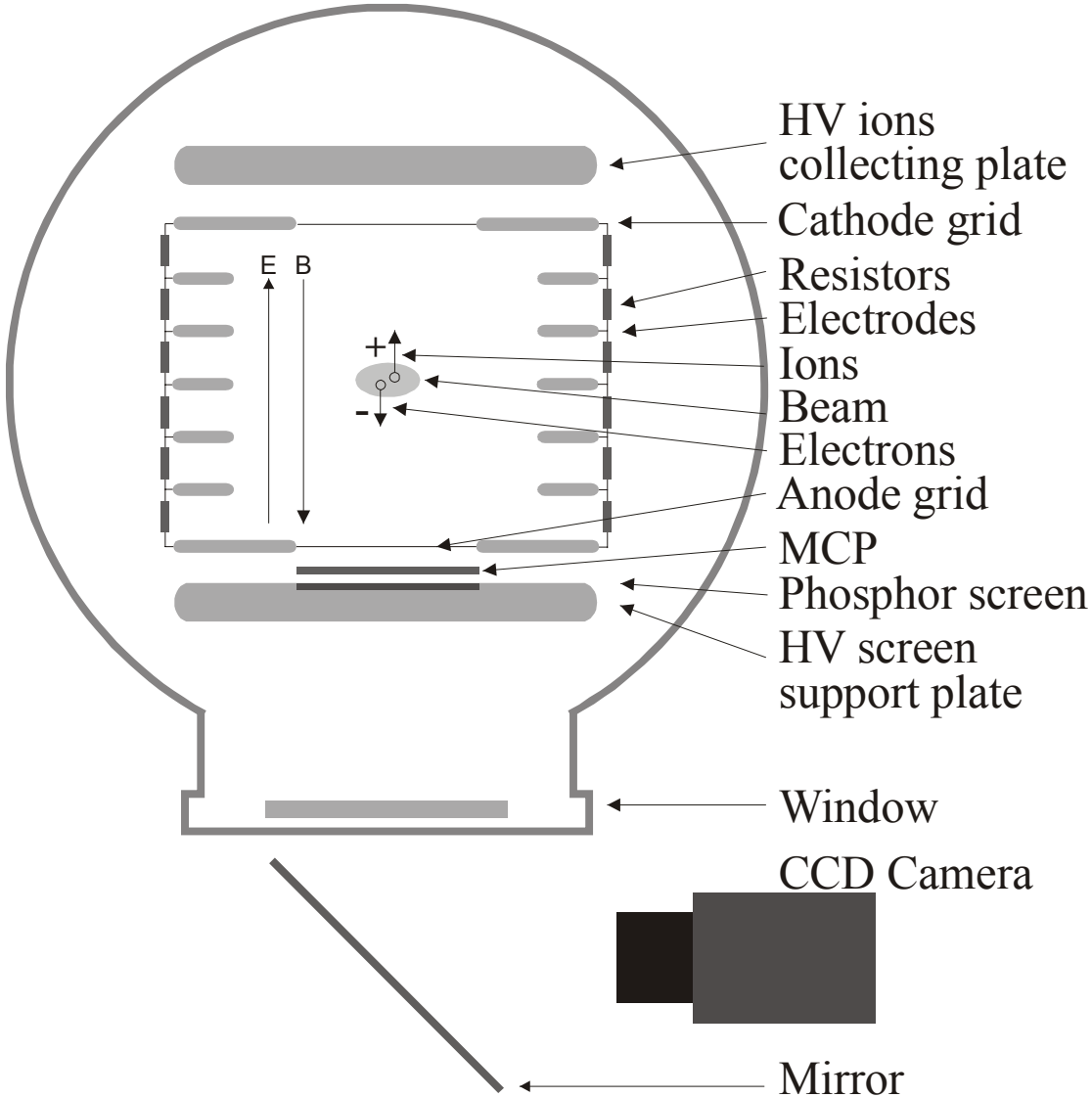
IPMV51734

Problems and Cures

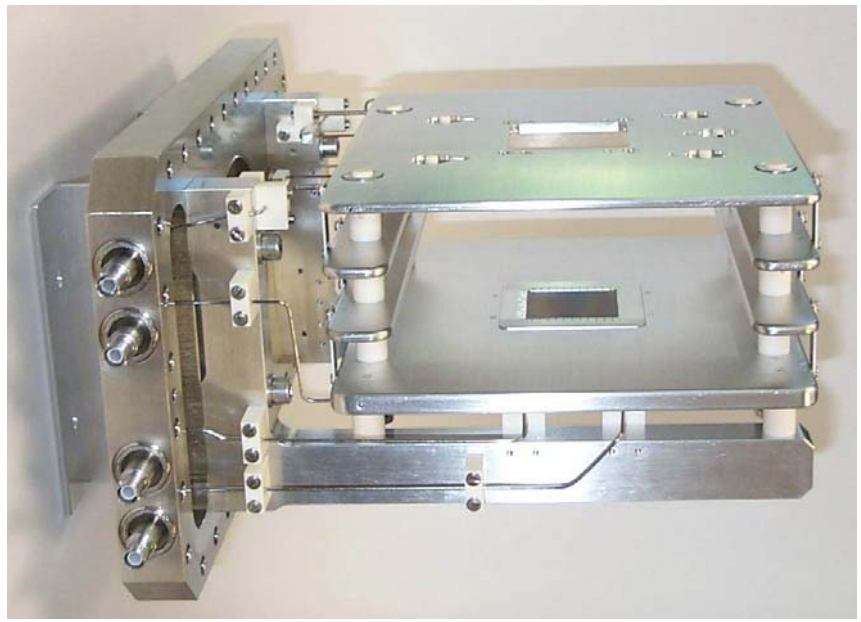
Special acknowledgements to D. Kramer

Working Principle



Installation LSS5

Inner Detector

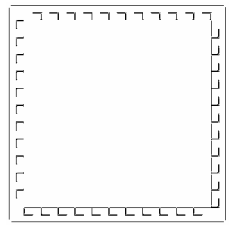


Problems encountered and cured during sdh 2003:

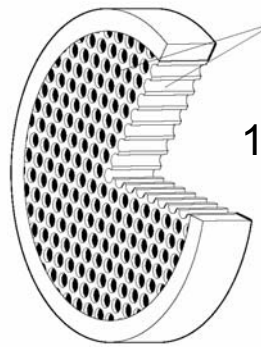
- Installation delayed due to supply problems (MCP, vacuum flange). Commissioning August 2002.
- Evidence for e-cloud:
  - DC voltage level increases after third injection when signal of electrode directly observed on a scope.
  - A test showed that electron emission current from heating wire decreases after third injection.
  - Video signal increases after third injection.
- Severe instabilities of HV power supplies due to electron cloud and RF with LHC type beam:
  - Application of NEG (Non Evaporable Getter, TiZrV: 15/34/51%) layer on electrodes: low SEY.
  - RF absorbers near HV PS and HV series resistors near detector.
- Beam related EMI on TV screen:
  - Cover plate for view port.
  - Repaired loose ground contact within video driver module.
  - Repaired interruption in video cable screen.
  - TV replaced by base band video B&W monitor.

Problems encountered and cured in course 2003.

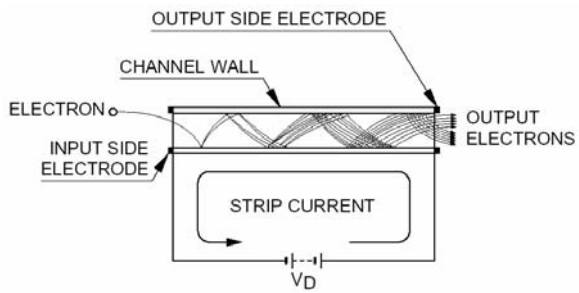
- Bad electrical contacts of phosphor screen after bake-out (200ºC) of NEG:
  - Insertion of thin CuBe frame with flexible contacts for phosphor.
- Damage to central region of MCP due to high output signal:
  - Decrease of MCP gain compensated by image intensifier. Decrease MCP output current, increase of life time.
- Lighting up of phosphor screen with short LHC bunches at high energy (Even without HV applied!):
  - Removal of HV series resistances.
- Limited image resolution:
  - Closed diaphragm of camera lens by 50%.
- Tilt on video image due to stray B-field:
  - Addition of μ-metal screen, decreasing influence B-field on image intensifier.
  - Reduction of magnet current by 50%.



CuBe frame

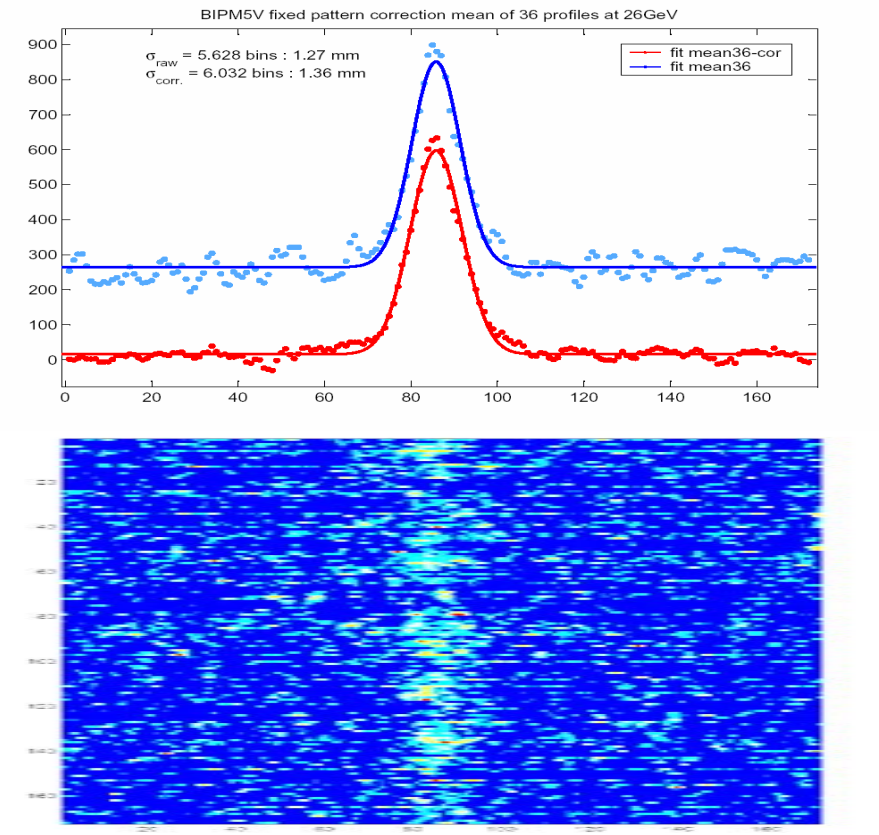


1-40 C/cm^2

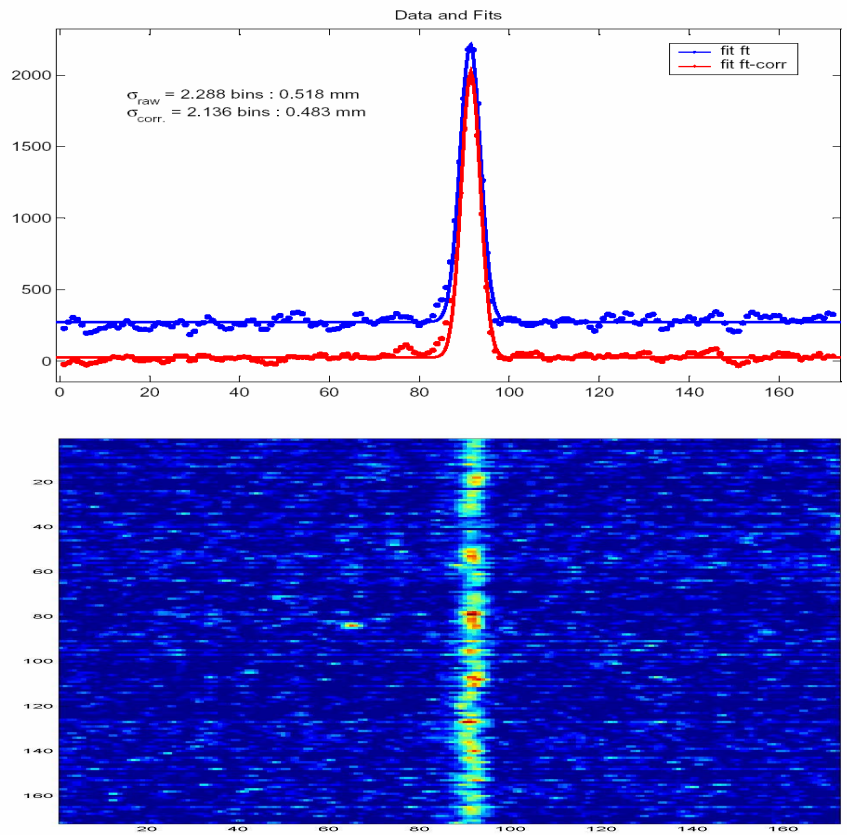


Observations in 2003 1/2

Pilot bunch @26 GeV

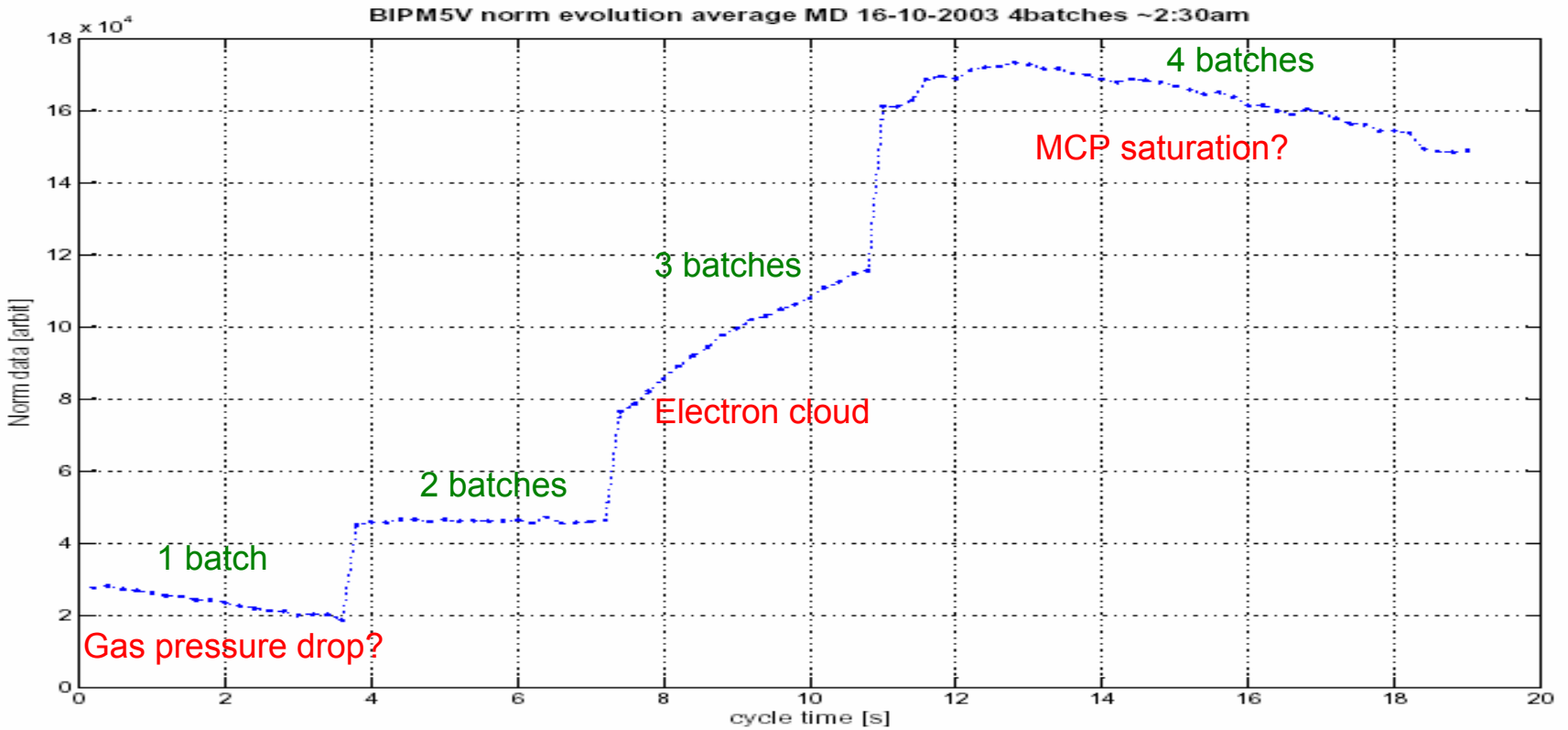


Pilot bunch @450 GeV



- Pilot bunch has been observed using intensified camera.
- Analysis of fixed pattern noise shows possibility of improving signal quality by subtraction, especially beneficial at low energy.
- At high energy, 50% too large sigma's were measured with bunch pilot (very small size): resolution limitation.

Observations in 2003 2/2



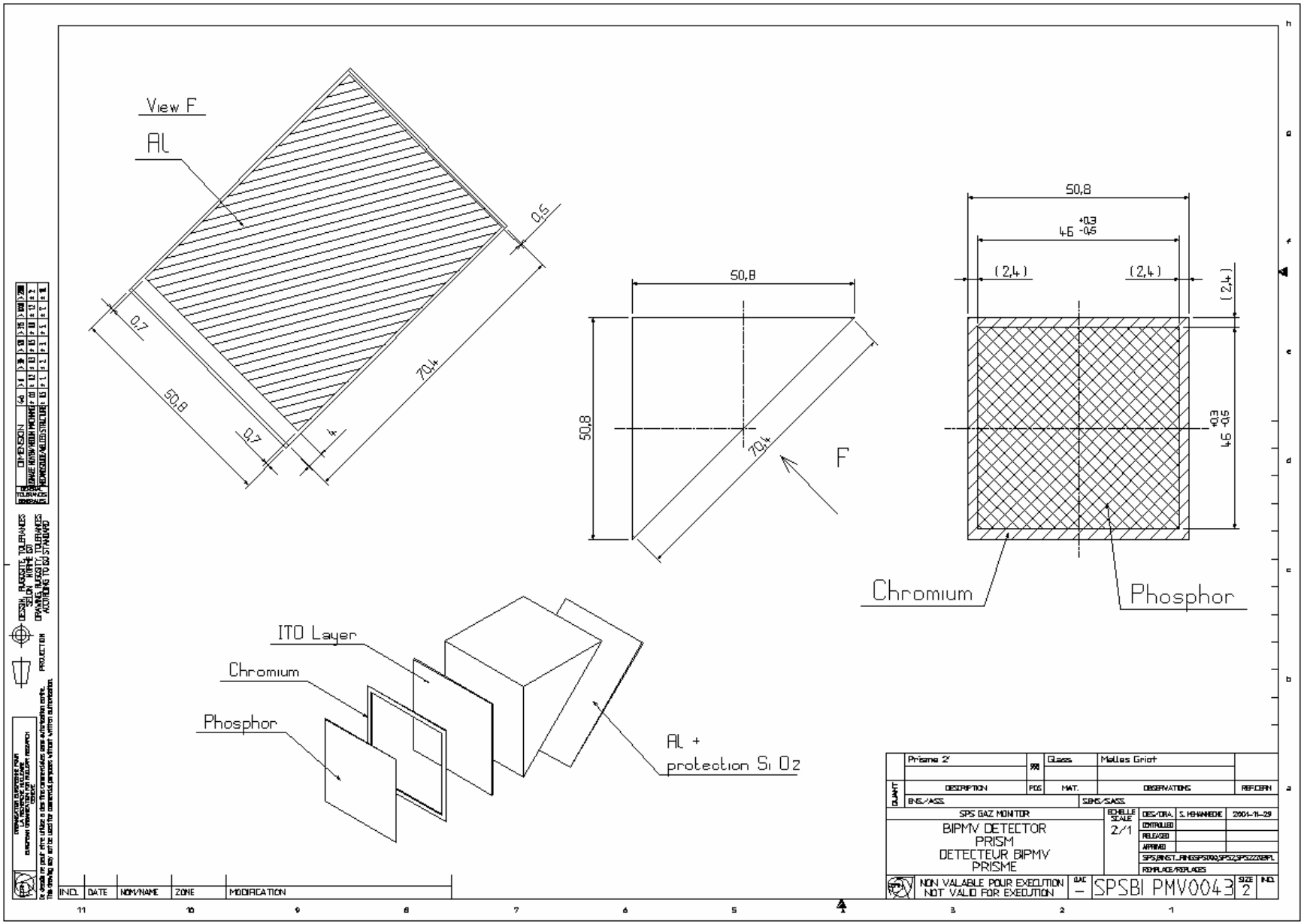
- Decreasing intensity until 2-nd injection:
  - Dropping vacuum pressure after vanishing e-cloud of previous cycle?
- Rising intensity after third injection:
  - Rising vacuum pressure due to electron cloud build-up?
  - Detected cloud electrons adding to useful signal?
- MCP saturation after acceleration:
  - Higher peak values due to beam size shrinking.

Remaining Problems and Cures in shd 2004 (1/2)

- Damaged MCP:
  - Replacement with new one operated at lower gain and relayed by LLL camera.
  - Suppression of 2-nd MCP in order to operate first one with higher voltage.
- Low phosphor gain leading to overexposure of MCP:
  - Phosphor change from CdS:In to $Y_3Al_5O_{12}$:Ce (P46) to increase sensitivity and decrease gain on MCP. Scarify high speed single bunch measurement.
- Heating wire does not procure sufficiently homogeneous signal for calibration purposes:
  - Removal of heating wire.
- Suppression of electron cloud in active region of detector.
  - NEG coating on MCP input and grid wires.
- Resolution limitation due to insufficient video bandwidth?
  - New video driver.
  - Turn camera by 90º?
- Contribution to tails of beam profile by secondary electrons from wire grid on cathode:
  - Decrease of number of wires on cathode grid to decrease contribution to tails.

Remaining Problems and Cures in shd 2004 (2/2)

- Non homogeneous light distribution in transverse direction due to non total internal reflection in prism:
  - Application of reflective Al coating on prism for total internal reflection to improve light distribution. (See drawing)
- Non homogeneous light distribution in longitudinal direction not yet understood, but probably no influence on profile measurement.
- Internal optical reflections:
  - Treatment of relevant surfaces to absorb and/or scatter parasitic reflections.
- Bright spot on phosphor (outside active region) depending on applied voltage and magnetic field :
  - Cleaning of MCP mounting parts.
- Still sometimes lighting up of phosphor in very special conditions (only once observed in 2003, believed to be due to RF):
  - Addition of external RF absorbers on the HV feed-throughs on the detector.


View F
Al
0,5
0,7
50,8
0,7
4
70,4
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70,4
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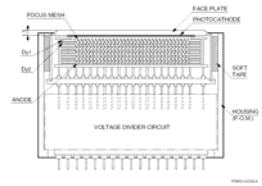
+0,3
46 -0,5
(2,4)
(2,4)
(2,4)
+0,3
46 -0,5
Chromium
Phosphor
ITO Layer
Chromium
Phosphor
Al +
protection Si O2
Prisme 2°
Glass
Melles Griot
DESCRIPTION
MAT.
OBSERVATIONS
SPS GAZ MONITOR
BIPMV DETECTOR
PRISM
DETECTEUR BIPMV
PRISME
ECHELLE
SCALE
2/1
DES./DRA. S. MEHAMMEDI 2004-11-29
CONTROLLED
RELEASED
APPROVED
REMPLACE/REPLACES
NON VALABLE POUR EXECUTION
NOT VALID FOR EXECUTION
SPSBI PMV0043
SIZE 2
IND.
IND. DATE NOM/NAME ZONE MODIFICATION

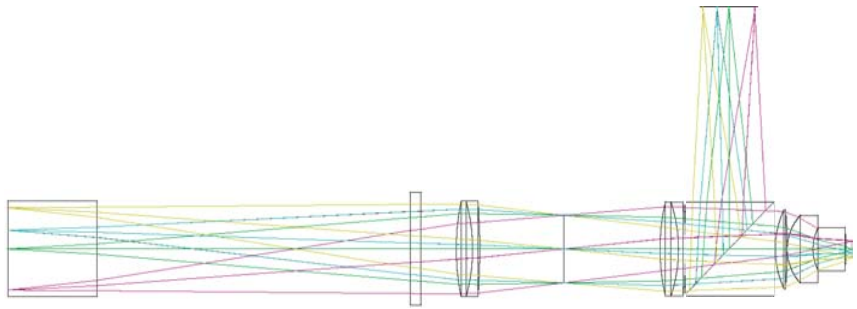
New Hardware

- Low Light Level camera:
  - Lower noise.
  - Higher resolution.
  - Insensitive to B-field.
  - Life-time insensitive to over exposure.

- 32 channel miniature photo multiplier tube:
  - High speed turn/turn measurement for injection studies.



- Dedicated optics:
  - Splitter.
  - Higher aperture.



- Video drivers:
  - Less EMI sensitivity, better signal quality.
  - More bandwidth, higher resolution.

Software Upgrades:

- Ongoing:
  - IPM HV control with programmable dynamic gain – BGIPFG:
    - Optimise dynamic behaviour for constant output current.
    - Avoid MCP saturation and damage at high beam energy.
    - Improve S/N ratio at low beam energy.
- Wish list:
  - Repair pending bugs in Biscoto BTVSPS:
    - Main problem: timing drift.
    - Some ergonomic issues.
  - Tilt correction:
    - Improve accuracy beam size measurement.
  - Fixed pattern noise measurement and subtraction:
    - Improve signal quality.
  - Control on/off/gain LLL camera.

Tests and measurements 2004:

- Test of effectiveness of modifications intended to be improvements.
- Correlation between pressure and signal decrease after first injection.
- Investigate remaining resolution limits (optics, B-field, video bandwidth/offset, image tilt).
- Calibration campaign of upgraded equipment with BWS with different type of beams.
- Compare results between FT and LHC beam:
  - Bunch shortening effects.
  - E-cloud effects.
- Investigate remaining unexplained behavior:
  - Gradual beam blow-up (~10%) at low energy and high intensity.
  - Gain instabilities of MCP.
  - HV jumps not in accordance with DAC values.
  - Cathode HV sometimes does not follow DAC values.
  - Non symmetry in magnet currents.

Future plans

- If necessary, build and test new idea of MCP calibration wire grid.
- If time available, upgrade HV control card.
- If possible, unify into one application all bits and pieces of software actually needed to control the instrument:
  - Camera control.
  - IPM HV control.
  - BTV data acquisition.
  - Magnet control.
- Build new horizontal IPM for 2006.
- Build 4 new IPMs for LHC for 2007.