PEP-II experiment on electron cloud and collimator wake fields from 16 May 2002.

Franz-Josef Decker, SLAC

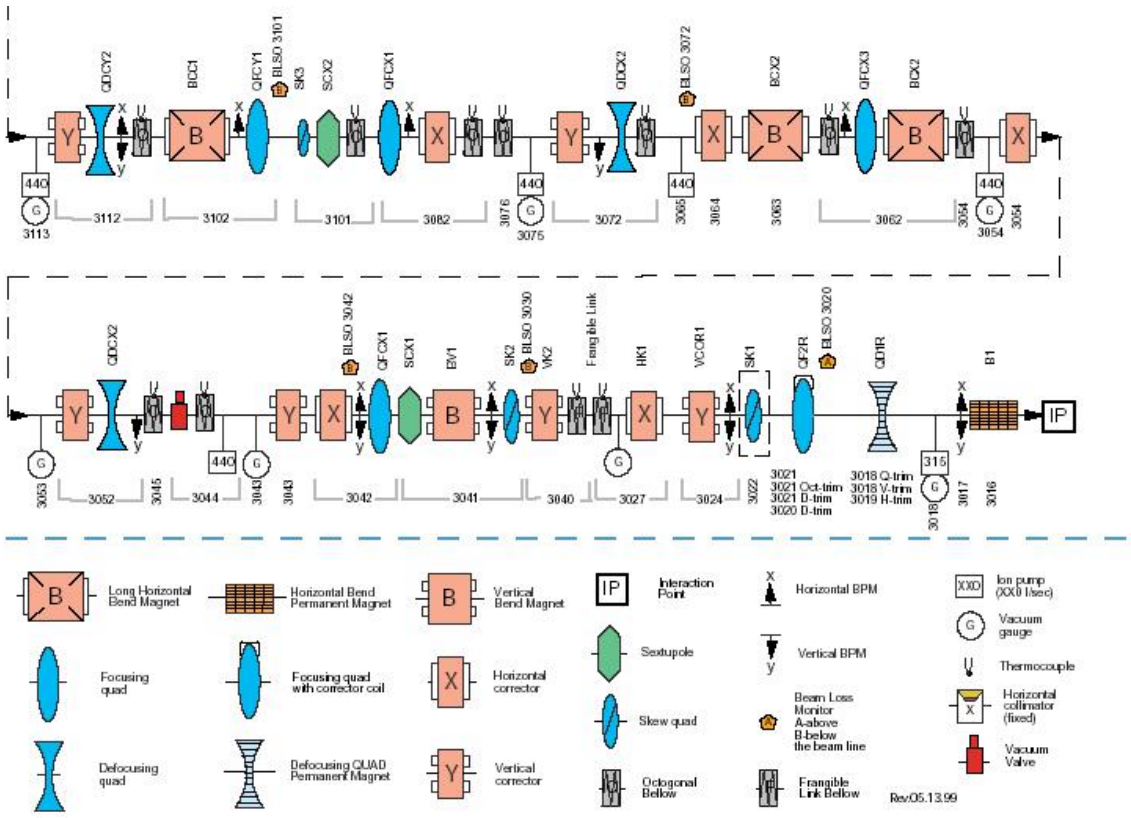
During normal colliding operations the collimators in the LER in PR02 (in front of the detector) were moved in about 3 mm to see if the generated wake field could have any effect on the electron cloud seen in the pump currents in between. The collimators are in x at 3077/3076 and 3044/3043. The observed pump current are from VP3044 (single), VP3054 (duplett with 3065) and VP3075 (duplett with 3081), see diagram of LER IR region. The base pressure is about 1E-9 Torr or below and goes up to 42E-9, 140E-9, 4E-9 Torr for the different pumps. So the first two see a strong electron current from the cloud while the last one might only see real vacuum.

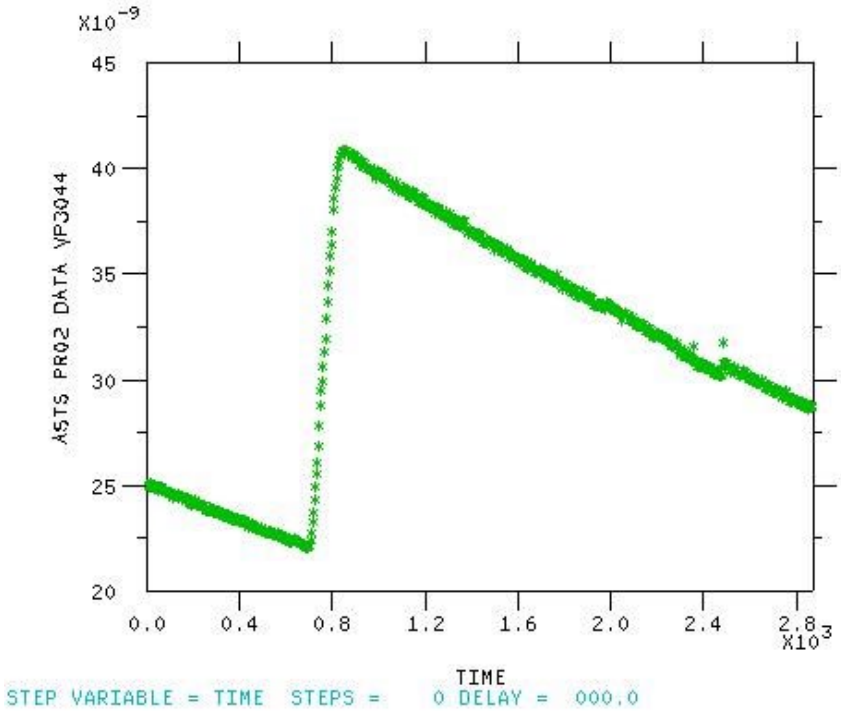
The observation was a pressure change by about 0.5E-9, especially visible in VP3075 (which is mistakenly labeled as VP3054.jpg down here). At about 1200-1400 sec the first collimator jaw was moved in (observing backgrounds, lifetime, loss rate), then the second between 1500-1700 sec, the third between 1900-2000 sec, the last between 2150-2300 sec.

All collimators got restored at once to their old values at 2500 sec. VP3044 sees a little of that restore, while at 3054 there is no signal.

It looks like someone did a good job designing these collimators so that they have a smooth slope up and down to the collimation, which suppresses the wake field generation quite a bit. On the other hand we see about a 0.5-1% effect AND it can REDUCE the vacuum reading, which is the opposite of what is expected from additional outgassing.

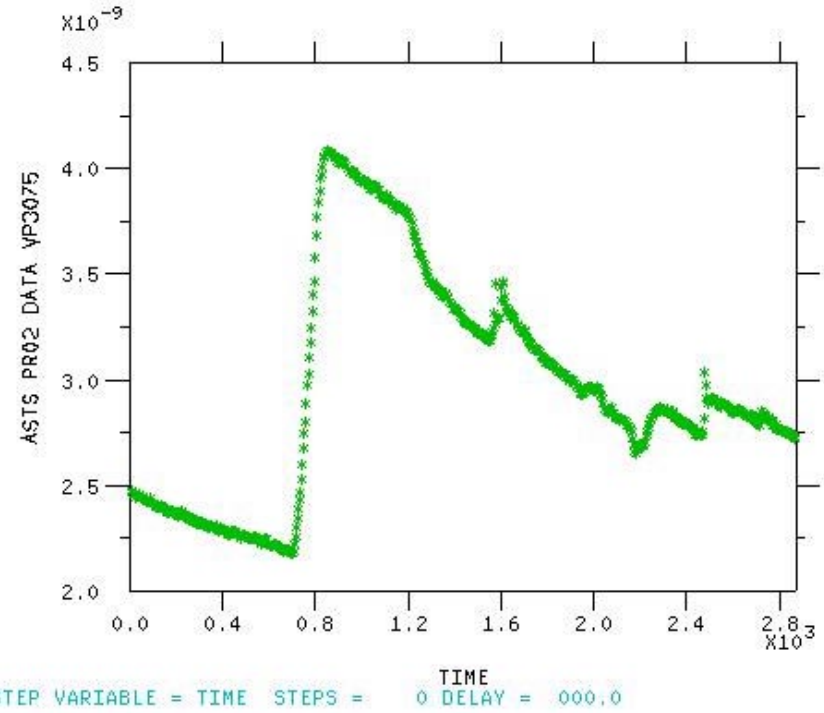
The bottom line is probably that we need to optimize the frequency of the wake field to see a clearer effect.





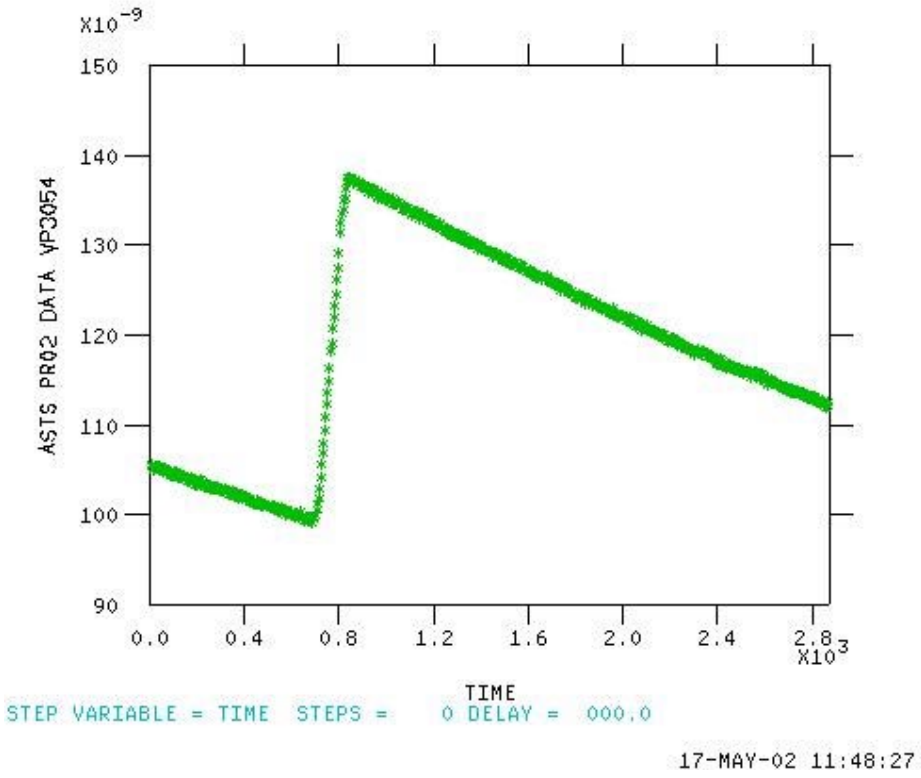
STEP VARIABLE = TIME STEPS = 0 DELAY = 000.0

17-MAY-02 11:49:52



STEP VARIABLE = TIME STEPS = 0 DELAY = 000.0

17-MAY-02 11:39:45



Background informations:

1. The electron cloud was killed >20 years ago in the ISR with 95% clearing electrodes.
2. So we thought we might do the same with an RF field.
3. The right RF field mode should be a "waveguide" mode or H-mode, which should not disturb the beam, but might clean up some electrons hanging around in a cloud.
4. So we need an input coupler (maybe BPM button), RF power 10-100W (maybe more), variable in frequency, phase, maybe chirp, etc.
5. And of course we need simulations.
6. BUT we can also make a quick test, which might be even non-invasive:
7. Modes as we know can be excited by mode converters like the movable collimators. So the two collimator pairs in PR02 might already doing this, trapping and RF mode between them with some power (are the bellows getting hot in that region?).
8. When we have now an electron cloud detector, like the vacuum pump reading, we (actually you) should be able to see any changes in that reading. (In the worst case when there is no electron cloud and therefore no reading right now we have to switch off the solenoid around there, which makes it more invasive). BUT no high reading right now might be not necessary a problem, since we might be suppressing electrons right.
9. The experiment goes like the following: Change the collimator jaws more out (find the ones which don't contribute too much to background reduction) and watch for ANY change in the pump current in that region.
10. Since the pump are shielded any change in RF should not reach them. The RF can only influnce the amount of electron going through the shielding.

This will most probably work, since it is not one of my original ideas, but it is from Fritz Caspers from CERN