

# PSD data format

**Beam Test 2023**

**PS T9 & SPS H4**

HERD - PSD group

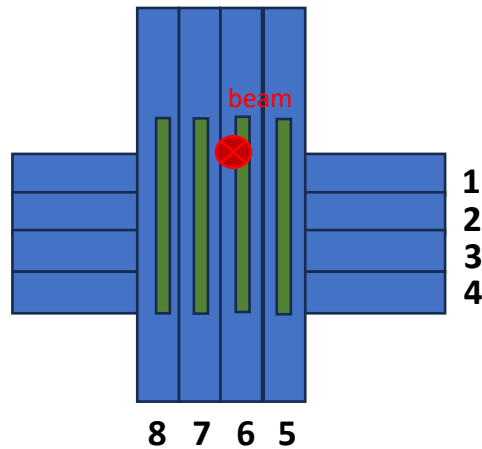
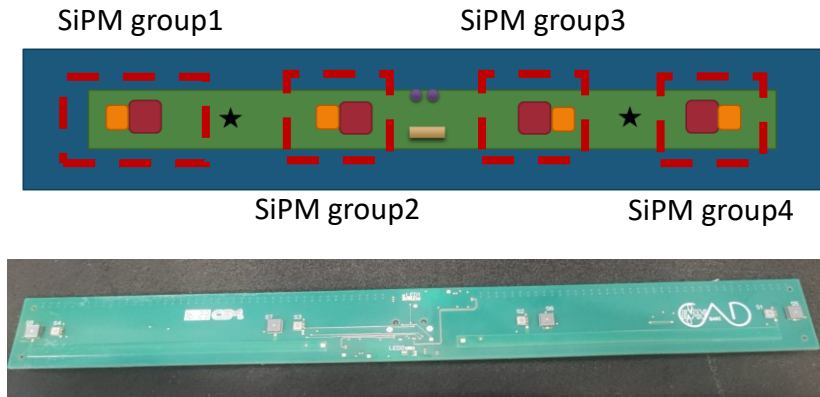


# PSD readout configurations

We are building a prototype PSD defined by 8 short trapezoidal plastic scintillating tiles 30cm long and 5/4cm wide

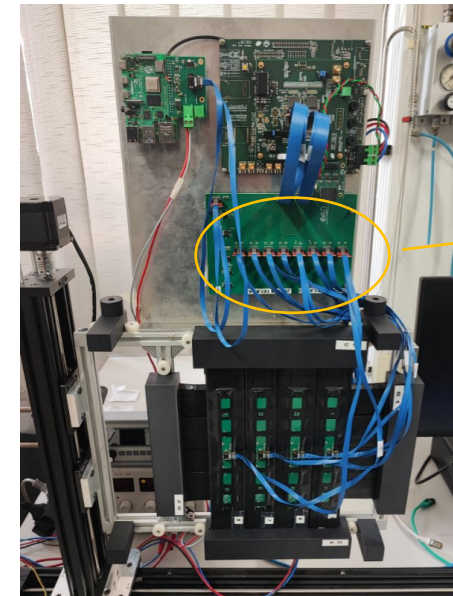
Each tile will be readout by different SiPMs in order to increase the light detection efficiency and the dynamic range for nuclei identification

- 4 SiPM (3.0x3.0mm<sup>2</sup> - 50umcell) - Low Z → ASIC 2-3
- 4 SiPM (1.3x1.3 mm<sup>2</sup> - 15um cell) - High Z → ASIC 0-1
- 2 LED for calibration
- ★ 2 Temperature sensors
- High density coaxial cable connector for space application



Tiles 1-4 → Horizontal  
 Tiles 5-8 → Vertical

PS → Tile 1 (H) / Tile 6-7 (V)  
 SPS → Tile 1 (H) / Tile 6-7 (V)  
 [last days Tile2 (H)]



SiPMs (PCBs) are connected (readout) by beta\_chip through an interface («concentrator») connected to each tile

Connections:

- J1->Tile1
- J2->Tile2
- ...
- J8->Tile8



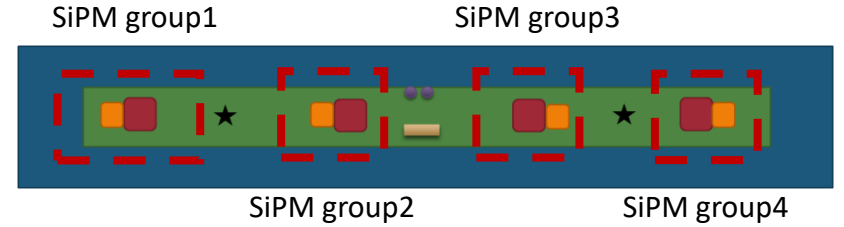
# PSD - channel mapping

## Horizontal Tiles

## Vertical Tiles

	Connector	ASIC	Channel (1-64)	SiPM group	SiPM Type
Tile1	J1	1	29	2 (Central)	LowZ
	J1	1	30	1 (Lateral)	LowZ
	J1	1	31	4 (Lateral)	LowZ
	J1	1	32	3 (Central)	LowZ
	J1	3	61	2 (Central)	HighZ
	J1	3	62	1 (Lateral)	HighZ
	J1	3	63	4 (Lateral)	HighZ
	J1	3	64	3 (Central)	HighZ
Tile2	J2	1	25	2 (Central)	LowZ
	J2	1	26	1 (Lateral)	LowZ
	J2	1	27	4 (Lateral)	LowZ
	J2	1	28	3 (Central)	LowZ
	J2	3	57	2 (Central)	HighZ
	J2	3	58	1 (Lateral)	HighZ
	J2	3	59	4 (Lateral)	HighZ
	J2	3	60	3 (Central)	HighZ
Tile3	J3	1	21	2 (Central)	LowZ
	J3	1	22	1 (Lateral)	LowZ
	J3	1	23	4 (Lateral)	LowZ
	J3	1	24	3 (Central)	LowZ
	J3	3	53	2 (Central)	HighZ
	J3	3	54	1 (Lateral)	HighZ
	J3	3	55	4 (Lateral)	HighZ
Tile4	J4	1	17	2 (Central)	LowZ
	J4	1	18	1 (Lateral)	LowZ
	J4	1	19	4 (Lateral)	LowZ
	J4	1	20	3 (Central)	LowZ
	J4	3	49	2 (Central)	HighZ
	J4	3	50	1 (Lateral)	HighZ
	J4	3	51	4 (Lateral)	HighZ
J4	3	52	3 (Central)	HighZ	

	Connector	ASIC	Channel (1-64)	SiPM Group	SiPM Type
Tile5	J5	0	1	2 (Central)	LowZ
	J5	0	2	1 (Lateral)	LowZ
	J5	0	3	4 (Lateral)	LowZ
	J5	0	4	3 (Central)	LowZ
	J5	2	33	2 (Central)	HighZ
	J5	2	34	1 (Lateral)	HighZ
	J5	2	35	4 (Lateral)	HighZ
	J5	2	36	3 (Central)	HighZ
Tile6	J6	0	5	2 (Central)	LowZ
	J6	0	6	1 (Lateral)	LowZ
	J6	0	7	4 (Lateral)	LowZ
	J6	0	8	3 (Central)	LowZ
	J6	2	37	2 (Central)	HighZ
	J6	2	38	1 (Lateral)	HighZ
	J6	2	39	4 (Lateral)	HighZ
	J6	2	40	3 (Central)	HighZ
Tile7	J7	0	9	2 (Central)	LowZ
	J7	0	10	1 (Lateral)	LowZ
	J7	0	11	4 (Lateral)	LowZ
	J7	0	12	3 (Central)	LowZ
	J7	2	41	2 (Central)	HighZ
	J7	2	42	1 (Lateral)	HighZ
	J7	2	43	4 (Lateral)	HighZ
	J7	2	44	3 (Central)	HighZ
Tile8	J8	0	13	2 (Central)	LowZ
	J8	0	14	1 (Lateral)	LowZ
	J8	0	15	4 (Lateral)	LowZ
	J8	0	16	3 (Central)	LowZ
	J8	2	45	2 (Central)	HighZ
	J8	2	46	1 (Lateral)	HighZ
	J8	2	47	4 (Lateral)	HighZ
	J8	2	48	3 (Central)	HighZ



### Pattern and logics:

- ASIC 1 SiPMs LowZ Horizontal Tiles
- ASIC 3 SiPMs HighZ Horizontal Tiles
- ASIC 0 SiPMs LowZ Vertical Tiles
- ASIC 2 SiPMs HighZ Vertical Tiles

SiPMs channels  
Groups: 2-1-4-3

### Dynamics

2 main gains → low gain (LG) and high gain (HG)  
Total ADC dynamic: 2048 ADC channels (11 bits)

- high gain (HG): 0-2048 ADC channels
- Low gain (LG): 2049-4096 ADC channels



# Root output file format & content

Def decodeTriggerID(num):

```
D=int('0b'+str(bin(num)[2:6]),base=2)
TT=int('0b'+str(bin(num)[6:14]),base=2)
Tid=int('0b'+str(bin(num)[14:]),base=2)
```

\* See i2C documentation

**DetectorID** → 9 for the PSD / 11 for Trigger Tile  
**TriggerType** → 1 Beam/ 0 Calib ... \*  
**TriggerID** → ID of the trigger (0 for calib events)

Progressive number

RootFileName:

RAW\_<RunID>\_<RunType>\_<Data&TimeTrigger>\_DAQ\_<Data&TimeStartDAQ>.root  
e.g. RAW\_BETA\_00547\_MIXED\_20231010\_005945\_DAQ\_20231010\_010104.root

**Tchan** → Number of total channel saved (16 channels x 4(2) ASICs = 64 (32))

**ADCch** → ADC counts for each channel

**Data is buffered in static block of 32/64 channels for each event. It means that:**

ADCch[0] = ADC counts of channel 0 ASIC0

....

ADCch[15] = ADC counts of channel 15 ASIC0

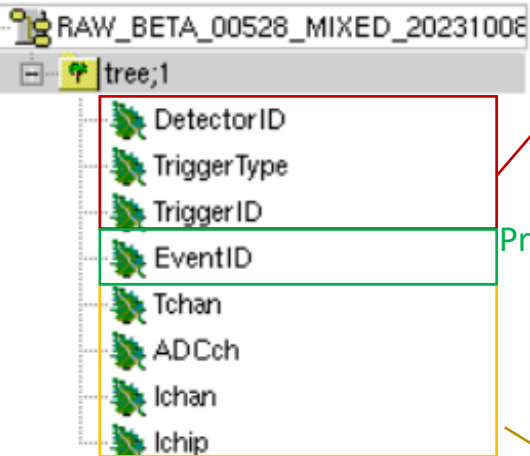
ADCch[16] = ADC counts of channel 0 ASIC1

.....

ADCch[31] = ADC counts of channel 15 ASIC1

**Ichan** → Channel number per chip (0-15)

**Ichip** → ASIC id (0-4)



```
root [1] tree->Show(0,1000)
===== EVENT:0
DetectorID = 9
TriggerType = 8
TriggerID = 0
EventID = 0
Tchan = 64
ADCch = 2793,
2793, 2772, 2778, 2790, 2784, 2879, 2801, 2760, 2848, 2771,
2778, 2824, 2755, 2847, 2805, 2621, 2638, 2665, 2625, 2639,
2680, 2615, 2636, 2611, 2629, 2665, 2644, 2665, 2619, 2581,
2624, 2621, 2638, 2665, 2625, 2639, 2680, 2615, 2636, 2611,
2629, 2665, 2644, 2665, 2619, 2581, 2624, 2621, 2638, 2665,
2625, 2639, 2680, 2615, 2636, 2611, 2629, 2665, 2644, 2665,
2619, 2581, 2624
Ichan = 0,
1, 2, 3, 4, 5, 6, 7, 8, 9, 10,
11, 12, 13, 14, 15, 0, 1, 2, 3, 4,
5, 6, 7, 8, 9, 10, 11, 12, 13, 14,
15, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50,
51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
61, 62, 63
Ichip = 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50,
51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
61, 62, 63
```



# Analysis examples

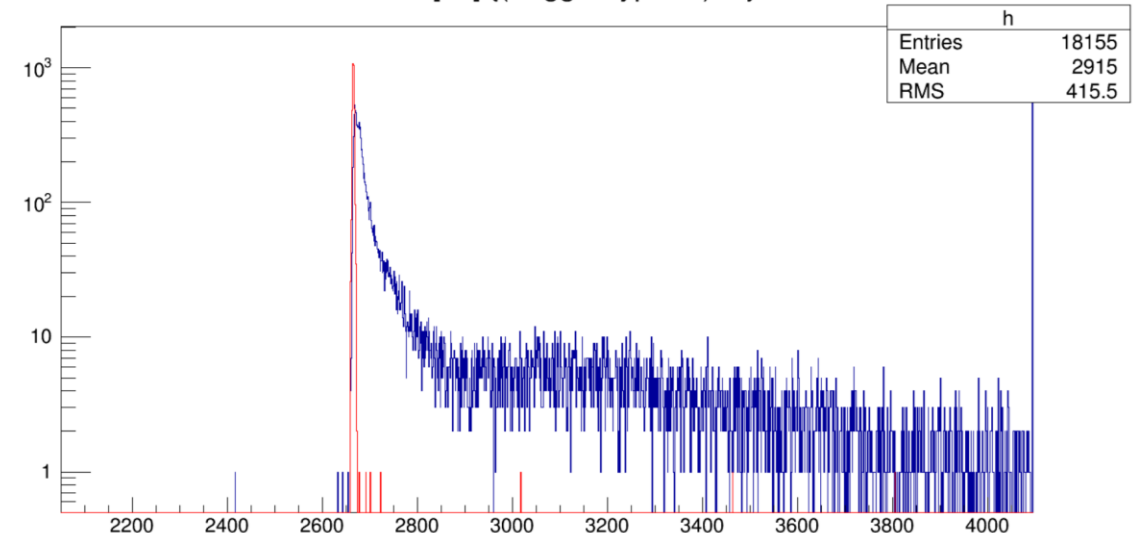
- SPS\_H4 Main readout tile «ICCUB» Tile 2-3
  - Channels 24-27 & 20-23
  - GAIN LG: ADCch from 2049-4096

• **For specific analysis ask us for details (logbook)** Condition to have signal/pede (on spill/off spill)

```
>> tree->Draw("ADCch[27]>>hPede(2048,2049,4096)", "(TriggerType&1)==0")
```

```
>> tree->Draw("ADCch[27]>>hSignal(2048,2049,4096)", "(TriggerType&1)>0")
```

ADCch[28] {(TriggerType&1)>0}



Examples:

To see the ADC counts for channel 12 ASIC 1

```
>>tree->Draw("ADCch", "Ichip==1&&Ichan==12")
```

equivalently:

```
>>tree->Draw("ADCch[28]", "")
```

This should be useful to compare 2 channel of 2 ASICs(scatterplots) :

```
>>tree->Draw("ADCch[8]:ADCch[28]", "", "colz")
```



# «Trigger» Tile

- Trigger Tile

- Small SiPM → PCB with 3 1x1 Hamamatsu SiPM
- Large SiPM → PCB with 3 3x3 Hamamatsu SiPM

Connected at physical channels:

- Small SiPMs → 25 (24 from root file since start to 0)
- Large SiPMs → 8 (7 from root file since start to 0)

SiPM Model	S14160-3015	S14160-1315
Size	3x3 mm <sup>2</sup>	1.3x1.3 mm <sup>2</sup>
Pixel pitch	15 μm	15 μm
Number of pixels	39984	7284
Refractive index	1.57	1.57
Peak sensitivity wavelength	460 nm	460 nm
PDE	32%	32%
Vbr	38 V	38 V

