



QA on Scintillation Properties for Six SIC Pre Series Crystals

Ren-Yuan Zhu

California Institute of Technology

February 7, 2018

Talk given in the Mu2e Calorimeter Group Meeting



Introduction



- A S-G crystal was measured to re-establish the test set-up with good overall consistency. Six pre series undoped CsI crystals from SIC were characterized.
- Crystals with the existing Tyvek wrapping plus an additional Tyvek layer were measured with both A and B end coupled to PMT via a 2 mm air gap, where A is the marked end.
- Reported today are the results with the coupling end chosen for a better LRU.



Six SIC Pre Series CsI Crystals



ID	Dimension (mm ³)	Polishing
SIC-C0002,3,5,6,11,12	34x34x200	All faces

Experiments

- Properties measured at room temperature : LO, ER, F/T, and LRU



Systematic Uncertainty Investigated S-G Csl-60 Measured in 2017 & 2018



Date	Coupling end	Basic Scintillation Performance (²² Na γ source placed at 25 mm from coupling end)						Light Response Uniformity (Ave and RMS/Ave)
		200 ns ER (%)	200 ns LO (p.e./MeV)	3000 ns LO (p.e./MeV)	LO(200)/LO(3000)	Fit LO (p.e./MeV)	Decay (ns)	LO (200)
Jan 2018	A	35.4	101	103	98.1%	102	29	98 (2.3%)
	B	35.5	103	103	99.9%	103	29	97 (3.6%)
April 2017	A	34.2	102	103	99.4%	102	30	97 (2.5%)
	B	35.1	104	104	100.0%	104	29	97 (4.0%)
RMS/Ave	A	1.7%	0.8%	0.4%	0.7%	0.4%	1.8%	0.6% (4.2%)
	B	0.6%	0.5%	1.1%	0.1%	0.6%	1.4%	0.1% (5.3%)

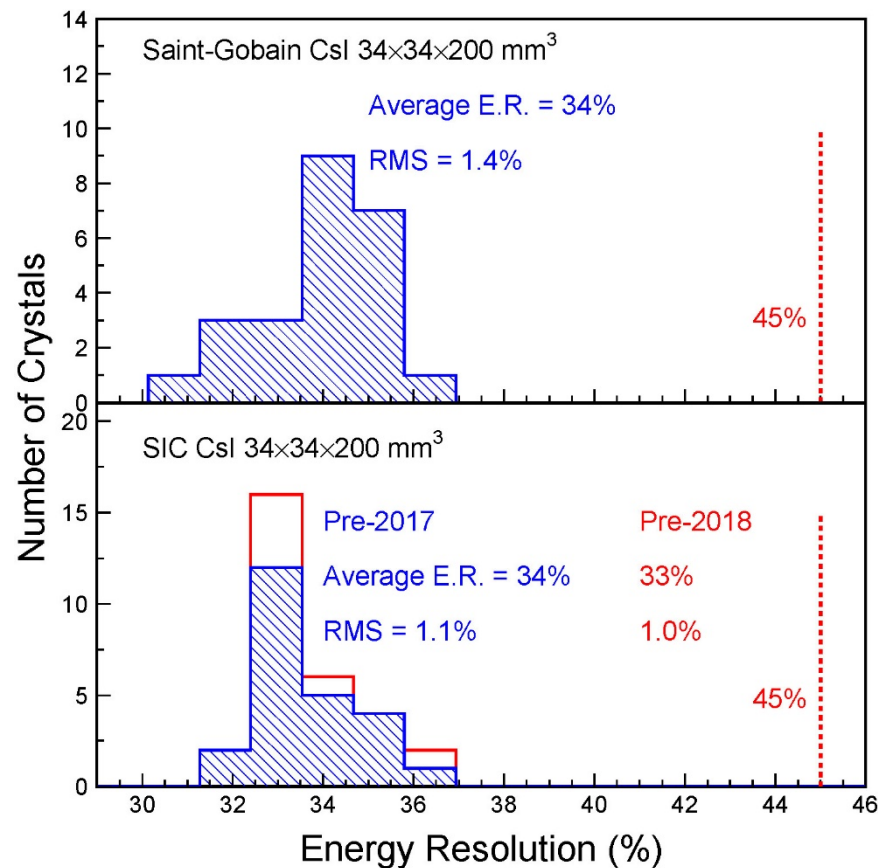
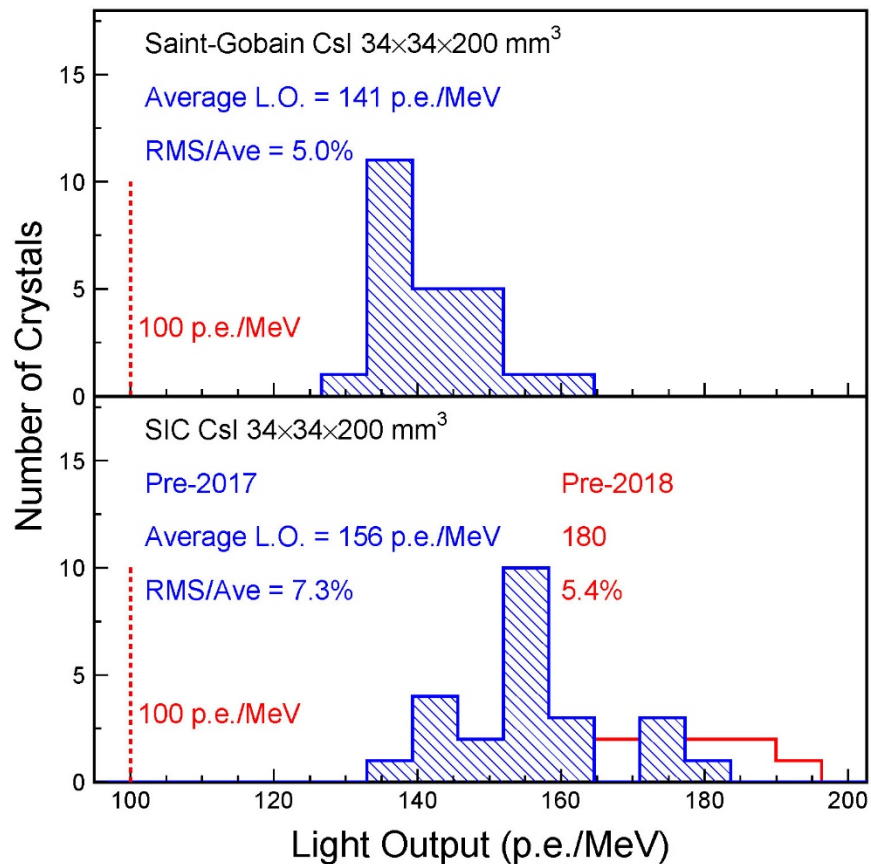
systematic uncertainties: 1% for LO and F/T ratio, 2% for energy resolution and decay time, and 5% for LRU



Summary: LO & ER



Better LO and energy resolution than preproduction crystals

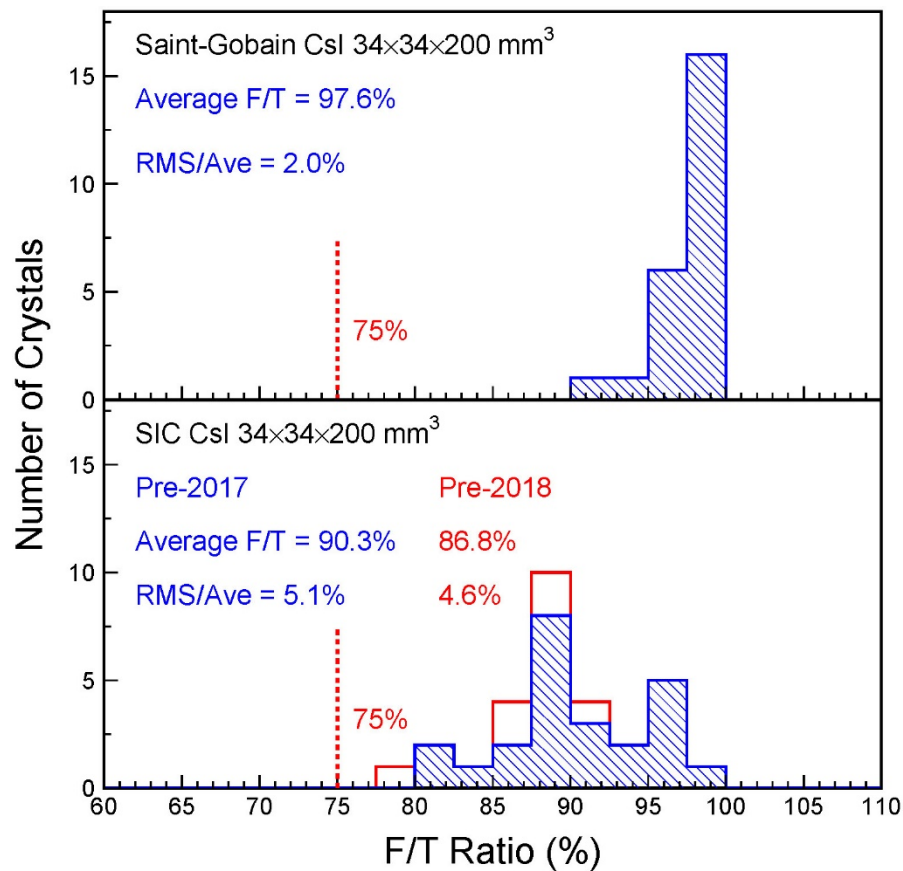
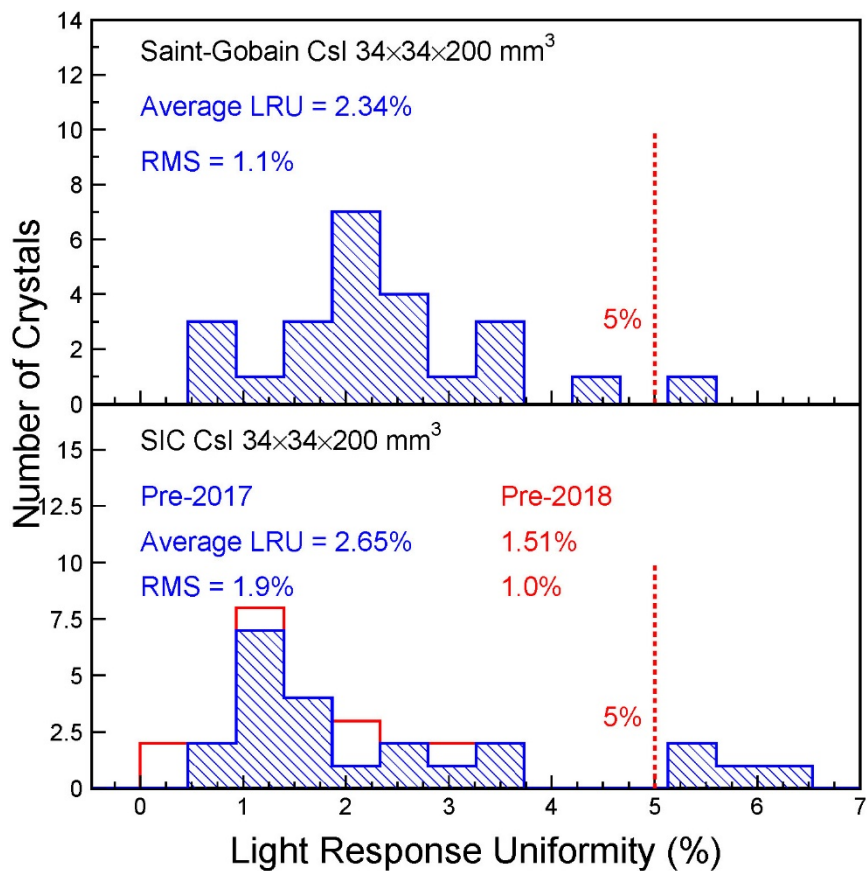




Summary: LRU & F/T Ratio



Better LRU and worse F/T ratio than preproduction crystals

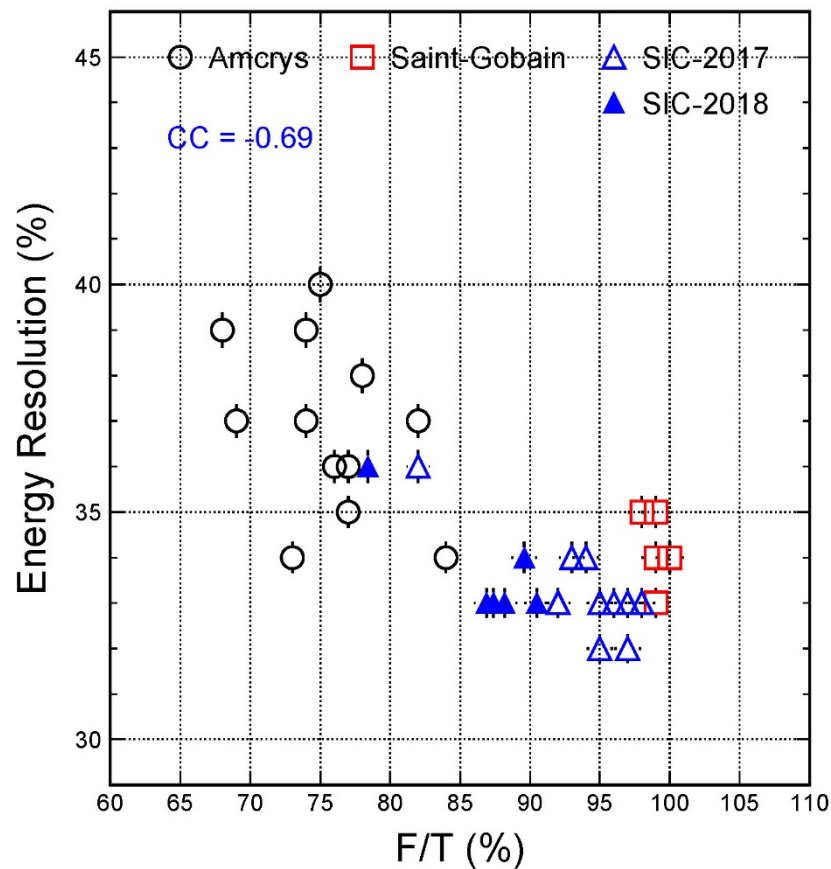
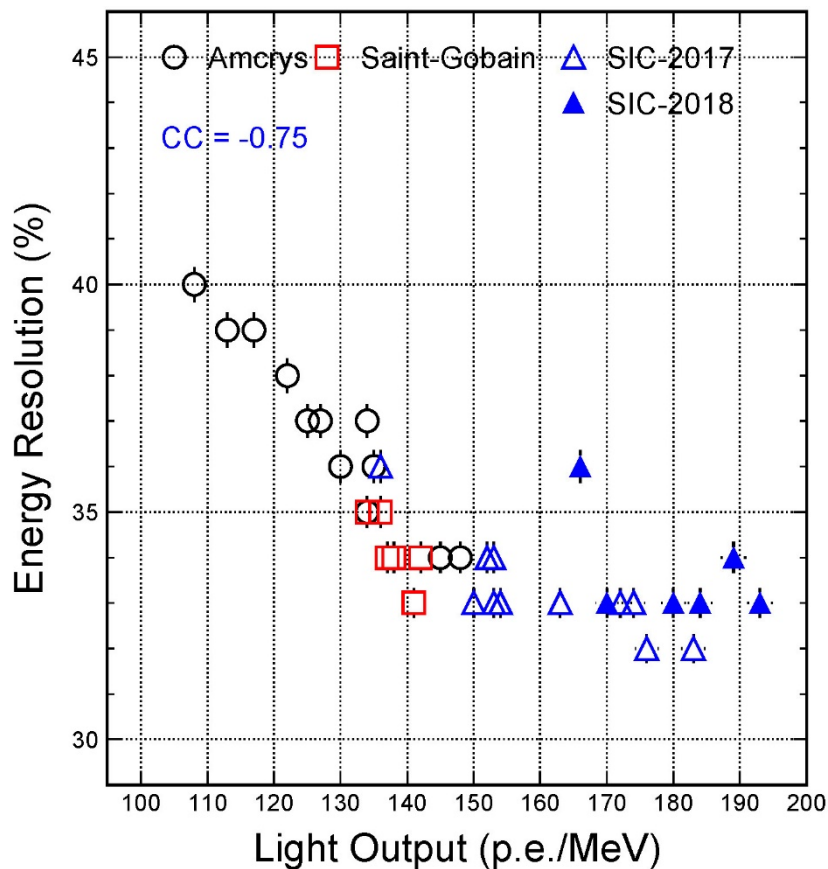




Correlations: ER vs. LO & F/T



Good correlations between the energy resolution vs. LO & F/T





Summary: Chosen End Coupling

Crystal ID	Coupling end	L.O. (p.e./MeV)	E.R. (%)	F/T (%)	LRU (%)
SIC-C0002	b	180	33	90.5	1.10
SIC-C0003	a	193	33	88.2	0.15
SIC-C0005	a	166	36	78.4	2.88
SIC-C0006	a	189	34	89.6	2.30
SIC-C0011	a	184	33	86.9	0.38
SIC-C0012	b	170	33	87.4	2.23
Average		180	33	86.8	1.51
RMS		5.4%	1.0	4.6%	1.03
Average (2017 SIC CsI)		159	33	93.1	3.29
RMS (2017 SIC CsI)		7.4%	1.1	5.2%	2.06



Summary: A End Coupling



Crystal ID	Coupling end	L.O. (p.e./MeV)	E.R. (%)	F/T (%)	LRU (%)
SIC-C0002	a	197	34	92.3	2.85
SIC-C0003	a	193	33	88.2	0.15
SIC-C0005	a	166	36	78.4	2.88
SIC-C0006	a	189	34	89.6	2.30
SIC-C0011	a	184	33	86.9	0.38
SIC-C0012	a	197	32	92.5	2.76
Average		188	34	88.0	1.89
RMS		5.7%	1.1	5.4%	1.16
Average (2017 SIC CsI)		159	33	93.1	3.29
RMS (2017 SIC CsI)		7.4%	1.1	5.2%	2.06



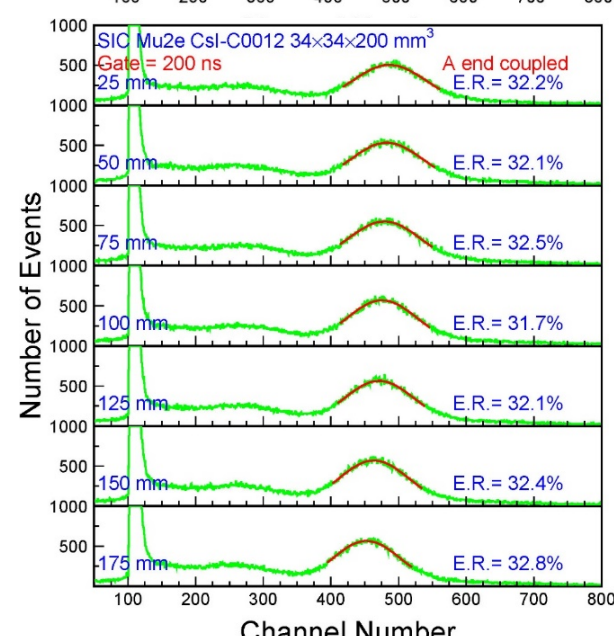
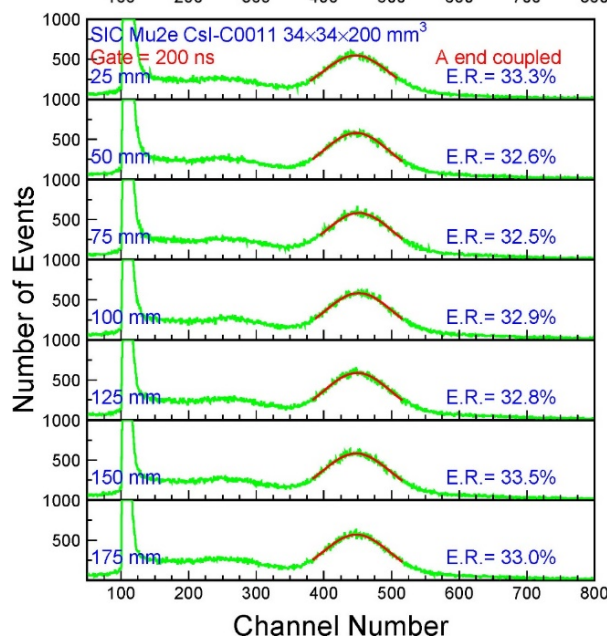
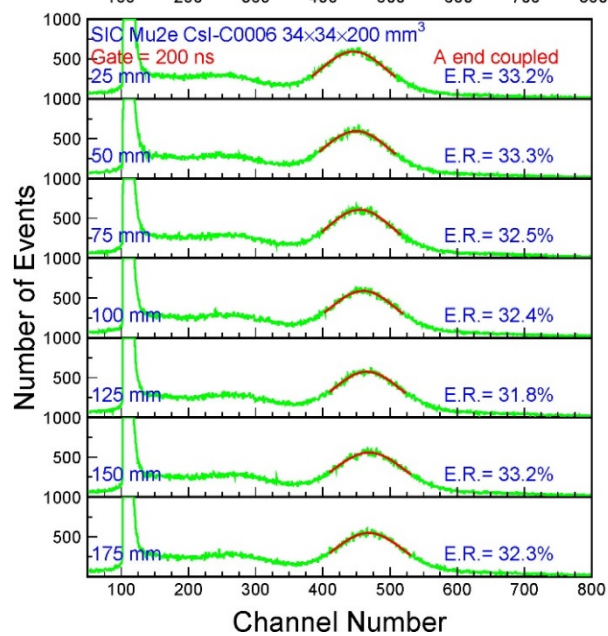
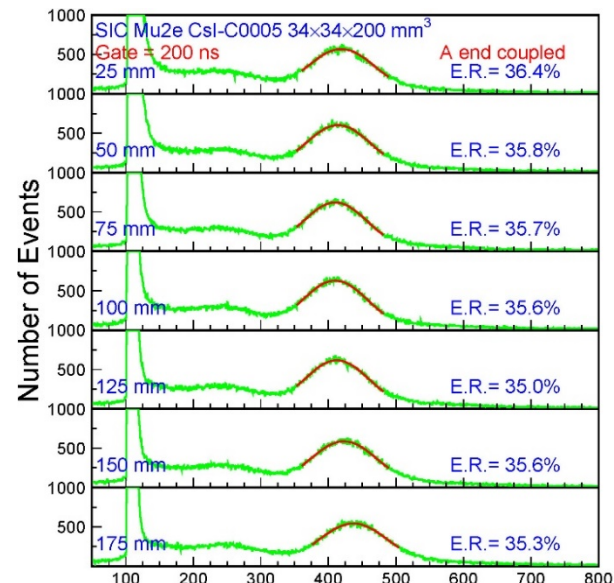
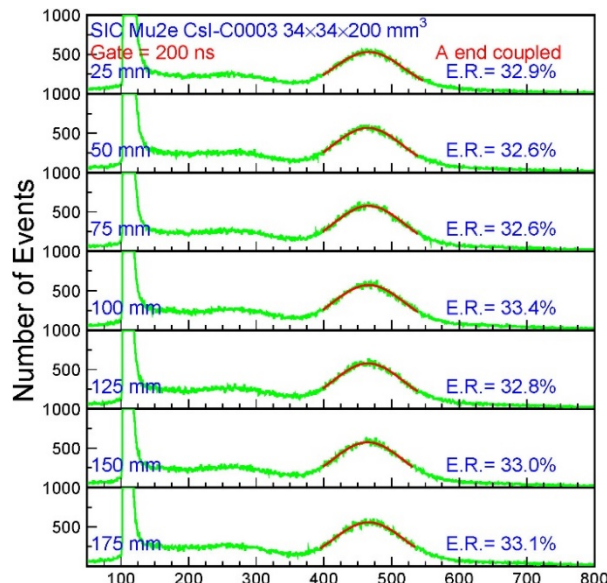
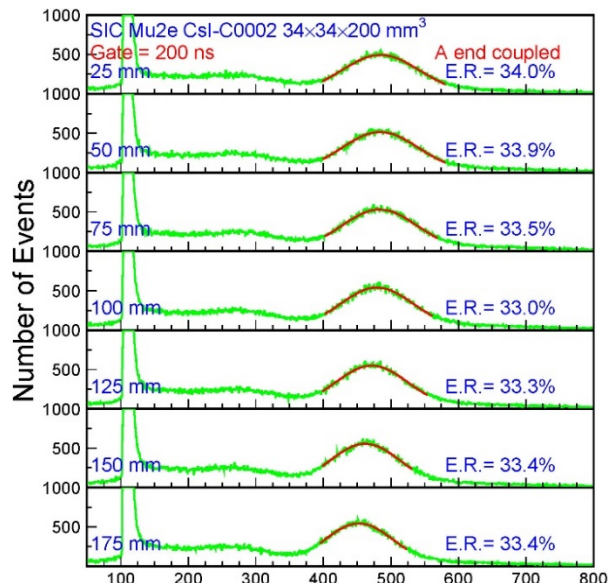
Summary: B End Coupling



Crystal ID	Coupling end	L.O. (p.e./MeV)	E.R. (%)	F/T (%)	LRU (%)
SIC-C0002	b	180	33	90.5	1.10
SIC-C0003	b	179	34	92.3	3.44
SIC-C0005	b	156	37	91.3	4.78
SIC-C0006	b	175	34	91.3	4.51
SIC-C0011	b	163	34	94.2	2.23
SIC-C0012	b	170	33	87.4	2.23
Average		171	34	91.2	3.05
RMS		5.1%	1.2	2.2%	1.32
Average (2017 SIC CsI)		159	33	93.1	3.29
RMS (2017 SIC CsI)		7.4%	1.1	5.2%	2.06

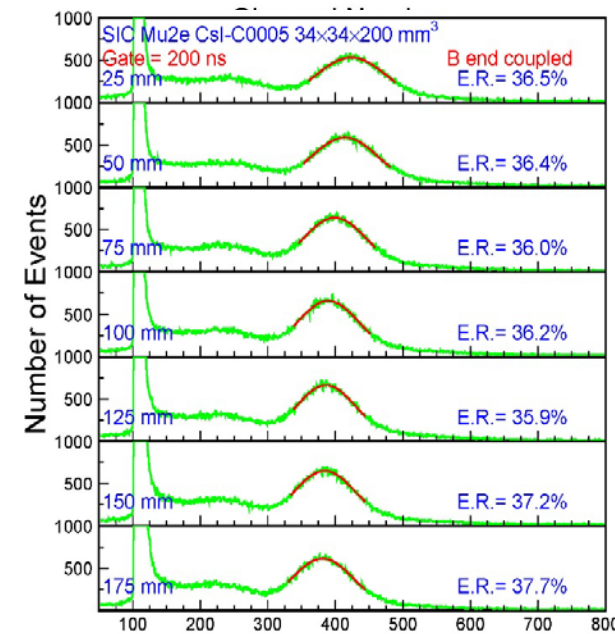
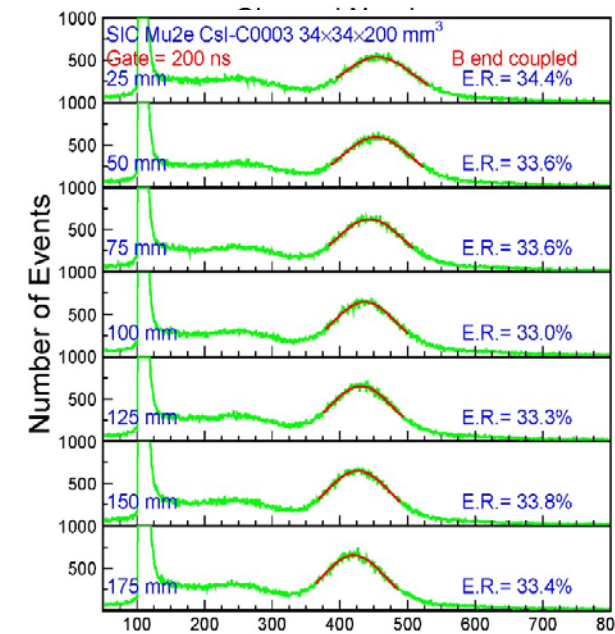
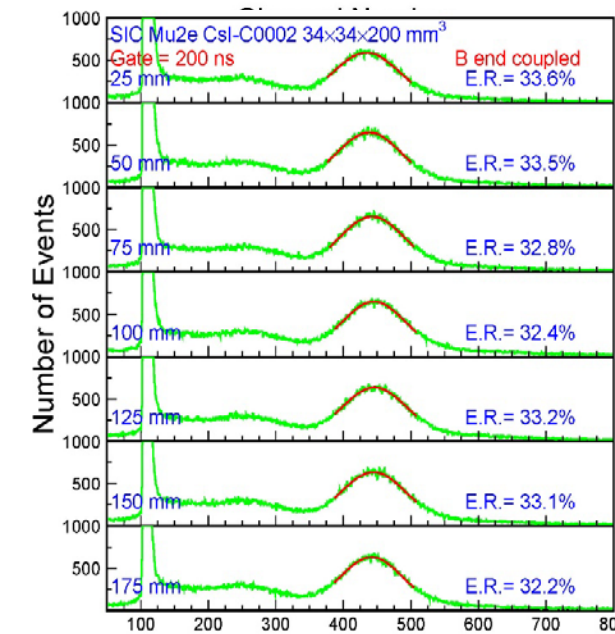
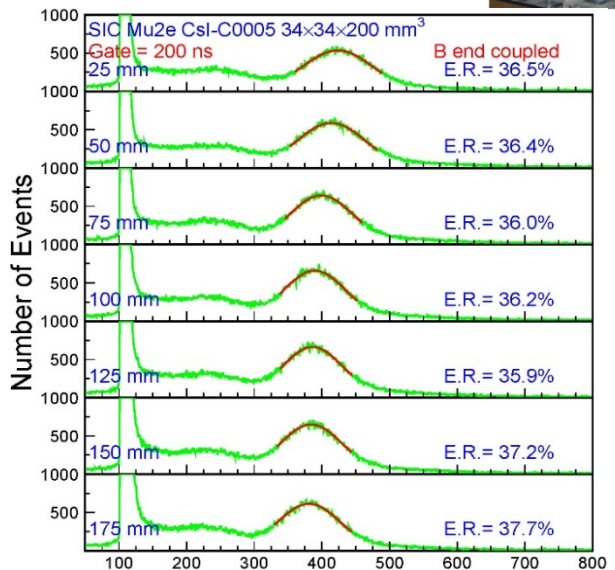
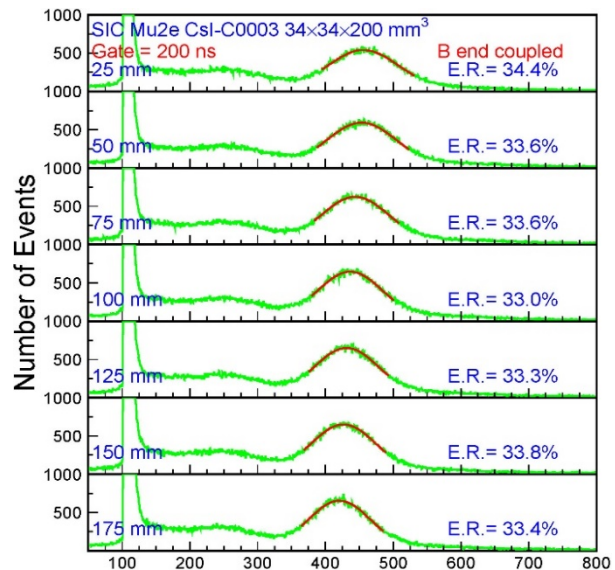
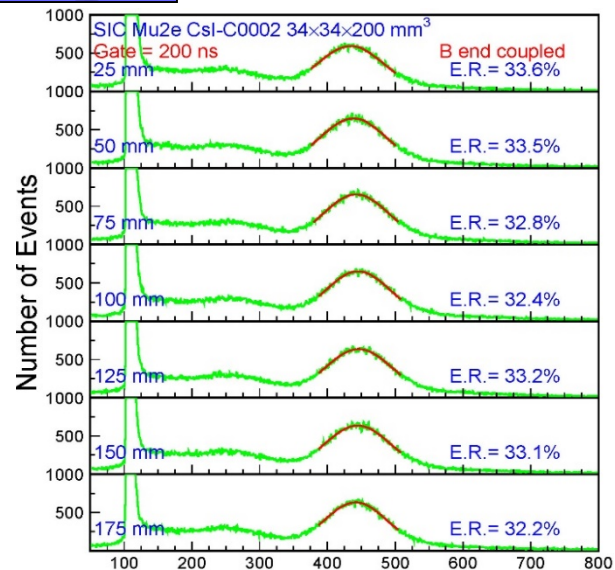


200 ns PHS: A End Coupling





200 ns PHS: B End Coupling



Channel Number

Channel Number

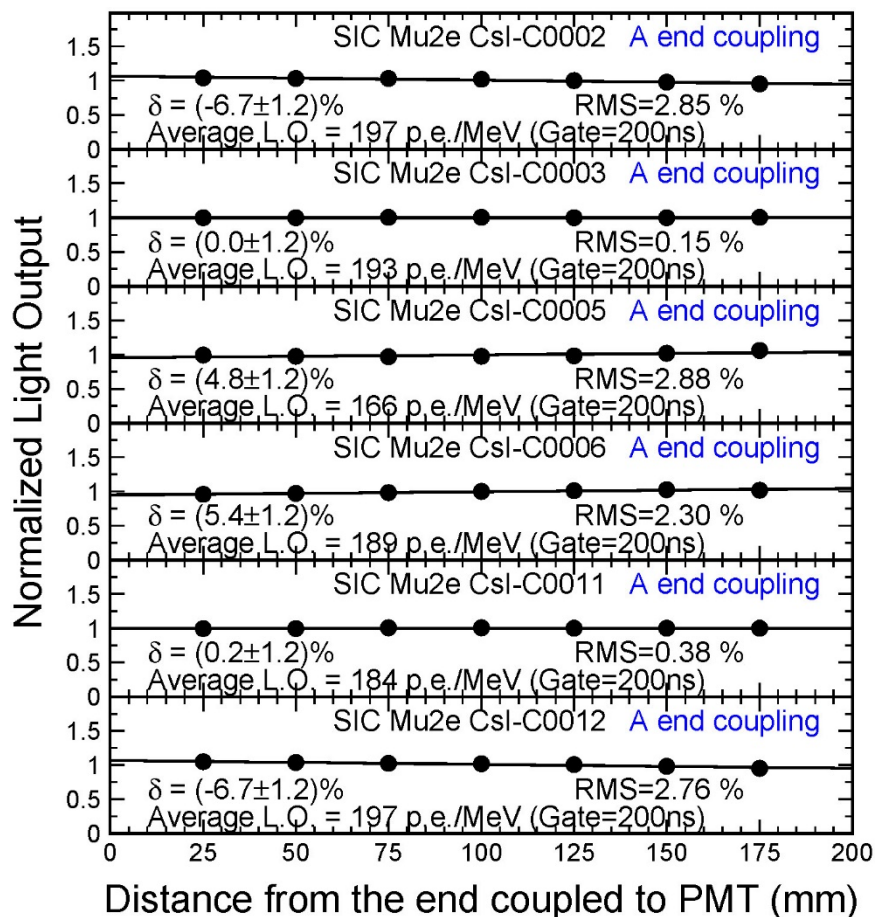
Channel Number



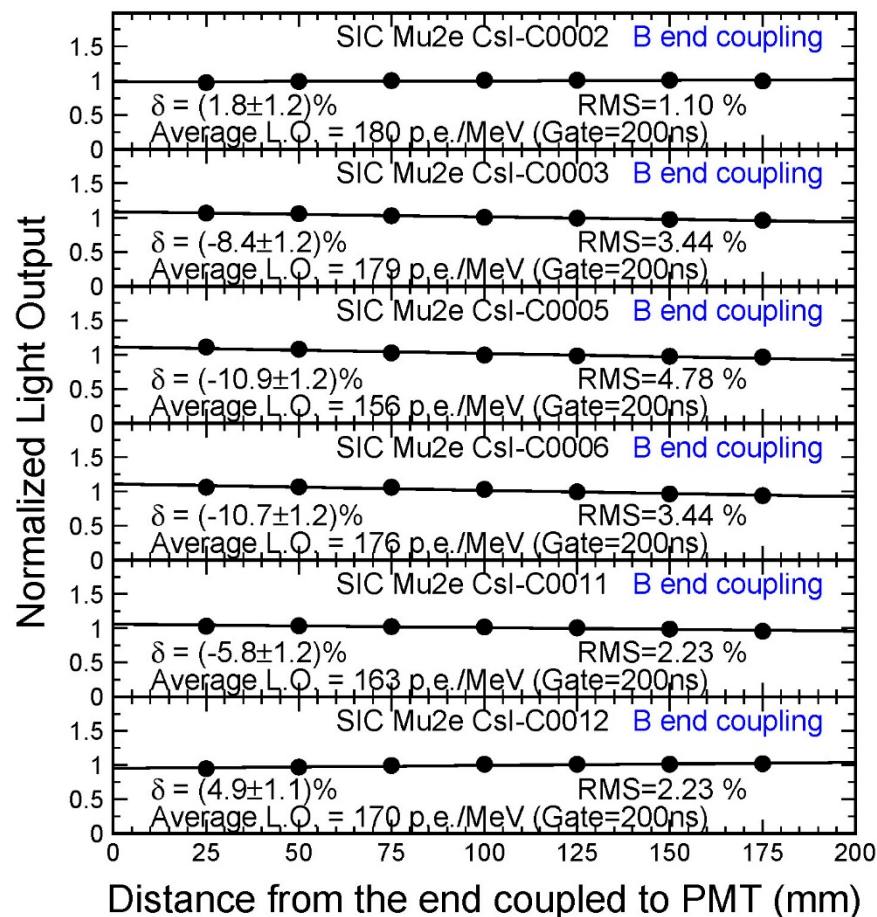
Light Response Uniformity



A end



B end





Summary



- Six pre series SIC crystals meet the Mu2e specifications. Their LO, energy resolution and LRU are better than the pre-production crystals, but the F/T ratio is worse.
- Six 1" cube Saint-Gobain CsI samples arrived Caltech. They are cut at the level where the final crystals will be cut in different ingots. Their F/T ratio and radiation hardness will be measured at Caltech to provide information for Saint-Gobain.