Emittance exchange measurement with fine decoupling

Yun, Mike, Al, Michiko

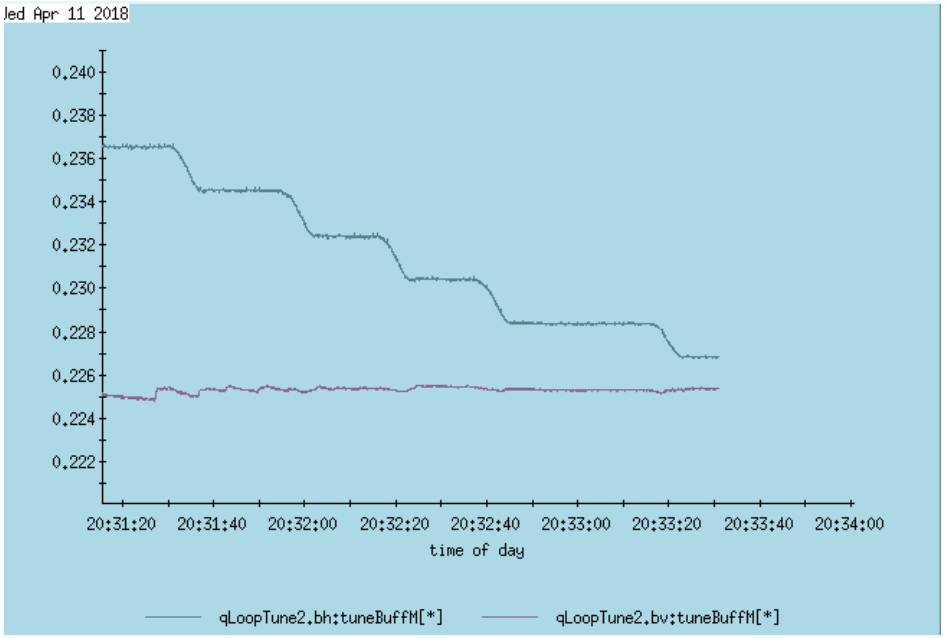
2018 April 11 AEPX Session

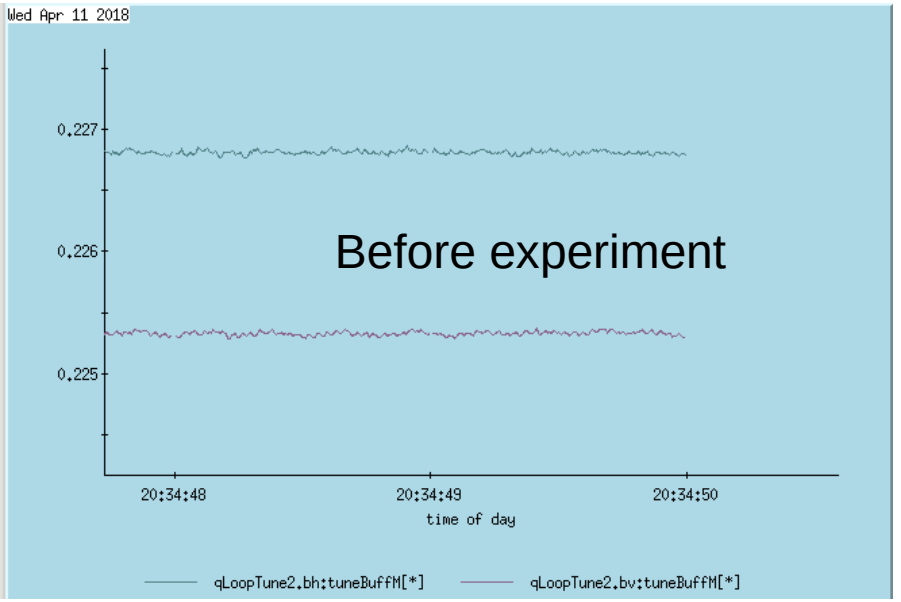
General Information

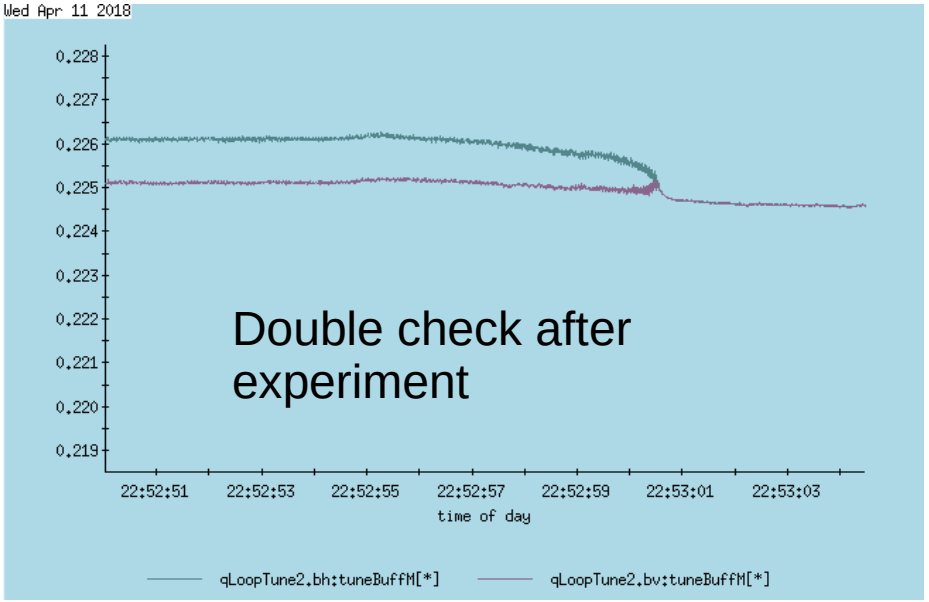
Fill 21587

- For eRHIC design, the proton transverse emittances differ by factor of 2-2.5. Since tunes are (0.31, 0.305), we need to avoid emittance exchange by coupling.
- We had 4 hours. 111*111 Ru+ bunches. We focused on Blue ring with robust BBQ and reloable IPM emittance measurement.
- We first check the minimum tune split ~0.001-0.0015.
- Then we measured emittance exchanges between H & V plane with various experiment condition.
- This experiment proposal is COMPLETE (if no objection).

Minimum tune split dQmin

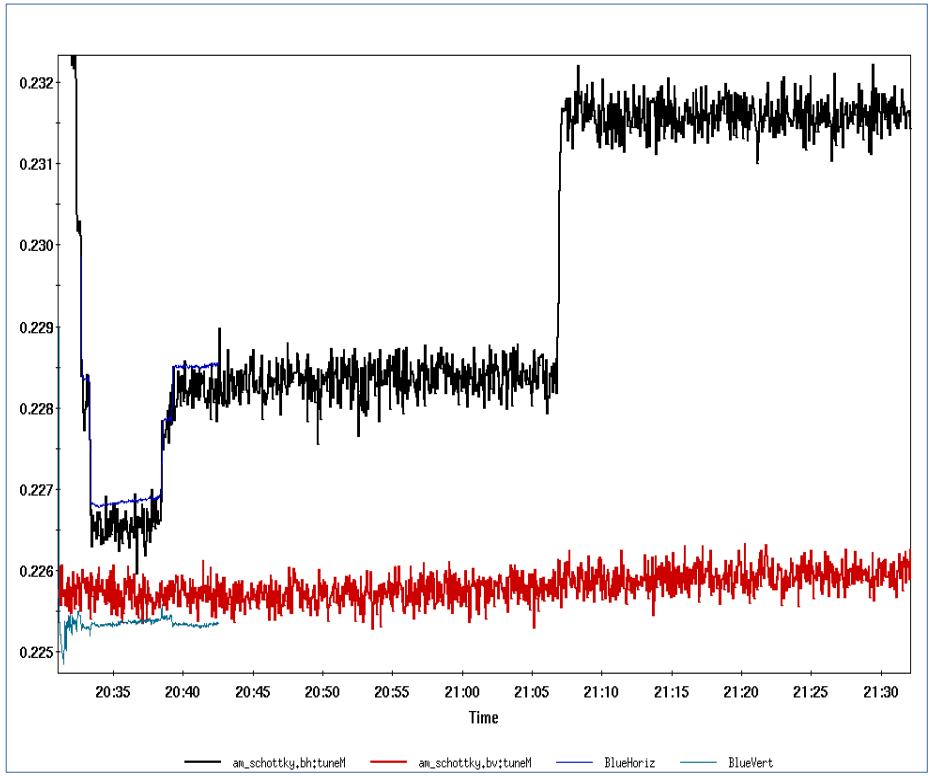


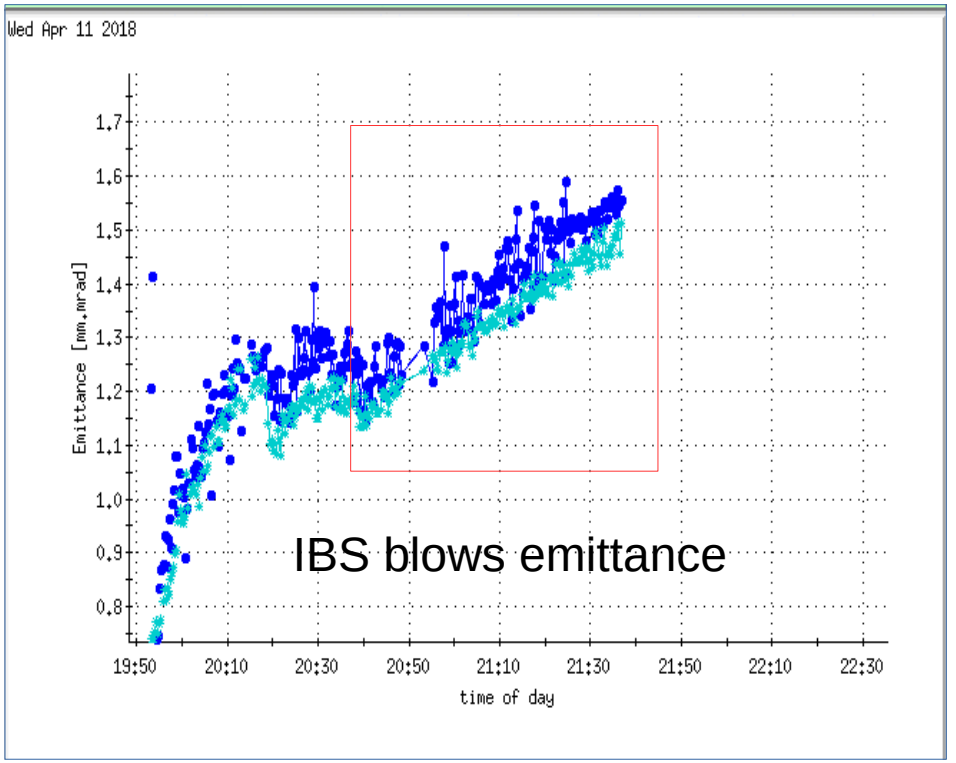




The minimum tune split is about 0.001 - 0.0015 .

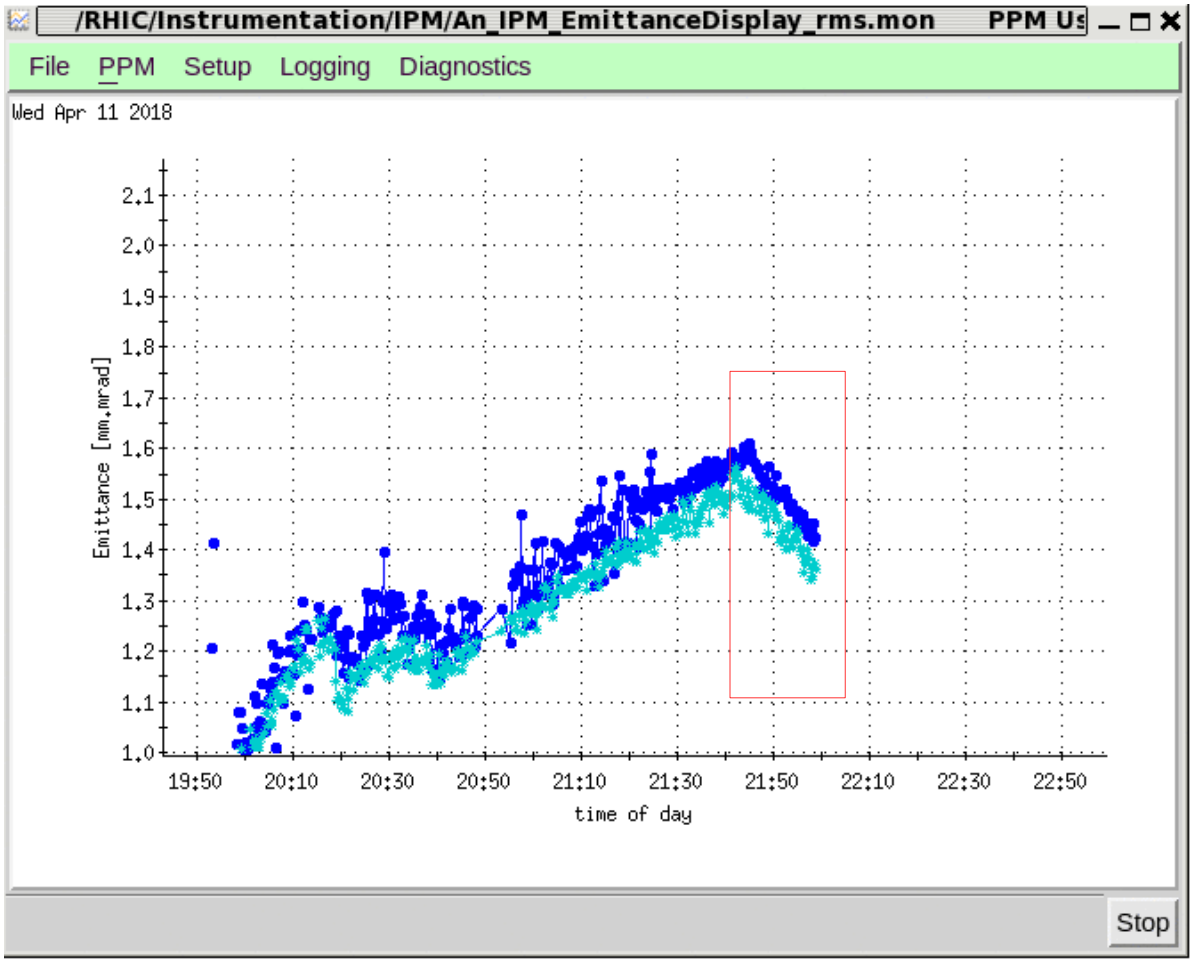
With L cooling, without H & V cooling





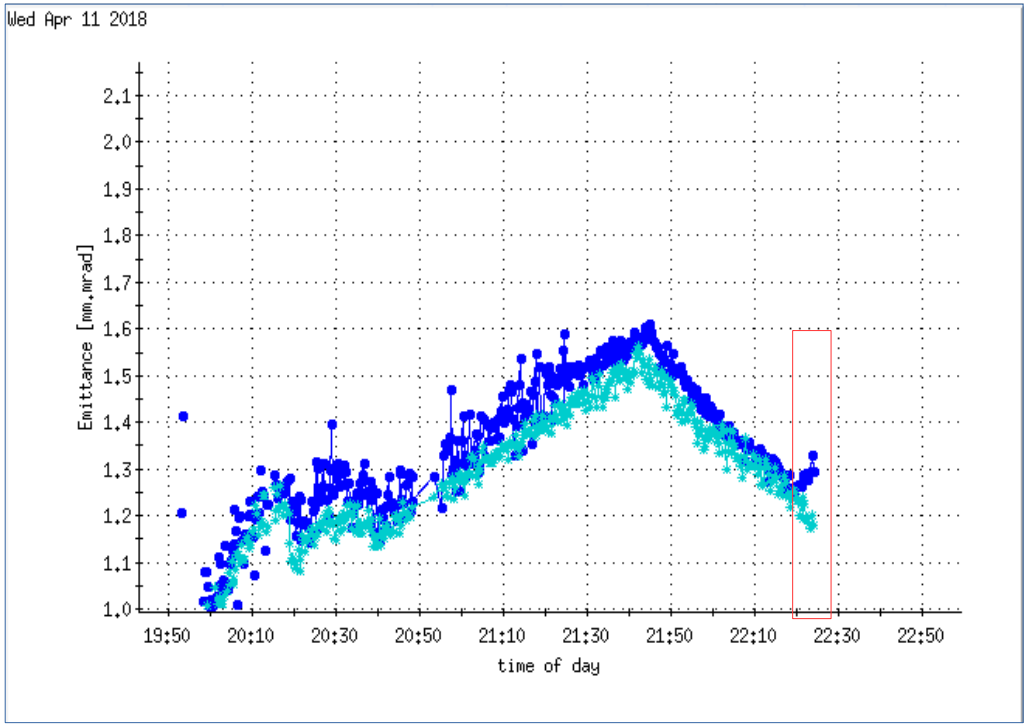
We were able to get the blue tunes within 0.001, then we used the tune quads to split the tunes by 0.003 and now they are split by .0056 yet we see full coupling in the IBS.

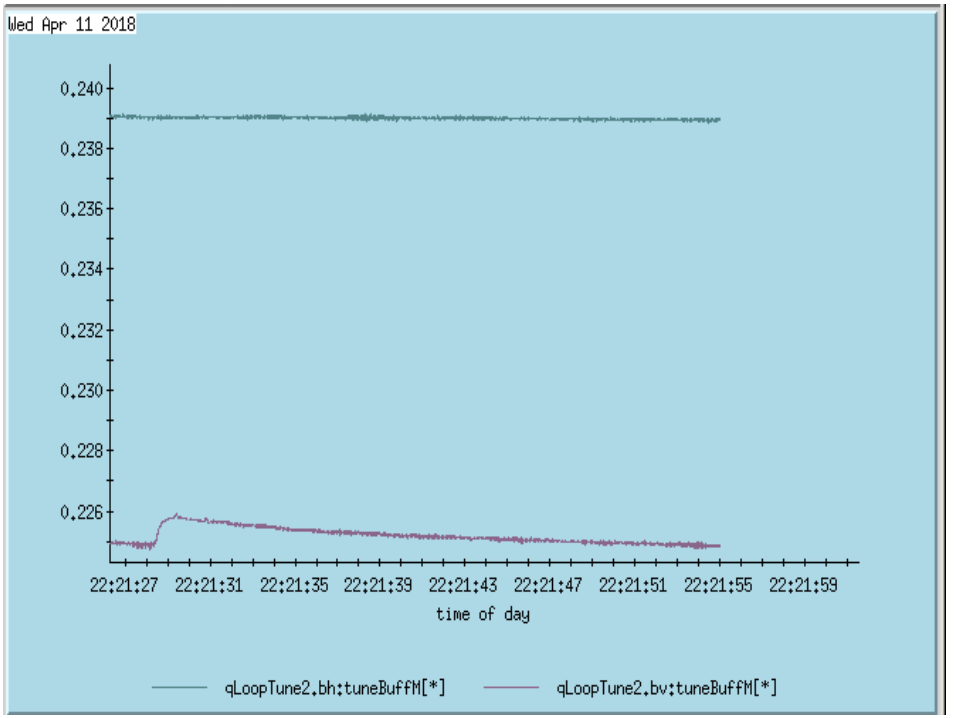
L& V cooling on, H cooling off



With V cooling and H cooling off, we observed both H & V emittances got cooled and continued sticking to each other.
Tune split ~0.003, 0.006, then 0.0015 were all tried. Vertical dispersion was measured, maxi. peak ~0.2meter. Local coupling caused emittance exchange?

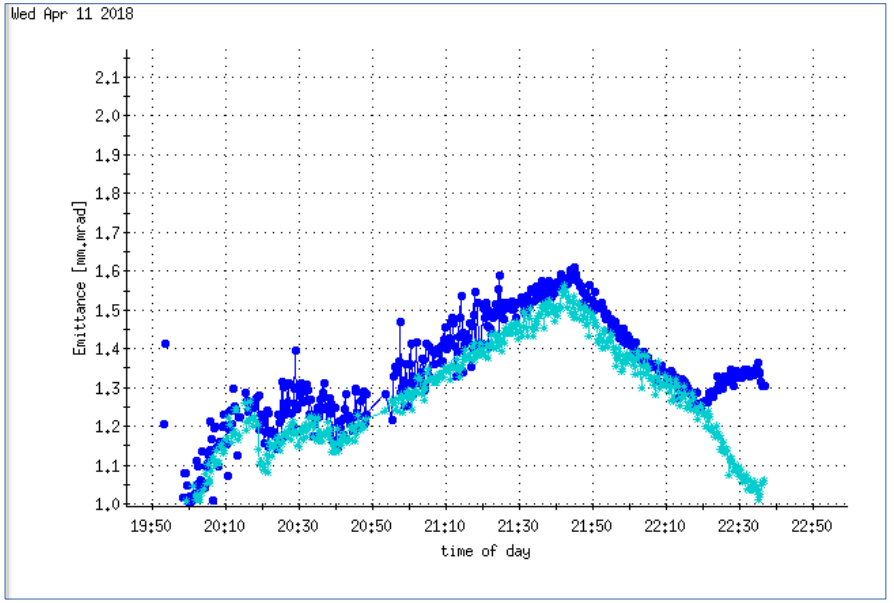
With even larger tune split

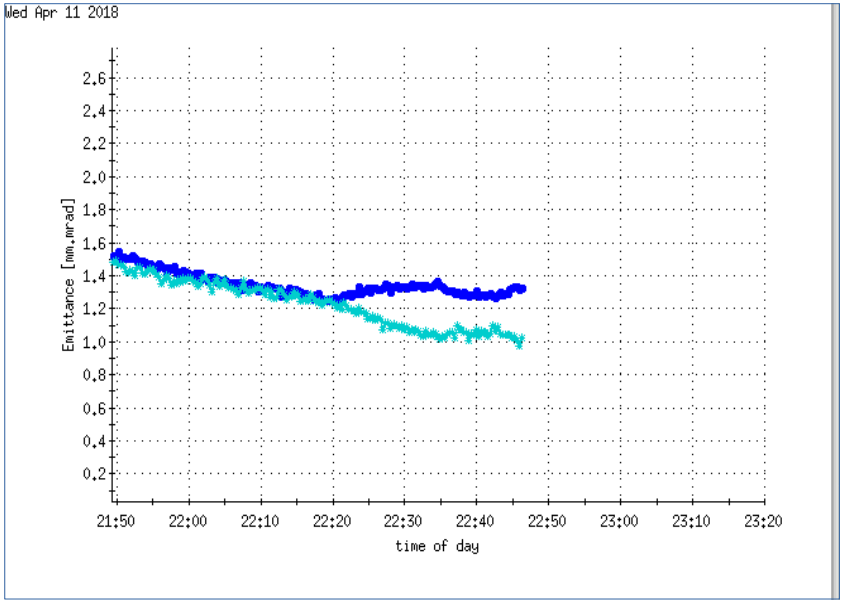




Then we turned to operational tune settings, H and V emittances are not exchanging ! Here tune split is ~ 0.014 !

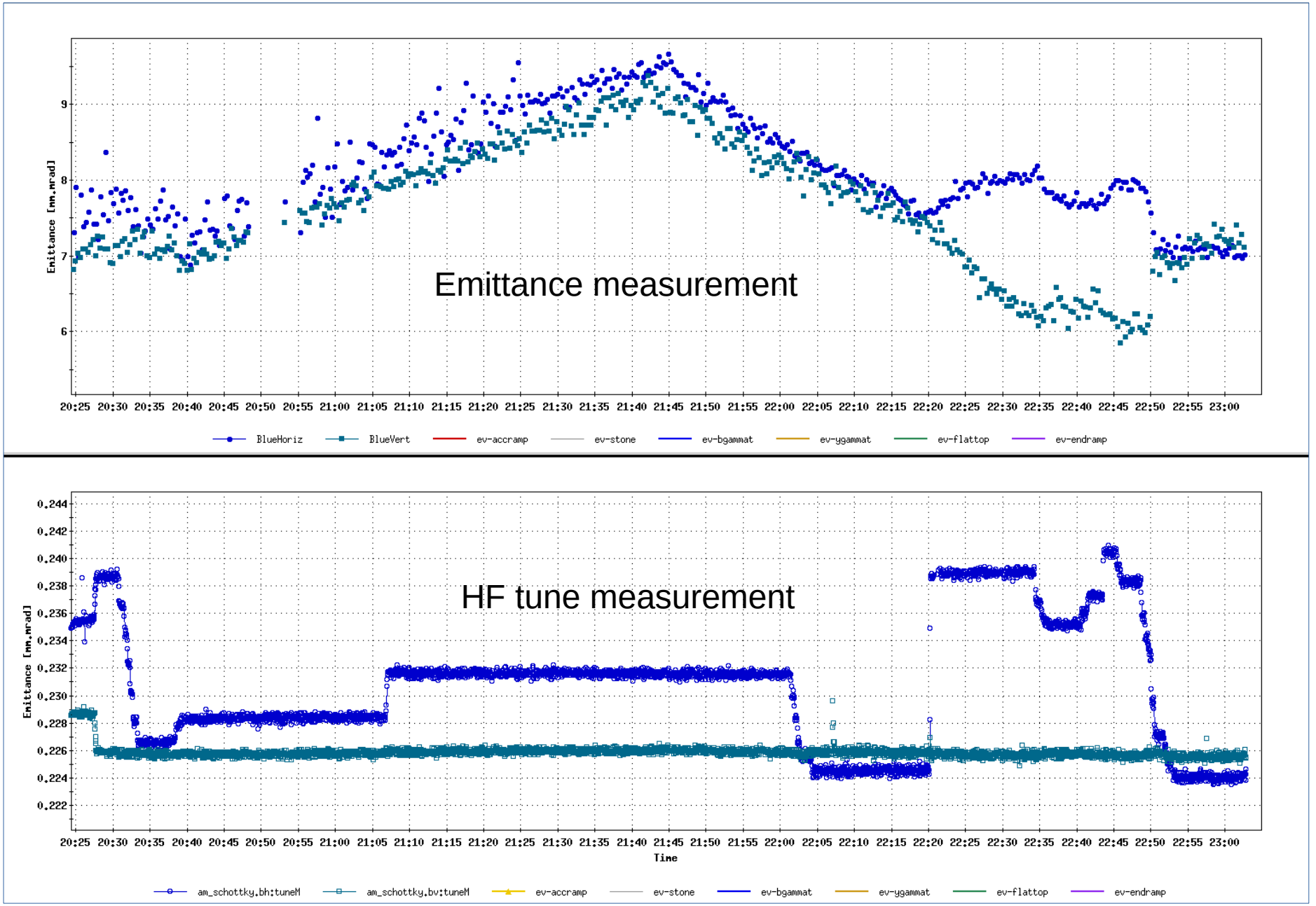
Searching critical tune split





We found when |Qx-Qy| > 0.013, the H & V emittances won't couple to each other. Note the measured dQmin ~0.001-0.0015.

Whole story in one plot



Summary

- We measured the emittance exchange with different coupling settings.
- After many tries we found when |Qx-Qy| =0.013, the transverse emittance will not exchange.
- The measured minimum tune split or so called dQmin ~ 0.001-0.0015.
- To achieve |Qx-Qy| =0.005 for eRHIC proton with different H and V emittance, dQmin **probably** needs to less than 0.0005, which we couldn't reach at this moment.
- dQmin ~ 0.0005 **probably** is a factor of 2 smaller than what we demonstrated in RHIC. We should continue improving global and local decoupling to achieve this goal.