BWA/cg

PS/DI/Note 95-20 (Min.)
20 October 1995

Minutes of PS Technical meeting N° 75
held on 11 October 1995

The Antiproton Decelerator (AD) Study

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1. D.J. Simon explained that following the Cogne meeting of SPSLC and the subsequent decision to stop pbar physics at the end of 1996, there were strong requests from the physicists to continue certain experiments (notably the trap experiments on antihydrogen studies). Some preliminary ideas were considered by S. Maury and D. Möhl to see if a simplified antiproton scheme could be found. It quickly emerged that it might be possible to use AC as a decelerator, and so at the end of August, the DG requested that a study rapidly be made of this scenario. The result must be presented to the DG before the end of October.

2. S. Maury presented the technical aspects of the study in which

   - the target area remains as it is today, and will receive 10^{13} proton/cycle during pbar production
   - the AC machine is modified to catch, cool and decelerate the pbars
   - deceleration is in a series of steps from 3.5 GeV/c to 200 MeV/c (or preferably 100 MeV/c) with cooling on the plateaux
   - there is fast extraction of the low energy beam to 3 experiments housed in half of the space at the centre of the present AAC rings.

3. The scenario uses the existing band 1 (0.9 to 1.65 GHz) stochastic cooling at the higher energies. Electron cooling at low energy is essential to obtain the highest beam quality for the 3 experiments. Cooling times on the various intermediate plateaux of the deceleration are from 15 to 40 seconds with stochastic cooling but less than 6 s at low energies with electron cooling.

4. The intention is to use fast extraction from the new AD machine. The desired intensity is 10^7 pbar every 60 secs (with electron cooling). Five experiments were considered, PS 194, PS 196, PS 200, PS 205 and PS 197 from LEAR. The first four are trap experiments. The beam is ejected with a fast extraction system at the lowest energy and degraded so as to fill the traps. The expected intensity is 10^7 every 60 s or 120 s without electron cooling. With electron cooling it seems possible to extract the whole intensity in one short bunch of 200-500 nsec. The fifth experiment PS 197, which would use a slow extraction system, has been studied as a possible option. The desired intensity is about 50 000 $\bar{p}$/s during 2 to 3 minutes. The slow extraction scheme found so far is limited to a maximum momentum of 2.2 GeV/c. To install the experiment an excavation of the floor is required because the beam extracted from AD will be below the axis of the detector.

5. Agreement has been reached with TIS that sufficient shielding can be installed to allow the experimenters to remain in hall 193 during operation of the facility, although it will be considered a primary zone during the setting-up.

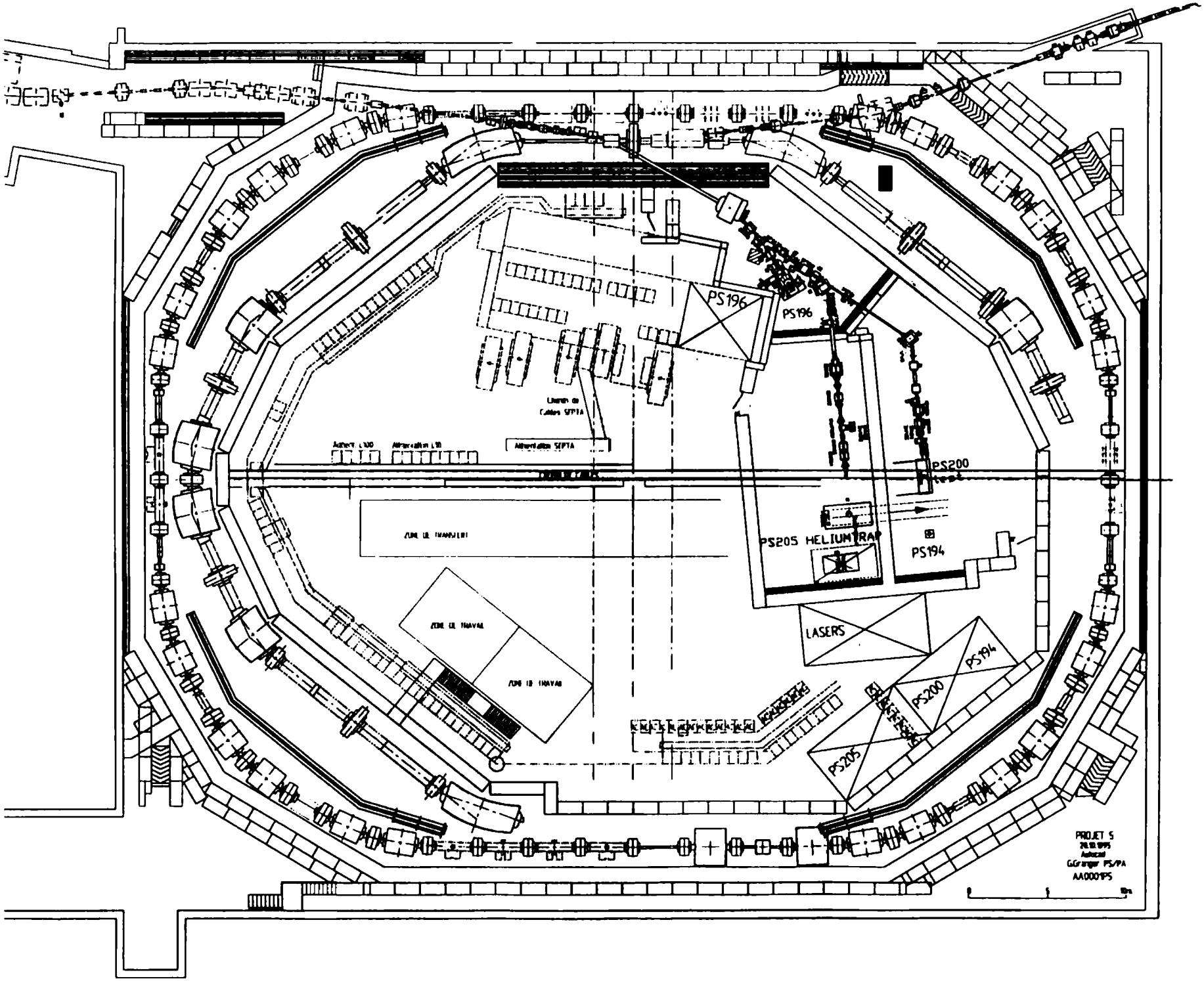
6. Tests are necessary to verify that the proposed scenario will work. These include decelerating the beam in the present AC so as to measure its lifetime because of fears about stability of supplies, improvement of the vacuum (10^{-10} torr N2 equivalent is required), etc. A list of AC studies which should be done by the end of this year was presented and discussed.

7. In the discussion, various points were raised that need further clarification, including the slow ejection scheme, the possibility of avoiding bunch rotation, the desire for the simplest possible scheme from the point of view of its operation, the suggestion of obtaining significant operating manpower from the experimental teams, etc.

8. The proposed time-scale of the AD scenario would be to make the design in 1996 while LEAR is in its last year, then install the hardware in 1997 and early 1998 so as to do the running-in during the second half of 1998. Operation would start in 1999 and last for at least 4 or 5 years. The operational rhythm could be say 3000 hours/year, from April to October, and Monday to Friday only.

9. S. Maury then presented the preliminary cost of the project. During the discussion it was said that the necessary resources do not seem to be available in PS division; if this new facility would be built, an important contribution from the outside would be necessary. Comments, clarifications and corrections were made from several groups, and an updated version will be produced (attached as annex).

B.W. Allardyce


PS196
PS196
PS200
PS205 HELIUM TRAP
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LASERS
PS194
PS200
PS205
PROJET S
GGranger PS/PA
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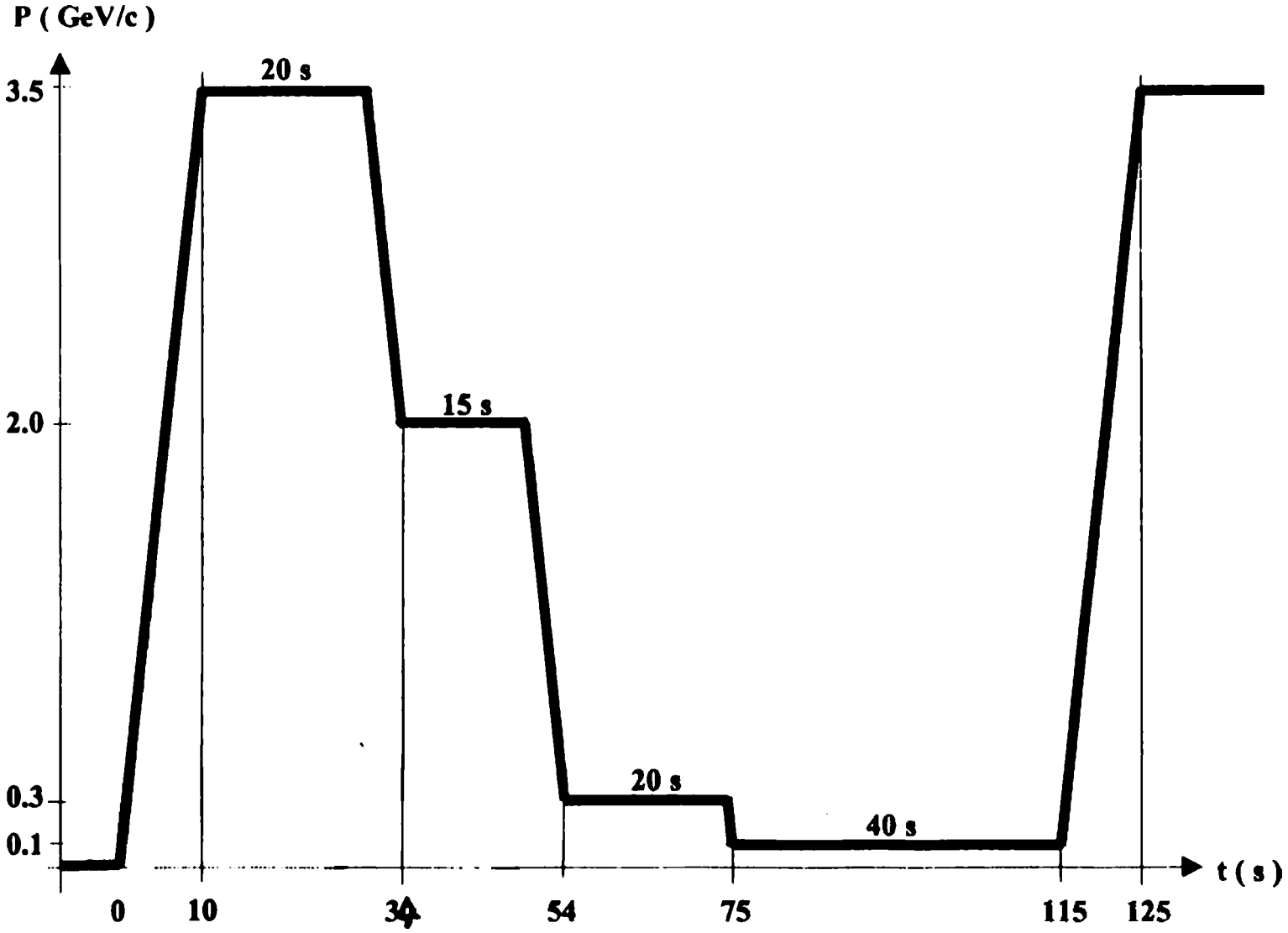
AD deceleration cycle



	STOCHASTIC COOLING					ELECTRON COOLING				
P [GeV/c]	ε_i [π mm·rad]	ε_f	$\Delta p/p_i$ [%]	$\Delta p/p_f$	t [s]	ε_i [π mm·rad]	ε_f	$\Delta p/p_i$ [%]	$\Delta p/p_f$	t [s]
3.5	200	5	1.5	0.1	BI + BII = 15 BI = 20	No				
2.0	9	5	0.18	0.05	BI = 15	No				
0.3	33	10	0.34	0.1	20	33	2	0.34	0.1	6
0.1	30	5	0.3	0.10	40	6	1	0.3	0.01	1

$10^7 \bar{p}$ / 120 s

$10^7 \bar{p}$ / 60 s

COST OF THE ANTIPROTON DECELERATOR (AD)

	Investments (kCHF)	Manpower (man-year)	
		Industrial support	CERN
Production beam	200	2.0	2.0
Target area.	150		0.5
RF (h=6) modif.	170	1.2	1.2
AC rf	70	0.2	0.5
Stochastic cooling	400		2.5
Electron cooling	500	2.0	3.0
Experimental area	790		3.5
Vacuum	1150	2.5	2.0
Controls	1300		5.0
Experimental area access	190		
Instrumentation	450		3.5
Kickers	50	0.6	
Power supplies	570	2.0	3.0
Water cooling	65		
Application programme		4.0	1.0
TOTAL	6055	14.5	27.7

FIRST ESTIMATION OF ADDITIONAL COST FOR THE SLOW EXTRACTION OPTION

Power supplies and controls	490
Pit	60
Electrostatic septum	200
Magnetic septum	250
8 Sextupoles	100
Power supplies for sextupoles	160
BLG's transfo	100
Stochastic cooling	340
TOTAL	1700 kCHF

OPERATION COSTS (PER YEAR)

Personnel and material costs in PS, AT, ST Divisions

	Groups	Man-year	Budget (kCHF)
PS Division	PA	1.2	60
	OP	2.2	
	RF	1.0	30
	PO	1.7	130
	CO	1.0	100
	BD	0.5	100
	Beam specialists	1.0	
AT Division	VA	0.2	100
ST Division	CV	0.2	30
TOTAL	Personnel:	9.0	Material: 550

The personnel could be shared approximately 50-50% between CERN and outside.

ANNUAL POWER CONSUMPTION (assuming 3000 h/year)

Base consumption		366 kCHF (500 today)
Cost of electricity:	AD machine	134
	Trap experiments	100
TOTAL		600

An additional sum of 200 kCHF must be foreseen for the slow extraction option.