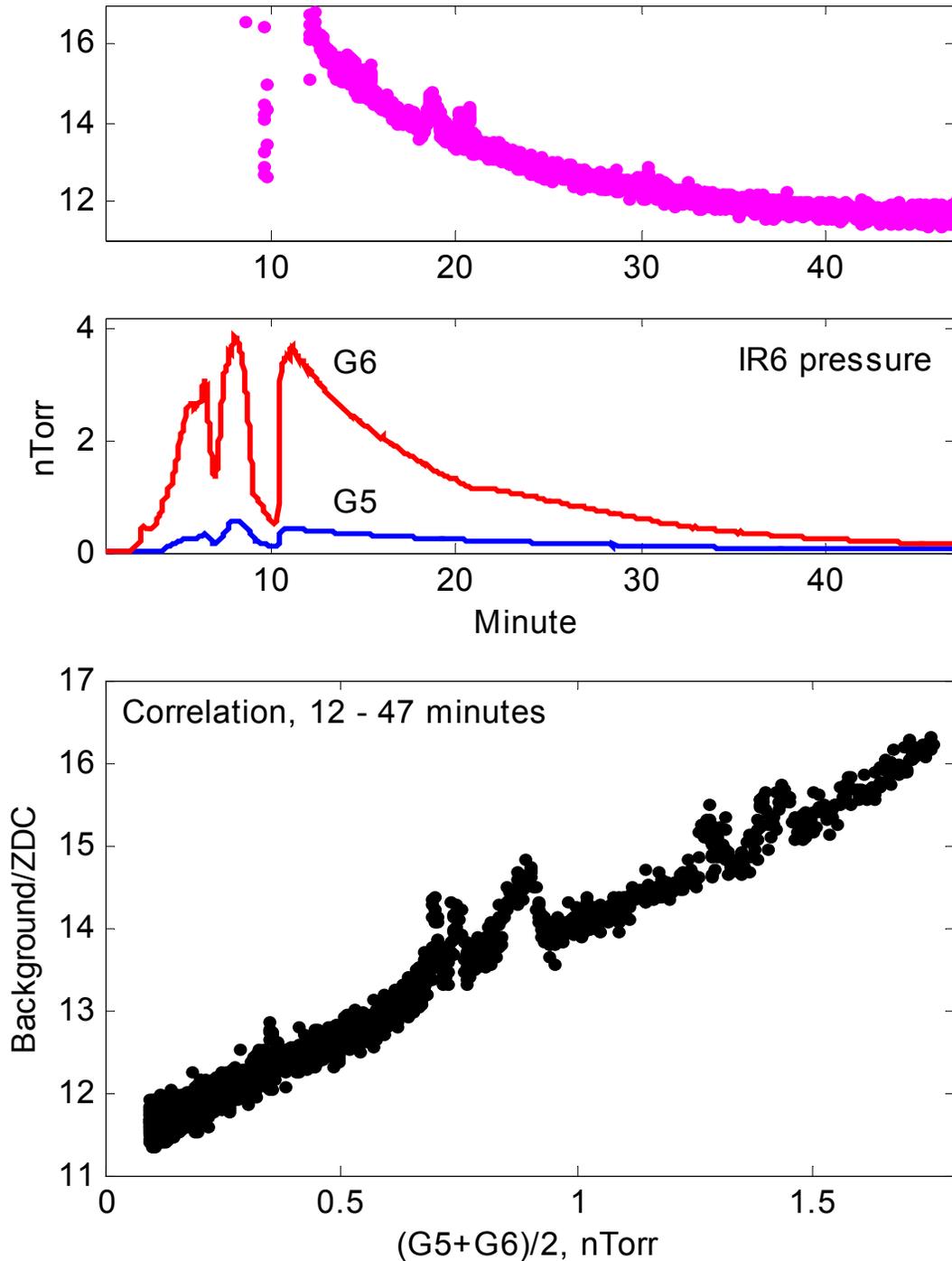


Effect of Short Bunches on e-cloud and Background

S.Y. Zhang and D. Trbojevic

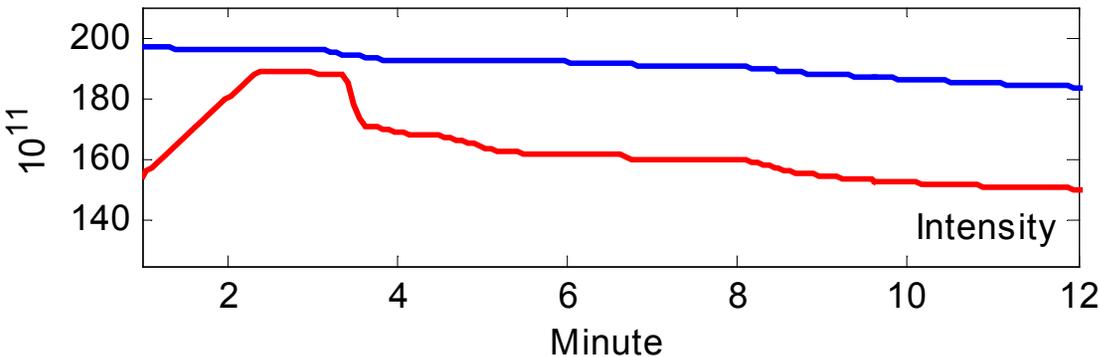
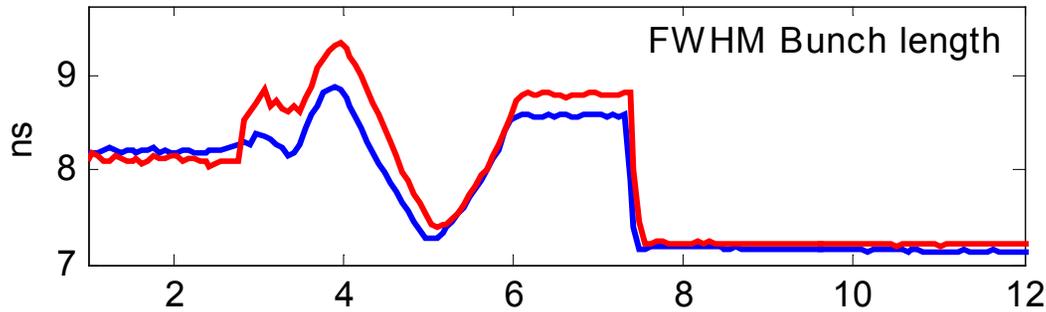
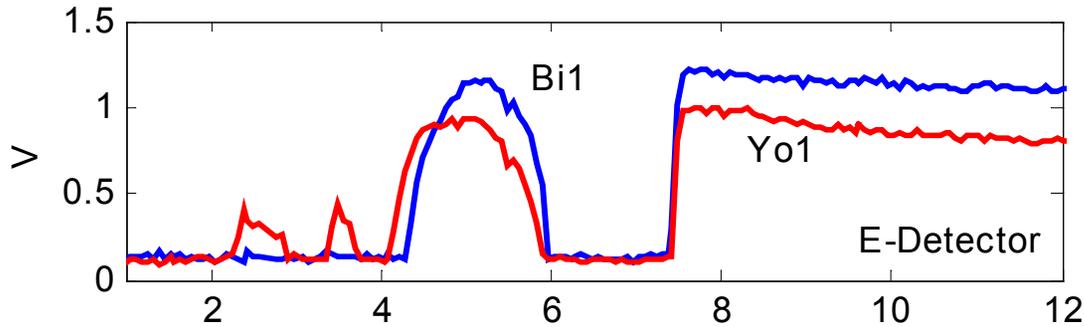
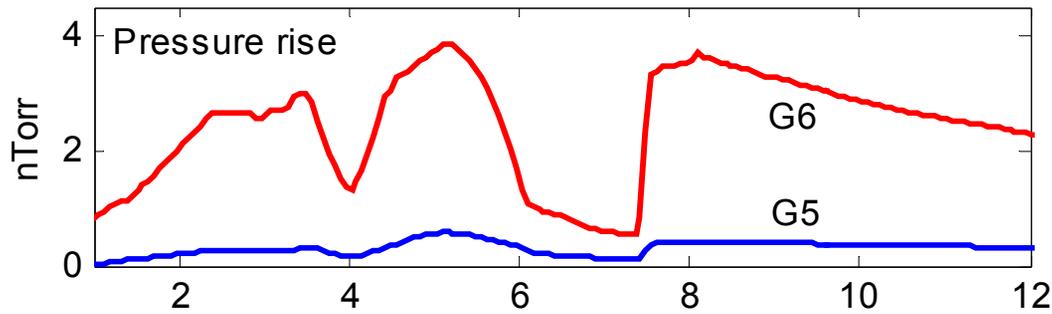
APEX Workshop, December 4-5, 2008

Background/ZDC, STAR, 9983

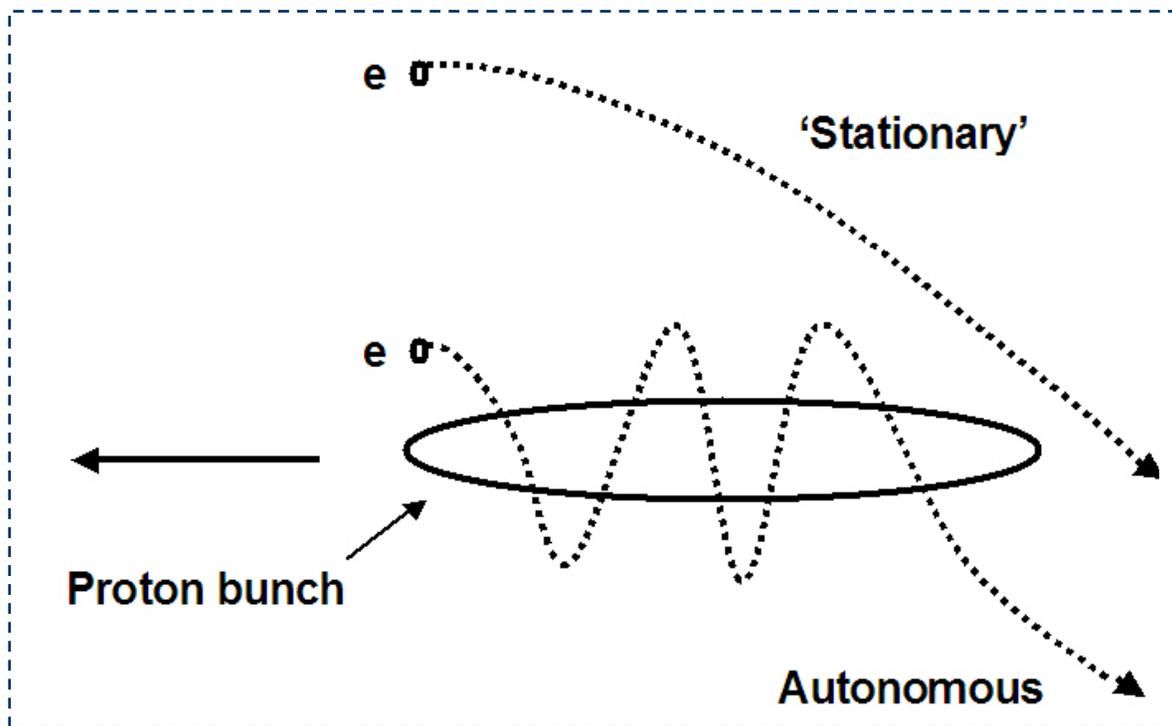


- For polarized proton runs, the ratio of background (ZDC singles) and ZDC coincidence is expected to be 10 to 11, which has been observed for both STAR and PHENIX in Run5, Run6, and Run8.
- The dynamic pressure rise at IR could add on beam-gas singles, which has been a problem in past runs, but mostly marginal.
- Fill 9983 has the highest dynamic pressure rise at IR6 in Run8. The ratio of background/ZDC of STAR reached > 16 . However, in about half an hour, the ratio is reduced to < 12 .

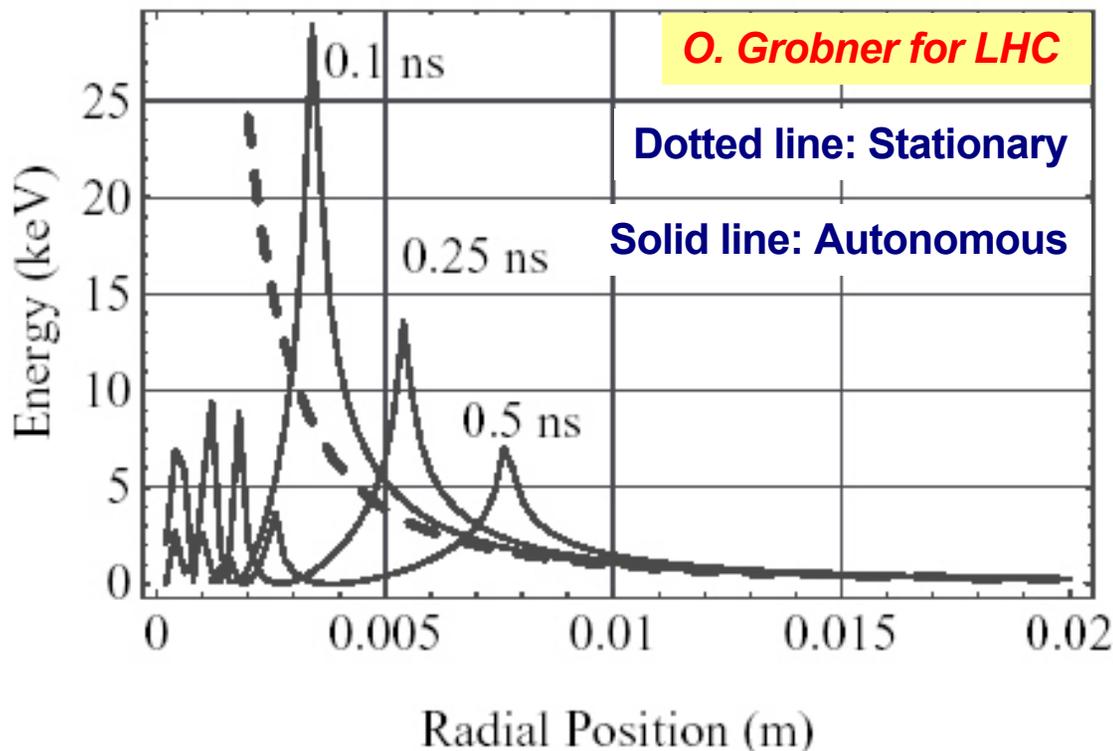
Fill 9983

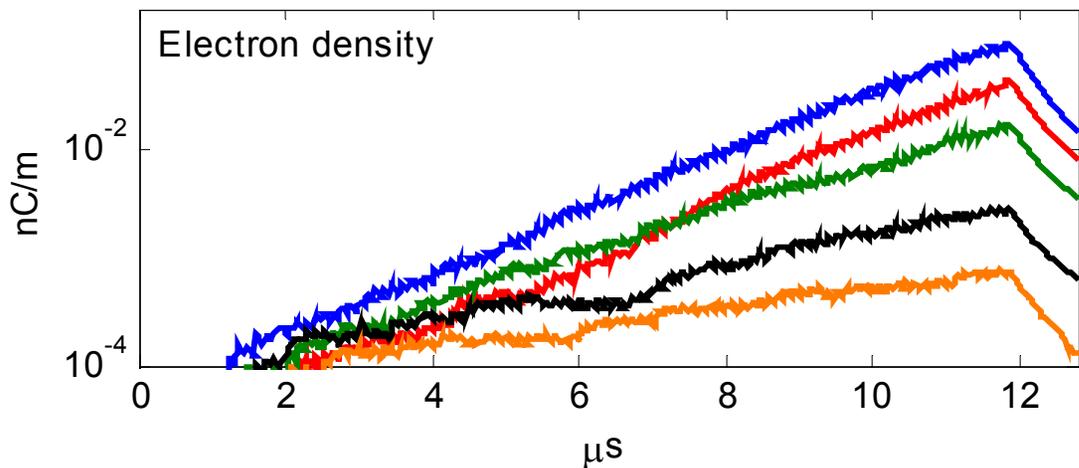
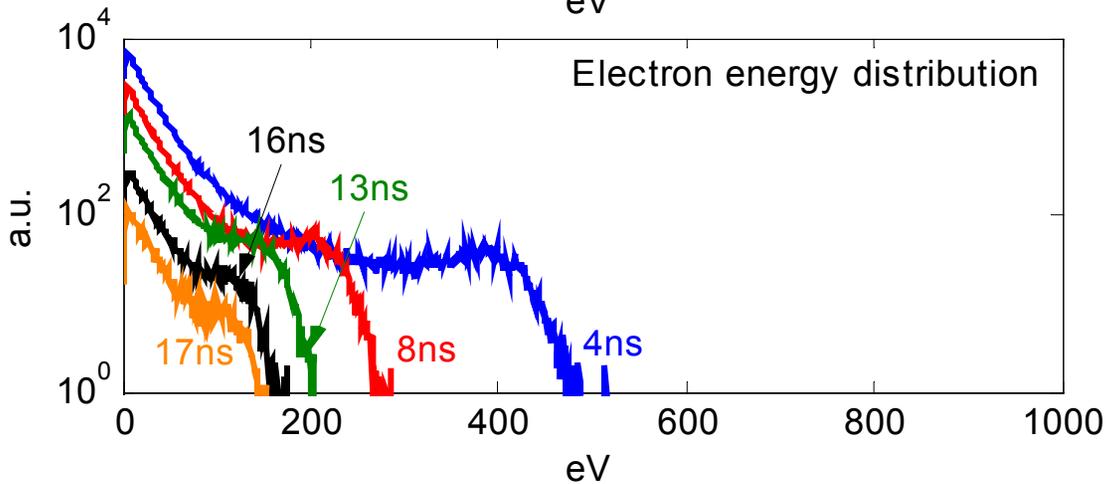
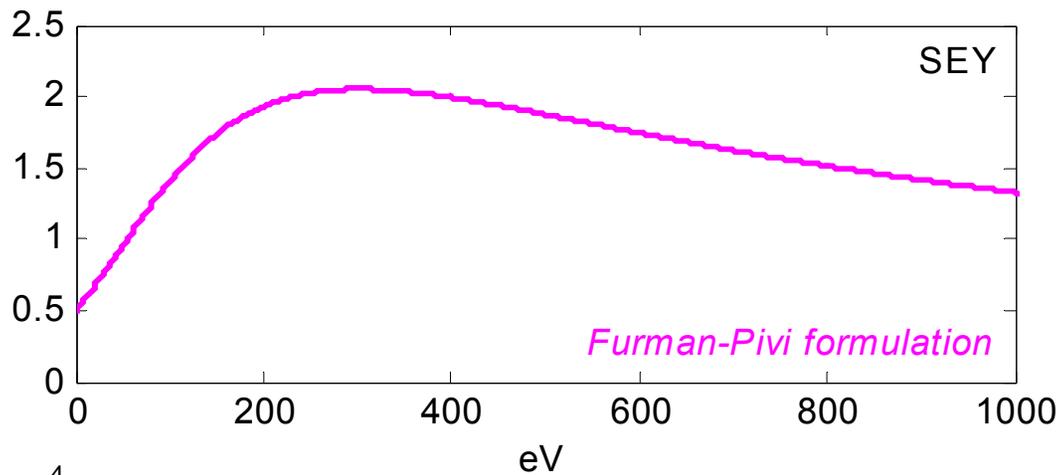


- The dynamic pressure rise at IR is caused by the electron cloud, observed from electron detectors at Yo1 and Bi1.
- For same beam intensity, the electron multipacting has a strong dependence on the bunch length.
- The RHIC upgrade plan calls for shorter bunches at store, from 13 ns in Run 2008 to 7.7 ns for 9 MHz cavity and 4 ns for 56 MHz cavity.
- Electron cloud induced pressure rise at IR, hence the background, is expected to be higher.

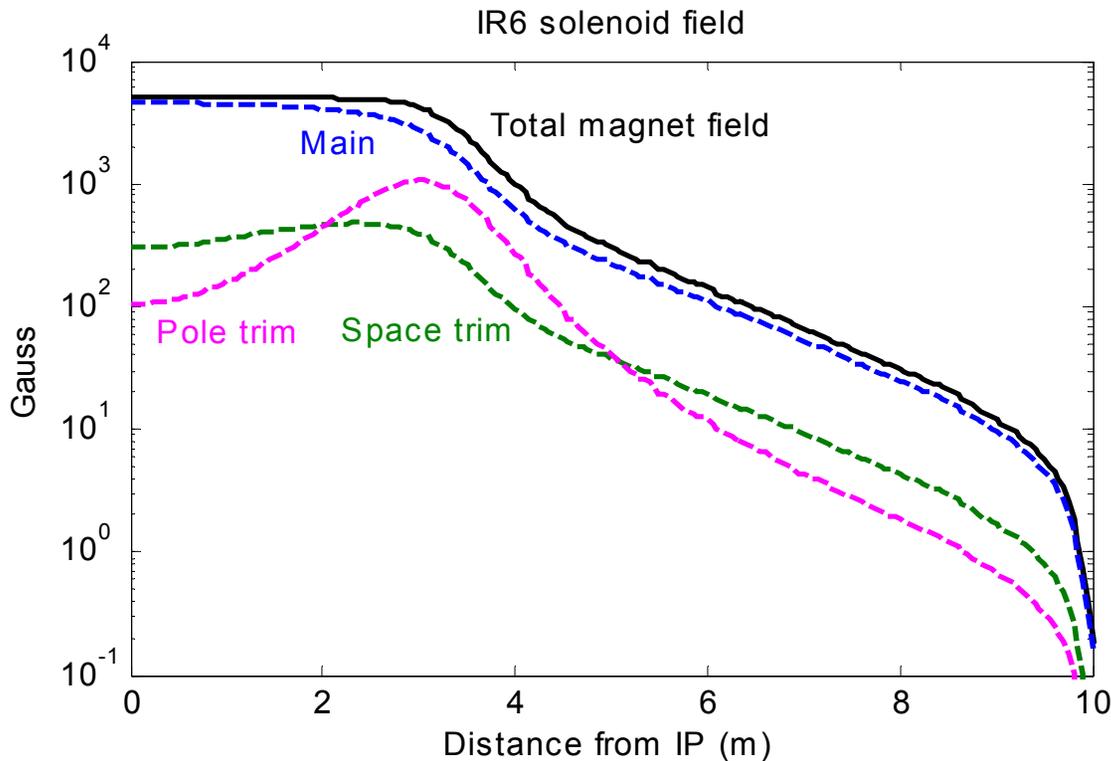


- For 'stationary' electrons, the energy gain during a bunch passing is $\Delta E \sim (N_{\text{bunch}} / r)^2$, $r \gg a$ with r the radial position, a the beam size. The ΔE is bunch length independent.
- Electrons with small r will oscillate with beam at Frequency $\omega_e \sim \sqrt{(\lambda)} / a$ where λ is the beam line density.
- Autonomous electrons gain peak energy at quarter oscillations exiting the bunch tail.
- Bunch length comes into play, along with bunch intensity and spacing, beam and chamber sizes.





- **Secondary electron yield (SEY) has a strong dependence on the energy of electrons when hitting the chamber wall.**
- **Simulation (CSEC) is used to estimate the electron multipacting strength for shorter bunches. RHIC observation (bunch length of 17 ns, 16 ns, 13 ns) is used for benchmarking.**
- **The electron energy spectra, together with 8 ns and 4 ns bunches, look plausible for a given intensity.**
- **The electron multipacting is enhanced with the shorter bunches.**



- **Electron multipacting cannot take place under strong solenoid field. So at IR6, the region with weak field (< 50 Gauss) at > 8 m from IP needs more attentions.**
- **The electron cloud activity within DX magnet is a big unknown.**
- **Beam study proposed to see the effect of the STAR main, space trim, and pole trim magnets, on the IR6 dynamic pressure rise.**
- **We are considering to propose solenoid wire installed 7 m from IP to DX cryostat, for information that may be useful for cures.**

