Au Beam Intensity Limit in Run7

S.Y. Zhang

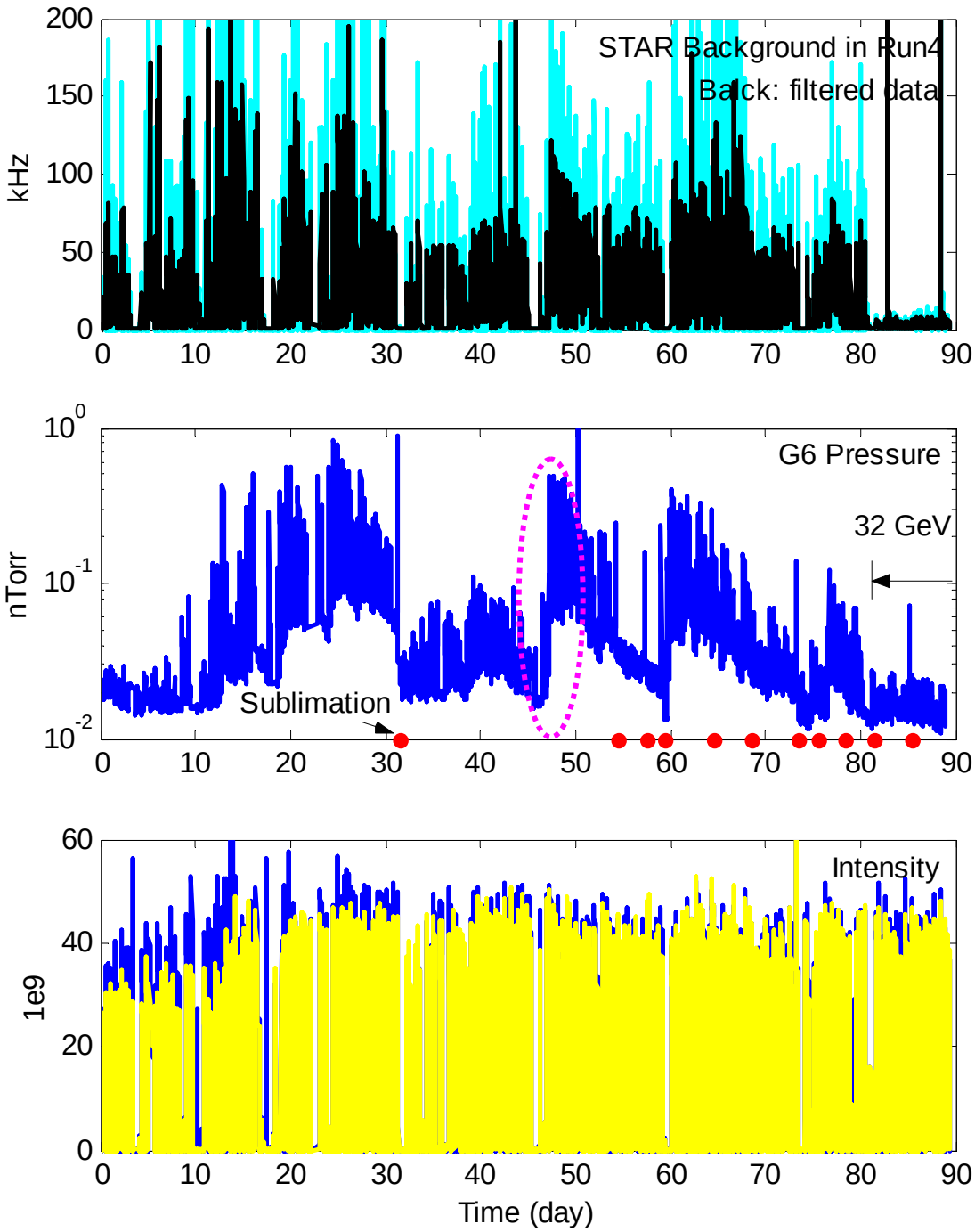
I. Possible STAR background problem

Static pressure, transition and rebucketing pressure rise, background/ZDC ratio, electron cloud.

II. Luminosity issues

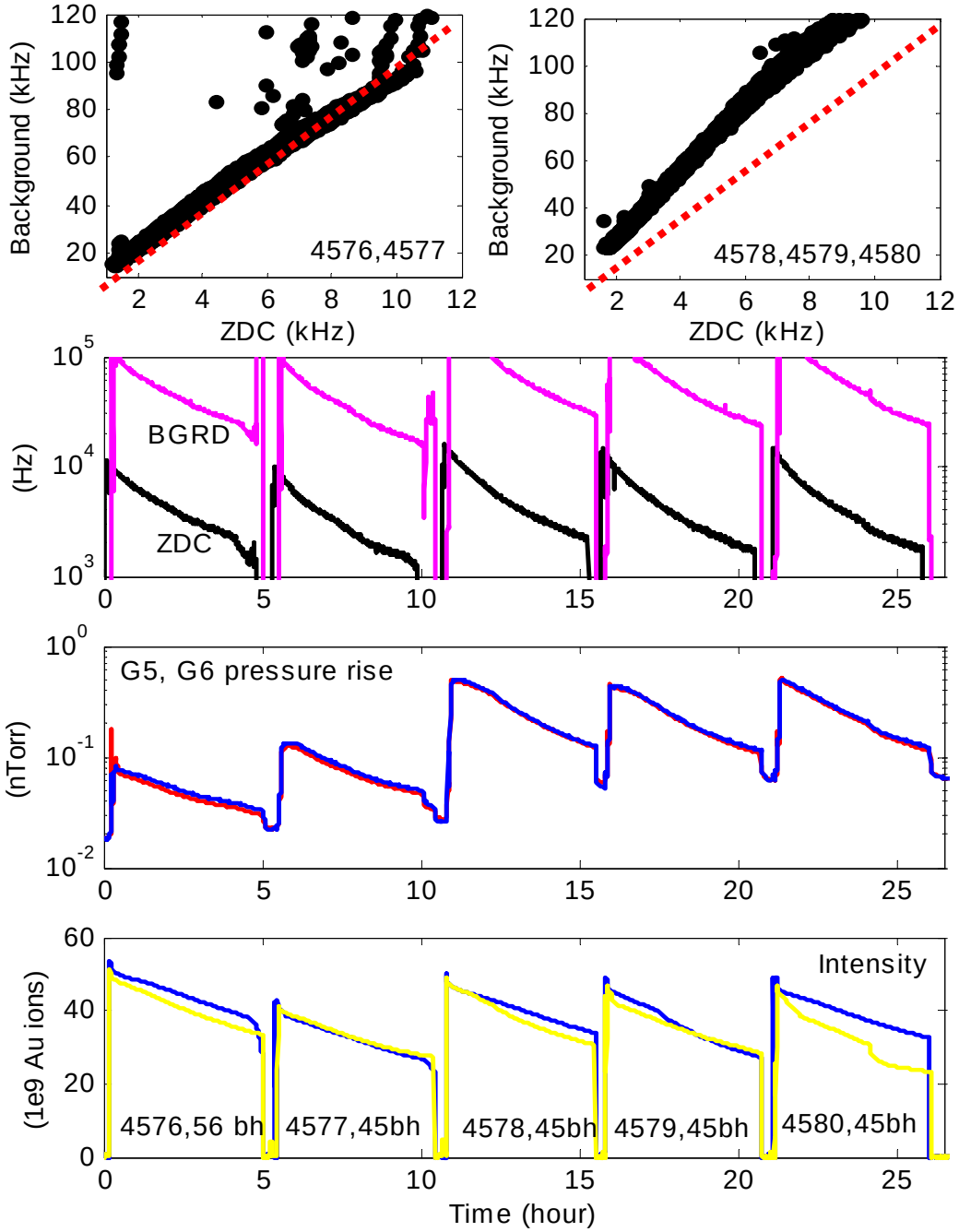
Emittance growth in ramping, intensity lifetime and emittance growth in store, luminosity lifetime.

APEX Workshop, November 2-3, 2006

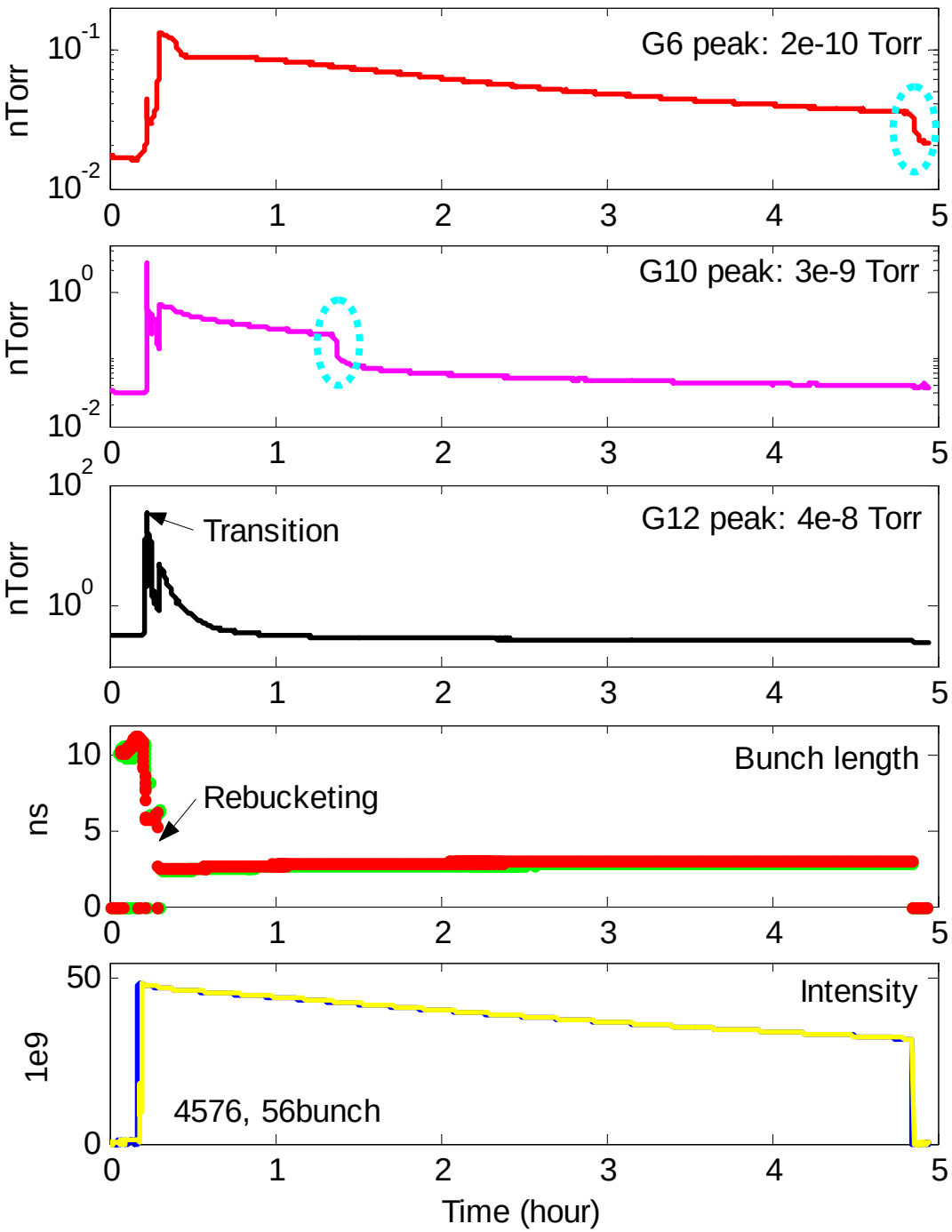


I. STAR background

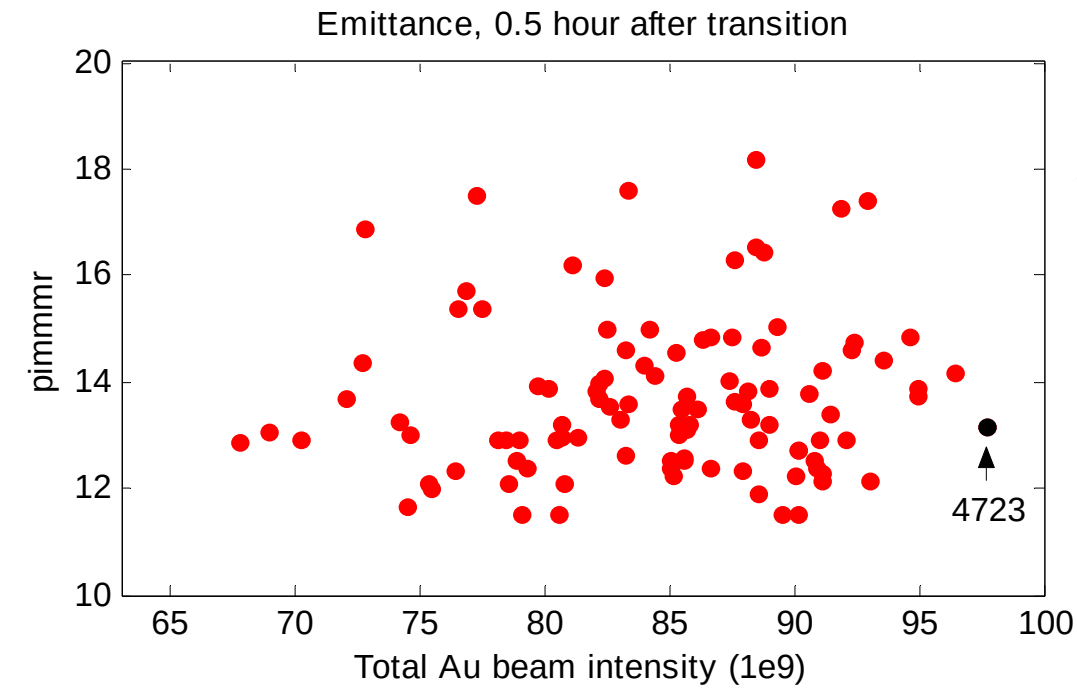
- **Beam intensity of past heavy ion runs was limited mainly by the PHOBOS background.**
- **STAR also had background problem in Au-Au Run4, during 4 or 5 periods of times.**
- **For G6 pressure, the lower envelop shows the static pressure, varying from 2e-11 to 1e-10 Torr. Some effect of sublimations.**
- **From this envelop to the peak is the dynamic pressure rise, starting from the beam rebucketing.**
- **Some correlation between the static and dynamic pressure rise.**
- **STAR background problem is from the large dynamic pressure rise.**

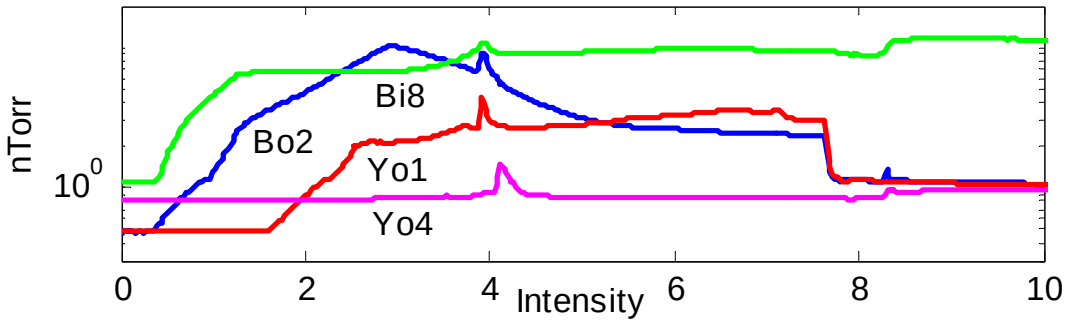


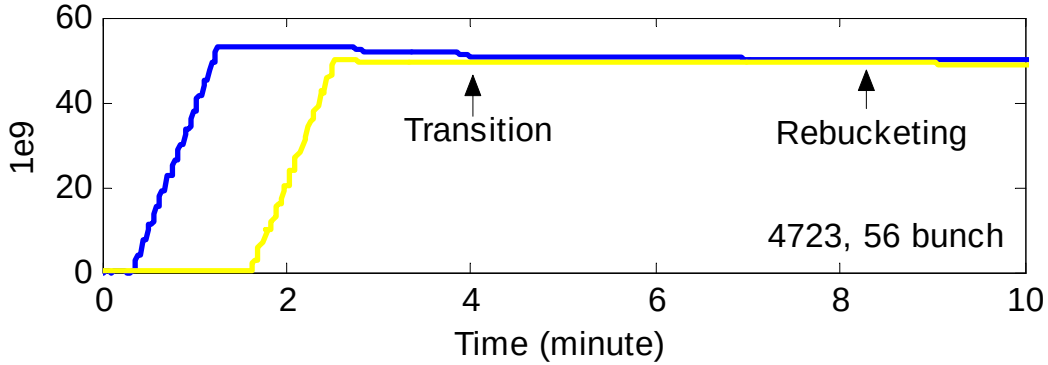
- **For fills 4576 to 4580, the STAR static pressure rises from 2e-11 to 8e-11 Torr, and the dynamic pressure rise is from 1e-10 to 6e-10 Torr.**
- **The STAR ZDC coincident rate (ZDC) is about the same, but for larger dynamic pressure rise, the background increased.**
- **The background/ZDC ratio of 4576, 4577 was about 10. It was > 14 for 4578 to 4580, where STAR had background problem.**
- **This background problem comes from beam-gas, shielding would not help.**
- **Questions remain, e.g. static and dynamic pressure rises for 4578 and 4579.**



- **For STAR, the rebucketing pressure rise was a main cause in Au-Au run4 background problem.**
- **The rebucketing pressure rise is believed due to electron cloud. At PHOBOS the large bunch spacing clearly helped.**
- **Compared with PHOBOS, the STAR rebucketing pressure rise was lower, but it stayed in full store.**
- **The sudden pressure drop in around 1.5 hours happened at PHOBOS and IP12, but not at STAR.**
- **Maybe because of the marginal beam conditions in Run4, many observations are difficult to explain.**

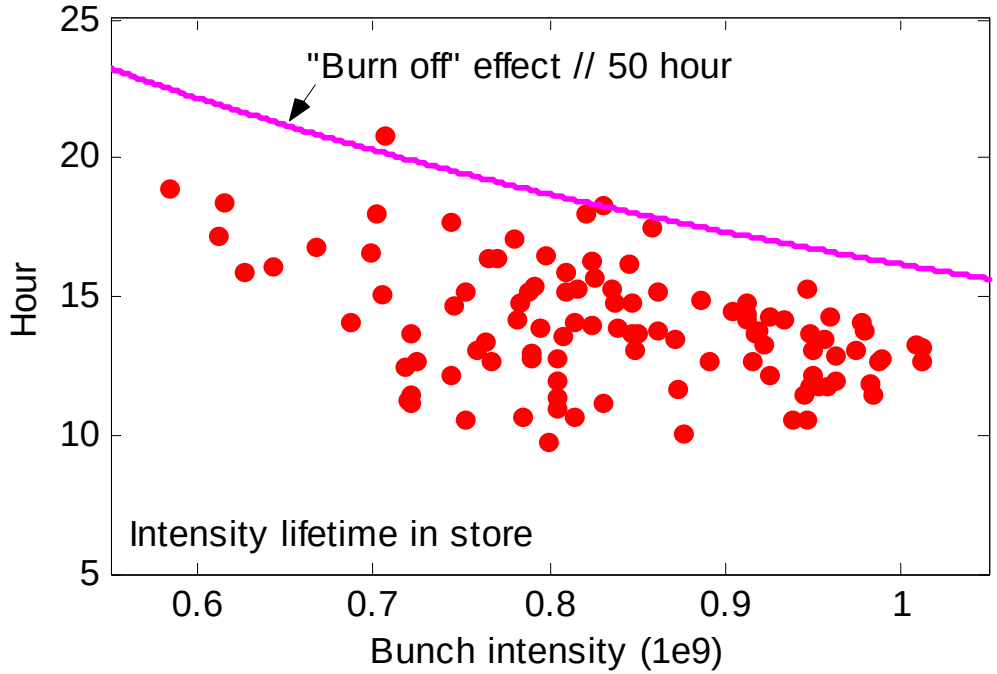


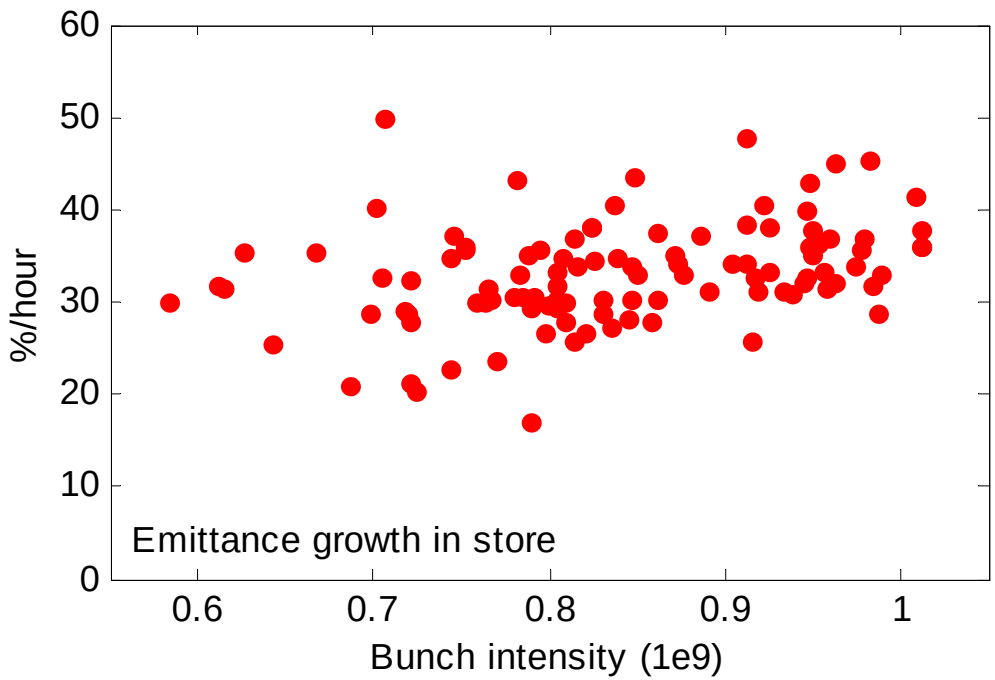




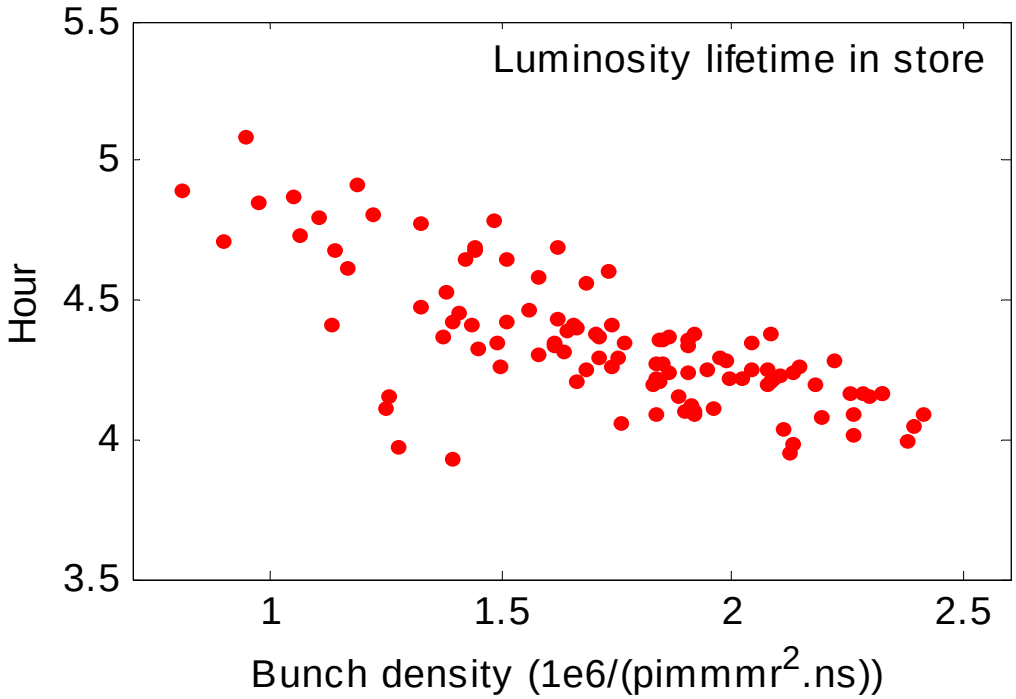
II. Luminosity issues

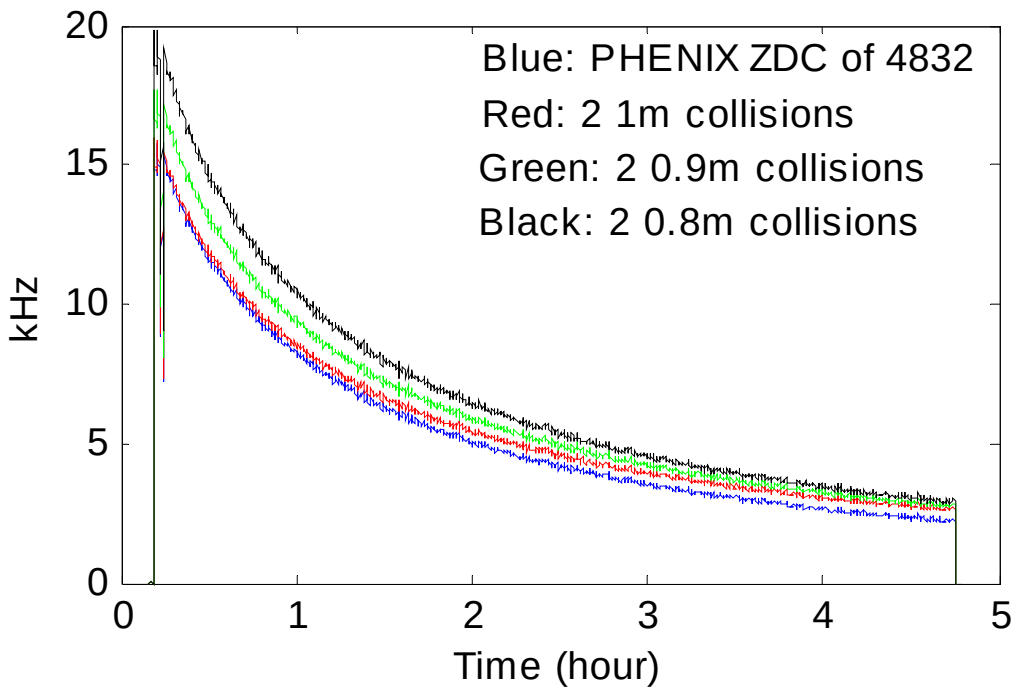
- **The Au beam emittance calculated from the ZDC coincident rate at early store (0.5 hours after transition) did not show growth with intensity increase in Run4.**
- **For 4723 with 56 bunches and almost the highest total intensity, only 4 Q3-Q4 sections had pressure rise.**
- **For proton beams having electron cloud induced emittance growth, the dynamic pressure rise takes place at almost all Q3-Q4 sections, except the fully NEG coated ones.**
- **It remains to see this emittance growth for more bunches in Run7.**





- **For Run4 in store, data are taken at 3.5 h after transition (early store is at 0.5 h).**
- **Intensity 'burn off' effect: 2 collisions at β^*= 1m, and two at β^*= 3m, with total cross section 227b (nuclear collision 6b, Coulomb dissociation, single and mutual, 96b, pair production with e^- capture 125b).**
- **The intensity lifetime in store is close to "burn off" plus typical proton intensity lifetime of 50 h.**
- **For Run7 with 2 β^*= 1m, 20% increase in intensity lifetime.**
- **The emittance growth rate is 30% - 40%/hour (average of early 3 hours). It is 3%/hour for proton beams.**





- **Luminosity lifetime in store (calculated from 0.5 h to 3.5 h after transition) follows a straight line with the 6D bunch density, suggesting the dominance of IBS induced emittance growth in store.**
- **The beam-beam parameter reached 0.0075 (4 collisions) in Run4 Au-Au. Is it relevant? Is beam-beam scattering relevant? A beam study by removing 1 collision: beam-beam effect on emittance growth, also to varify the 'burn off' cross section.**
- **ZDC of 4832 compared with the Run7 scenarios of 2 collisions: 1m, 0.9m, 0.8m. Assuming same emittance growth, but intensity lifetimes are different.**