# LHC Abort Gap Monitoring (BSRA)

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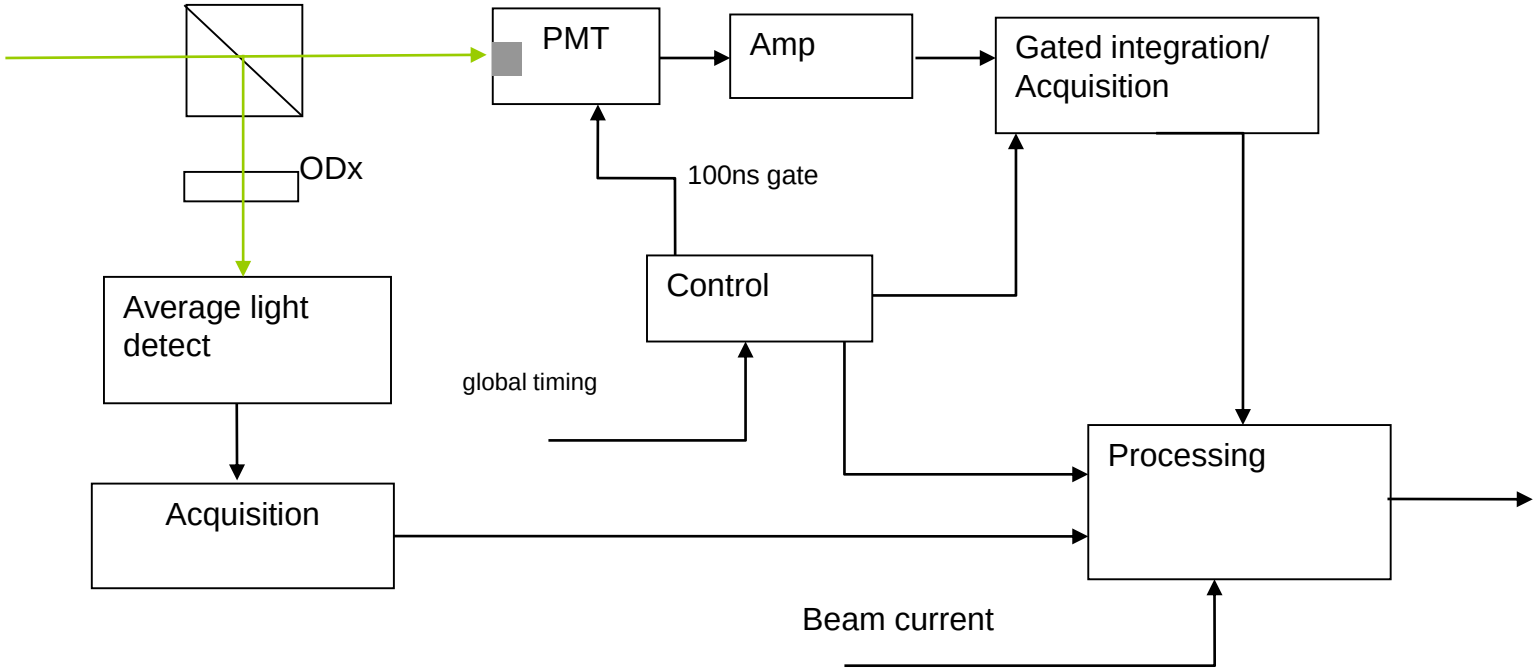
- Instrument + status
  - operating principle
  - lab tests
- Planned tests
  - SPS abort gap monitor: Sept. 2006
- Reliability of data issues
  - Light source,
  - optical transmission
  - calibration
- So, is it an Alarm or a Monitor?
  - connection to BIC?

# LHC Abort Gap Monitor

- Use synchrotron light from the transverse diagnostics telescope
- Gated Photomultiplier can be easily switched at the required speed
- S/N ratio seems adequate
- Fast photocathode recovery (Pockels cell not required)
- One 100ns sample each turn, 33 slots for the 3.3us gap
- 100ms measurement time: 30 samples/ slot (1100 turns)

# System schematic diagram

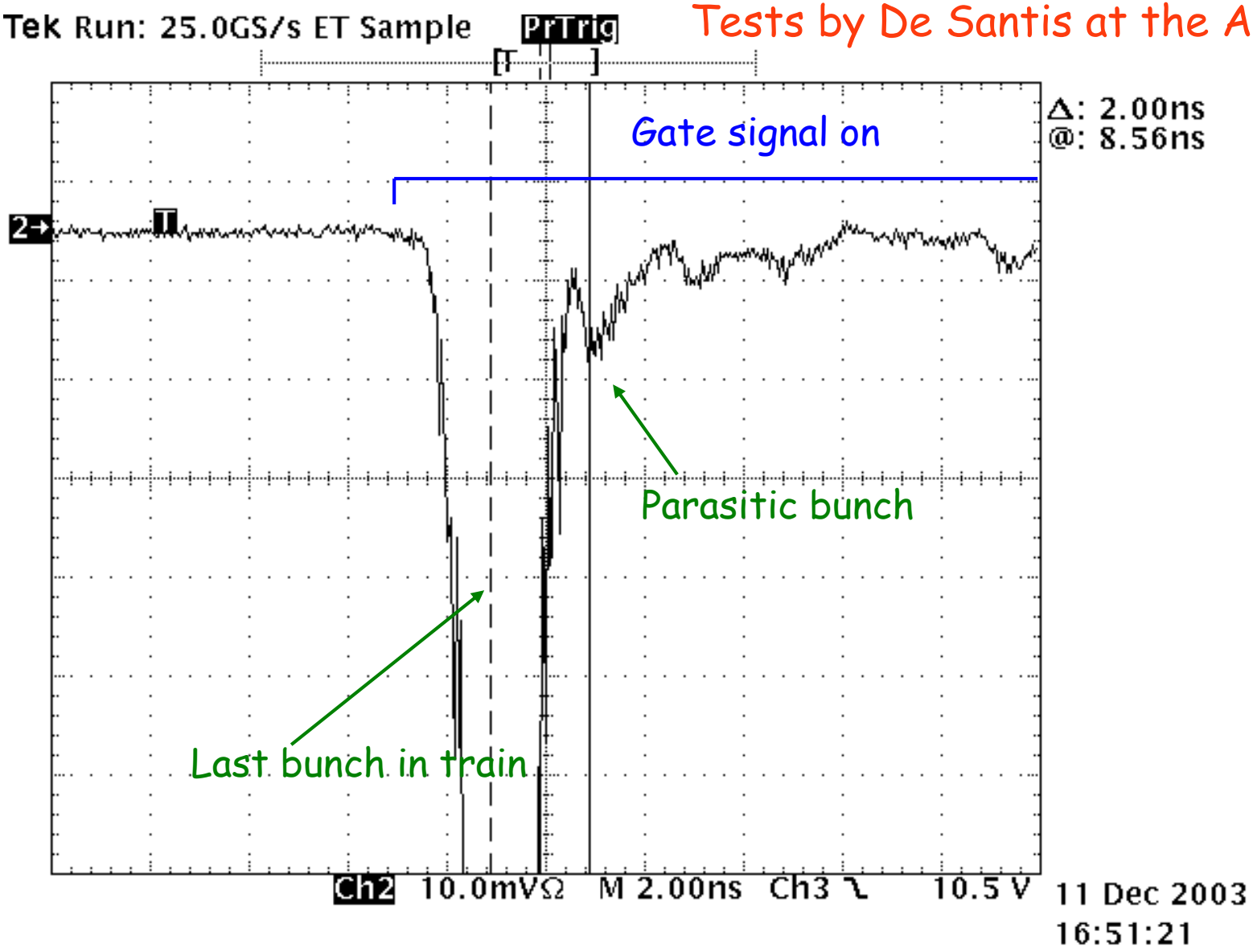
Light from BSRT
Via optical fibre



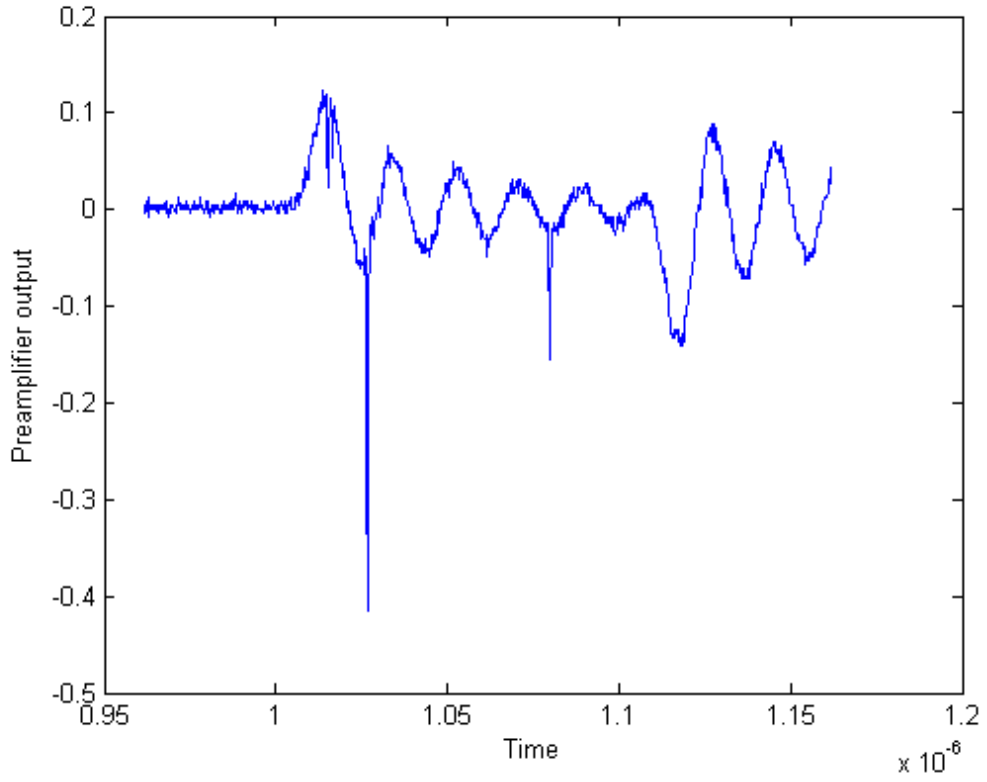
# Abort gap photon production

| Data from functional spec, rev 2.0, + simulations M.Facchini | Sensitivity level, Protons<br>protons/100ns | Quench level, Protons<br>protons/100ns | Photon production Sensitivity level | Abort gap Photons available: Sensitivity level (1% available photons, 90% optical losses, 7% detector efficiency) |
|---|---|---|---|---|
| 450 GeV | $4\ 10^{9}$ | $4.6\ 10^{10}$ | **($10^{-23}$ J/proton/turn)**<br>$4\ 10^{-13}$ J/Turn<br>$= 10^{6}$<br>**photons/100ns/turn** | = 43<br>**photo-electrons /100ns/turn** |
| 7 TeV | $6\ 10^{6}$ | $66\ 10^{6}$ | **($10^{-21}$ J/proton/turn)**<br>$6\ 10^{-14}$ J/Turn<br>=150,000<br>**photons/100ns/turn** | = 7<br>**Photo-electrons /100ns/turn** |

# Tests by De Santis at the ALS



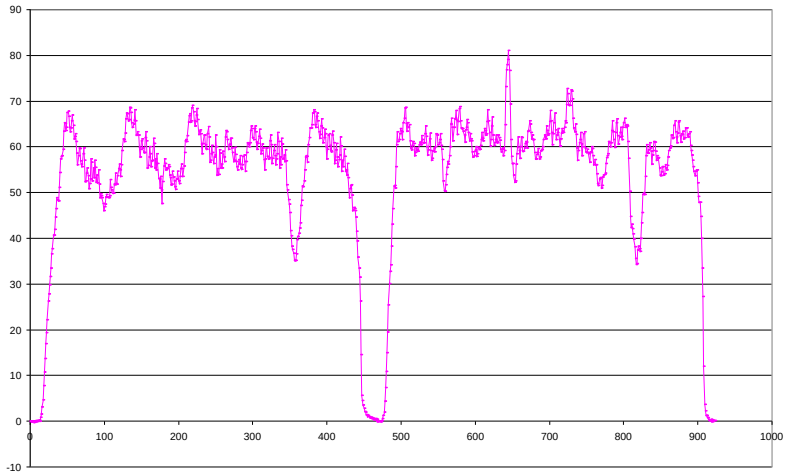
Output signal from detector, 100ns sample, showing oscillations due to internal impedance matching, plus some detected photons producing signals of different amplitudes




Two detection possibilities are under study: integration to remove the oscillations and digitisation with pulse counting

# SPS abort gap tests 2006

- Good live test of LHC prototype equipment
- 1 us gap: 10 slices of 100ns
- Will setup in SPS synch light station (no matching camera)
- From data of scraping tests, estimate we can improve on the current fast BCT measurement, in noise level and sensitivity.
- Will only have sufficient photons at the flat top energy
- Plan to install for September
- !! equipment still needed for LHC



# BSRA confidence issues

- Light source is not constant:
  - Low energy: undulator, Higher energy : D3 bending magnet
  - Light polarisation changes between these two
  - Changing energy = changing light spectrum = photon acquisition
- Optical path is not constant:
  - Optical alignment will change with time, temperature +?
  - Matching of light into fibres may drift
- System calibration chain:
  1. Known beam population from Beam Current Monitors
  2. Total optical power detected (D2)= photons/proton
  3. Photons detected in gap (D1) =protons in gap
  4. Light splitting ratio D1 and D2 kept constant

There are still issues of detector/amplifier ageing/stability, etc.

# BSRA: monitor or alarm?

- Data noise reduction, analysis + calibrations may take time
  - System is becoming dependant on computing power!
  - Aim to maintain a histogram available on a server
  - 33 bins calibrated in protons/bin

Do we also need to flag when a danger level is reached?

Would this flag be via ethernet or BIC?
(we have no connection planned at present)