CNGS Target Area
Beam Position Monitors

OUTLINE

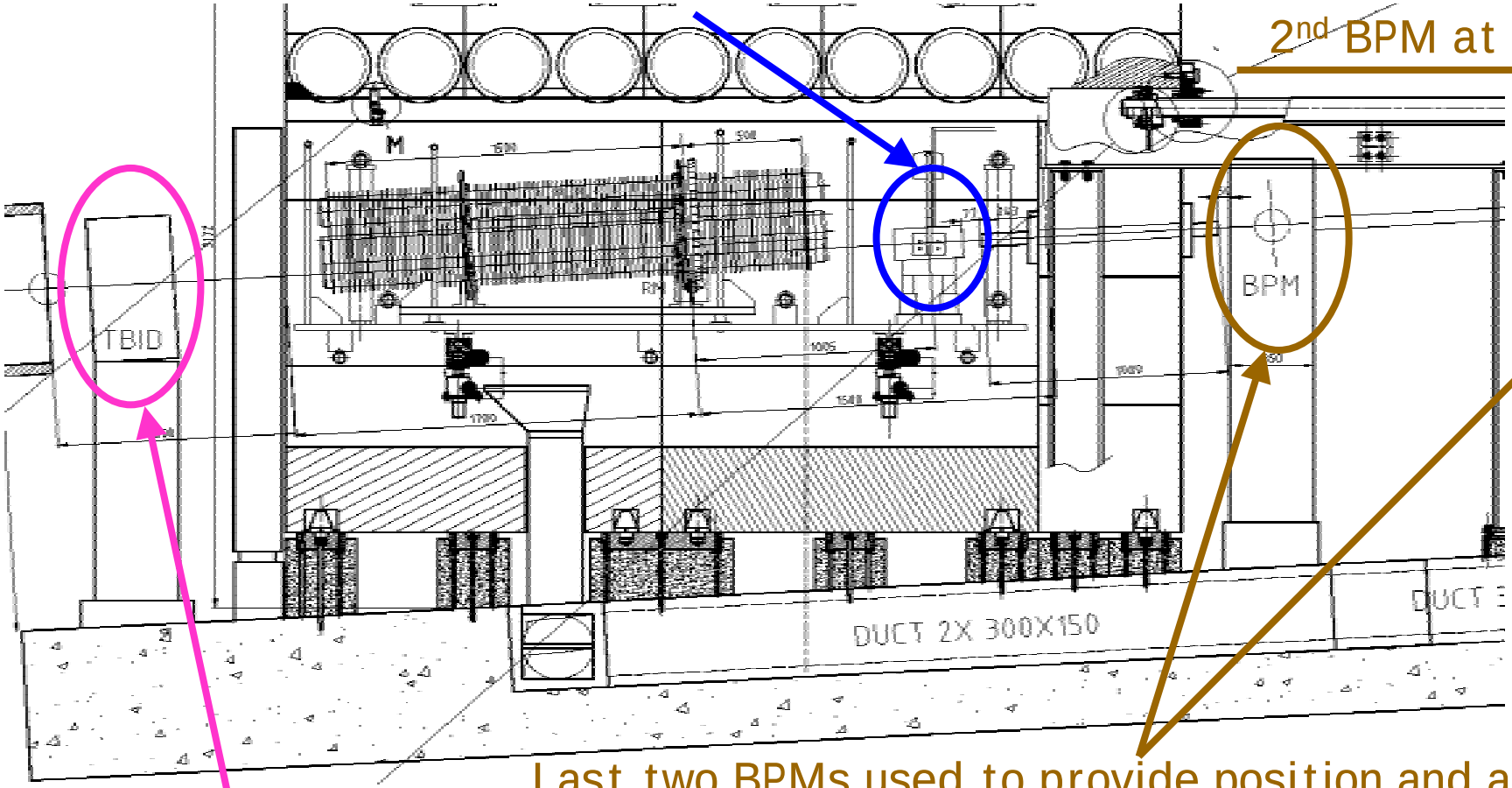
1. **Recap of Requirements & Layout**

2. **Monitor Candidates**
   - *Secondary Emission Monitor*
   - *Pick-up in Air*

3. **Recent Results**
   - *Response of Pick-ups in air to an intense proton beam*

Layout of T40 Beam Diagnostics

Target position monitor fixed to target table & aligned wrt target



T40 Beam Diagnostic Requirements

Measurement of Position and Angle of Proton Beam

- *Last 2 standard BPMs of the proton beam line*
  - ⇒ *used to adjust trajectory angle*
  - ⇒ *3 times less accuracy required for angle than for position at target*
- *Final standard BPM of the proton beam line & target BPM*
  - ⇒ *used to provide position at the target*
  - ⇒ *setting up performed using final beam line BPM*
  - ⇒ *aiming at target rods verified & tracked using target BPM*
  - ⇒ *accuracy of measurement ±0.2mm in ±2mm central region.*
  - ⇒ *accuracy of measurement ±0.5mm outside ±2mm central region.*

error source	*rms uncertainty*	*tolerance*
BPM (global accuracy)	0.1 mm & ≤± 0.15 mm	± 0.2 mm & ≤± 0.3 mm
Alignment	0.10 mm	± 0.2 mm
Total	0.14 mm	≤± 0.35 mm

Choice of Target Station Monitor

	Advantages	Disadvantages
TBIU Upstream secondary emission monitor	✓ Intensity & Position ✓ Measured position depends only on mechanical alignment	✘ Requires vacuum ⇒ Ti or Be windows ⇒ vacuum pump ✘ Carbon foils ⇒ ageing not known ✘ Complicated & heavy
BPKG Position Pick-up	✓ Simple construction ✓ Radiation resistant ? No vacuum (⇒ tests) ? Little effect by 2ndary particles (⇒ tests)	**Chosen as baseline solution** ✘ Position only (+ intensity?) ✘ Centre depends on electric & mechanical offset

Pick-up Choice

Electromagnetic Stripline
Coupler Pick-up

Electrostatic
Button Pick-up

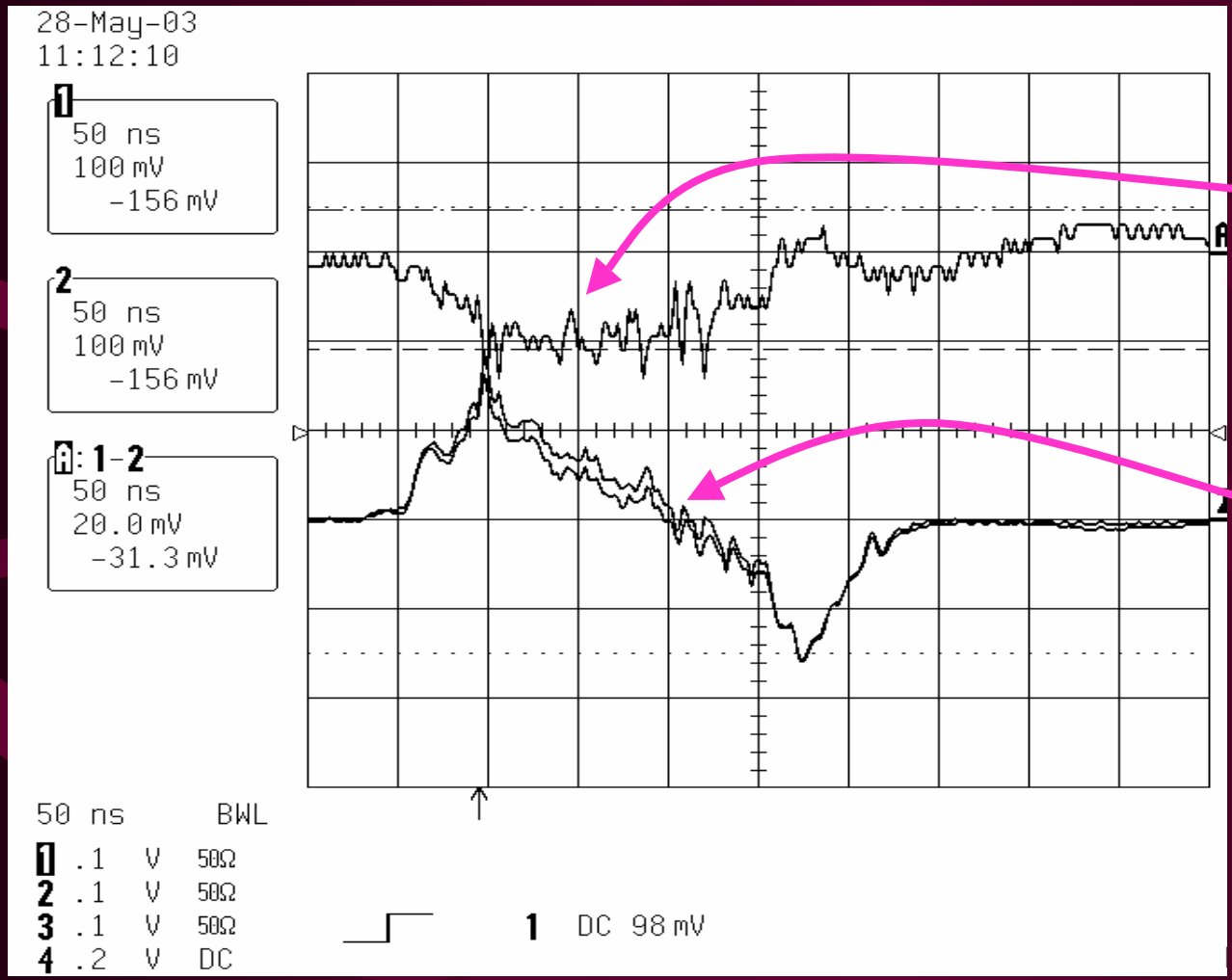
Inductive Pick-up

Tests in the CERN-PS Booster

Test Conditions

- *Coupler & Button Pick-ups installed in air in front of the Booster Dump*
- *Beam Type*
  - *Intensity: ~2.5E13 in 4 bunches of ~6.25E12 per bunch*
  - *Bunch length: ~230ns*
  - *Bunch spacing: 572 ns*
  - *Energy = 1.4 GeV*
- *Measurements*
  - *One plane connected*
  - *Passive Hybrid used to give Sum and Difference signals*
  - *Data acquired on digital oscilloscope*

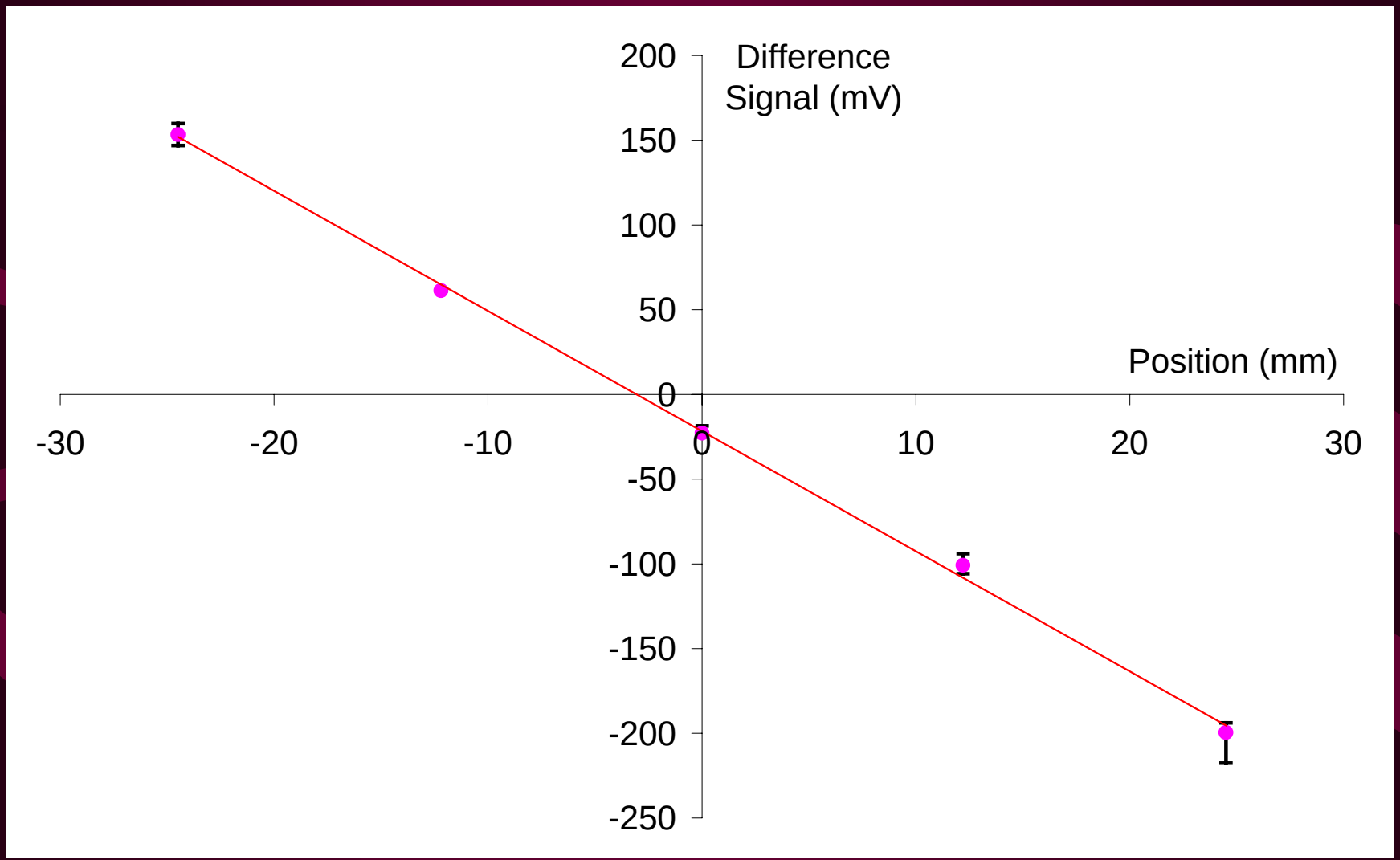
Stripline Coupler Test Results



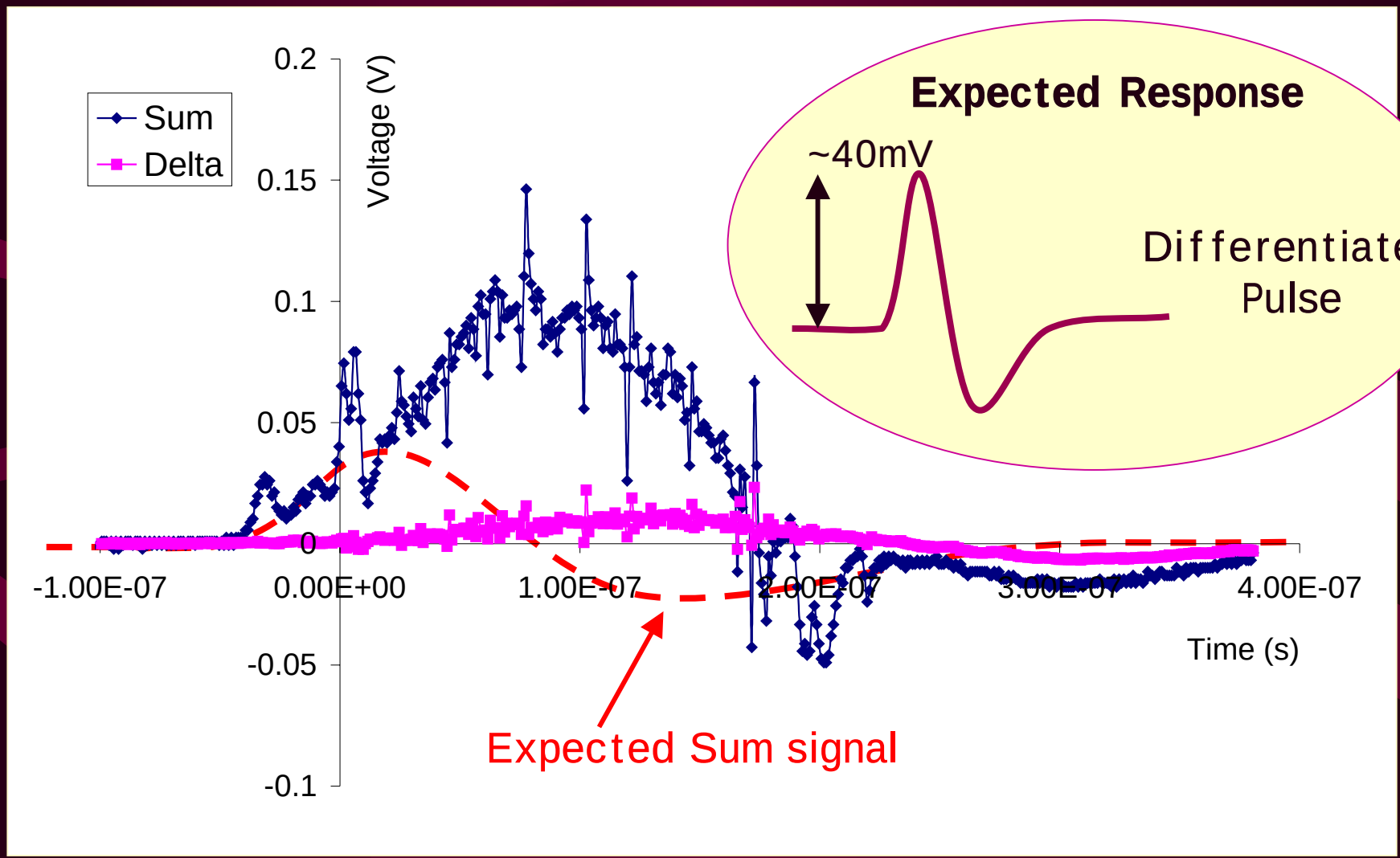
Difference Signal

Raw Signal from each electrode (after 30MHz Low Pass Filter)

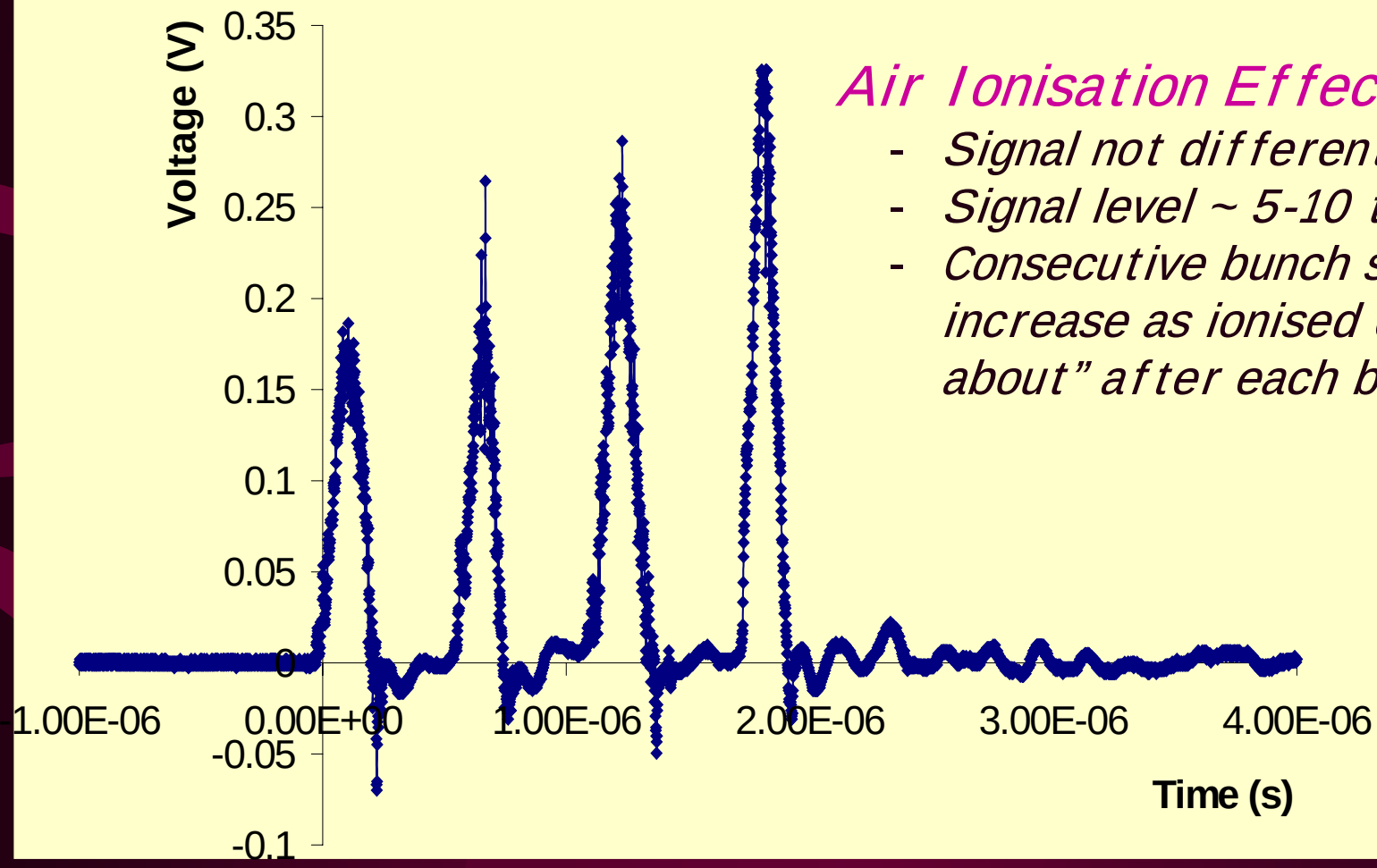
Stripline Coupler Test Results



Button Pick-up Test Results



Button Pick-up Test Results

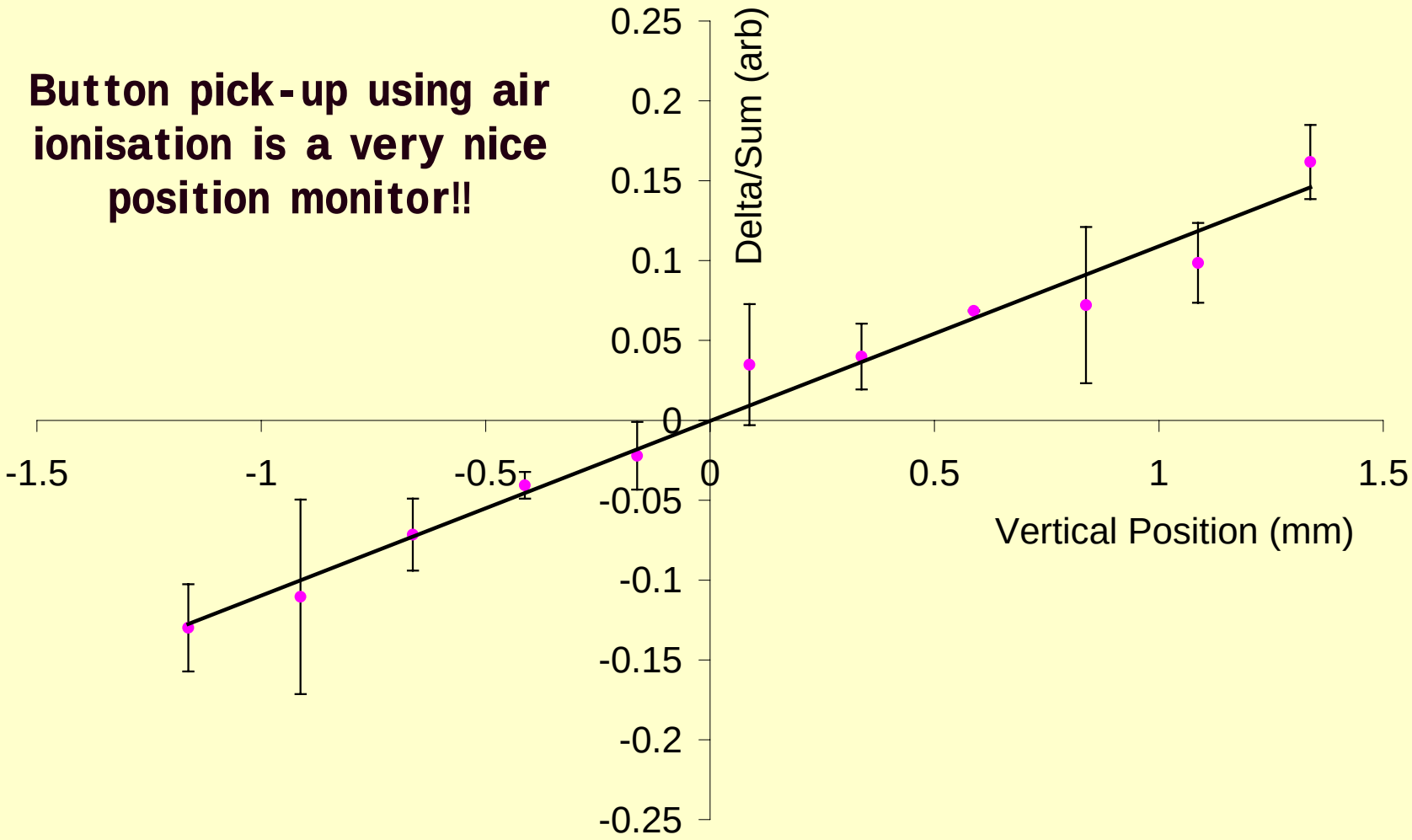


Air Ionisation Effects

- Signal not differentiated
- Signal level ~ 5-10 times higher
- Consecutive bunch signals increase as ionised cloud "hangs about" after each bunch passage

Button Pick-up Test Results

Button pick-up using air ionisation is a very nice position monitor!!



Conclusions

Button Electrode Monitor

⇒ *Sensitive to air ionisation*

- *Mechanism for observed signal response still under investigation*

⇒ *Position measurement possible BUT:*

- *Signal amplitude will depend non-linearly on beam intensity*
- *Signal shape will change depending on the level of ionisation*

Stripline Coupler Monitor

⇒ *Seems less sensitive to air ionisation than button*

⇒ *Position measurement possible BUT:*

- *Noisy Signal observed (seems broadband – so possibly OK)*
- *Tests using 200MHz structure CNGS beam required for final verification*
- *Add solenoid or HV for clearing ionised air cloud (?)*

Inductive Monitor

⇒ *Tests yet to be performed*