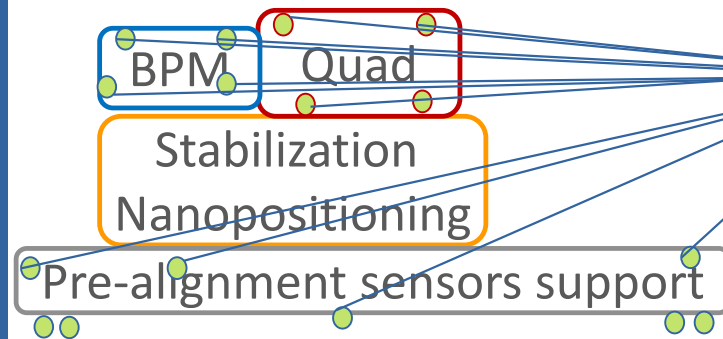
BPM

Quad

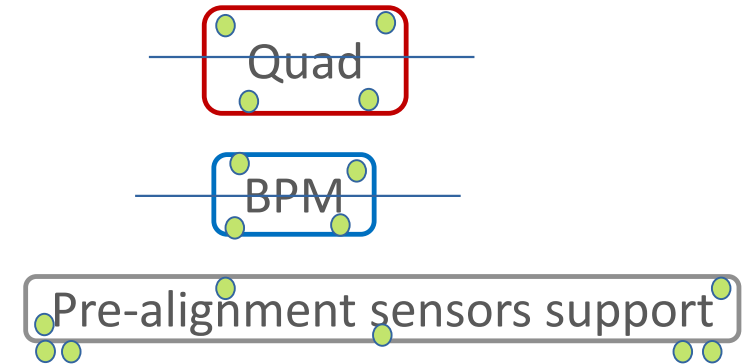
Pre-alignment sensors support

Stabilization  
Nanopositioning

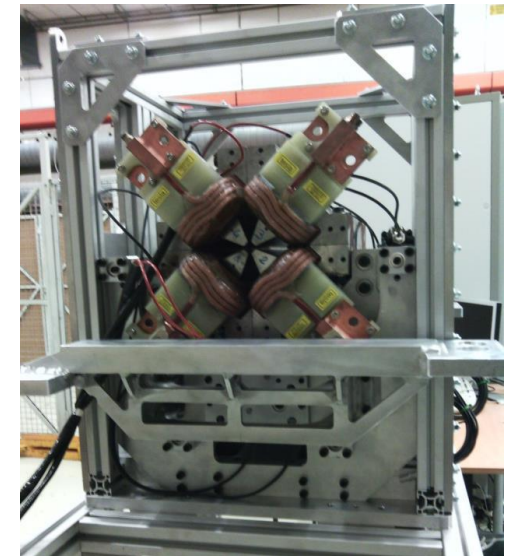
### Initial alignment:



### Fiducialisation:



### Transfer in tunnel & alignment



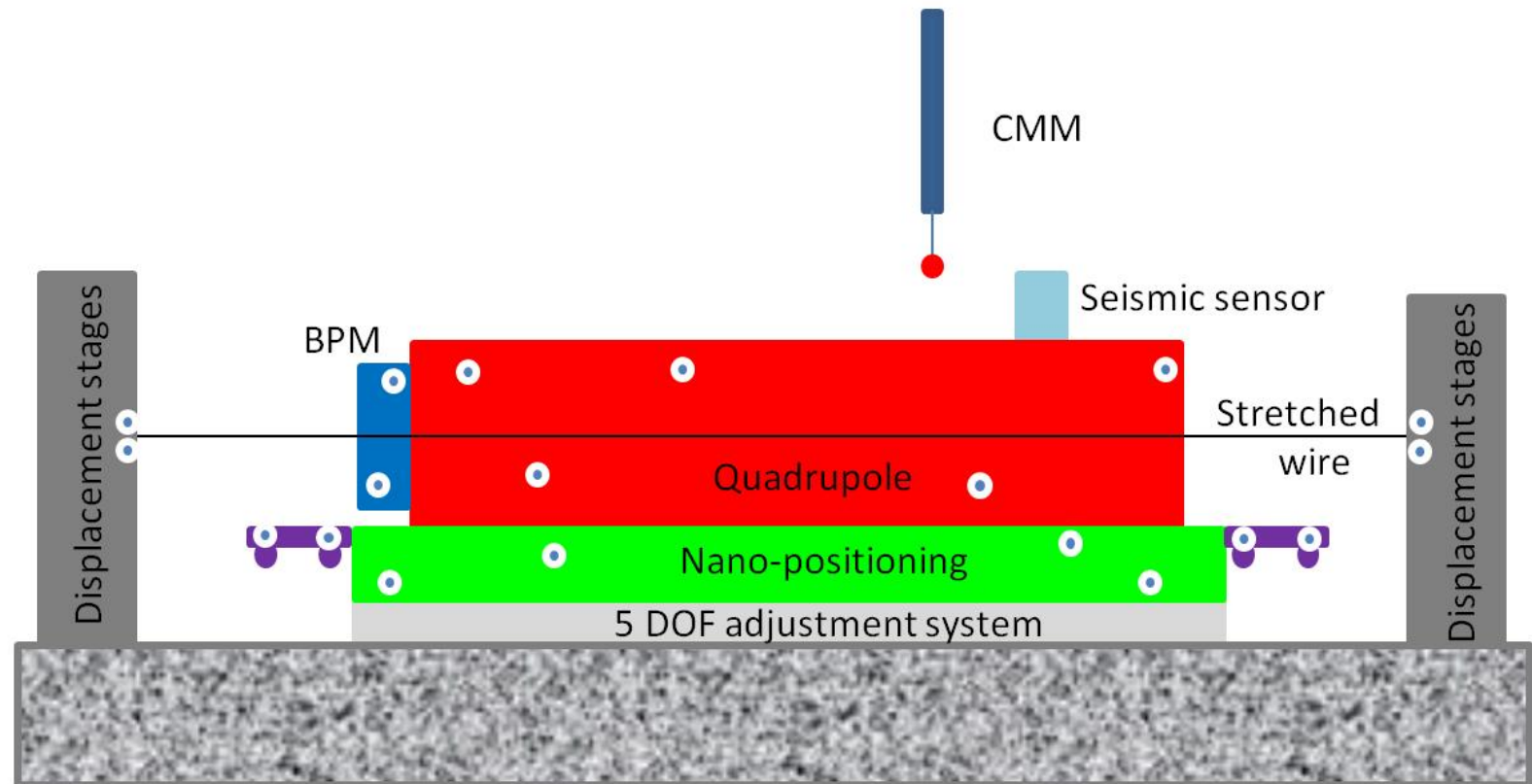
# Scientific aspects

## Objectives

Combine references & methods of measurements in the same place to gain time and accuracy

Prove their feasibility on a final bench

Extrapolate the tools & methods developed to other projects





ESR 3.3



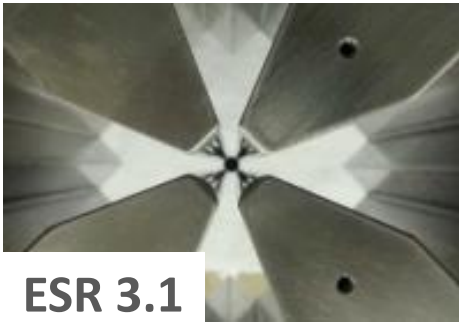
ESR 4.1



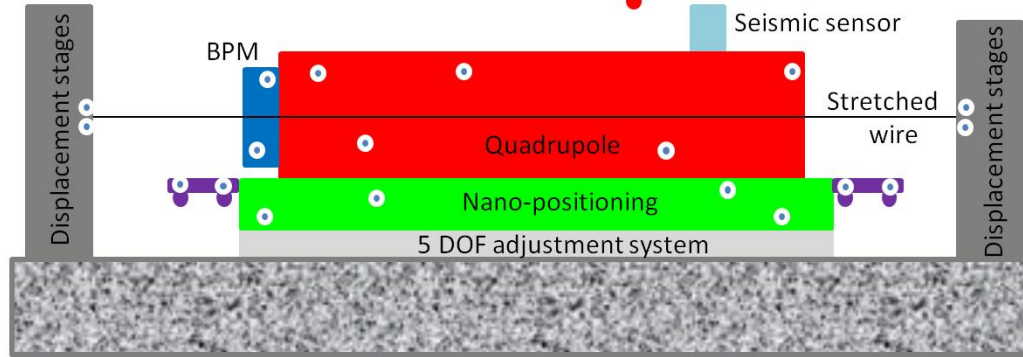
ESR 3.2



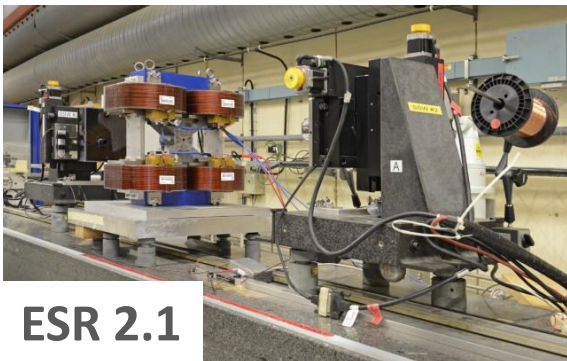
ESR 1.1



ESR 3.1



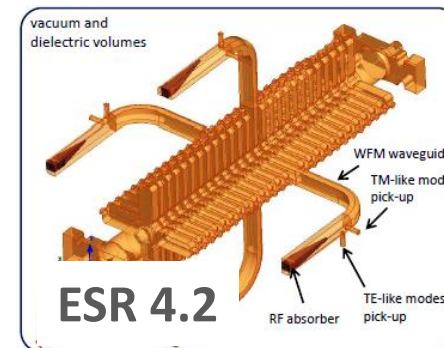
ESR 1.3



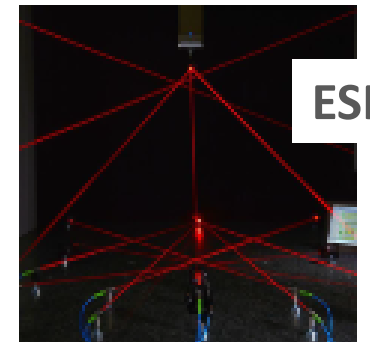
ESR 2.1



ESR 2.2



ESR 4.2



ESR 1.2

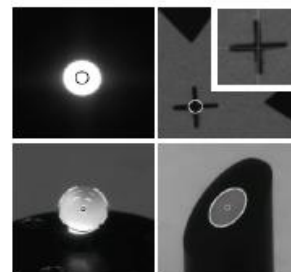
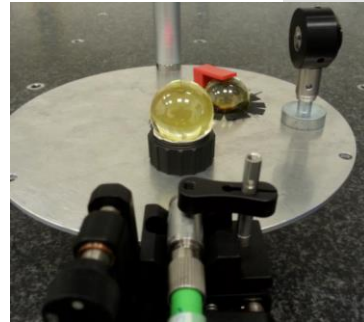
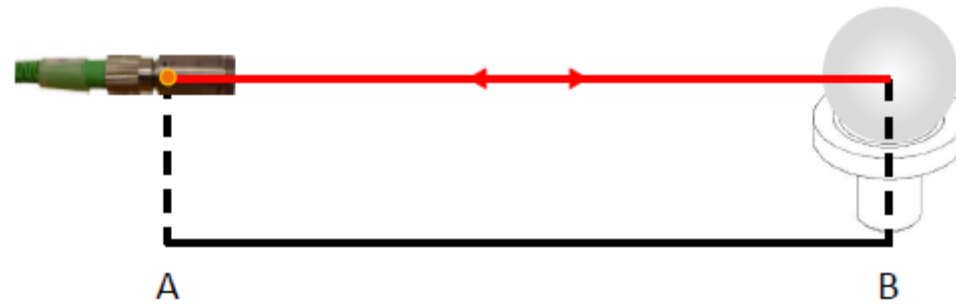
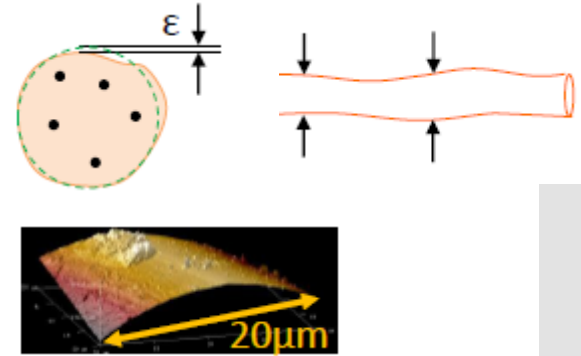
# WP1

## First results

Characterization of the wire

How to measure the wire?

Leitz Infinity CMM is disturbed by magnetic fields







WP2

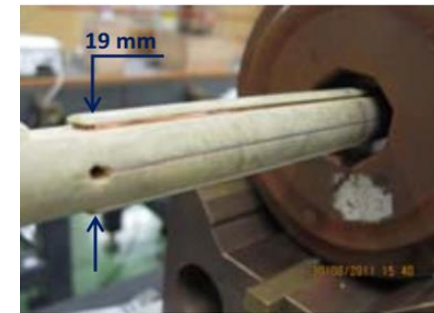
First results

Comparison of different methods: single stretched wire versus vibrating wire

Correction of effects from non homogeneous background fields

Performance optimization

Optical sensors to measure the wire vibrations



- Characterization of the existing field probes
- Characterization of the existing test bench

# WP3

## First results

- Identification of error sources of the final bench assembly



- Characterization of the existing seismic sensors in collaboration with LAPP (self noise: theory vs real measurements, measuring noise with background signal)
- Investigation of improvement possibilities



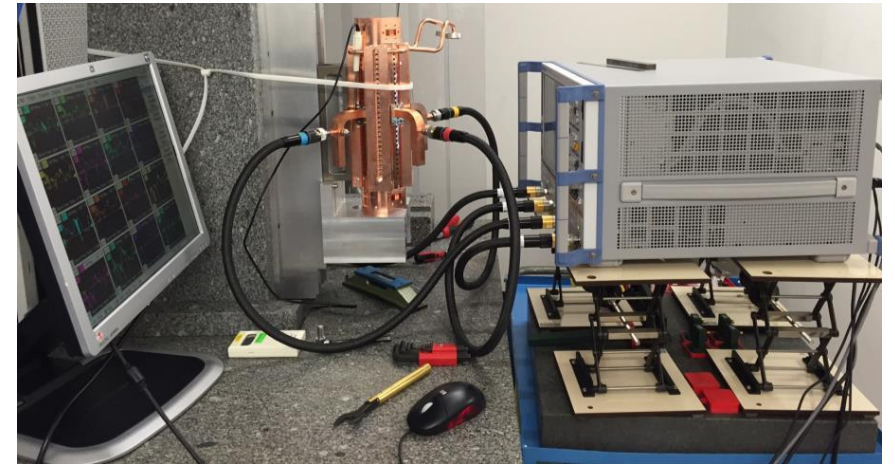
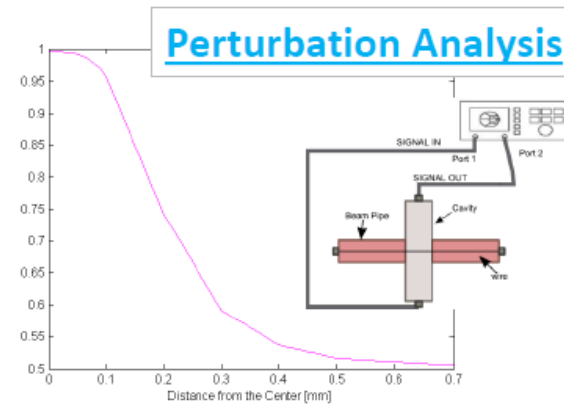
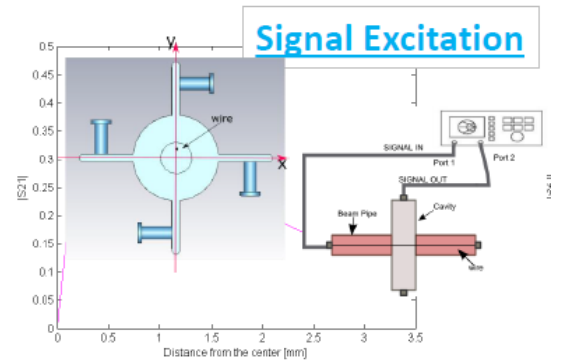
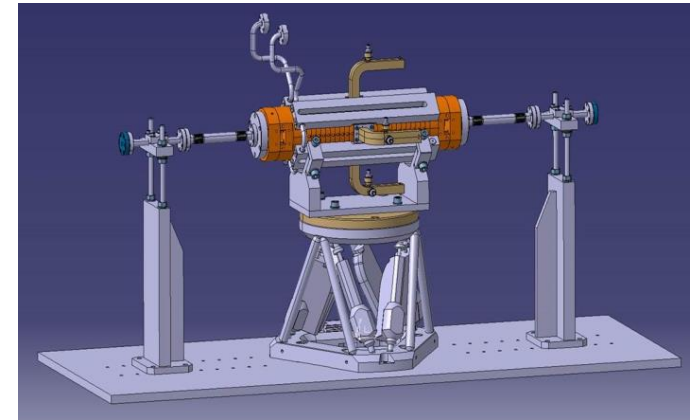
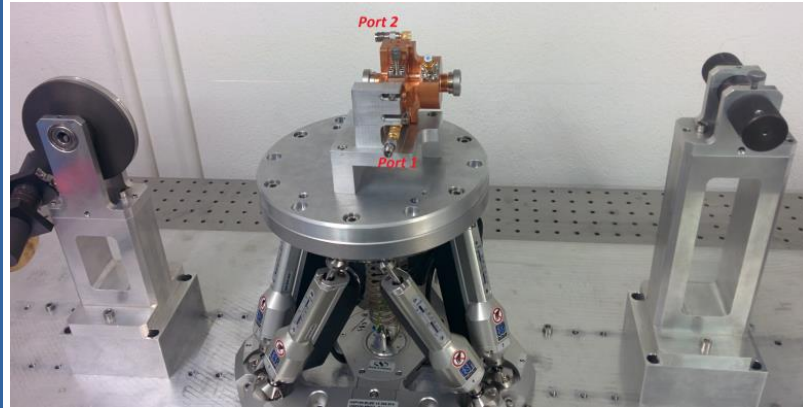
1. 91.6 Hz
2. 117.2 Hz
3. 167.14 Hz
4. 244 Hz
5. 270.39 Hz
6. 278.4 Hz

- Larger flat contact surface with ground
- Base plate reinforcement (longitudinal)
- Lowest mode in longitudinal direction  
(not an issue)

- Inverted level mechanism to increase the stroke

# WP4

## First results



# SUMMARY

First results are there, with the first papers and participation to conferences

Mid- term review took place on the 29-30/05: very positive feedback. See presentations under Indico: <http://indico.cern.ch/event/389642/>

Preparation of the final PACMAN bench under way

Secondments nearly finished

Next events:

IP workshop: October-November 2015

2<sup>nd</sup> PACMAN workshop: Spring 2016



# NETWORKING

## Tools

**PACMAN** Innovative Doctoral Program

HOME PACMAN RESEARCHERS NETWORK PARTNERS EVENTS OUTREACH PUBLICATIONS GALLERY CONTACT US

**PACMAN** Particle Accelerator Components' Metrology and Alignment to the Nanometre scale. Main aim: improve the accuracy of alignment for the components to be installed in the next generation of particle accelerators.

**PACMAN** is an Innovative Doctoral Program Network, offering training to 10 Early Stage Researchers hosted by CERN thanks to The European Commission's FP7 Marie Curie Action5. The human objective of the Marie Curie program is to create a new generation of scientists equipped with a wide-ranging expertise in advanced engineering and instrumentation. The technical objective of the PACMAN project is to develop very high accuracy metrology and alignment tools and validate them in a single automatic test stand integrating all of them. This multidisciplinary research project strengthens the co-operation between the most innovative universities, laboratories and industries of Europe in these fields.

HOME PACMAN RESEARCHERS NETWORK PARTNERS EVENTS OUTREACH PUBLICATIONS GALLERY CONTACT US

Home » NETWORK PARTNERS

- CERN, CH
- Cranfield University, UK
- Delft University of Technology, NL
- ETH Zürich, CH
- IFIC, ES
- LAPP, FR
- University of Sannio, IT
- University of Pisa, IT
- SYMME, FR
- DMP, ES
- ELTOS, IT
- ETALON, DE
- Hexagon Metrology, DE
- METROLAB, CH
- National Instruments, HU
- SIGMAPHI, FR

**PACMAN PROJECT IN FIGURES**

- 4 Years project
- 10 PhD students
- 8 Universities & laboratories partners
- 7 Industrial partners
- From 13 Countries

**FEATURES**

- Collaboration
- Mobility
- High quality training
- Science promotion
- Career development
- Knowledge transfer
- Delivery Excellence
- Sub-micrometric measurements
- Diversity
- Woman in science

**THE WORK PACKAGES**

- WP1 Metrology & Alignment
- WP2 Magnetic Measurements
- WP3 Precision mech. & nano-positioning
- WP4 Microwave technology

**IMPACT**

- Train young researchers in topics of interest for European industry
- Improve the career prospects and employability of young researchers
- Simulate creativity and entrepreneurial mind-sets in the next generation of scientists
- Enhance public and private research collaboration
- Disseminate the results in the private and public sector
- Strengthen the links between partners working on metrology, high accuracy alignment, nano-positioning, precision mechanics, microwave technologies, magnetic measurements
- Develop new high tech solutions to be applied not only on future particle accelerators at CERN or elsewhere but also in fields such as medical physics and technology, instrumentation, defense, telecommunication, aerospace or nanotechnologies
- Promote science and women in science, enhance the participation and the role of women in research laboratories, universities and industries

CERN logo and European Union flag.

<http://pacman.web.cern.ch/>

## PACMAN Video



Thank you for your  
attention

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PACMAN

