Gamma Ray Energy Tracking
In-Beam Nuclear Array

GRETINA

Detector, cable, and digitizer numbering scheme

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/gretina/tk/numbering.doc

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Mounting position on the support structure

There are 30 mounting positions (holes) for the 4π array GRETA. There are numbered 1 – 30. In the standard setup the two halves split horizontally and the tracks are perpendicular to the beam. The coordinate system of GRETINA defines z-axis as the beam direction, x-axis the direction of gravity (pointing down), and the y-axis defined by the z- and x-axis using the right-hand rule. Thus, in Cave 4C at 88-Inch Cyclotron, the z-axis points to north and y-axis points to west. The following table shows the polar coordinates of the center line of the mounting holes. Currently, the two GRETINA frames have 10 (east) and 11 (west) usable mounting positions respectively.

Mounting position	θ	ϕ	hemisphere	note
1	31.72	36		Cut out
2		108		Cut out
3		180		Cut out
4		251		Cut out
5		323		Cut out
6	58.28	72	W	
7		144	W	
8		216	E	
9		288	E	
10		360		Cut out
11	90.00	18	W	
12		54	W	
13		90		axial
14		126	W	
15		162	W	
16		198	E	
17		234	E	
18		270		axial
19		306	E	
20		342	E	
21	121.72	36	W	
22		108	W	
23		180		interfere
24		252	E	
25		324	E	
26	148.28	72	W	
27		144	W	
28		216	E	
29		288	E	

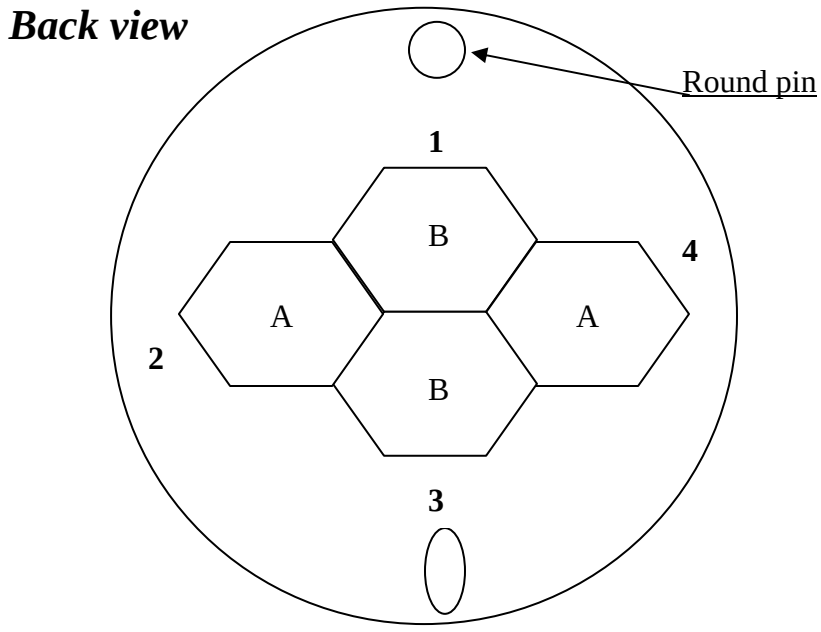
30		360	W	

Alignment of detector module with the mounting hole

The detector module has a 180° rotational symmetry. However this symmetry is broken with two different shaped alignment holes on the flange, for a round pin and a diamond pin respectively. The same arrangement is used on the wedge plate. Thus, there is only one way to mount the detector module on the support structure. The clock angle of the alignment pin on the frame is the same for mounting holes at the same angle with respective to the beam. This is to ensure the interchangeability of the detector and maintain the same crystal numbering sequence for detector at the same angle with respective to the beam (see next section).

Detectors in detector module

There are 4 detectors (crystals) in each detector module. There are numbered 1-4 by the manufacture (0 – 3 in the data header). Crystal position 1 is the B-type crystal next to the round hole for the alignment pin on the flange. Viewing from the back of the detector, position 2 is the A-type crystal counter-clock wise from crystal number 1, etc.

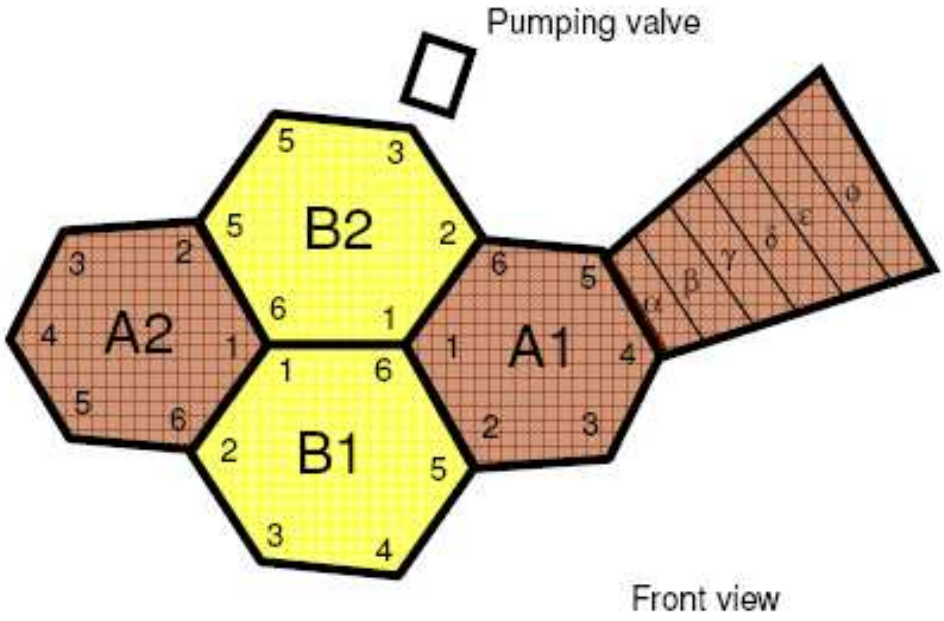


The angles of the 4 detectors in each module are listed in the following table.

Module			Detector 1		Detector 2		Detector 3		Detector 4	
N	θ	ϕ	θ	ϕ	θ	ϕ	θ	ϕ	θ	ϕ
1	31.72	36	35.3	19.58	47.6	42.3	30.6	54.72	16.65	19.58
2	31.72	108	35.3	91.58	47.6	114.3	30.6	126.72	16.65	91.58
3	31.72	180	35.3	163.58	47.6	186.3	30.6	198.72	16.65	163.58
4	31.72	252	35.3	235.58	47.6	258.3	30.6	270.72	16.65	235.58
5	31.72	324	35.3	307.58	47.6	330.3	30.6	342.72	16.65	307.58
6	58.28	72	67.71	74.63	55.02	91.23	48.92	68.77	64.18	54.55
7	58.28	144	67.71	146.63	55.02	163.23	48.92	140.77	64.18	126.55
8	58.28	216	67.71	218.63	55.02	235.23	48.92	212.77	64.18	198.55
9	58.28	288	67.71	290.63	55.02	307.23	48.92	284.77	64.18	270.55
10	58.28	0	67.71	2.63	55.02	19.23	48.92	356.77	64.18	342.55
11	90	18	87.15	8.71	105.79	13.65	92.85	27.29	74.21	22.35
12	90	54	97.01	47.25	100.78	66.39	82.99	60.75	79.22	41.61
13	90	90	87.15	80.71	105.79	85.65	92.85	99.29	74.21	94.35
14	90	126	97.01	119.25	100.78	138.39	82.99	132.75	79.22	113.61
15	90	162	87.15	152.71	105.79	157.65	92.85	171.29	74.21	166.35
16	90	198	97.01	191.25	100.78	210.39	82.99	204.75	79.22	185.61
17	90	234	87.15	224.71	105.79	229.65	92.85	243.29	74.21	238.35
18	90	270	97.01	263.25	100.78	282.39	82.99	276.75	79.22	257.61
19	90	306	87.15	296.71	105.79	301.65	92.85	315.29	74.21	310.35
20	90	342	97.01	335.25	100.78	354.39	82.99	348.75	79.22	329.61
21	121.72	36	112.29	33.37	124.98	16.77	131.08	39.23	115.82	53.45
22	121.72	108	112.29	105.37	124.98	88.77	131.08	111.23	115.82	125.45
23	121.72	180	112.29	177.37	124.98	160.77	131.08	183.23	115.82	197.45
24	121.72	252	112.29	249.37	124.98	232.77	131.08	255.23	115.82	269.45
25	121.72	324	112.29	321.37	124.98	304.77	131.08	327.23	115.82	341.45
26	148.28	72	144.7	88.42	132.4	65.7	149.4	53.28	163.35	88.42
27	148.28	144	144.7	160.42	132.4	137.7	149.4	125.28	163.35	160.42
28	148.28	216	144.7	232.42	132.4	209.7	149.4	197.28	163.35	232.42
29	148.28	288	144.7	304.42	132.4	281.7	149.4	269.28	163.35	304.42
30	148.28	0	144.7	16.42	132.4	353.7	149.4	341.28	163.35	16.42

Segment Number of Crystal

As shown in the following drawing, The segments are labeled in angular coordinates by numbers 1 – 6 and in depth by Greek alphabets (α, β, γ, δ, ε, ϕ). The angular label 1 starts at the segment closest to the center of the module and continue counter-clockwise as viewed from the front of the detector. As of 7/14/08 Q1 has a different numbering scheme for crystal B.

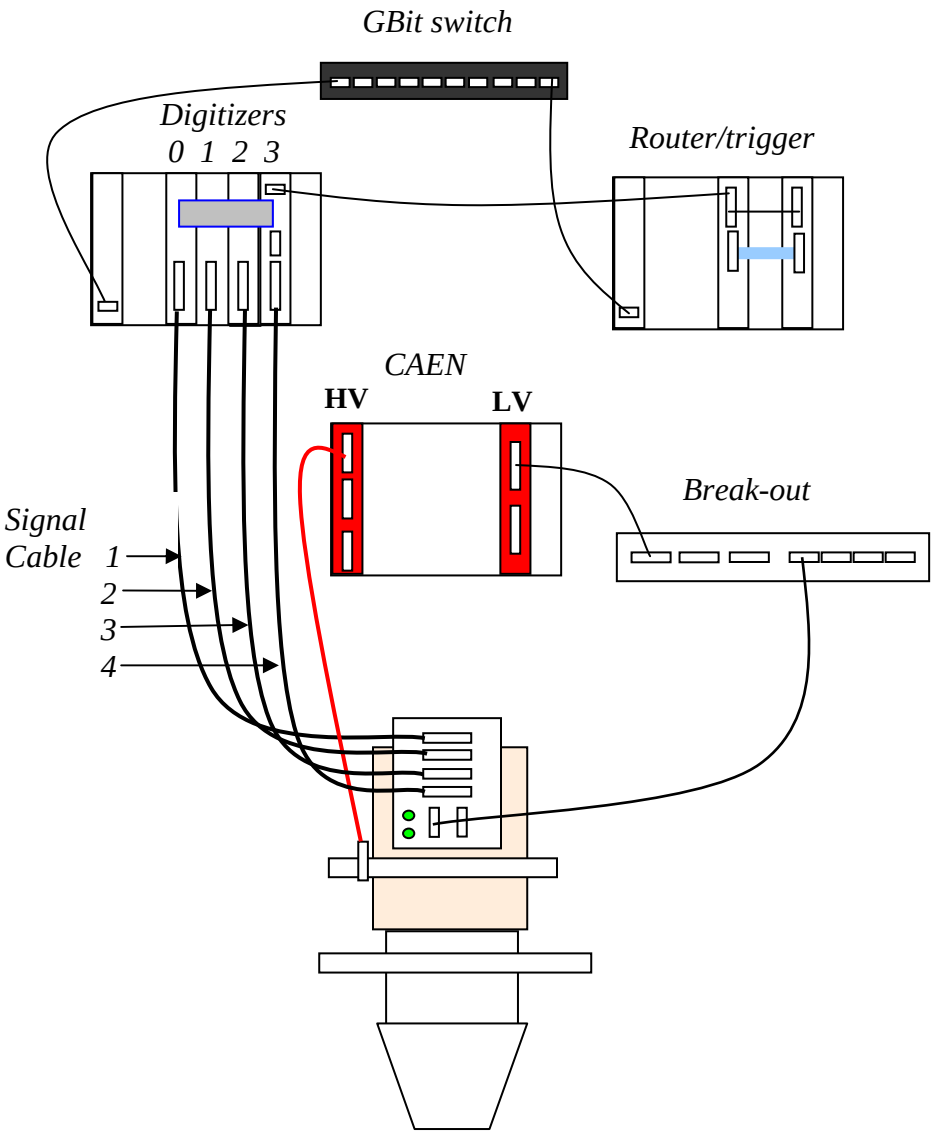


Cable and Digitizer

From each crystal, there are 4 cables feeding 4 digitizers. The numbering scheme is the following.

Cable #	*1*	*2*	*3*	*4*
Digitizer ID	**0**	**1**	**2**	**3**
Digitizer Ch #	**Segment Number**			
0	α1	β4	δ1	ε4
1	α2	β5	δ2	ε5
2	α3	β6	δ3	ε6
3	α4	γ1	δ4	ϕ1
4	α5	γ2	δ5	ϕ2
5	α6	γ3	δ6	ϕ3
6	β1	γ4	ε1	ϕ4
7	β2	γ5	ε2	ϕ5
8	β3	γ6	ε3	ϕ6
9	-	-	c.c.	c.c (30MeV)

The cable connection is shown in the following:



ID in event header

The 13 least significant bits of the first word of the data header (user defined) are used to uniquely define the electronics channel (segment) of GRETA. The following table gives the bit assignments, with bit 0 the least significant bit.

Bit number	Number of bit	Definition	Range of value
0 - 3	4	Digitizer channel ID	0 - 9
4 - 5	2	Digitizer number	0 - 3
6 - 7	2	Crystal number	0 - 3
8- 12	5	Detector position	1 - 30

Data base entry

The data base has the following entries to determine the current location of each detector module, the HV value of each crystal, and the VME/IOC number of the digitizer bank connected to the crystal. This table needs to be updated whenever the detector position and/or the cable to the digitizer are changed.

Detector number	Crystal number	HV value	Detector position (1-30)	VME/IOC number
Q1	0			
	1			
	2			
	3			
Q2	0			
	1			
	2			
	3			

The IOC(VME crate controller) during setup state (not running) will monitor for any changes of the data base and the latest entry will be used to relate the VME/IOC number to the detector position and crystal number, and place them in the data header.

The IOCs send the data to a number of computer nodes. Each node has 8 copies of the signal decomposition program, each process data from one crystal. The links between the IOCs and the nodes are defined in the EPICS data base which is monitored by the nodes during setup state and the latest entry is used by the node. In addition, the nodes use the data base to determine from IOC number the detector+crystal number and load the corresponding signal basis.

The tracking program uses the detector position and the crystal number in the data stream to determine the global crystal position which is used to transform the position of interaction points (given by the decomposition code) from crystal coordinate to the laboratory coordinate system.

The liquid nitrogen filling system uses the detector position occupied to determine which detectors need to be filled.