May 31, 2001

RHIC START UP Plan for 2001 (draft)

1. Beam in Tandem, Booster, and AGS (L. Ahrens and C. Gardner)

1.1. Set-up Tandem, Booster, AGS

1.2. Set-up the AGS for the RHIC 3 bunches extraction.

1.3. Measure emittances and stability.**Goal:** 4 bunches per AGS cycle with 5 x 10^8 Au each, 0.3 eVs/nucleon; 10 π μm, γ = 10.520

2. ATR beam to the W-dump (W. Glenn)

2.1. Run the ATR with γ = 10.520.

2.2. Find the best settings for 5 and 20 degrees bends for the beam to be in the center of the aperture. Use the BPM multi orbit display SAFE the BEST CONDITIONS.

1.3. Measure orbit differences.

2.4. Set the beam positions in the center of the quads and save the BPM's and flag. Check stability.
Goal: Reproducibility better than 0.5 * beam sigma.

3. ATR to X and Y arcs (W. Glenn)

3.1. Find the best settings for the bend current (use the same Orbit DISPLAY for different bend settings) switching magnet current for the new 2001 γ = 10.520 nominal value. Save the setting.

3.1.1. *Systematic horizontal aperture scans of the XP1 and YP1 vertical bend magnet – set the beam in the center and save the settings!*

3.2. Systematic aperture scans of the vertical aperture through the Lambertson magnet.

4. INJECTION (W. Fischer)

4.1. Start with either single bunch or four bunches from the AGS. The RF should be in the **60 bunch pattern** (the same as at the end of the summer 2000).

4.2. Ramp few times magnets to the top energy (E=100 GeV/nucleon) if the **DX magnets were previously trained**. If DX were not trained yet ramp to the top energy E=70 GeV/nucleon.

4.3. Set the RHIC injection field for γ=10.520 . (SCAN the injection field (γ) and measure **dispersion function** by the scans. Compare to the model).

- ***4.3.1.*** **Adjust the BPM timing for correct TBT triggering.**
- ***4.3.2.*** **Check /adjust injection kicker timing and strength.** Remove orbit oscillations**.**

4.4. Correct the first turn. Close the orbit. Check the horizontal and vertical apertures around the Lambertson magnet from both first turn as well as from the circulating beam. Check stability.

4.5. Set the bend field **to get average zero off-set in the arc BPM's** for γ=10.520 and nominal injection energy - save settings.

4.6. Set the chromaticity (**S. Tepikian**).

4.7. Measure and scan the tunes (**A. Drees**).

4.8. Local and Global Decoupling (**F. Pilat**).

4.9. **Measure the transverse and longitudinal emittances** at injection **(R. Connolly,S. Tepikian and J. van Zeijt).**

4.10. D0 and DX study through the IP (Special attention to the D0 power supply response).

4.11. Measure the **orbit differences** and betatron functions by the ***rms*** orbit injection error **(V. Ptitsyn).**

4.12. **Phase Lock-loop Tune feed back commissioning (P. Cameron)**

- ***4.12.1.*** Measure tunes by both methods – with and without the feedback and compare.
- ***4.12.2.*** Apply feedback at the steady injection magnetic field conditions **(J. van Zeijts, A. Marusic, and C. Schultheiss)**

4.12.2.1. Use open-loop beam measurements vs. ΔK changes to determine loop parameters

4.12.2.2. Close feedback loop; measure response to requested tune change.

4.13. **Transverse damper commissioning (A. Drees)**

4.13.1. Measure injection oscillations by the IPM's and BPM's.

4.13.2. Remove the oscillations by best beam closure.

4.13.3. Apply in both directions the damper and check results.

5. Systematic Check of the Quadrupole Polarities (V. Ptitsyn and J. van Zeijts)

5.1. Check systematically polarity of the **TRIM quadrupole power supplies** (tq) around both blue and yellow ring with the software. Measure the betatron functions at these quadrupoles.

5.2. Check systematically polarity of the rest of interaction region power supplies with new software and measure betatron functions.

6. RF System Commissioning (M. Brennan)

6.1. Measure revolution frequency, *rf specialist, labview* mountain range.

6.2. RF capture:

6.2.1. Make adjustments to AGS **B**ρ.

6.2.2. Capture with each cavity by itself, set phase, check synchrotron frequency (longitudinal Schottky).

6.2.3. Phase up both cavities, set good matching voltage.

6.2.4. Tweak injection phase, measure reproducibility.

6.2.5. Set bunch zero marker for beam sync clock.

6.3. Wake up radial electronics.

6.3.1. Set number of bunches according to signal to noise requirements.

6.3.2. Perform radial steering scans to check calibration in DSP.

6.3.3. Commission new "new-bunch" radius data.

6.4. Set up new cordic phase detector:

6.4.1. Test “new-bunch” ID RTDL frame.

6.4.2. Set timing from kicker trigger.

6.4.3. Set starting values for AGC circuit, check intensity tracking.

6.4.4. Check DSP data of phase, 1,4,8,54 bunches.

6.5. Set up new cavity Vector Sum circuit

6.5.1. Calibrate in kV per ADC counts

6.5.2. check DSP calculation of _$_s$ from V_{rf} and R-dot

6.5.3. measure (calibrate) angle-magnitude coupling

6.6. Close feedback loops, single bunch

6.6.1. test auto-zero of phase and radius

6.6.2. check/adjust feedback gains from injection error signals (use many injections of one bunch)

6.6.3. close loops, measure bunch emittance open and closed

6.6.4. perform radial ramps to calibrate radial steering, 1 count/micron

6.6.5. test loops on-to-off-to-on mode

6.7. Test ring-to-ring synchro at injection

6.7.1. lock ring to master

6.7.2. test Lock_In setup ADO

6.7.3. check/optimize gains for synchro at injection

6.7.4. test new bucket counter/auto cogging

6.7.5. select rates for rampdown and cogging

7. Chromaticity Measurements (S. Tepikian)

7.1. Measure and correct the PERISTENT CURRENT EFFECT.

7.2. Correct Chromaticity.

7.3. **Measure the momentum aperture and dispersion function**. (**T. Satogata and V. Ptytsin**)

8. Tuning the Abort at Injection (L. Ahrens)

8.1. Introduce either by the permit link or an event at injection the abort and tune the extracted beam. Test Post-mortem analysis with the **beam positions (BPM).**

9. Measure the transverse and longitudinal emittances (R. Connolly, S. Tepikian and M. Blaskiewicz)

9.1. Use the IPM's and the Wall Current monitors and measure emittances. Check each bunch as a mode with well many turns.

10. Ramps and Acceleration (J. van Zeijts)

10.1. Set up the ramp without and with the Phase lock loop feedback.

10.2. RF ramp set up

10.2.1. Need ~4 ramps with beam surviving at least to transition.

10.2.2. Iterate on Brho RTDL frame calibration.

10.2.3. Ramp through transition with no jump.

10.3. Commission the persistent current correction.

10.4. Tune the chromatic correction.

10.5. Measure wall current monitor vs DCCT.

10.6. Average radius vs. time during the ramp.

10.7. Commissioning of the multi- instruments data acquisition and collection **(R. Michnoff and R. Lee).**

11. Commissioning of the γ_t JUMP System (Jorg Kewisch)

11.1. Measure the function I(γ_t) vs. value of the transition (GeV).

11.2. Adjust the Tune compensation circuit.

11.3. Measure the α_1 through transition.

12. Measure Difference orbits along the ramp (V. Ptitsyn)

12.1. Check beam positions in arcs and correction element distribution.

12.2. Compare the betatron functions to the model.

13. Measure the dispersion function along the ramp (V. Ptitsyn and S. Tepikian)

13.1. From the radial loop offset difference orbits measure the dispersion function *Check dispersion within the IR regions.*

14. Orbit correction-Feed Forward along the ramp (V. Ptitsyn)

14.1. Using stepping stones check the orbits and correct. Additional DX and D0 current correction might be needed. *Include a plan here on how to correct the DX and D0 currents.*

15. Phase Lock Loop feedback Commissioning along the Ramp (P. Cameron and A. Drees)

15.1. Measure tunes along the ramp and correct by feedback or "manually" **(J. van Zeijts, A. Marusic, C. Schultheiss).**

15.2. Commissioning of the 'Tune Matrix' dependence on gamma **(J. van Zeijts, A. Marusic, C. Schultheiss).**

15.3. Check Tune feedback loop parameters vs. gamma **(J. van Zeijts, A. Marusic, C. Schultheiss).**

15.4. Collect high resolution tune/correction information along ramp for use in Orbit Feed-Forward **(J. van Zeijts, A. Marusic, C. Schultheiss, V. Ptitsyn).**

15.5. Run the ramp without the feedback tune and compare.

16. Measure Chromaticity along the ramp(S. Tepikian)

16.1. Correct the sextupole's settings before and after transition.

16.2. Tune chromaticity along the ramp.

17. Tune the abort along the ramp (L. Ahrens)

17.1. Requires a special shift.

18. Measure momentum aperture before and after transition (J. Kewisch)

18.1. Transition crossing studies.

18.2. Measure transverse and longitudinal emittance before and after transition.

19. Coupling measurements and correction (F. Pilat)

19.1. Correct coupling along the ramp.

20. Improve efficiency along the ramp

20.1. Orbit Correction **FEED FORWARD** **(V. Ptitsyn)**

20.2. Tune Correction **(P. Cameron and A. Drees).**

20.3. RF tuning **(M. Brennan).**

20.4. Chromaticity correction before and after transition **(S. Tepikian).**

20.5. **Commissioning of the multi data correlation and logging along the ramp** **(R. Michnoff).**

21. FLAT TOP – STORE CONDITIONS (A. Drees)

21.1. Correct the orbit **(V. Ptitsyn).**

21.2. Difference orbit measurements. Betatron function measurements **(V. Ptitsyn).**

21.3. RF set-up at store. (M. Brennan)

21.3.1. Set time delay correction coefficient.

21.3.2. Another iteration on Brho coefficient.

21.3.3. Set up gains and test ring-to-ring synchro at _ = 100.

21.3.4. Check bucket counter and autocogging.

21.3.5. Test no-synchro store mode.

21.3.6. Cogging **(W. Fischer).**

21.4. Tuning the IP regions:

21.4.1. Maximize the luminosity.
21.4.2. Vernier Scans.
21.4.3. Beta star measurements.

21.5. Tune measurements and corrections **(A. Drees and P. Cameron).**

21.6. Coupling measurements and corrections **(F. Pilat).**

21.7. Chromaticity Measurements and corrections **(S. Tepikian).**

21.8. IR nonlinear corrections **(F. Pilat).**

21.9. Abort system studies **(L. Ahrens).**

21.10. **Continuous Data acquisition commissioning (R. Michnoff)**

21.11. **Luminosity Measurements** (**A. Drees**)

21.12. **RF Storage System commissioning (M. Brennan)**

21.12.1. Operate storage system on harmonic number 2530:

21.12.1.1. Frequency = 196.89 MHz.

21.12.1.2. Lock to h = 253.

21.12.2. Set up injectors for "5E8" intensity:

21.12.2.1. Turn off L10.

21.12.2.2. Set synchro reference to 3x19 Frev (=4.436 MHz).

21.12.3. Capture in h=360:

21.12.3.1. Vrf = 400 kV

21.12.3.2. Bunch length = 11.5 ns

21.12.3.3. Close phase loop at immediately at injection.

21.12.4. Adjust phase of each ring storage cavity:

21.12.4.1. Snap on storage cavity/snap off accel cavities.

21.12.4.2. Adjust phase to put bunch back in phase w.r.t. rev tick.

21.12.5. Calibrate cavity voltage with synchrotron frequency (Schottky).

21.12.6. Exercise rebucketing gymnastics, compare satellites:

21.12.6.1. Conventional bunch rotation.

21.12.6.2. Quad mode pumping.

21.12.6.3. Rotation at unstable fixed point.

21.12.6.4. Two-step bunch rotation.

21.12.7. Repeat process for common cavities.

21.12.8. Combine ring and common cavities, check total voltage with synchrotron frequency.

21.12.9. Repeat process for other ring.

21.12.10. Done at injection, ready to run storage system at _ = 100.