Updates and Programme for SLAC RC Tests

LHC Collimation Upgrade Specification Meeting

April 11th, 2014

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with input from:

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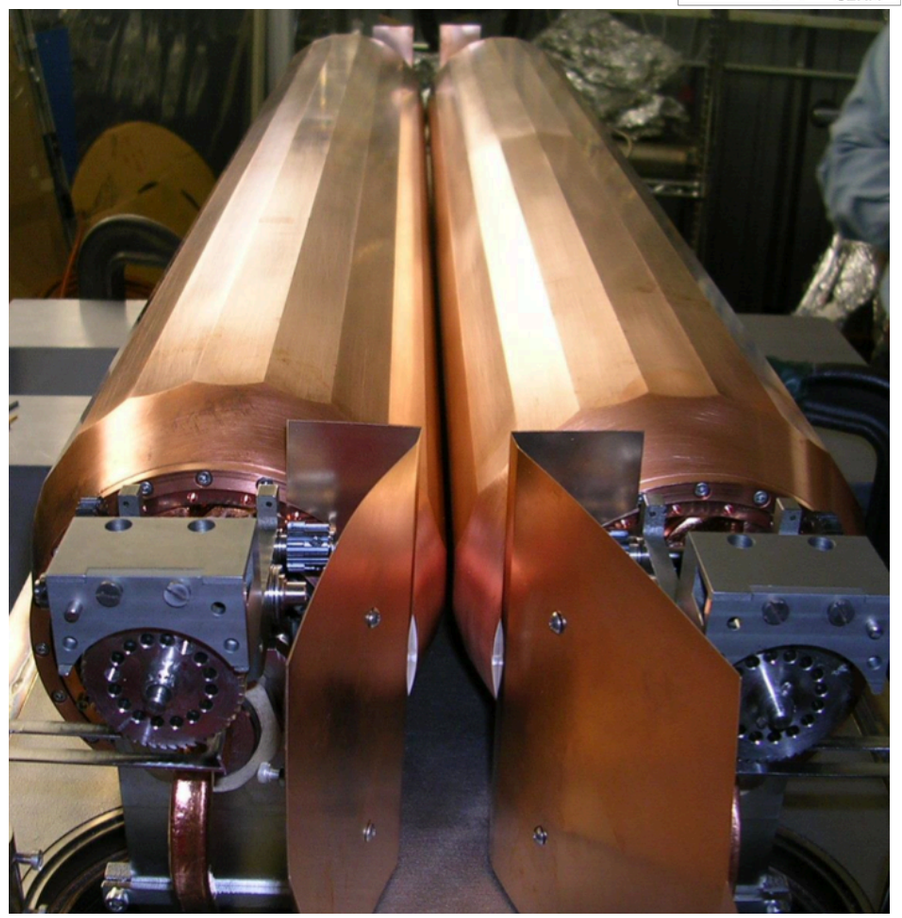
SLAC Rotatable Collimator



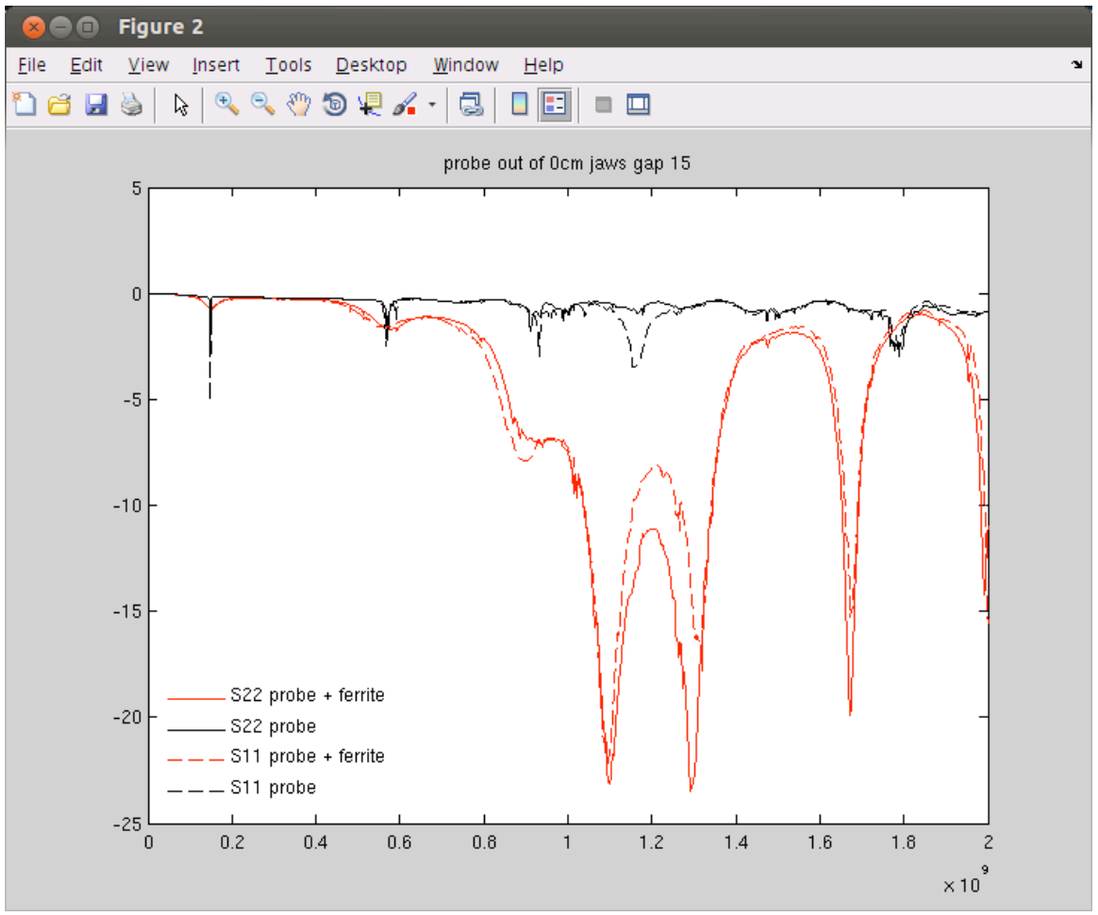
- The SLAC RC was built as part of the US-LARP collaboration.
- **Objective:** produce a machine-ready prototype for beam tests in SPS/LHC (or HiRadMat).
- **Rotatable jaw concept:** offers up to 20 collimating surfaces in case of beam damage.
- **Timeline:**
  - ➡ 27.11.2013: Arrival of SLAC collimator at CERN.
  - ➡ 12.02.2014: SLAC RC tank opened.
  - ➡ 05.03.2014: SLAC RC passed first leakage test.
  - ➡ 11.03.2014: First jaw movement tests.
  - ➡ 20.03.2014: Start of wire impedance tests.
  - ➡ 22.04.2014: Foreseen start of controls tests.

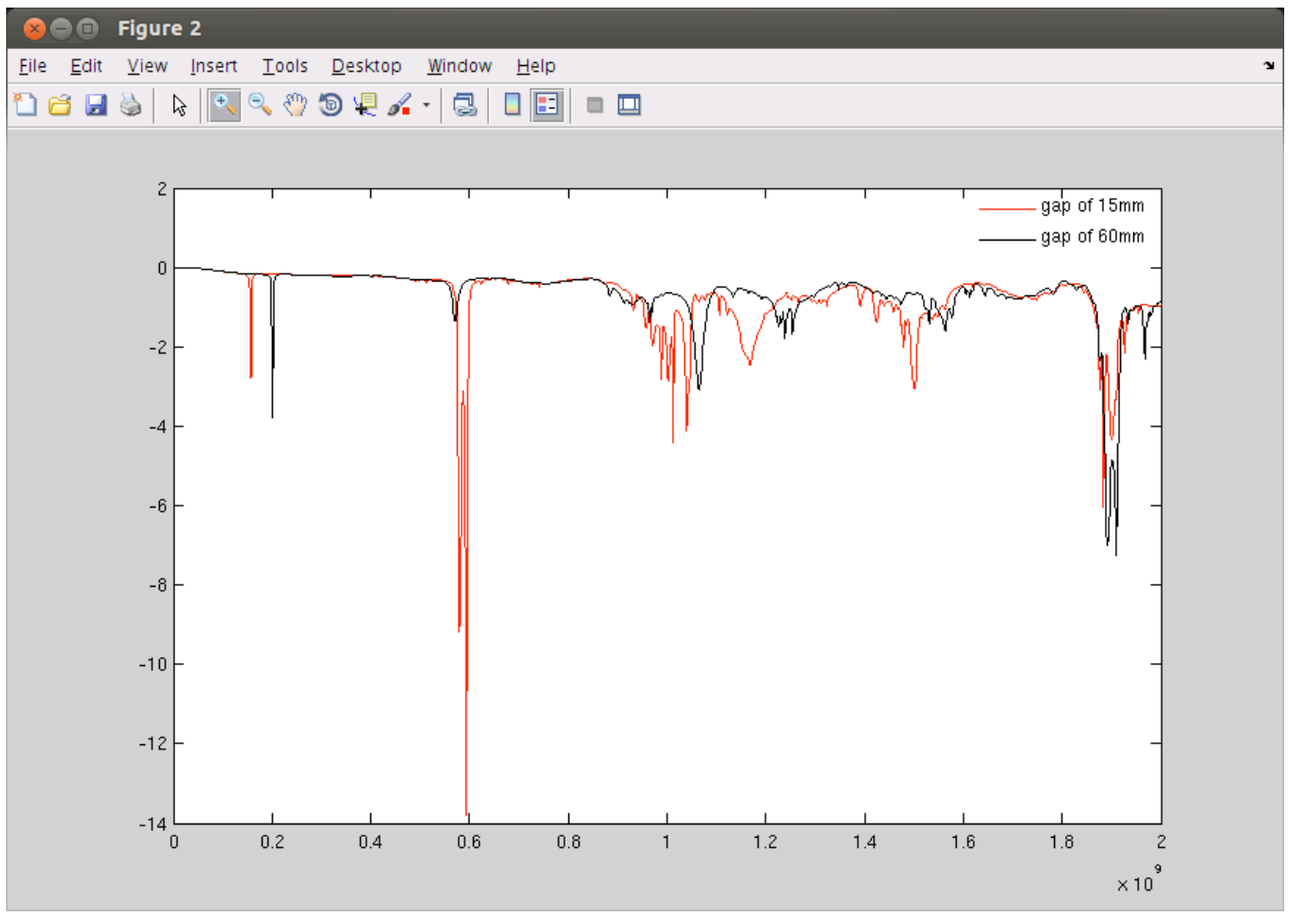
Leakage tests

- Leakage tests were performed on 05.03.2014 and 11.03.2014.
- Nitrogen sprayed around the flanges, collimator found to be correctly sealed:
  - 7.3E-7 mbar (internal pressure level)
  - 1.0E-9 mbar/s (leakage level)
- The external company performing the tests should send additional reports shortly (P. Gradassi).

Impedance Tests (Preliminary)

- **Reminder:** SLAC RC design not optimized for impedance.
- Wire impedance tests performed in the last couple of weeks, with and without ferrites rings, and at different jaw gaps.
    - Ferrites: allow to distinguish between real collimator modes and those created by the probe.
- Several resonant frequencies observed in the range of 0.5 to 2 GHz.





Courtesy of N. Biancacci, J. Kuczerowski, O. Berrig

- Observed the same modes as L. Xiao, estimates of impedances will be provided soon.
- To be discussed further within the impedance team.

Proposed Controls Tests

- First movement tests performed on 11.03.2014, jaws moved from inner to outer switches.
- Several controls tests scheduled for 22-25 April to coincide with T. Markiewicz's visit to CERN. These tests should all take place in bldg. 272.
- A dedicated test stand has been ordered and should be received before the tests (P. Gander). If not, if TCTP impedance tests are finished, we can use the TCTP test stand.
- Draft proposal for controls tests based on those for standard LHC collimators has been circulated for discussion:

- **Torque measurements**
  - Test stand available in bldg. 272
- **Translational movements:**
  - Metrology (bldg. 72) for jaw parallelism + perpendicularity to horizontal: still to be decided if CMM or optical tooling will be used (A. Cherif).
  - Movement of the jaw from inner to outer switches, without losing steps.
  - Measurement of mechanical play for each axis with an accuracy of 5 μm.
  - Maximum tilt angle: T. Markiewicz suggests standard software tilt protection of 2 mm (like for standard collimators), to be checked with engineer at SLAC.

Proposed Controls Tests

- **LVDT calibration:**
  - Calibration done at SLAC was not satisfactory, should be repeated at CERN.
  - Ensure that LVDT follows motor position during jaw movement.
  - Should use mechanical end stop data, however this is not available (P. Gander). Could try to make some measurements.

- **Playing of functions:**
  - A table with jaw positions will be input to the control software to ensure repeatability of motion.

- **Jaw auto-retraction:**
  - Verify that the jaws automatically retract in the event of a power cut via return springs.
  - Rods tying downstream and upstream ends of the drive table to allow one motor end to drag the other around can be shipped to CERN, if needed.

Proposed Controls Tests

- **Rotational movement:**
  - All tests will be done with the standard LHC collimator FESA class. The controls interface will be modified to handle the rotational movement (M. Donze, P. Gander).
  - From the beam's view, left jaw rotates clockwise, right jaw anti-clockwise.
  - Ensure that opposite jaw facets facing the beam are parallel.
  - T. Markiewicz proposes several steps to verify that the rotation system of each jaw operates as it did before shipment:
    - As there isn't a readout angle, use visual evidence to show that requested #steps is delivered.
    - The "zero" mark is inscribed on the drive wheel, which sits directly under the pawl when the facet is aligned.
    - One facet requires 8 full turns of the drive wheel; drive wheel has 48 teeth; 384 "clicks" required for one facet to rotate.
  - Rotation tests to be done first in air, then under low quality vacuum, then after bakeout.
  - Rotations cause cooling tube along support axle to twist.
  - A number of facet rotations should be saved for HiRadMat tests (jaw designed for 1 full rotation only).

Tests for 22-25 April

- Should schedule tests to profit from Tom's presence:

✓ **Torque measurements**

✓ **Translational movements**

✓ **LVDT calibration**

- Playing of functions
- Jaw auto-retraction

✓ **Rotational movements**

Future programme

- T. Markiewicz will come to CERN in the week from 21-25 April, when controls tests will be performed.

- This will be followed by vacuum tests (location and dates to be decided).

- A. Bertarelli will present the next status at the LARP / Hi-Lumi LHC Collaboration meeting in early May.

- Take decision whether to install in HiRadMat or SPS based on vacuum tests.