EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
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CERN - PS DIVISION

PS/RF/Note 2001-16

Hollow Bunches in the PSB

Request for resources and possible planning

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Ref. PS/RF-LL

Geneva, Switzerland
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Preamble

Hollow bunches have been produced in the PSB already in 1999. It has been shown that $7 \cdot 10^{12}$ particles can be accelerated with a hollow distribution until the end of the cycle. Some efforts still need to be invested to improve the general robustness (reliability) of the operation and its readability. The fact is that, during the MD, the beam quality was not perfectly reproducible and even worse, the following day it has not been possible to get the same beam although the settings were the same. For further improvements, we need to invest in the following domains:

1. An instrument to measure the longitudinal energy distribution: the BTFM. This tool will allow to set the empty-buckets deposition in the coasted beam and also to observe any drift or jitter of the Linac parameters. This tool needs to supply results online, to any workstation.
2. Test of robustness versus various acceleration settings. This concerns bubbles clearing, bucket deposition, blow-up, transversal tune, acceleration parameters. This analysis should be analytical, numerical and empirical.
3. Monitoring of instabilities and scenario to cure them. Study of the general stability problem using BTF computation.
4. Test of synchronization process. This may lead to the need of some new hardware to make the process compatible with all possible beams.
5. Test of capture in dual harmonic mode to improve the bunching factor at low energy (needs also some BTF computation).

This type of beam is very new and the former paragraph reveals it needs a real and rather heavy development stage. At this point the major problem will certainly be to find available and valuable people to analyze the subject. It must be said that nothing proves yet that such a hollow beam can be supplied reliably with little effort (software or hardware).

Strategy

At this point it seems premature to set a final timetable. Nevertheless, some strategy needs be applied. Note that all diagnostic tools need to be ready first. The following table summarizes a most predictable schedule but doesn't take into account the cures to apply to the Linac in case of a sensible effect of a jitter in energy.

Object	**Participants / Date**	**Description**
BTFM (Specifications)	A. Blas before 8/10	Description of the required environment and all expected measurements and calculations to be performed
BTFM (control)	J. Serrano 8/10 > 26/10	Writing of RT tasks and Equipment Module for the use of a DAC and GPIB interface.
BTFM (application)	J.F. Comblin 1/11 > 15/11	Writing of the application program
Test of robustness and monitoring of instabilities	S. Koscielniak (mainly), A. Blas, S. Hancock, M. Lindroos + dedicated CERN physicist. 15/11 > 30/11	Make all possible measurements with a full dedication to the hollow beam during 2 weeks. Empirical work with some numerical analysis.
Rf Hardware (specification)	A. Blas December 01	Specification of new hardware (if needed)
Rf hardware (design)	A Findlay, J.P. Terrier 1/1/02 > 1/7/02	Quadripolar mode damper + Ejection synchro module
Rf hardware (construction)	External 1/7/02 > 1/9/02	Material orders, PCB construction, cabling.
Rf hardware (test)	A Findlay, J.P. Terrier 1/9/02 > 15/9/02	Test of new cards
Rf hardware (implementation)	A. Blas, A Findlay, J.P. Terrier 15/9/02 > 30/9/02	Implementation of hardware in beam control systems (taking care not to disturb current operation)
Numerical analysis	Machine physicist (CERN) 1/11/01 > 1/9/02	Analysis of capture process for various initial conditions; effect on beam distribution during acceleration, effect on transfer function and stability.
END OF PROJECT	END 2002	

Cost and Manpower

The previous table can be interpreted in terms of money and equivalent full time working days.

Object	**Cost (CHF)**	**People**	**Time**
DAC VME GPIB interface	1150 900		
RT and EM		J. Serrano	1 week
BTFM application		JF. Comblin	3 weeks
BTFM environment: 4 rf multiplexers	 5000	JP Terrier for testing	1 week
Shane's visit Flight: Subsistence (2 weeks):	 2000 2000		
First set of machine tests		A. Blas, S. Hancock, M. Lindroos + dedicated machine physisist	2 days x 3 1 week
RF hardware specification (2 modules)		A. Blas	2 weeks
Hardware design		A. Findlay, JP. Terrier	4 months x 2
PCB design	6000 x 2		
Modules construction	2000 x 12		
Production test		A. Findlay, JP. Terrier	1 week x 2
Various beam dynamics analysis		Dedicated machine physicist	4 months
General follow-up		A. Blas	3 months
Second set of machine tests		A. Blas, S. Hancock, M. Lindroos + dedicated machine physisist	1 week x 4
Total	50 kCHF		19 month-man

Note the vacancy for a machine physicist!