

BEAM DIAGNOSTIC SYSTEM OF THE RCNP RING CYCLOTRON

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ABSTRACT

The beam diagnostic system of the RCNP ring cyclotron was designed to optimize relevant machine parameters, through injection, acceleration and extraction.

INTRODUCTION

The beam diagnostic system for the RCNP ring cyclotron consists of various types probes.¹⁾ Each of them has been designed to measure one or more specific beam properties such as current, position, shape etc. At present, the basic layout of all the beam diagnostic devices has been determined, and the specifications of each probe, monitor and beam stopper are being designed.

BEAM DIAGNOSTIC ELEMENTS

The layout of all the devices is illustrated in Fig. 1.

The various functions of the main components of the system are described as follows:

i) The beam stopper (BS-INJ) located in the injection line can interrupt the beam from the AVF cyclotron and can measure the beam current. It will be temporarily

used to protect the ring cyclotron from the damage due to the wrong operation.

ii) Beam stoppers (BS-ACC) located on the accelerated orbit inside the vacuum chamber move vertically up and down by stepping motors. They can measure the total beam current at each radial position.

iii) The beam stopper (BS-EXT) located at the outermost radius can stop the highest energetic particle ($E_p \approx 400$ MeV) produced by the ring cyclotron.

iv) Beam profile monitors (TPM) set at the injection beam line, the injection and extraction orbits, and the beam transport line are of the types with a three-wire beam probe; three isolated wires, which are tilted relatively to each other, are moved simultaneously through the beam. The beam position and the corresponding beam cross section are reconstructed from the three views tomographic method.

v) The single-wire profile monitor (SPM) set at the injection orbit measure the betatron frequency of the vertical oscillation. It consists of a single wire moved vertically in a circular arc across the median plane.

BS-INJ	13	SL-4	19
BS-ACC-1	36	SL-5	22
BS-ACC-2	37	SL-6	23
BS-ACC-3	38	SL-7	26
BS-ACC-4	39	SL-8	27
BS-EXT	45	SL-9	29
RPM	42	SL-10	30
TPM-1	2	SL-11	32
TPM-2	8	SL-12	33
TPM-3	9	SL-13	47
TPM-4	11	SL-14	48
TPM-5	16	SL-15	49
TPM-6	59	SL-16	50
TPM-7	60	SL-17	52
TPM-8	61	SL-18	53
TPM-INJ-1	21	SL-19	54
TPM-INJ-2	25	SL-20	55
TPM-INJ-3	34	SL-21	56
TPM-EXT	51	SL-22	57
SPM-INJ	14	PPEN-INJ	31
SPM-ACC-1	24	PPEN-EXT	44
SPM-ACC-2	28	TVM-INJ	12
SPM-ACC-3	35	TVM-EXT	62
SPM-EXT	46	TVM-ACC	43
ESL-1	4		
ESL-2	6		
EPM-1	6		
EPM-2	7		
PP-ACC	41		
PP-INJ	10		
PP-EXT	58		
MP	40		
VSL-1	1		
VSL-2	3		
VSL-INJ	20		
VSL-EXT	63		
SL-1	15		
SL-2	17		
SL-3	18		

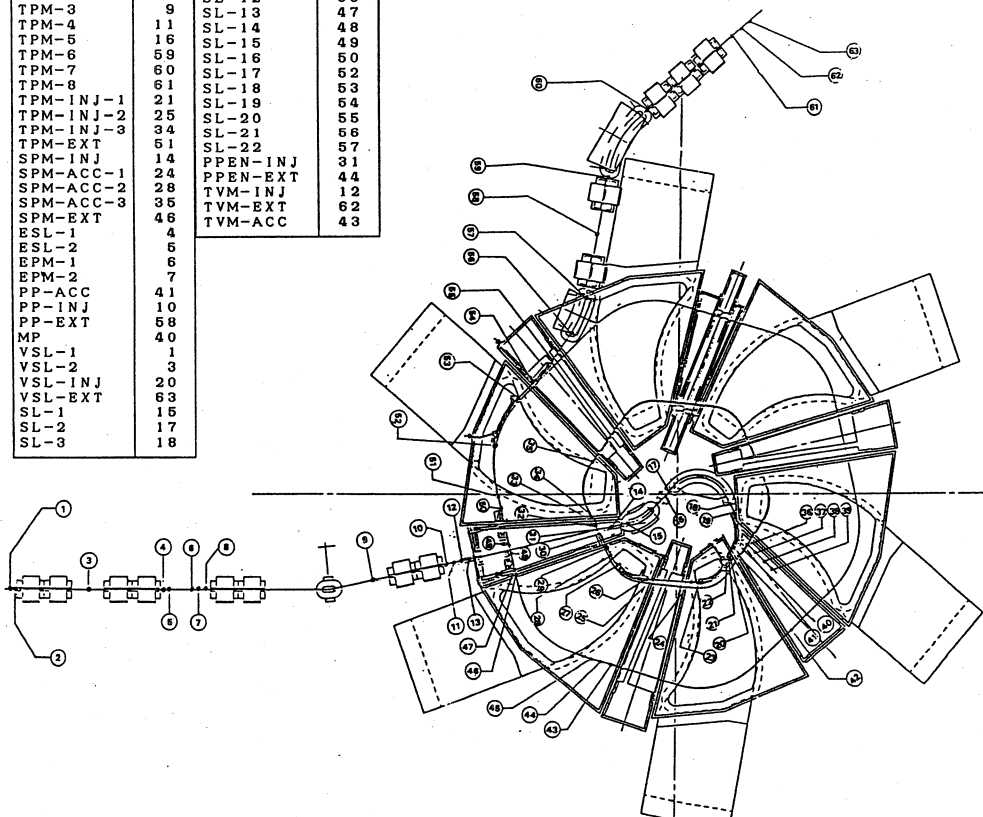


Fig. 1. Layout of beam diagnostic devices in the ring cyclotron.

vi) The emittance monitors (ESL & EPM) set in the injection line from the AVF cyclotron use the conventional slit-detector assembly. They can measure the transverse beam emittance. That measurement will be useful for matching the six dimensional phase space of the beam to the acceptance of the ring cyclotron.

vii) A radially displaceable multi-detector phase probe (PP-ACC) is located in the valley of the ring cyclotron, and it consists of eight pairs of capacitive detector heads set at intervals of 25 cm on the same support. They can measure the beam phase and width without interception of the beam.

viii) Capacitive pickups of the beam (PP-INJ, PP-EXT) are located at the inlet of the injection line and at the exit of the extraction line. They can measure the beam phase to the RF, and also can measure the beam current. They are helpful for calculating the turn number inside the ring cyclotron by taking the cross-correlation function between the beam intensity distribution in time domain.²⁾

ix) A multi-finger main probe (MP) is located in the valley region. It covers radius from the injection to the extraction. The head contains four different probes.

All the other diagnostic elements including the buffer slits, variable width slits and the devices for measurement of the time structure of the beam are set inside or around the ring cyclotron as shown in Fig. 1.

REFERENCES

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