Startup for NSRL and RHIC

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Caution! The following schedule is subject to change. Please note release date above.

NSRL is to begin taking beam on Monday 27 October 2003.

Beam Order:

1. Iron. 800 MeV per nucleon (Miller). Oct 27–28.
2. Iron. 1000 MeV per nucleon. Oct 28–Nov 12.
3. Titanium. 1000 MeV per nucleon. Nov 13–Nov 18.
4. Carbon. 290 MeV per nucleon. Nov 19–24.

Ions for NSRL are to be delivered from MP6 during the day. Gold is to be delivered from MP7 in the evenings and on the weekends. Booster Users 1 and 2 are to be used for Gold operation. Users 3 and 4 are to be used for NSRL operation.

Iron will be injected into Booster at same rigidity as last NSRL run. We have not delivered Iron to NSRL at 800 MeV per nucleon. This will require modification of the existing 1000 MeV per nucleon setup.

The Titanium setup will be the same as it was for the last NSRL run.

Carbon (C^{5+}) is to be injected into Booster at the same rigidity as Gold (Au^{32+}). This will allow for ppm operation of RHIC and NSRL. This is a new setup.

1 NSRL Setup Oct 18–26

1.1 Sat Oct 18

Transport Fe^{20+} beam to Booster from MP6. Use NSRL archive for TTB magnets. 11DH1 NMR = 4364.1 Gauss.

Inject and accelerate to 1000 MeV kinetic energy per nucleon in Booster on User 3 as per archived setup. **Use Booster magnetic cycles stored in the FY04 Library.** RF commissionning work needs to be done. (This involves new circuitry that calculates frequency "on the fly").

1.2 Sun Oct 19

Setup extraction and R line transport as per archive (1000 MeV kinetic energy per nucleon). (Strip to Fe^{26+} prior to extraction.)

1.3 Mon Oct 20

Continue work on Iron setup.

1.4 Tue Oct 21

6:00–9:00 Adam Rusek in to work with Iron beam in NSRL.

9:00–13:00 Mike Brennan and Joe DeLong work on Gauss clock calibration and phase back.

Archive 1000 MeV per nucleon setup.

Then Kevin Brown and Nick Tsoupas set up Fe^{20+} extraction and R line transport at 800 MeV per nucleon. Archive setup.

Go back to 1000 MeV per nucleon setup.

Booster access to fix B4 and D1 PUES (R. DeFranco and helper).

1.5 Wed Oct 22

Adam Rusek in early morning to do bragg curve in R line.

"Mock Gold" setup on User 2 (Brennan et al).

Evening extraction studies on User 3 (Kevin Brown).

1.6 Thur Oct 23

Adam Rusek in early morning (6:00 AM) to do bragg curve in R line.

Development work with Iron on Users 3 and 2.

Evening switch to Carbon (C^{5+}) source.

1.7 Fri Oct 24

Transport C^{5+} beam to Booster at Au^{32+} rigidity. Use Gold archive for TTB magnets. 11DH1 NMR = 5580 Gauss.

Inject and accelerate to 300 MeV kinetic energy per nucleon on User 4. **Use Booster magnetic cycles stored in the FY04 Library.**

1.8 Sat Oct 25

Setup Carbon extraction at 300 MeV per nucleon.

Transport Gold Au^{32+} beam (from MP7) to Booster at same rigidity as C^{5+}. 11DH1 NMR = 5580 Gauss. Inject and accelerate in Booster on User 1 as per archive.

Evening switch from Carbon back to Iron source.

1.9 Sun Oct 26

Switch back to Iron source.

8:00–12:00 LIPA test with Booster main magnet power supply pulsing. No beam available during this time.

Transport Fe^{20+} beam to Booster. (11DH1 NMR = 4364.1 Gauss.)

Inject and accelerate to 800 MeV kinetic energy per nucleon on User 3.

2 800 MeV/n Iron Oct 27–28

2.1 Mon Oct 27

7:00 to 15:00: Setup extraction and R line transport of Iron at 800 MeV per nucleon as per archive.

NSRL Physics with Iron (Miller) begins at 15:00.

2.2 Tue Oct 28

NSRL Physics with Iron ends at 7:00.

3 1000 MeV/n Iron Oct 28 to Nov 12

3.1 Tue Oct 28

9:00 to 13:00: Setup extraction and R line transport (of Iron) at 1000 MeV per nucleon kinetic energy as per archive. (During this time we will want to set up the Iron cycle with Brennan's "mock gold" cycle also running. We need to make sure that this will work with a three second repetition period. We also need to check that the Iron cycle can run with a 2.5 second repetition period without Brennan's cycle.)

NSRL Biology begins at 13:00.

3.2 Tue Oct 28 to Fri Oct 31

Daytime delivery of Iron to NSRL.

Nighttime mode switch to Gold setup in Booster and AGS. This will be either the standard setup on User 1 or the new setup on User 2. For both setups use the Gold archive for the TTB magnets with 11DH1 NMR = 5580 Gauss. For the standard setup use the Gold archive for Booster and AGS. Going back and forth between the standard and new Gold setups in AGS requires a mode switch of the A5 kicker. (Proton mode is used for the new setup; Heavy Ion mode is used for the standard setup.)

3.3 Sat Nov 1

Daytime delivery of Iron to NSRL. Then mode switch to Gold setup.

3.4 Sun Nov 2

Continue work on Gold setup. Mode switch back to Iron setup Sunday night.

3.5 Mon Nov 3 to Fri Nov 7

Daytime delivery of Iron to NSRL.

Nighttime work on Gold setup.

3.6 Fri Nov 7 to Sun Nov 9

Saturday work with Gold on User 1. RF group and power supply group try to understand why gold cycle is unstable.

Vacuum group needs Booster access for a few hours on Friday and Saturday to check the progress of the BTA bakeout. They will need most of the day on Sunday to finish the BTA bakeout and remove their equipment.

3.7 Mon Nov 10 to Tue Nov 11

Daytime delivery of Iron to NSRL.

Nighttime work on Gold setup.

3.8 Wed Nov 12

Iron running ends at 16:00. Switch from Iron to Titanium source.

4 1000 MeV/n Titanium Nov 13 to Nov 18

4.1 Thur Nov 13

Transport Ti^{18+} to Booster. Use NSRL archive for TTB magnets. 11DH1 NMR = 4364.1 Gauss.

Inject and accelerate to 1000 MeV kinetic energy per nucleon in Booster on User 3 as per archived setup.

Setup extraction and R line transport as per archive. (Strip to Ti^{22+} prior to extraction.)

NSRL Biology begins at 13:00.

Nighttime work on Gold setup.

4.2 Fri Nov 14 to Sun Nov 16

Friday delivery of Titanium to NSRL.

Friday night switch to Gold for entire weekend. Work on intensity and stability in AGS (Operations and maby Zeno).

Saturday work on AGS extraction setup (Nick Tsoupas). Also set up two Gold-merge cycles on Booster User 2 (Kip).

Saturday evening through Sunday morning work on intensity and stability in AGS (Operations and maby Zeno).

Sunday afternoon work on AGS-RHIC Synchro (Brennan). This requires reasonable beam intensity in AGS at extraction.

Late Sunday night or early Monday morning switch back to Titanium for NSRL.

4.3 Mon Nov 17

Daytime and nighttime delivery of Titanium to NSRL.

4.4 Tue Nov 18

Titanium running ends at 20:30.

Switch from Titanium to Carbon source.

5 300 MeV/n Carbon Nov 19–24

5.1 Wed Nov 19

Setup Carbon on User 4 in Booster and R line as per archive.

NSRL Biology begins at 16:00.

5.2 Thur Nov 20 to Sun Nov 23

Weekday delivery of Carbon to NSRL. Work on PPM between Carbon and Gold in Booster.

Nighttime and weekend work on Gold setup for RHIC.

5.3 Mon Nov 24

NSRL Biology ends at 15:00.

6 Commissionning Tasks and Studies

1. Commission new Low Level RF system in Booster.
2. Commission bunch merge and "sqeeze" in Booster. This is the new Gold setup.
3. NSRL spill studies.
4. Commission PPM switching between Au^{32+} and C^{5+} in TTB and Booster.
5. Commission the new Booster PUE system.
6. Study the new BTA foils with Gold beam.
7. Emittance measurements in Booster, BTA, and AGS.
8. Study effect of AGS extraction bumps on orbit circumference.

7 Injection and Extraction Parameters

Tables 1, 2, 3 and 4 list the parameters for various ions at Booster injection and extraction. The parameters to be used for this NSRL run are as follows:

1. For the injection of iron (Fe^{20+}) and titanium (Ti^{18+}) into Booster, use the parameters listed in **Table 1**.
2. For the injection of carbon (C^{5+}) and gold (Au^{32+}) into Booster, use the parameters listed in **Table 2**. (Note that C^{5+}, not C^{6+}, will be injected into Booster this NSRL run.)
3. For the extraction of iron (Fe^{20+}) and titanium (Ti^{18+}) at 1000 MeV per nucleon, use the parameters listed in **Table 3**. (These are the parameters on the Booster flat top just prior to extraction.)

4. For the extraction of iron (Fe^{20+}) at 800 MeV per nucleon, use the parameters listed in **Table 4**.

5. For the extraction of carbon (C^{5+}) at 300 MeV per nucleon, use the parameters listed in **Table 4**.

Table 1: Iron, Titanium, and Carbon Parameters at Booster Injection. Note that C^{6+} will not be injected into Booster this NSRL run. It is listed here only for reference.

Parameter	Ti^{18+}	Fe^{20+}	C^{6+}	Unit
mc^2	44.6540277	52.0928437	11.1748622	GeV
Date	24 June 03	2 June 03	27 May 03	
11DH1 NMR Probe	4364.1	4364.1	4364.1	Gauss
hf	358.45(10)	341.15(10)	475.89(10)	kHz
h	3	3	3	
$T = 1/f$	8.3694	8.7938	6.3040	μs
Kinetic Energy W	145.101856	153.258446	64.24366	MeV
$B\rho$	0.667638100	0.666936878	0.66711783	Tm
$B\rho/\rho$	481.507	481.001	481.132	Gauss
Booster Hall Probe	4512	4512	4512	Counts
Booster Gauss Clock	252	252	252	Counts
"Injection Field"	476.4	476.4	476.4	Gauss
Inflector Setpoint	31.556	30.079	42.122	kV
Inflector Predicted	31.304	29.762	41.528	kV

Table 2: Gold, Carbon, and Silicon Parameters at Booster Injection

Parameter	Au^{32+}	C^{5+}	Si^{9+}	Unit
mc^2	183.456812	11.17537316	26.05574058	GeV
Date	–	–	–	
11DH1 NMR Probe	5580	5580	5580	Gauss
hf	397.607	507.130	392.545	kHz
h	6	3	3	
$T = 1/f$	15.0903	5.9156	7.6424	μs
Kinetic Energy W	182.7568	73.0440	101.6387	MeV
$B\rho$	0.8538	0.8538	0.8538	Tm
$B\rho/\rho$	615.769	615.769	615.769	Gauss
Booster Hall Probe	–	–	–	Counts
Booster Gauss Clock	–	–	–	Counts
"Injection Field"	610.5	610.5	610.5	Gauss
Inflector Setpoint	22.498	57.430	44.448	kV
Inflector Predicted	22.203	56.638	43.841	kV

Table 3: Carbon, Iron, and Titanium Parameters at Booster Extraction.

Parameter	C^{6+}	Fe^{20+}	Ti^{18+}	Unit
mc^2	11.1748622	52.0928437	44.6540277	GeV
Date	9 June 03	19 June 03	23 June 03	
hf	2.9208(6)	3.90872(60)	3.91144(60)	MHz
h	3	3	3	
$T = 1/f$	1.02712	0.76751	0.76698	μs
Kinetic E per Nucleon	301.5832	1005.3420	1009.9121	MeV
$B\rho$	5.3894886	15.85321093	15.14496712	Tm
$B\rho/\rho$	3886.95	11433.48	10922.69	Gauss
Predicted MM Current	1600	4705	4495	Amps
Magnetic Field Setpoint	3962	11600	11100	Gauss
MM Current Setpoint	1692	4934	4663	Amps

Table 4: Carbon, Iron, and Silicon Parameters at Booster Extraction

Parameter	C^{5+}	Fe^{20+}	Si^{9+}	Unit
mc^2	11.17537316	52.0928437	26.0557406	GeV
Date	–	–	–	
hf	2.9208	3.758231	3.757978	MHz
h	3	3	3	
$T = 1/f$	1.02712	0.79825	0.79830	μs
Kinetic E per Nucleon	301.597	800	800	MeV
$B\rho$	6.467682	13.625755	15.141622	Tm
$B\rho/\rho$	4664.553	9827.022	10920.28	Gauss
Predicted MM Current	1920	4044	4394	Amps
Magnetic Field Setpoint	4751	9981	11088	Gauss
MM Current Setpoint	–	–	–	Amps

Table 5: Fluorine, Carbon, and Silicon Parameters at Booster Injection

Parameter	F^{7+}	C^{5+}	Si^{9+}	Unit
mc^2	17.693321845	11.17537316	26.05574058	GeV
Date	–	–	–	
11DH1 NMR Probe	5580	5580	5580	Gauss
hf	449.070	507.130	392.545	kHz
h	3	3	3	
$T = 1/f$	6.6805	5.9156	7.6424	μs
Kinetic Energy W	90.4901	73.0440	101.6387	MeV
$B\rho$	0.8538	0.8538	0.8538	Tm
$B\rho/\rho$	615.769	615.769	615.769	Gauss
Booster Hall Probe	–	–	–	Counts
Booster Gauss Clock	–	–	–	Counts
"Injection Field"	610.5	610.5	610.5	Gauss
Inflector Setpoint	50.154	57.430	44.448	kV
Inflector Predicted	50.154	56.638	43.841	kV

Table 6: Carbon, Fluorine, and Silicon Parameters at Booster Extraction

Parameter	C^{5+}	F^{7+}	Si^{9+}	Unit
mc^2	11.17537316	17.693321845	26.0557406	GeV
Date	–	–	–	
hf	2.9208	3.904808	3.757978	MHz
h	3	3	3	
$T = 1/f$	1.02712	0.79828	0.79830	μs
Kinetic E per Nucleon	301.597	1000	800	MeV
$B\rho$	6.467682	15.318075	15.141622	Tm
$B\rho/\rho$	4664.553	11047.54	10920.28	Gauss
Predicted MM Current	1920	4546	4394	Amps
Magnetic Field Setpoint	4751	11217	11088	Gauss
MM Current Setpoint	–	–	–	Amps