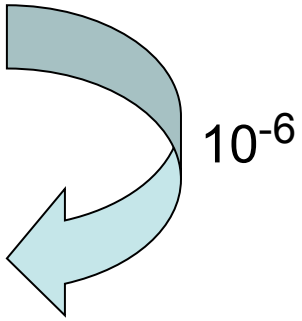
DORIS e+/e- Operation for Olympus

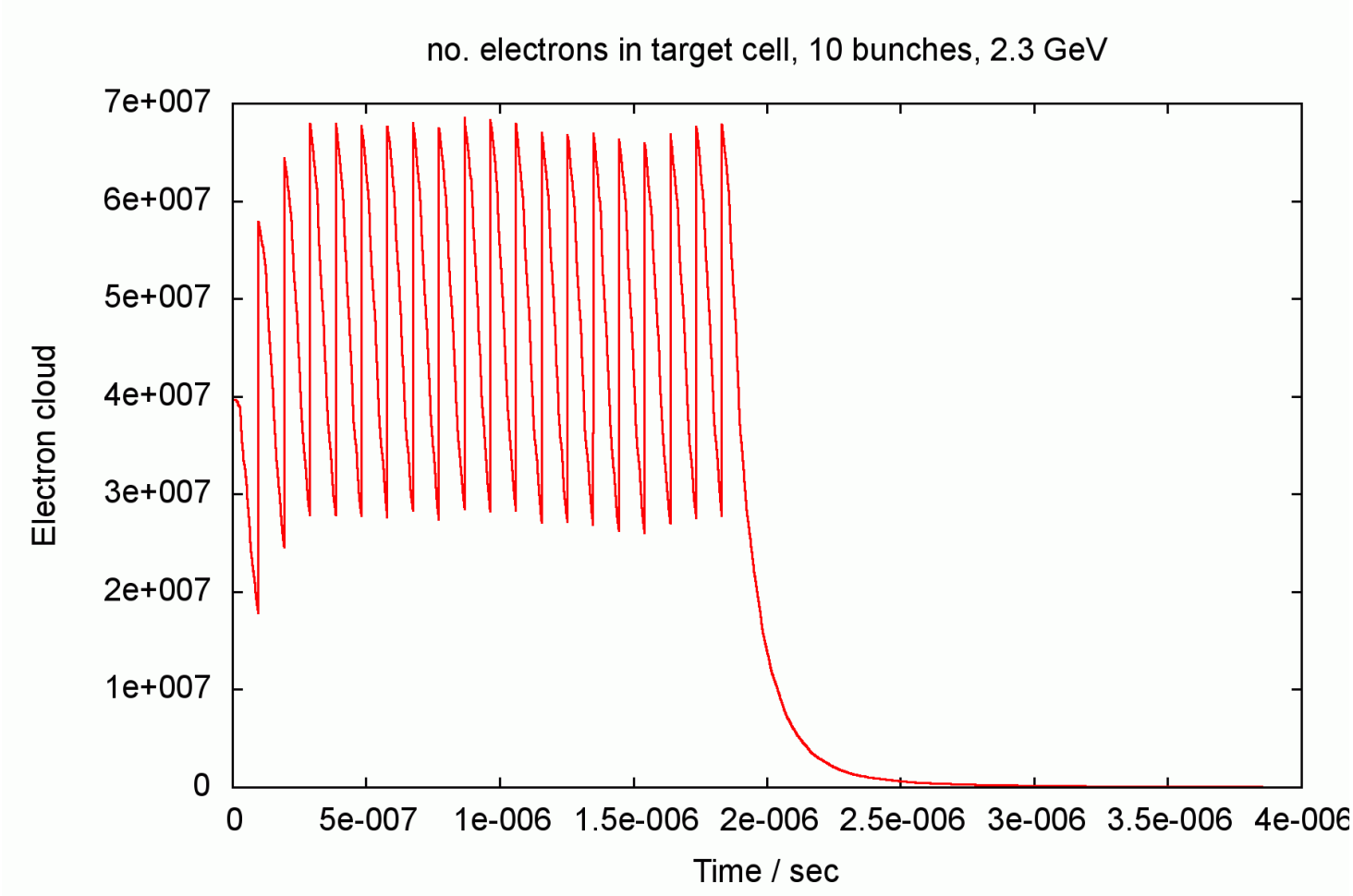
DESY Machine Advisory Committee, November 10th/11th 2010, F.Brinker

Ionization Target cell

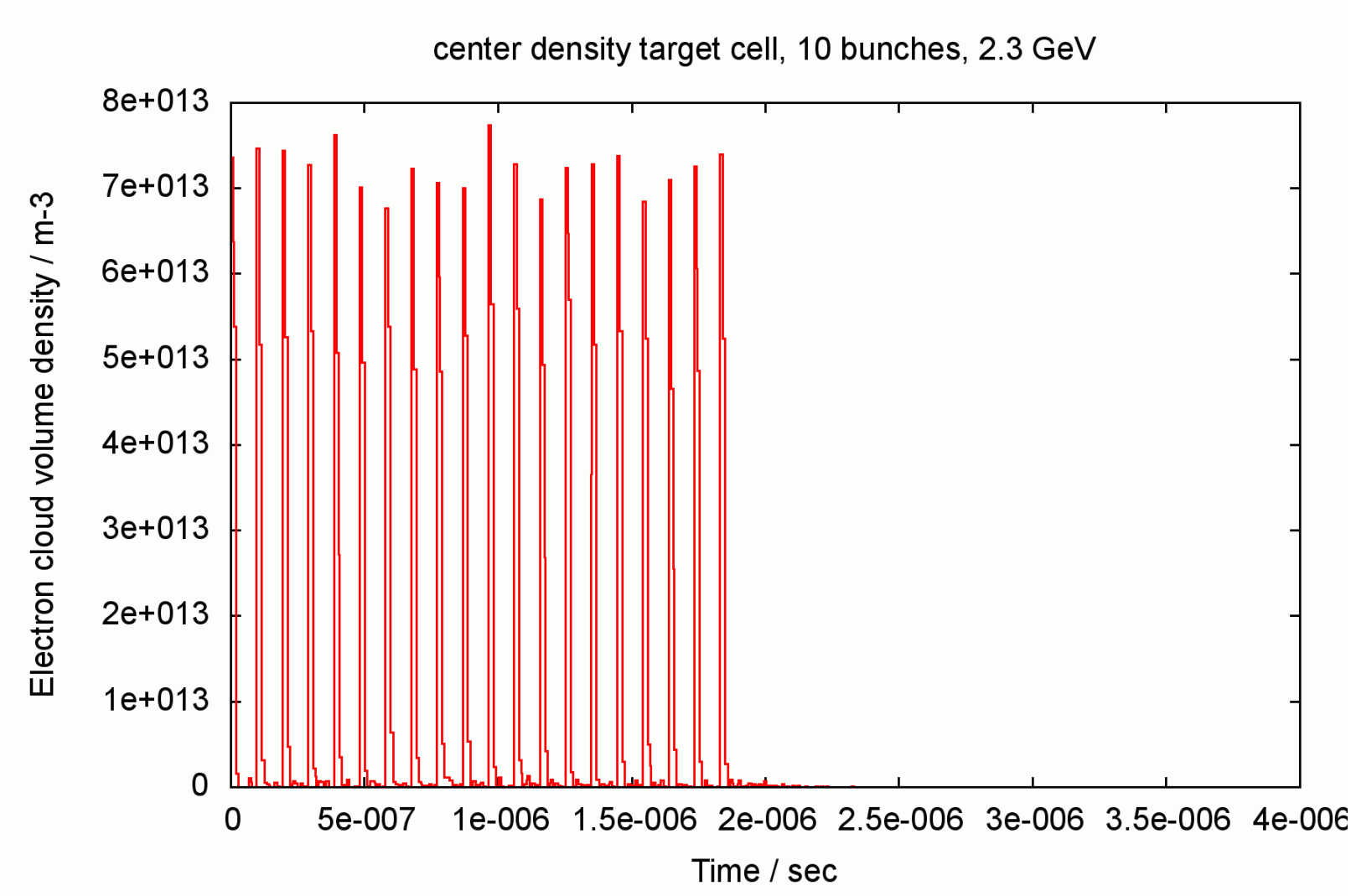
Energy[GeV]	2.3
Beam size (sigma)mm^2	0.6x0.1
Proton density (H_2) [$1/cm^2$]	$3x10^{15}$
Proton density (H_2) [$1/m^3$]	$5x10^{19}$
Ionization cross section [Mbarn]	0.36
Ions per bunch crossing (10 bunch)	$4.5x10^7$
max. electron centre density [$1/m^3$]	$8x10^{13}$



„Ecloud“ calculation: total number of electrons (calculated for first 20 bunches)



„Ecloud“ calculation: density within positron beam

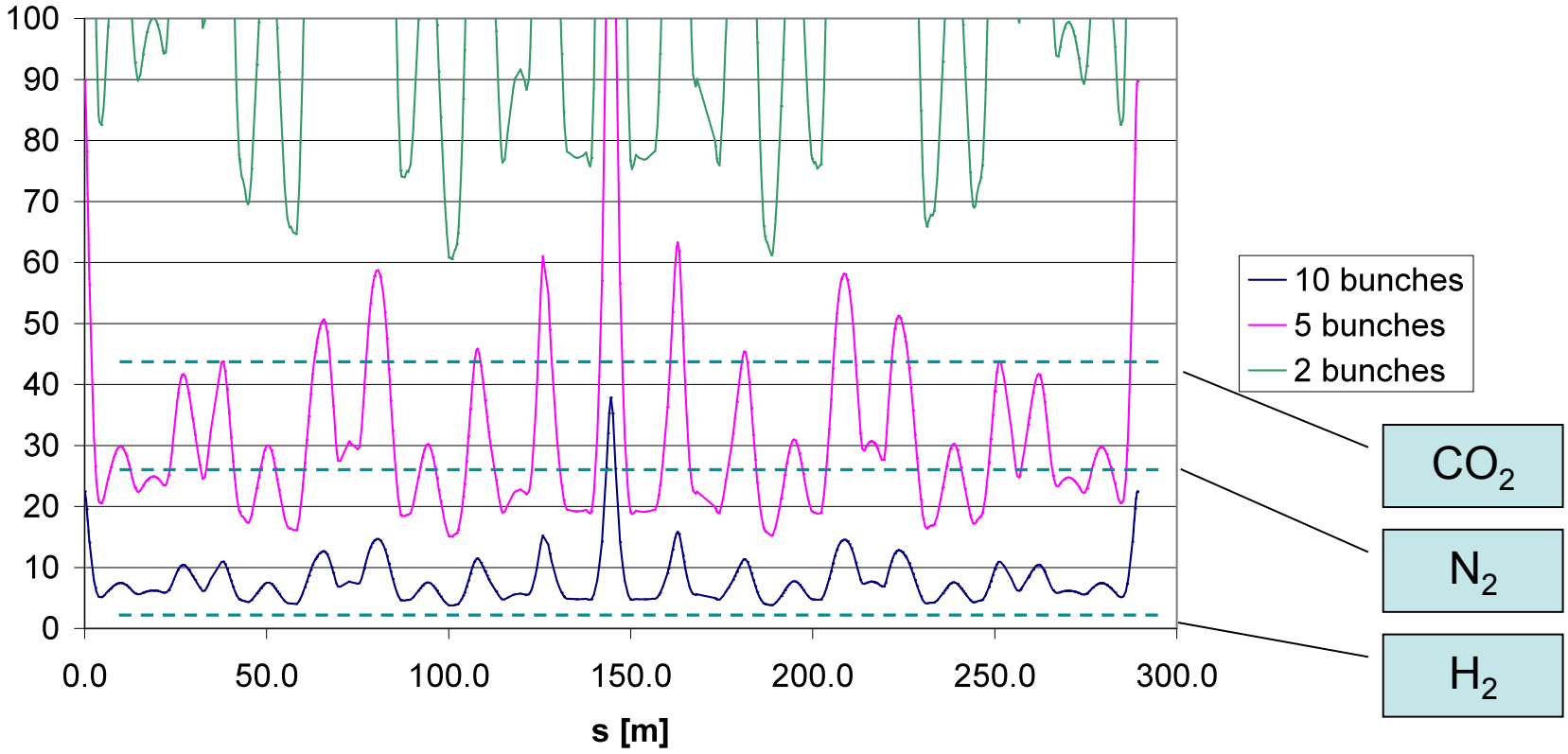


Stable ions within electron beam ?

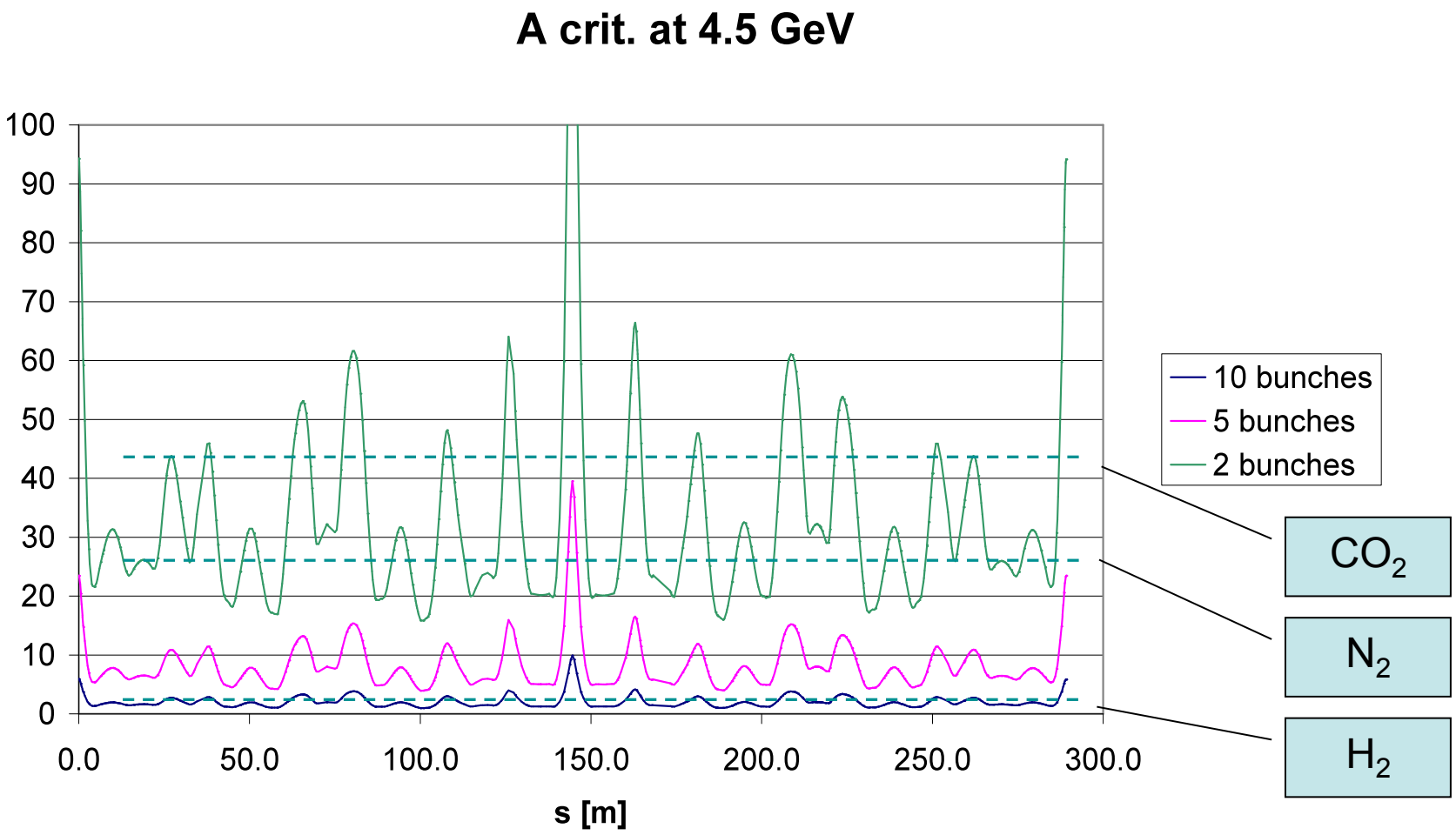
Heavy ions can be trapped in the central (linear) field of the bunches. Light particles (A<A crit.) get overfocused and thrown out of the beam potential.

$$\frac{A_{crit}}{Q} = \frac{N_e \cdot r_p \cdot L_{sep}}{2 \cdot \sigma_y \cdot (\sigma_x + \sigma_y)}$$

A crit. at 2.3 GeV

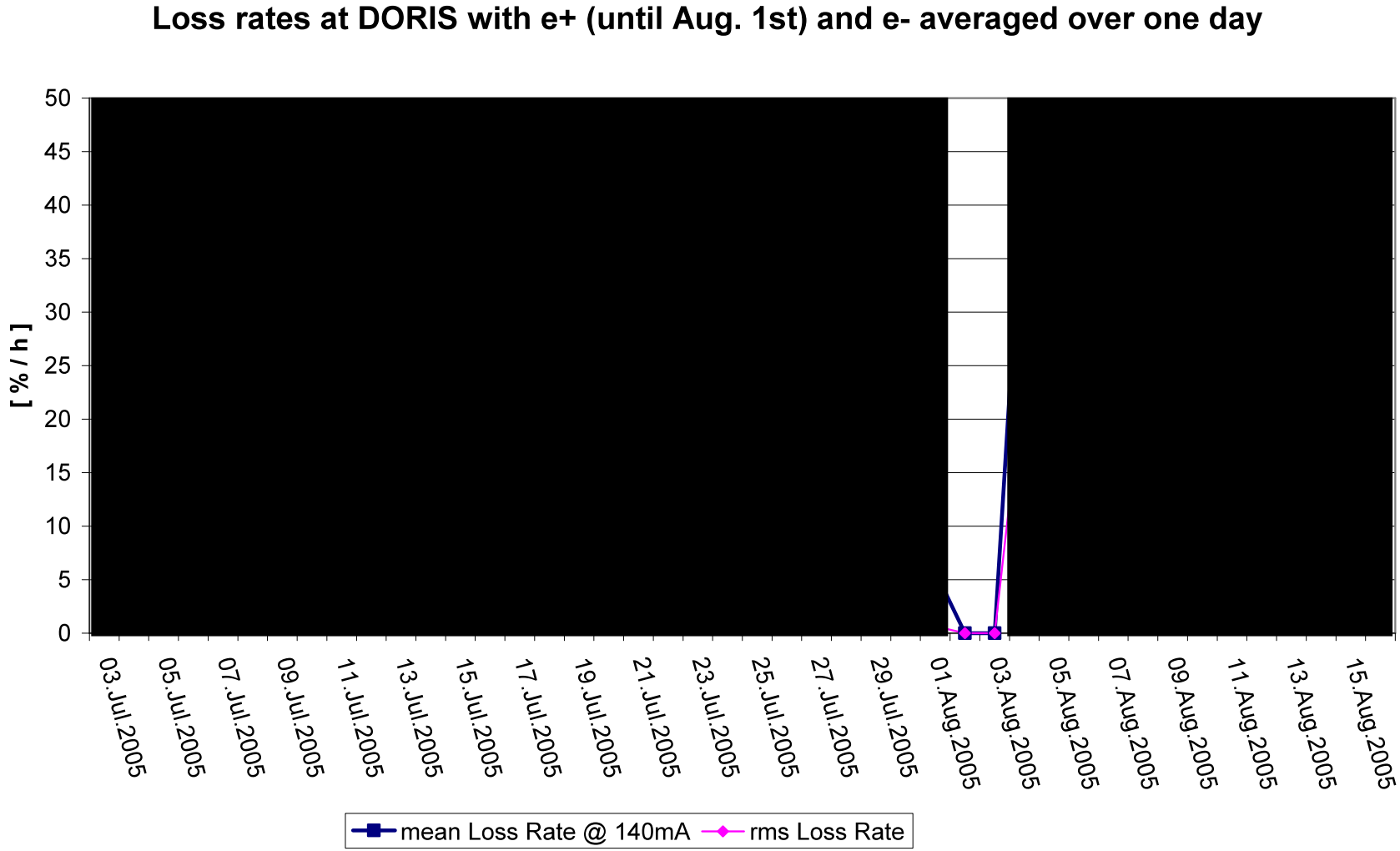


For small oscillations :



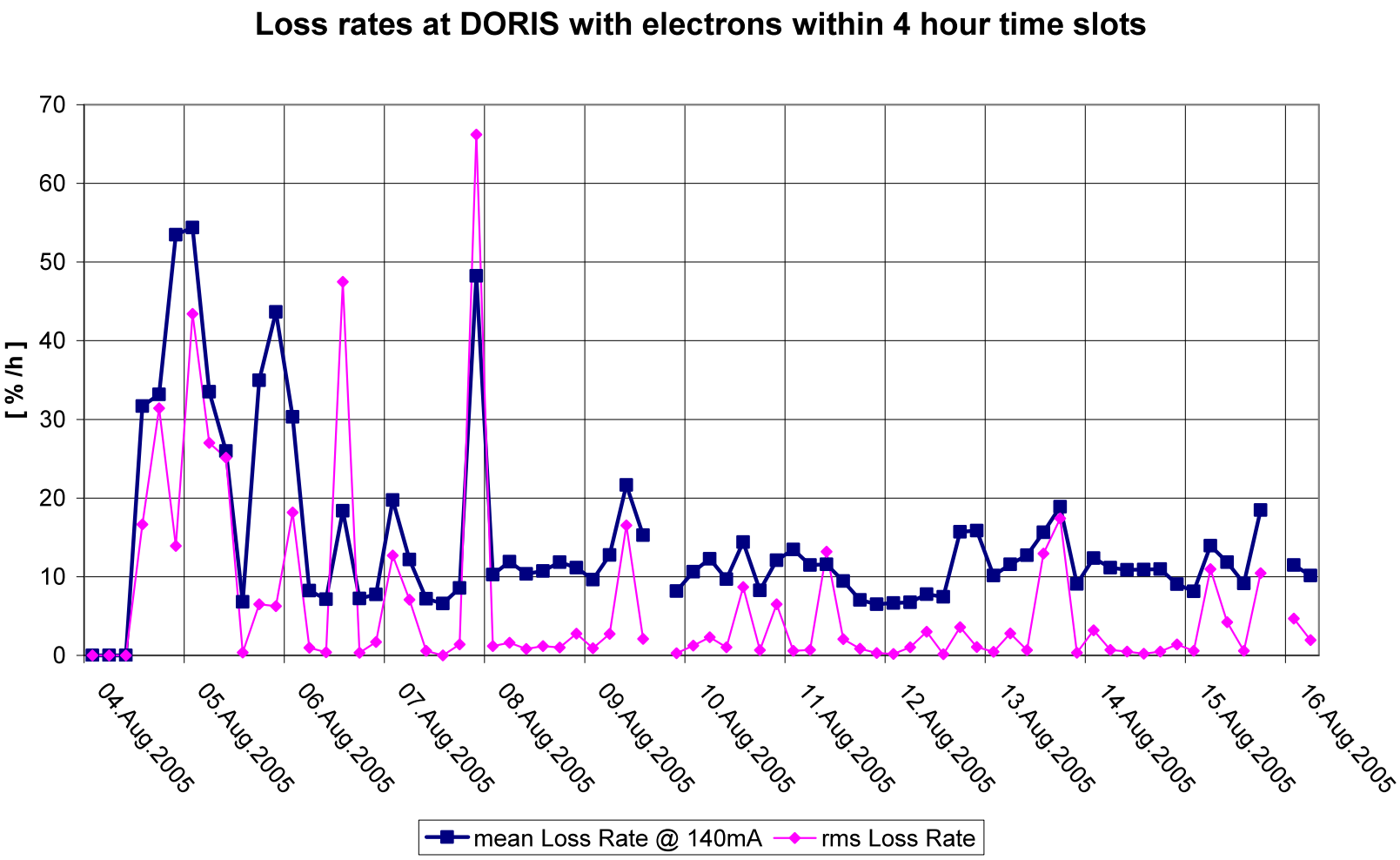
Electron test run in 2005

lifetime drastically lower for e^- than for e^+:



Electron test run in 2005

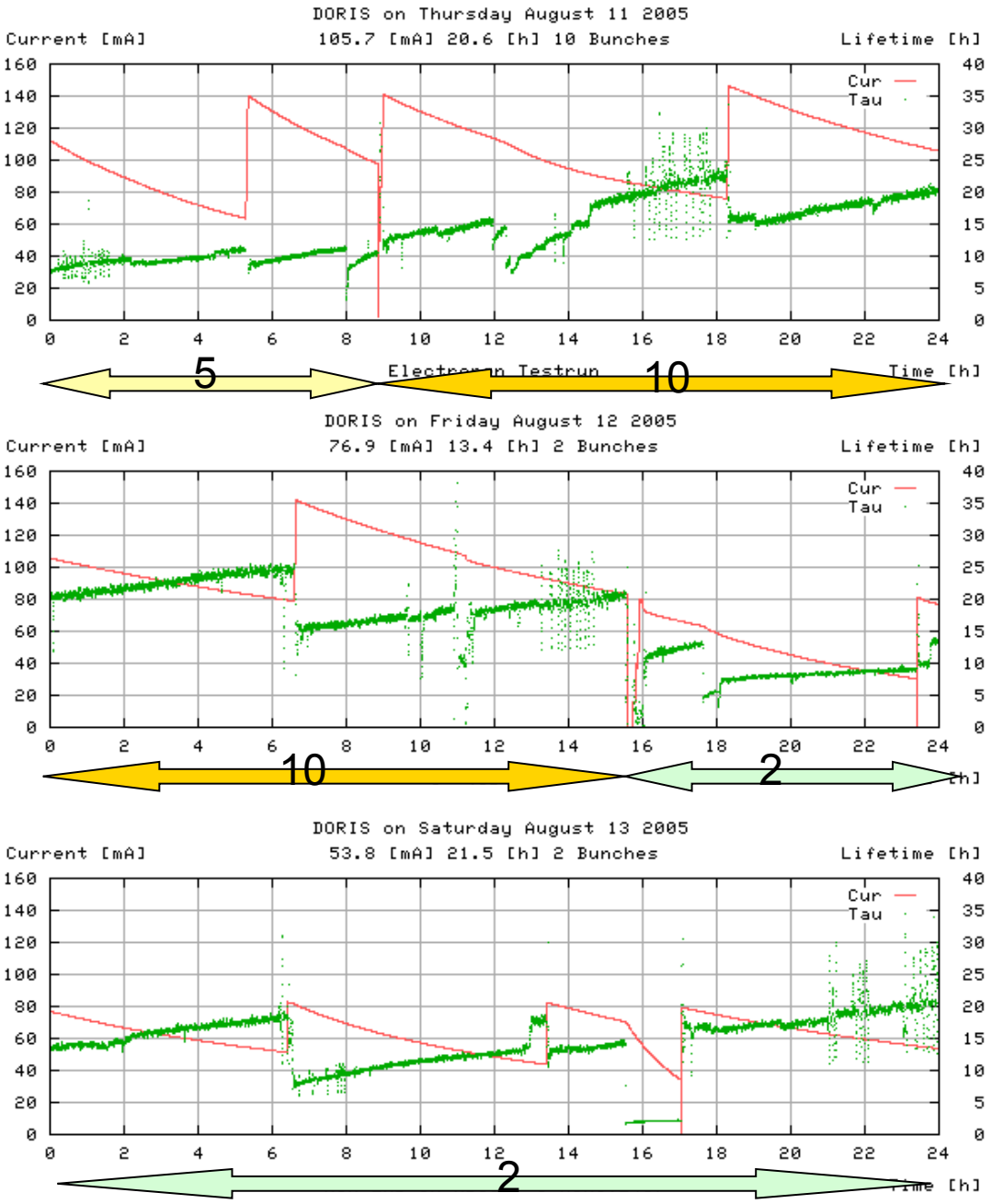
significant improvements seen after 4 days:



Runs with 5, 10 and 2 bunches of electrons

No significant dependence on the filling pattern had been observed!

Ion trapping should be nearly impossible for 2 bunch operation – therefore we assume that heavier ionized particles (dust) are caught by the beam potential.



Systematic energy shift at VEPP-3:

Assume…

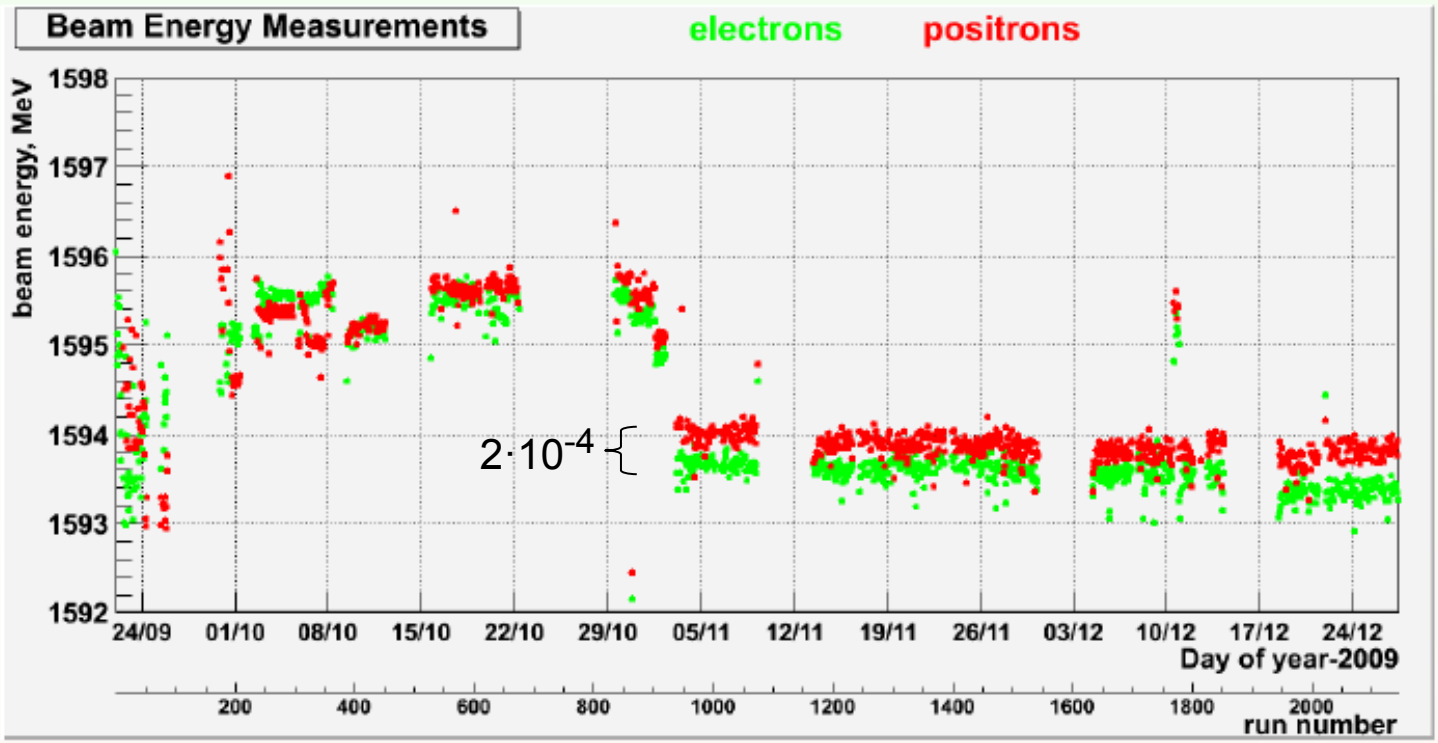
Earth magnetic field of 56 μT

Half of the ring shielded

Faktor 2 missing to explain the effect

Similar effect expected at DORIS, 2.3GeV

Energy of e+/e- beams being measured with the use of Back Compton scattering monitor during the experiment [D.Toporkov, BINP]



Beam parameters and tolerances

	Nominal value	typ. Tolerances run to run, day to day	Required for 0.1% error	e^+/e^- difference
energy	2.3 GeV	$1 \cdot 10^{-4}$ Dipole current $1 \cdot 10^{-4}$ corrector coils $1 \cdot 10^{-4}$ quad misalignment	$5 \cdot 10^{-4}$	$\sim 3 \cdot 10^{-4}$ stray fields earth magnetic field
position	0	1 µm BPM 200 µm temperature drift (3m alu, 3Kelvin)	100 µm	
angle	0	2 µrad BPM ~ 50 µrad temperature drift	52 µrad ?	
Hor. size	0.6 mm	10 %		
Vert. size	0.1 mm	20 %		coupling from stray fields ? ion effects ?
Bunch length	9 mm	20 %	σ_l << target	
$(N(e^-)-N(p))$ / $N(p)$	0			$3.2 \cdot 10^{-6}$
background				e- : dust events

Schedule for studies

- Operation at 2.3 GeV successfully tested in 2009/2010
- Electron tests in February 2011
- First runs with test experiment in February 2011

6 shifts in 1 week

- Test runs without detector during two service weeks in April and June 2011 (~ 48 hours each week) — **4 days**
- Starting full operation with detector in August 2011 — **2 days**
- Detector commissioning and beam studies during service weeks in September and October 2011 + parasitic running at 4.5 GeV (w/o target) — **4 days**
- Possibilities for access and short tests on most Wednesdays

12 days

- 1 week commissioning in January 2012