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HIGH VOLTAGE PULSER FOR STREAMER TUBES AT THE SLD

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ABSTRACT

A board has been designed for the test of the Warm Iron Calorimeter streamer modules at the SLD. The board pulses in a programmable way the High Voltage distribution Boards.

1. INTRODUCTION

A board, called High Voltage Pulser, has been designed as a part of the electronics for the Warm Iron Calorimeter at the SLD. The WIC[1] consists of a system of plastic streamer tubes which instruments the iron structure for the flux return of the magnetic field. The streamer tube signals are collected either by pads ($\sim$ 8500) or by strips ($\sim$ 80000).

Signals from the strips are preamplified, discriminated and latched by the SGS cards[2] and then daisy-chained through a multi-purpose module, called Splitter Board[3] which sends them to the next level of the data acquisition system.

The pads signals are organized in projective towers which match the geometry of the Liquid Argon Calorimeter inside the magnetic coil.

The High Voltage system chosen for the WIC is controlled by the CAEN SY127[4] which has 10 plug-in CAEN A432 HV modules for each mainframe. These modules have 4 channels each one connected to 4 High Voltage Boards[5].

The HV pulsing system is designed to provide both an alternative way to calibrate the pad system and to check the integrity of the strip/pad readout chain.

The HV Pulser is a programmable board which generates voltage signals of variable amplitude and time length distributed to the anode wire of the WIC tubes through the High Voltage Boards, as shown in Fig. 1. The HV Pulser is programmed and controlled by a FASTBUS module, the Timing and Control Module[6] (TCM) which gives the capability to sinchronize the pulsing with the strip/pad readout. The complete programmability of the pulse shape allows the study of the trigger efficiency and thresholds and adds flexibility to the tests.

2. MODULE DESCRIPTION

The pulsing system consists of 20 HV Pulsers, 8 for the barrel (one for each octant), 8 for the two end-caps and 4 for the 45° chambers (used to increase the muon identification between barrel and end-cap). Each pulser controls up to 64 HV Boards subdivided into 16 independent groups of 4 channels each.

The HV Pulser communicates with the TCM via the standard SLD *3-wire protocol*[3] (i.e. the lines COMMAND, CLOCK and DATA) through a Fiber-Optics Fan-Out module.

Two specific commands (*write* and *read*) are sent by the TCM in order to fill or read back a table containing the parameters describing the pulse amplitude and width and the module groups to be pulsed. The table is organized in the following fields:

- (8 bits) *HVP address*: Pulser ID
- (1 bit) *pulsing mode*: Free or Synchronized
- (1 bit) *pulse length*: Long or Short mode
- (1 bit) *enable*: to enable/disable the board.
- (8 bits) *pulse amplitude*: $1.2 \div 6.6$ V
- (4 bits) *pulse width*: $65 \div 340$ ns
- (16 bits) *HV Boards group*: select the HV Boards groups to be pulsed

For both commands, the address field is compared with a hardwired ID in order to validate the commands themselves.

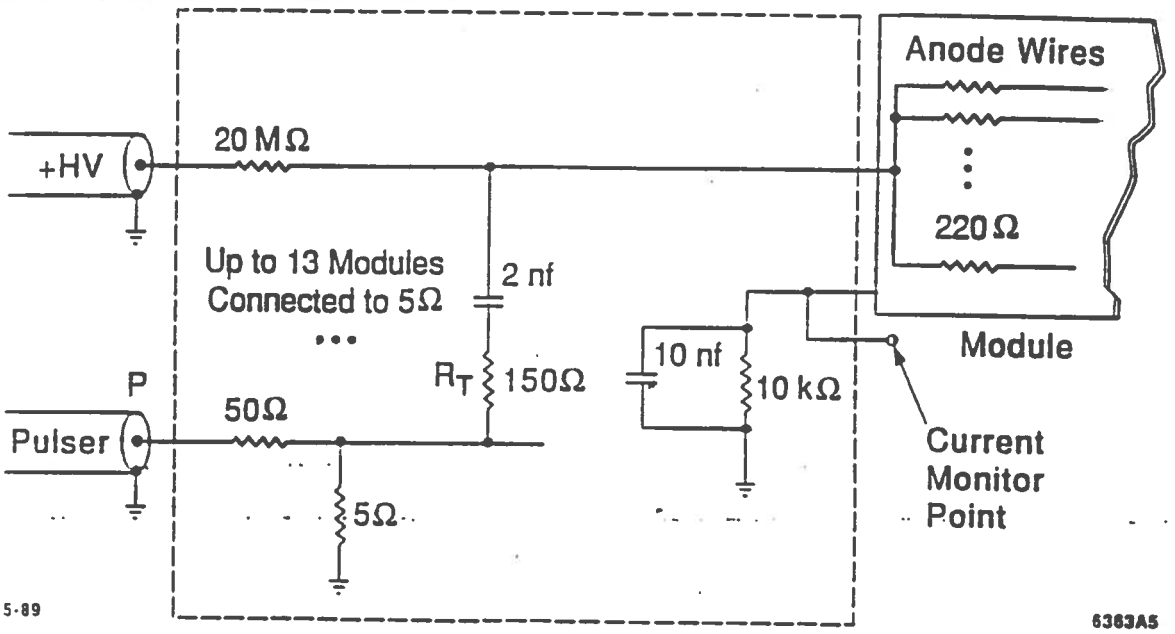


Fig. 1

In Free pulsing mode the pulse is synchronized to an internal oscillator (1 kHz) while in the Synchronized mode the pulse is triggered by an external START signal.

The Long pulse (8 or 4.5 μs selected by a dip-switch) is produced by a one-shot device while the Short pulse is set by a programmable delay line (L-65-221) accordingly to the value specified in the pulse width field.

The pulse amplitude is set by an 8-bit DAC from 1.2 to 6.6 V in steps of 21 mV.

In the Short mode, the pulse width can be selected in the range from 65 to 340 ns in steps of 18 ns.

The pulse is then fed into the drivers which are enabled by the corresponding bits in the HV Boards group selection field.

3. CIRCUIT DESIGN

The HV Pulser is logically divided into 3 functional blocks (see Fig. 2):

- Differential receiver
- Command and address decoding
- Pulse generation

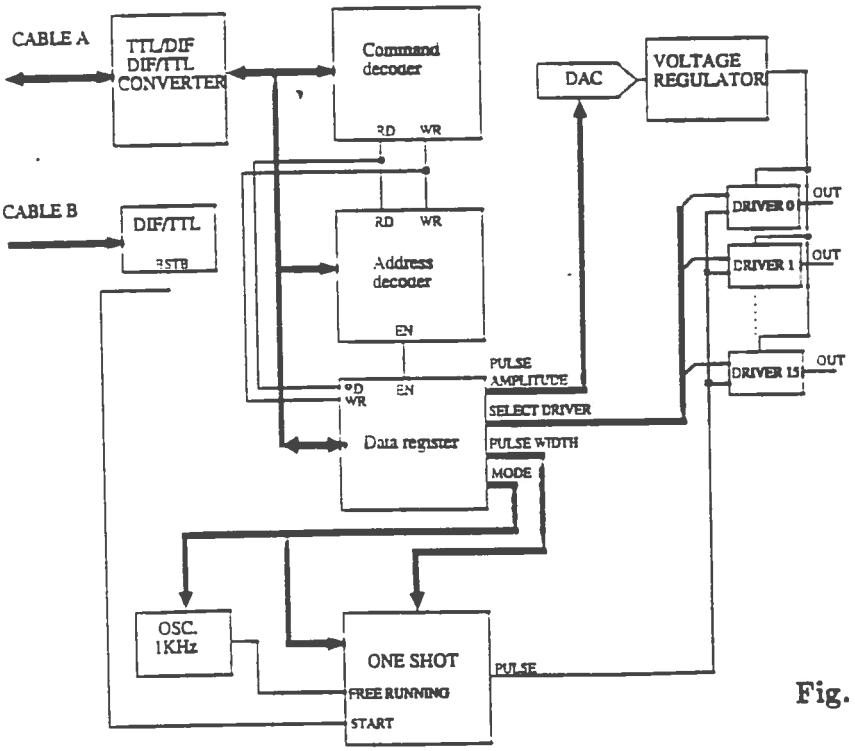


Fig. 2

In order to maintain the compatibility with the main readout system of the WIC (i.e. Splitter Board readout), two differential cables (A and B) connect the HV Pulser to the Fiber-Optics Fan-Out module. In this case, only Cable A is used for the COMMAND, CLOCK and DATA lines while the START signal alone is sent along Cable B (BSTB).

When the COMMAND line is high the Command Decoder checks for the *write/read* codes in the DATA line (code=6 or 7). If one of these codes is recognized, the address field is compared to the hardwired HV Pulser ID. In case of positive matching the Data register is enabled.

The pulse amplitude is generated by a one-shot and strengthened by a ***push-pull*** driver realized with two MOSFETs (Fig. 3). The amplitude variation in the output pulse is produced by varying the source-drain voltage of the *pull* MOSFET.

Table 1 summarizes the electrical characteristics of the module.

Table 1

Electrical Characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Pulse Amplitude range		1.20	-	6.6	V
Pulse Amplitude step		19	21	23	mV
Pulse Amplitude temperature stability		-	1	-	%
Short Pulse width range		65	-	340	ns
Short Pulse width variation		-	+/-300	-	ppm/°C
Short Pulse step	pulse=90 to 340ns	18	20	22	ns
Short Pulse jitter		-	500	-	ps
Long Pulse width	jumper on R=100K C=94pF	-	8	-	us
	jumper off R=100K C=47pF	-	4.5	-	us
Long Pulse width variation over temperature range		-	±0.5	-	%
Long Pulse jitter		-	<10	-	ns
Fall time	pulse amplitude=6.6V	-	-	30	ns
	" " =2V	-	-	15	ns
Rise time	pulse amplitude=6.6V	-	-	10	ns
	" " =2V	-	-	8	ns
Propagation delay from START to output pulse		-	100	120	ns
Free Running Mode Frequency	C4 = 470nF	-	1	-	kHz
Power Supply Current +8V	static conditions	-	0.7	1	A
Power Supply Current +14V	static conditions	-	40	-	mA
Peak Power Supply Current +14 V	2 driver enabled	-	1	-	A
Power Supply Current -12V	static conditions	-	60	-	mA

4. CONCLUSIONS

The HV Pulser is a board designed for the WIC streamer tubes pulsing at the SLD. These pulsers, used mainly for testing purposes, are installed in the WIC. Fig. 4 and 5 show the patterns produced in the strips (short pulse, 4V amplitude) and pads (long pulse 6 V amplitude) by pulsing a single HV Pulser channel (i.e. 4 HV Boards).

In the strips case the HV Pulser helps in checking the continuity of all electric connections and in finding malfunctioning electronics channels. In the pads case it can be used to check the response of individual pads included in a tower and as an independent check of the pad system performance.

This system has been used recently to obtain information about detector problems: a few cases of dead SGS boards or bad connections have been found which were not already known of. A cross-check made with cosmic rays passing through the problematic regions without producing any hit has suggested the replacement of these boards.

REFERENCES

(1) SLD Design Project, SLAC-Report-273 (1984)
(2) F. Beconcini et al., Nucl. Instrum. Methods A276 (1989) 94
(3) N. Bacchetta et al., IEEE Trans. on Nucl. Sci. 36 (1989) 1657
(4) CAEN SY127 HV System, User Manual. Costruzioni Apparecchiature Elettroniche Nucleari SpA, Via Vetraia 11, 55049 Viareggio, Italy
(5) U. Schneekloth, WIC-Note 90-003, April 4 1990
(6) S. MacKenzie, SLD LAC Timing Unit, SLD internal note (1987)

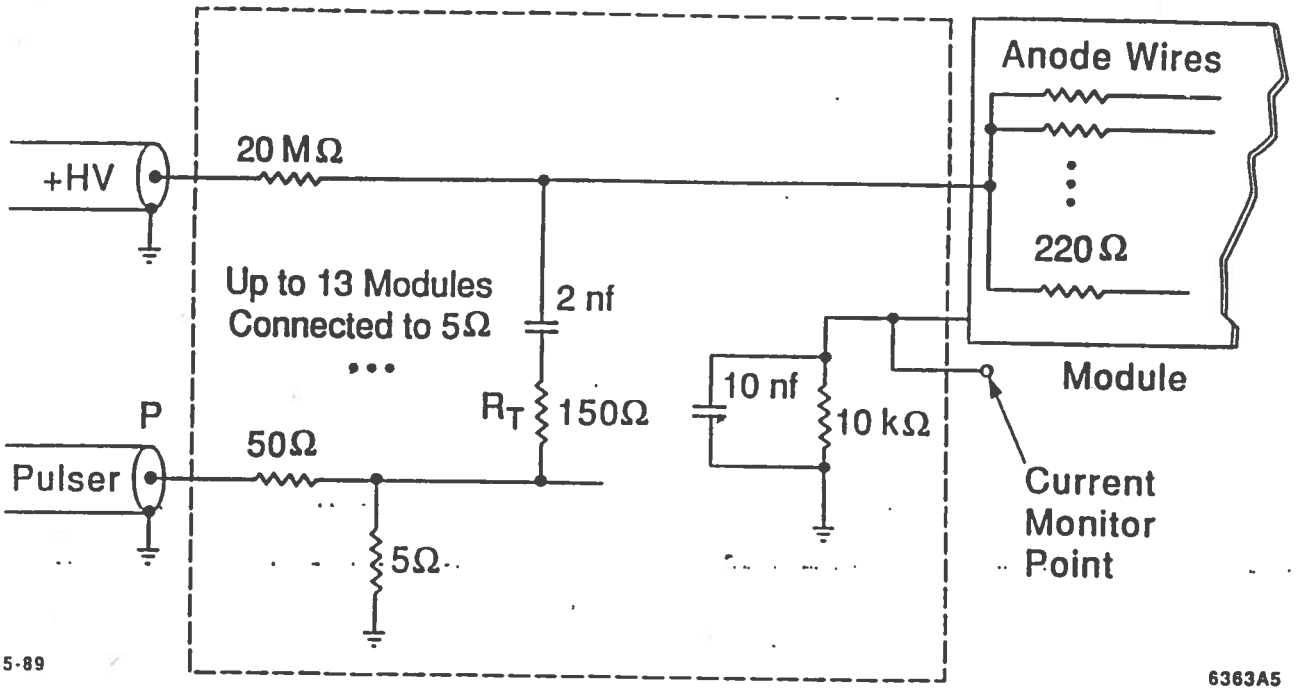

Anode Wires
+HV
20 MΩ
220 Ω
Up to 13 Modules
Connected to 5Ω
2 nf
10 nf
Module
P
Pulser
50Ω
R_T 150Ω
10 kΩ
Current
Monitor
Point
5Ω
5-89
6363A5

Fig. 1

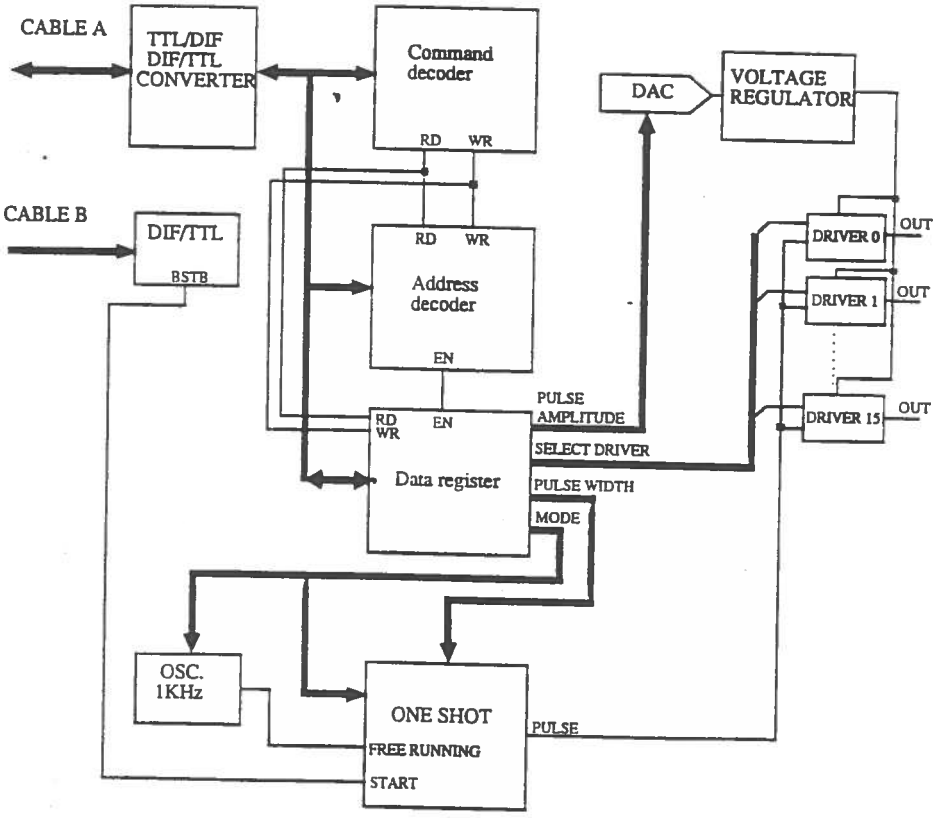

CABLE A
TTL/DIF
DIF/TTL
CONVERTER
Command
decoder
RD WR
DAC
VOLTAGE
REGULATOR
CABLE B
DIF/TTL
BSTB
RD WR
Address
decoder
EN
DRIVER 0
OUT
DRIVER 1
OUT
DRIVER 15
OUT
RD
WR
EN
Data register
PULSE
AMPLITUDE
SELECT DRIVER
PULSE WIDTH
MODE
OSC.
1KHz
ONE SHOT
FREE RUNNING
START
PULSE

Fig. 2

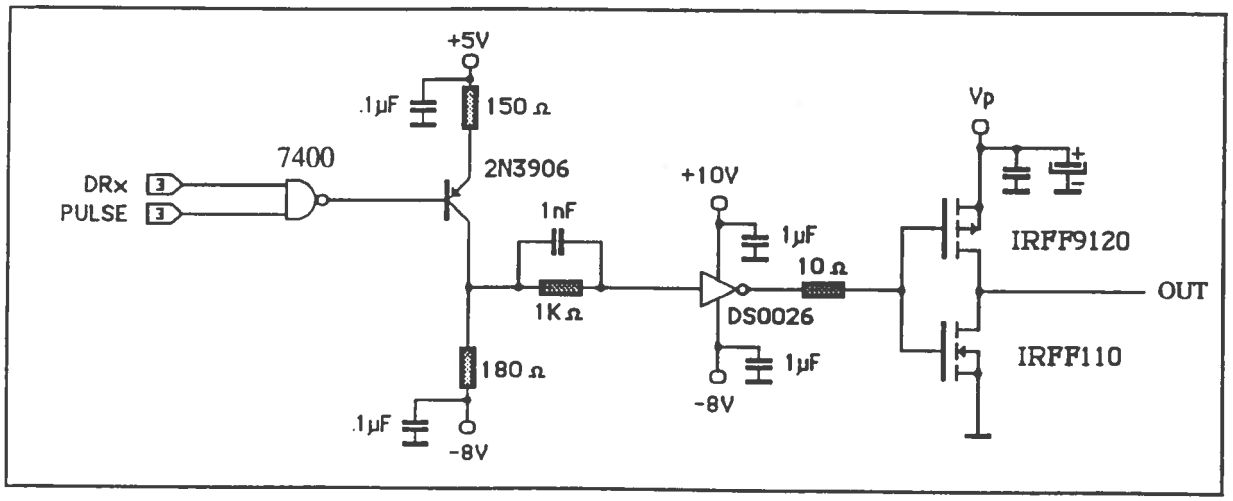
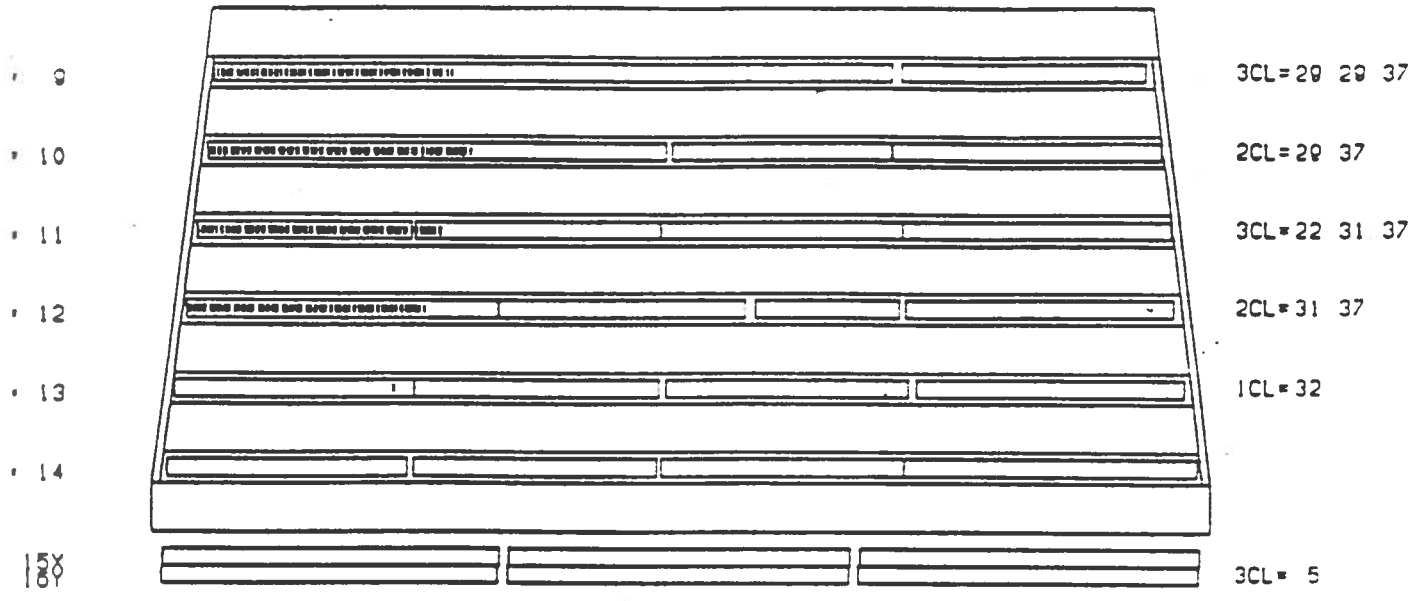


Fig. 3



Octant 5 - South Side Looking North

Fig. 4

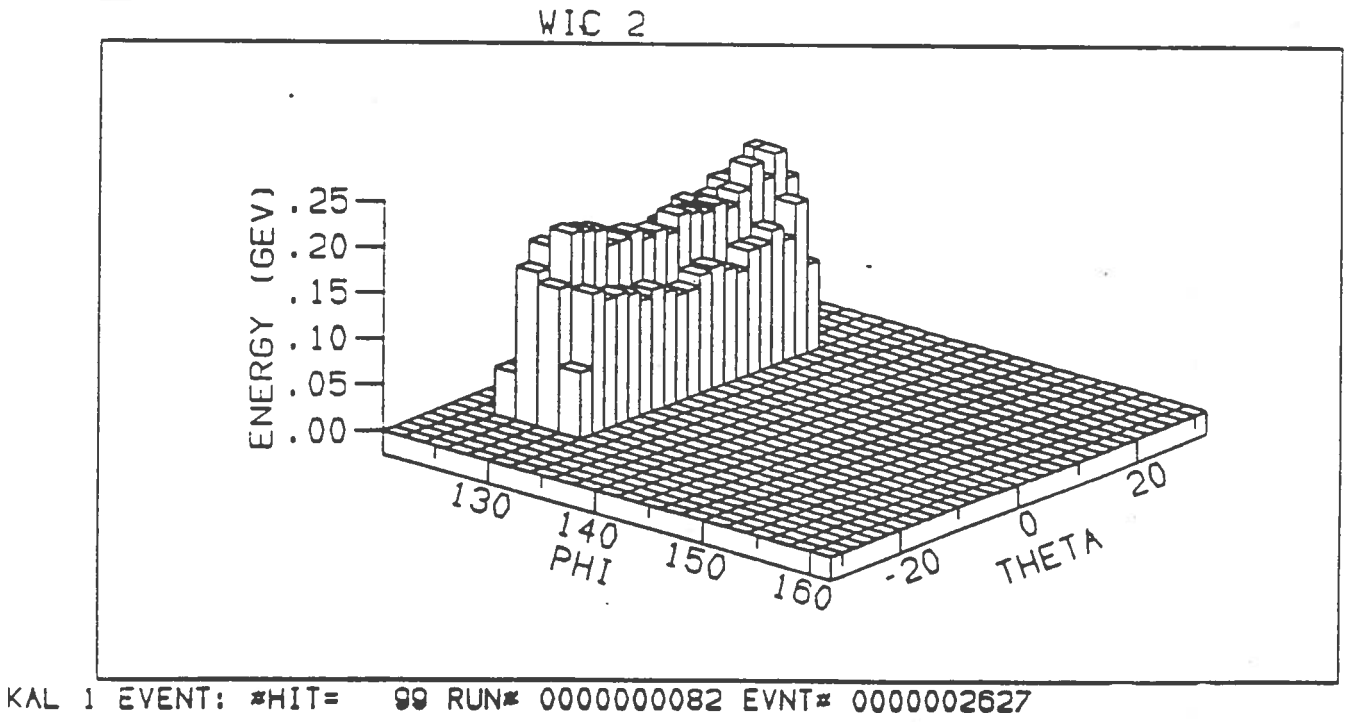

WIC 2
ENERGY (GEV)
.25
.20
.15
.10
.05
.00
130
140
150
160
PHI
-20
0
20
THETA
KAL 1 EVENT: #HIT= 99 RUN# 0000000082 EVNT# 0000002627

Fig. 5