Beam Instrumentation for TT40 Extraction tests in 2003

- ◆ **1) What was done ?**

- ◆ **2) BDI Instruments:**
  - ■ BCT (DC)
  - ■ BPM BPCE 4.18
  - ■ BPMs up to TED
  - ■ Fast BCT
  - ■ Beam Loss Monitors
  - ■ BTV screens

- ◆ **Future tests**

- ◆ **Changes for 2004+**

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**AB/BDI - LTI Coordinator**

What was done ?

- ◆ **Dry runs:**
  - ▪ **Very useful for debugging low-level servers and applications but we could not check everything ..**

- ◆ **Test #1 (08/09/03):**
  - ▪ **Single LHC pilot bunches 5E9 protons**
  - ▪ **First extraction attempts took place around 16:00**
    - ● **It worked so .. champagne ..**
    - ● **A physical aperture was found in LSS4 (vacuum valve)**

- ◆ **Test #2 (08/10/03):**
  - ▪ **Single LHC pilot bunches 5E9**
  - ▪ **Double batch LHC pilot bunches (CNGS)**
  - ▪ **1/6 nominal LHC batch (12 bunches) for BPM and BCT verification as these systems acquire at 40MHz**
    - ● **Generally a success**

Layout Drawing LSS4 -> TT40

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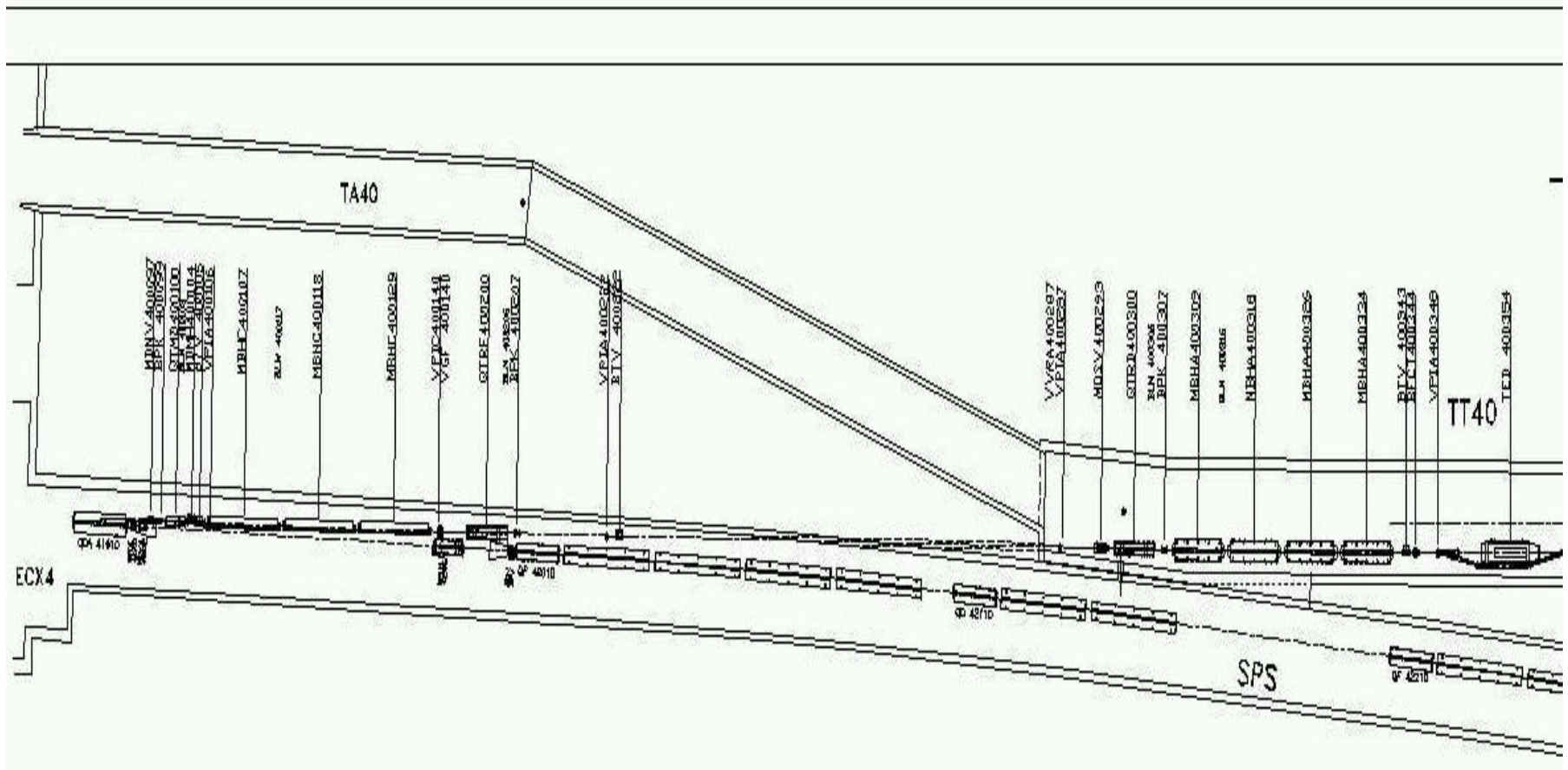
BCT (DC)

- ◆ **A dedicated surveillance process on the SPS MTG was developed by AB/CO to make sure that the intensity never exceeded 2.5E11. This would dump the beam real-time**

- ◆ **The interlock was never active during the tests, but was tested beforehand -> OK**

BPCE 4.18

- ◆ **Extraction pick-up (BPCE 4.18) in the SPS ring**

  - ■ **Acquire bumped beam position over 20 msec during flat-top.**

  - ■ **MOPOS acquisition system BA4 with non-linear pickup correction (large bump amplitude)**

  - ■ **Part of SPS Interlock system through the BIC module (AB/CO)**

  - ■ **No problem apart from timing event used, at the wrong time in the cycle (not at flat-top)**

  - ■ **A dedicated web page was used to show the results for each acquisition as well as the history of previous cycles.**
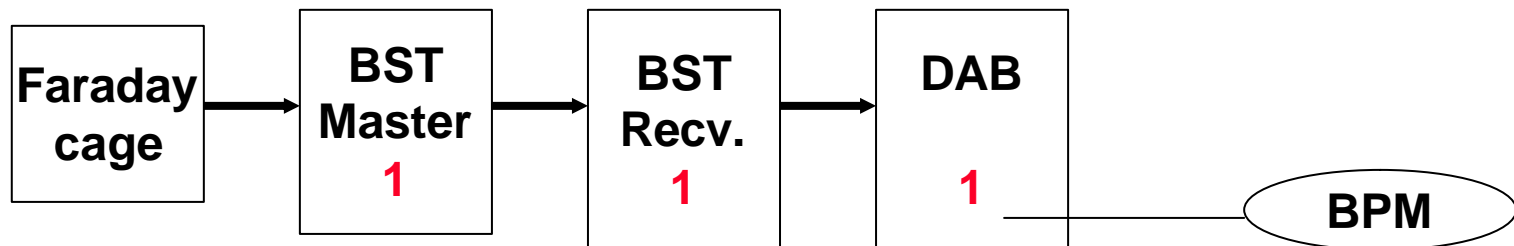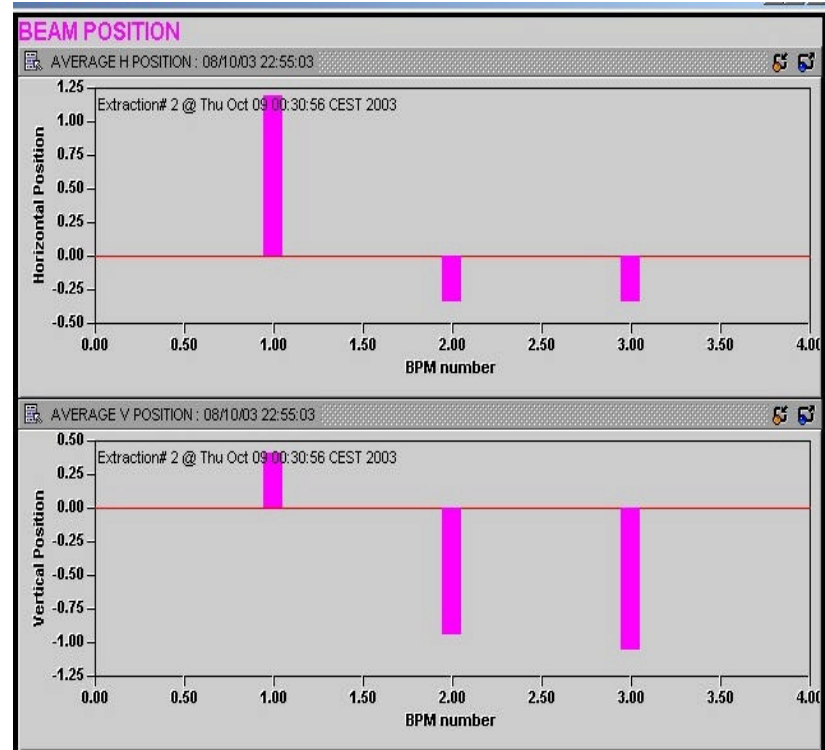

Beam Interlock Test Layout

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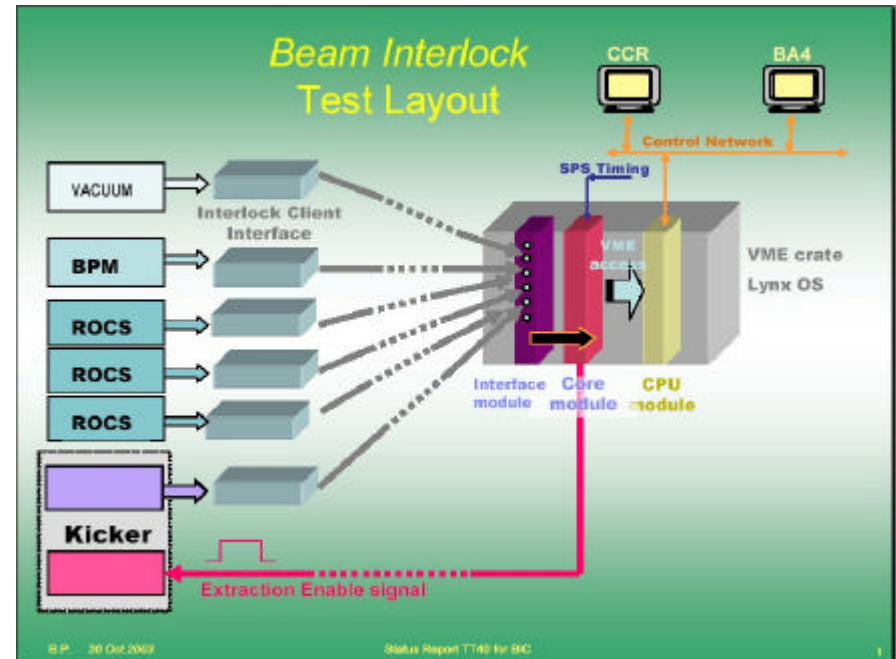
BPMI's up to TT40 TED

- ◆ **3 couplers (BPKs) in TT40**
  - ▪ **Used to acquire H + V trajectories at 40MHz (individual LHC bunches).**
  - ▪ **Acquisitions triggered using pre-pulses transferred over the SPS BST which had important consequences for the 2nd test where we started the acquisition too late. Problem solved by delaying extraction by one SPS turn**
  - ▪ **Interfaced to AB/OP steering program**
  - ▪ **Overall resolution with pilot bunches was ~200 [um] as expected**


```
Faraday   →   BST      →   BST      →   DAB
cage          Master       Recv.
              1            1            1          —  BPM
```

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BDI DAY 14/01/2004

Fast BCT

FBCT 400344 (TT40)

- **Used to acquire the intensity of individual LHC bunches (and will also be used to acquire the integral of CNGS beams).**

- **Acquisitions are triggered using the extraction pre-pulses**

- **During first extraction test we had problems acquiring a single bunch -> quick fix -> OK.**

- **This problem was solved for the second test where a noise level of 3E9 was used.**

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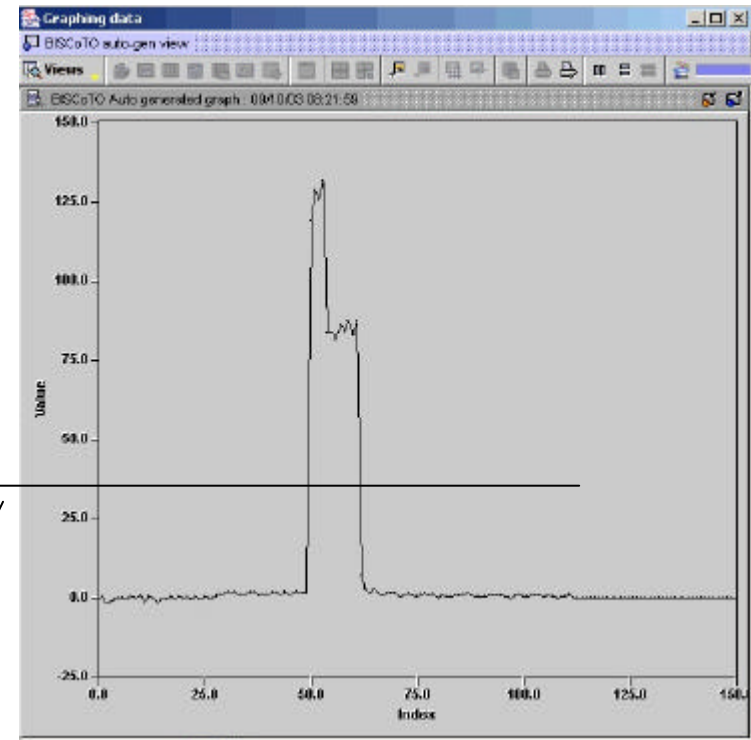
Beam Loss monitors

- ◆ **Extraction region LSS4**
  - ■ **8 monitors in region 4.18 around septa**
- ◆ **TT40**
  - ■ **6 monitors up to BL400416 (after TED)**
- ◆ **General:**
  - ■ **Acquisition every 20 [msec] during the whole elementary cycle**
  - ■ **Last value acquired taken as caused by the fast extraction (no losses before)**
  - ■ **Interfaced to SPS interlock (beam dump) and alarm systems**
  - ■ **False acquisition values showed out to be hardware compatibility problem**

BTV Screens

- ♦ **5 screens**
  - ■ **2 in LSS4 (region 4.18)**
  - ■ **3 in TT40 before TED400354**
- ♦ **Acquisition using old BTV profile card**
- ♦ **Acquisitions are triggered using SPS timing event**
- ♦ **Analogue BTV image transferred to SPS matrix through remote-controlled multiplexer**
- ♦ **During both tests the data were saturated. Despite lowering the gain on the (fixed) optics in the tunnel after first test, there was still too much signal (alumina screens), and we didn't see anything with the OTRs**

It's saturated

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The future tests

- **2004:**
  - **1) TI8 test up to TED end of TI8 (2 days)**
    - Single LHC pilot bunches
    - Single nominal LHC bunches for precise beam size measurements (OTR) and improved BPM resolution
  - **2) High intensity tests in TT40 (2 sessions)**
    - Full LHC batches (up to 4 batches -> 3E13 protons)
    - Collimator tests
    - Material tests

- **2006:**
  - **LHC Sector tests:**
    - SPS->TT40->TI8->LHC tunnel left of point 8
    - Only single LHC pilot bunches for radiation reasons

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Changes in 2004 #1

◆ **BCT DC:**

  ■ In 2004 the intensity interlock will have to be done differently as the old SPS MTG will no-longer be used. The present proposal is to use the BIC to disable the extraction if the intensity > threshold

  ■ Safe-beam flag also being discussed which would disable masking of channels if intensity > X

◆ **BTV screens:**

  ■ Two acquisition systems (BB4 and UA87)

  ■ For 2004 we will install remote-controlled filters on all BTV tanks. This will allow a factor attenuation of signal before the CCD camera. Alumina and OTR screens

  ■ New AB department wide BTV acquisition module will be used (we would like to start testing in TT10 Q2 2004). The new module is hoped to be operational end Q1 2004

  ■ Analogue signal transmission from LHC into the standard SPS matrix coax would be very expensive (not foreseen).

    ● Attempt during 2003 (with IT/CS group) to use Ethernet (controllogic box) to a stand-alone MS Windows application.

    ● We would need support from AB/CO for incorporating this into the SPS control system

Changes in 2004 #2

- ◆ **BPM:**
  - ■ Two acquisition systems (in BB4 as we use optical fibres)
  - ■ It was foreseen to use the new generation of the DAB64x acquisition module in the VME64x crates but due to delays in the specification/fabrication this may not be possible. We have launched the fabrication of more of the presently used module -> We're ok for 2004.
  - ■ New WorldFIP master based on AB/CO proposed gateway PCs foreseen. We need and expect support from AB/CO for this to work.
  - ■ If we do use the DAB64x we need to get the new BST receiver (AB/BDI product) working as well (including software).

- ◆ **BCT:**
  - ■ Two acquisition systems (BB4 and UA87)
  - ■ Either DAB III as now or DAB64x (see above)

- ◆ **BLM**
  - ■ Three acquisition systems (BA4, BB4 and UA87)
  - ■ Acquisition systems LSS4 and TT40 (TI8) will be separated. New BLMI low-level server will be developed this shutdown.