



QA of CsI Reference Crystals at Caltech

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Talk given in the Mu2e Calorimeter Group Meeting

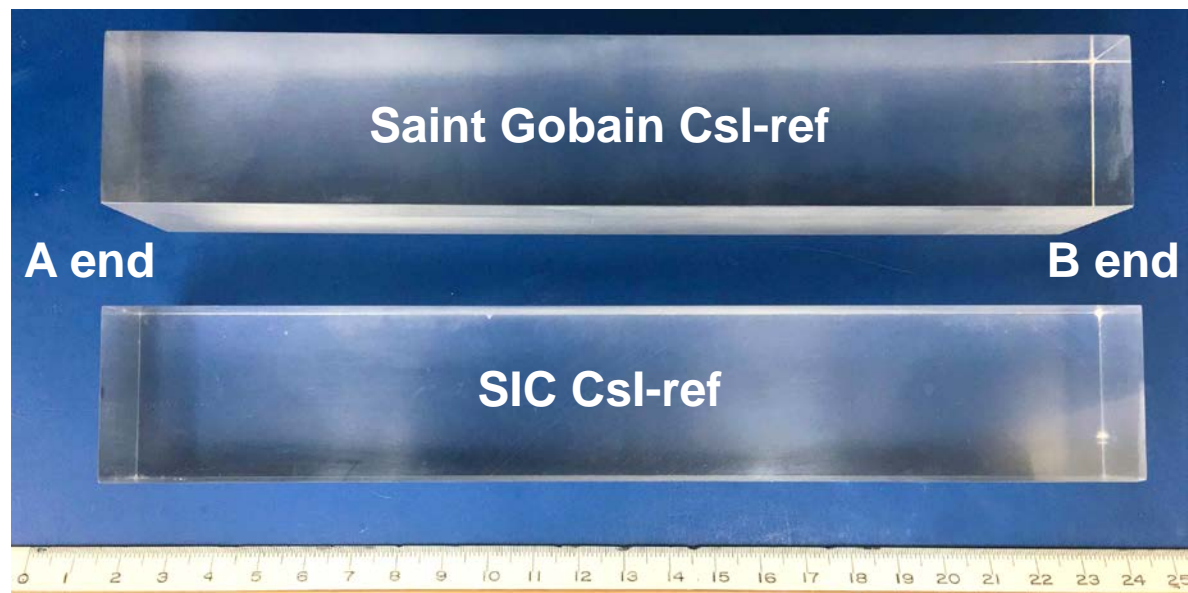


Introduction

- Mu2e specification for CsI crystals was defined in early August. A total of 72 crystals from three vendors (AMCRYS, SICCAS and Saint-Gobain, 24 each) were delivered to Fermilab early December.
- After QA on visual inspection and mechanical dimension by a CMM machine at Fermilab, 36 CsI crystals arrived Caltech in three batches on Dec 15 and 19. Two additional reference crystals one each from Saint-Gobain and SICCAS also arrived Caltech.
- Reported today is the QA result for two reference CsI samples.



2 REF from Saint-Gobain and SIC



ID	Dimension (mm ³)	Polishing
Saint Gobain Csl-ref	34x34x200	All faces
SIC Csl-ref	34x34x200	All faces

Experiments

- Properties measured at room temperature : PHS, LO & decay kinetics



Specifications for Pure CsI



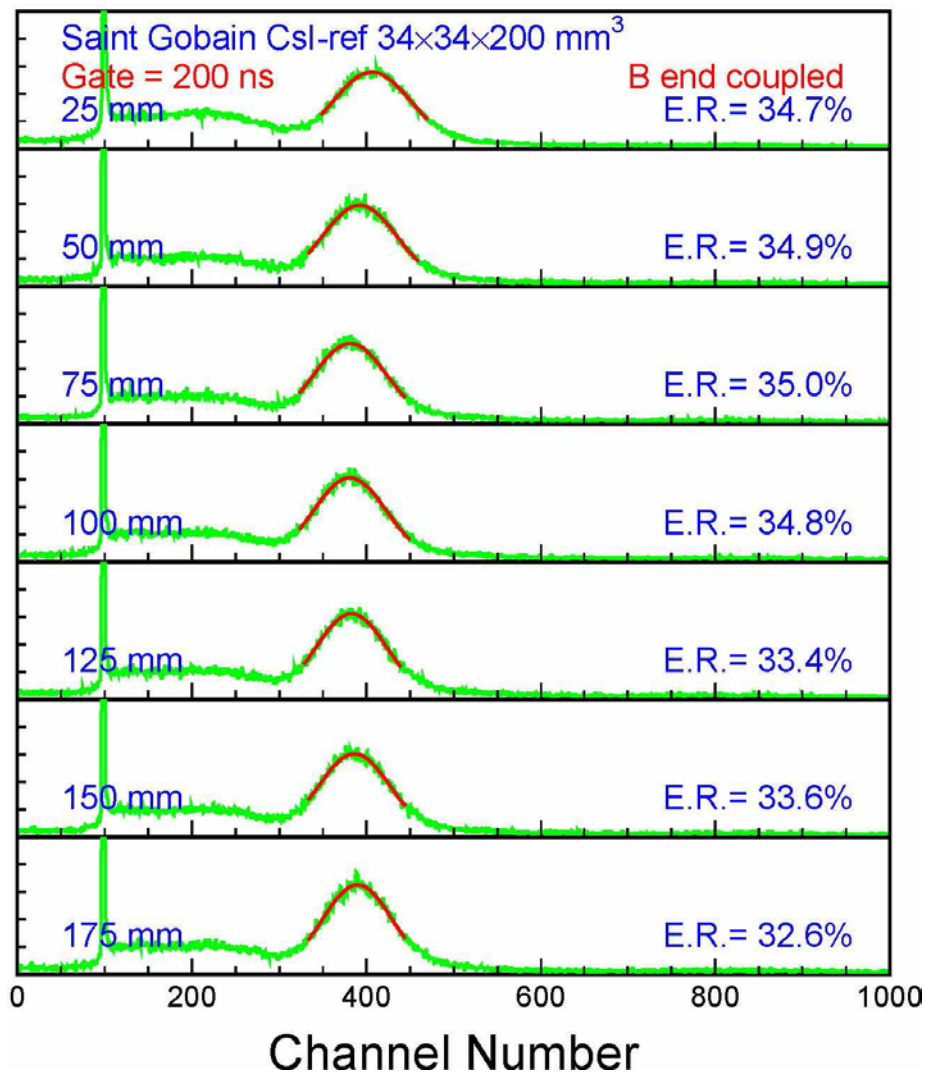
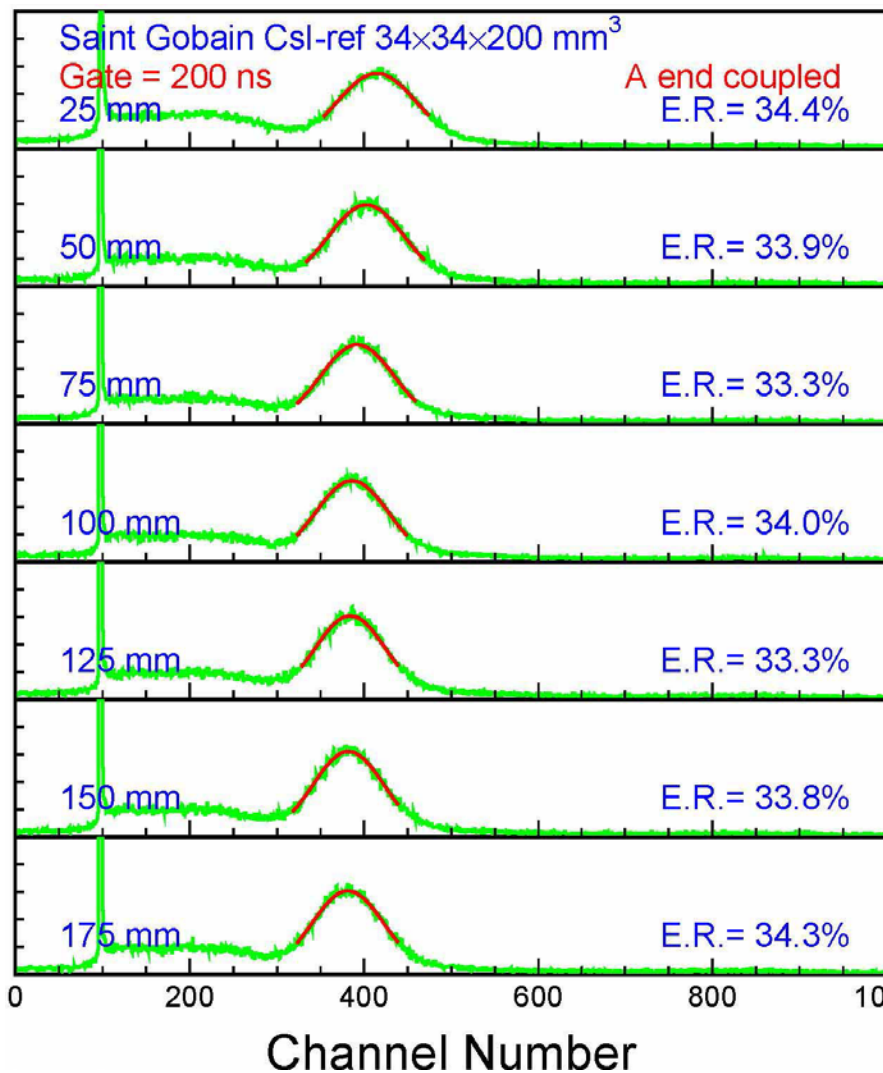
- ❑ Crystal lateral dimension: $\pm 100 \mu$, length: $\pm 200 \mu$.
- ❑ Scintillation properties at seven points along the crystal wrapped by two layers of Tyvek paper of $150 \mu\text{m}$ for alternative end coupled to a bi-alkali PMT with an air gap. Light output and FWHM resolution are the average of seven points with 200 ns integration time. The light response uniformity is the rms of seven points. F/T is measured at the point of 2.5 cm to the PMT.
 - ❑ Light output (LO): **> 100 p.e./MeV with 200 ns integration gate, will be compared to reference for cross-calibration;**
 - ❑ FWHM Energy resolution: **< 45%** for Na-22 peak;
 - ❑ Light response uniformity (LRU): **< 5%.**
 - ❑ Fast (200 ns)/Total (3000 ns) Ratio: **> 75%.**
- ❑ Radiation hardness:
 - ❑ **Normalized LO after 10/100 krad > 85/60%.**
 - ❑ Radiation Induced Current (RIC) @1.8 rad/h: **< 0.6 MeV.**



PHS Saint-Gobain Csl-ref: 200 ns



Excellent energy resolution and uniformity

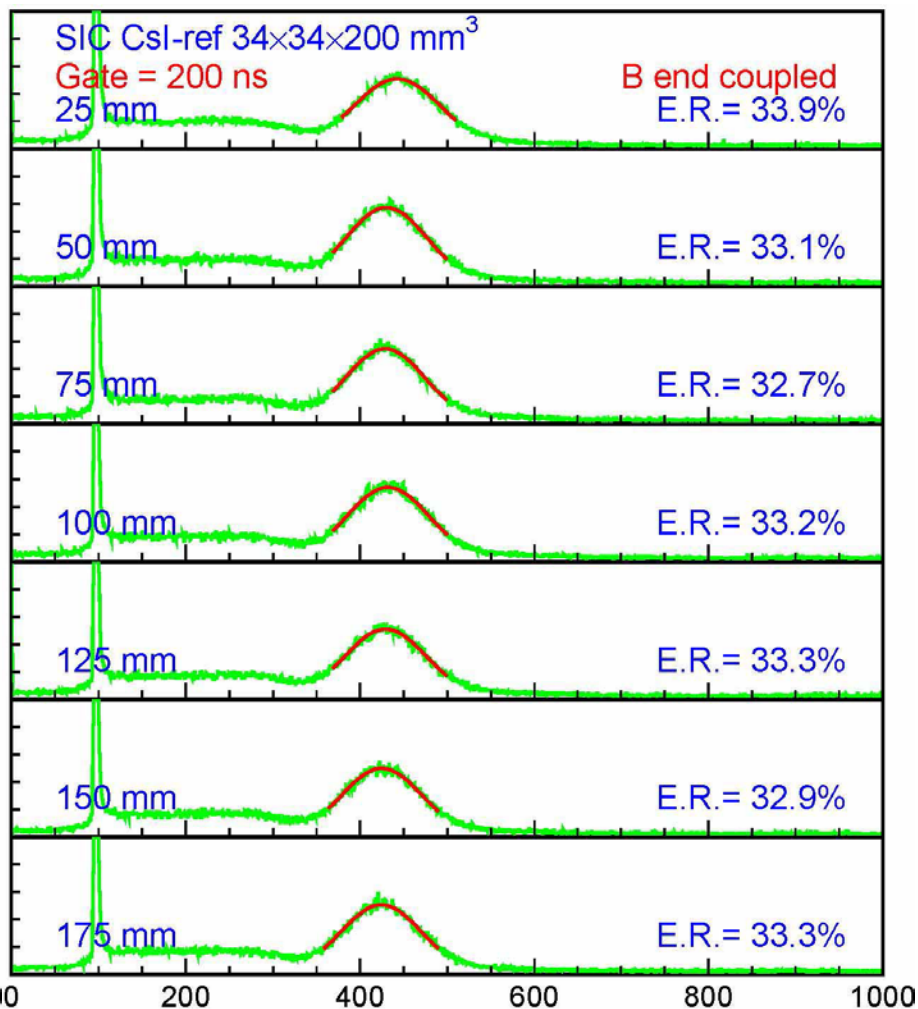
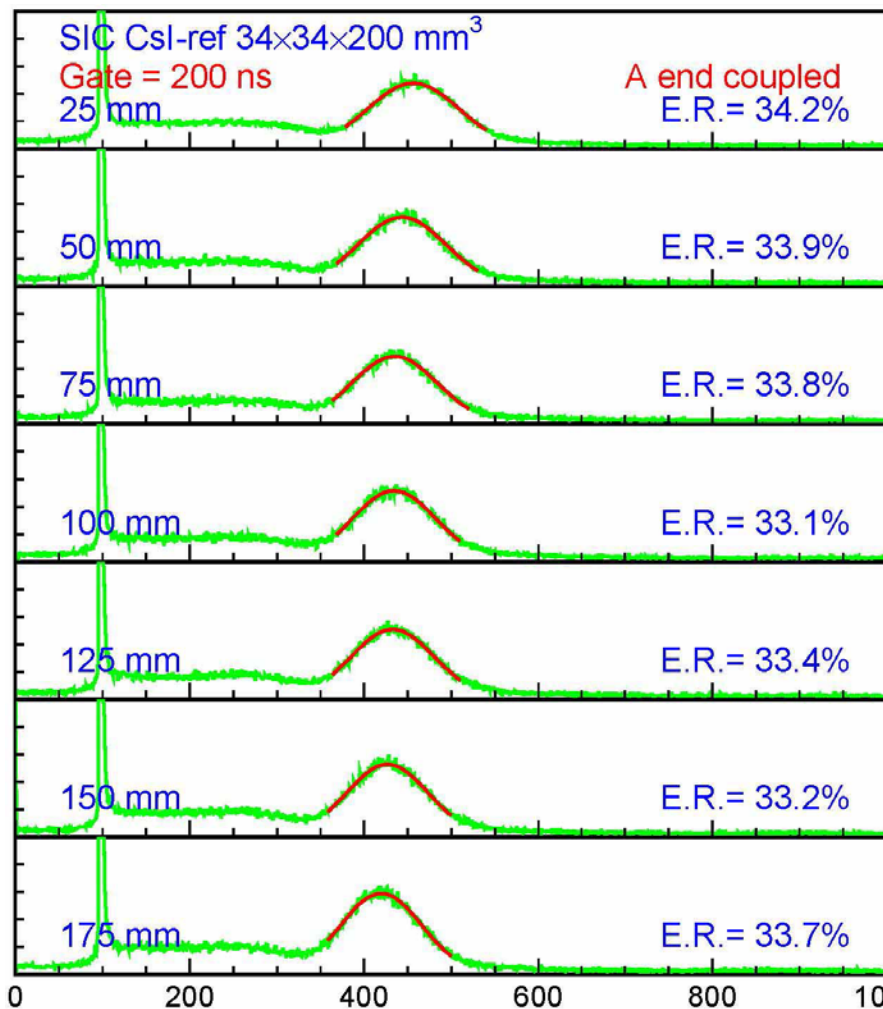




PHS SIC Csl-ref: 200 ns



Excellent energy resolution and uniformity

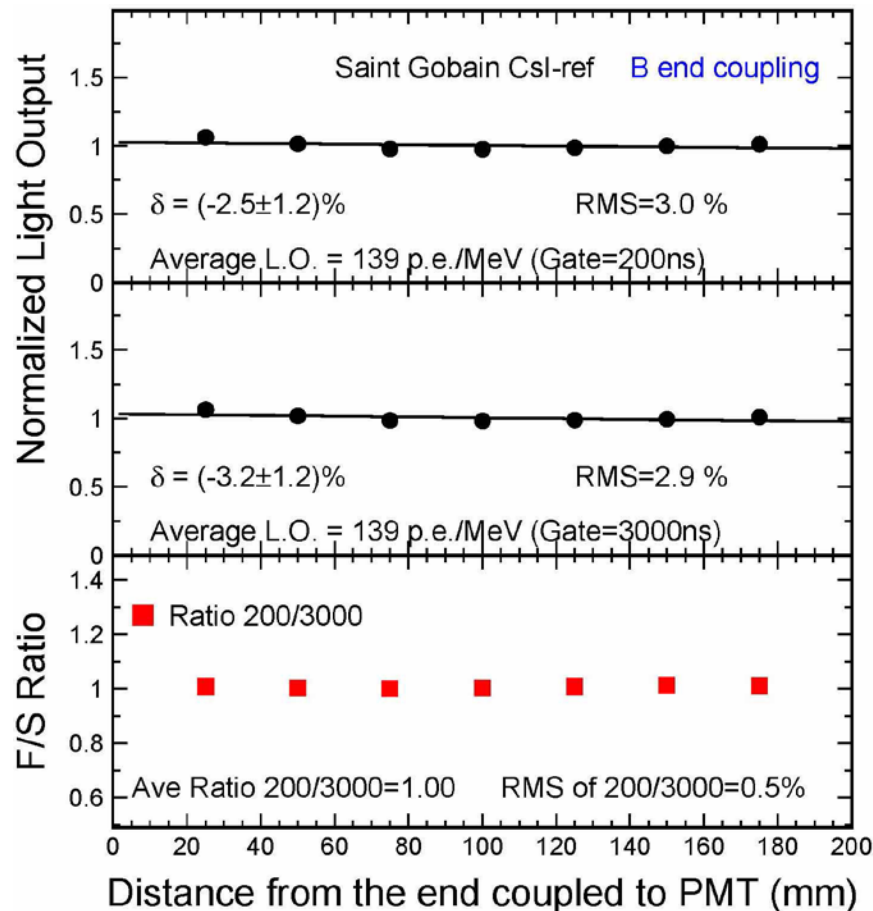
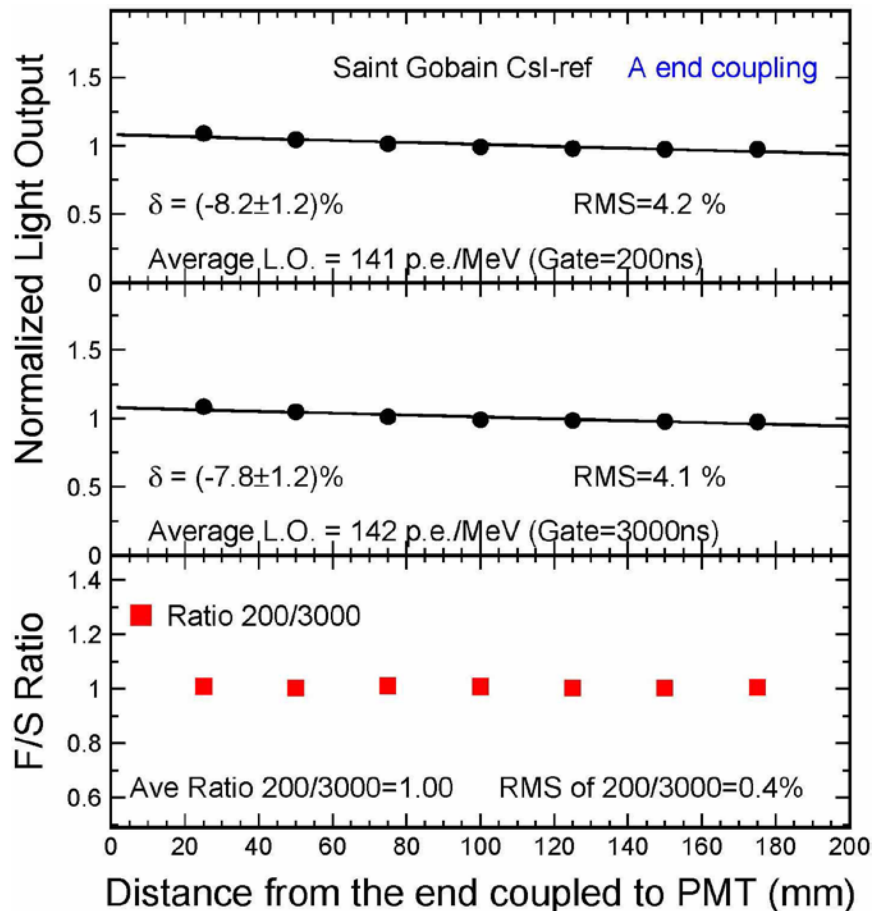




Light Response Uniformity Saint Gobain Csl-ref



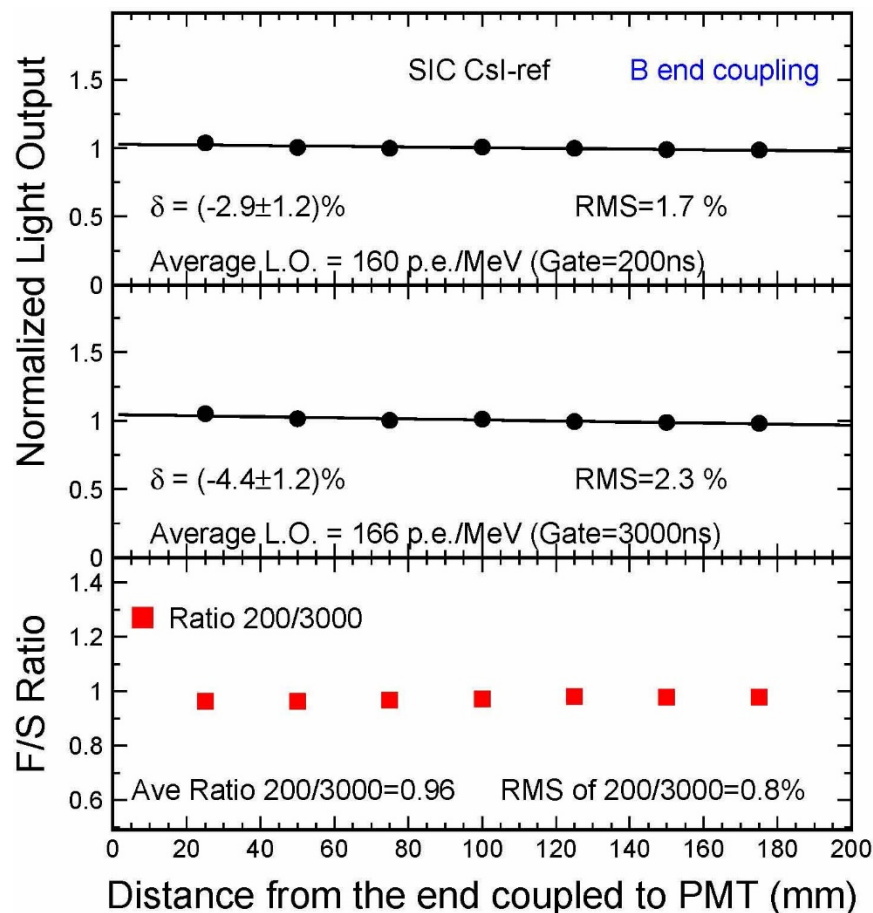
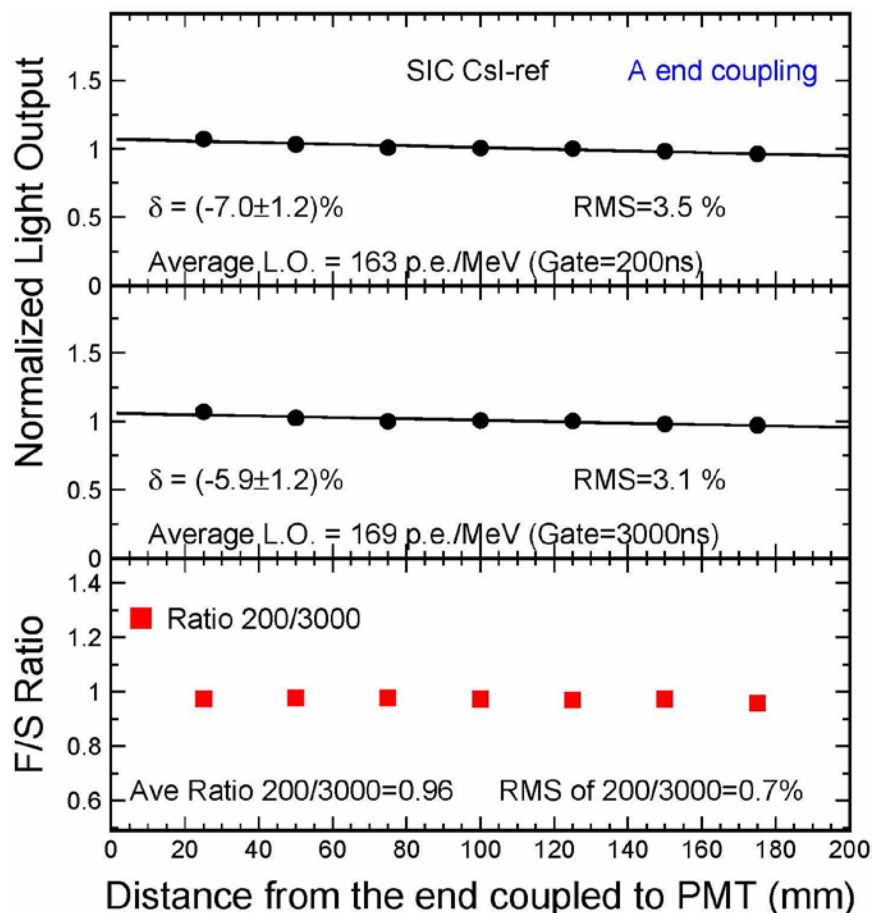
Excellent light response uniformity and F/T ratio



Light Response Uniformity SIC Csl-ref



Excellent light response uniformity and F/T ratio

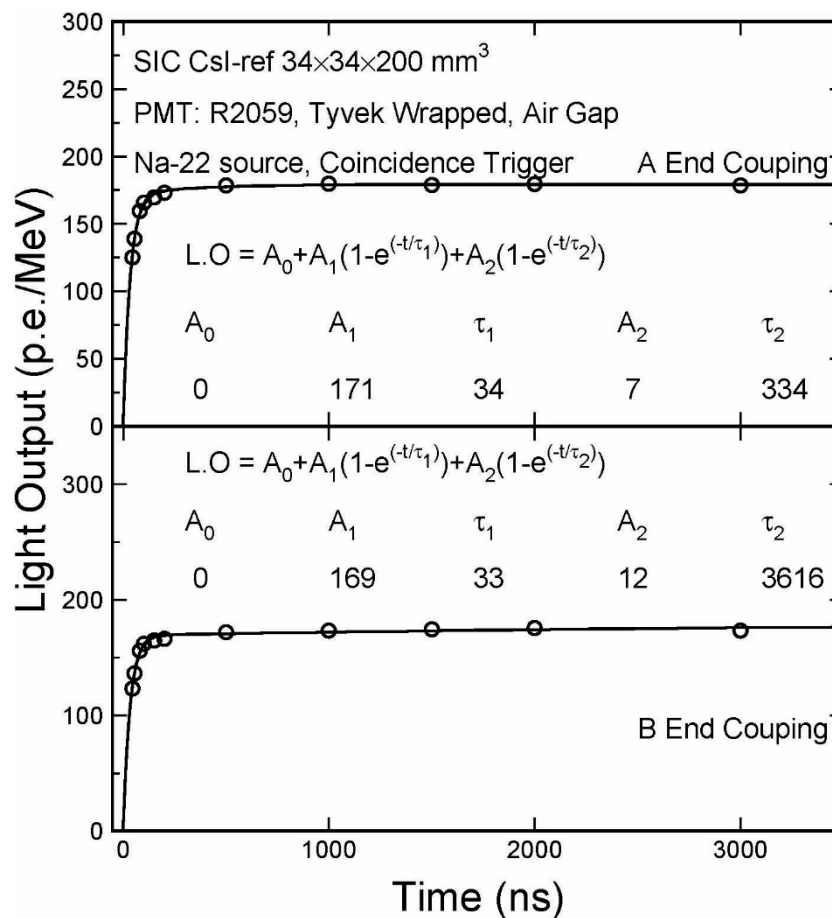
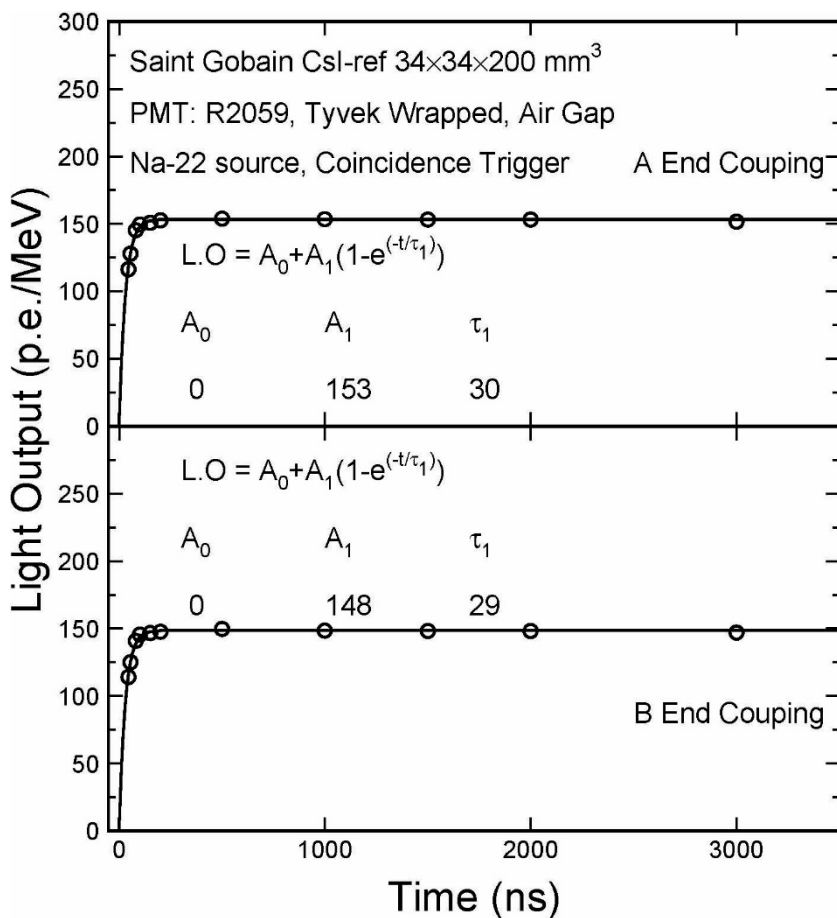




LO and Decay Kinetics

Measured at 25 mm from the end coupled to the PMT

Very small or no slow component





Summary



Both references are better than spec with better uniformity for the B end coupling

ID	Dimension (mm ³)	Coupling end	Basic Scintillation Performance (²² Na γ -source at 25 mm from the coupling end)					Light Response Uniformity Ave (p.e./MeV) and RMS/Ave (%)			
			200 ns LO (p.e./MeV)	3000 ns LO (p.e./MeV)	LO(200)/LO(3000)	Fit LO F+S (p.e./MeV)	Decay (ns)	LO (200)	200 ns ER (%)	LO (3000)	LO(200)/LO(3000)
Saint Gobain Csl-ref	34x34x200	A	152	153	99.3%	153	30	141 4.2%	34.4	142 (4.1%)	1.00 (0.4%)
		B	148	148	100%	148	29	139 3.0%	34.7	139 (2.9%)	1.00 (0.5%)
SICCAS Csl-ref	34x34x200	A	173	179	96.6%	171+7	34/ 334	163 3.5%	34.2	169 (3.1%)	0.96 (0.7%)
		B	166	173	96.0%	169+12	33/ 3616	160 1.7%	33.9	166 (2.3%)	0.96 (0.8%)
Specification					>75			>100 <5%	<45		

QA for 36 crystals will be carried out for four specification items



Summary



- Two reference CsI crystals from Saint-Gobain and SICCAS show excellent performance much better than the specifications. Their light response uniformity for the B end coupled to the PMT is much better, so is defined as the coupling end.
- The Saint-Gobain reference crystal will be shipped back to Saint-Gobain directly. The SICCAS reference will be shipped to Frascati.
- Kharkov will be contacted for a reference crystal.
- QA on 36 CsI crystals has started. Result will be reported in the next meeting.