New Diagnostics in the FLASH Dump Line

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for the Dump-Diagnostics team
Contents

• Motivation of Dump Line upgrade
  ➢ Problems with the old dump line

• New Dump Line Diagnostics
  ➢ Beam Position Monitors (BPMs)
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  ➢ Beam Halo Monitors (BHMs)

• Some data analysis and questions

• Summary
September 2008

• 9 mA studies
  ➢ achieved 550 bunches/pulse, 2.5 nC, 1 MHz, 890 MeV
  ➢ terminated by vacuum problem in the dump line

⇒ not sufficient diagnostics at the dump
• Strange behavior of BPM signals
  - measured impedance from end of cable (in bld. 49):
    - L, R, D: high Z
    - U: voltage measured (~800mV)
  - buttons or connectors damaged by radiation

J. Kruse
Old Dump Line

- all contacts loose
- Teflon disappeared almost completely from adaptors

» J. Kruse
Dump Line Upgrade 2009
New BPMs

BPM 16DUMP
BPM 13DUMP

BPM 9DUMP

BPM 10DUMP

Toroid 9DUMP

OTR screen 9DUMP

BLM 14DUMP

BLM 13.1DUMP 13.2DUMP

BLM 6DUMP

BLM 1.1DUMP 1.2DUMP

BLM 5DUMP
Dump Line Upgrade 2009
New Loss Monitors

- BPM 16DUMP
- BPM 13DUMP
- BPM 9DUMP
- BPM 5DUMP
- Toroid 9DUMP
- OTR screen 9DUMP
- Ionization Chambers:
  - I14R.DUMP
  - I14L.DUMP
  - I14U.DUMP
  - I14D.DUMP
- Cerenkov monitors:
  - BLM 14R.DUMP
  - BLM 14L.DUMP
  - BLM 14U.DUMP
  - BLM 14D.DUMP
- BLM 1.1DUMP
- BLM 1.2DUMP
- BLM 6DUMP
- BLM 13.1DUMP
- BLM 13.2DUMP
- BLM 14R.DUMP
- BLM 14L.DUMP
- BLM 14U.DUMP
- BLM 14D.DUMP
Dump Chamber

magnetic loop BPM

BHM

for glass fibres

for ionization chambers

» T. Wohlenberg, M. Schmitz, MDI3
• Idea
  ➢ Not possible to use (button) BPMs in air (or Nitrogen),
  ➢ ⇒ magnetic loops
  ➢ signal not (significantly) influenced by ions
• Simulations and analytical calculations
  ➢ in agreement with each other

» D. Lipka
Magnetic loop (in-air) BPM 16DUMP (2)

- Measurement

» D. Lipka
Magnetic loop (in-air) BPM 16DUMP (3)
Glass fiber BLMs

BLM/14U.DUMP

BLM/14R.DUMP

BLM/14L.DUMP

BLM/14D.DUMP

H. Tiessen
Ionization Chambers

- air filled HF cables
- measures O$_2^-$
- electronics -> large dynamic range
  - $V_{out} = 0.25V \cdot \log(I/1\mu A)$
  - voltage (not current) displayed in DOOCS

- test measurement in FLASH
  
  » P. Smirnov
Ionization Chambers (2)

BLMs: Glass fibers (14) and ionization chambers (114)

- 200 bunches/pulse
- short pulse

Graphs showing ionization chamber output over samples with labeled time periods.
Solid state ionization chambers
- sensitive to very small losses

» A. Ignatenko
Beam Halo Monitors (BHM) (2)
Beam Scan: BHM vs. BPM

Scan made on Sep. 18, 2009, 16:20 – 16:40
Beam Scan: BHM signals

Signals from the BHM sensors (diamonds)

Signals from the BHM sensors (sapphires)

A. Ignatenko
Beam Rotation on BHM

beam rotation at dump to be seen on BPM 16DUMP
Beam Scan with Steerers 93BYP

Scan made on Sep 8, ~14:30
Beam Scan with Steerers 93BYP

coupling between X and Y planes?
Beam Scan with Steerers 93BYP
Beam Scan with Steerers 93BYP
Beam Scan with Steerers 93BYP
Beam Scan: BPM Correlations

The diagrams show the correlations between BPMs at different dump stations. The graphs illustrate the movement of the beam in both the X and Y directions across various dump stations.
Beam Scan: BPM Correlations (2)
Summary

• Motivation of dump line upgrade
  - damage of dump line with long pulses in Sep 2008

• Lots of new useful diagnostics
  - BPMs
  - BLM: glass fibers, ionization chambers, beam halo monitors (diamond and sapphire), Cerenkov fibers
  - still some things not understood (BPM calibration, BLM signals and correlations)
  - however, good diagnostics for beam alignment

• Still to do
  - understand beam movement
  - calibrate dump BPMs