Proposal to Build a Small-Area Planar Scintillating-Fiber Tracking Station

Motivation

Small-Area Planar tracking stations are useful for testbeam and general purpose beam-line instrumentation

At Fermilab, “Fenker” MPWC's and SWIC's are the instruments of choice. They were designed in the 70's, and typically use custom electronics.

While gaseous technology works, scintillating fiber-tracking technology potentially offer much more elegant solution.

A sci-fi tracker can replace MPWC's, SWIC's, and scintillation counters. The Beams Division has expressed interest in a planar sci-fi tracker for the Switch Yard.

Hogan Nguyen 5-18-06

Desirable characteristics we can get from sci-fiber trackers:

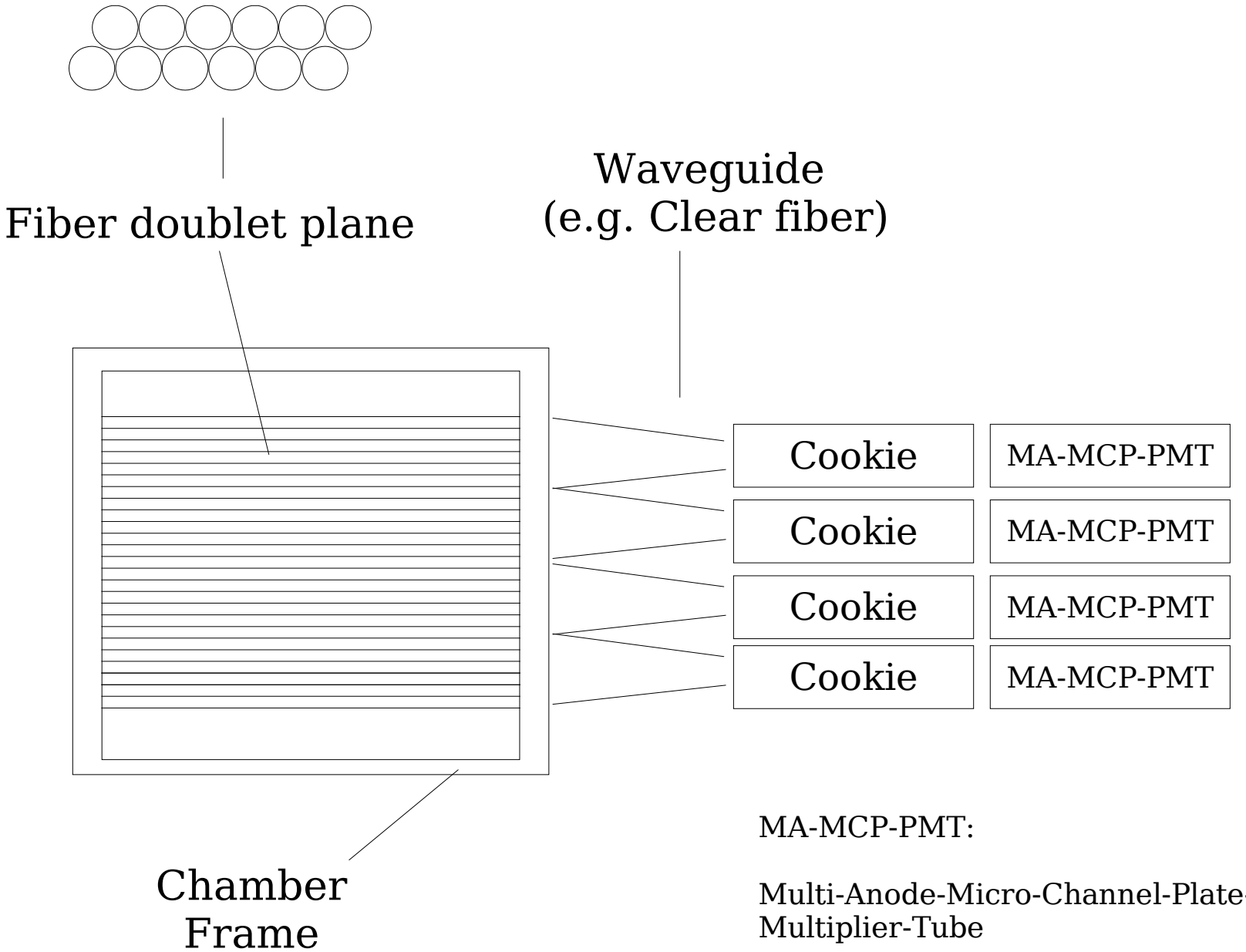
- Spatial resolution ~ 200 microns
- Prompt signal speed
- Low operating over-head
- Allows for Off-the-shelf electronics
- Simple modular construction
- Small material scattering *
- Can operate inside a vacuum tank
- Easy enough for any untrained (but experienced) researcher to learn quickly and operate.

* state-of-the-art is 0.35% X^0 for 6 planes of 350 micron fibers

Expertise in PPD

- D0 fiber tracker
- Many many sci-fiber calorimeters
- PPD is about to build the MICE fiber tracker
- Fiber mirroring and polishing facilities
- A few local experts: A. Bross, M. Ellis, G. Guttierez, E. Hahn, J. Krider, A. Pla
- Typical light yield is few photoelectrons per MIP

A possible technical solution



MA-MCP-PMT:

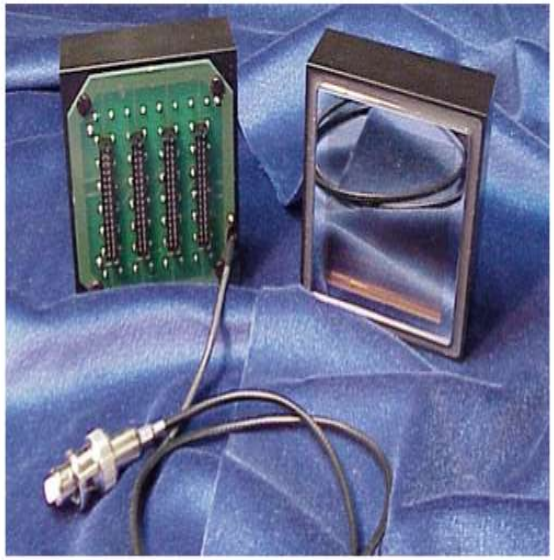
Multi-Anode-Micro-Channel-Plate-Photo-Multiplier-Tube

Photonic signals allow for compact and elegant Off-the-shelf electronics

PLANACON™ PHOTOMULTIPLIER TUBE ASSEMBLY 85011-501

BURLE

July 2005



The 85011 assembly is based on a new photomultiplier tube that uses microchannel plates (MCP) for electron multiplication, the PLANACON™. This 51 mm square head-on MCP-PMT has a very low profile, less than one inch thick including the voltage divider network. The sixty-four anodes provide 6 mm position resolution when used as a discrete pixel device. Improved resolution can be obtained using a charge-sharing technique. The dual MCP multiplier provides excellent time response, good gain, and extremely high pulse linearity. Response uniformity over the full active area is exceptional, typically 1:1.5. The assembly comes with ribbon cable connectors and an SHV cable for ease of use. Applications include specialized medical imaging, ring imaging Cherenkov counters, fluorescence microscopy, and high-speed applications such as LIDAR.

GENERAL

Parameter		Value	Unit
Spectral Response		185 to 660	nm
Wavelength of Maximum Response		400	nm
Active Area		51 × 51	mm
Photocathode Material		Bialkali	--
Window	Material	UV Grade Fused Silica	--
	Thickness	2.0	mm
Multiplier	Structure	MCP (25μm pore, 40:1 L:D)	--
	Number of Stages	2	--
Anodes	Number	64 (8 × 8)	
	Size / Pitch	5.9 / 6.5	mm
Voltage Divider Resistance		13	MΩ

Maximum Ratings (Absolute Maximum Values)

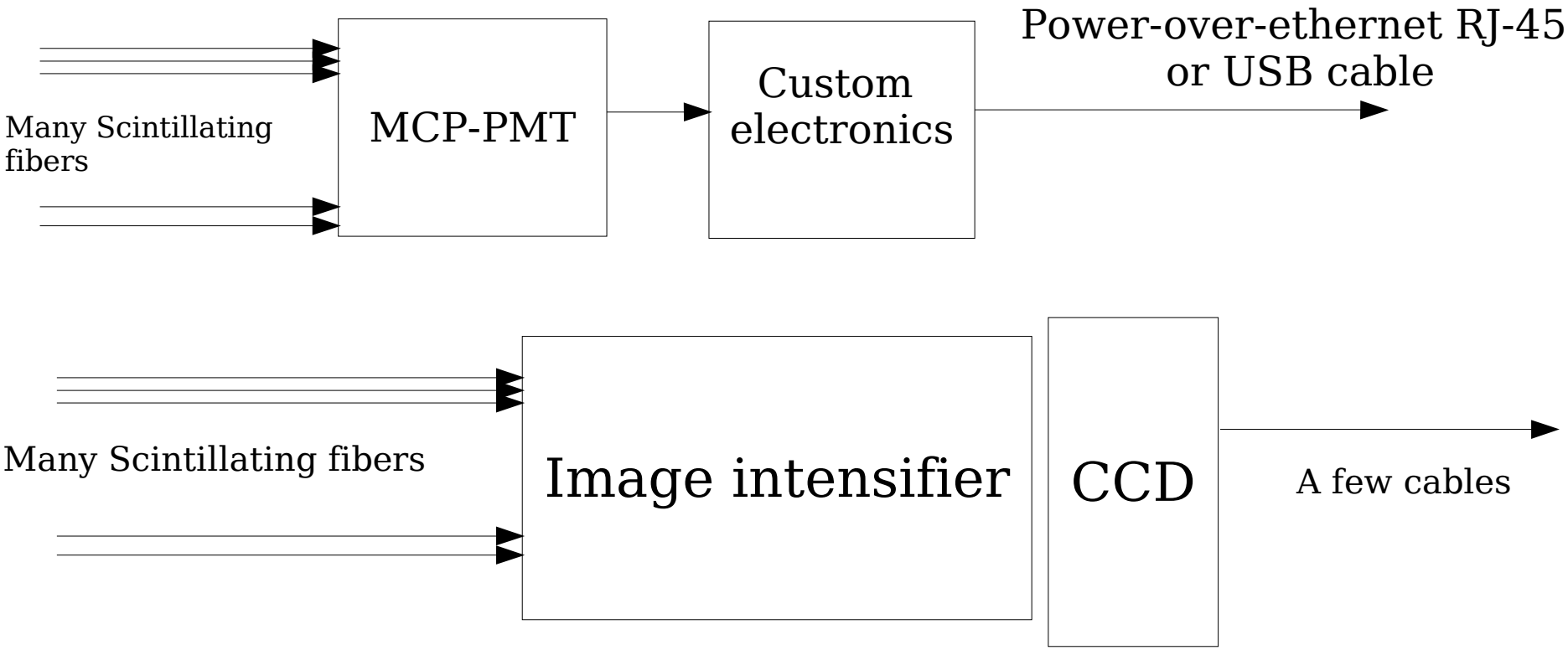
Parameter	Value	Unit
Supply Voltage	-2600	VDC
Average Anode Current, sum of all anodes	3	μA
Ambient Temperature	- 15 to + 50	°C

Suitable for Single-Photon Counting

Analog electronics can be handled using bread-and-butter CAMAC electronics

LRS 16-channel discriminator

Or crate-less solution (suggested by Sten Hansen):



Request to PPD

- To allow us to proceed with designing, building, and testing a prototype chamber.
- Need M&S funding for off-the-shelf components such as scintillating fibers, MAP-PMT, consumables, raw materials.
- Techcenters can provide the staff responsible for designing, fabricating, and delivering the final product. TC would provide Greg Sellberg as the lead technician. Other TC staff are available at Lab 3 and Lab 8.
- In-house (PPD) fabrication of mechanical components such as chamber frames and cookies.
- We don't forsee needing mechanical engineering.
- We would need EE help for more novel readout solutions.

- We are not doing detector R&D.

- We are taking advantage of recent advances in photon detection and electronics in order to build compact and elegant systems.

- I've (and many of you) have personally been in the front lines of many types of tracking technologies (wire drift chambers, TPCs, PWCs, straw chambers, and a little bit of silicon).

- Sci-fi tracking technology appears to me to be the most simple, robust, and forgiving.