Mu Metal Shielding

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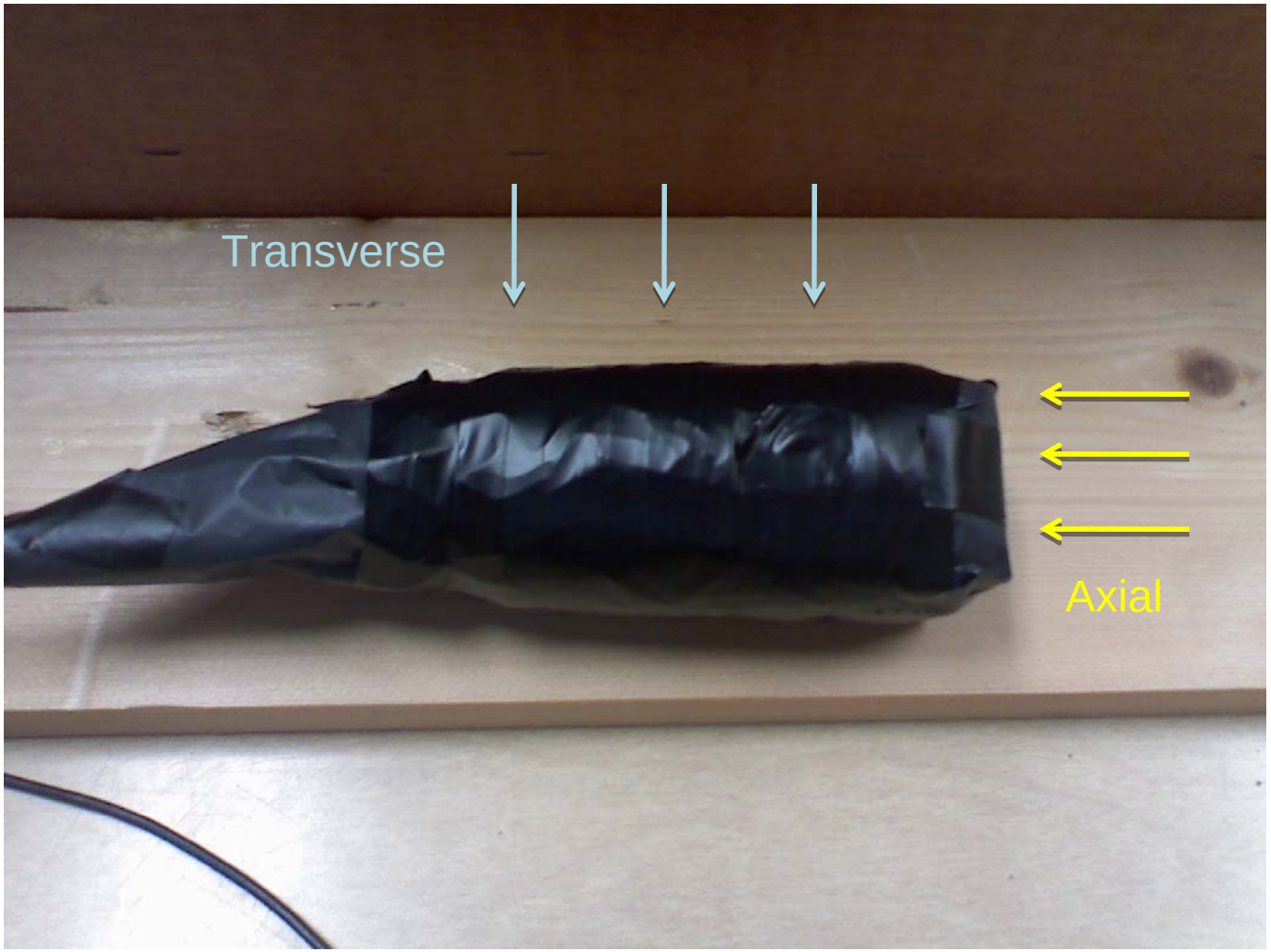
Known Problem

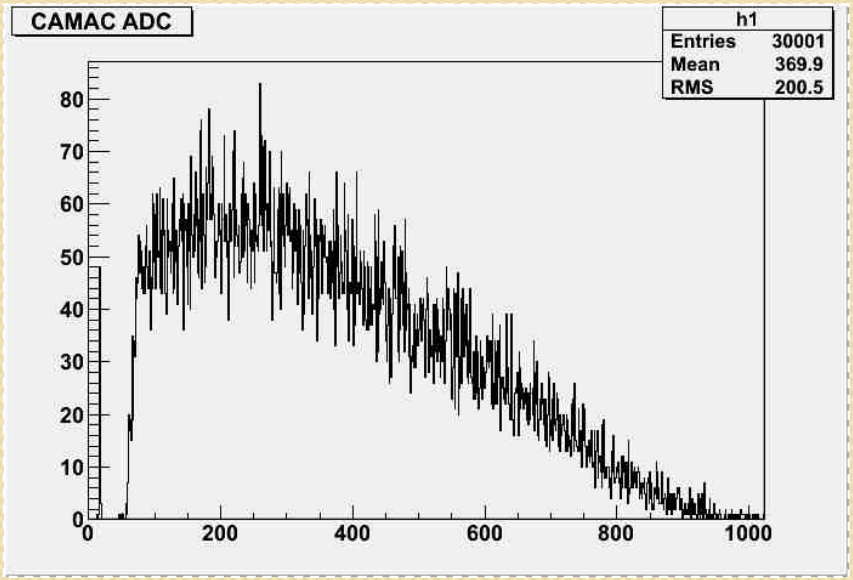
- ADC signal strength decreases in the presence of a magnetic field
- PMTs must be shielded for the FTOF detector
- Must decide the best way to shield while dealing with space constraints
- Using a homogeneous magnetic field created in a Helmholtz Coil

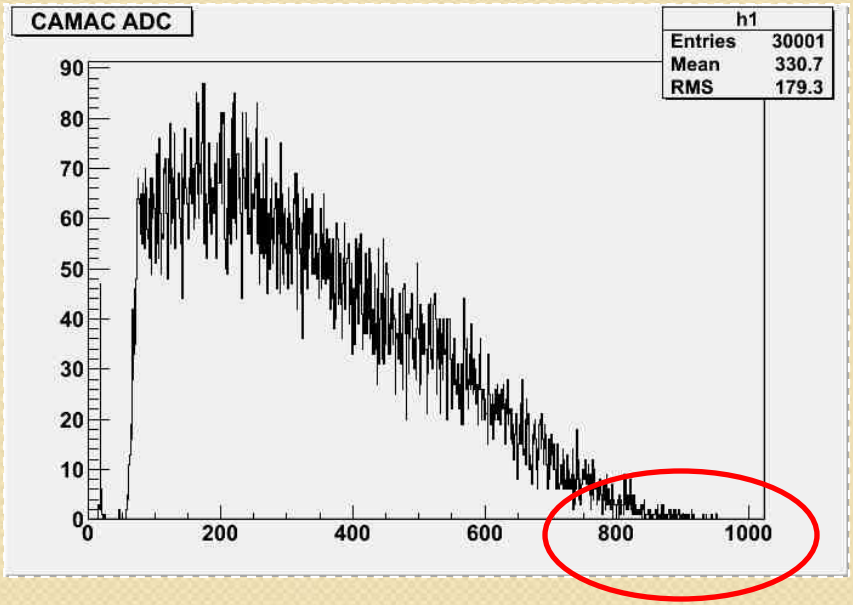
Axial and Transverse Fields



No Magnetic Field

10 Gauss Axial Field





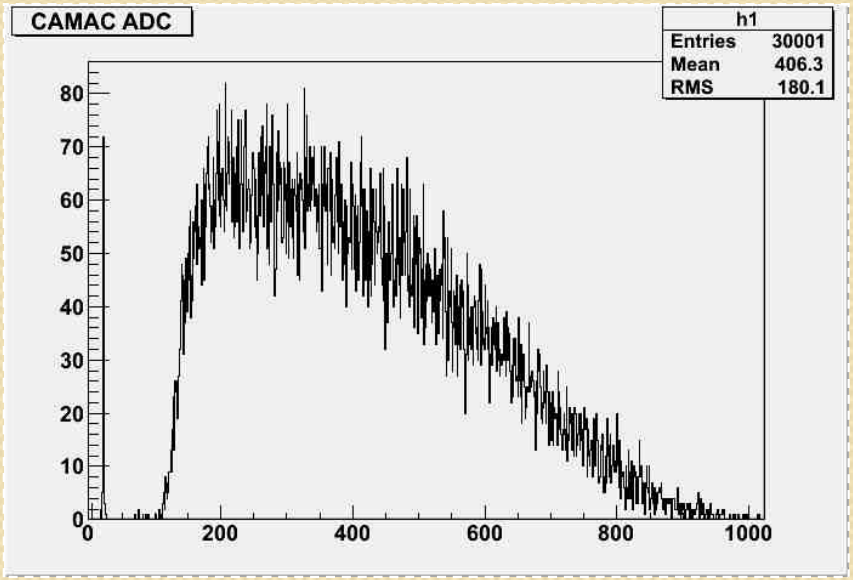
Signal Loss

PMT without any Shielding

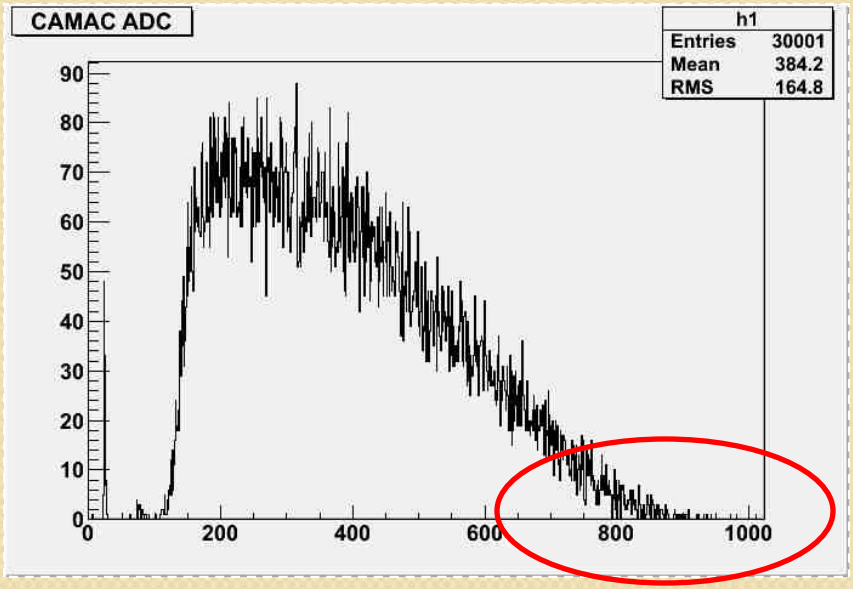
PMT with no Shielding

- Signal loss under axial field depending on strength
- Complete signal loss under a transverse field
- Hamamatsu tubes have optional shielding built in

No Magnetic Field



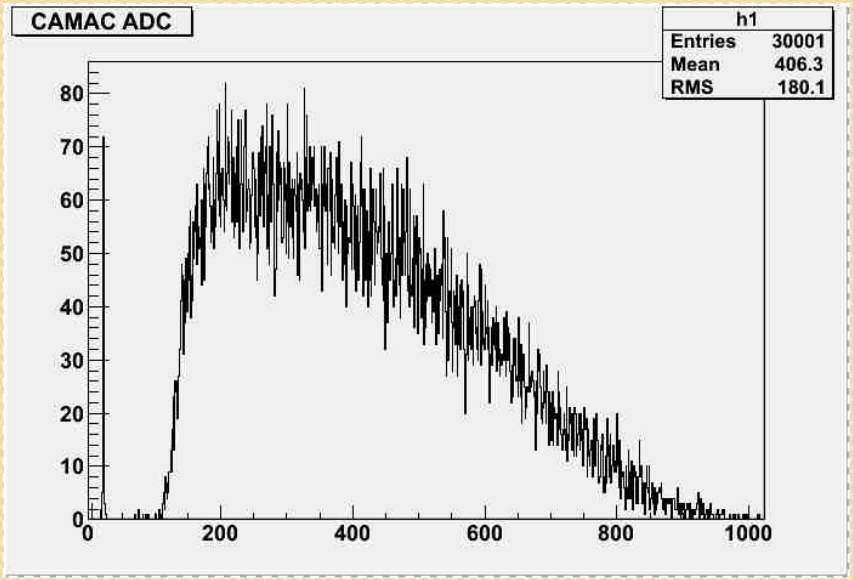
10 Gauss Axial Field



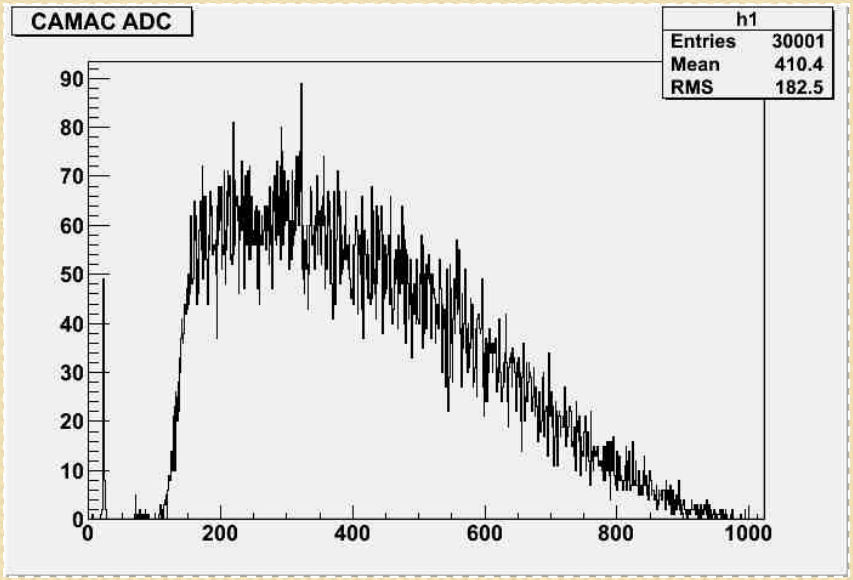
Signal Loss

PMT with Shielding Built In

No Magnetic Field



10 Gauss Transverse Field

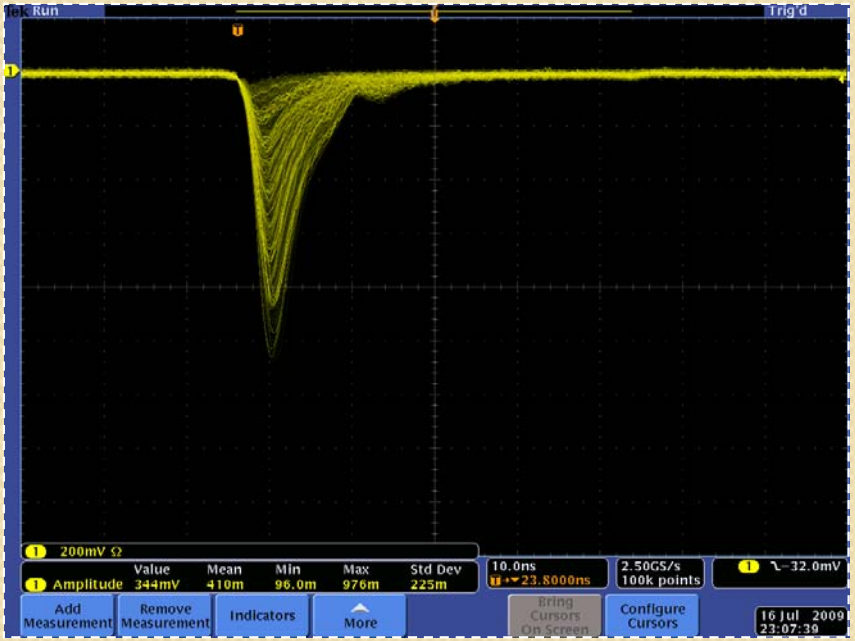


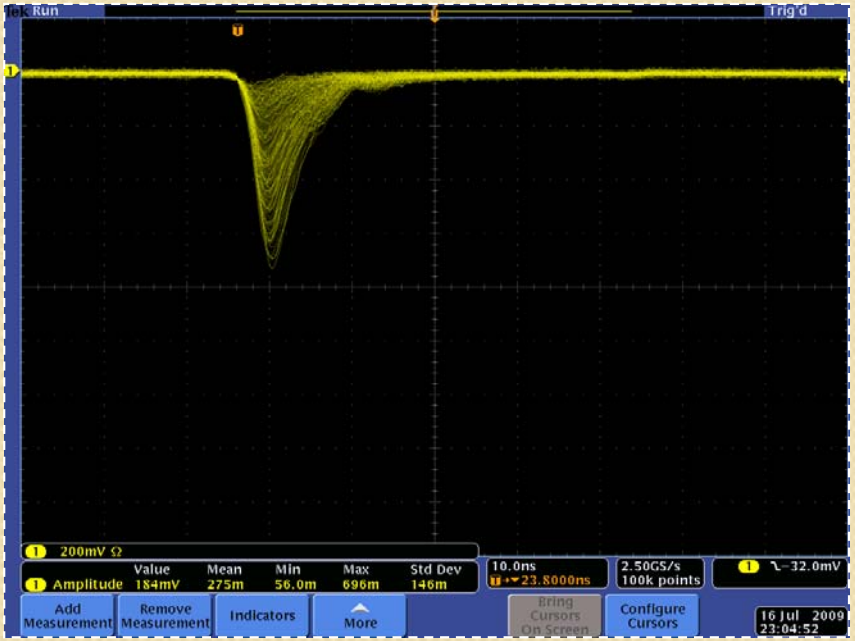
Very Similar Results

PMT with Shielding Built In

No Magnetic Field

12 Gauss Axial Field



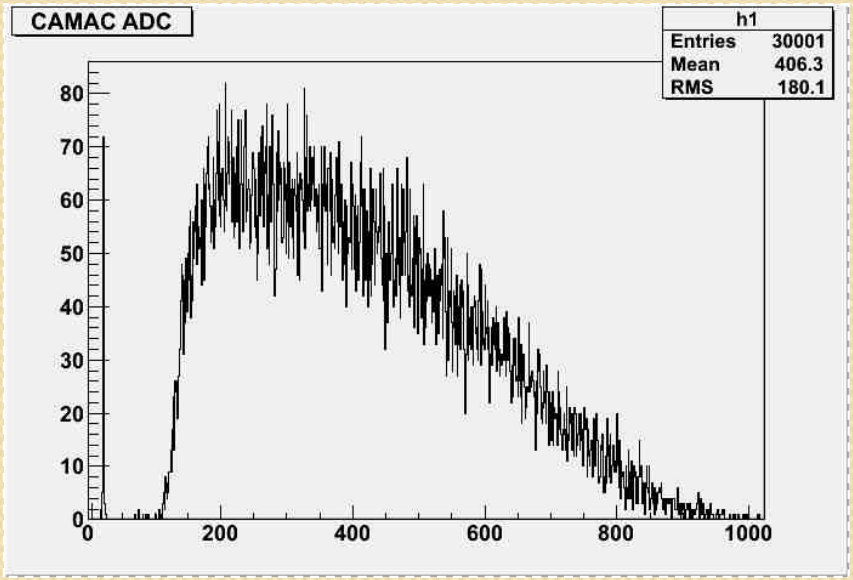


Preserved Signal Shape

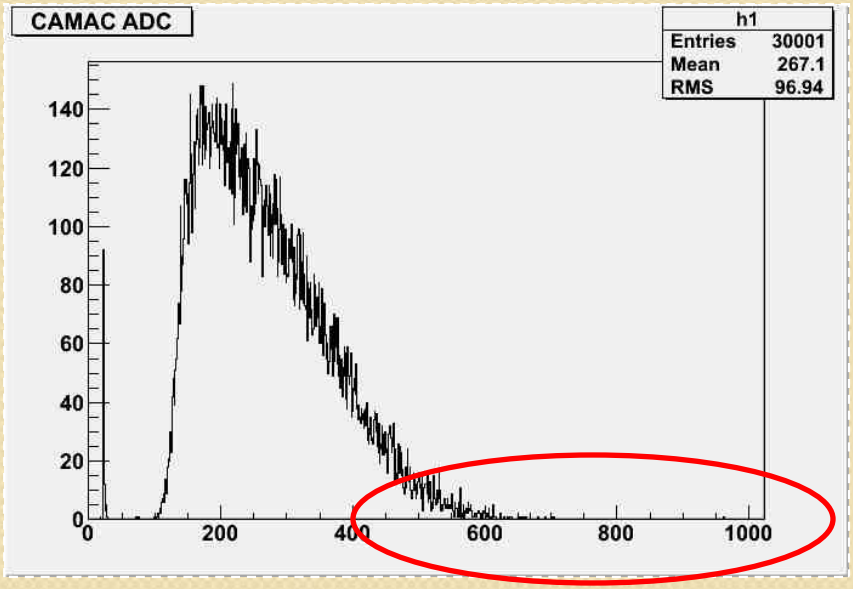
Conclusions from 10 Gauss Test

- Axial => 5%-10% Signal Decrease
- Transverse => Preserved Signal
- Signal shape always maintained
- Built-in mu metal shielding of the PMT is adequate

No Magnetic Field



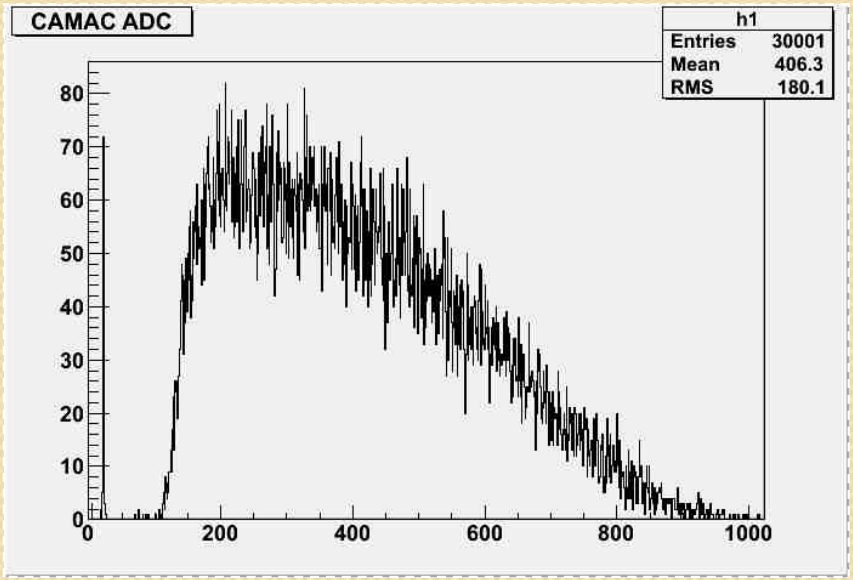
20 Gauss Axial Field



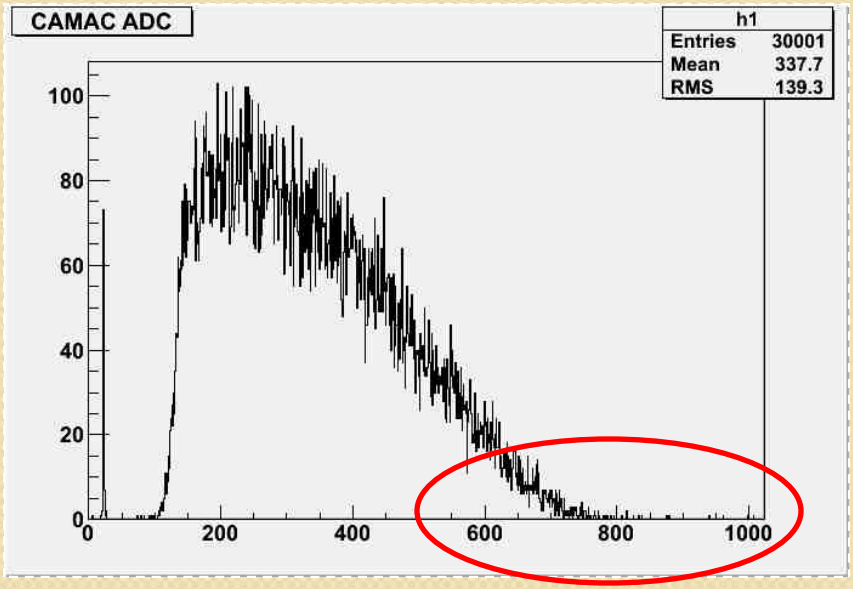
Significant Signal Loss

PMT with Built-in Shielding

No Magnetic Field



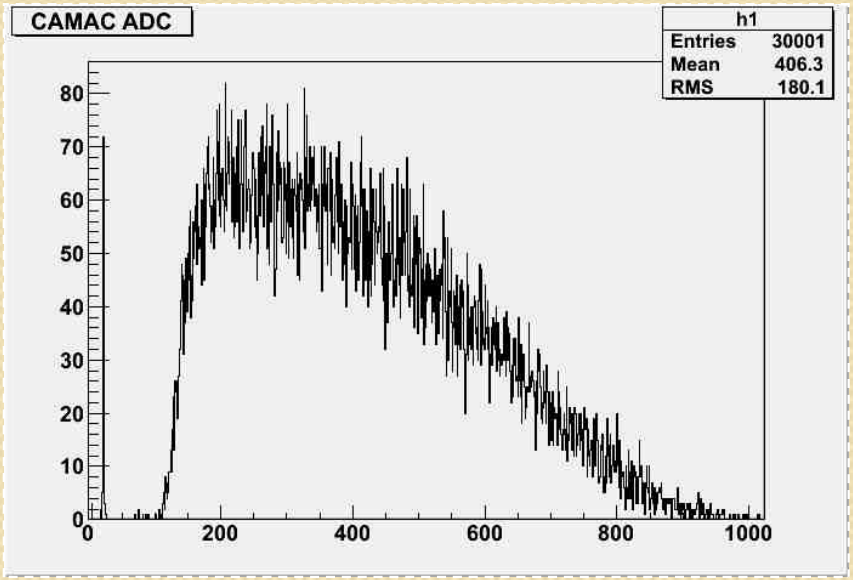
20 Gauss Transverse Field



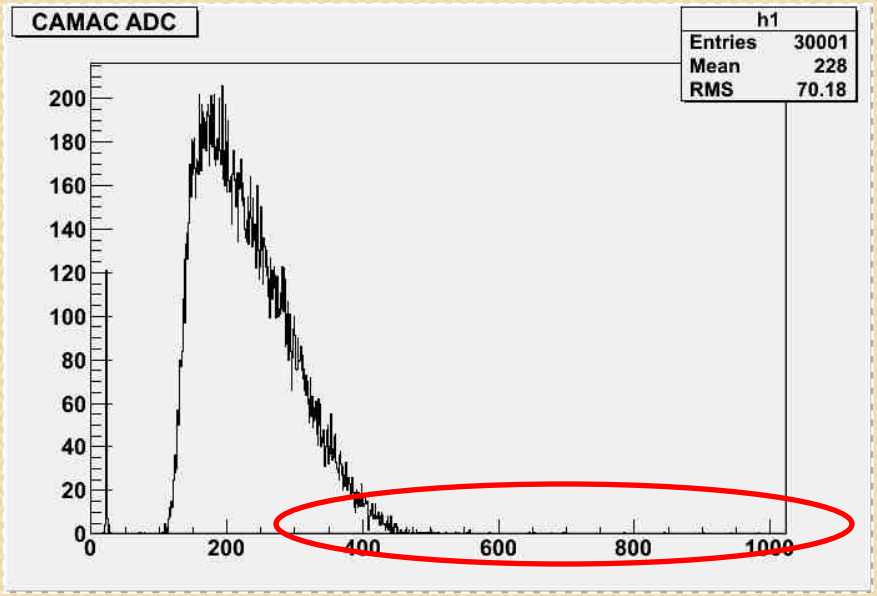
25% Signal Loss

PMT with Built-in Shielding

No Magnetic Field



25 Gauss Transverse Field

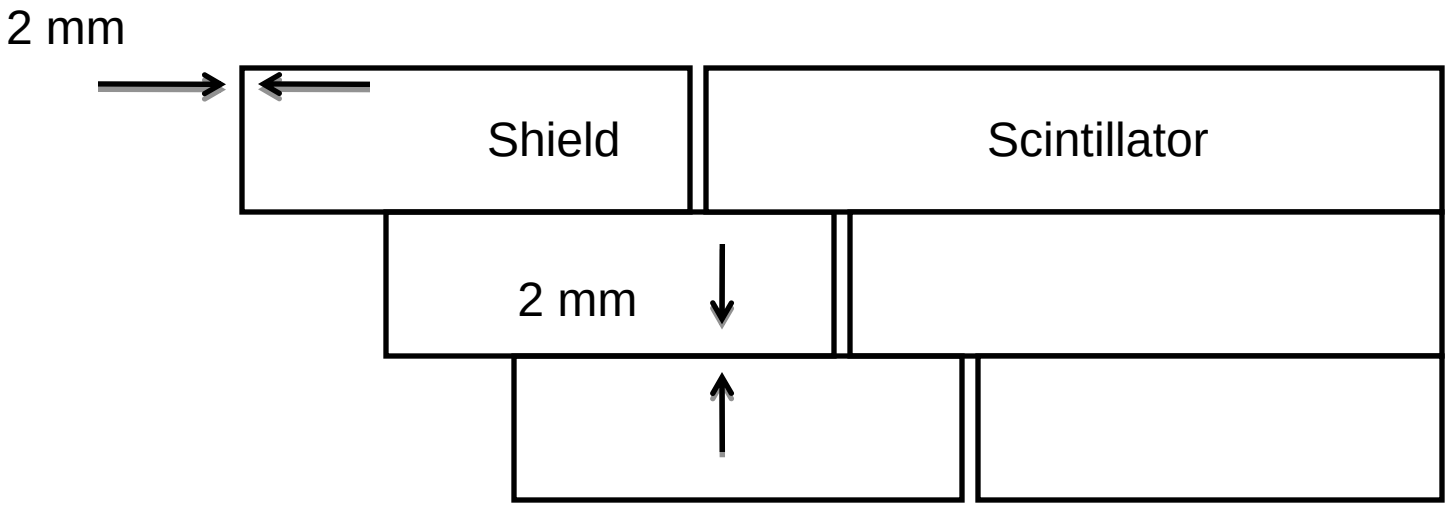


Significant Signal Loss

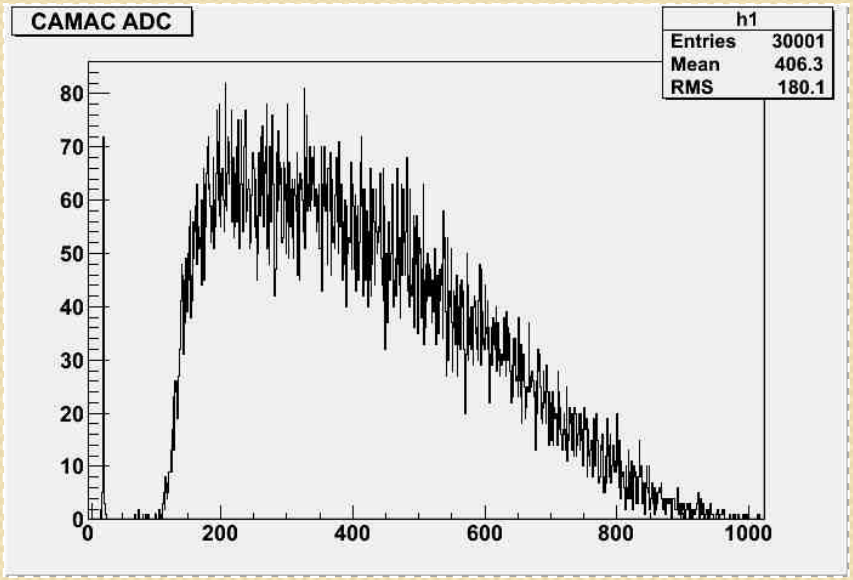
PMT with Built-in Shielding

Options for Transverse Field

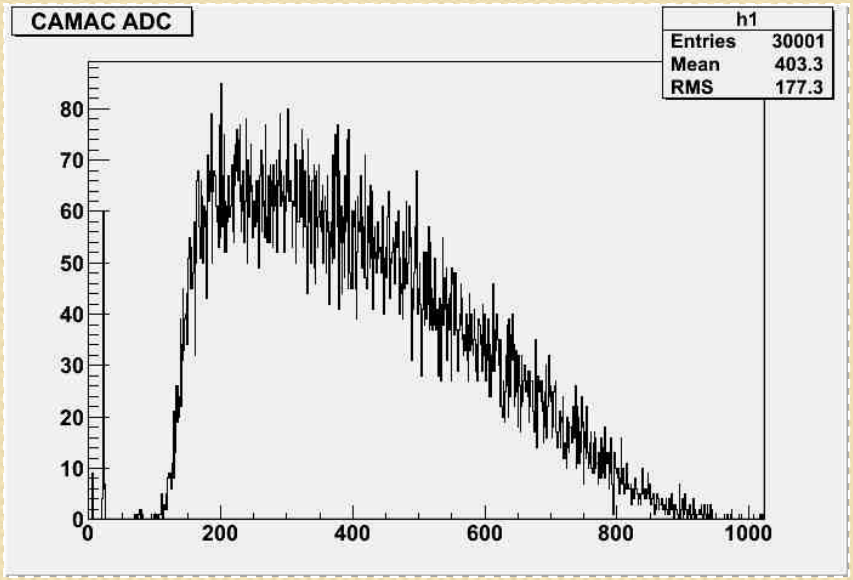
- Apply additional shielding
- Square boxes allow us to adjust the thickness of the shield more easily



No Magnetic Field



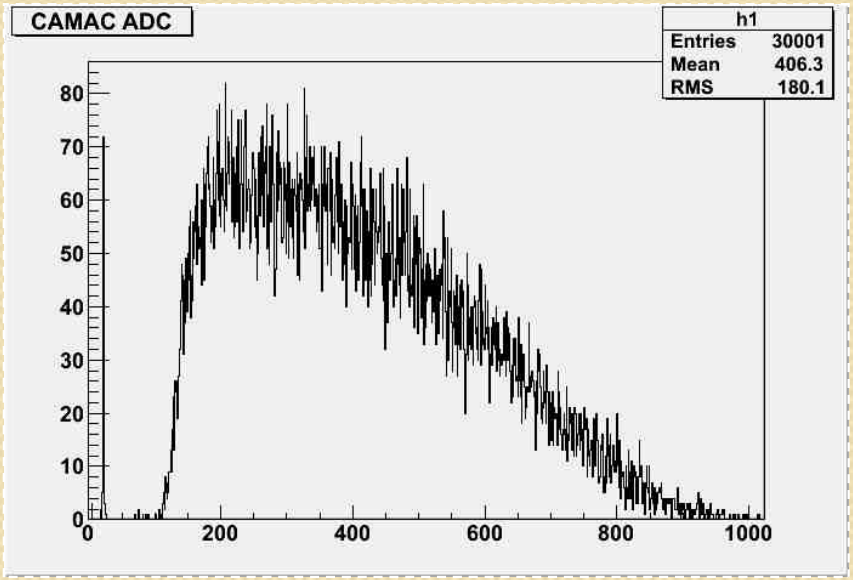
25 Gauss Transverse Field with 2mm Mu Metal Box



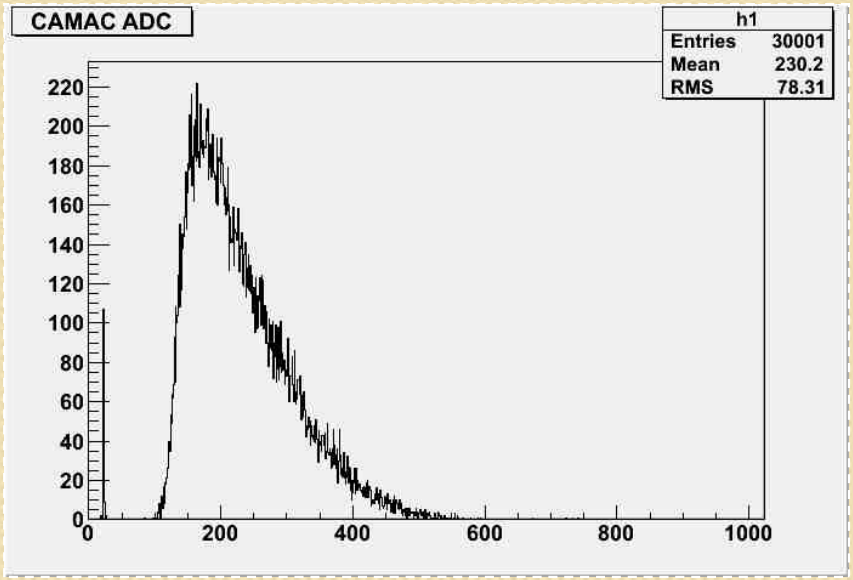
Signal Restoration

Built-in and Additional Shielding

No Magnetic Field



25 Gauss Axial Field with 2mm Mu Metal Box

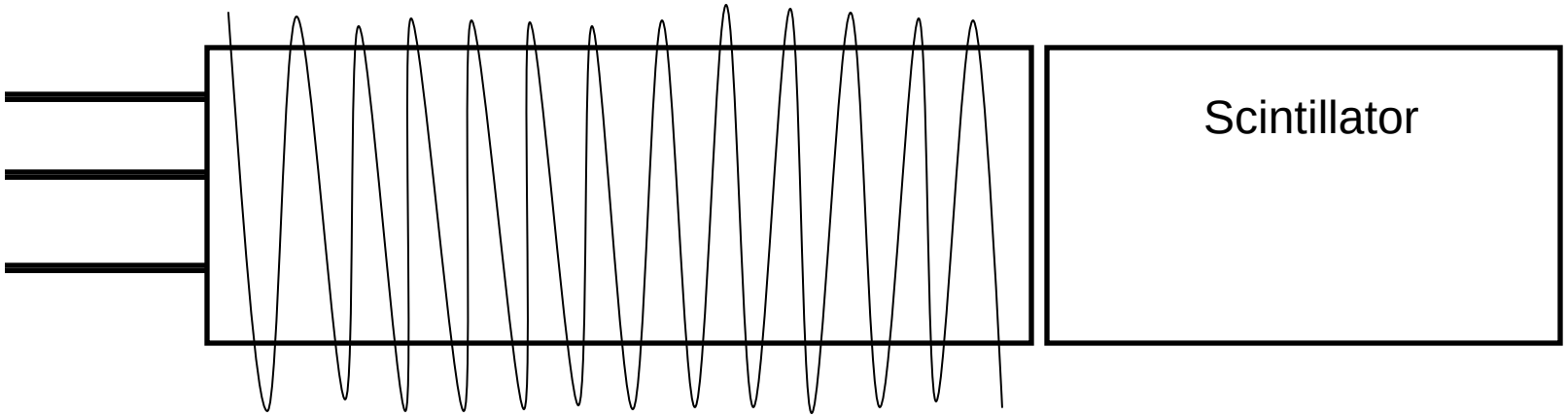


No Improvement

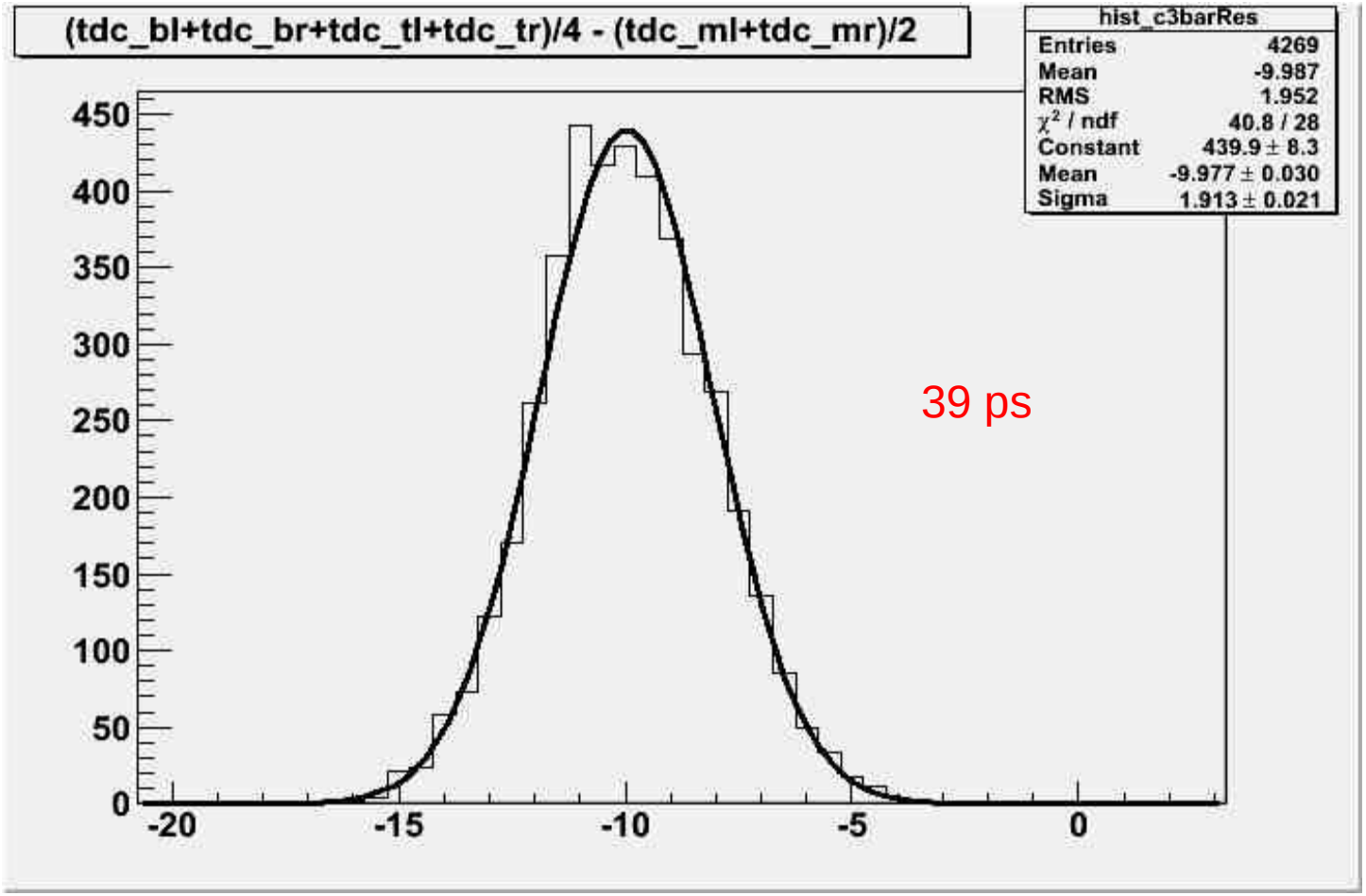
Built-in and Additional Shielding

Conclusions for Higher Fields

- Additional shielding needed for transverse fields above 20 Gauss
- Apply an external field (active shielding) to compensate for axial fields above 10 Gauss

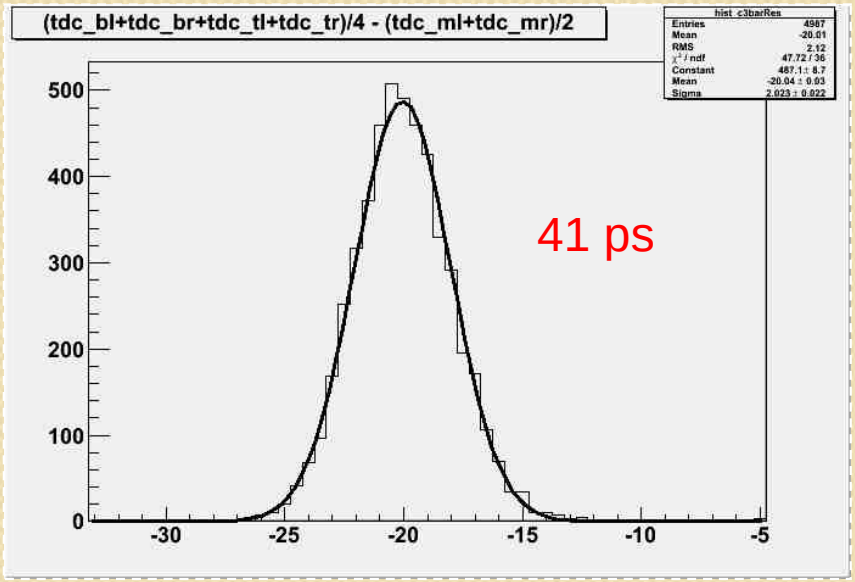


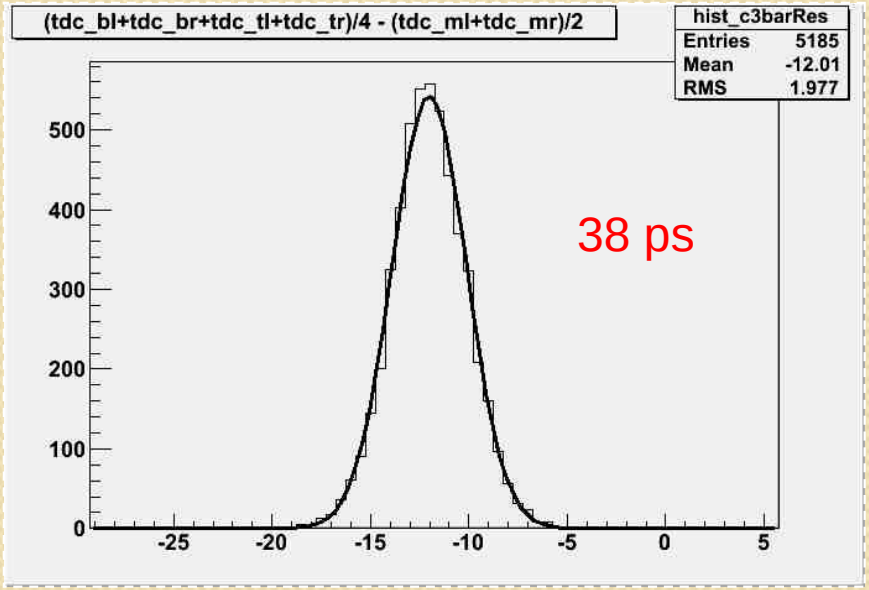
Time Resolution Without Magnetic Field



20 Gauss Transverse Field

10 Gauss Axial Field





Effect on Time Resolution?

Final Remarks

	< 10 Gauss	< 20 Gauss	> 25 Gauss
Axial Field	Shielding in tube is enough	Steel frame and possible active shielding	Active shielding
Transverse Field	Shielding in tube is enough	Shielding in tube is enough	Additional shielding required