MERIT beam request

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http://cern.ch/proj-hiptarget

Collaboration meeting, October 2005

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Available Information

APC: Accelerator Performance Committee

- Platform to discuss all issues relevant to CERN accelerators
- http://ab-div.web.cern.ch/ab-div/Meetings/APC/Welcome.html

Following the approval of MERIT:

- Presentation of beam request to APC (June 2005)
  - http://proj-hiptarget.web.cern.ch/proj-hiptarget/default/Documents/subsystems/ProtonBeam/APC_Jun05_AFabich.ppt
  - APC asked for a pulse list as follow-up action:
- MERIT pulse list: http://proj-hiptarget.web.cern.ch/proj-hiptarget/redir.asp?short=pulselist (July 2005)
- APC responded on feasibility of configurations

MERIT pulse list

Version in June was a suggestion for discussion:

- 80 different configurations
  - Each two pulses
  - Total: 160 pulses = $4.4*10^{15}$ protons on TARGET
    - Remember: limited to $3*10^{15}$ p.o.t. by RP safety
  - varying intensity, time structure, displacement, spot size and solenoid field
  - Solenoid field not in the responsibility of PS
    - → About 25 different proton beam configurations

MERIT pulse list (ff)

#	B-field	momentum	protons/bunch	bpp	buckets	dx	dy	spot r rms	scan
[]	[T]	[GeV/c]	[*10^12 p+]	[]		[mm]	[mm]	[mm]	
1	0	24	1	4	1-2-3-4	0	0	1.2	intensity
2	0	24	2	4	1-2-3-4	0	0	1.2	
3	0	24	3	4	1-2-3-4	0	0	1.2	
4	0	24	4	4	1-2-3-4	0	0	1.2	
5	0	24	5	4	1-2-3-4	0	0	1.2	
6	0	24	6	4	1-2-3-4	0	0	1.2	
7	0	24	7	4	1-2-3-4	0	0	1.2	
8	3	24	7	4	1-2-3-4	0	0	1.2	B-field
9	6	24	7	4	1-2-3-4	0	0	1.2	
10	9	24	7	4	1-2-3-4	0	0	1.2	
11	12	24	7	4	1-2-3-4	0	0	1.2	
12	15	24	7	4	1-2-3-4	0	0	1.2	
13	-5	24	7	4	1-2-3-4	0	0	1.2	inverse B-field
14	-10	24	7	4	1-2-3-4	0	0	1.2	
15	-15	24	7	4	1-2-3-4	0	0	1.2	
16	3	24	4	4	1-2-3-4	0	0	1.2	B-field
17	6	24	4	4	1-2-3-4	0	0	1.2	
18	9	24	4	4	1-2-3-4	0	0	1.2	
19	12	24	4	4	1-2-3-4	0	0	1.2	
20	15	24	4	4	1-2-3-4	0	0	1.2	
21	15	24	7	4	1-2-3-4	-7	0	1.2	horizontal scan
22	15	24	7	4	1-2-3-4	-5	0	1.2	
23	15	24	7	4	1-2-3-4	-3	0	1.2	
24	15	24	7	4	1-2-3-4	3	0	1.2	
25	15	24	7	4	1-2-3-4	5	0	1.2	
26	15	24	7	4	1-2-3-4	7	0	1.2	
27	15	24	7	4	1-2-3-4	0	-7	1.2	vertical scan
28	15	24	7	4	1-2-3-4	0	-5	1.2	
29	15	24	7	4	1-2-3-4	0	-3	1.2	
30	15	24	7	4	1-2-3-4	0	3	1.2	
31	15	24	7	4	1-2-3-4	0	5	1.2	
32	15	24	7	4	1-2-3-4	0	7	1.2	
33	0	24	7	4	1-2-3-6	0	0	1.2	
34	15	24	7	4	1-2-3-6	0	0	1.2	
35	0	24	7	4	1-2-3-8	0	0	1.2	
36	15	24	7	4	1-2-3-8	0	0	1.2	

#	B-field	momentum	protons/bunch	bpp	buckets	dx	dy	spot r rms	scan
[]	[T]	[GeV/c]	[*10^12 p+]	[]		[mm]	[mm]	[mm]	
37	0	14	7	4	1-2-3-4	0	0	minimum	pump-probe method
38	15	14	7	4	1-2-3-4	0	0	minimum	
39	0	14	7	4	1-2-3-7	0	0	minimum	
40	15	14	7	4	1-2-3-7	0	0	minimum	
41	0	14	7	4	1-2-3-10	0	0	minimum	
42	15	14	7	4	1-2-3-10	0	0	minimum	
43	0	14	7	4	1-2-3-12	0	0	minimum	
44	15	14	7	4	1-2-3-12	0	0	minimum	
45	0	14	7	4	1-2-3-14	0	0	minimum	
46	15	14	7	4	1-2-3-14	0	0	minimum	
47	0	14	7	4	1-2-3-16	0	0	minimum	
48	15	14	7	4	1-2-3-16	0	0	minimum	
49	0	14	7	4	1-2-3-20	0	0	minimum	
50	15	14	7	4	1-2-3-20	0	0	minimum	
51	0	14	7	4	1-2-3-28	0	0	minimum	
52	15	14	7	4	1-2-3-28	0	0	minimum	
53	0	14	7	4	1-2-3-40	0	0	minimum	
54	15	14	7	4	1-2-3-40	0	0	minimum	
55	0	14	7	4	1-2-3-400	0	0	minimum	
56	15	14	7	4	1-2-3-400	0	0	minimum	
57	0	24	7	8	2 bunches every 20 ms	0	0	1.2	rep rate
58	8	24	7	8	2 bunches every 20 ms	0	0	1.2	
59	15	24	7	4	2 bunches every 20 ms	0	0	1.2	
60	0	24	7	8	4 bunches every 20 ms	0	0	1.2	
61	8	24	7	8	4 bunches every 20 ms	0	0	1.2	
62	15	24	7	4	4 bunches every 20 ms	0	0	1.2	
63	0	24	7	4	1-2-5-6	0	0	1.2	pump-probe method 2
64	15	24	7	4	1-2-5-6	0	0	1.2	
65	0	24	7	4	1-2-7-8	0	0	1.2	
66	15	24	7	4	1-2-7-8	0	0	1.2	
67	0	14	7	4	1-2-9-10	0	0	minimum	
68	15	14	7	4	1-2-9-10	0	0	minimum	
69	0	14	7	4	1-2-11-12	0	0	minimum	
70	15	14	7	4	1-2-11-12	0	0	minimum	
71	0	14	7	4	1-2-13-14	0	0	minimum	
72	15	14	7	4	1-2-13-14	0	0	minimum	
73	0	14	7	4	1-2-15-16	0	0	minimum	
74	15	14	7	4	1-2-15-16	0	0	minimum	
75	0	24	7	4	1-2-3-4	0	0	1.4	spot size
76	0	24	7	4	1-2-3-4	0	0	1.6	
77	0	24	7	4	1-2-3-4	0	0	1.8	
78	0	24	7	4	1-2-3-4	0	0	2	
79	0	24	7	4	1-2-3-4	0	0	2.3	
80	0	24	7	4	1-2-3-4	0	0	2.6	

Summary of pulse list

- Counting only PS beam parameter changes
  - About 30 different beam configurations: varying
    - Intensity
    - Beam displacement on target (hor./ vert.)
    - Pump-probe method
    - 50-Hz operation
    - Spot size
- APC statement: two “surprises”
  - Intensity limited to $4*10^{12}$/bunch (harmonic 8)
  - 50 Hz operation not possible
    - Kicker can do it, but not the septum

Comments to the configuration list

- The majority of the bunch configurations can be made using correct PS Booster synchronisation and by timing the PS extraction kicker precisely.
- The double batch extraction separated by 20 ms cannot be done (6 cases).
- This means that 10 out of 80 cases cannot be done.
- The intensity that can be guaranteed is 4E12 protons per bunch.
- The beam spot is based on optics calculations made by the collaboration. The collaboration is responsible for the result. We will provide the initial beam parameters.
- Some MD time, in order to increase the intensity per bunch, can be allocated end 2006.

Appendix 1

- Complete pulse list as provided by A. Fabich.
- In all cases bunch length should be around 50 ns and constant.

Cases that cannot be produced

MERIT pulse list This list contains all desired pulse variations. It does not include the information of priority and chronological order during experiment.

list of proton extractions | Total intensity [10^15] 4.528 | number of pulses 160 | author: A.Fabich

#	B-field	momentum	protons/bunch	bpp	buckets	dx	dy	spot r rms	intensity/pulse	repetitions	
[]	[T]	[GeV/c]	[*10^12 p+]	[]		[mm]	[mm]	[mm]	[10^12]		
1	0	24	1	4	1-2-3-4	0	0	1.2	4	2	8
2	0	24	2	4	1-2-3-4	0	0	1.2	8	2	16
3	0	24	3	4	1-2-3-4	0	0	1.2	12	2	24
4	0	24	4	4	1-2-3-4	0	0	1.2	16	2	32
5	0	24	5	4	1-2-3-4	0	0	1.2	20	2	40
6	0	24	6	4	1-2-3-4	0	0	1.2	24	2	48
7	0	24	7	4	1-2-3-4	0	0	1.2	28	2	56
8	3	24	7	4	1-2-3-4	0	0	1.2	28	2	56
9	6	24	7	4	1-2-3-4	0	0	1.2	28	2	56
10	9	24	7	4	1-2-3-4	0	0	1.2	28	2	56
11	12	24	7	4	1-2-3-4	0	0	1.2	28	2	56
12	15	24	7	4	1-2-3-4	0	0	1.2	28	2	56
13	-6	24	7	4	1-2-3-4	0	0	1.2	28	2	56
14	-10	24	7	4	1-2-3-4	0	0	1.2	28	2	56
15	-15	24	7	4	1-2-3-4	0	0	1.2	28	2	56
16	3	24	4	4	1-2-3-4	0	0	1.2	16	2	32
17	6	24	4	4	1-2-3-4	0	0	1.2	16	2	32
18	9	24	4	4	1-2-3-4	0	0	1.2	16	2	32
19	12	24	4	4	1-2-3-4	0	0	1.2	16	2	32
20	15	24	4	4	1-2-3-4	0	0	1.2	16	2	32
21	15	24	7	4	1-2-3-4	-7	0	1.2	28	2	56
22	15	24	7	4	1-2-3-4	-5	0	1.2	28	2	56
23	15	24	7	4	1-2-3-4	-3	0	1.2	28	2	56
24	15	24	7	4	1-2-3-4	3	0	1.2	28	2	56
25	15	24	7	4	1-2-3-4	5	0	1.2	28	2	56
26	15	24	7	4	1-2-3-4	7	0	1.2	28	2	56
27	15	24	7	4	1-2-3-4	0	-7	1.2	28	2	56
28	15	24	7	4	1-2-3-4	0	-5	1.2	28	2	56
29	15	24	7	4	1-2-3-4	0	-3	1.2	28	2	56
30	15	24	7	4	1-2-3-4	0	3	1.2	28	2	56
31	15	24	7	4	1-2-3-4	0	5	1.2	28	2	56
32	15	24	7	4	1-2-3-4	0	7	1.2	28	2	56
33	0	24	7	4	1-2-3-5	0	0	1.2	28	2	56
34	15	24	7	4	1-2-3-5	0	0	1.2	28	2	56
35	0	24	7	4	1-2-3-6	0	0	1.2	28	2	56
36	15	24	7	4	1-2-3-6	0	0	1.2	28	2	56
37	0	14	7	4	1-2-3-4	0	0	minimum	28	2	56
38	15	14	7	4	1-2-3-4	0	0	minimum	28	2	56
39	0	14	7	4	1-2-3-7	0	0	minimum	28	2	56
40	15	14	7	4	1-2-3-7	0	0	minimum	28	2	56
41	0	14	7	4	1-2-3-10	0	0	minimum	28	2	56
42	15	14	7	4	1-2-3-10	0	0	minimum	28	2	56
43	0	14	7	4	1-2-3-12	0	0	minimum	28	2	56
44	15	14	7	4	1-2-3-12	0	0	minimum	28	2	56
45	0	14	7	4	1-2-3-14	0	0	minimum	28	2	56
46	15	14	7	4	1-2-3-14	0	0	minimum	28	2	56
47	0	14	7	4	1-2-3-16	0	0	minimum	28	2	56
48	15	14	7	4	1-2-3-16	0	0	minimum	28	2	56
49	0	14	7	4	1-2-3-20	0	0	minimum	28	2	56
50	15	14	7	4	1-2-3-20	0	0	minimum	28	2	56
51	0	14	7	4	1-2-3-28	0	0	minimum	28	2	56
52	15	14	7	4	1-2-3-28	0	0	minimum	28	2	56
53	0	14	7	4	1-2-3-40	0	0	minimum	28	2	56
54	15	14	7	4	1-2-3-40	0	0	minimum	28	2	56
55	0	14	7	4	1-2-3-400	0	0	minimum	28	2	56
56	15	14	7	4	1-2-3-400	0	0	minimum	28	2	56
57	0	24	7	8	2 bunches every 20 ms	0	0	1.2	56	2	112
58	8	24	7	8	2 bunches every 20 ms	0	0	1.2	56	2	112
59	15	24	7	8	2 bunches every 20 ms	0	0	1.2	56	2	112
60	0	24	7	8	4 bunches every 20 ms	0	0	1.2	56	2	112
61	8	24	7	8	4 bunches every 20 ms	0	0	1.2	56	2	112
62	15	24	7	8	4 bunches every 20 ms	0	0	1.2	56	2	112
63	0	24	7	4	1-2-5-6	0	0	1.2	28	2	56
64	15	24	7	4	1-2-5-6	0	0	1.2	28	2	56
65	0	24	7	4	1-2-7-8	0	0	1.2	28	2	56
66	15	24	7	4	1-2-7-8	0	0	1.2	28	2	56
67	0	14	7	4	1-2-9-10	0	0	minimum	28	2	56
68	15	14	7	4	1-2-9-12	0	0	minimum	28	2	56
69	0	14	7	4	1-2-11-12	0	0	minimum	28	2	56
70	15	14	7	4	1-2-11-12	0	0	minimum	28	2	56
71	0	14	7	4	1-2-13-14	0	0	minimum	28	2	56
72	15	14	7	4	1-2-13-14	0	0	minimum	28	2	56
73	0	14	7	4	1-2-15-16	0	0	minimum	28	2	56
74	15	14	7	4	1-2-15-16	0	0	minimum	28	2	56
75	0	24	7	4	1-2-3-4	0	0	1.4	28	2	56
76	0	24	7	4	1-2-3-4	0	0	1.6	28	2	56
77	0	24	7	4	1-2-3-4	0	0	1.8	28	2	56
78	0	24	7	4	1-2-3-4	0	0	2	28	2	56
79	0	24	7	4	1-2-3-4	0	0	2.3	28	2	56
80	0	24	7	4	1-2-3-4	0	0	2.6	28	2	56

Proposals and Conclusion:

- For obtaining higher intensities:
  - One should look into using higher harmonics (h16 instead of h8), using more bunches in same time slot.
  - One should consider the possibility of double batch injection in combination with the above.
  - One should try not to do the experiment within the two months after the machine start-up.
- We will make another iteration on the configuration list with A. Fabich, taking some of the previously mentioned proposals into account in order to decide the MD subject(s).

How to overcome restrictions?

- Intensity?
  - Consider running PS in harmonic 16
    - increases intensity to $5*10^{12}$ p^+ per 1/8 of PS
    - Beam structure changes to double number of bunches in same time interval
- 50 Hz operation
  - Operate at 14 GeV/c only (pulse #57-62)
  - Like pump-probe method, but extend bunch-to-bunch distance extensively (milliseconds)

Next steps

MERIT pulse list:

- Next iteration of proposal process
- Incorporate suggestions of APC
- Finalize list of requested beam configurations

- Estimate MD time needed

- PS-SPS coordinator was present at APC
  - Re-discuss with him possible dates of beam time