BROOKHAVEN NATIONAL LABORATORY

Pressure Rise Studies

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I. NEG Coated Pipes

II. Anti-grazing Ridges

III. Transition Pressure Rise

IV. Rebucketing Pressure Rise

V. Cold-bore Pressure Rise

VI. Ion Desorption

VII. Phobos Magnet Effect

RHIC Beam Experiments Workshop, September 16-17, 2004

I. NEG coated pipes

1. Large scale application at RHIC

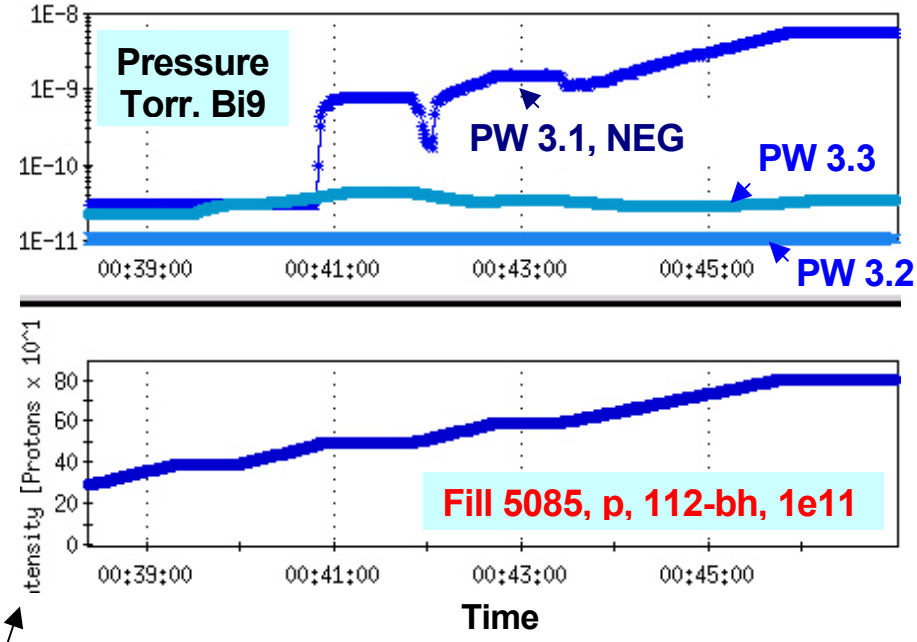
- 60m installed in '03, 200m in '04, and more is planned for '05.
- Not only in Q3-Q4, but also in IR.
- Activation, re- activation, and saturation, aging, ...
- Pumping, SEY, electron and ion desorption, ...

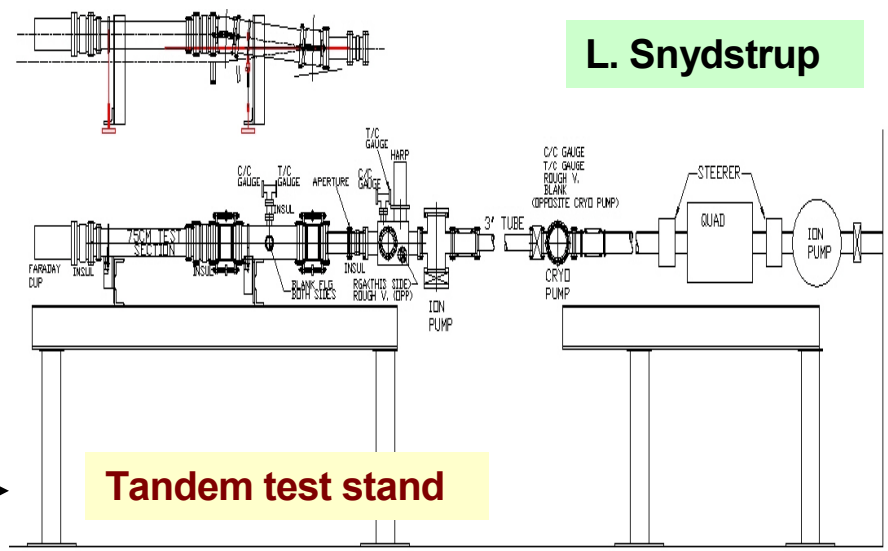
2. Evaluation in Run-4

- Slow loss, warm dipole, one- turn shot and 112-bunch high intensity beams were used for evaluation.
- Results were in general positive, but with exception: Bi9 in 2 cases of electron multipacting.

3. Plan for Run-5

- Evaluation by beam study.
- Develop NEG coating at BNL.
- Tandem test stand for evaluation - also for activation study?





II. Anti-grazing ridges

1. RHIC installation

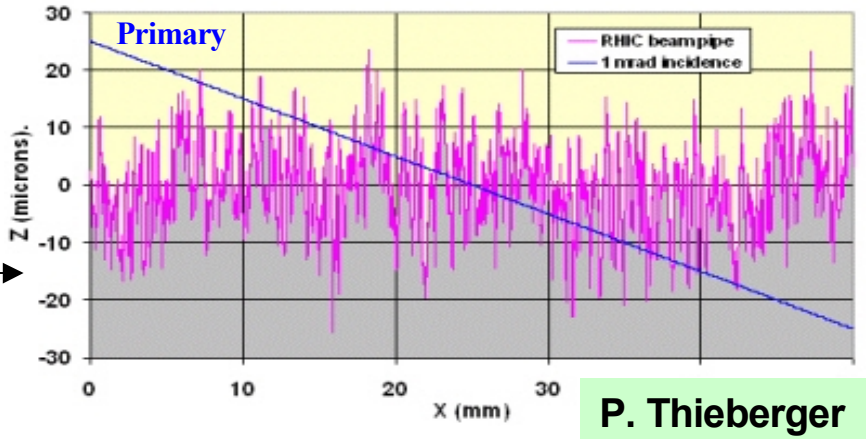
- Five ridges each installed at Yo5 and Bi5 for test.
- Beam grazing angle scraping produced ions are suspected to be responsible for RHIC warm electron cloud. If true, then anti-grazing ridges may help.

2. Evaluation in Run-5

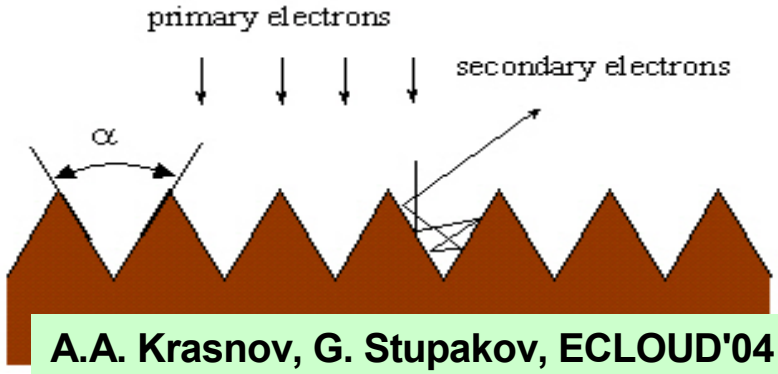
- Slow loss, warm dipole, one- turn shot and 112- bunch high intensity beams are planned for evaluation.
- Electron multipacting type pressure rise is the most important evaluation.
- Aperture limitation study.

3. Surface as one aspect in EC cure

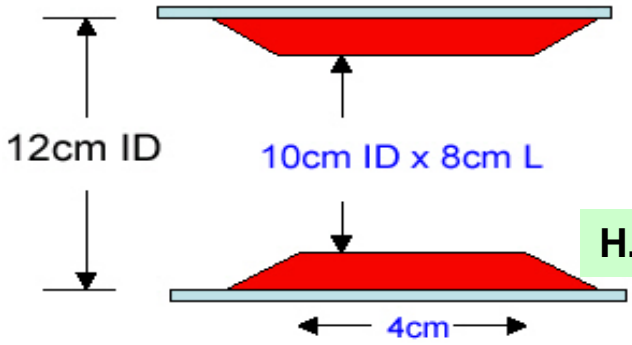
- Serrated and grooved surfaces are in application and/or under study.
- Anti-grazing ridge is a new addition, which is perhaps more relevant for RHIC warm section electron cloud.



P. Thieberger



A.A. Krasnov, G. Stupakov, ECLOUD'04



H.C. Hseuh

III. Transition pressure rise

1. Experiment background

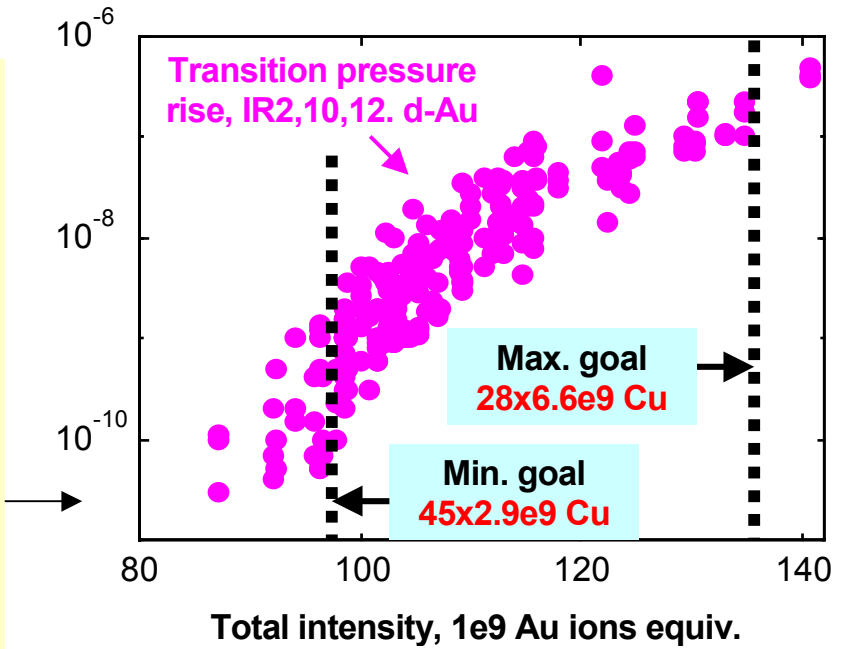
- Transition pressure rise affected experiment background in d- Au run.
- In Run-4 Au-Au operation, transition pressure rise was also relevant at highest intensities.
- It is of concern in Cu-Cu run because of 96e9 to 136e9 Au equiv. intensities.

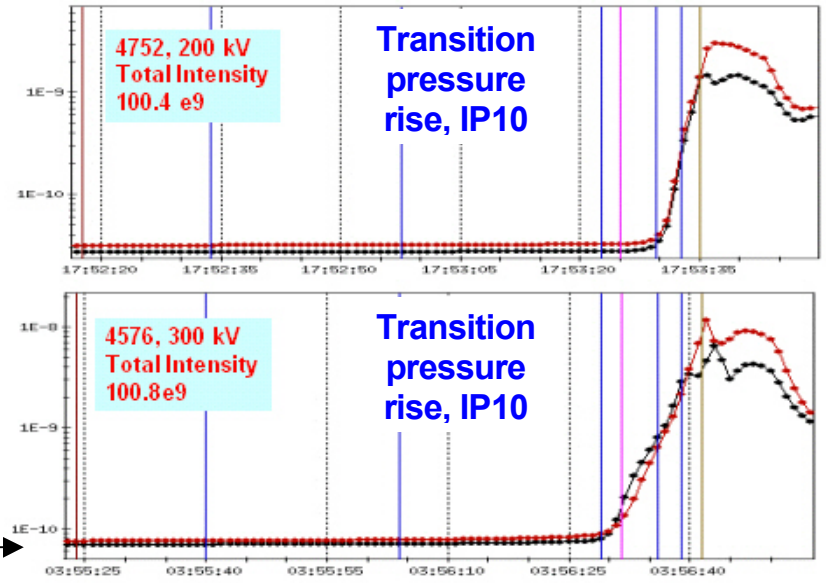
2. Experience in Run-3 and Run-4

- Transition pressure rise is related to total beam charge intensity.
- Not tightly related to bunch spacing, ion species and beam loss.
- Might be caused by halo scraping associated with beam momentum spread.

3. Plan for Run-5

- Copper operation may provide better understanding.
- Further study, such as the RF voltage effect?





IV. Rebucketing pressure rise

1. Experiment background

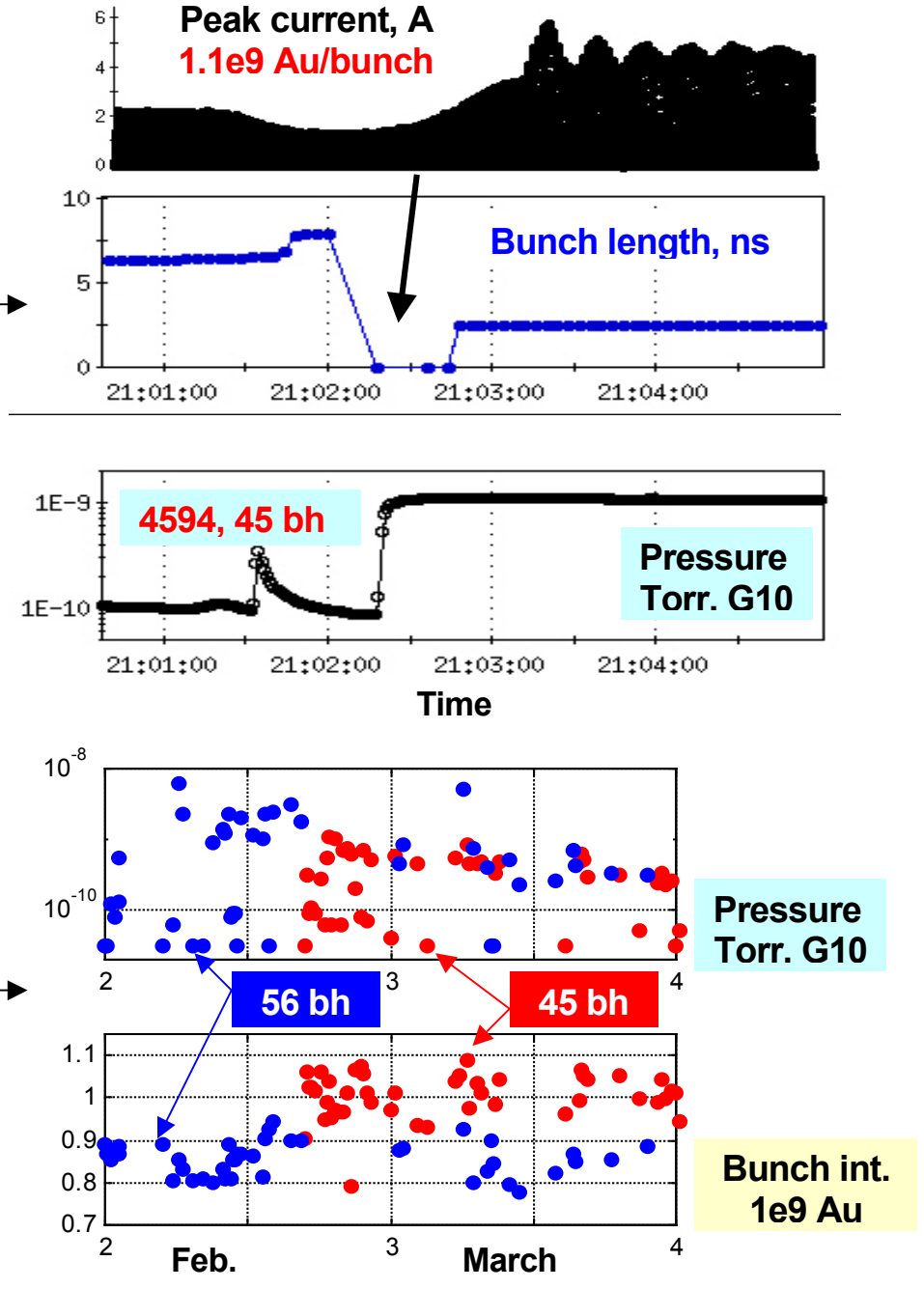
- Rebucketing pressure rise directly affected experiment background in Run-4 Au-Au operation.
- This problem will be more serious along with the improvement in the beam rebucketing.

2. Questions in Run-4

- Effects of bunch intensity, length, and bunch spacing are better understood as for normal electron multipacting.
- The effect of vertical bump at the Phobos is not as well understood.
- Sudden pressure drop at IR10 and IR12, but not at IR6.

3. Mitigating the problem

- Larger bunch spacing helped in Run-4, agreeable with understanding of normal electron multipacting.
- Possible cure from the understanding of RHIC warm EC?



V. Cold-bore pressure rise

1. Cold pressure rise is relevant

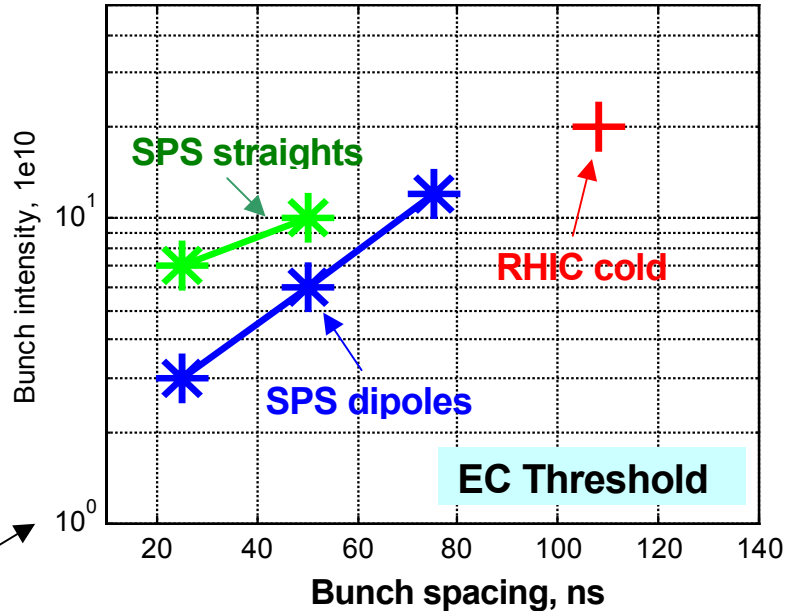
- It could be a problem to RHIC design of 112- bunch, 2e11 protons/bunch.
- It will be an e-RHIC intensity limit.

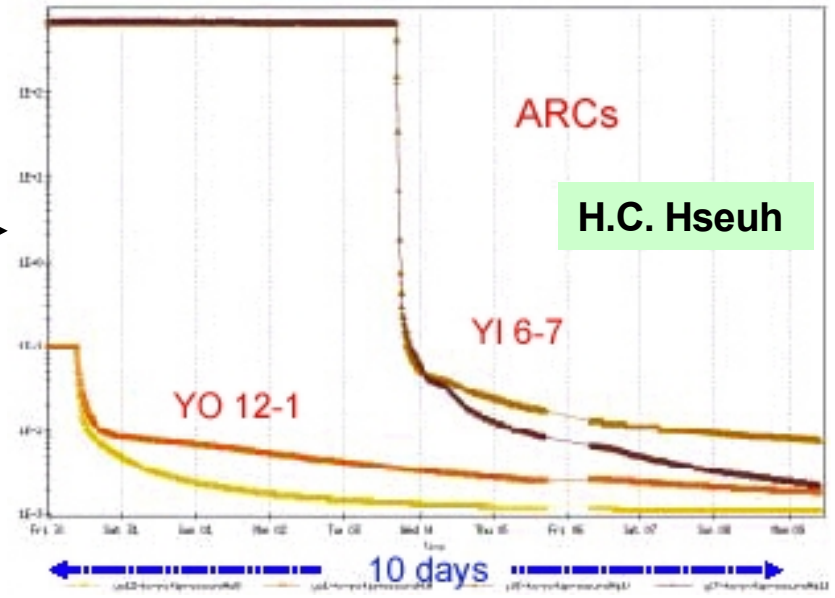
2. Observation and questions in Run-4

- Pressure rise observed for 112-bunch high proton intensity study 5350.
- Interpolation into SPS dipole electron cloud threshold shows that this could be a normal EC.
- Gas density at cold bore needs to be confirmed.
- No heat load was detected.

3. Preparation of study in Run-5

- Pumping to < 1e-2 Torr before cool down to reduce the physi-sorbed gas to sub-monolayers at some locations, for comparison.
- Heat load and pressure observations will be modified for study.





VI. Ion desorption

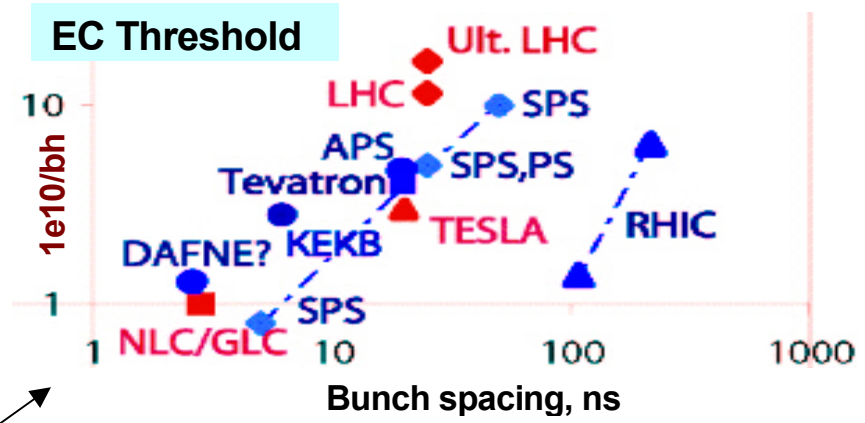
1. Relevant to RHIC intensity limit

- Broad interest in many physical societies, usually normal incidents.
- Intensity limitation of some heavy ion accelerators, scraping incidents.
- Large ion desorption may be related to the RHIC run-away pressure rise and warm section electron cloud.

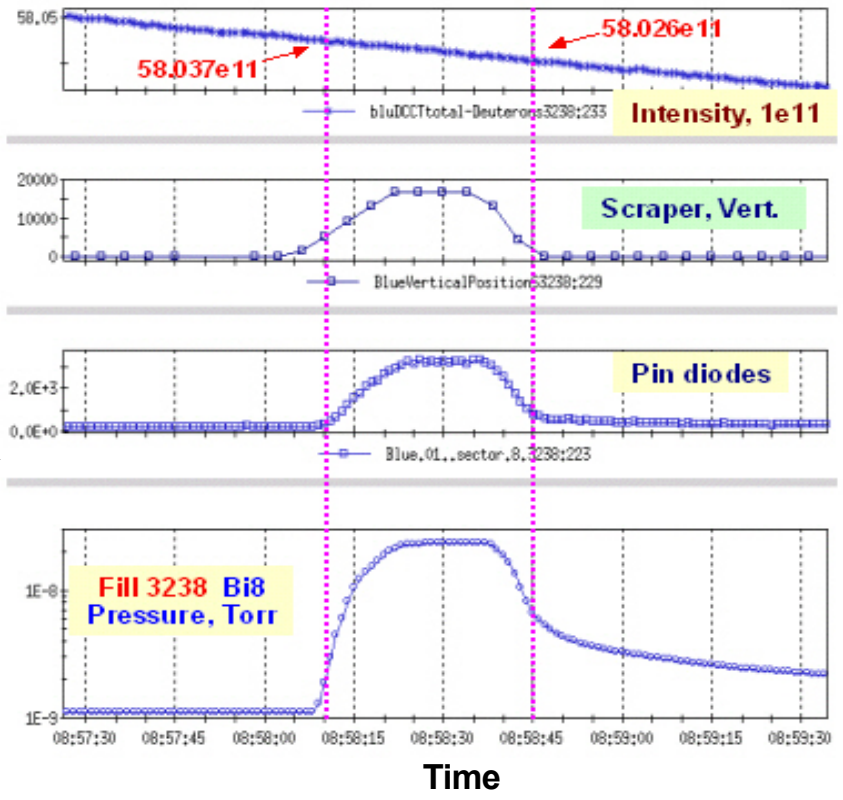
2. Observation at RHIC

- Large ion desorption was observed for run- away pressure rise and loss related pressure rise, but EC and non- beam ions may contribute.
- Cases of collimator scraper induced pressure rise imply very large ion desorption rate, without interfering factors.
- Run-4 warm dipole and one- turn shot study results show that further investigation is needed.

3. ATR SEY and ion production study?



F. Zimmermann, ECLOUD'04



VII. Phobos magnet effect

1. Observation in Run-4

- In Au-Au run, pressure dropped when the Phobos magnet ramped down. Also, no rebucketing pressure rise if the magnet is off.
- In p-p run, pressure dropped when the magnet ramped up.
- Possible application in operation, ramp up magnet later in Au-Au run, ramp up earlier in p-p run?

2. Questions

- Quadrupole effect in electron trapping and electron multipacting.
- Location of electron multipacting in the Be pipe is not clear.
- Pressure rise situation deteriorated in time, but some scrubbing effect seems in place (page 5)?

3. Study in Run-5

- Study will be incorporated with the experiment and operations.