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Mr. Volker RODEL E-7

Multi-foil real-time BSI in the West and North transfer lines

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1. Introduction

The range of beam intensity in the transfer lines depends on the extraction mode. For instance, the average intensity ratio between (one second) slow and fast extraction is of the order of 1/44000, and between slow and fast resonant extraction typically of the order of 1/2000. The beam intensity may also vary by a factor of 100 during each extraction mode.

For analog beam intensity observation, one has thus to cope with a range of more than 10^6. Signals with such a large amplitude range cannot be transmitted over the SPS distances, but must first be amplified, within the range of interest, to a suitable level. As slow extraction and fast resonant extraction occur both during one machine cycle, precisely timed gain switching is required during the cycle when more extraction modes must be observed simultaneously. However, remote gain switching remains a tedious procedure. A more reliable and flexible solution is the use of a multi-channel observation scheme in which each channel is perfectly adjusted to the required extraction mode.

Therefore, BSI's with 4 individual emitting electrodes have been installed in the West and North transfer lines just behind the extraction equipment.

Three foils have been connected to amplifiers with different gain whilst the fourth foil has been connected via a high quality coax to a panel in the BA. A test procedure has been implemented.

In Annex 1, one can find a summary of the measured electrical parameters whilst in Annex 2, a brief physical and mechanical description of this detector is given.

The photos of fig. 1 show the typical performance of the foils for the slow extraction and the fast resonant extraction. The parameters of the foil dedicated to the fast extraction have not yet been measured.

2. Equipment layout

Figure 2 shows the layout of the different electronic parts of the system. Only two channels are for the moment available via direct lines in the BC. These channels have been optimized for the present two resonant extraction modes.

The third amplified channel is only available in the BA and may be used for future purposes or, in case of breakdown, as immediate replacement for the slow extraction channel. If requested, all amplified channels can be connected to the usual waveform system.

Observation of the fast extraction may be done in the BA only by using the direct coax line to the fourth foil.

3. Test features

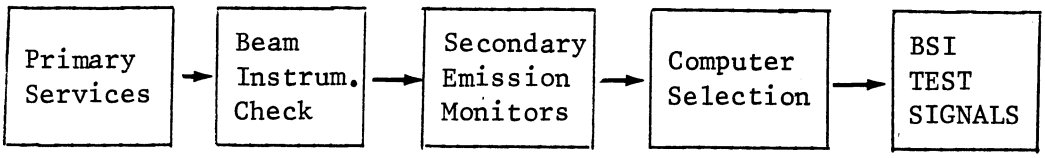
Remote-controlled test signals are available on two positions in the chains:

(a) a 2 kHz sinusoidal test signal of the proper amplitude may be injected into the bias foils of the detector,

(b) the outgoing cables from the BA can be connected to a 2 kHz sinusoidal source.

By observing the BSI signal on an oscilloscope in the BC, an operator is able to check the complete chain including the detector itself (signal (a)), or to check the electronic chain from BA to destination (signal (b)).

The test itself can be performed after the following 'touch-button' sequence in the MCR:



After this procedure, the 'Touch-Button' configuration of fig. 3 appears:

- buttons : fast resonant, slow-1, slow-2 deals with test signal (a)
- buttons : 'waveform lines only'deals with test signal (b).

Important remarks

A. The test may only be done when there is no circulating beam (or at least no extracted beam). If not, the SPS will be strongly disturbed because the output of the BSI is used also for the servo-spill.

B. The operator must not forget to switch the test signal off (see fig. 3).

ANNEX 1

Electronics specification

	Fast Resonant	Slow-1	Slow-2
Output voltage swing	20 V_{pp}	20 V_{pp}	20 V_{pp}
Bandwidth	100 kHz	10 kHz	10 kHz
Sensitivity (current)	$10 \cdot 10^{-6}$ A/V	$25 \cdot 10^{-9}$ A/V	$25 \cdot 10^{-9}$ A/V
Sensitivity (protons)	$1{,}3 \cdot 10^{15}$ p/s/V	$3.3 \cdot 10^{12}$ p/s/V	$3.3 \cdot 10^{12}$ p/s/V
Output test level (test signal to detector)	1 V_{pp}	1 V_{pp}	1 V_{pp}
Output test level (test signal to waveform)	20 V_{pp}	20 V_{pp}	20 V_{pp}
Bias voltage (in common)	200 V	200 V	200 V

ANNEX 2

The special BSI-monitor

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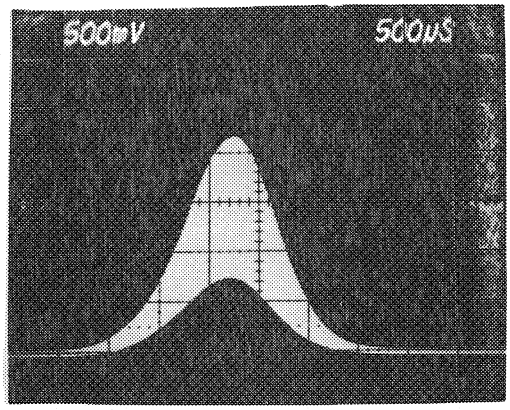
To allow analog observation of three types of extraction a special BSI-monitor has been developed. Two monitors of the SEM (Secondary Emission Monitor) type have been assembled, namely: one for the WEST (position 610211) and one for the NORTH extraction (position 210216).

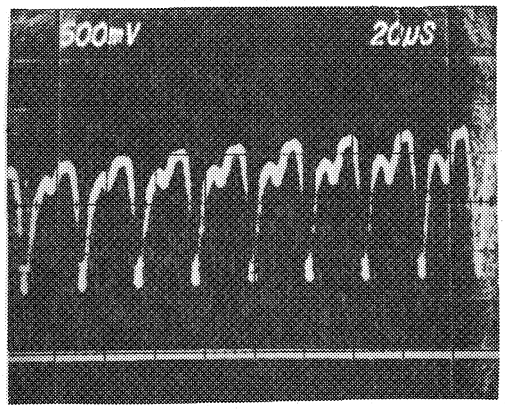
The monitor heads are housed in standard vacuum tanks and their moving mechanisms are arranged to allow continuous operation in the 'IN' position. Nevertheless, if required, the monitor heads can be switched 'IN' or 'OUT' of the beam by using the standard routine for movement (D.M.S.:IN-OUT)

The detector head consists of 4 emitting foils and 5 bias electrodes, i.e. each emitting foil is held by an electron-collecting foil (bias) on both sides. The spacing of the bias foils with respect to the signal foils is kept at 10 mm. The emitting and bias foils are made of pure aluminium of 25 μm thickness. The total mass involved for a centered proton beam is therefore 27 mg/cm^2. Blow up of beam for energies of 200 GeV/c or higher can therefore be ignored.

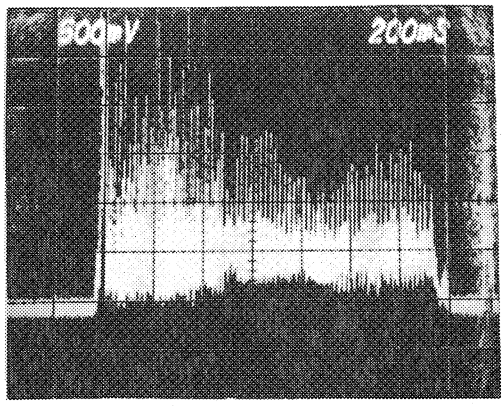
The emitting foil of the BSI which is foreseen for the fast extraction is connected to a special coaxial line. This coaxial line is operating under vacuum and carries the fast signal via feedthrough to a standard BNC-connector from where it can be transmitted with normal coaxial cables. The outgassing rate of the whole monitor is therefore kept at very low values. An enlarged shielding head holds the monitor elements together. Except for the shielding head, ceramics and coaxial line, the monitor is equipped with standard components of the SEM type already installed. The detector layout can be seen in fig. 4 and 5.



FAST RESONANT EXTRACTION



FAST RESONANT EXTRACTION



SLOW EXTRACTION

Fig. 1

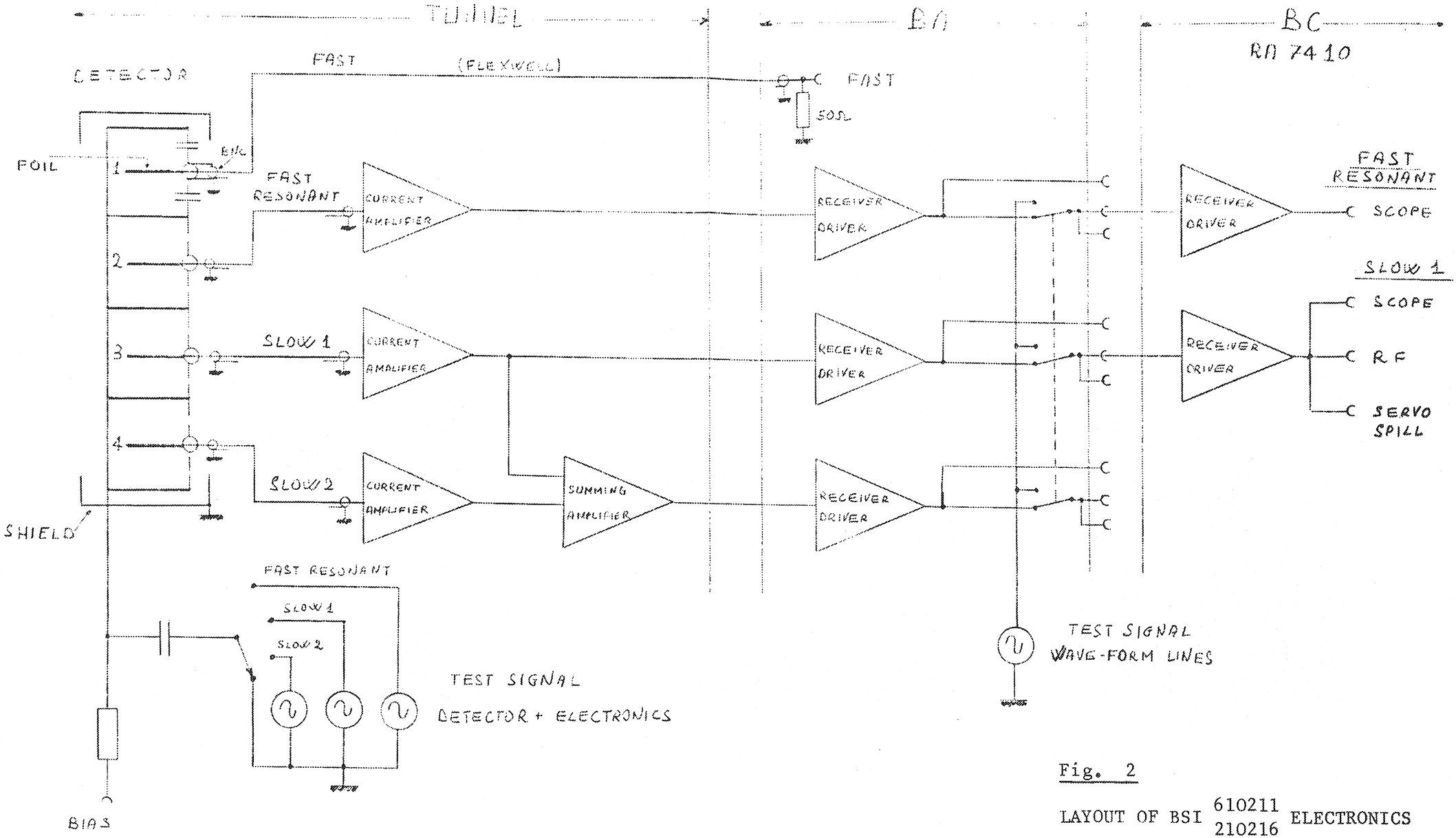
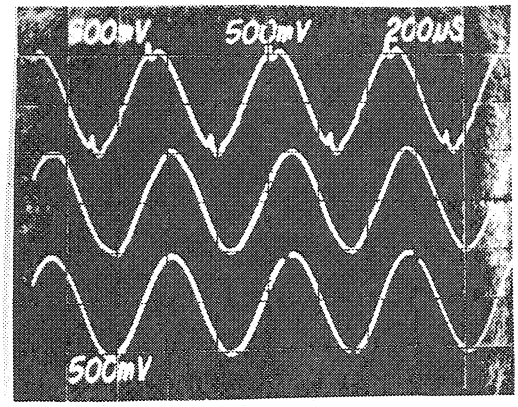
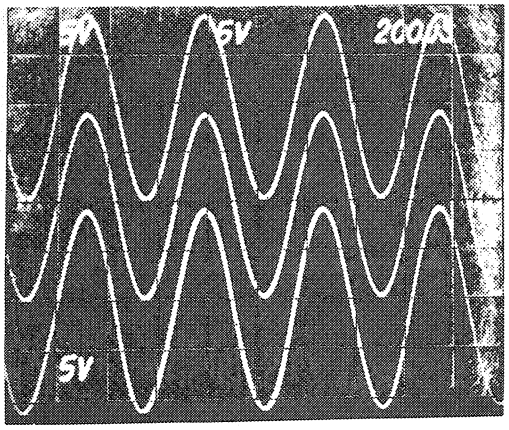


Fig. 2

LAYOUT OF BSI 610211 210216 ELECTRONICS



	OUTPUT CHANNEL	TEST BUTTON
o	FAST RESONANT	← FAST RESONANT
o	SLOW-1	← SLOW-1
o	SLOW-2*	← SLOW-2



o	FAST RESONANT	← WAVEFORM LINE ONLY
o	SLOW-1	← WAVEFORM LINE ONLY
o	SLOW-2*	← WAVEFORM LINE ONLY

TEST SIGNALS REAL TIME BSI's IN WEXTR/NEXTR

FAST RESONANT NEXTR	SLOW-1 NEXTR	SLOW-2* NEXTR	WAVEFORM LINE ONLY NEXTR
FAST RESONANT WEXTR	SLOW-1 WEXTR	SLOW-2* WEXTR	WAVEFORM LINE ONLY WEXTR
			TEST SIGNAL OFF

*) OBSERVATION POSSIBLE IN BA ONLY.
AMPLITUDES MEASURED IN BC RA7410

Fig. 3

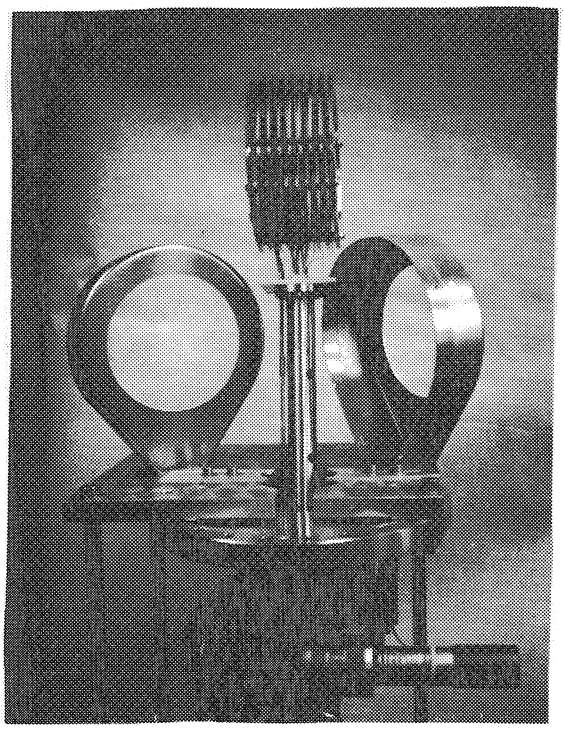


Fig. 4

Special BSI with vacuum flange, moving mechanism and removed shield

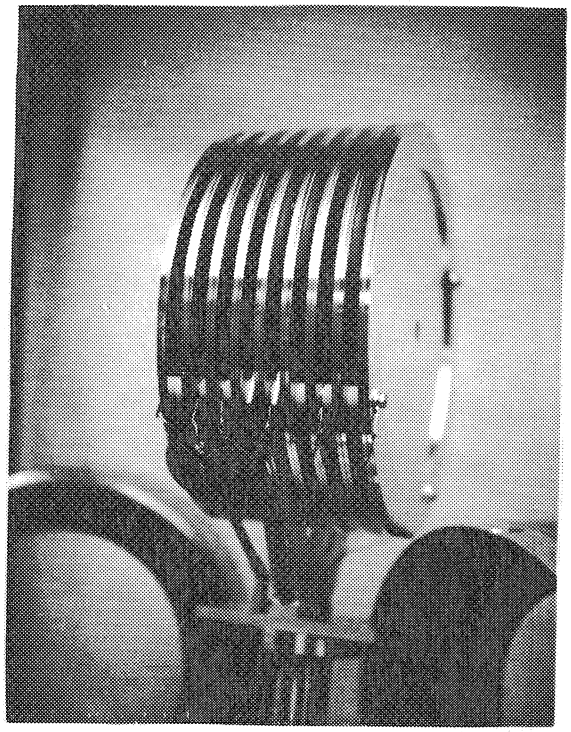


Fig. 5

View of foil assembly of special BSI