BEAM POSITION MONITORS IN THE TRISTAN ACCUMULATION RING

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INTRODUCTION

Eighty-six beam position monitors are set near almost all quadrupole magnets in the accumulating ring of the TRISTAN. We are intending to measure the closed orbit distortion with an accuracy of about 0.1 mm. Twenty position monitors have already been tested by a test bench system.

BEAM POSITION MONITOR

The structure of a position monitor is shown in Fig. 1. Four disk electrodes pick up beam signal electro-statically. SMA connectors are welded on the beam duct. Head cables are semi-rigid type of high noise immunity.

DETECTOR CIRCUIT

The beam signal is a pulse of 1.2 μsec period, 100 psec width and 340 V peak voltage at maximum beam current of 35 mA. We adopted double super-heterodyne method to detect the harmonic frequency of beam revolution in order to cope with the short pulse length and to get high sensitivity. We will pick up 380.641 MHz, 479-th harmonic, avoiding the influence of RF signals (508.58 MHz). The final IF frequency is 10.7 MHz. Rectified signal is put into CAMAC ADC, and then CAMAC serial highway transmits the data to a control computer. (Fig. 2)

CALCULATION

To get the beam position, the following steps are necessary. Let signals at four electrodes be A, B, C and D. Firstly, the electrical position (H, V) is obtained by the following normalization.

$$(H,\ V) = \left(\frac{(A+B) - (C+D)}{A+B+C+D},\quad \frac{(A+D) - (B+C)}{A+B+C+D} \right)$$

Secondly, (H, V) are calibrated to the geometrical coordinates (X, Y) in the chamber.

$$(X,\ Y) = (\ f(H,\ V),\ g(H,\ V)\ )$$

where f and g are calibration functions. We approximated f and g by third order polynominals. We fitted the polynominals to test bench measurements with least means square method. Fitting error is less than 0.1 mm within the region of 20 mm × 12 mm. Lastly, final beam position is obtained by the correction of setting errors.

TEST BENCH SYSTEM

To obtain the calibration function, mapping data of the position monitors have been measured by a test bench system. As shown in Fig. 3, it consists of an antenna, a pulse-motor-driven X-Y table, a coaxial switch, a detector circuit and a CAMAC micro-computer system with a graphic display. The antenna is an end-stripped thin coaxial line. It excites fields in the chamber. The precision of antenna setting is 10 μm. An example of the coordinated mapping is shown in Fig. 4.

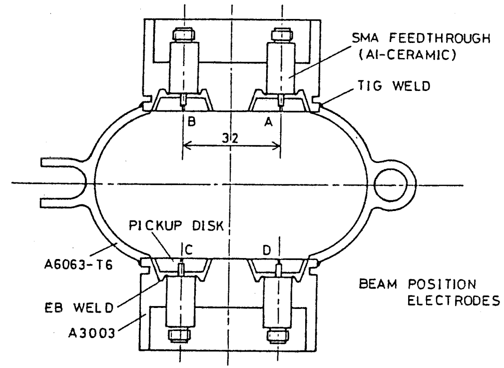

Fig. 1 Beam position monitor for the TRISTAN accumulating ring.

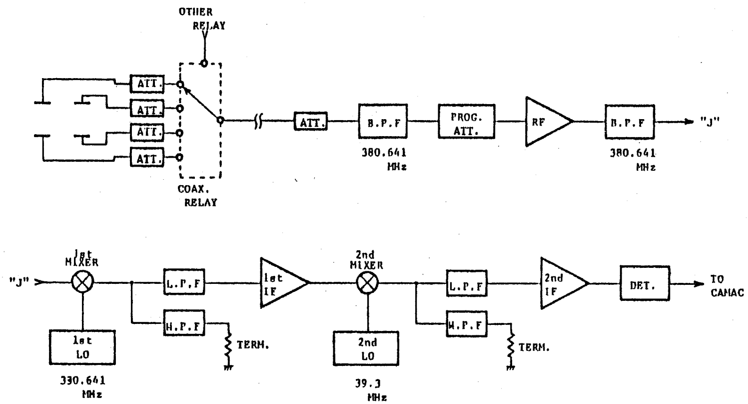

Fig. 2 Block diagram of detector circuit.

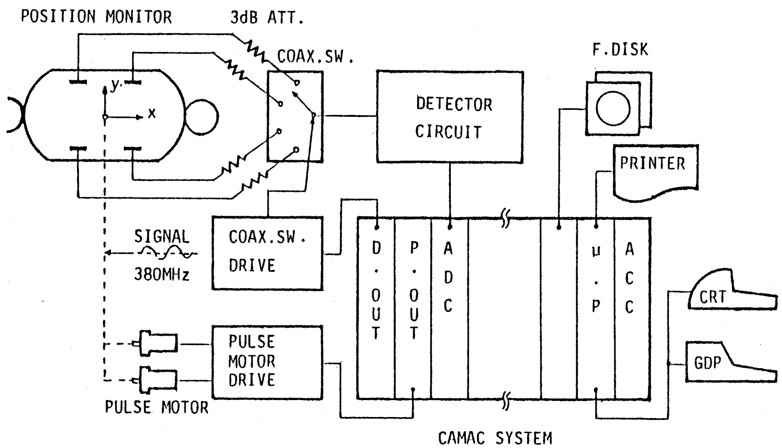

Fig. 3 Block diagram of test bench system.

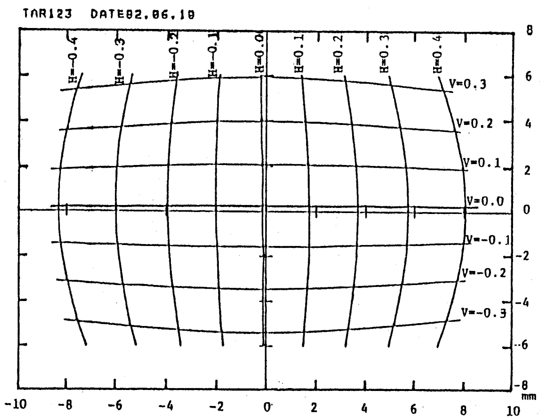

Fig. 4 Coordinated mapping diagram.