



# Development of FRS electronic, DAQ and detectors

## Report on the FRS000 experiment of 2009

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# FRS000 experiments 2009

Block 2 / 2009										March 2009										Schedule as of 06-Mrz-2009										
W	Week 10					Week 11					Week 12					Week 13					Week									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	U236, Jungclaus/Wollersheim, ECR, 122, 124Sn, 3.8 MeV/u, 1.2 pA, X7										U225, Heßberger, 54 Cr (ECR), 4.6 - 5.1 MeV/u, 1000 pA 50 Hz, 5 ms, Y7										UMAT, C.Trautmann, Au, PIG, 11.4 MeV/u, 5 Hz, long pulses (4 ms), X0									
											UBIO, Scholz, Ru, 11.4 MeV, X6					B/UMAT, commissioning M-Branch, Ru, Cr, X0					UBIO, Scholz, Cr, 11.4 MeV, X6									
S338, Herrmann/Leifels, 96Ru (PIG), 1.69 AGeV (42+), 5e6/spill, long extraction 10s, HTB																														
E062, Heil/Litvinov, 96Ru (PIG), 200 MeV/u, >5e6/spill, SIS cooler, fast extraction, ESR																														
FRS000, Nociforo, 96Ru, 200-500 MeV/u, 5e6/spill (SIS), slow extraction (3-5 s), FRS, S4 (HFS)															SMAT, Trautmann, Au, 200 MeV/u, max., HTA					S367, Tauschwitz, Au, 200 MeV/u, >4E9/bunch, fast extraction, 1 bunch, HHT					S304/S357, Ducrot/Simon, 197Au, 1000 MeV/u, PIG, 30000/spill, 10 s extraction, HTC					

Block 3 / 2009										August 2009										Schedule as of 13-Aug-2009															
Week	Week 32					Week 33					Week 34					Week 35					W														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
	B, W. Barth, 40Ar MUCIS, 11.4 MeV/u, UNILAC					U000, machine experiments					UBIO, Scholz, C, 11.4 MeV, X6					UMAT, Voss/Voss, 12C, 4.8 MeV/u, 50 Hz, long pulses, X0					UBIO, Scholz, 56Fe, 11.4 MeV, 5 Hz, 1 ms, X6														
						B, P.Forck/E.Gu etlich, 40Ar, 11.4, 1mA, 1Hz, 1ms, X2					UMAT, Severin/Trautmann, C, 11.4 MeV/u, Intensität nach Absprache mit K. Voss, M-branch					a)					b)														
																					U243, Yakushev/Düllmann, 48Ca (ECR), ~4.5-5.5 MeV/u, 4 particle-microAmp (pulse) in X8, >=5 ms / 50 Hz, X8 TASCA														
																					c)					U238, Block, 48Ca, 4-5 MeV/u, long pulses: 5ms, 5 Hz, Y7 SHIPTRAP									
	B, U.Scheeler, 12C, SIS					S000, Spiller, 40Ar MUCIS, SIS					SBIO, Schardt/Schardt, ECR, 12C, 80-400 MeV/u, 1e3 - 1e9/spill, therapy conditions (Cave M), HTM / HTA					d)					S319, Saito/Saito, 6Li, ECR, 2000 MeV/u, 1,2e8/spill, HTC					S349, Fabbietti/Leifels, p, MUCIS, 3.5 GeV, ~5-10 10e7/spill, long extraction (max), HTB									
																e)										S272, Tanihata & Kanungo/Geissel, 40 Ar, PIG, 750 MeV/nucleon, 1e7/spill, FRS					f)				

Block 4 / 2009										September 2009										Schedule as of 11-Sep-2009																													
Week 36					Week 37					Week 38					Week 39					Week 40																													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30																				
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																				U226, M. Roth/A. Blazevic, Ca, mean charge state, Z6 stripper, 4.9, 1 pA, 1 ms, Z6																													
S349, Fabbietti/Leifels, p, MUCIS, 3.5 GeV, ~5-10 10e7/spill, long extraction (max), HTB										S351, Yamazaki/Bräuning, U89+, MEVVA, 190 MeV/u, 1e4/s, SIS cooler, long flat extraction, HTA										S361, Bruce/Gorska, 238U73+, MEVVA, 750 MeV/u, 5e9 particles per spill, 4 s extraction, FRS.																													
d)					e)					S386, Schwarz/Schwarz, p, 2.5 GeV, 1e5, 10s extraction, HTD					f)					S331, Mintsev/Varentsov, U73+, 200-500 MeV/u, MAXIMUM (>2e9), preferably SIS cooler, HHT					S394, Lemmon/Leifels, U, 400MeV/u, ~5e5/spill, long extraction (10s), HTD					g)					h)														
										B, U.Scheeler, U, ESR										E080, Grisenti/Winters, 238U92+, 50-400MeV/u, 10e8 particles, ESR										E093, Thorn/Thorn, 238U91+, 100,200,400 MeV/u, normal ESR intensity, ESR										E085, Brandau/Kozuharov, 238U, 200 MeV/u, 1e8/spill (SIS), SIS cooler, ESR									

Block 4 / 2009										October 2009										Schedule as																			
Week 40					Week 41					Week 42					Week 43																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26														
a)										UMAT, Severin/Severin, U, PIG, 5,9 MeV/u, 50 Hz, long pulses, M-Zweig										b)																			
										UBIO, Scholz, U238, 5,9 MeV, X6										UMAT, Severin/Severin, U, 5,9 MeV/u, 50 Hz, long pulses, X0																			
c)										S319, Saito/Saito, 6Li, ECR, 2000 MeV/u, 1,2e8/spill, HTC										S000, Spiller, 238U MEVVA, SIS										S392, J. Kurcewicz, 238U73+, 700-1000 MeV/u, 1e10/spill, slow extraction, FRS									
e)										FRS000, Nociforo/Gorska, U, PIG, 300-500 MeV, 1e4/spill -1e9/spill, slow extraction, FRS										249, Berdermann, 6Li, two energies: 1 GeV, 3 GeV, 1e6/spill, spill = 10 s, HTA										d)									
f)																																							

# FRS000 experiments 2009

**Chiara Nociforo is organizing them :**

**Aim : used by the core team to improve/test FRS/super FRS EDAQ and detectors, could be used (sometimes) for Nustar projects (should not be the normal place for commissioning Nustar detectors)**

**Running mode :**

**Only parasitic beam time (sharing either block or continuous)**

**Few days every time (means few hours beam on target) → hard to do difficult FRS settings**

**Most of the time before/after other FRS beam time (after good → use settings)**

**→A lot of effort every time (organization/preparation) for few hours of beam on target**

**→Requires proper coordination (lot of tests in parallel)**

**→Presently discussion : try only full beam time, only one test at the time??**

# FRS000 experiments 2009

## March 2009

1. TPC in vacuum
2. Isomer TAGger
3. TUM-Music high rate test
4. Twin music test (for S304-land)
5. Multi hit TDC instead of TACs
6. RPC test for R3B

## October 2009

1. Multi event DAQ
2. (Ge test for DESPEC)
3. Time test for LYCCA plastic
4. Diamond “pre-test” for PRESPEC
5. Prepare S392

After RISING beam time and before s392, could use RISING settings. 3 days for point 2 non part of FRS000, point 3 tested in // of point 2

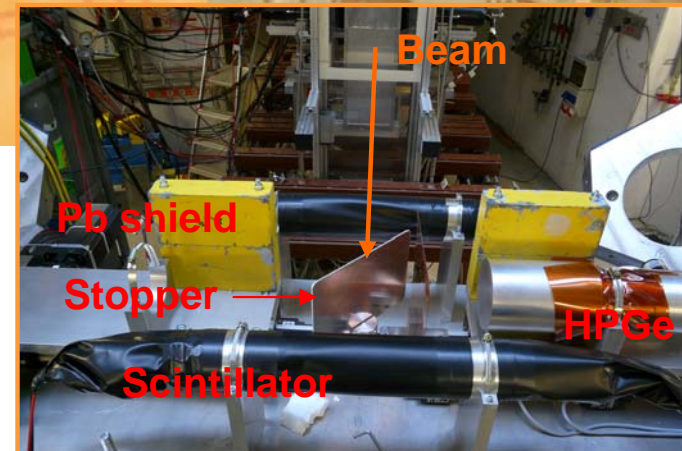
## August 2009

1. TPC calibration for S272
2. Diamond test for S1
3. Fission@ELISE tof test (people from BIII/Bruyere le Chatel)

Just before S272, beam only at S2

TPC in vacuum with TUM high rate test → TPC efficiency ~80% at  $10^5$

# ITAG @ FRS



**Isomeric TAGging system @ FRS** consists of:

- 2 movable HPGe detectors mechanically cooled;
- 2 scintillators for particles counting and veto;
- exchangeable passive stopper.

The whole system is foreseen to lift up from the beam line.

## First test – March '09:

Beam:  $^{96}\text{Ru}^{42+}$  at 500 MeV/u  
 $5 \times 10^4$  /spill

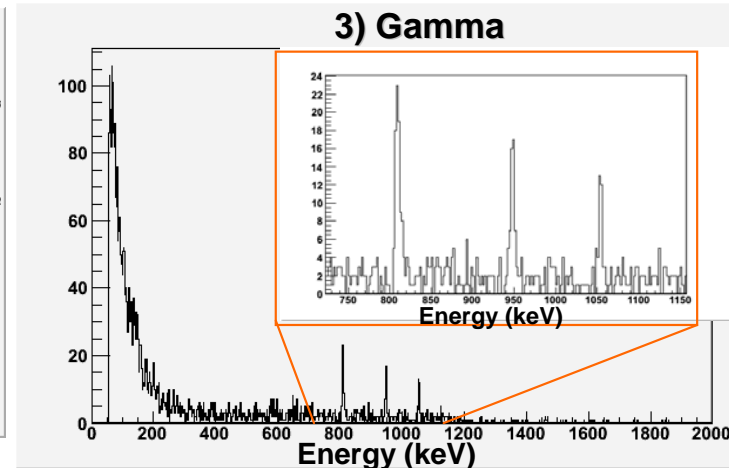
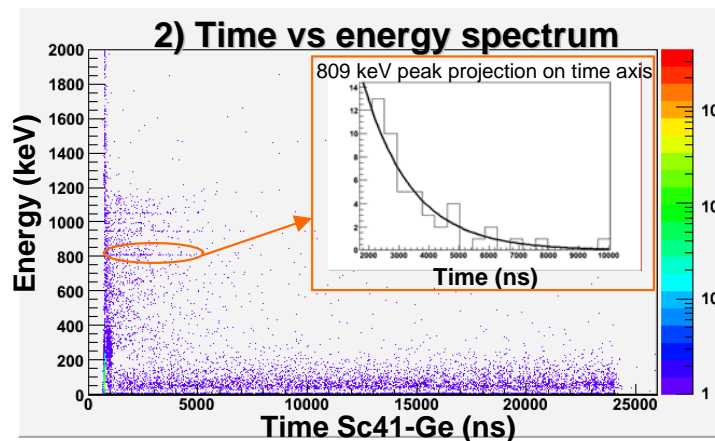
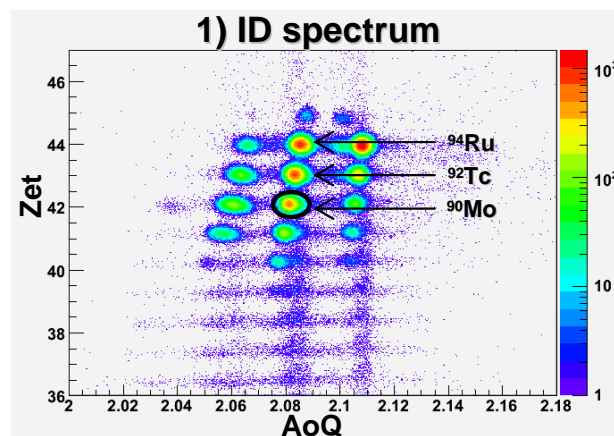
Results (~ 68 min data):

Gamma lines:  $^{94}\text{Ru}$ ,  $^{92}\text{Tc}$ ,  $^{90}\text{Mo}$

## $^{90}\text{Mo}$ analysis:

- 1) Select the expected isomer;
- 2) Include some conditions to clean the gamma spectrum;
- 3) Look for  $\gamma$ -lines and eventually for the half-life of the isomeric state.

	Literature	ITAG
$T_{1/2}$ ( $\mu\text{s}$ )	1.12	$1.13 \pm 0.16$
$\gamma$ (keV)	809.57	$809.9 \pm 4.0$
$\gamma$ (keV)	947.97	$947.8 \pm 3.9$
$\gamma$ (keV)	1054.10	$1053.9 \pm 3.9$



→ Development, test and pictures from Fabio Farinon

→ Mechanical cooled Germaniums from Ivan Koujouharov

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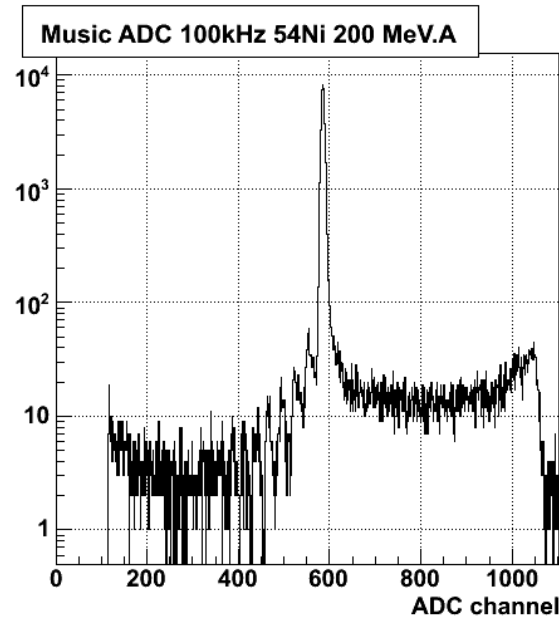
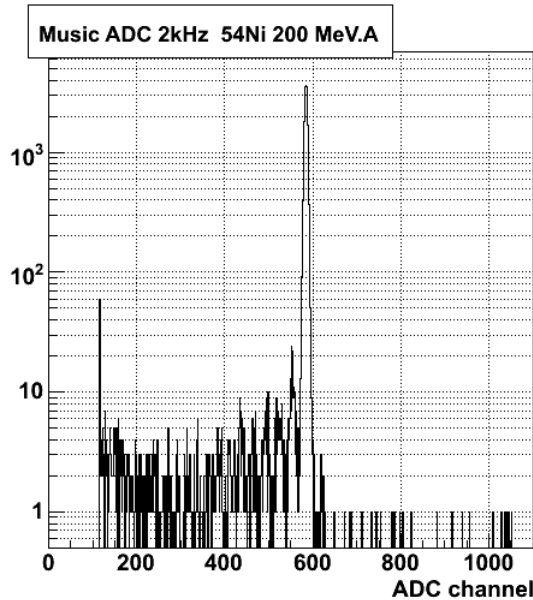
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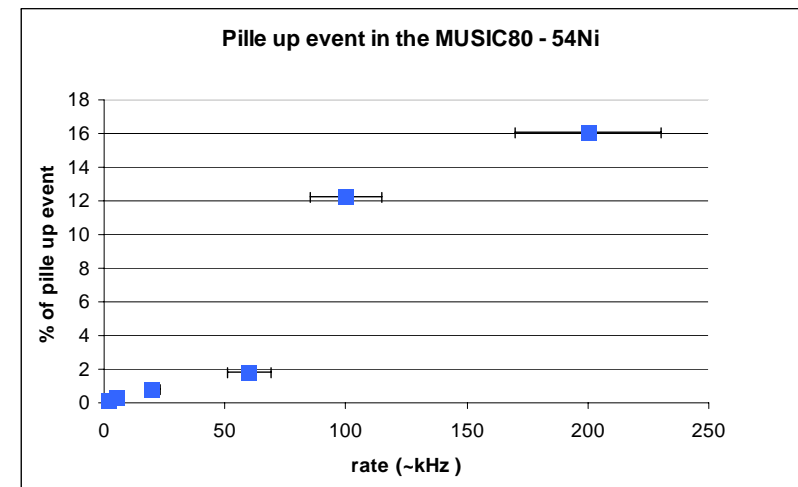
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# Music faster read-out/pille up problem



**At high rate : pile up in the music shaper output gives wrong Z identification**



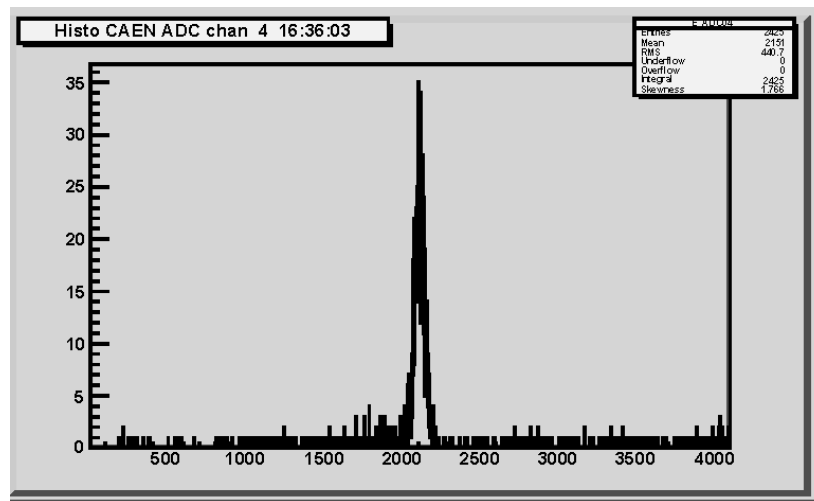
**For comparison : TEGIC chambers at RIKEN 40% pileup at 200 kHz**

- Solutions :**
- 1. Identify the pileup events in the front end.**
  - 2. Disentangle piled up events to get their energy (not for 2010?)**

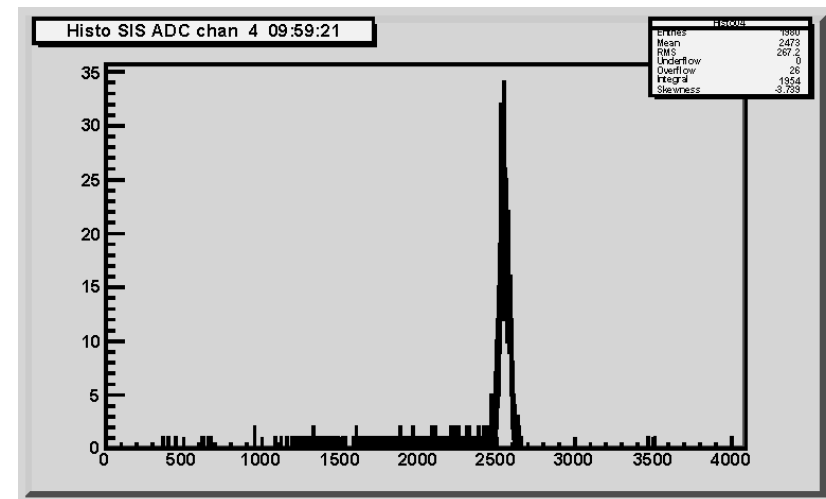
# Music faster read-out / pile up problem

March 2009 : comparison SIS3302 module with normal firmware and the normal CAEN peak-sensing ADC

100 kHz 96Ru beam



CAEN ADC



SIS3302 processing with pile-up flag rejection in the analysis

→ Development, test and pictures from Henning Schaffner



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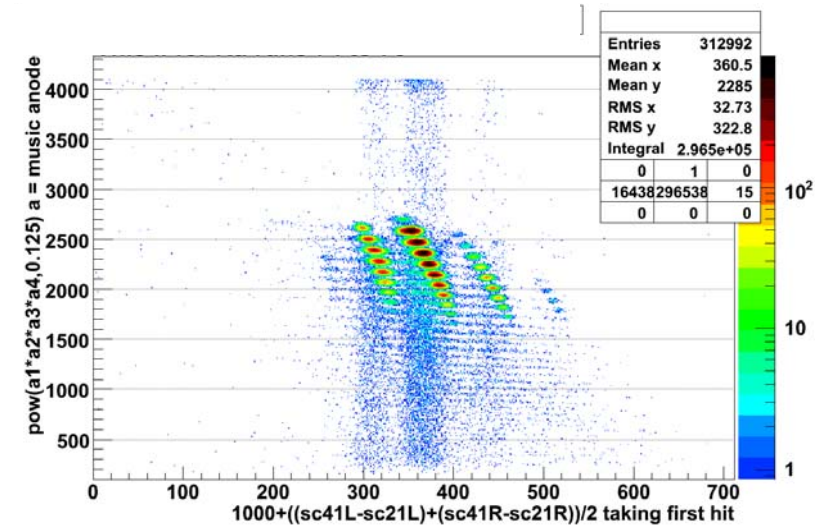
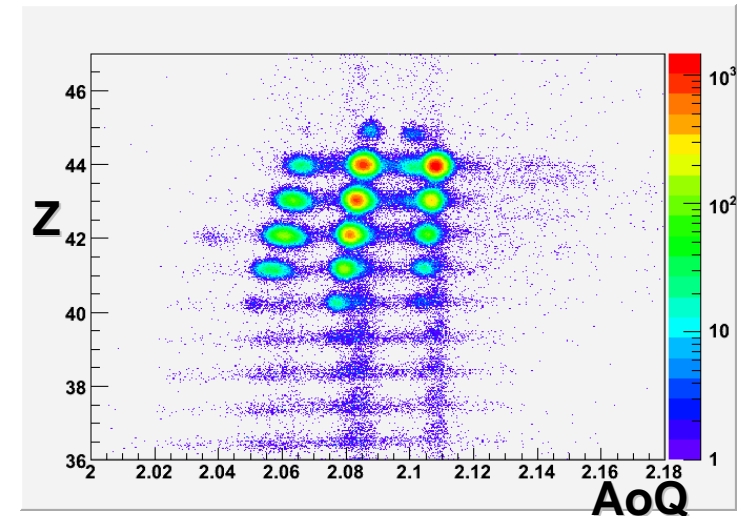
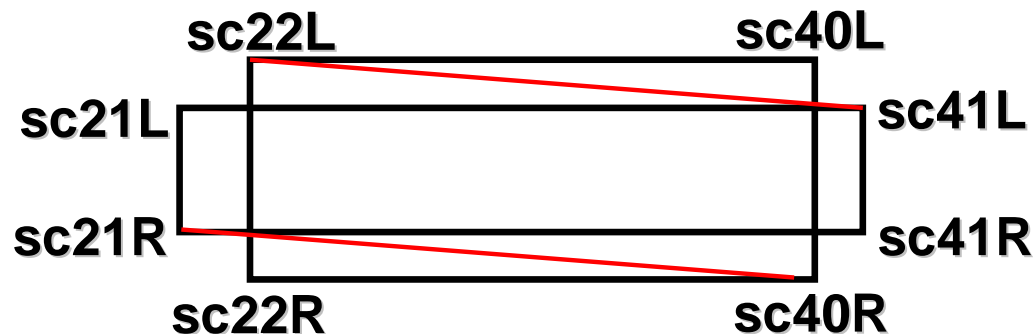
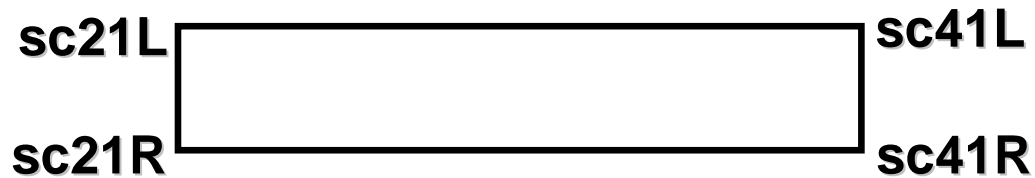
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# Caen v1290 multi hit TDC instead of TAC?

## V1290 CAEN TDC :

- 21 bit, 25ps step (up to 51 us range)
- 32 channels multi-hit

For ToF and position of plastic we use TACs:



**This is a different setting, tof vs  $\Delta E$**

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# Multi event DAQ

**Normal cycle for 32 events :**

**(conversion of the digitiser + read out ) x 32**

**Use the multi event buffer of CAEN digitisers (ADC, TDC, QDC)**

**(conversion x 32 ) + 1 big readout**

**Optimal → readout outside of spill, 32 events too small memory**

**October 2009 : a crate allowing full FRS ID (tac signals+ADC music+TPC timing)  
running in multi-event mode (in // of the normal FRS DAQ)**

- At high rate not dead time saturated while normal DAQ was (roughly a x2 faster)**
- Scalers still not implemented**

**→ Development and test from Chiara Nociforo**