



SPS Kicker-Magnet Outgassing with Different Bunch Spacing's

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Acknowledgements:

**V. Baglin, E. Benedetto, F. Caspers, E. Chapochnikova,
K. Cornelis, L. Ducimetière, G. Papotti, G. Rumolo**

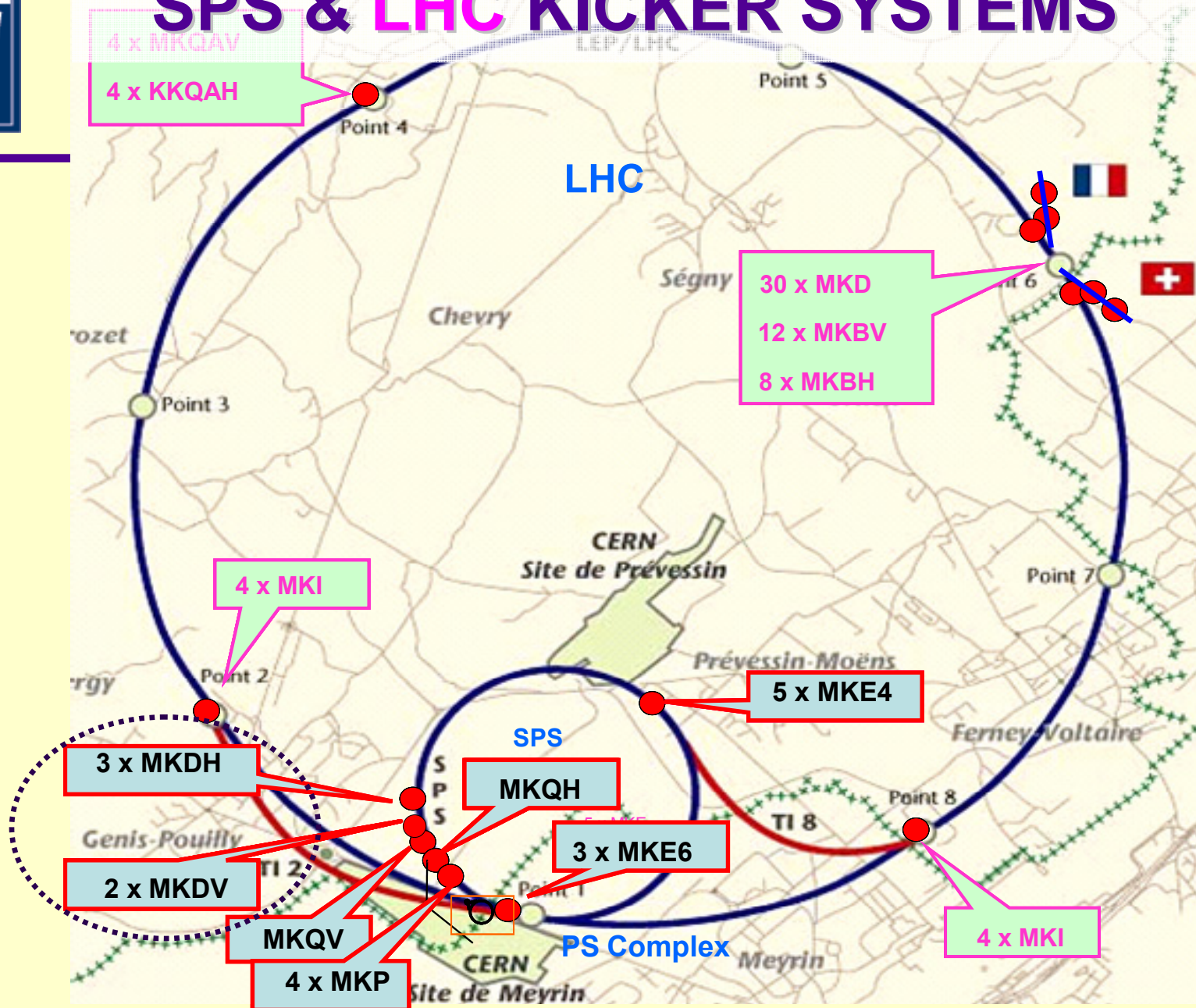


Overview of Presentation

- Brief description of a kicker magnet;
- During MD of August 12th to 14th, 2008 interlocks (trips) due to pressure rise, with 50ns beam, at MKDV1 and ion traps.
 - Summary, for SPS kicker magnets, of temperature and pressure;
 - Significant temperature rise of some kicker magnets noted, at some bunch spacing's; this is thought to be understood and independent of out-gassing;
 - Out-gassing summary for a bunch spacing of 25ns, 50ns or 75ns.
- During MD of October 6th to 8th, 2008 pressure rise-noted at MKDV1, but no trips (however, interlocks due to ion traps).
 - Summary of out-gassing for SPS kicker magnet, from MD, of high resolution vacuum measurements.
- Overall summary.



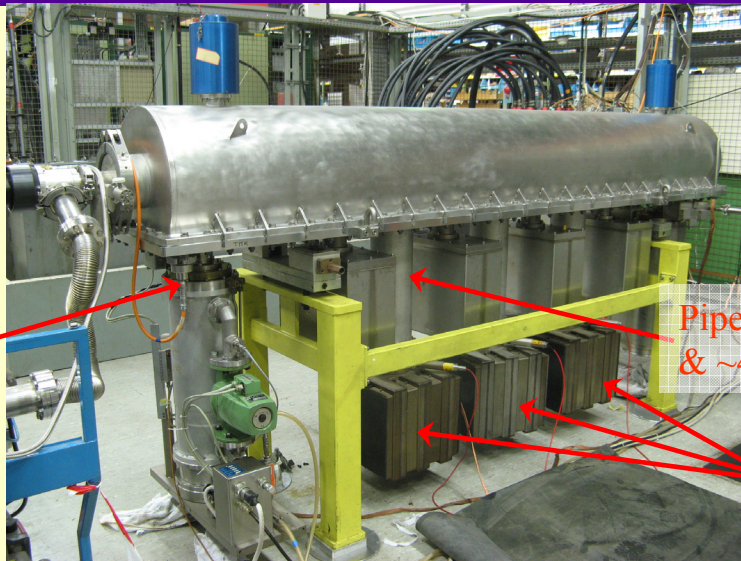
SPS & LHC KICKER SYSTEMS





Simplified view of a transmission line kicker magnet

MKDV1:



Pressure Gauge

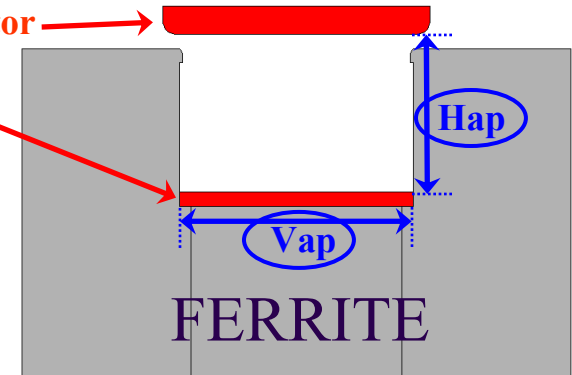
Pipe: ~16cm ID & ~49cm long

Pumps

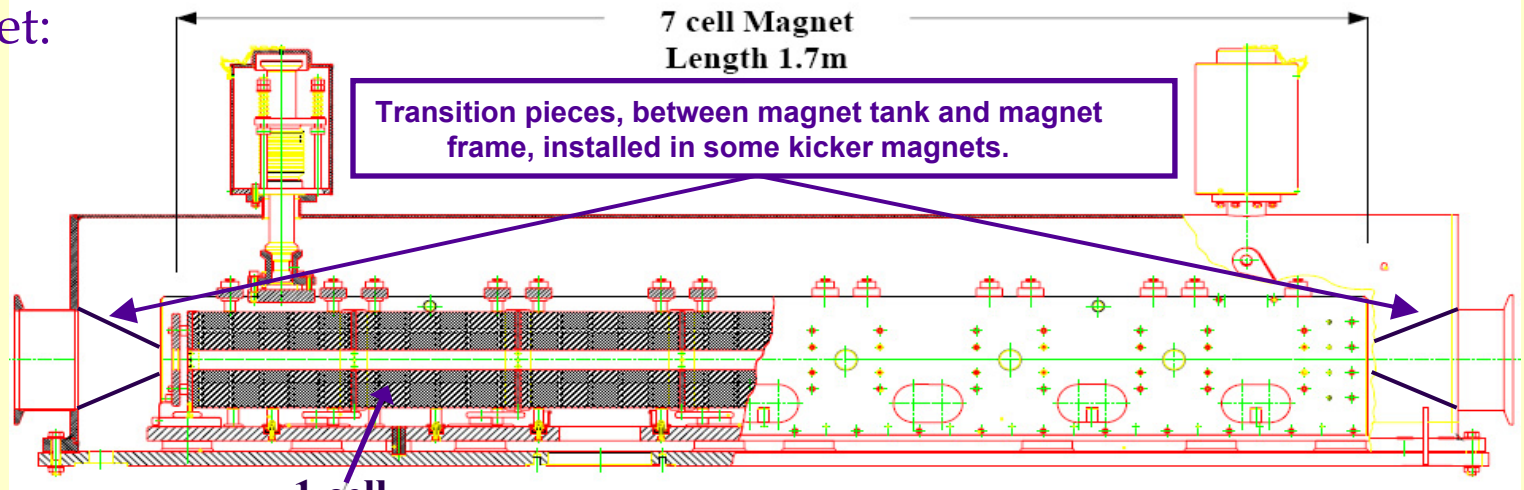
Cross-Section of MKDV1 (Vertical) Aperture

Return Conductor

Go Conductor



MKE magnet:





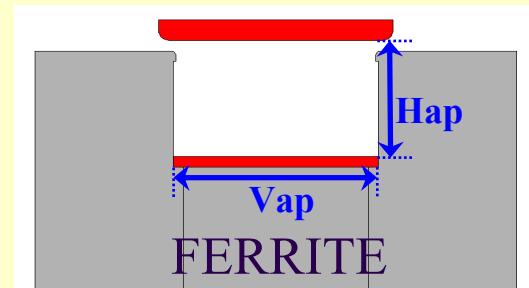
SUMMARY OF SPS KICKER APERTURES & MATERIALS

SPS KICKER	COMMENTS	Hap (mm)	Vap (mm)	MAGNETIC MATERIAL	Max. Pressure [MD Aug 2008] (1s resolution)
MKP-S MKP-L	Beryllium for return cond.	101 141	61 54	8C11 Ferrite 8C11 Ferrite	} Not significantly: ~2e-8mbar
MKQH	Inserts with Silver paint	135	33.9	8C11 Ferrite	
MKQV		56	102	8C11 Ferrite	50ns beam: ~2e-7mbar
MKDV1 ^A MKDV2		56 56	75 83	8C11 Ferrite 8C11 Ferrite	50ns beam: ~1e-6mbar 50ns beam: ~7e-7mbar
MKDH1/2 MKDH3	Glass fibre	96 105	56 60	Laminated Si Steel Laminated Si Steel	50ns beam: ~1e-7mbar 50ns beam: ~5e-8mbar
MKE-S MKE-L	Silver/Glass stripes for L10	135 147.7	32 35	8C11 Ferrite 8C11 Ferrite ^B	} MKE6 (50ns): ~4e-7mbar } MKE4 No: : ~3e-8mbar

Aluminium (Anticorodal 110) generally used for conductors.

^A Remnant field estimated to be <1 G for 8C11 and ~5G for 4E2;

^B Except “L9” @ MKE6 ⇒ 4E2 ferrite (higher degassing rate than 8C11)

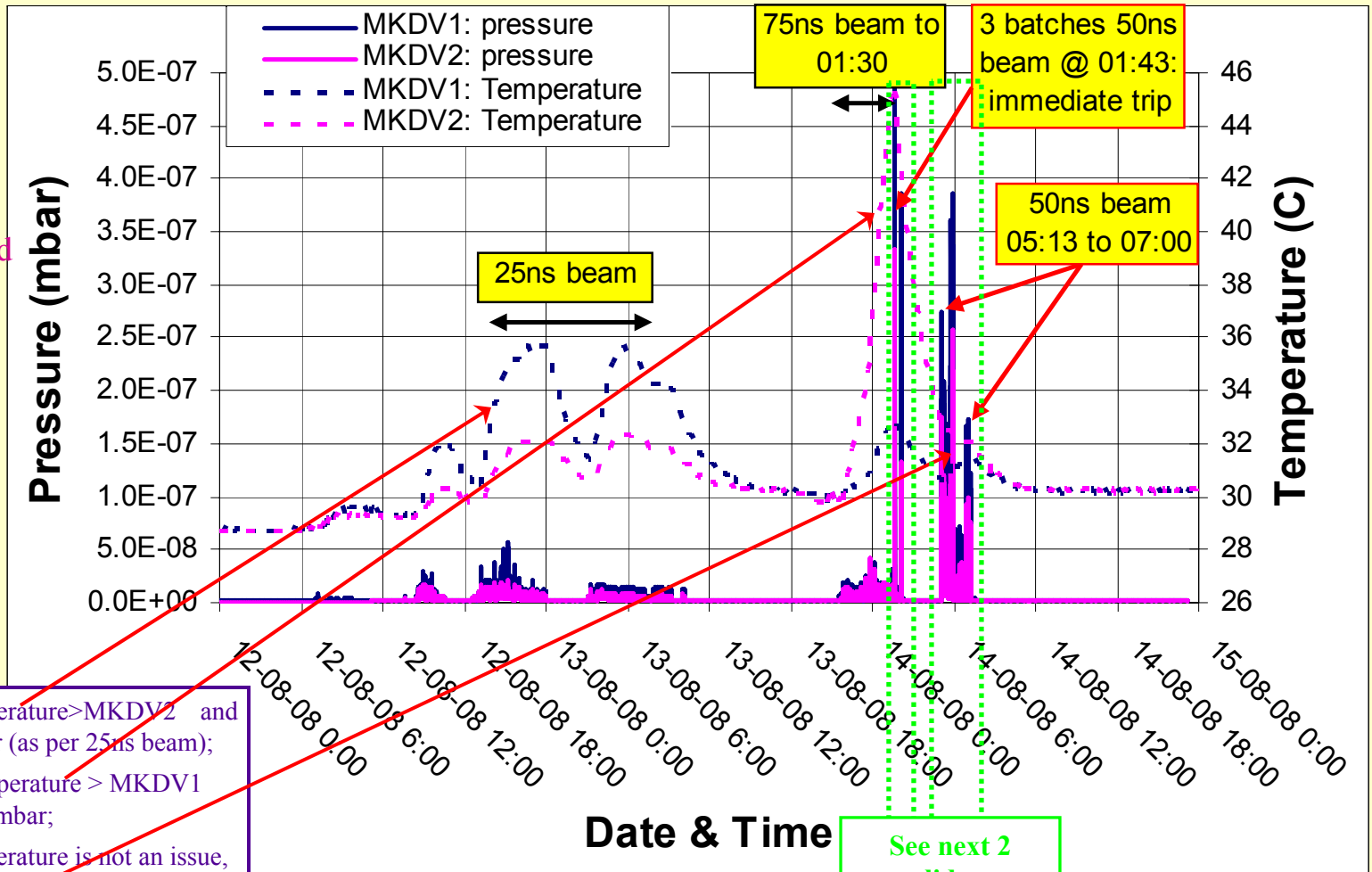




MKDV Temperature & Pressure on 12, 13 & 14th August 2008

8s resolution:

Note: Ecloud monitors show maximum Ecloud with 25ns bunch spacing.

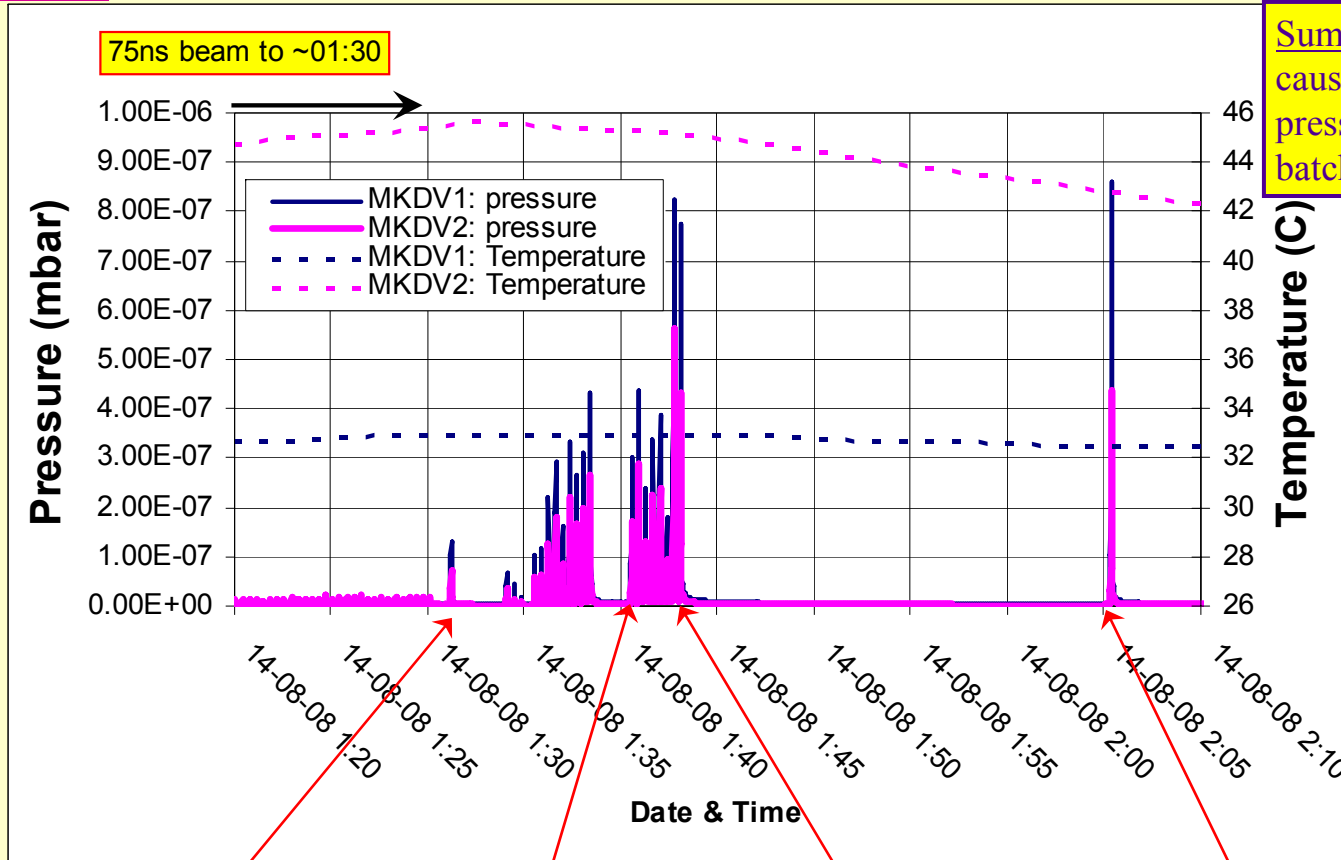


Normally: MKDV1 temperature > MKDV2 and pressure < 6e-8 mbar (as per 25ns beam);
 For 75ns beam MKDV2 temperature > MKDV1 and pressure < 6e-8 mbar;
 For 50ns beam MKDV temperature is not an issue, but pressure is an issue!
 8s resolution for pressure.



MKDV Pressure on 14/08/2008, between 01:20hrs & 02:10hrs.

1s resolution



Summary: 50ns beam causes pressure rise; high pressure with 3 or 4 batches per shot.

Information from: Giulia Papotti:

Started 1 batch 50ns beam at 1:32hrs, continuously.

One shot of 2 batches of 50ns beam at 1:42hrs.

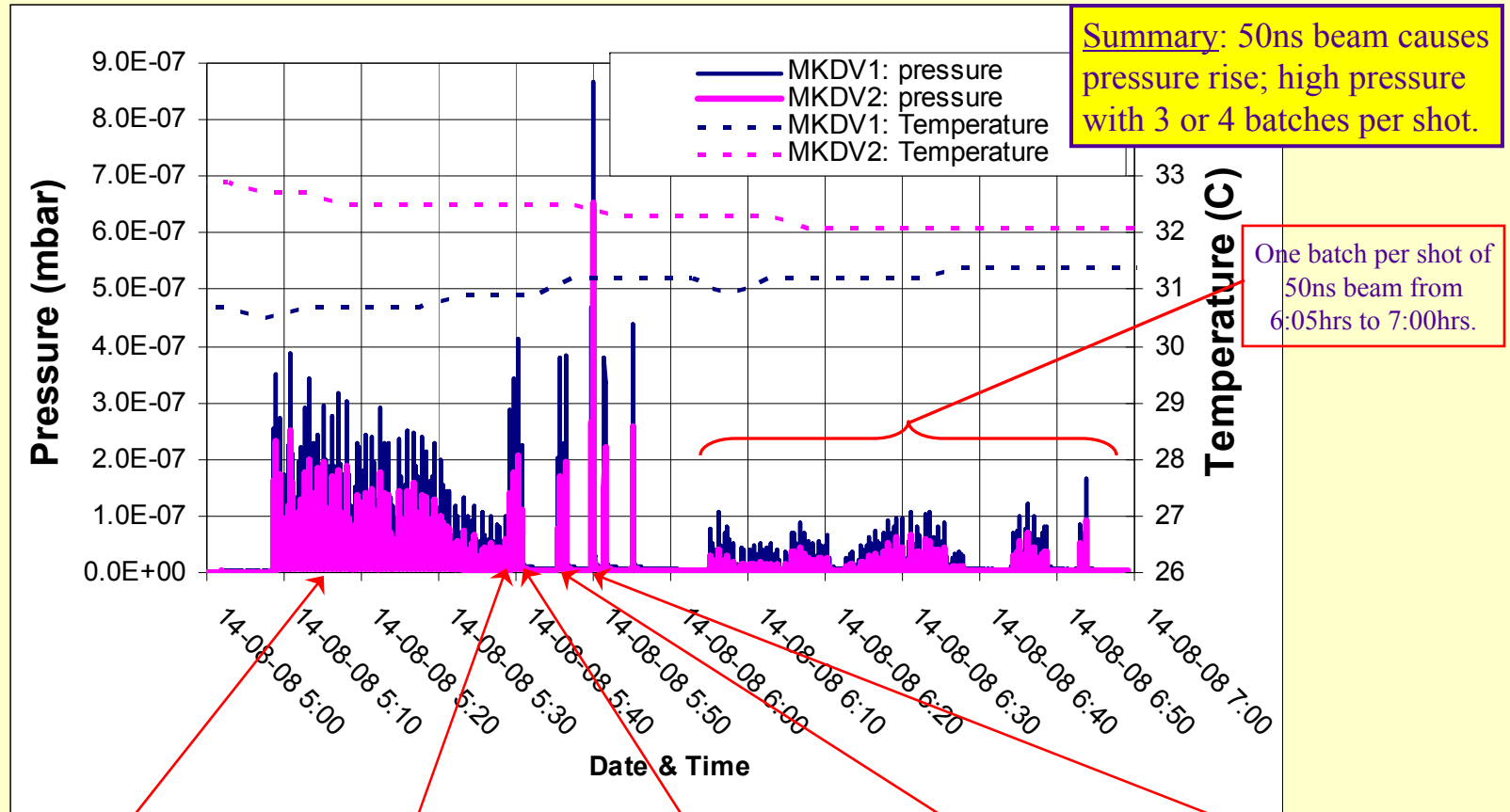
One shot of 3 batches of 50ns beam at 1:43hrs: interlock.

Single shot of 4 batches of 50ns beam at 2:05hrs: interlock.



MKDV Pressure on 14/08/2008, between 05:00hrs & 07:00hrs.

1s resolution



Information from: Giulia Papotti:

Started 1 batch 50ns beam at 5:13hrs.

One shot of 3 batches of 50ns beam at 5:39hrs.

Four shots of 4 batches of 50ns beam at 5:41hrs: interlock.

Four shots of 4 batches of 50ns beam at 5:45hrs.

Two shots of 4 batches of 50ns beam at 5:49hrs.

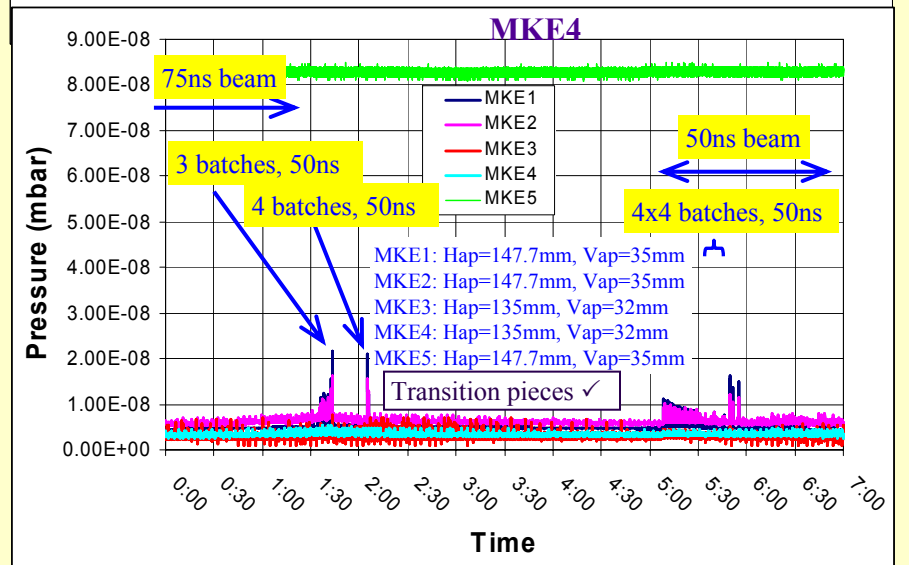
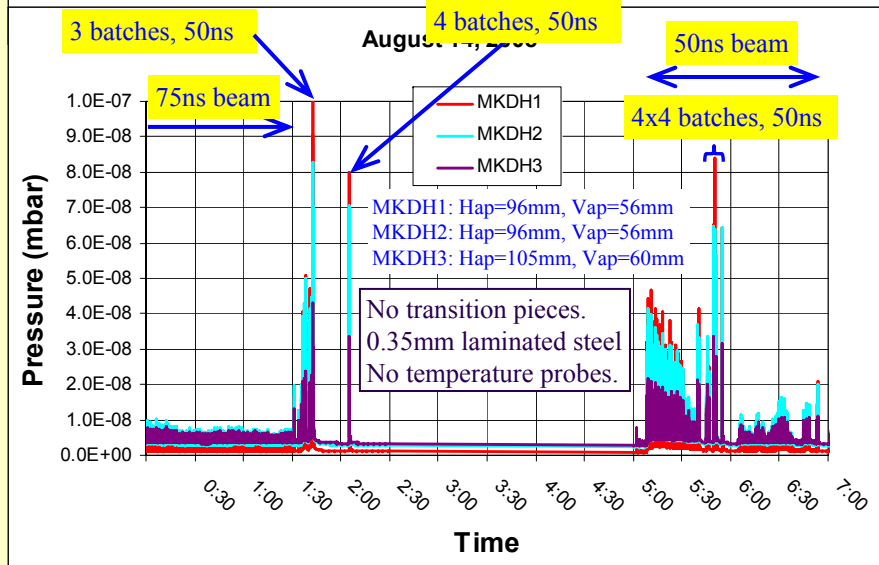
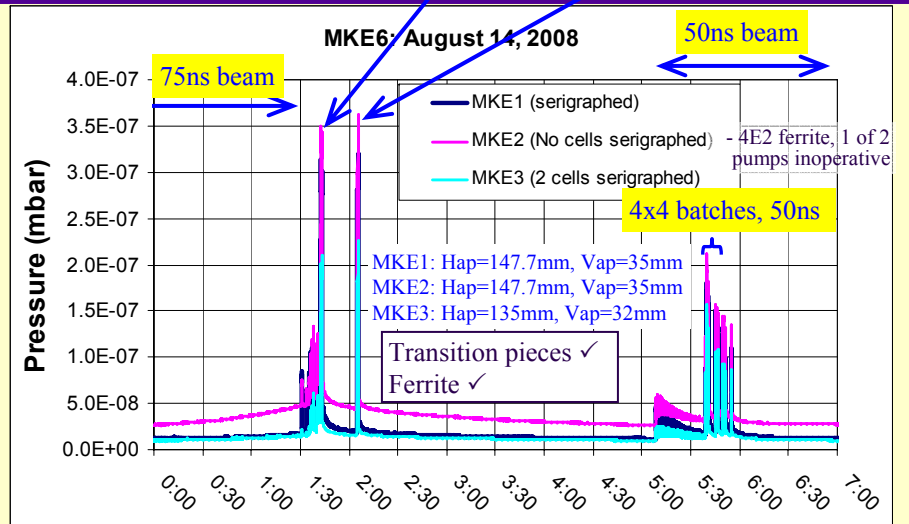
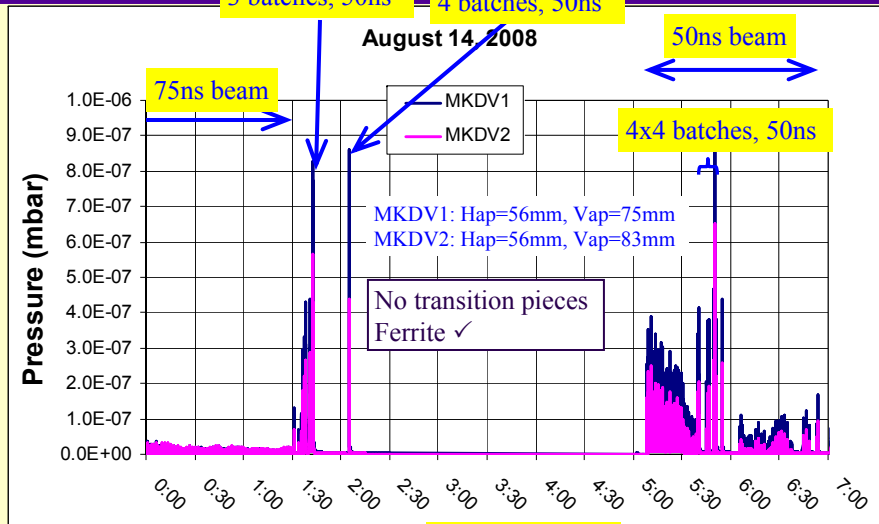


SPS Kickers: Vacuum, August 14, 2008

1s resolution

3 batches, 50ns

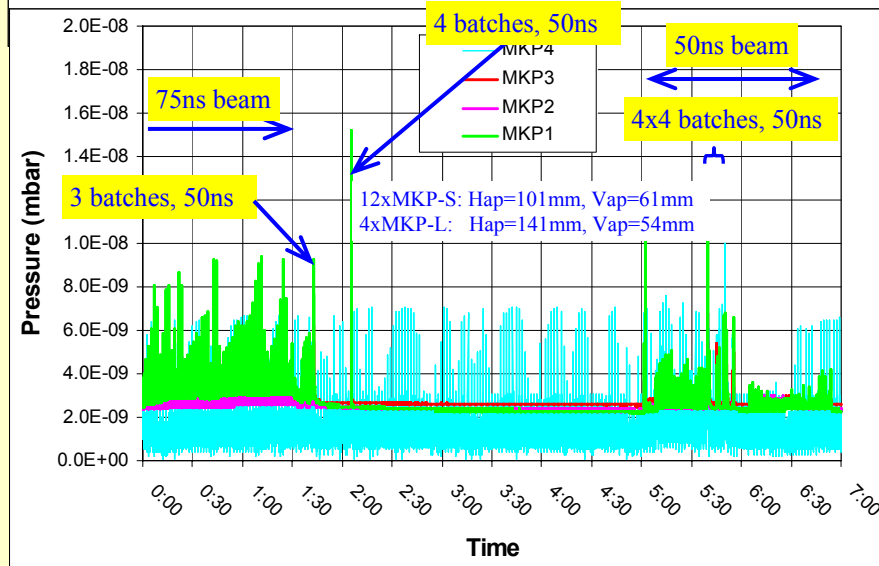
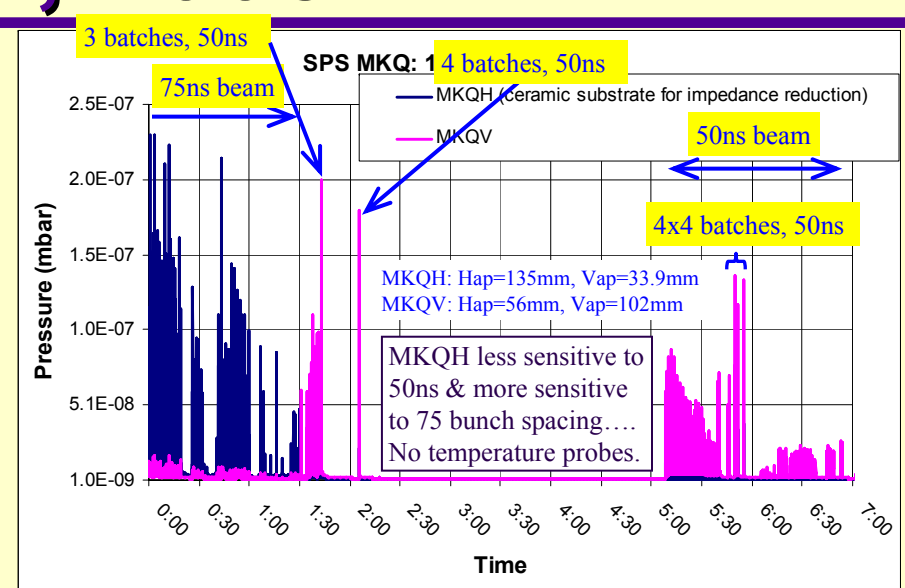
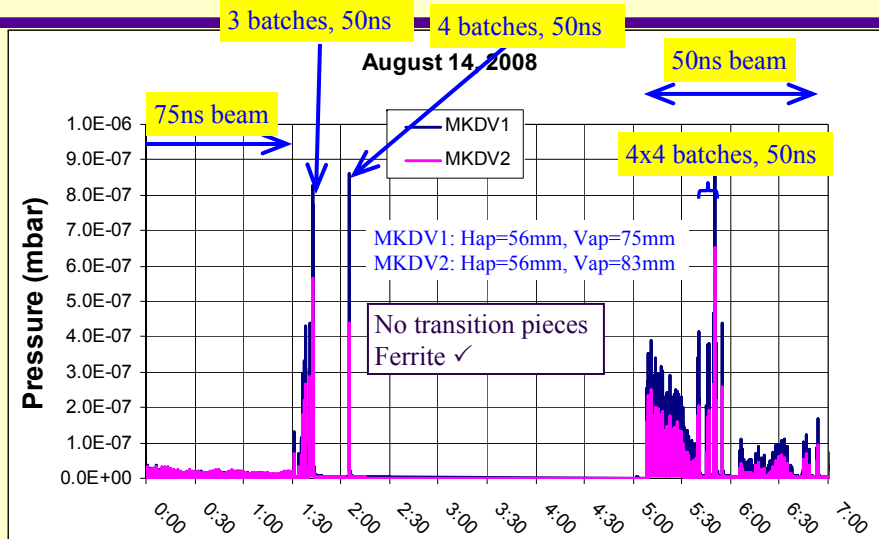
4 batches, 50ns





SPS Kickers: Vacuum, August 14, 2008

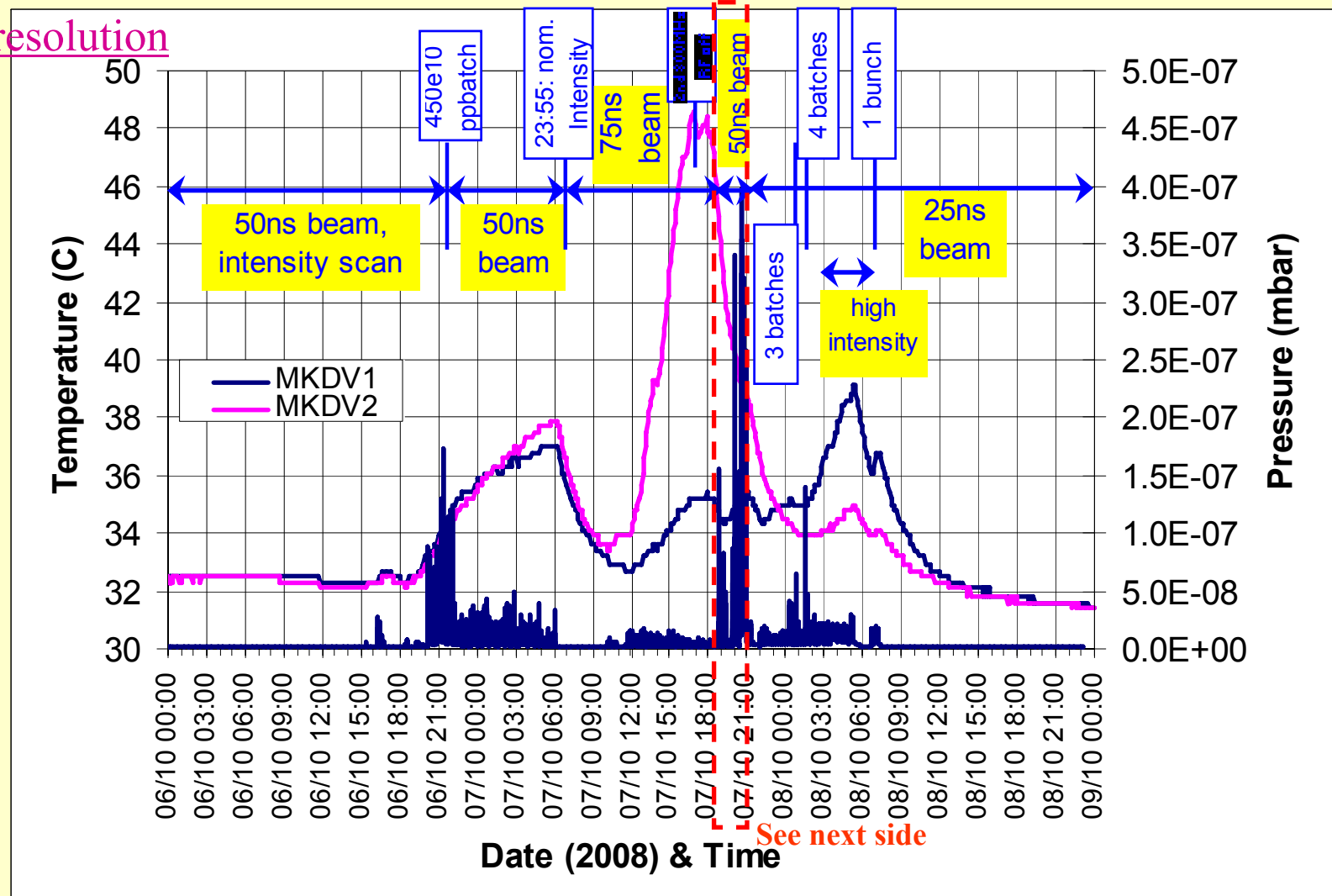
1s resolution





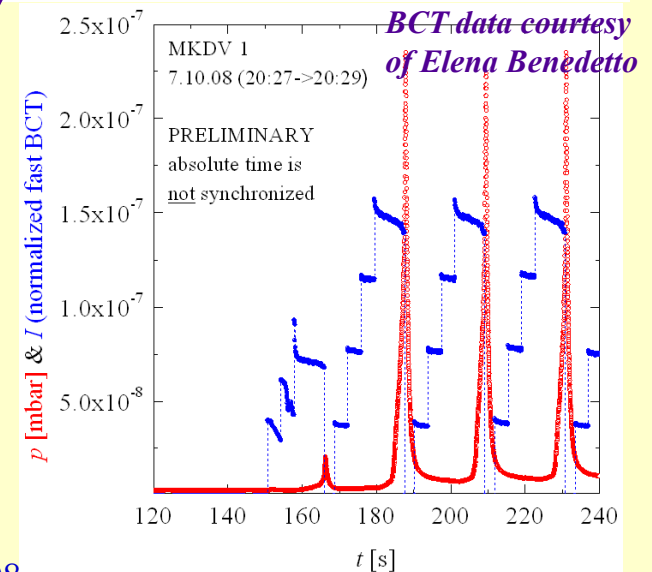
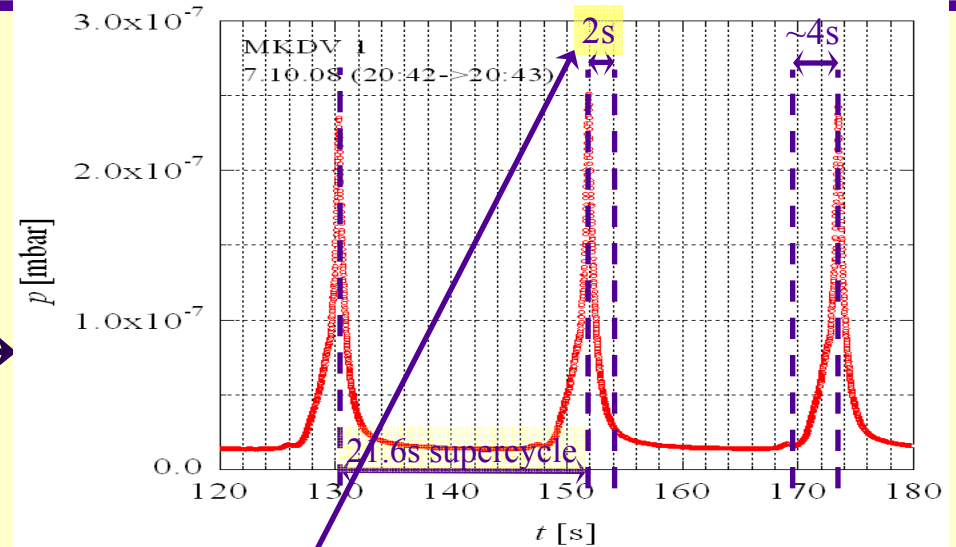
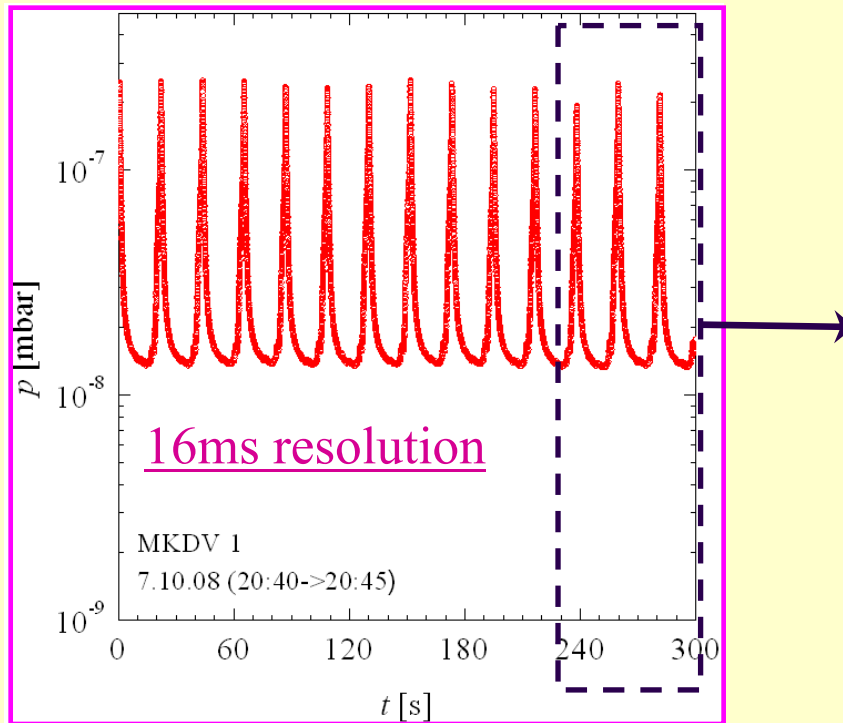
MKDV1 Kicker: Vacuum, October 6th to 8th, 2008

8s resolution





MKDV1 Kicker: Vacuum, October 7th, 2008: 50ns beam



- Volume of MKDV1 tank is $\sim 0.3\text{m}^3$;
- 3 ion pumps for each magnet, rated at 350 l/s each (1050 l/s total);
- \Rightarrow ideal τ for decay of pressure of 0.3s;
- 3τ is \sim consistent with measurement (16cm ID, 49cm long pipes connecting to pump...).

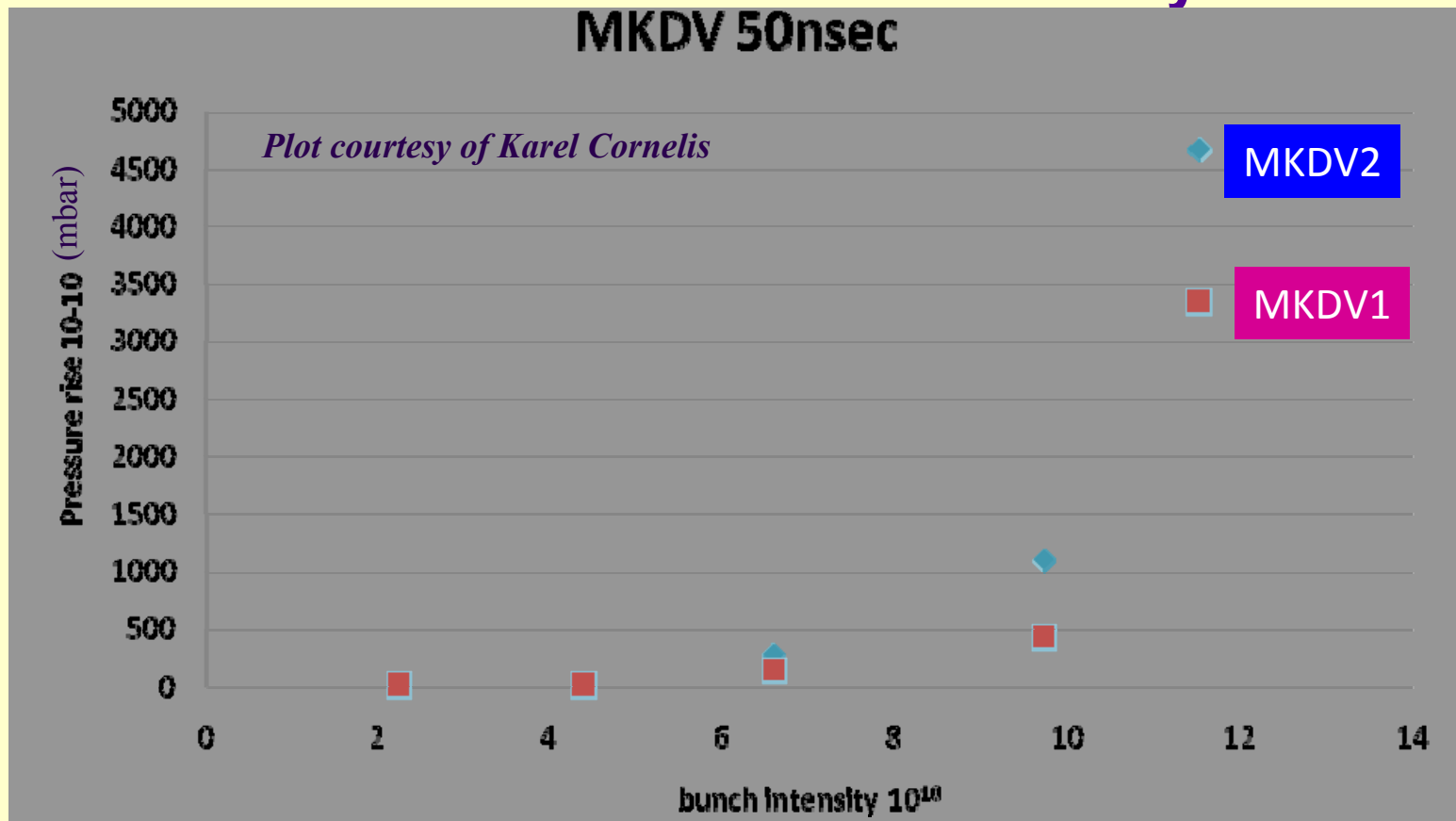
Mike Barnes, AB/BT

ECLLOUD Workshop: Nov. 20-21, 2008



MKDV Pressure Peak versus Bunch Intensity (4 batches)

- ◆ 50ns bunch spacing;
- ◆ The instantaneous pressure rises in MKDV kickers shows a clear threshold effect with intensity.





Summary

- ◆ 50ns bunch spacing causes immediate pressure rise (surface effect-e.g. electron cloud) for both MKDV1 & MKDV2 – but MKDV1 is more significant;
- ◆ Pressure rise shows an intensity threshold ($>6 \times 10^{10}$ protons/bunch);
- ◆ Measured pressure rise appears to be real as pressure fall is reasonably consistent with installed pumping rate;
- ◆ Pressure rise is dependent upon:
 - ◆ Beam intensity;
 - ◆ Number of batches;
 - ◆ Bunch length (K. Cornelis presentation to SPSU 18/11/2008);
- ◆ MKE6, MKDH, MKDH & MKQV kickers all show immediate pressure rise with 50ns bunch spacing But MKQH sensitive to 75ns bunch spacing;
- But Ecloud monitors show maximum Ecloud with 25ns bunch spacing...



Questions & Comments



MKE: Beam Coupling Impedance Reduction

- ◆ Beam coupling impedance is reduced using conductive stripes (serigraphy), i.e. interleaved comb structure, directly printed onto the ferrite blocks and a reliable contact to the metallic HV plates at either side;
- ◆ Capacitive coupling between stripes (stripes carry beam image current).

