NON RESONANT SLOW EXTRACTION OF PROTONS FROM THE IHEP ACCELERATOR TO THE SWD SETUP

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1 INTRODUCTION

For the physical research on the setup-spectrometer SWD, installed on the beam line 22 [1], the 70 GeV proton beam of the intensity $\sim 10^8$ ppc with the high quality time structure is required. At this one need to combine the work of SWD with the work of another experimental setups in their tuned regimes. This mode of extraction was not planned before, since the proton beam extraction to the SWD has to be done by another method – a deflection to beam line 22 by bent crystal [2] of a part of the beam, which is extracted to beam line 8 during a resonant slow extraction [3]. Delay in realization of this regime defined a search of the nonresonant slow extraction possibility to SWD. In the paper results of setting up the extracting mode and the main characteristics of the extracted beam are given.

2 PECULIARITY OF THE EXTRACTING MODE

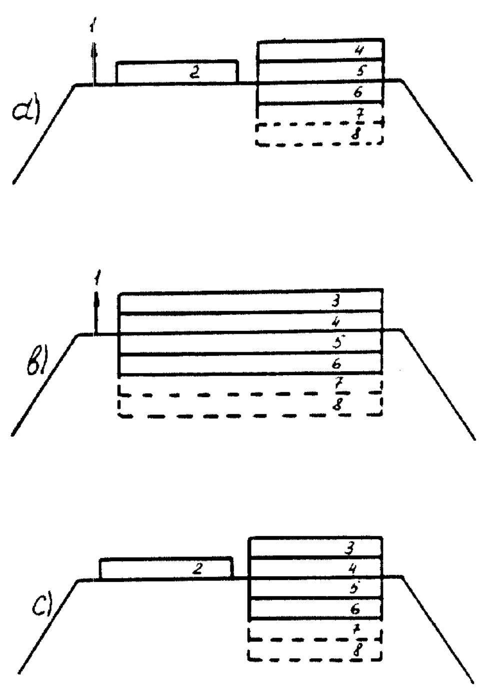

Figure 1: The typical working regimes combinations of the beam extracting systems. 1 – fast ejection, 2 – resonant slow extraction, 3 – nonresonant slow extraction, 4-8 – extraction of the particles from internal targets.

The different systems extracting the beam for the physical experiments work on the flat top of the IHEP accelerator magnetic cycle (see fig.1). There are fast ejection (FE), resonant slow extraction (RSE), internal targets (IT), nonresonant slow extraction (NRSE) [4,5], etc. on the flat top.

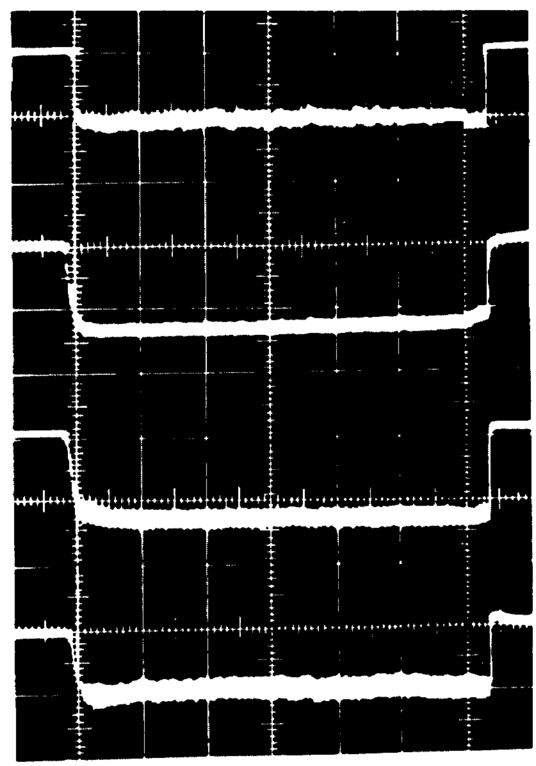

Figure 2: The beam time structure oscillograms during nonresonant slow extraction of the protons (lower trace) is made simultaneously with extraction of secondaries from the internal targets (three upper traces). Time scale – 100 ms/div.

Two regimes of NRSE, when the beam scattering by IT is used for extraction of particles, were mastered. The first one is used for extraction of a "high" intensity $10^7 \div \geq 10^{10}$, the second one – for a "low": $\leq 10^7$ ppc. The second regime does not satisfy the SWD requirements because of low intensity of an extracted beam. Difficulty of the first using regime is in a fact, that at the successive with RSE work one is not able to use the first septum magnet SM-18 [6] of the slow extraction system on the second half of the flat top (see fig.1a) because of a short duration of its current pulse, that is defined by the septum thermal characteristics.

The estimations show, that the proton beam of intensity by 10^8 ppc one can extract simultaneously to IT work, if using the hit of a scattered beam to the second septum magnet SM-20 aperture (see fig.2 from [5]). This septum magnet [7] provides the current pulse duration by 2c, that allows one to extract the particles thrown to its aperture on the second half of the cycle flat top simultaneously with IT work (fig.1c). Irradiation of the septum magnets in this regime of extraction (even at the worst case – extraction $\sim 1\%$ of the intensity, which could be extracted through SM-18) is by two orders less, compare to the case of the high intensity beam extraction with the help of resonant swinging.

3 CHARACTERISTICS OF THE EXTRACTED BEAM

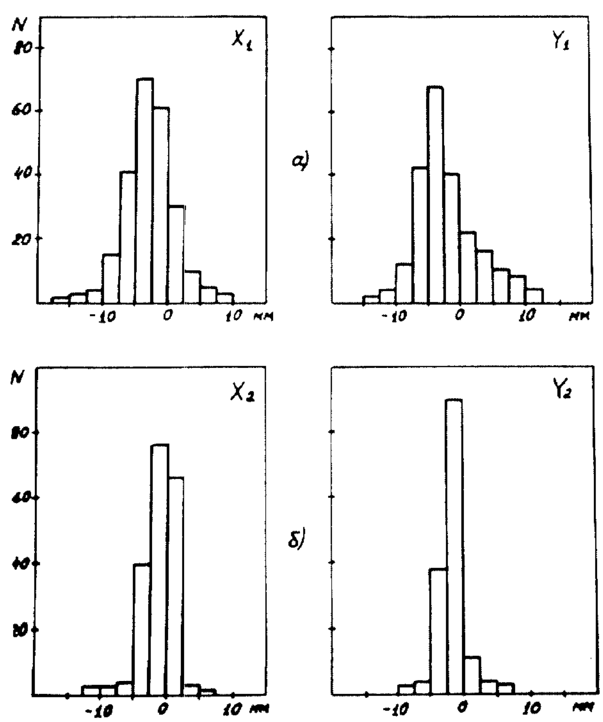

Figure 3: The beam profiles at the intermediate focus point.

Some of the characteristics connected with the beam dinamics in accelerator during scattering and extraction (e.g. distribution of the particles in the septum magnet apertures, the beam phase parameters on input of the system and output of the accelerator, value of the emittances etc.) were reported earlier [4,5]. Here we give the characteristics concerned the used regime.

The most important of the characteristics defining the efficiency of the physical experiment is a time structure of the extracted beam. Fig.2 shows the oscillograms related to the case of NRSE of protons to beam line 22 simultaneously with the extraction of the secondary particles from

Table 1: Characteristics of the beam intensity meters.

	Characteristic of the detector	Dimensions	Value	Note
1.	Range of measured intensity	ppc	$10^6 - 10^{11}$	
2.	Quantity of the matter under the beam	mg/cm^2	70	
3.	Measuring precision	%	3-5	
4.	Thickness of Al foil	μ	5-7	
5.	Filling		Ar	Purity 10^{-6} ppm
6.	Gas pressure	mmHg	500 ± 2	

IT. Three upper traces are the signals of the secondary particle monitors from the targets of beam lines 2, 4 and 18 installed into magnetic blocks 24, 27, 35 of A-70, accordingly. The lower trace is a monitor signal of the particles, which are got the septums of SM-18 and SM-20 during extraction of protons to SWD setup. High quality of the time structure for all simultaneously working experimental setups is defined by the work of the thin IT of beam line 2, consisting of the carbonic cloth of the equivalent thickness $\sim 50mg/cm^2$ [8]. The typical profiles of the beam for two planes at the intermediate focus point, where the preliminary focusing line [4] is separated from beam line 22 [1] are given on fig.3. The profiles of fig.3a correspond to the extracted intensity $\sim (2-3) \times 10^8$, 3b – to $\sim 2 \times 10^7$ ppc.

Farther transporting the beam to the fast cycling bubble chamber being used as a peak detector for SWD setup is made by the magnetic – optical elements of beam line 22. The beam profiles were got with detectors, are constructed for measuring the parameters of the low intensity beams [9]. Some of the characteristics of the intensity meters are given in the table. The automatic treatment of the measuring results assists operator to tune the regime of extraction and focusing, as well as to keep it stable during the accelerator run.

4 REFERENCES

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