



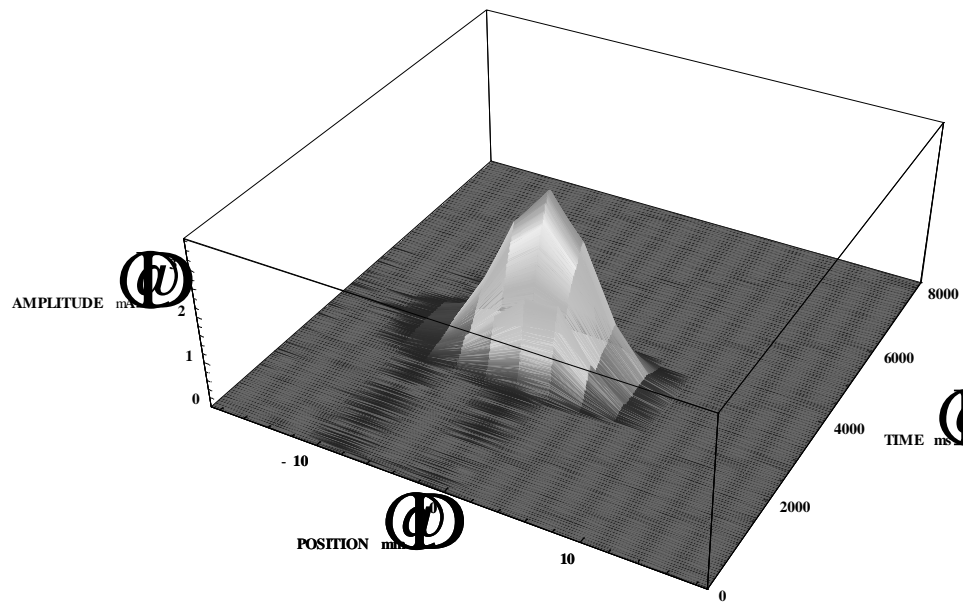
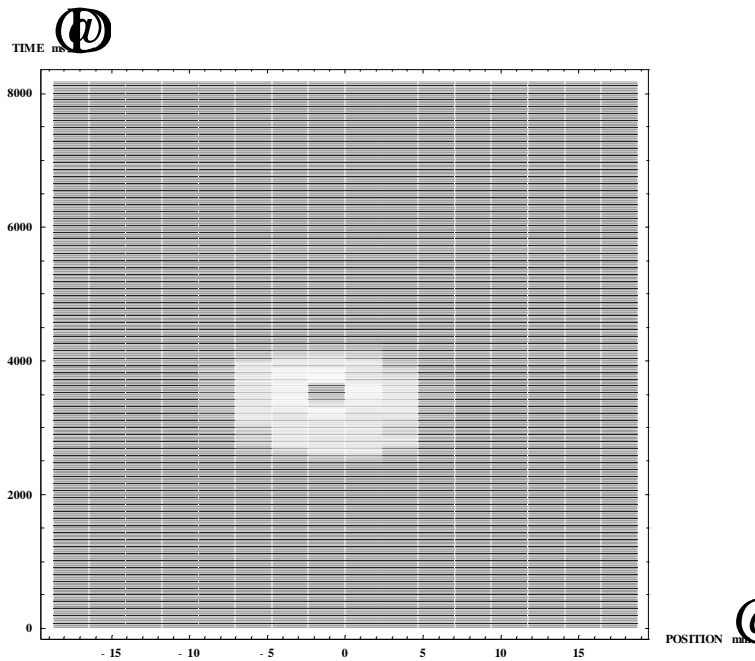
Electron cloud measurements

G. Arduini SL/OP

Measurements performed in collaboration with B. Henrist, J.M. Jimenez, K. Weiss (LHC/VAC), F. Zimmermann (SL/AP), G. Ferioli (SL/BI), W. Hofle (SL/HRF), P. Collier (SL/OP) and others...

FT beam

- 2.9×10^{13} p @ 400 GeV ($\sim 7 \times 10^9$ p/bunch)
- 4200 bunches (almost uniformly distributed in the SPS) - 5 ns spacing

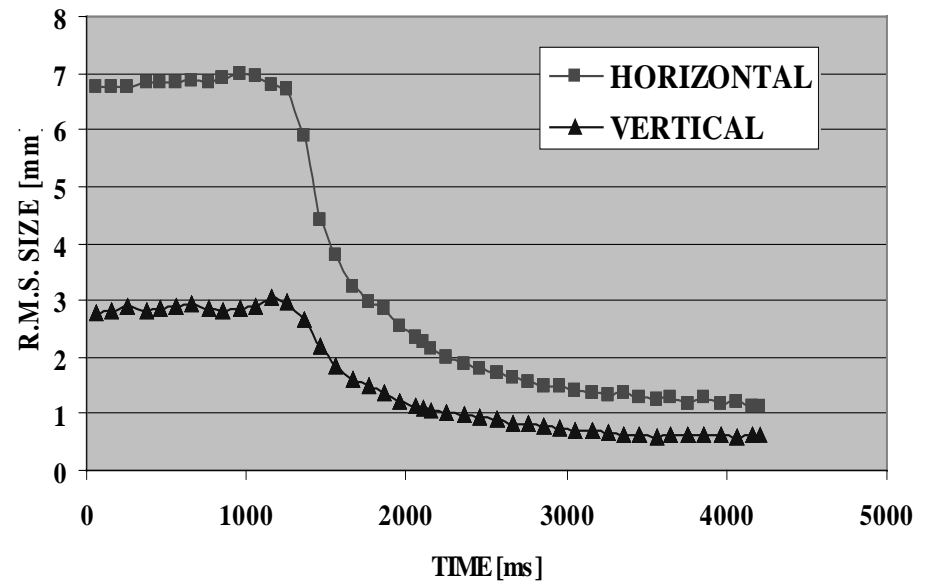
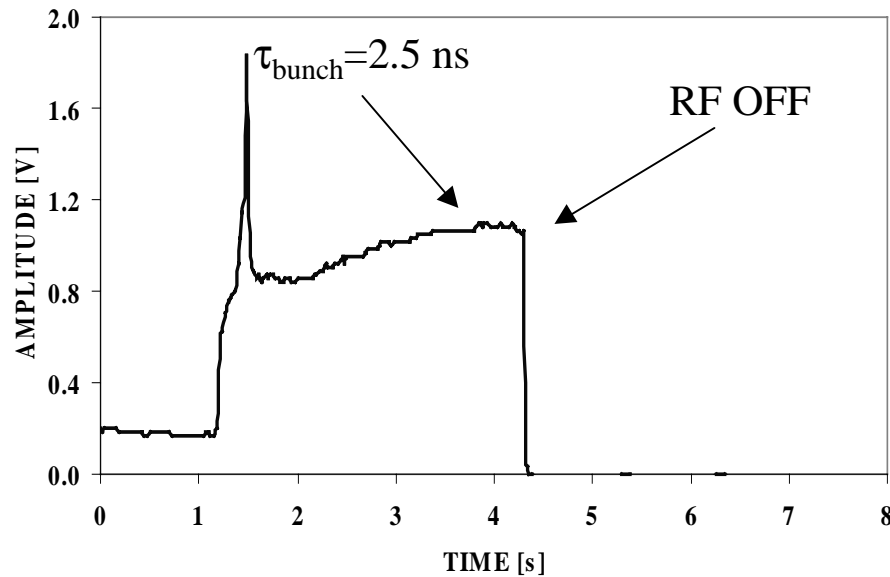


09/10/2001

G. Arduini – Electron cloud
measurements

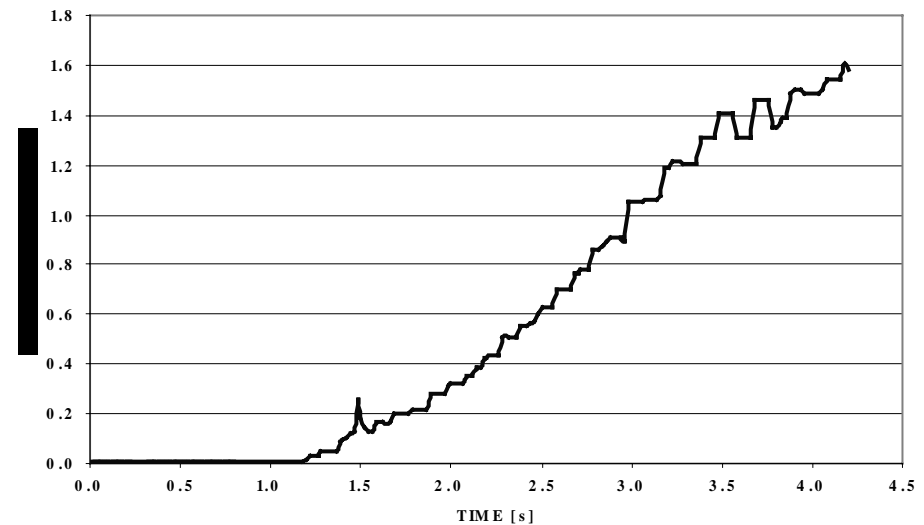
Why during the ramp?

- AEW peak detected signal ($\propto 1/\tau_{\text{bunch}}$)
- Beam size

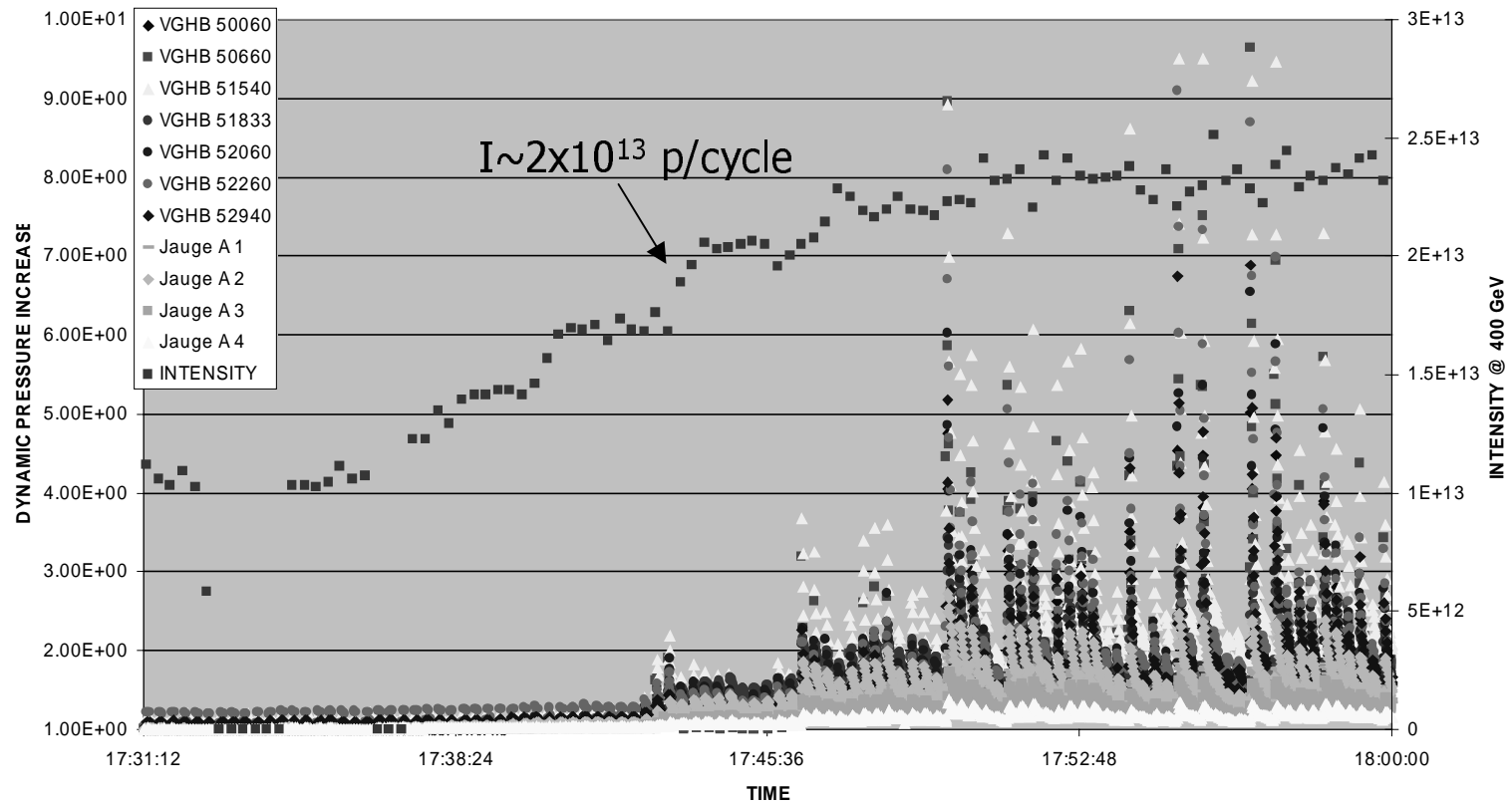


Why during the ramp?

- Electron cloud signal inversely proportional to 'bunch charge density' $\propto (\tau_{\text{bunch}} \sigma_H \sigma_V)^{-1}$



Threshold for FT beam (08/08/2001) - arcs



09/10/2001

G. Arduini – Electron cloud
measurements

Thresholds (in the arcs)

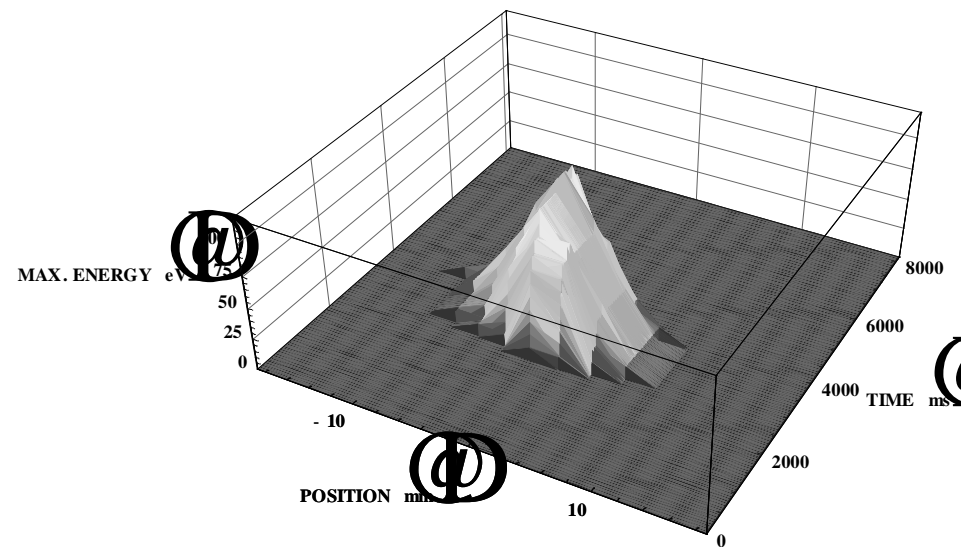
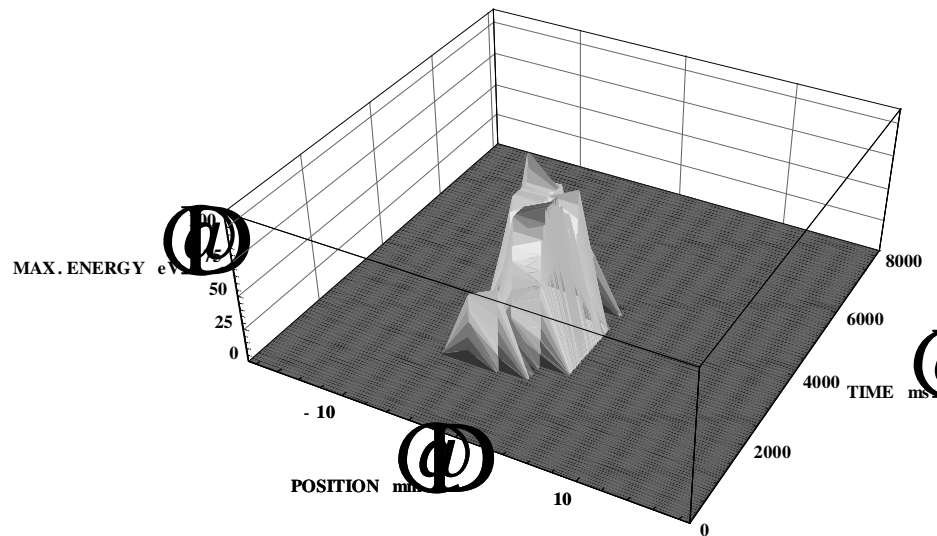
Date	Effective time above threshold [h]	Threshold [10 ¹⁰ p/bunch]
17/07	~ 0	~2
25/07	~ 7	~2
28/08	~ 16 h (LHC) + 48 h (FT)	~3

- FT beam: ~ 5 x 10⁹ p/bunch (16/08)
- LHC-50 ns: ~ 6 x 10¹⁰ p/bunch (10/09)

Energy spectrum (FT)

■ 0.244 T

■ 0.009 T



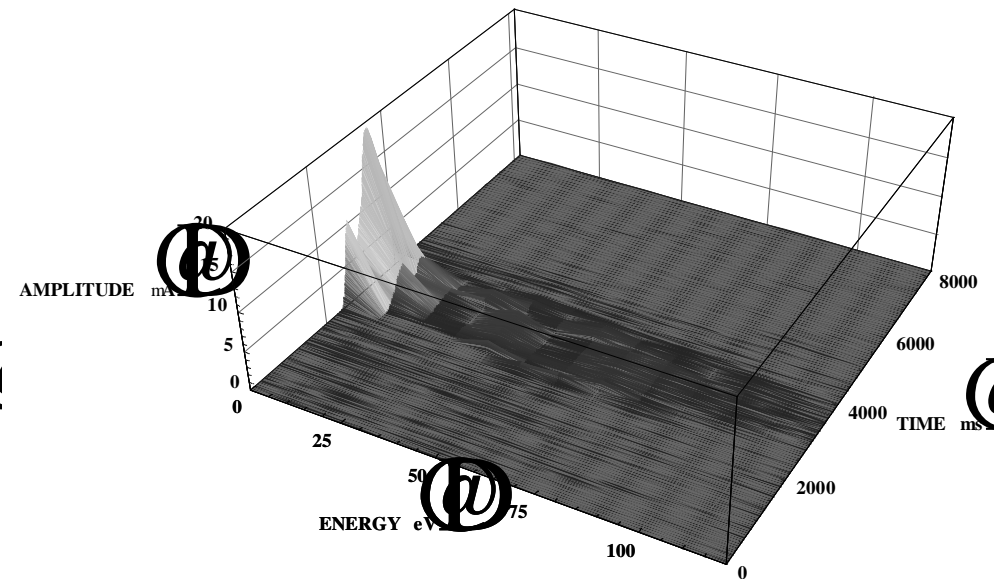
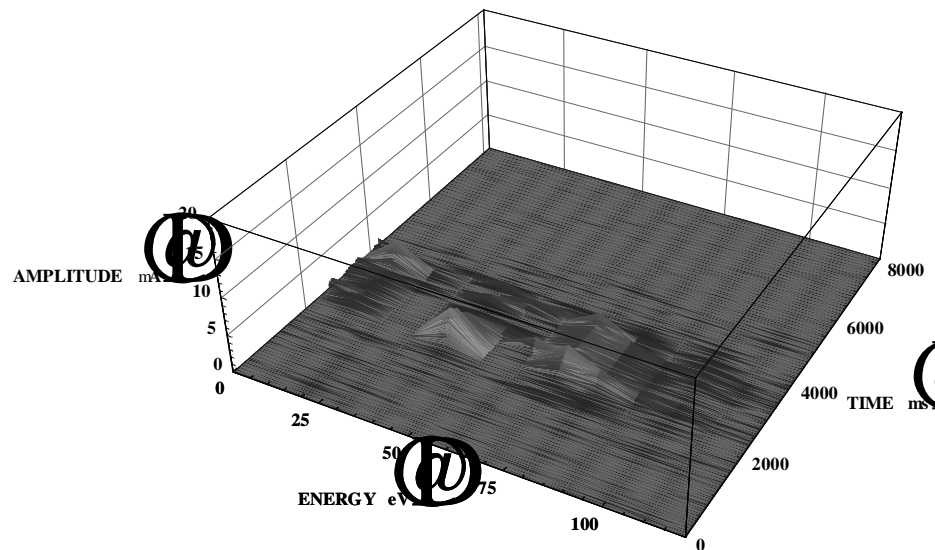
09/10/2001

G. Arduini – Electron cloud
measurements

Energy spectrum (FT)

■ 0.244 T

■ 0.009 T



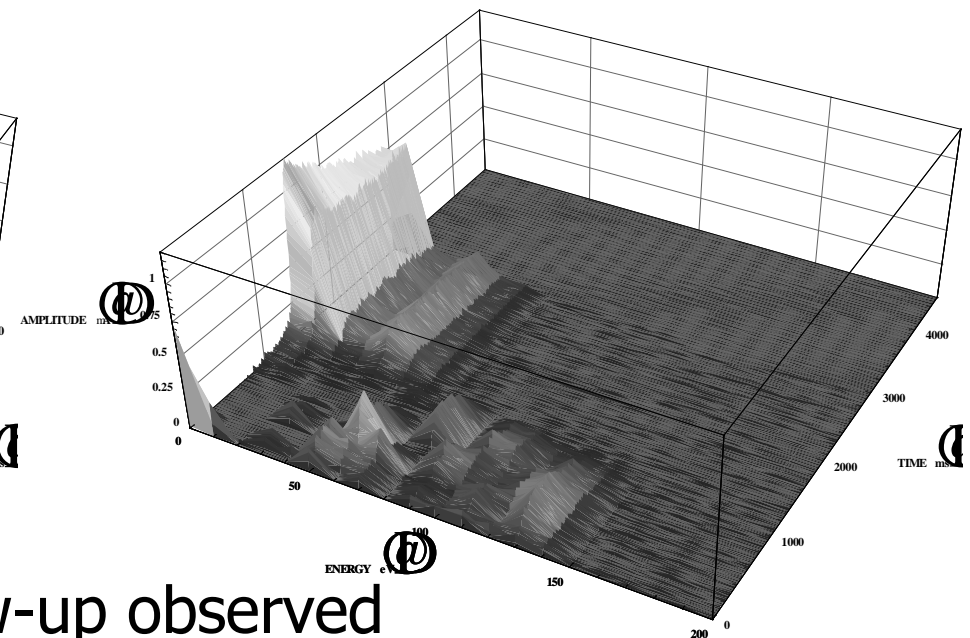
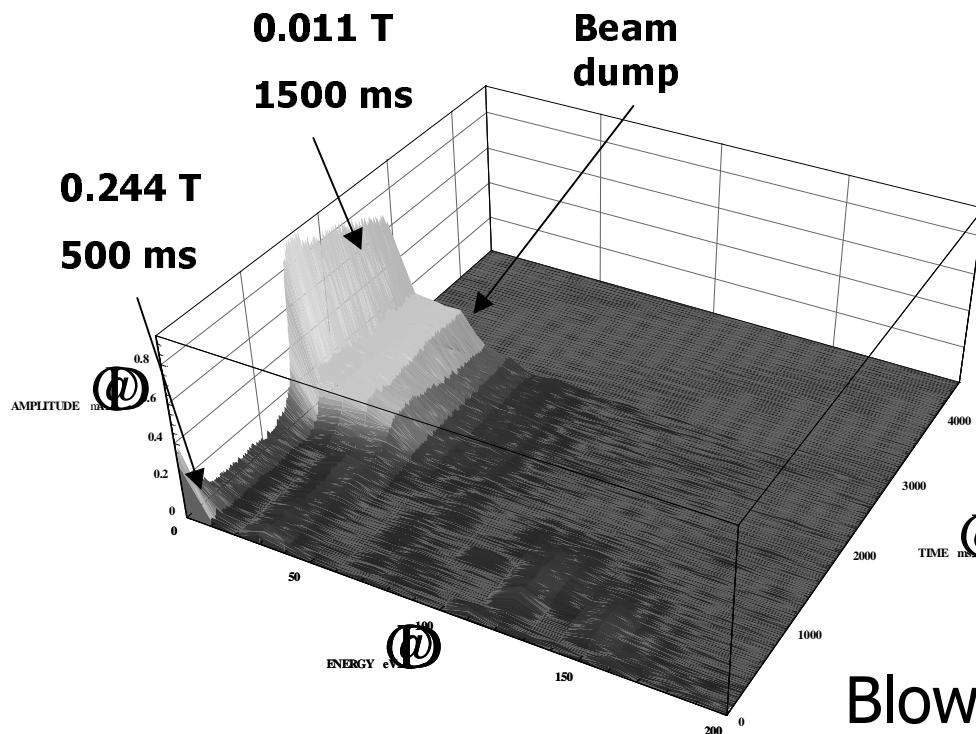
09/10/2001

G. Arduini – Electron cloud
measurements

Energy spectrum (LHC)–28/08

■ 3×10^{10} p/bunch

■ 5×10^{10} p/bunch



Blow-up observed

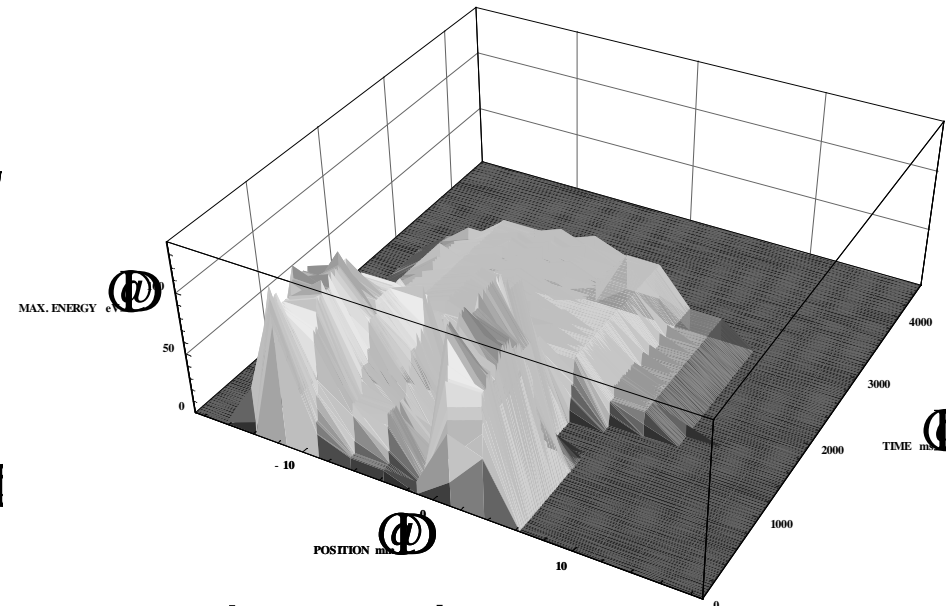
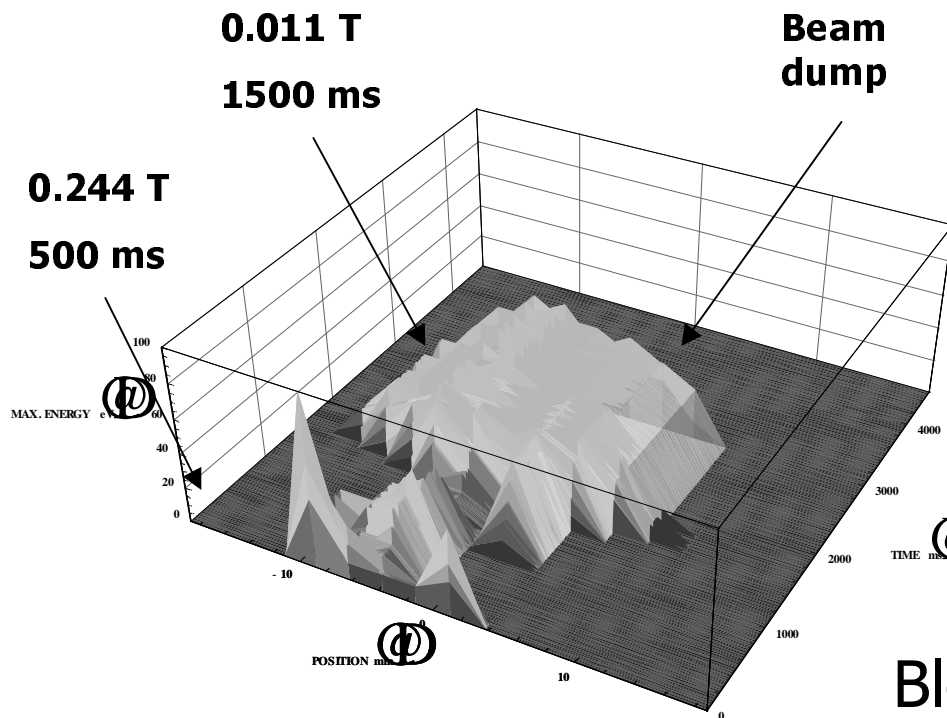
G. Arduini – Electron cloud
measurements

09/10/2001

Energy spectrum (LHC)-28/08

■ 3×10^{10} p/bunch

■ 5×10^{10} p/bunch



Blow-up observed

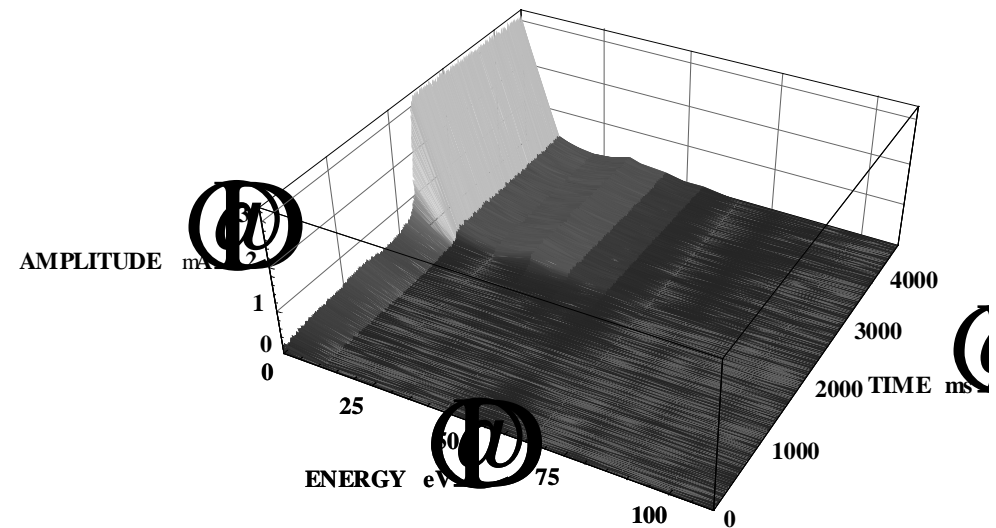
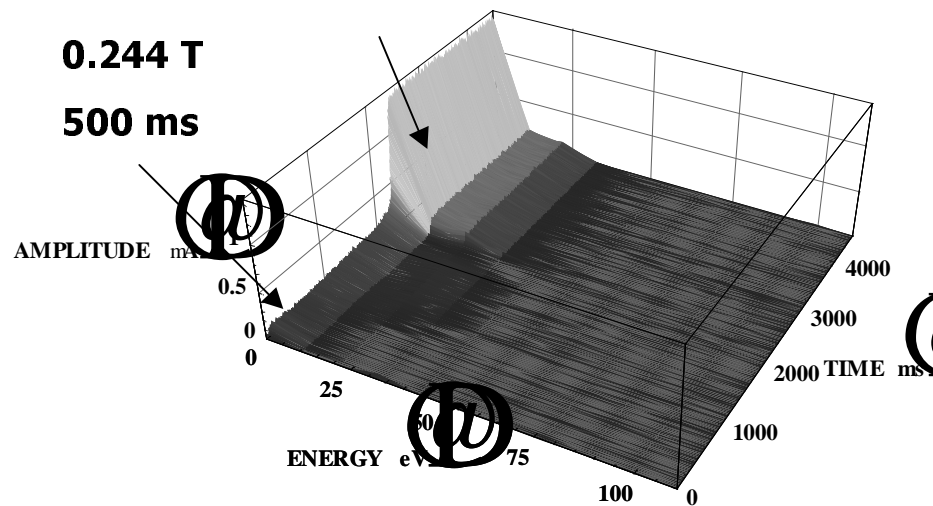
Energy spectrum (LHC)-03/09

■ 3×10^{10} p/bunch

■ 5×10^{10} p/bunch

0.011 T
2250 ms

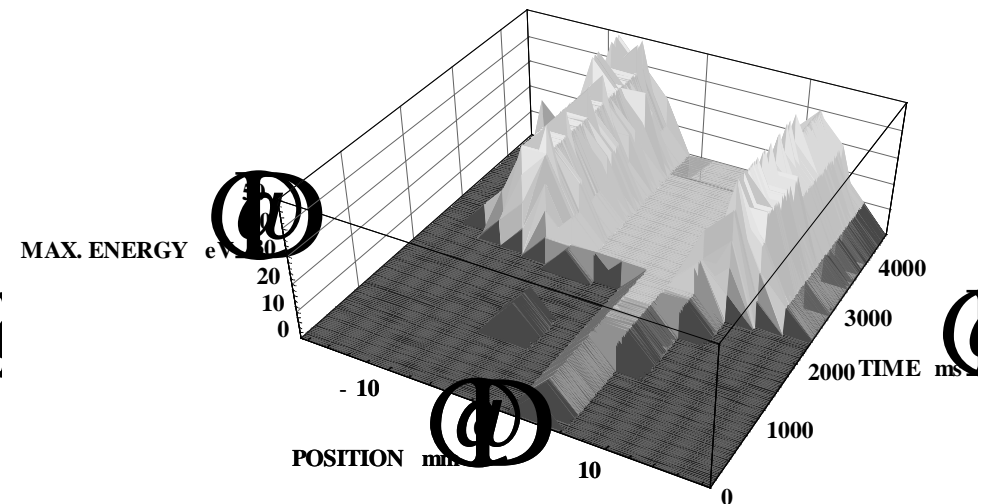
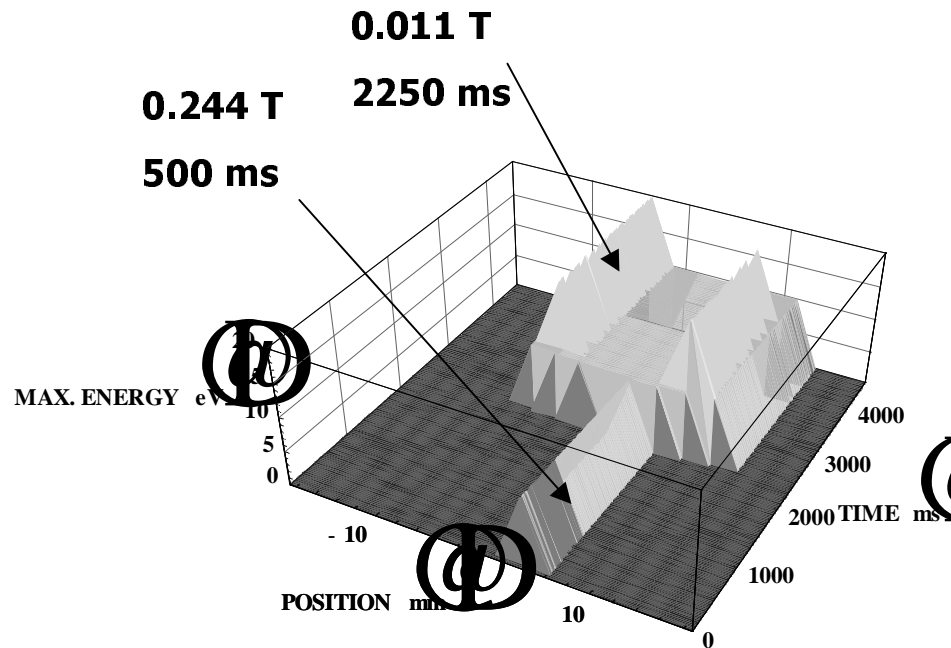
0.244 T
500 ms



Energy spectrum (LHC)-03/09

■ 3×10^{10} p/bunch

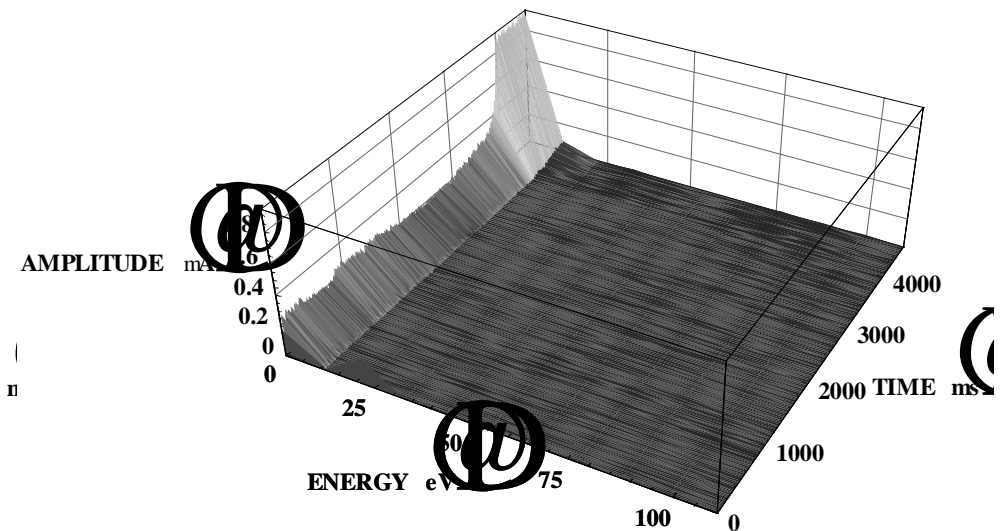
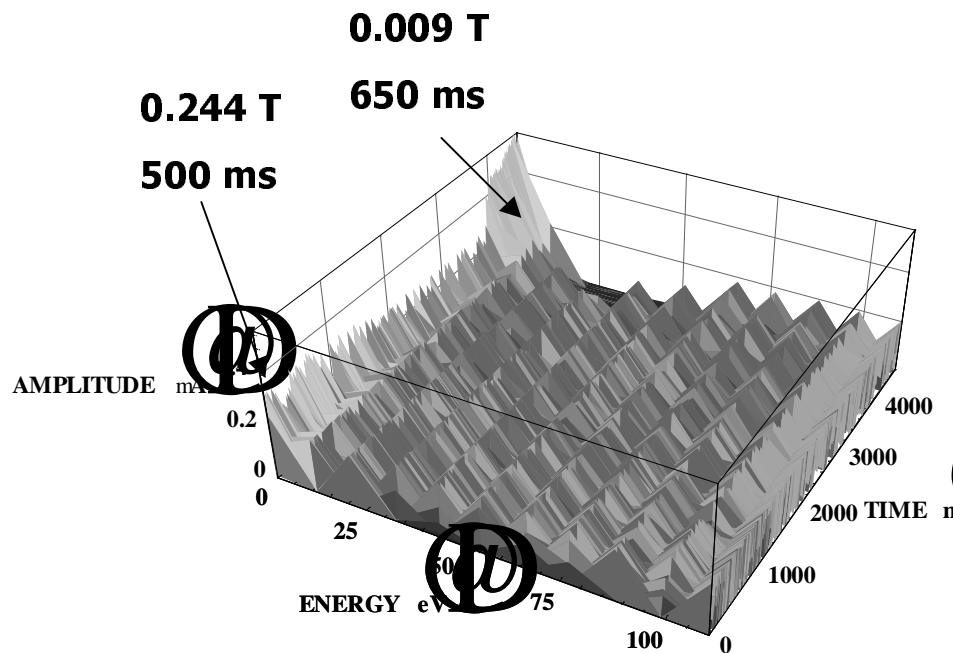
■ 5×10^{10} p/bunch



Spectrum (LHC-50ns)-11/09

■ 8×10^{10} p/bunch

■ 9.7×10^{10} p/bunch



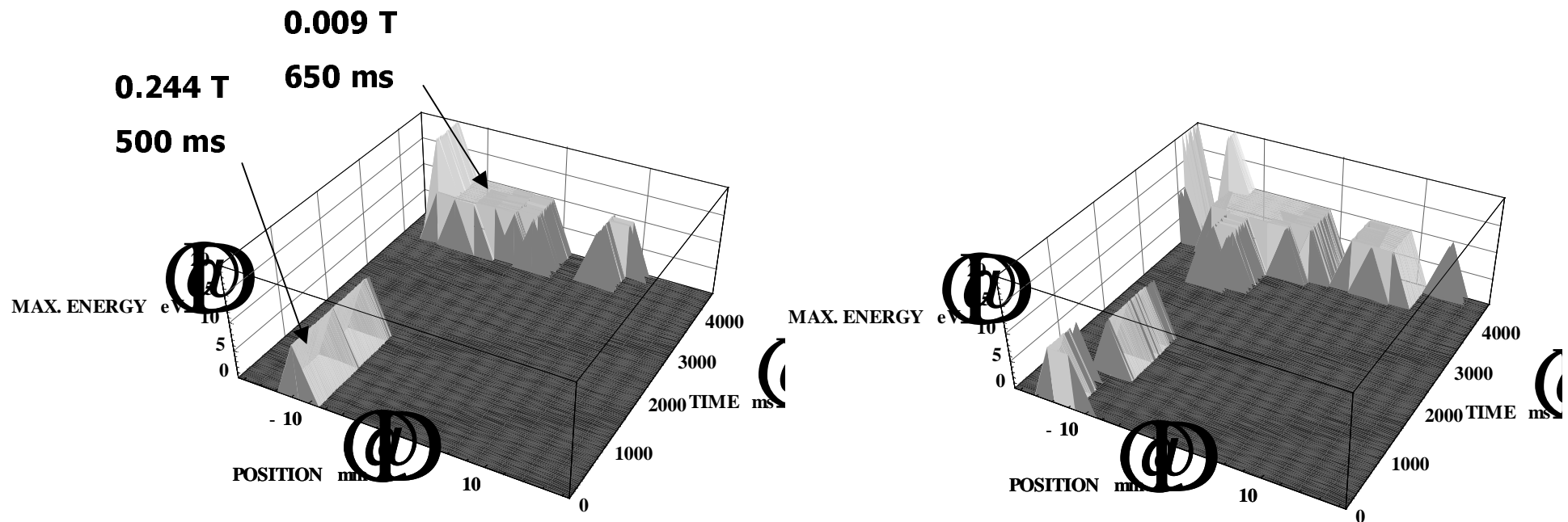
09/10/2001

G. Arduini – Electron cloud
measurements

Spectrum (LHC-50ns)-11/09

■ 8×10^{10} p/bunch

■ 9.7×10^{10} p/bunch



09/10/2001

G. Arduini – Electron cloud
measurements



Energy spectrum

- Electron energy up to 110 – 120 eV for FT – up to 150 eV (?) for LHC (5×10^{10} p/bunch)
- Lower energy for larger spacing for LHC beam (real?). Effect of integration?
- Reduction of e-energy with blow-up
- More signal at low field
- Instrumental or real?

Instrumental effect ?

- Cyclotron radius vs. Transverse energy/B field

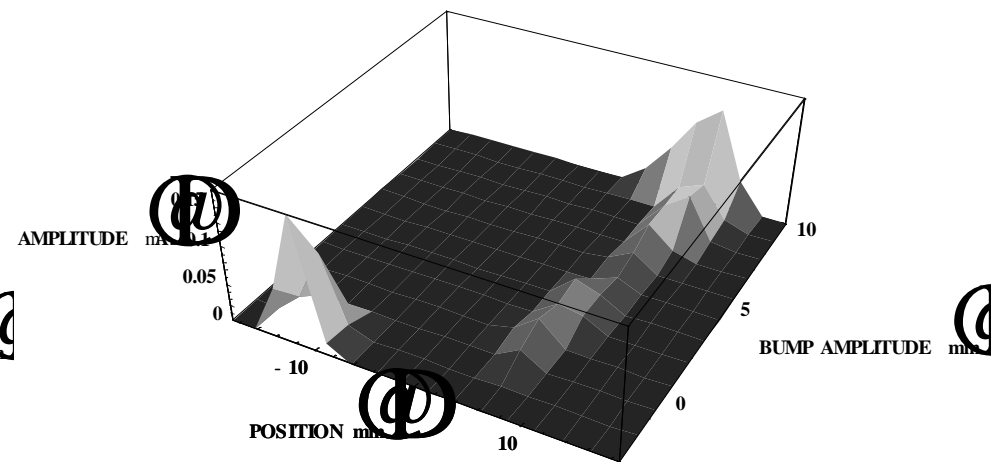
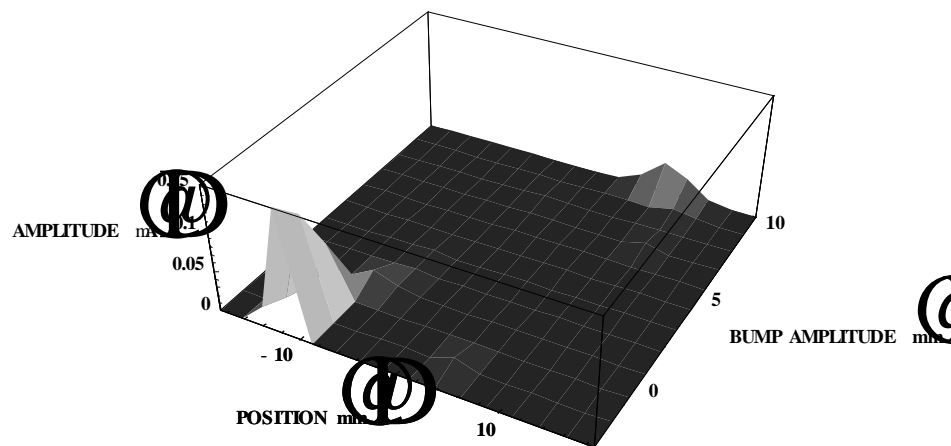
	10 eV	100 eV
0.001 T	11 mm	34 mm
0.011 T	0.96 mm	3.1 mm
0.244 T	0.04 mm	0.14 mm

- Hole radius 2 mm
- Wall thickness: 1.5 mm
- Beam r.m.s. H size \sim a few mm

Scrubbing? (LHC-50ns-13/9)

■ 0.244 T

■ 0.044 T



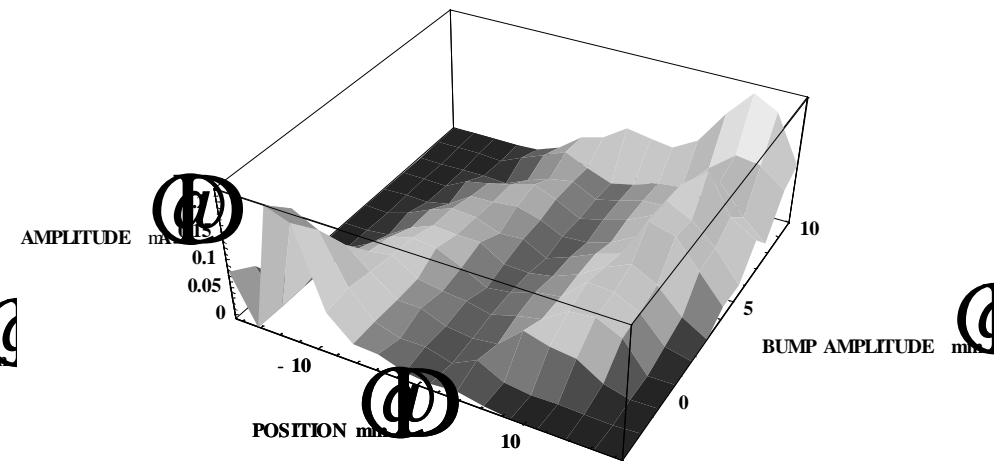
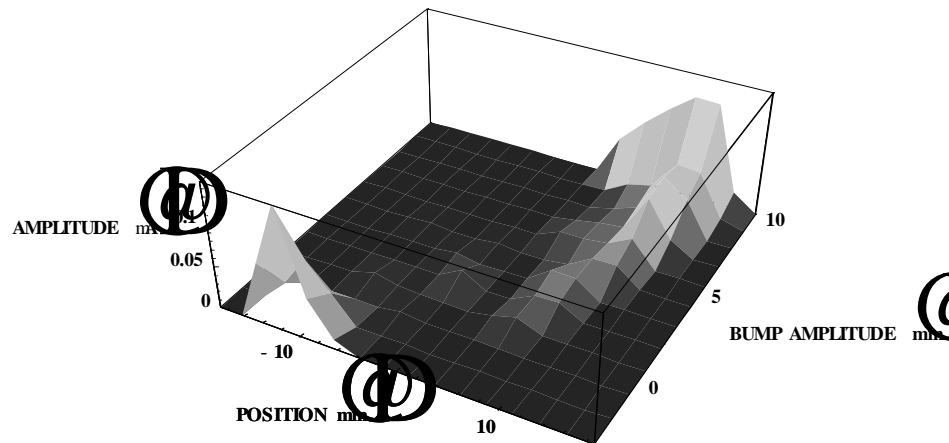
09/10/2001

G. Arduini – Electron cloud
measurements

Scrubbing? (LHC-50ns-13/9)

■ 0.022 T

■ 0.009 T

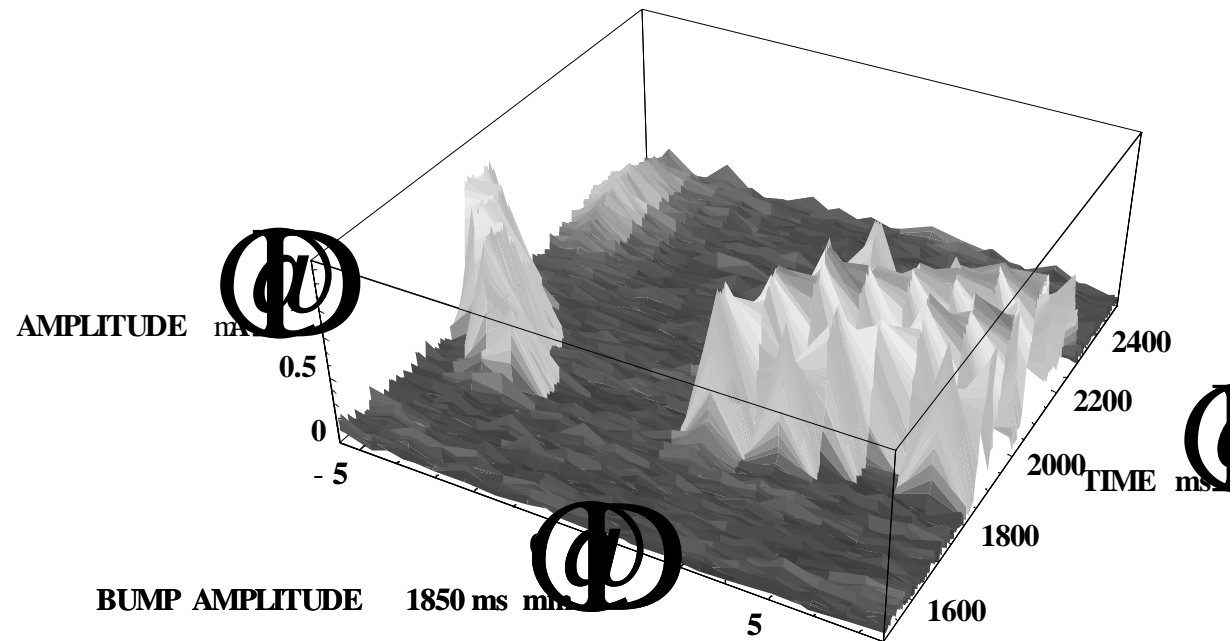


09/10/2001

G. Arduini – Electron cloud
measurements

Scrubbing? (FT-13/8)

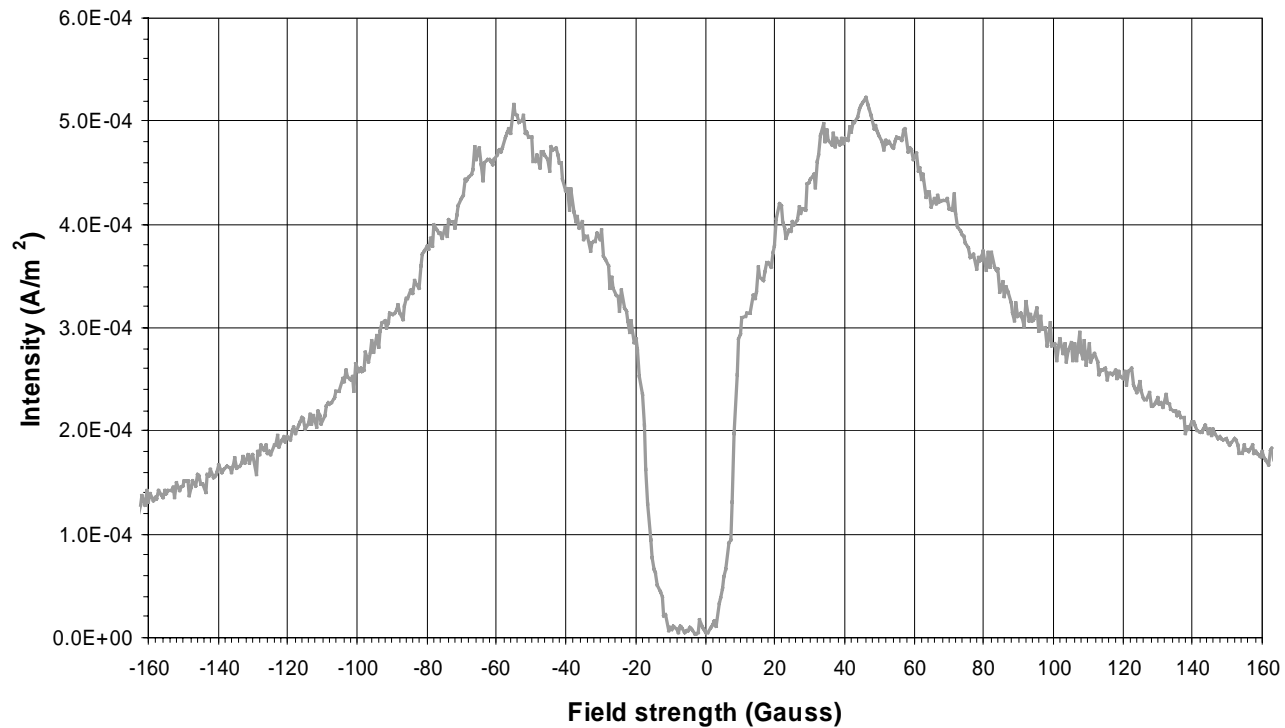
■ 0.244 T



09/10/2001

G. Arduini – Electron cloud
measurements

Magnetic field dependence

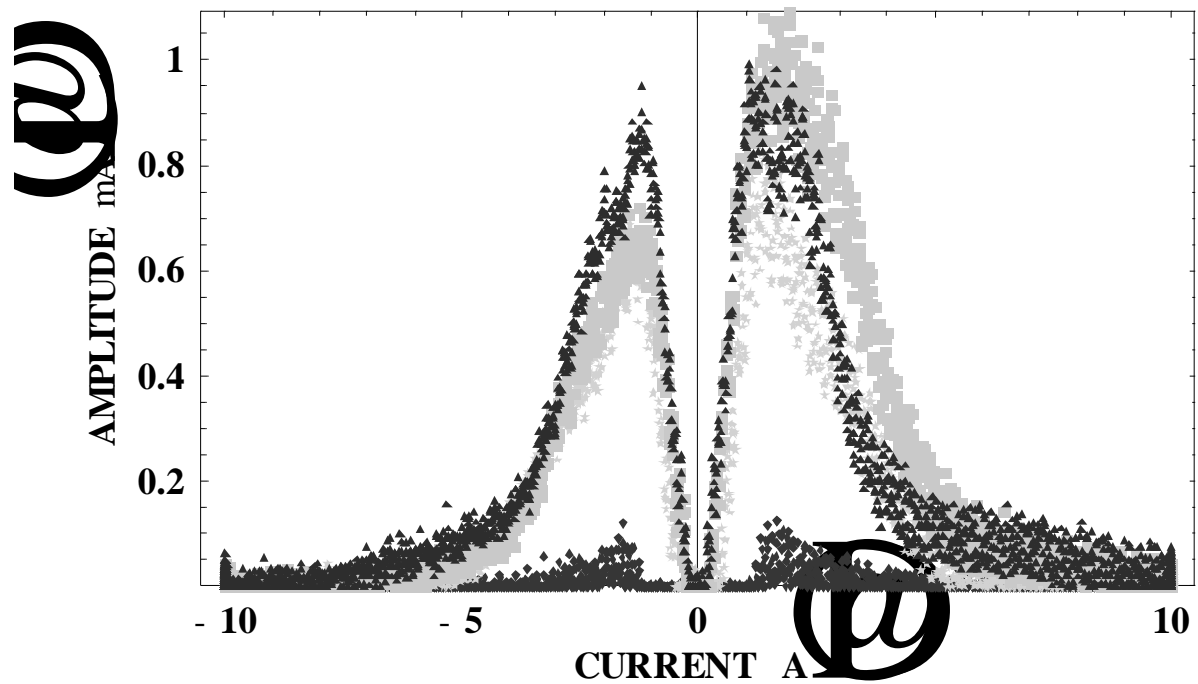


Courtesy of J.M. Jimenez

G. Arduini – Electron cloud
measurements

09/10/2001

Magnetic field dependence

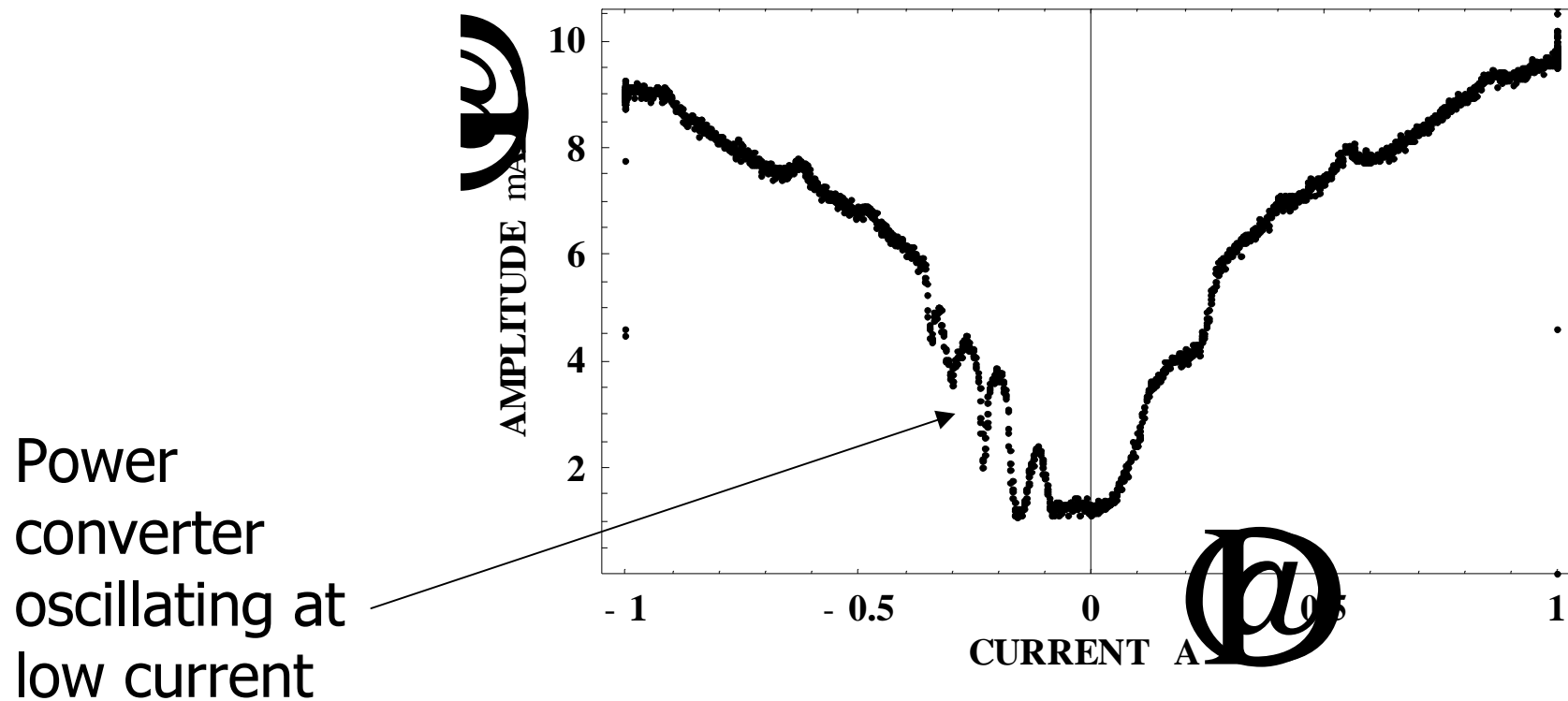


I_{bunch}
[10^{10} p/bunch]



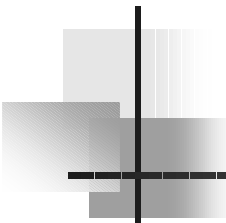
Electron cloud at 0 field?

- LHC beam – $I_{\text{bunch}} \sim 5 \times 10^{10}$ p



09/10/2001

G. Arduini – Electron cloud measurements



To be done (a proposal)

- Thresholds
- Turn-by-turn measurement
- LHC beam:
 - Dependence on bunch length and transverse size (only qualitatively assessed)
 - Measurement of electro cloud evolution along the batch (1 – 2 batches with different spacing)
 - Go higher in intensity under controlled conditions
- FT beam:
 - Local scrubbing (Intensity vs. bump amplitude and magnetic field)