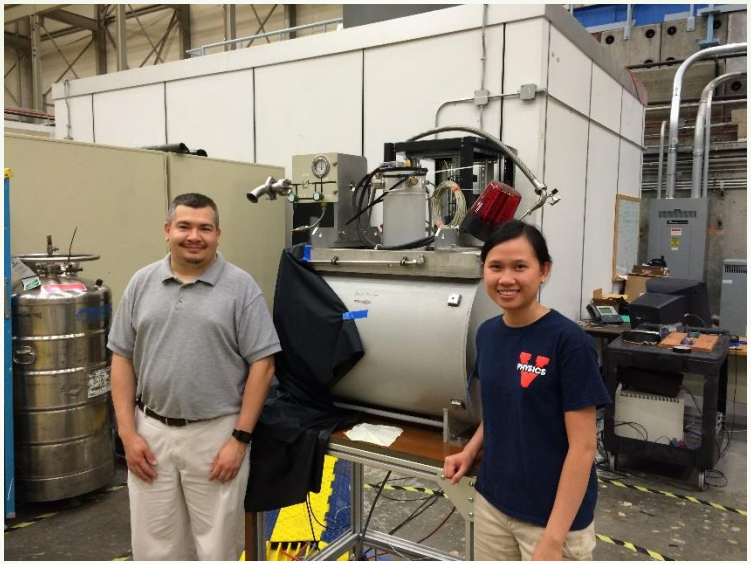
PMT Gain & Resolution Measurements in High Magnetic Fields



Vincent Sulkosky
University of Virginia

September 12th, 2015

SoLID Collaboration Meeting

Major Components

Magnet:

- superconducting solenoid
- max. field: 5.1 T at 82.8 A
- 12.7-cm (5-inch) diameter warm bore
- length of bore: 76.2 cm (30 inch)
- central field inhomogeneity: $\leq 5 \times 10^{-5}$ over a cylindrical volume of a diameter of 1.5 cm and length of 5 cm

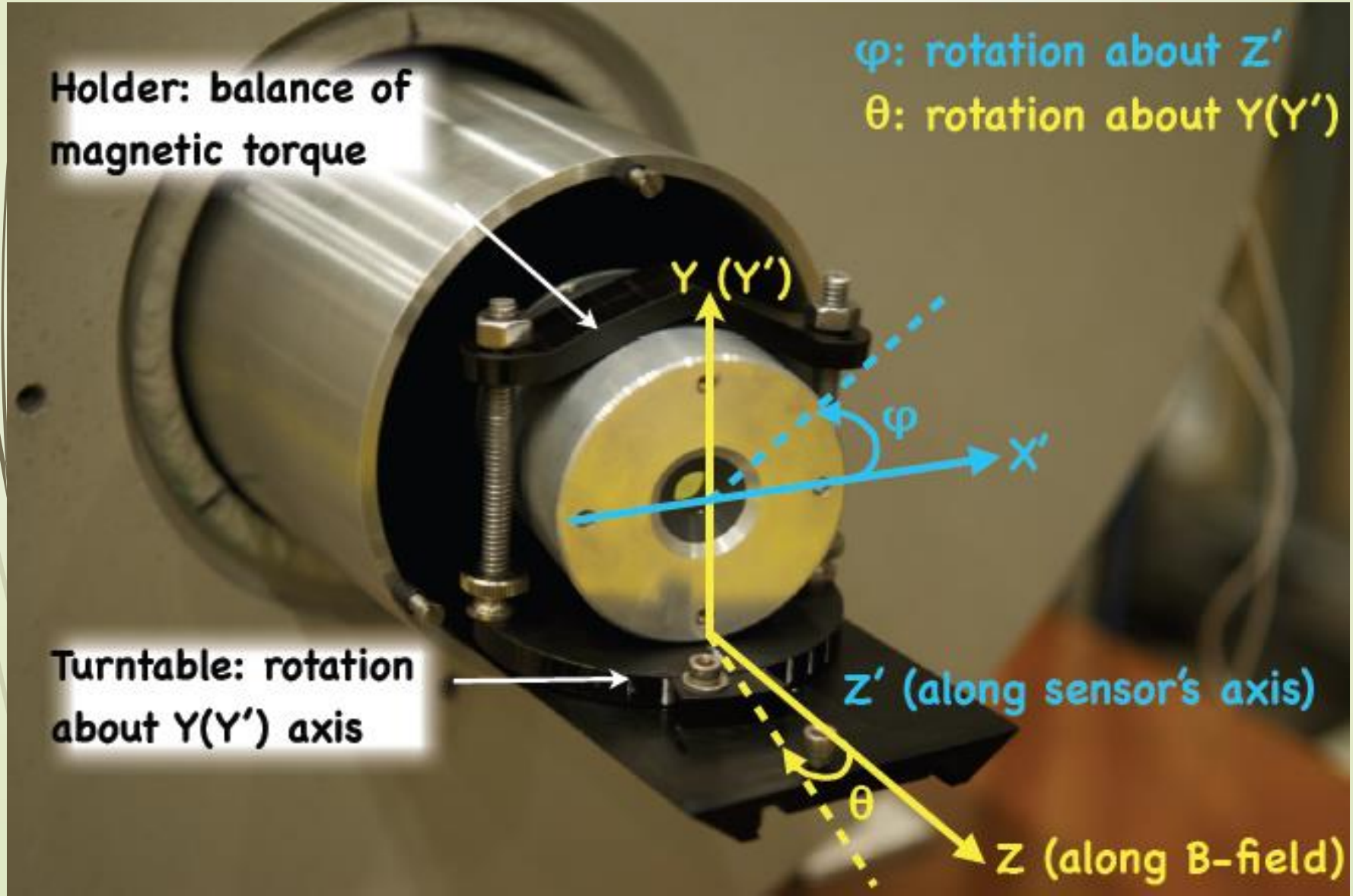
Test Box:

- non-magnetic, light-tight
- cylindrical shape: $d_{in} \sim 4.5$ inch, L ~ 18 inch
- allows for rotation of sensors
- LED light source

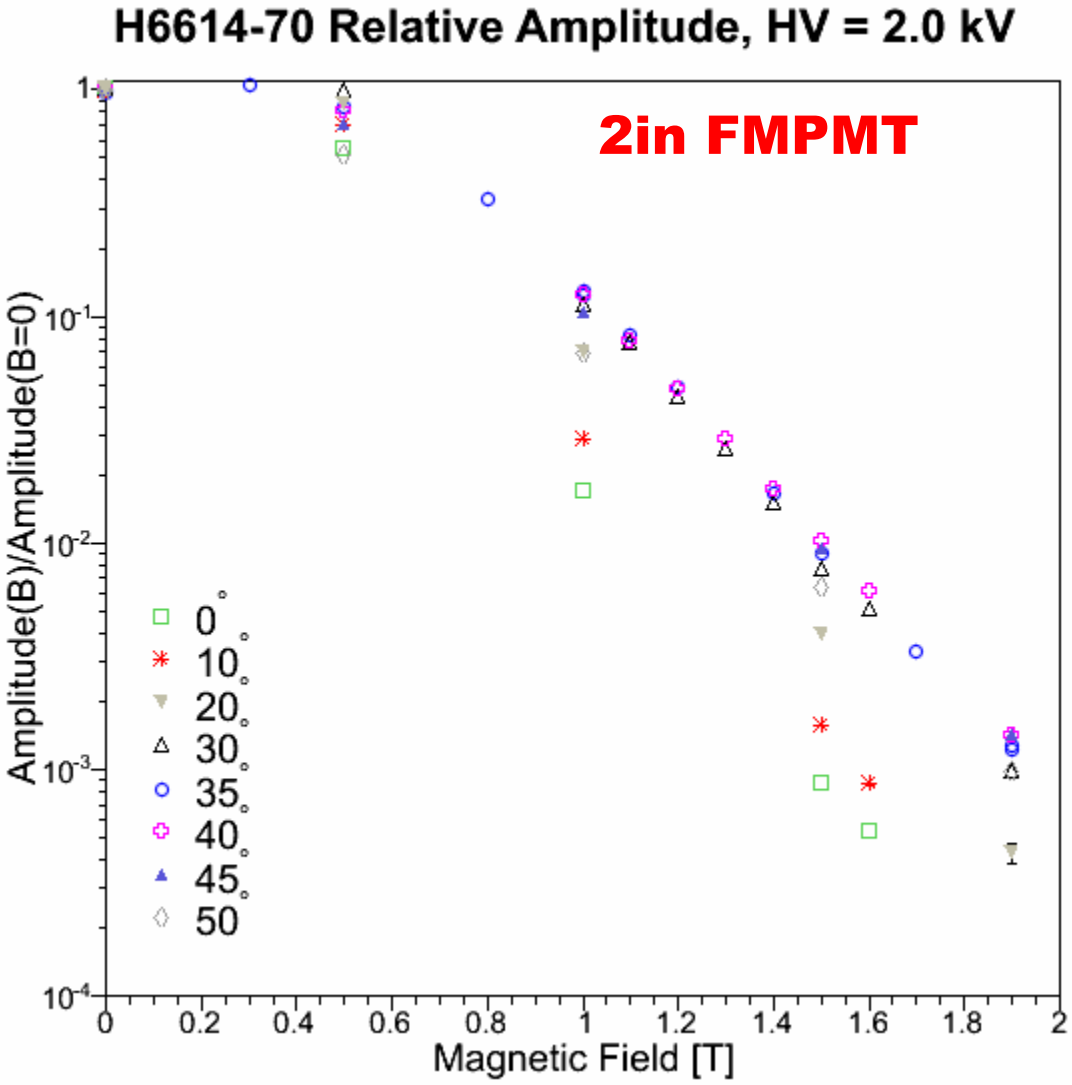
PMT Properties

PMT	Assembly Length [cm]	Assembly Diameter [cm]	Rise Time [ns]	Transit Time [ns]	TTS [ns]	Gain
R11102	13.7	4.61	3.2	34	----	5e6
H6152-70	12.8	3.1	1.5	5.6	0.35	5e5
H6614-70	8.0	6.0	2.5	9.5	0.44	1e7

Sensor Orientation Capabilities



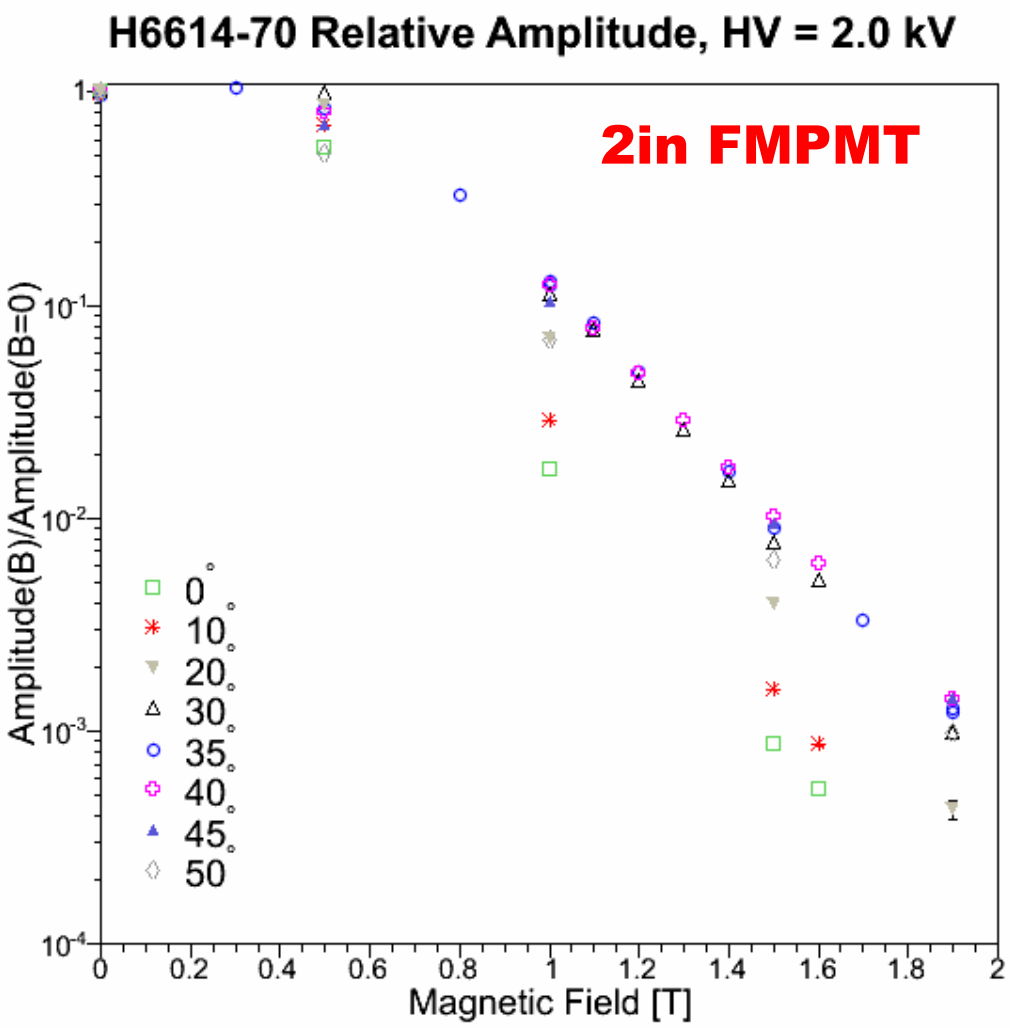
H6614-70 All Angles

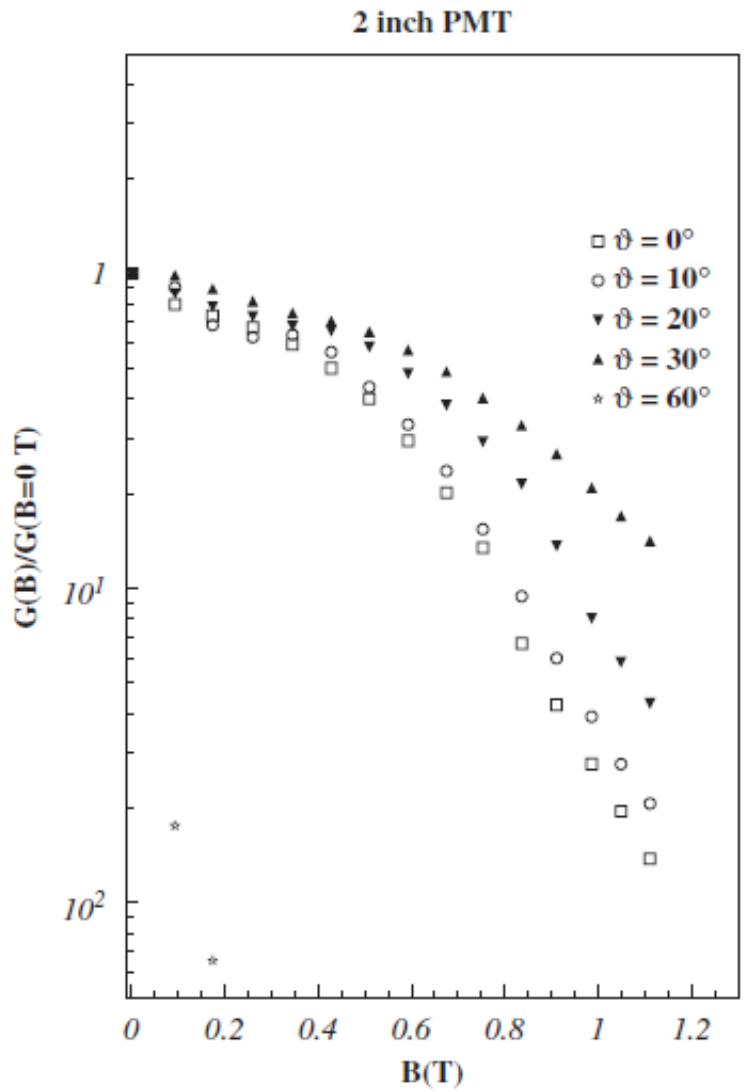


- Data were taken at a series of angles between 0˚ and 50˚ for magnetic fields up to 1.9 T
- Between 35˚ and 45˚ the relative amplitudes are approximately the same
- The analysis with the full statistics is shown.

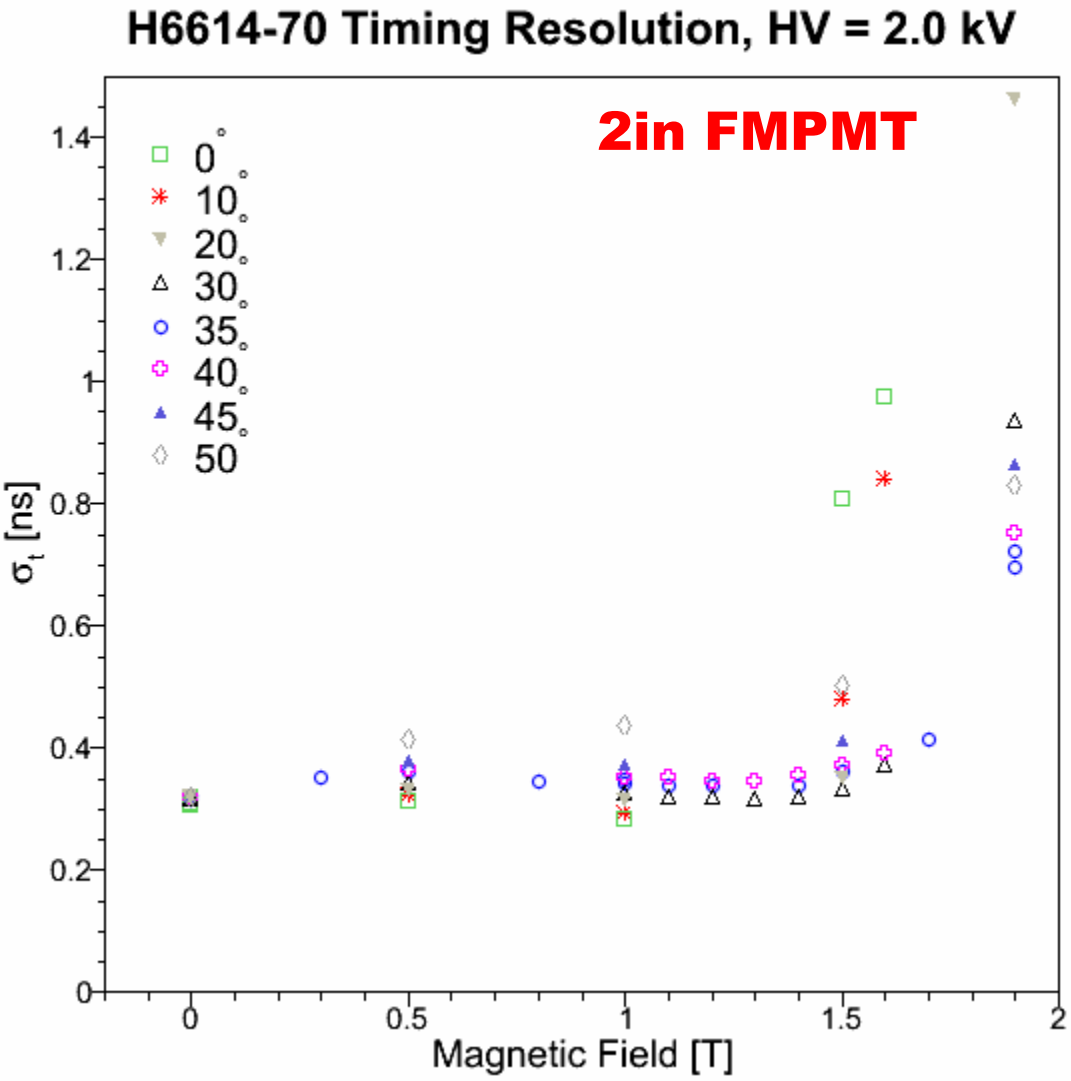
H6614-70 Comparison to INFN

M. Bonesini et al. NIM A **572** (2007) 465





H6614-70 All Angles



- Data were taken at a series of angles between 0˚ and 50˚ for magnetic fields up to 1.9 T
- The timing resolutions were scaled to account for the loss of light collected as the PMT was rotated wrt the LED fiber
- The analysis with the full statistics is shown.

H6614-70 Comparison to INFN

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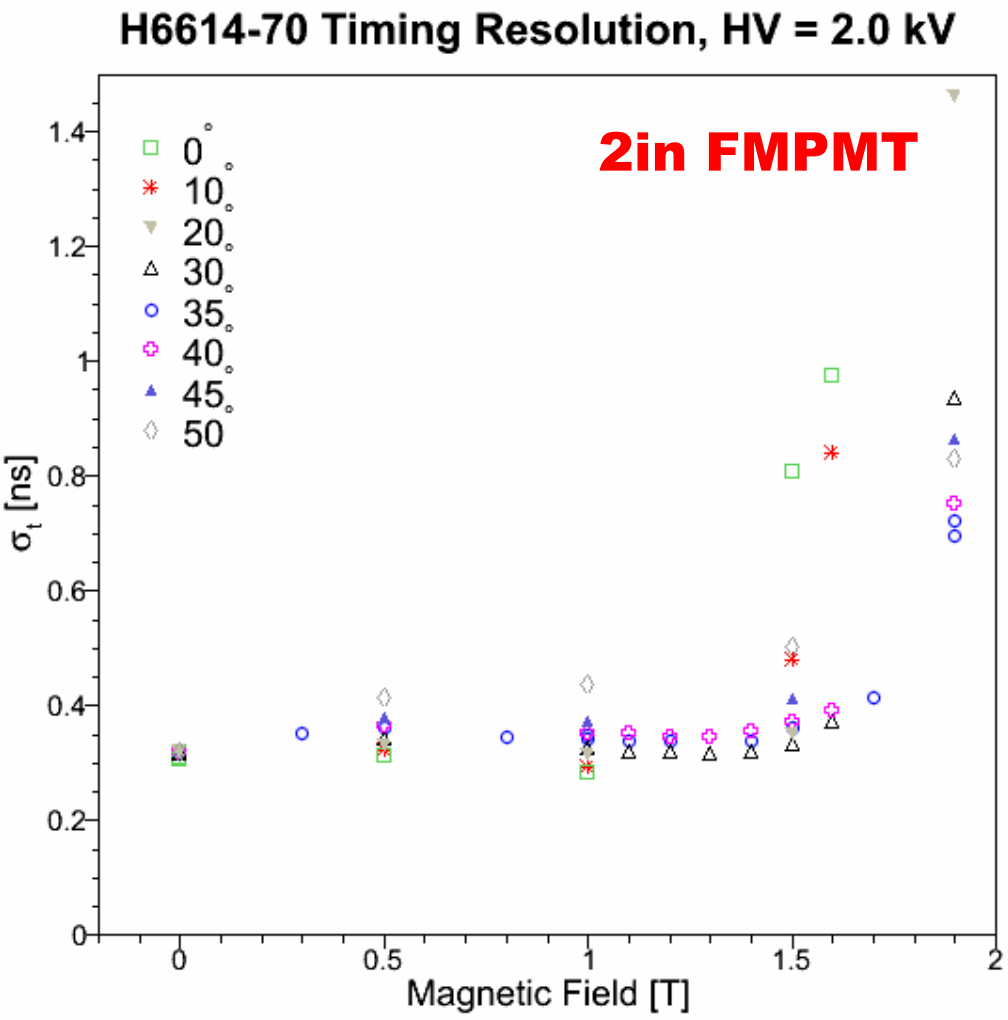
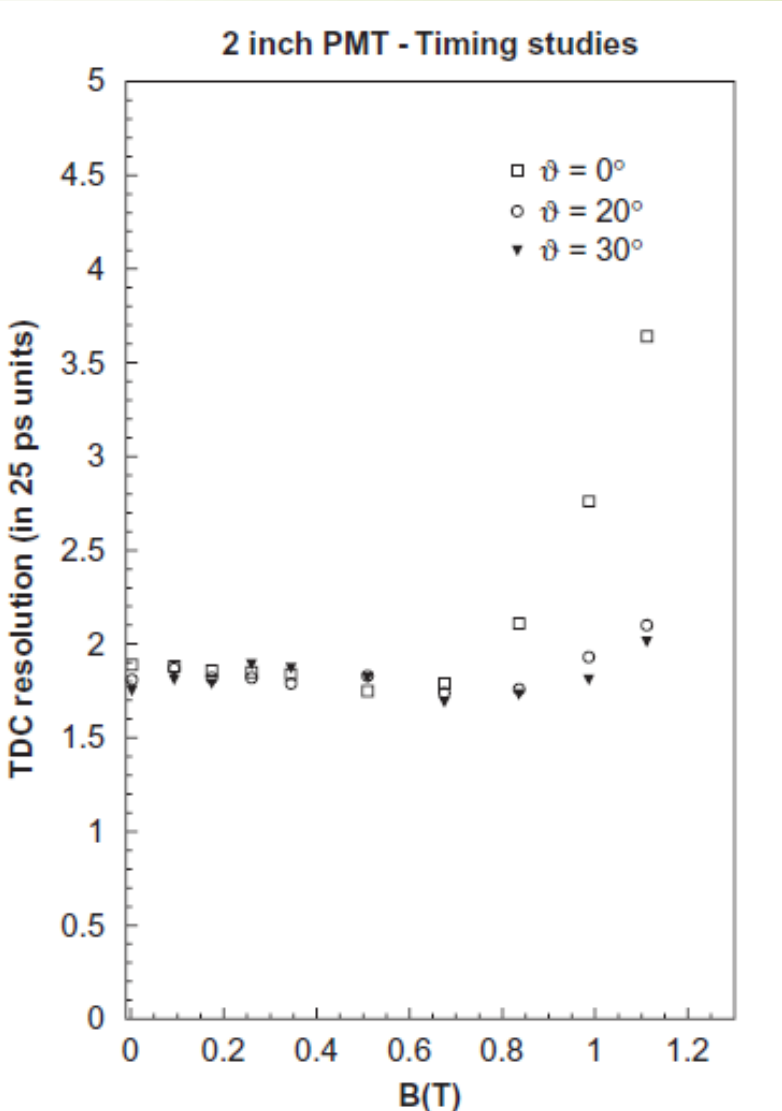
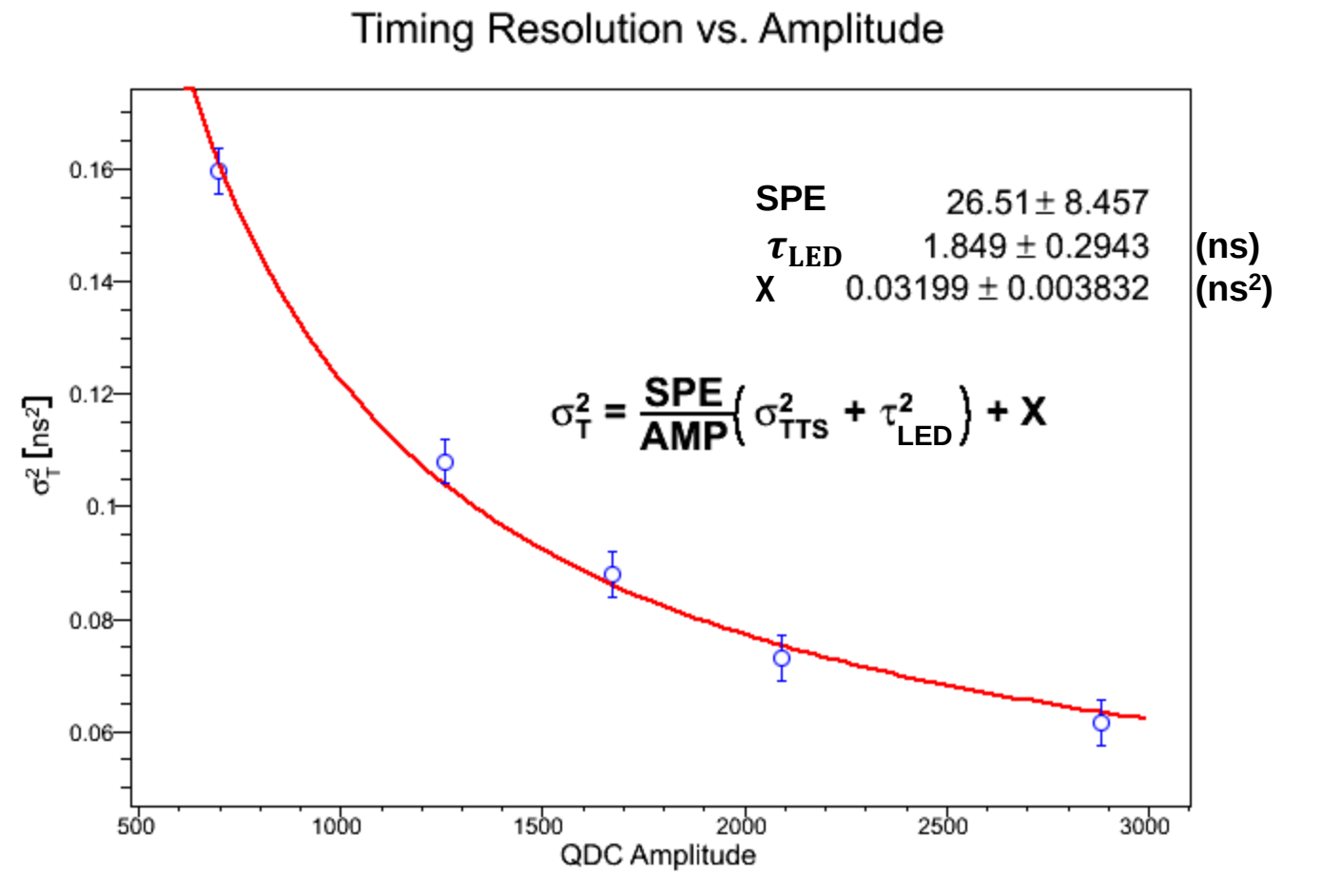


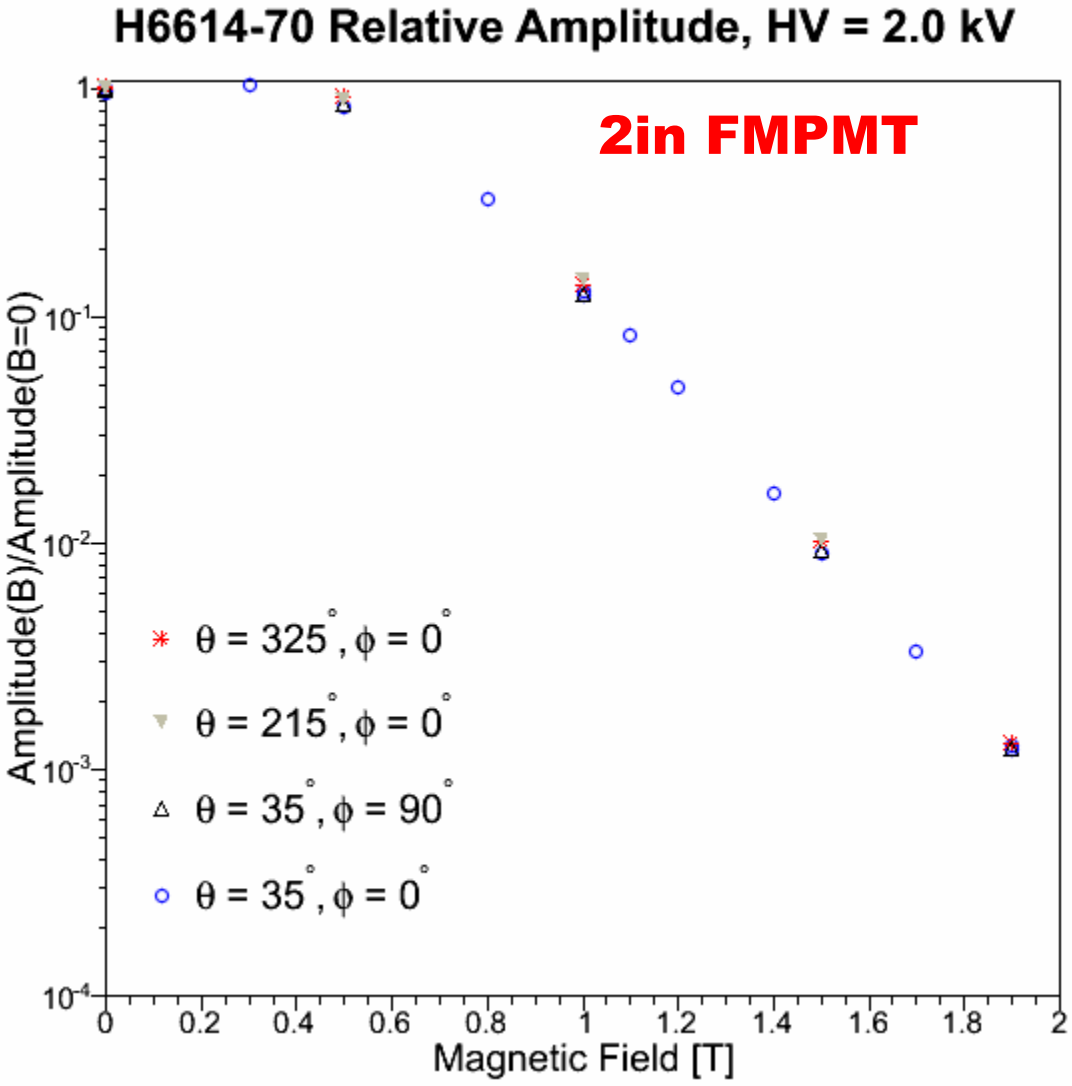


Timing Resolution Components



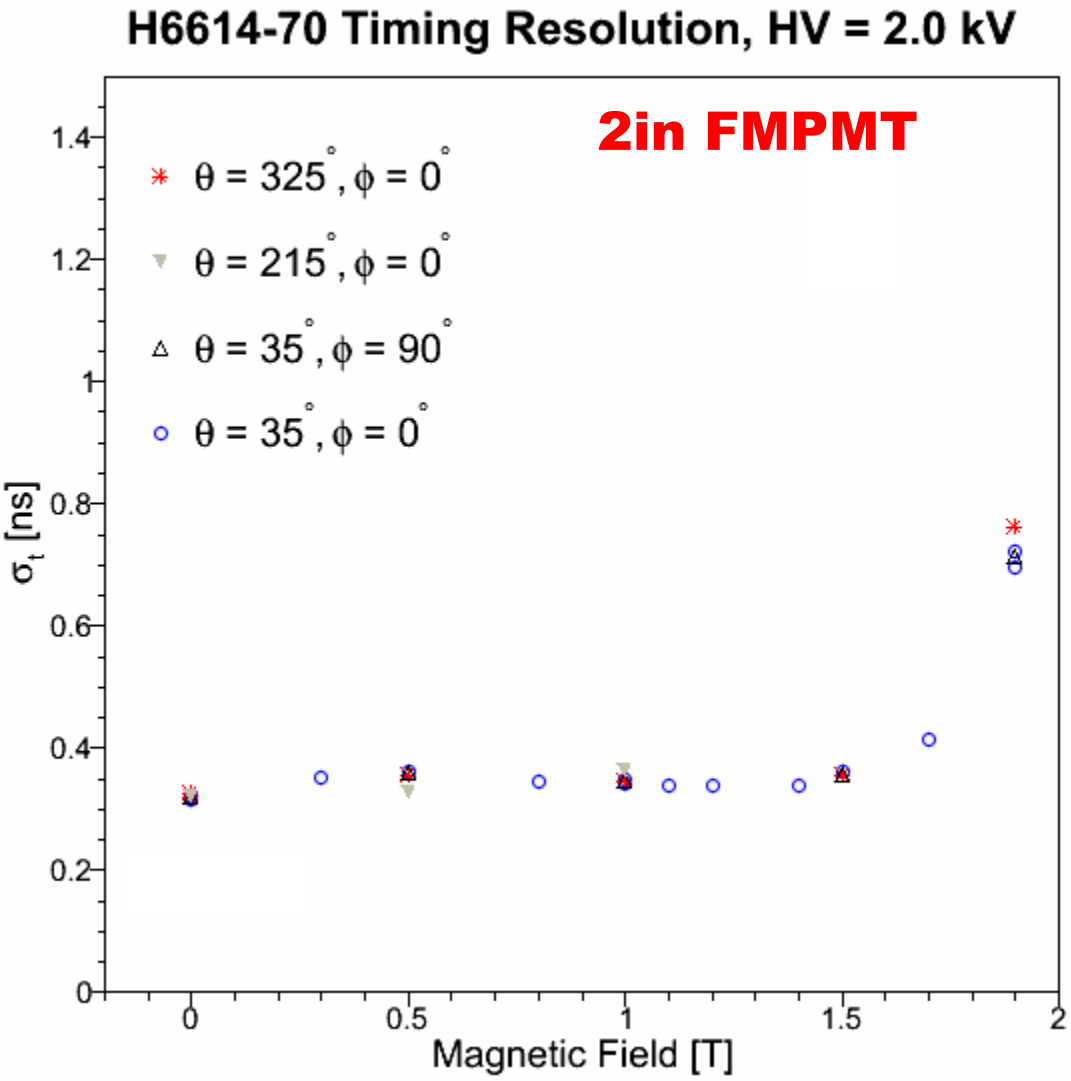
- Data were taken at a series of amplitudes with the pulse generator at 0 T and 0 degrees.
- Number of photoelectrons = amplitude/single photoelectron
- τ_{LED}: LED capacitance, expected to be ~ 1 ns

H6614-70 Symmetry Check



- Data were taken at a set of angles ~ 35˚ wrt the field:
  - θ= 35˚ and φ = 0˚
  - θ= 325˚ and φ = 0˚
  - θ= 35˚ and φ = 90˚
  - θ= 215˚ and φ = 0˚
- No discernible difference is seen for ±35˚ and φ = 0˚ or 90˚

H6614-70 Symmetry Check



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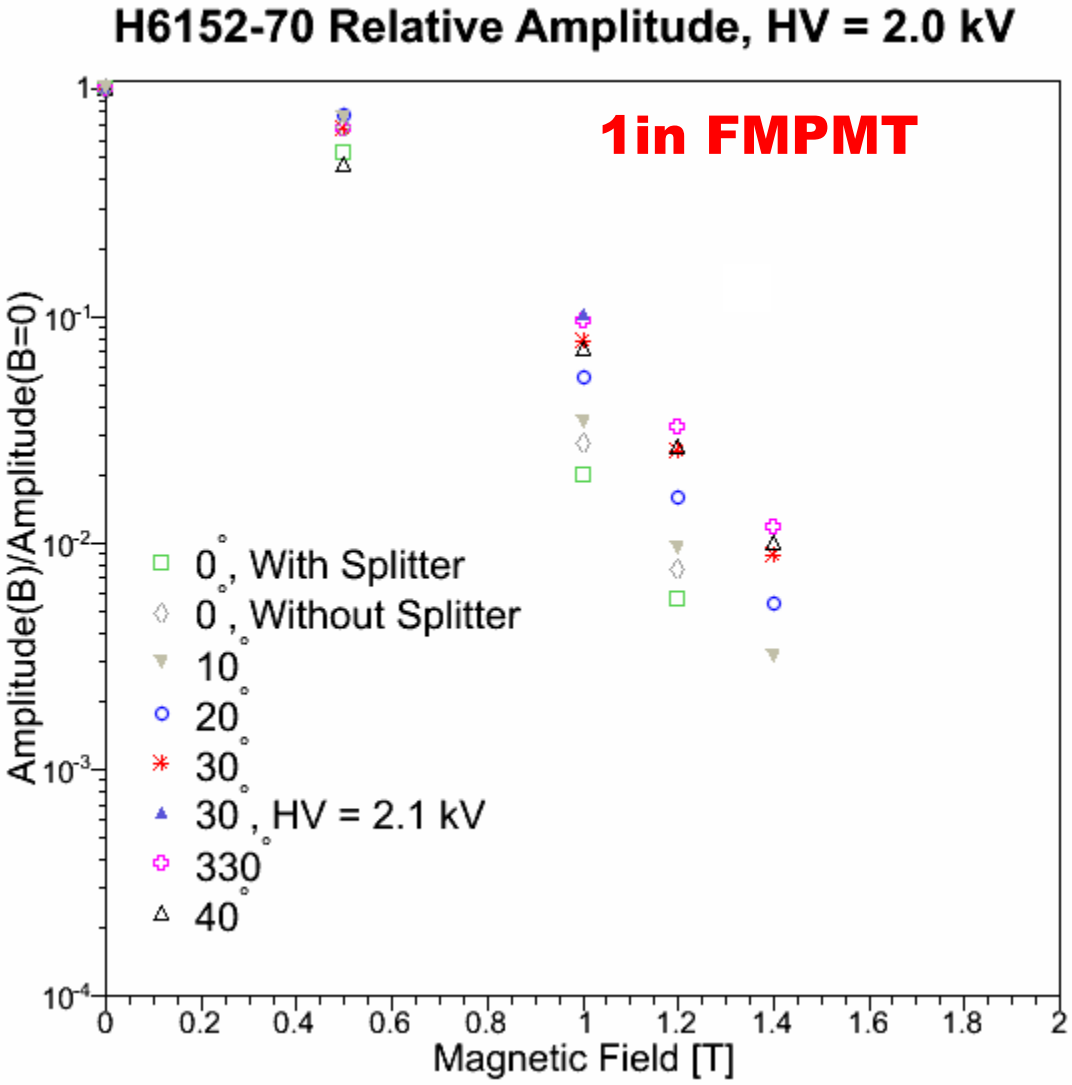
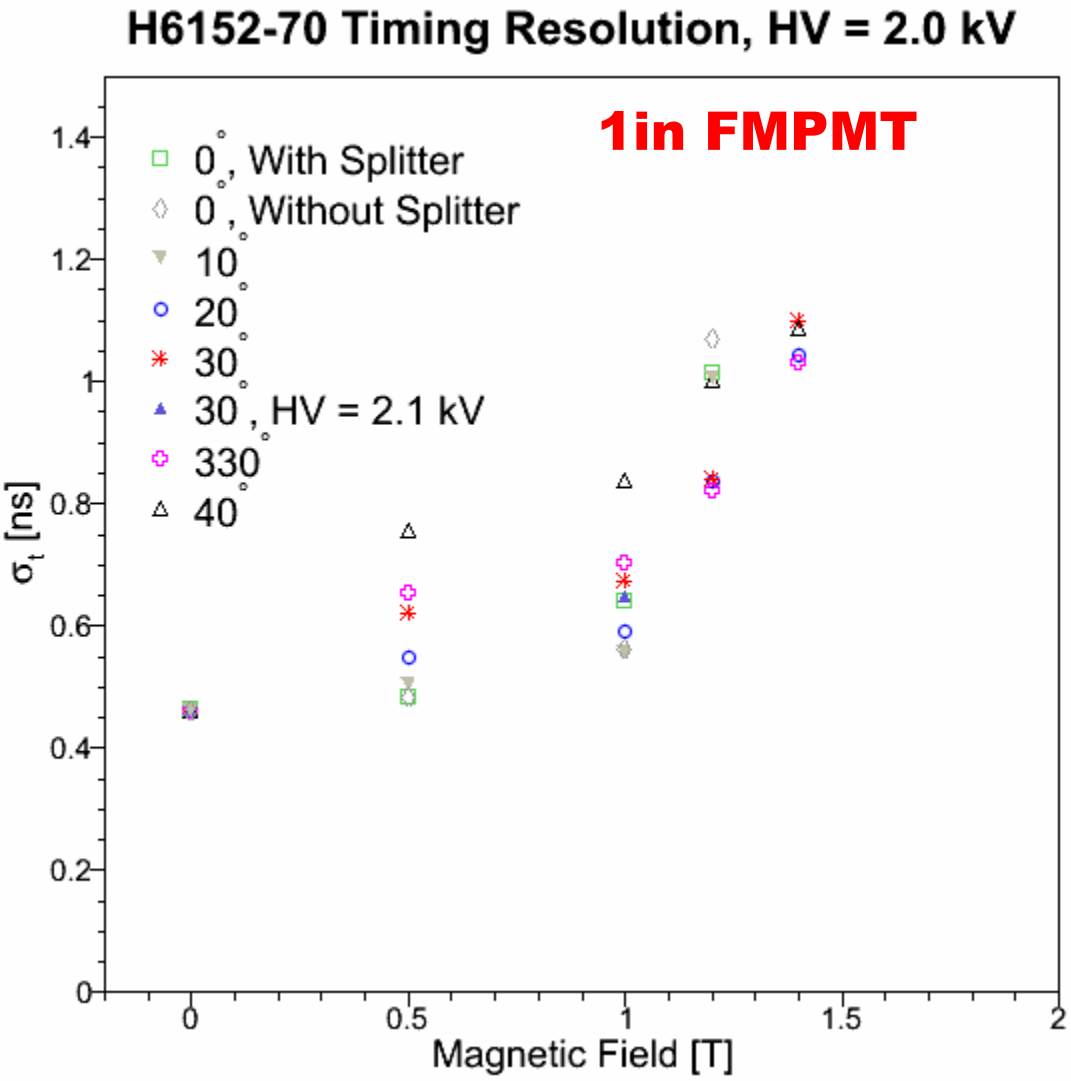
H6152-70 All Angles



No Previous Data Available

- Data were taken at a series of angles between 0˚ and 40˚ for magnetic fields up to 1.4 T
- Between 30˚ and 40˚ the relative amplitudes are approximately the same
- It appears that at 330˚ (-30˚) that the relative amplitude is a bit better than +30˚.

H6152-70 All Angles



- Data were taken at a series of angles between 0˚ and 40˚ for magnetic fields up to 1.4 T
- The timing resolutions were scaled to account for the loss of light collection as the PMT was rotated wrt the LED fiber