

CNGS Proton Beam Line Instrumentation



OUTLINE

1. BPM System Update

- *Requirements*
- *Acquisition system*

2. BCT System Update

- *Requirements*
- *Acquisition system*

For other systems see NBI 2002 talk by R. Jung

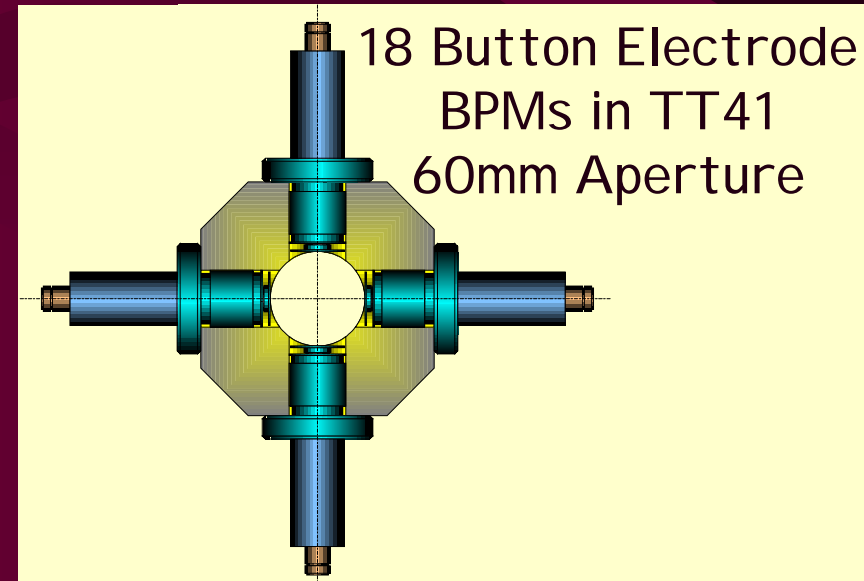
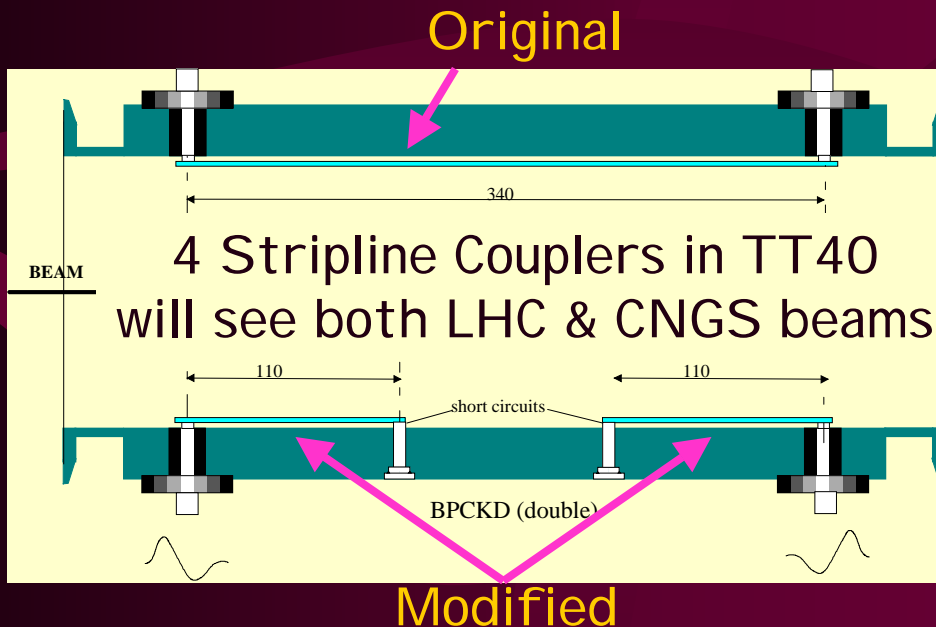
CNGS Beam Position Monitoring



CNGS Beam Position Measurement Requirements

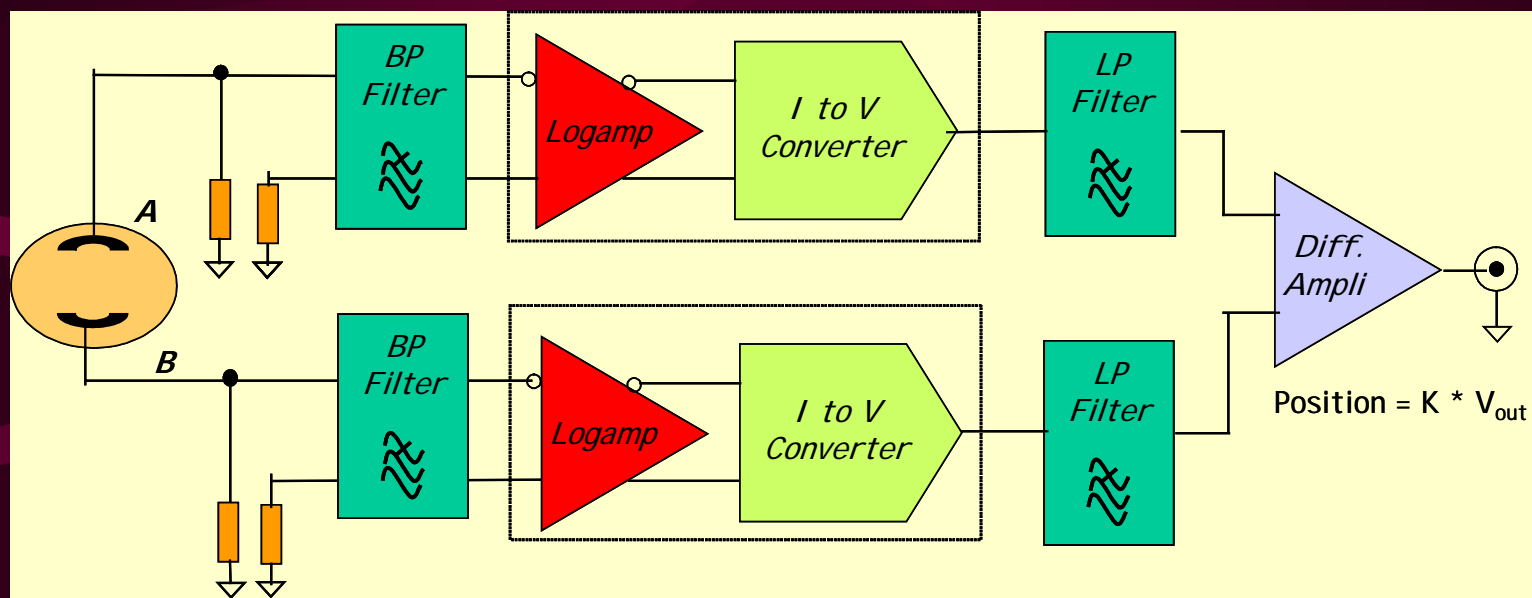
source	rms uncertainty	tolerance
BPM (global accuracy)	0.25 mm	± 0.5 mm
Alignment	0.20 mm	± 0.4 mm
Total	0.32 mm	± 0.6 mm

Intensity Range:
 1×10^{12} to 3.5×10^{13}



CNGS Beam Position Monitoring

CNGS Beam Position Measurement Acquisition System

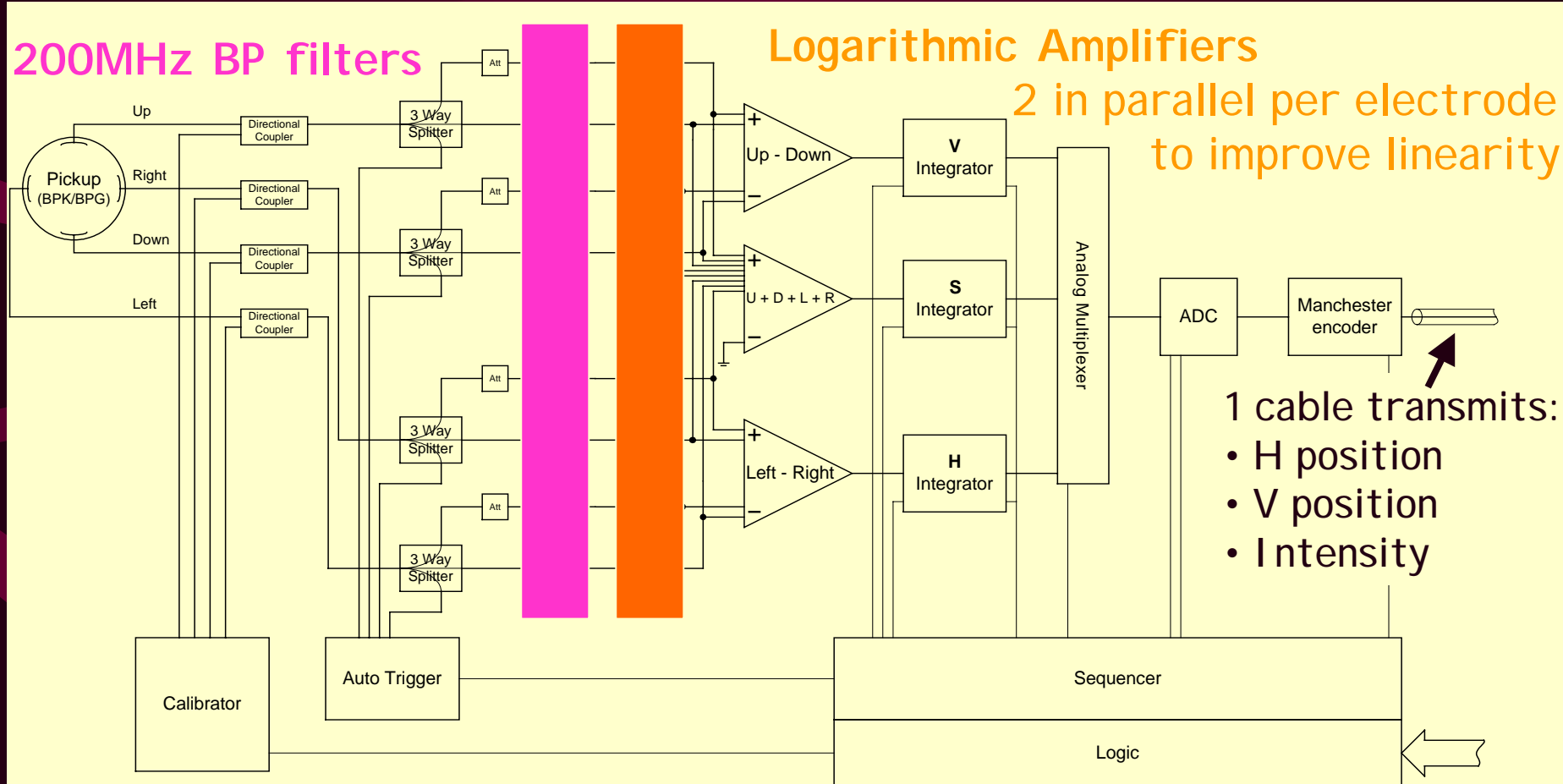


- Each signal is compressed by a *logarithmic amplifier*, filtered and applied to a differential amplifier.
- The position response is: $\text{Pos} \equiv [\log(A/B)] = [\log(A) - \log(B)] \equiv (V_{\text{out}})$ where V_{out} is the voltage difference between the log-amp outputs

CNGS Beam Position Monitoring



CNGS Beam Position Measurement Acquisition System



CNGS Beam Position Monitoring



CNGS Beam Position Measurement Acquisition System

Why this choice?

- ⇒ low cost – as it requires only 1 coax cable per pick-up.*
- ⇒ large dynamic range without requiring gain switching.*
- ⇒ simple engineering*
- ⇒ autotrigger capability*

Potential Problems:

- ⇒ linearity with position*
 - o log amp has inherent non-linearity in the % of aperture range*
 - o hopefully improved using a compensation log amp in parallel*
- ⇒ radiation issues with digital electronics in the tunnel*
 - o Experience gained from testing LHC components*
 - o Attempt to use radiation tolerant components*

CNGS Beam Current Monitoring



CNGS Beam Current Monitoring Requirements

Two Monitors – one at the beginning & one at the end of the line
Absolute Accuracy of 1% for the Intensity Range: 1×10^{12} to 3.5×10^{13}



First BCT sees both LHC & CNGS beams

- Has to fulfill additional requirement of LHC bunch by bunch capability (i.e. 25ns resolution)

New development for LHC - Fast BCT (BFCT)

- 500MHz Bandwidth
→ Not required for CNGS
- Low droop ($\sim 0.1\%/ \mu\text{s}$)
→ 1% effect for CNGS

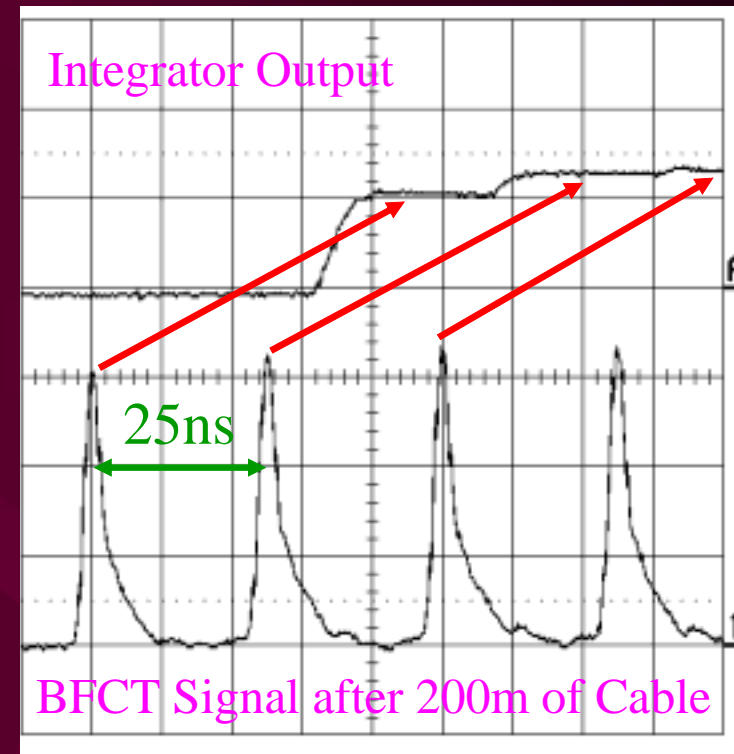
CNGS Beam Current Monitoring



CNGS Beam Current Measurement Acquisition System

Analogue Acquisition based on a fast integrator chip

- Designed by the Laboratoire de Physique Corpusculaire, Clermont-Ferrand for use in the LHCb Preshower Detector. (Large Hadron Collider beauty experiment for precise measurements of CP violation and rare decays)
- Uses interleaved, 20MHz integrators and sample & hold circuitry to give 40MHz data
(only total sum required for CNGS)



CNGS Beam Current Monitoring



CNGS Beam Current Measurement Calibration

Fast BCT fitted with calibration winding.

Switched current source injects 128mA for 5 μ s

- o equivalent to 2×10^{10} charges in 25ns*
- o same signal level as a CNGS train of 8.4×10^{12} protons*

