Tune/Orbit/Chromaticity Stability

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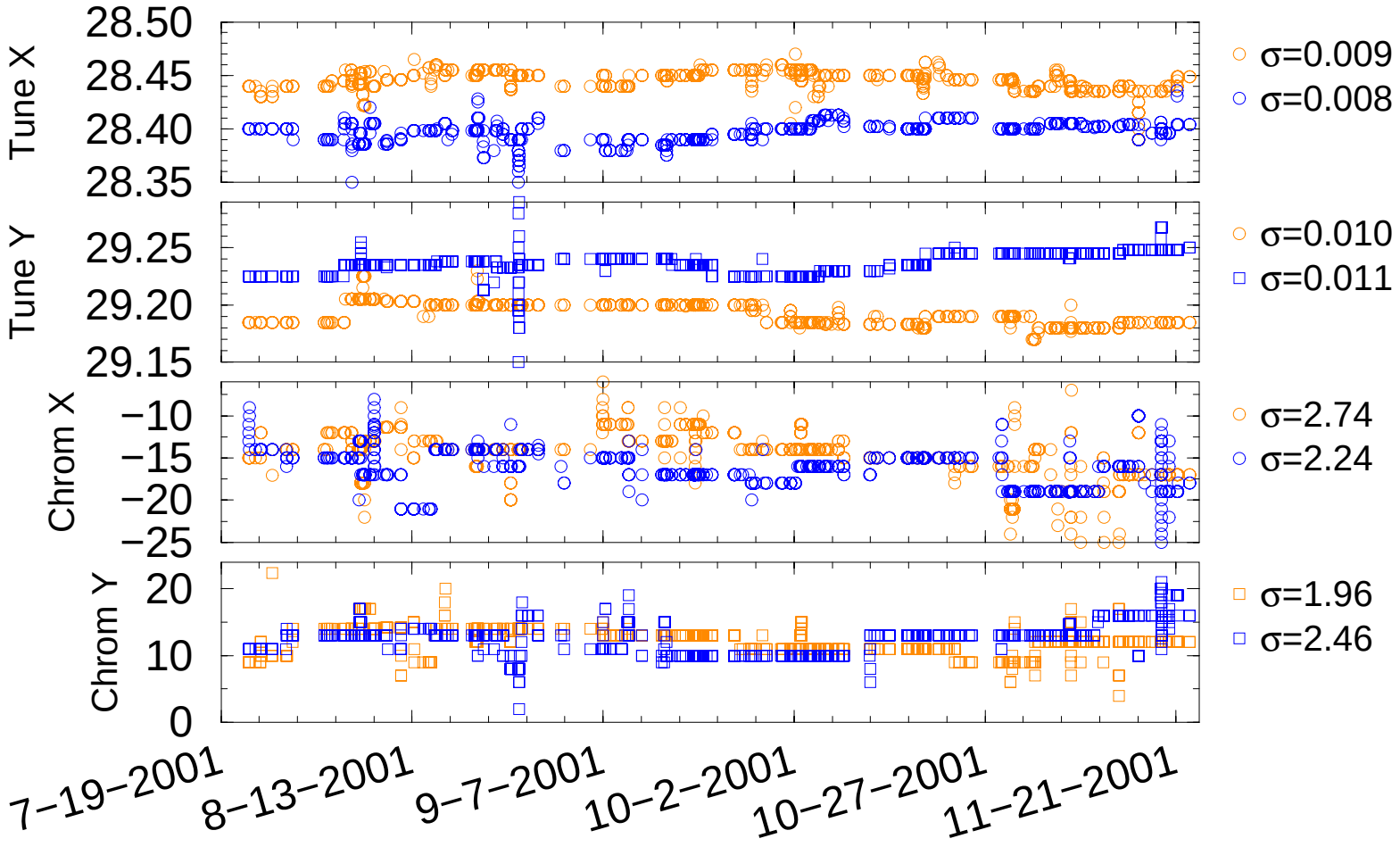
- Summary and Some History
- Tunes and Chromaticities
- Orbits and Steering
- Recommendations

- **Tunes**
  - *ΔQ was quite reliable (caveat coupling)*
  - *Did the difference between set and measured tunes drift?*
  - *Were production tunes consistent from ramp to ramp?*
- **Chromaticities**
  - *A major item: snapback, transition, instabilities, ...*
  - *No show stoppers, but no operations-ready feedback and not mature*
- **Orbits**
  - *Global orbit corrections c. 1/week*
  - *Orbit behavior (cf. `OrbStat`) reproducible/tunable at 1 mm level*
  - *Beam-beam separations generally were reliable (caveat sequencer)*
  - *Often spend 15-30 min in IR steering for luminosity*
  - *Orbit/BPM reliability thoroughly tangled (cf another talk)*

Injection: Set Tunes and Chromaticities



✓ *No (real) evidence of aimless wandering or long-term drifts*

- *Blue/Yellow tune differential signature looks provocative*

Tunes: (Biased) Observations

- **ΔQ set vs measurement**
  - ✓ *Comparable of typical stepsize, $\Delta Q = 0.0005 - -0.001$*
  - ✓ *Tune noise must be much lower (cf. PLL, little modulation!)*
  - *Comparison between flattop optics not done yet, data in hand*
  - *Long term drifts?*

- **Tunes up the ramp**
  - ✓ *Consistently reproducible at measurement level, ≈ 0.005*
  - ✓ *Proof: Ramp tuning was very predictable, even for $\vec{\mathrm{p}}$-$\vec{\mathrm{p}}$*
  - ✓ *PLL/tune feedback should demonstrate even better behavior*

- **Should also settings/measurement plot for storage stones**
  - *Expect few surprises, but does yellow/blue correlation trend?*

- **Major reliability issues here kill the machine anyway**
  - *Main quad PS failures, serious regulation issues, ...*

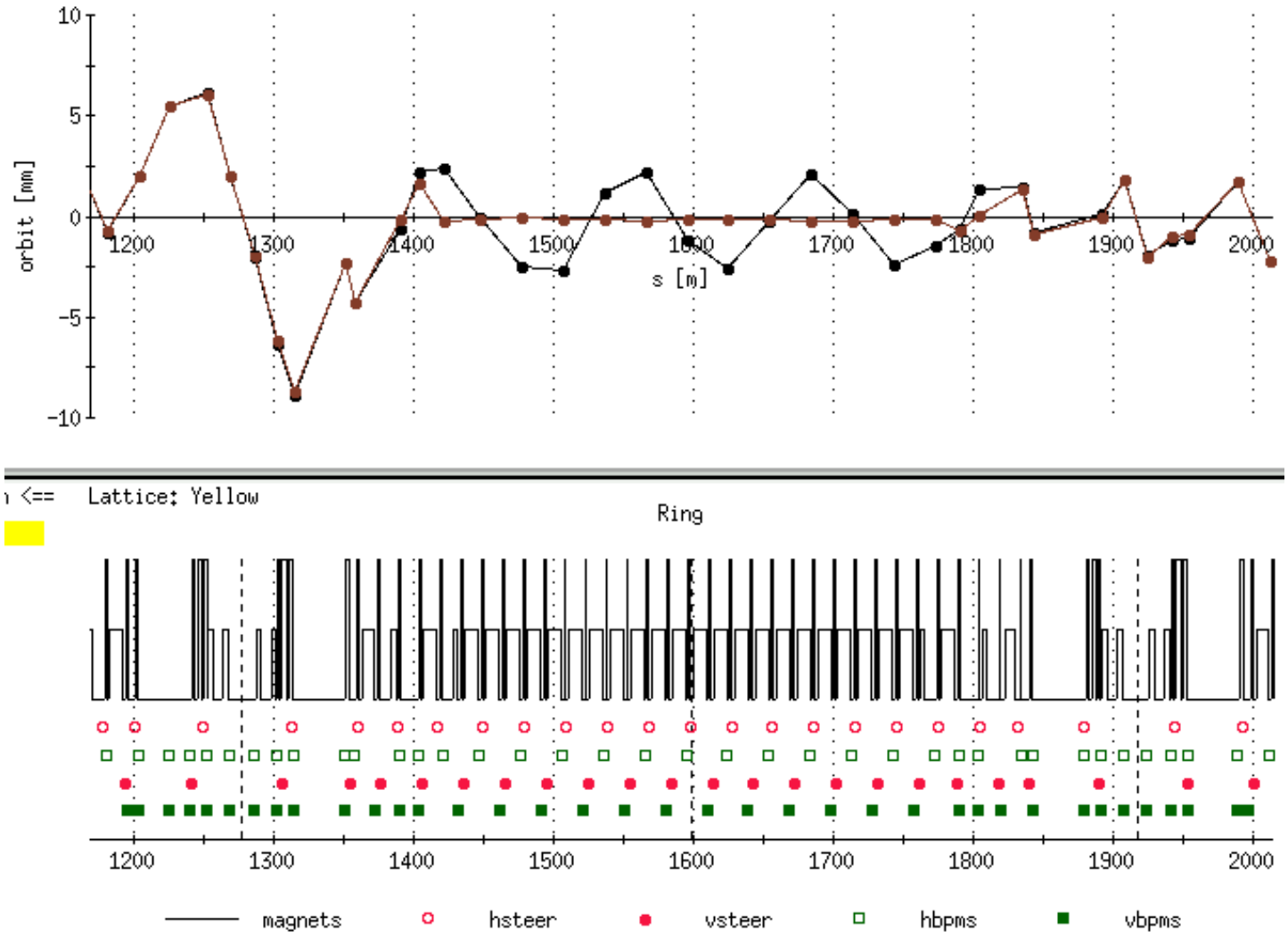
Chromaticities: (Also Biased) Observations

- **Chromaticity not measured routinely (always destructive)**
  - ✗ *Hard to make quantitative conclusions* ⇒ **inherently unreliable?**
  - *Many arguments even about sign of chromaticity!*
  - *Dispersion is crucial for flattop aperture, measurements*

- **Transition requires clean chromatic control**
  - *Difficult to measure, difficult to control*
  - *Few-unit tolerance can easily confuse instability issues*
  - *Fast jump of transition chromaticities sounds promising*

- **Control issues at low-field, through snapback**
  - *Fortunate snapback is not a major issue*
  - *Typical injection current 0.7A/50A; regulation issues?*

Typical Orbit Correction Effectiveness (Jul 31)



Orbits: (Biased^2) Observations

- **Orbit Consistency**
  - ✓ *Orbit behavior (cf.* `OrbStat`*) quite reproducible/tunable*
  - *Typical drifts (caveat corrector trips)* $\sim 1-2\,\mathrm{mm}$ *rms/week*
- **Orbit Correction**
  - *Typical: Arcs consistently reduce from* $\sim 3\,mm$ *to* $\sim 100\,\mu m$ *RMS*
  - *Triplets not quite so good* ($\sim 300\,\mu m$)
- **Collision Steering**
  - *Need reproducible orbits on the order of* $0.1\,\sigma \approx 50\mu m$
  - *Don't have this but we get close, o*$(200-300\,\mu m)$
  - *Will orbit correction to a golden collision orbit be reliable?*

Recommendations/Conclusions

- **Tunes**
  - *Apparent systematic difference between ring setpoints;* **is this real?**
  - *The system works effectively as is; PLL/tune feedback will only get better*
  - **To Do:** *Force set and measured tunes together*
  - **To Do:** *Evaluate tune setpoint/measurement trends in different optics*
- **Chromaticities**
  - *No substantial difference in ring setpoints at injection*
  - **To Do:** *Establish consistent* **routine** *measurements*
  - **To Do:** *Establish clean chromaticities around transition*
  - **To Do:**
- **Orbits**
  - *Orbit correction in arcs quite good; IRs may need attention*
  - *Global orbit corrections c. 1/week, typical for this type facility*
  - **To Do:** *Robust DX BPMs; automatic collision tuning (orb correction?)*
  - **To Do:** *More routine global correction, orbit feedback?*