



EUROTeV PBPM final report

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Abstract

In the framework of EUROTeV FP6, a Precision Beam Position Monitor (PBPM) has been designed, manufactured and tested. The new PBPM requirements are a resolution of 100 nm in a 6mm aperture. A dedicated test bench has been designed and constructed to fully characterize and optimize the PBPM, and beam tests have been carried out in the CERN CLIC Test Facility 3 (CTF3). This final report reviews the design and reports on test results.

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Introduction

The design and tests of the new Precision Beam Position Monitor (PBPM) for EUROTeV has reached its final stage. One prototype has been manufactured and fully characterized in a dedicated test bench, where resolution of 190nm was measured for a CLIC type beam. Three additional PBPM's were manufactured and beam tests were carried out in CTF3. Here the measured resolution for a CLIC type beam was 650nm.

Design

The design of the new Precision Beam Position Monitor (PBPM) for EUROTeV was reported in [1], and a photo of the assembled proto type can be seen in Figure 1, the different parts of the assembly in Figure 2 and a schematic drawing of the vacuum assembly in Figure 3.

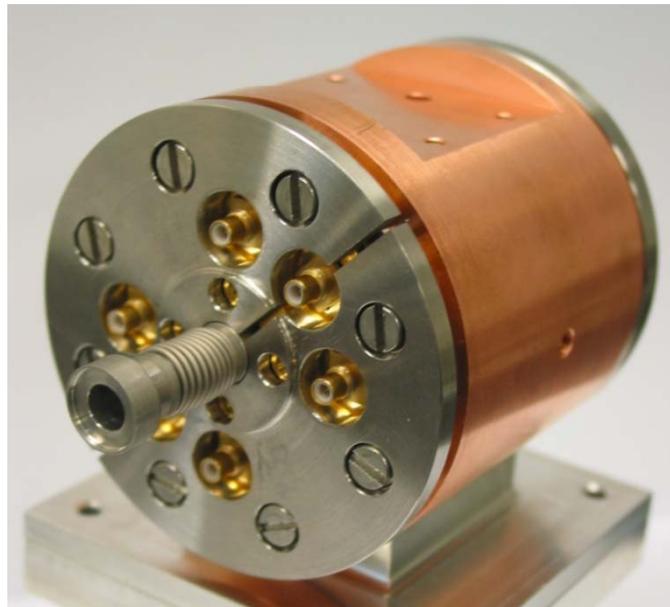


Figure 1: Assembled PBPM



Figure 2: Parts of the PBPM assembly

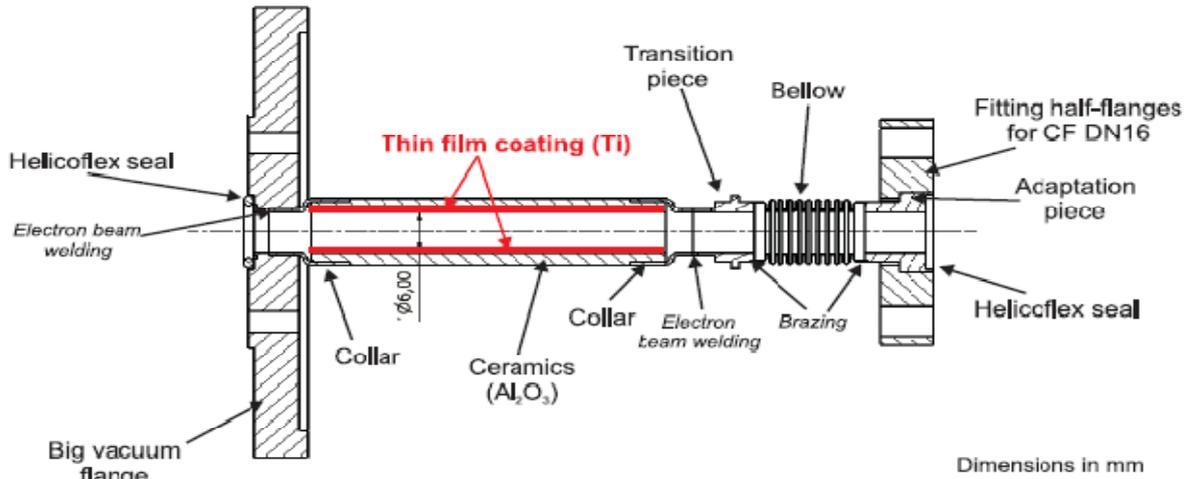


Figure 3: PBPM vacuum assembly

Bench tests

A dedicated test bench was designed and manufactured. It includes micro movers having a resolution of 100nm, and a vibration damped table, see Figure 4. The preliminary results of the bench tests were reported in [2] and a report summarizing all the tests in [3]. The main results are summarized in Table 1.

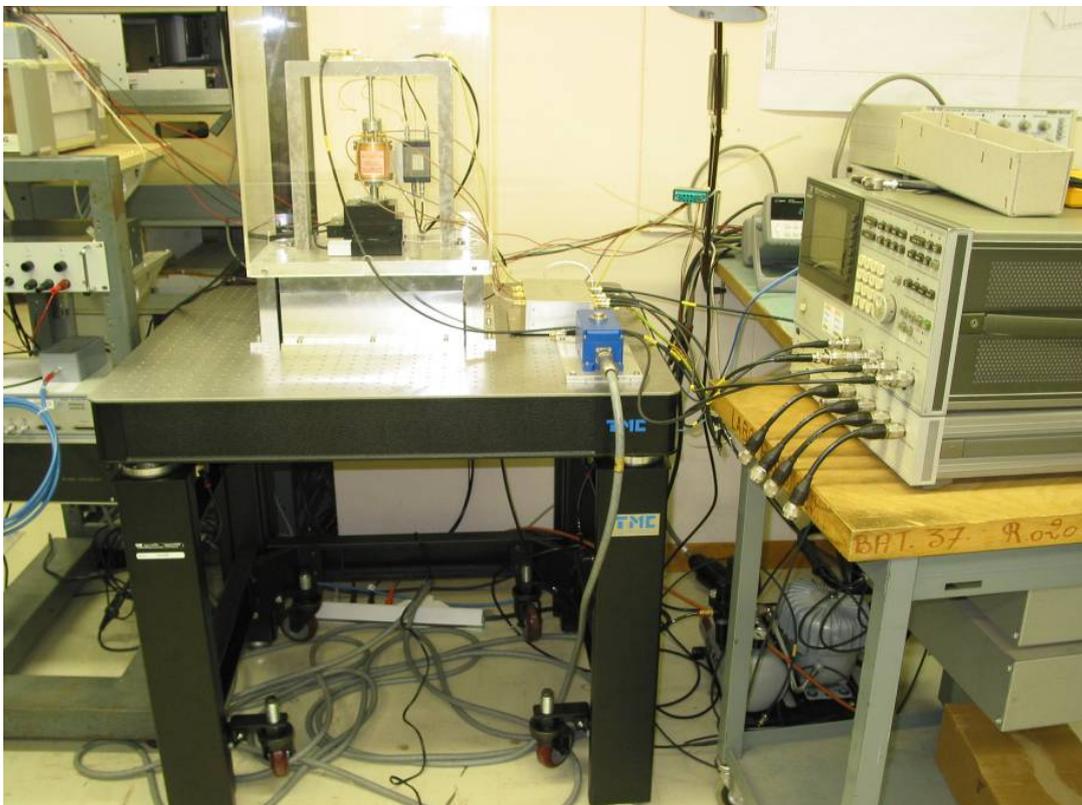


Figure 4: PBPM test bench

Sensitivity	11.88mm
Linearity error $\pm 500\mu\text{m}$	< 1%
Bandwidth	500Hz- 30MHz
Resolution CLIC (1.5A)	190nm
Resolution ILC (55mA)	5.2 μm
24H stability	2 μm

Table 1 : Bench test results

Beam tests

Several beam tests were carried out during the year 2008 on the high resolution triplet installed in CTF3, Figure 5 and Figure 6. The beam tests in May gave very poor transmission efficiencies, and it was understood that the lack of metallization on the inside of the ceramic vacuum tubes, on the second and third PBPM, was the cause of this. The high frequency components were no longer bypassed by the titanium coating and saturated the current transformers.

Three new vacuum assemblies were manufactured and installed in July and a 40mm diameter BPM was added downstream of the setup, to provide independent measurement of transmission efficiencies. A new attempt with beam in August 2008, gave much better results were transmissions of ~90% of the beam were achieved, and an equivalent CLIC beam (1.5A, 200ns) resolution of **2 μm** was measured in the horizontal plane. The vertical plane was perturbed by the beam losses, and a resolution measurement was not possible.

Further beam tests were made in end of September where the beam energy was two times higher (200MeV), and quite some time was spent in order to optimize the steering and beam size. The transmission through the setup was not improved significantly (~90%), but the measured resolution (single sample) was measured to 2 μm in the horizontal plane for a 600mA beam, which corresponds to **650nm** for a CLIC nominal beam, Figure 7. In the vertical plane 1.9 μm was measured for a CLIC type beam.

We believe that the beam losses are still limiting the measured resolution especially in the vertical plane, and it is foreseen to continue the test in order to obtain loss free transmission in the three PBPM's. Also the gain of the acquisition system will be optimized for the future tests, since in order to cover a bigger dynamic position range in this test, the LSB of the ADC was 1.7 μm . The complete results of the beam test are published in [4].

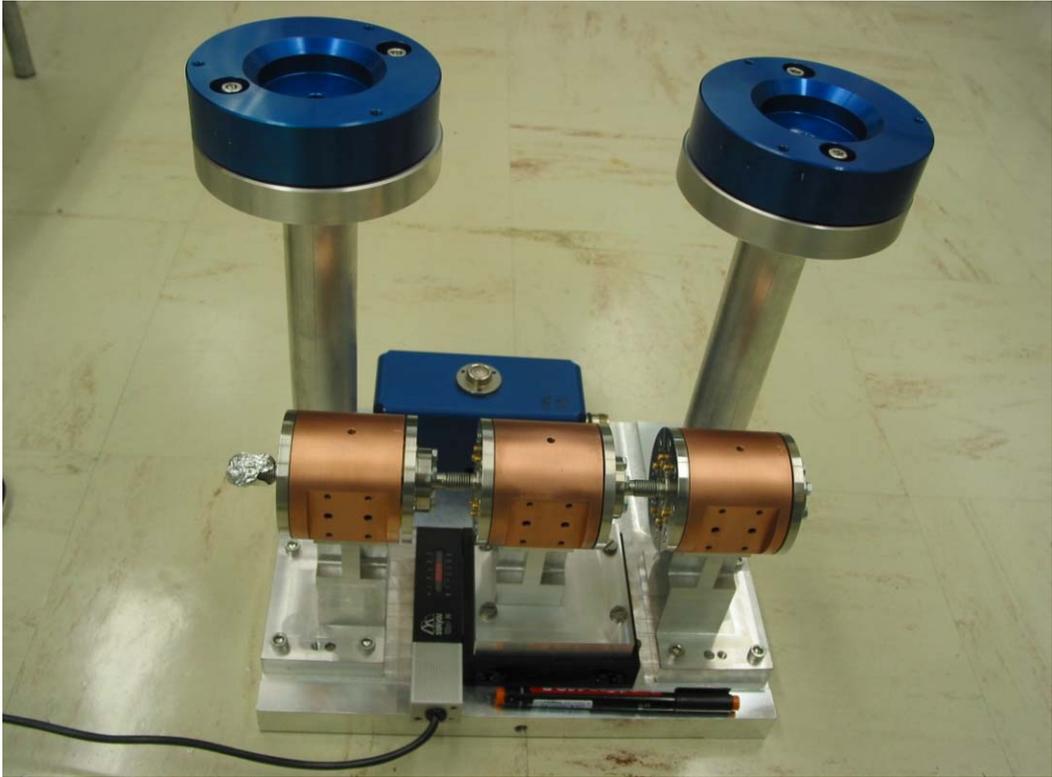


Figure 5: PBPM triplet for the CERN CTF3 beam test

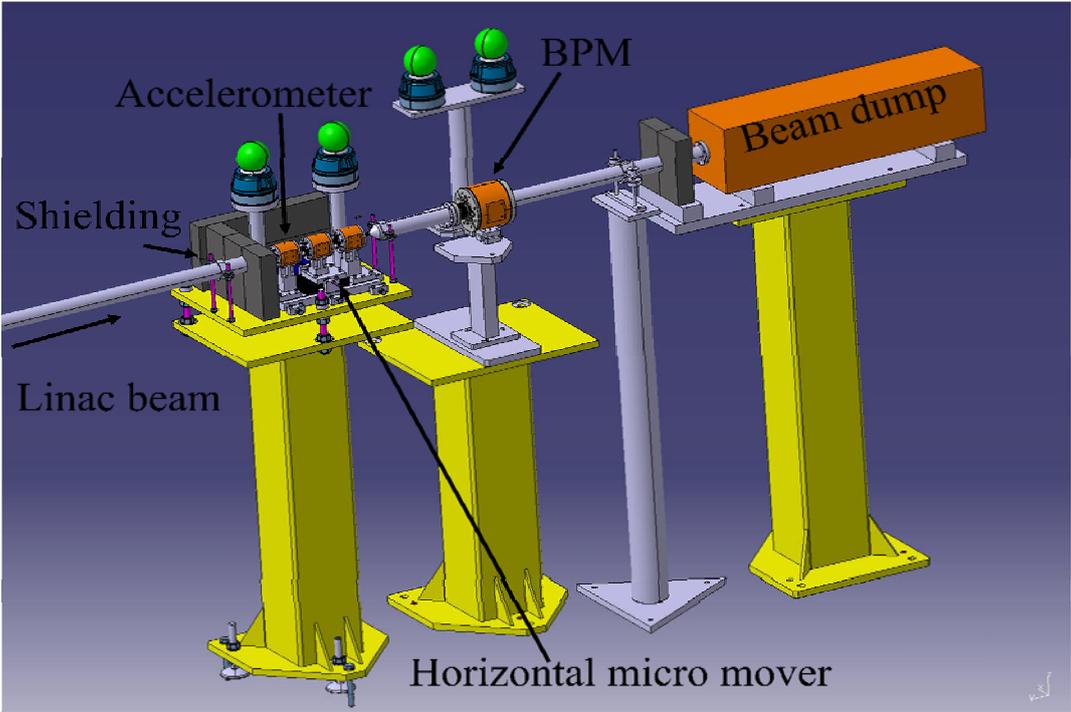


Figure 6: Outline of the PBPM setup in CTF3

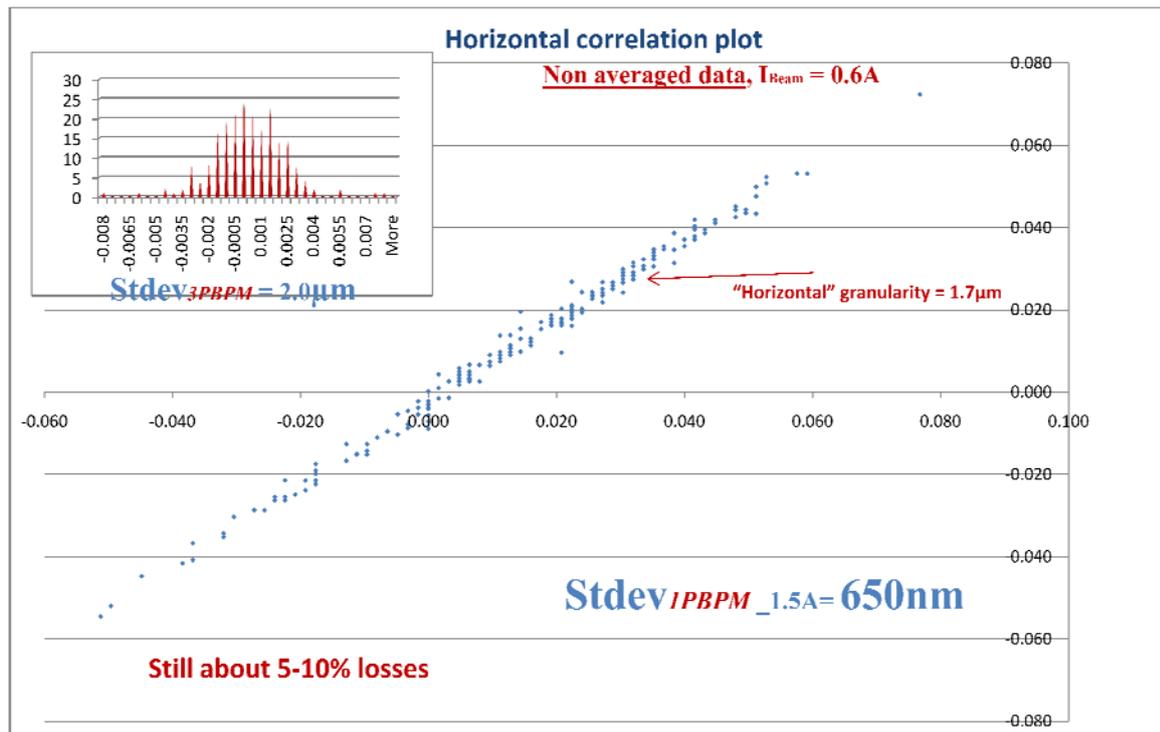


Figure 7: Beam tests with three PBPM's in CTF, September 2008. Correlation plot of measured position at the centre PBPM, against the calculated position obtained from the first and last PBPM.

Conclusion

All of the deliverables of the PBPM work package have been full filled. Prototypes have been designed, build and tested on a test bench. A resolution of 190nm has been measured in the laboratory. Three PBPM's have been installed in the CERN CTF3 and resolution tests with beam have been done at several occasions. A resolution of 650nm has been measured for a CLIC type beam.

Acknowledgement

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References

- [1] I. Podadera Aliseda and L. Sjøby. Design of a new Precision Beam Position Monitor (PBPM) for EUROTeV. EUROTeV-Report-2007-008.
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