Scintillation counters + Xen's new board. JAW, 5th March 2010.

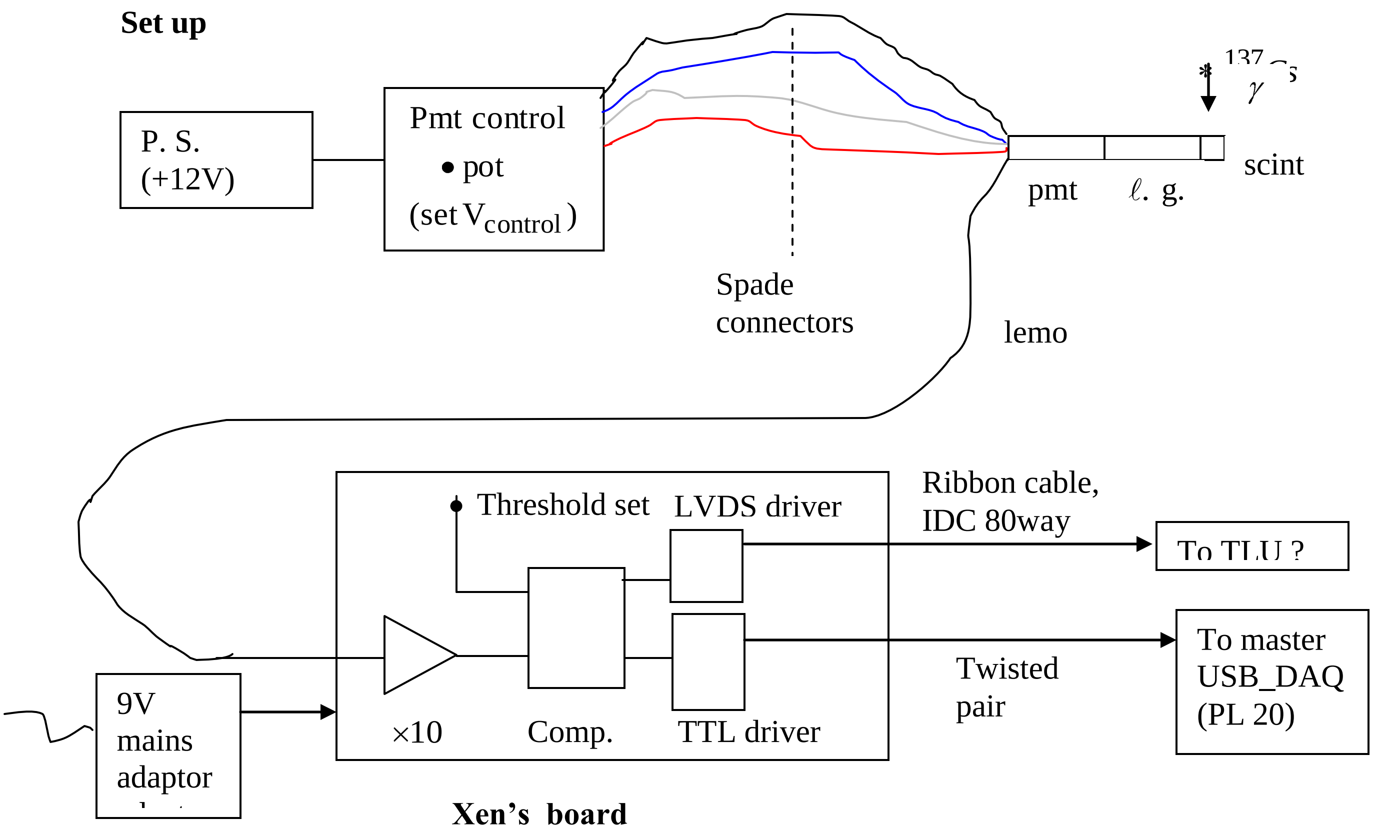
The scintillators and their settings are unchanged from the last run but Xen has produced a new version of his board (which discriminates the pmt signals). The new board is much less prone to oscillations.

Dimensions
Beam particles traversing the TPAC sensors are detected by three scintillation counters. Each plastic scintillator measures $10\times10\times6\,mm^3$. The $10\,mm\times10\,mm$ face defines the beam spot and matches the size of the sensors. A beam particle will traverse $6\,mm$ of scintillator and so should produce sufficient light. The $10\times6\,mm^2$ face is connected to a perspex light guide of cross-sectional area $10\times6\,mm^2$, which tapers at its the end to match the $8\,mm$ diameter window of a miniature Hamamatsu photomultiplier tube.

	Light guide length	Hamamatsu phototube
Scint counter 1 :	$10\,cm$	H6780
" " 2 :	$10\,cm$	H5783
" " 3 :	$5\,cm$	H6780

(The H6780 and H5783 are physically identical and only slightly different in their response and in their operation – please see the attached spec sheets).

Set up



The pmt gain is set by supplying a low voltage (0.9V maximum) via a potentiometer in a control box which is fed by a +12V power supply (IsoTech Lab supply). This control voltage can be monitored from the control box by a DVM. Typically the control voltage is 0.65V.
The pmt output emerges on a lemo cable which is connected to “Xen’s board” (a board designed by Xen Serghi to discriminate pmt signals – compact and light to avoid our having to take a crate + NIM modules to CERN) . Xen’s board is powered via a 9V mains adaptor, stepped down to 5V with regulators on board: analogue LV (-5V, 0V, +5V), digital LV (0V, +5V).
In this board the pmt signals are amplified by a factor 10 and then discriminated by a fast comparator whose threshold is set by a potentiometer (and measured via monitoring pins). The thresholds for all three pmt channels have been set to $50mV$. The logic outputs from the comparators are converted to
i) TTL and then sent via twisted pair cables to the Master USB_DAQ board on to the pins of connector PL20;
ii) LVDS and then sent via an 80 way IDC ribbon cable (to the TLU?).

Setting the pmt “HV”.

A Caesium source, ^{137}Cs which emits γ rays of energy $0.662keV$, was used. These gamma rays Compton scatter in the plastic scintillator, producing a spectrum of pulses corresponding to energies ranging from $0\,MeV$ to $0.662MeV$. Since a minimum ionizing particle will deposit $2.0MeV\,cm^{-1}$ in plastic scintillator, a beam particle will leave at least $1.2MeV$ in the $6mm$ thick scintillator, corresponding to a signal about twice as large as the maximum pulse seen from ^{137}Cs.
In setting up, the “HV” (i.e. $V_{control}$) applied to each phototube was increased until the maximum signal observed from ^{137}Cs, after amplification, exceeds significantly the comparator threshold. With these settings, a beam particle is sure to trigger the comparator.

Setting up (results)

	$V_{control}$ (V)	Maximum pulse height (mV)
Pmt 1 (H6780)	0.60	6
	0.70	20
	0.80	70
Pmt 2 (H5783)	0.50	5
	0.60	20
	0.70	70

Pmt 3 (H6780)	0.50	2
	0.60	12
	0.70	40

$\Rightarrow$ **very roughly, an increase of** $0.1\,\mathrm{V}$ **in** $\mathrm{V_{control}}$ **produces an increase in pulse height of a factor 3-4.**

For each pmt, we set $\mathrm{V_{control}}$ so that the maximum signal from ^{137}Cs at the input to the comparator is $\approx 200mV$. With the comparator threshold set to $50mV$, signals from minimum ionizing particles should be very safely visible.

Final settings

	Pmt	$\mathrm{V_{control}}$ (V)	Comparator threshold (mV)
H6780	1	0.70	50
H5783	2	0.60	50
H6780	3	0.65	50

Attachment/alignment to the TPAC stand.

Pmts 1 and 2 are fixed at the upstream edge of the TPAC stand (i.e. the end with feet attached) and are mounted at $90°$ to each other. Pmt 3 is mounted at the downstream edge of the stand. Although the plates on which the pmts are fixed are held by the same alignment pins as the sensors, the pmts themselves are not positively fixed; they are located on the beam position by eye (aided by threading wires between the ends of the alignment pins).

Potential problems

We see common-mode noise due to the LV regulators. This noise looks troublesome at first sight but does not seem to affect the operation of the circuit.

In case of problems

During the beam tests,
Xen will be in Birmingham (0121 414 4616; x.serghi@bham.ac.uk) ;
JAW will be in Bham (0121 414 4654, jaw@hep.ph.bham.ac.uk) until 24th March; then at CERN (jaw@hep.ph.bham.ac.uk).
In case of problems, please contact either of us.