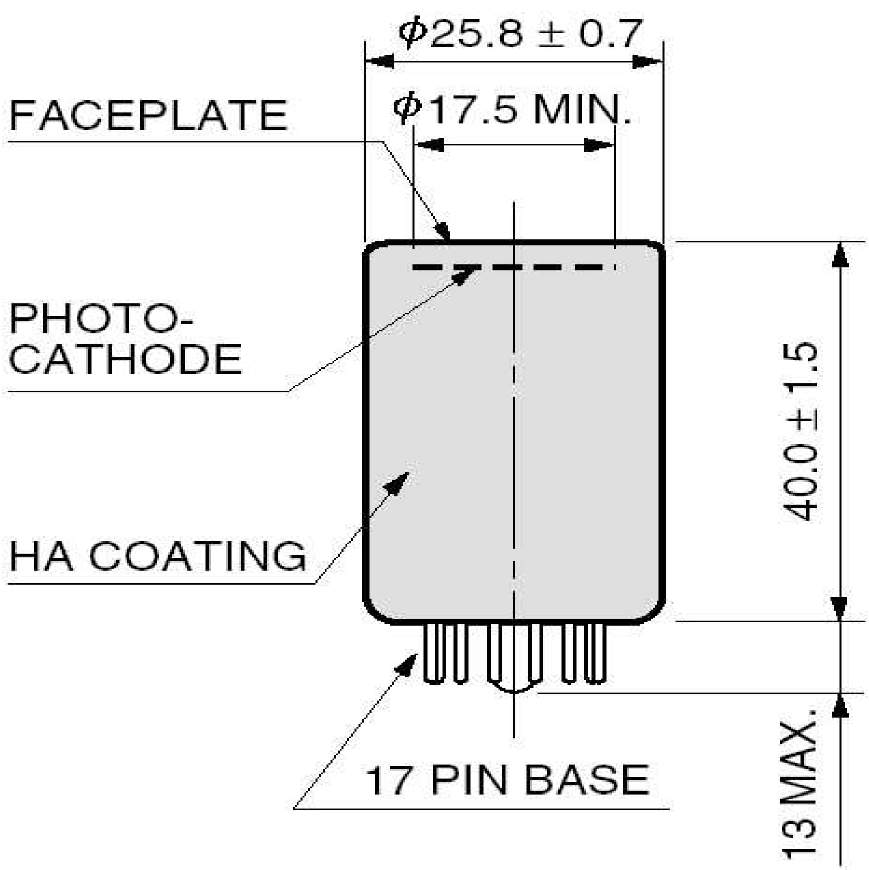
Phototransducer for High B-Fields: Hamamatsu Fine Mesh PMT

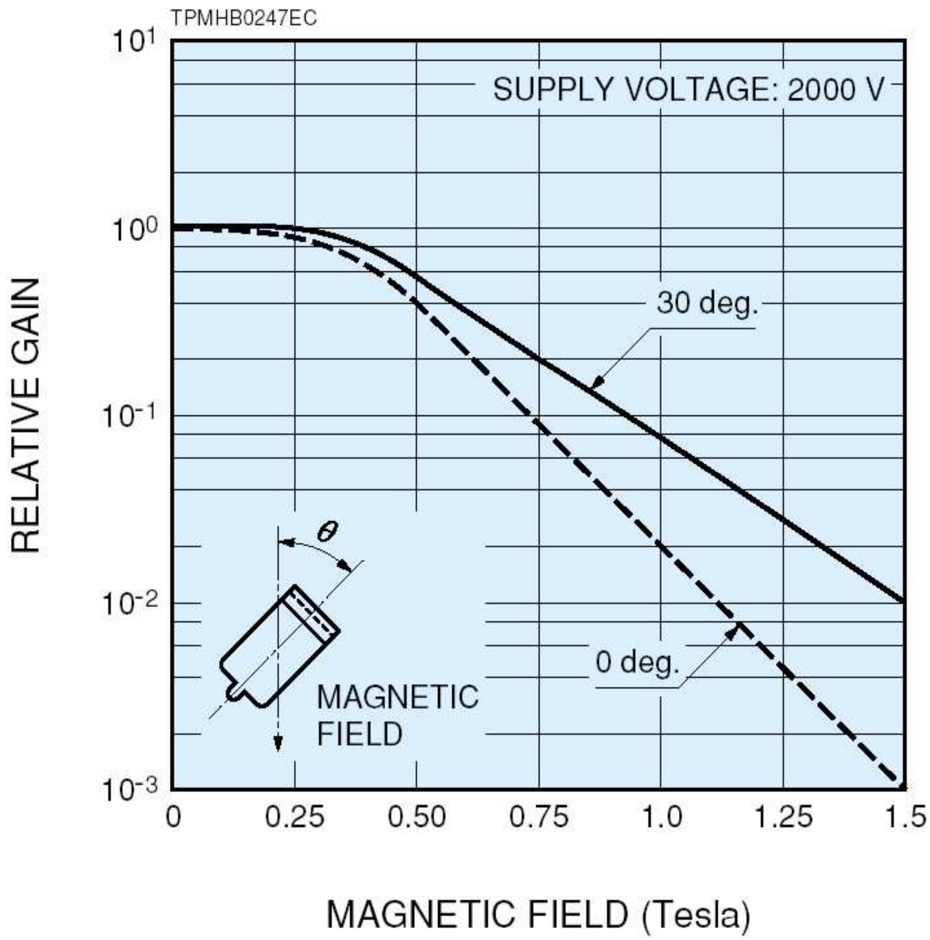
The Hamamatsu R5505-70 uses closely spaced mesh dynodes to produce a compact, B-field insensitive PMT.

This model is 2.5 cm diameter and 4 cm long.



Magnetic Field Insensitivity

Measurements of the field sensitivity of the related R5924 model (larger diameter, more stages, so probably similar):



Magnetic Fields of order 1 KGauss have little effect on the gain.

Other Advantages of Fine Mesh PMT's

- **With UVT or Quartz windows and bi-alkali photocathodes, this technology is a good match to the Cerenkov spectrum. It will give many more pe's than Avalanche Photodiodes, for example.**

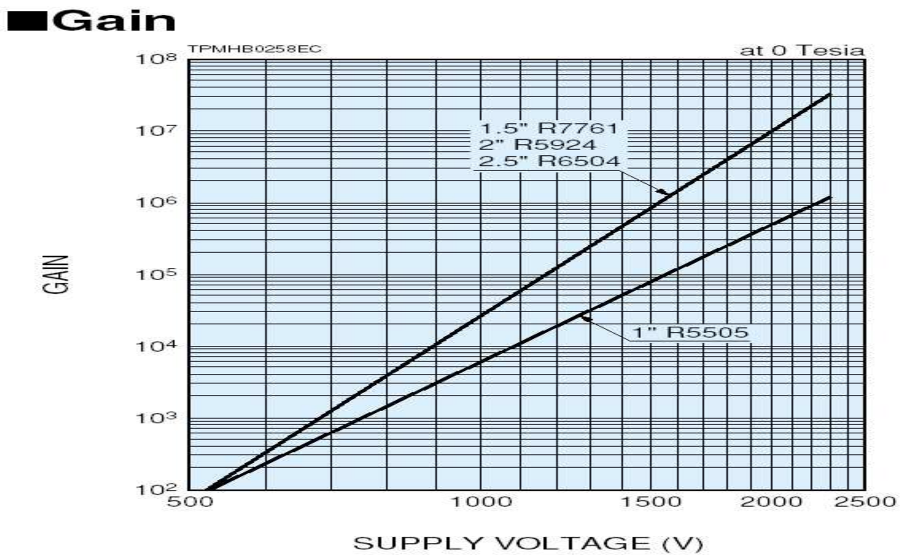
- **Compact size reduces potential background from particles hitting PMT.**

- **Compact structure yields good timing and good linearity.**

So why aren't they more commonly used?

Intrinsically Low Gain

Partial transparency of the dynodes means reduced gain. The manufacturer compensates by adding stages, but with 15 stages gain is only 5×10^5!.



Estimating the signal size for 10 pe's into 50 Ohm impedance:

$$V = IR = \frac{10pe \times 510^5 1.610^{-19} C/e}{510^{-9} sec} 50 Ohms = 8mV$$

which is marginal.

A gain-optimized base design can do a bit better, but these PMT's must be feedback limited to $<< 10^7$ gain.

Therefore, we should expect to use x10 amplifiers on each channel. This is not a serious problem, merely an annoyance.

Relatively High Cost

Cost is $ 1,520 each with the standard glass window, small quantities.

Quartz or UV windows will give us at least a factor of 2 more pe's than regular glass.

I'll assume for the moment that the extra cost of the windows will be offset by a quantity discount.

For 60 channels (1 cm pitch, 20 cm x 40 cm array, single-ended readout), that would be $ 91,200 for the PMT's alone.

To summarize: the perfect technology exists if we can afford it.