SoLID JPsi_LH2
Hit and Occupancy

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Introduction

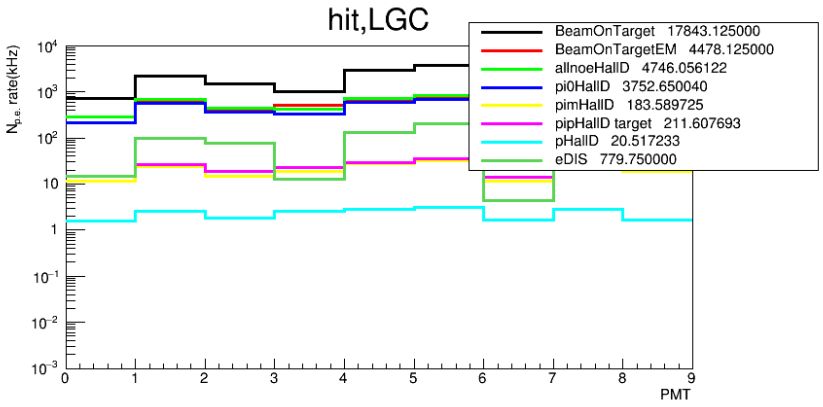
- “Hit”, look at detector response from different source particles to get hit rate
- “Occupancy”, assume certain threshold cut on hit information to get event rate
- We look at each detector channels (no GEM or MRPC yet)
- We assume each particle entering a detector is independent, so no time window for integration yet
- Simulation data of “JPsi_LH2_JLAB_VERSION_1.3/pass5” is used

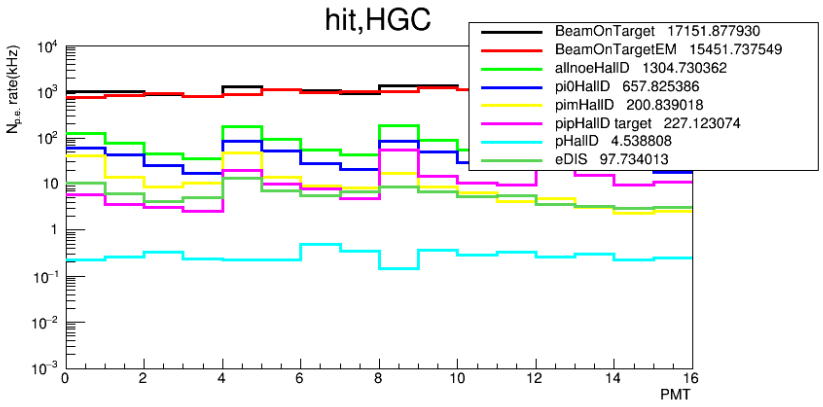
All source

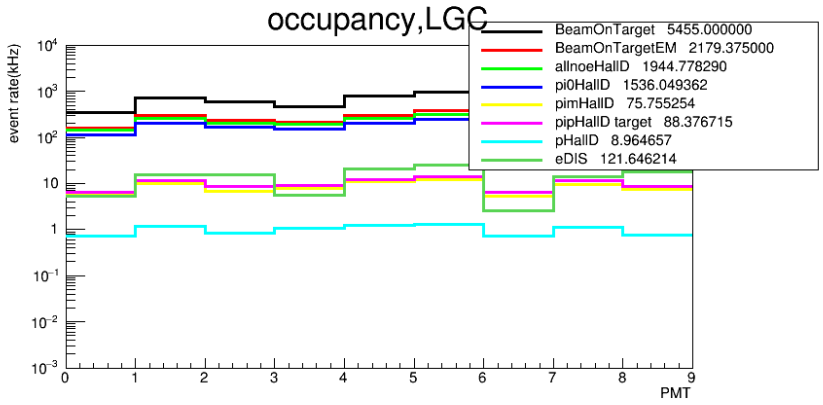
- all source from target and windows
  - BeamOnTarget, BeamOnTargetEM by Geant4
  - eDIS, pions and proton by HallD
- Occupancy threshold cut (low)
  - LGC > 0 N of p.e.
  - HGC > 0 N of p.e.
  - SPD_FA > 0.1MeV (1/5 of trigger cut 0.5MeV)
  - SPD_LA > 0.3MeV (1/5 of trigger cut 1.5MeV)
  - EC preshower > 0.4MeV
  - EC shower > 6MeV
- Occupancy threshold cut (high)
  - LGC > 1 N of p.e.
  - HGC > 1 N of p.e.
  - SPD_FA > 0.25MeV (1/2 of trigger cut 0.5MeV)
  - SPD_LA > 0.75MeV (1/2 of trigger cut 1.5MeV)
  - EC preshower > 0.8MeV
  - EC shower > 12MeV

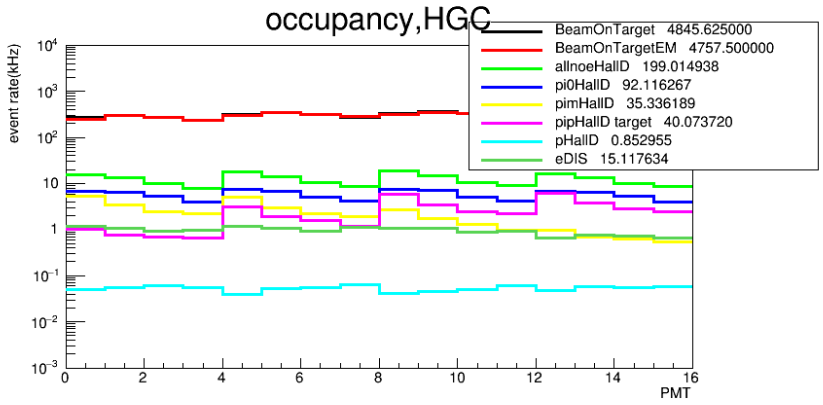
LGC and HGC

Occupancy cut (low), LGC > 0 N of p.e. HGC > 0 N of p.e.



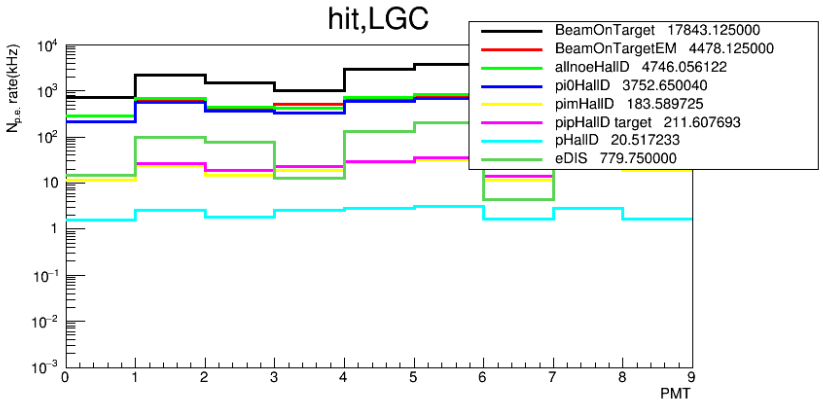


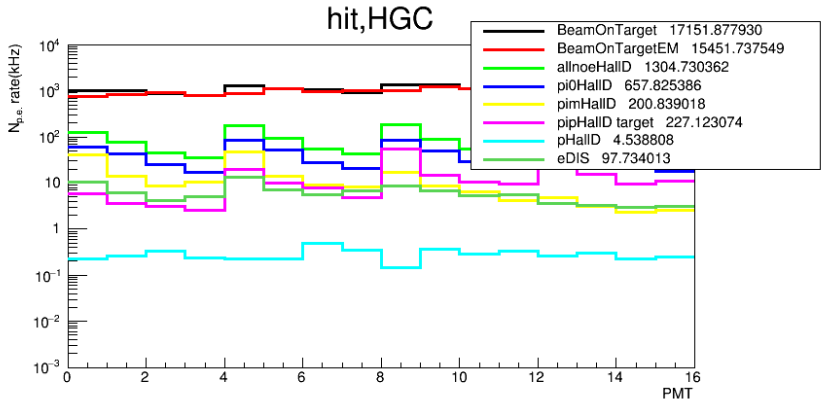


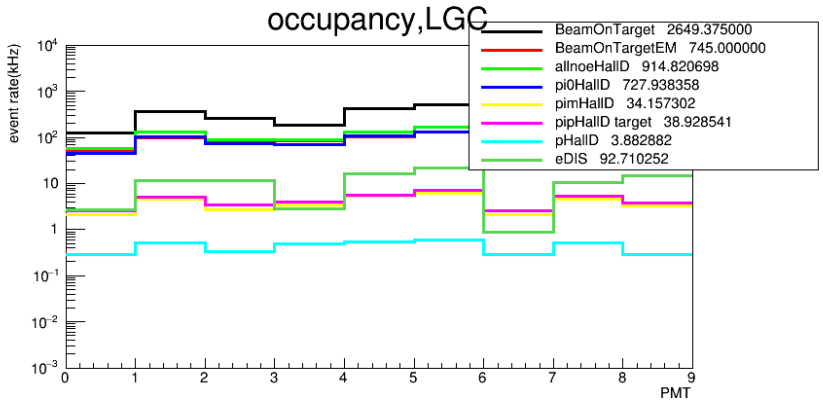


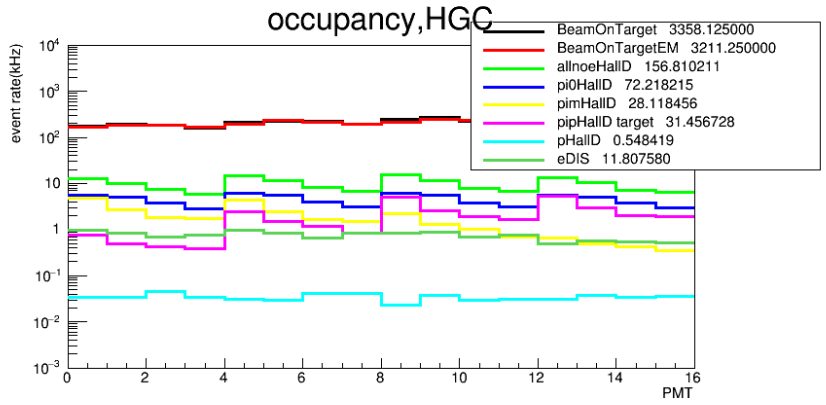
LGC and HGC

Occupancy cut (high), LGC > 1 N of p.e. HGC > 1 N of p.e.



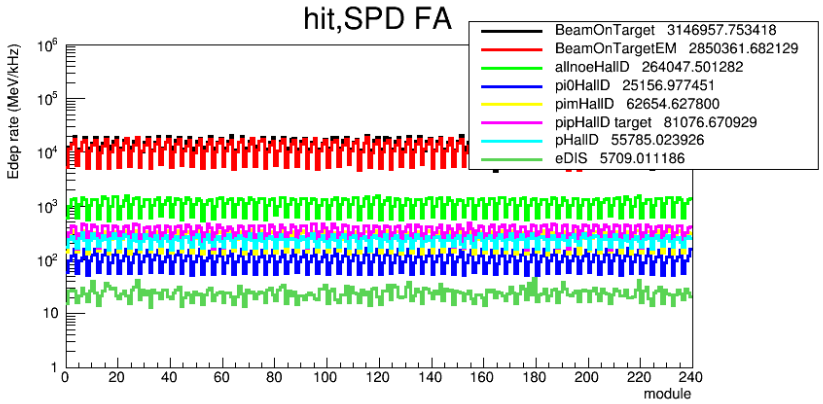


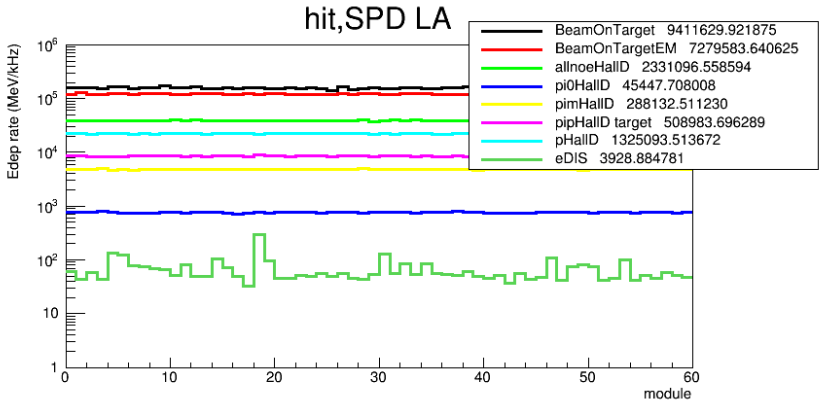


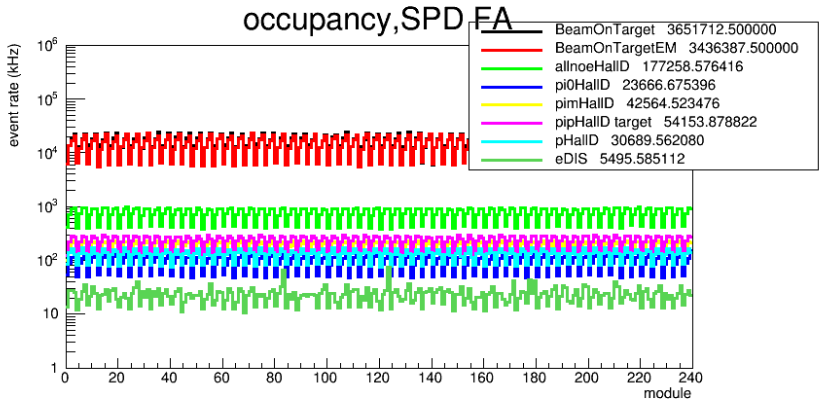


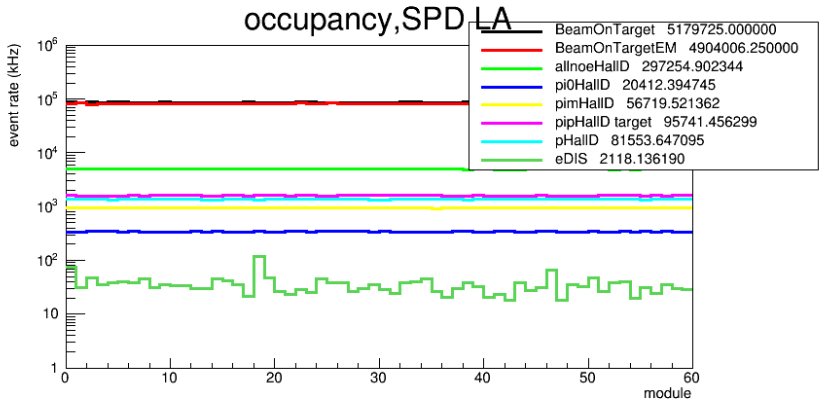
SPD

Occupancy cut (low), FA > 0.1 MeV, LA > 0.3 MeV



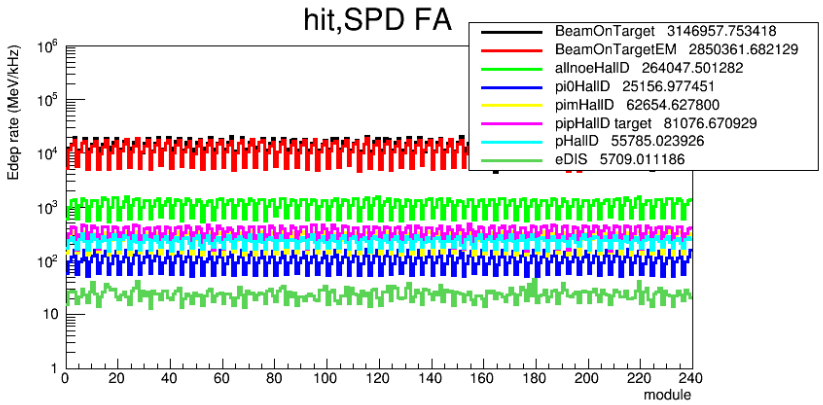


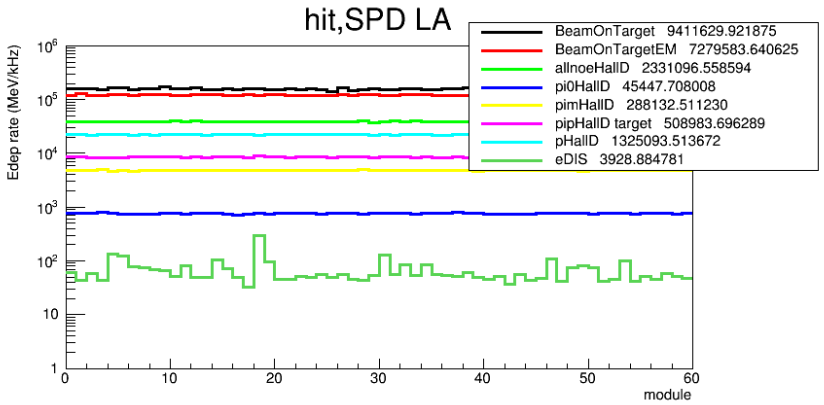


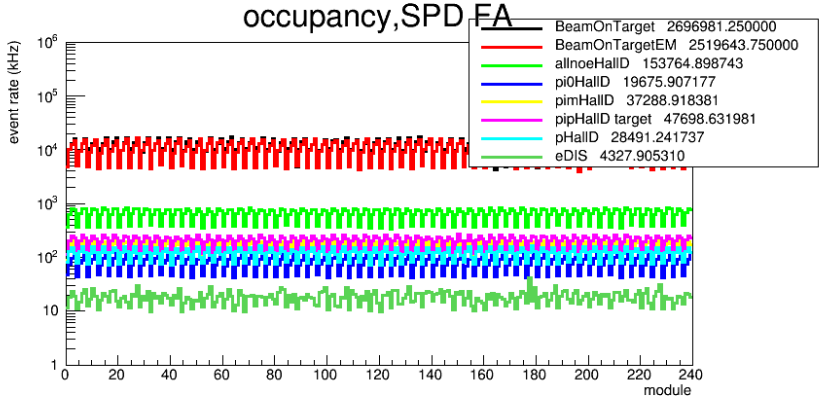


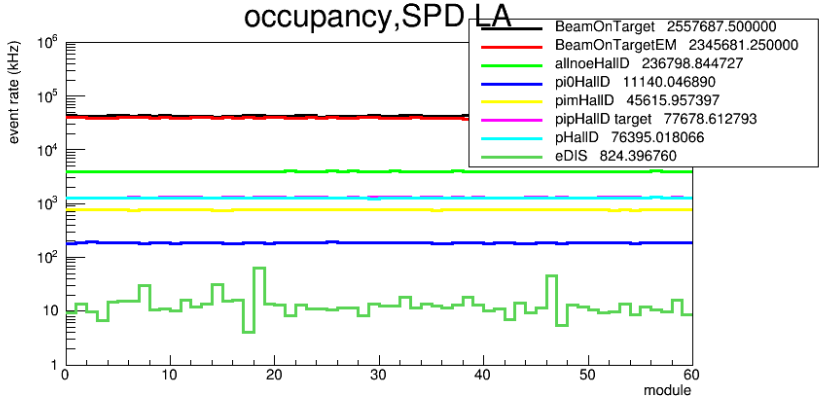
SPD

Occupancy cut (high), FA > 0.25 MeV, LA > 0.75 MeV



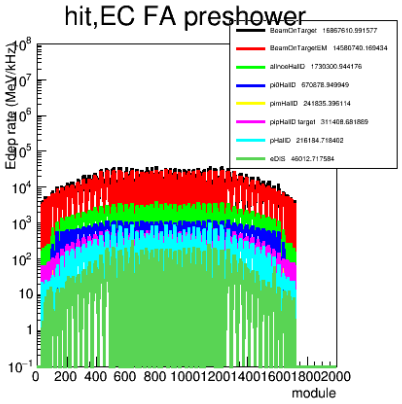


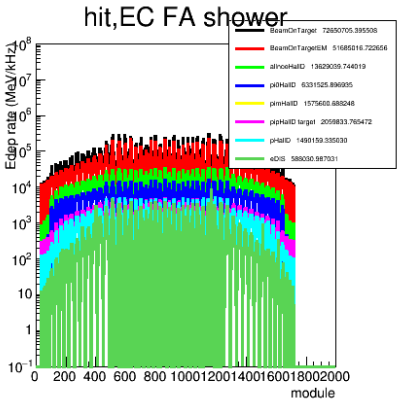


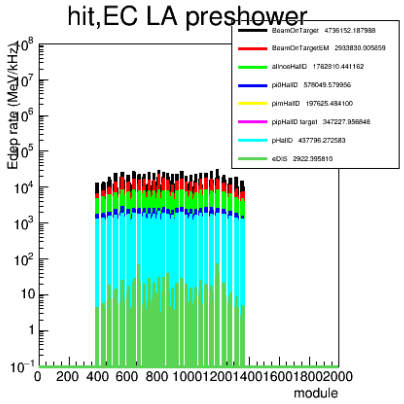


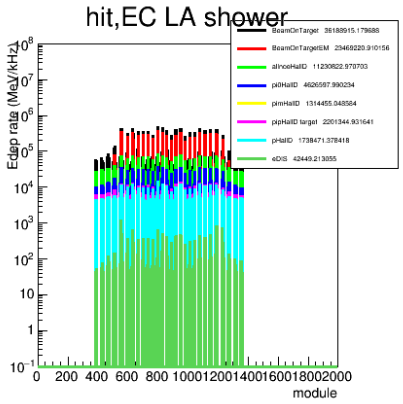
EC

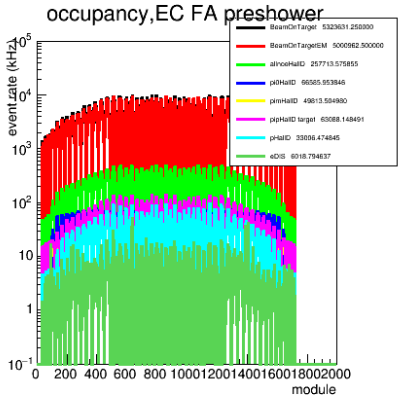
Occupancy cut (low), preshower > 0.4 MeV, shower > 6 MeV

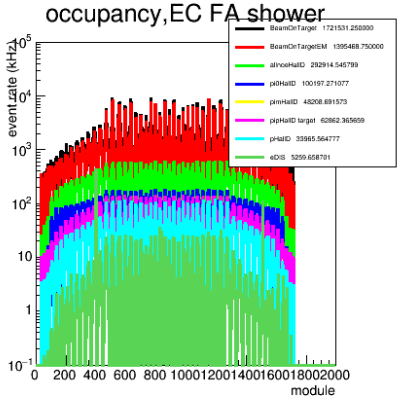


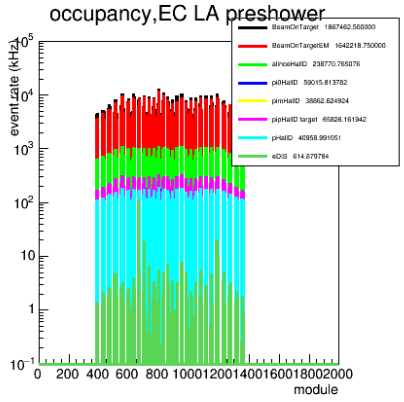


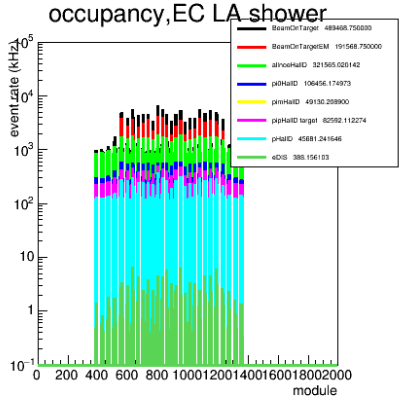






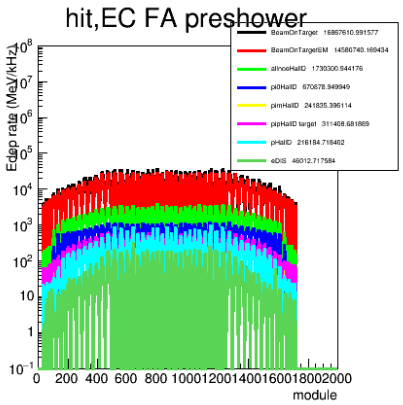


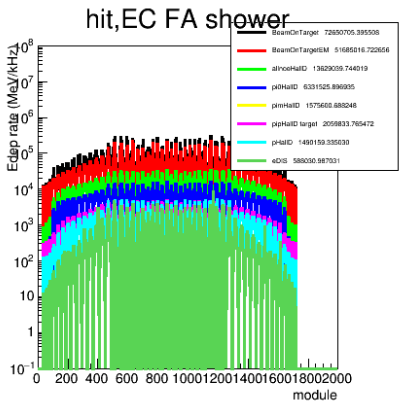


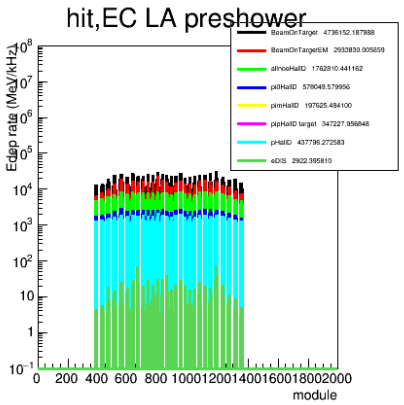


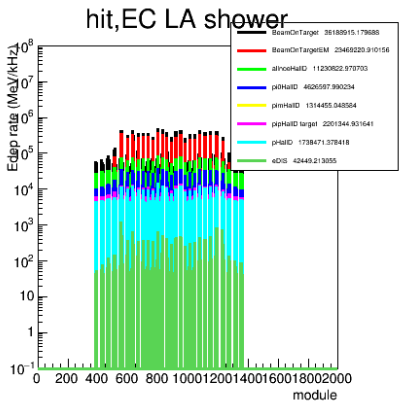
EC

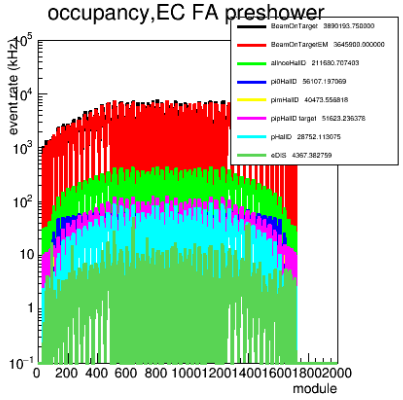
Occupancy cut (high), preshower > 0.8 MeV, shower > 12 MeV

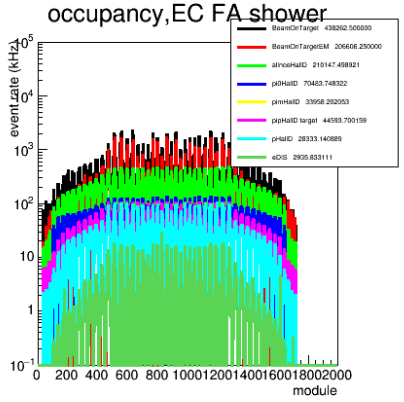


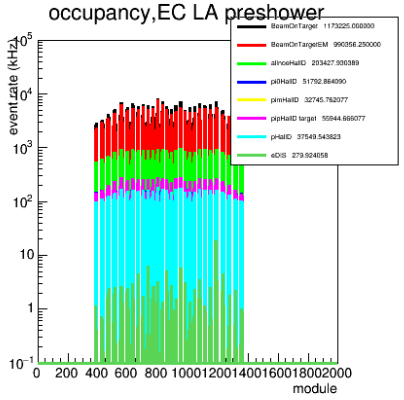


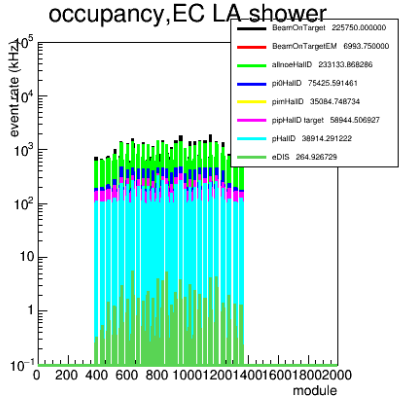












Occupancy Result: LGC and HGC

- The table shows
  - For LGC: sum of 9 channels
  - For HGC: sum of 16 channels

Occ(kHz)	BeamOn Target	BeamOn TargetEM	Pi0 Halld	allnoe HallD	eDIS Halld
LGC (>0)	5455	2179	1536	1945	122
LGC (>1)	2649	745	728	915	93
HGC (>0)	4845	4757	92	199	15
HGC (>1)	3358	3211	72	157	12

For LGC, EM and hadron contribute half and half
For HGC, EM is dominating

Occupancy Result: SPD

- The table shows
  - For SPD_FA: sum of 240 channels
  - For SPD_LA: sum of 60 channels

Occ(kHz)	BeamOnTarget	BeamOnTargetEM
SPD_FA (>0.1)	3.65e6	3.44e6
SPD_FA (>0.25)	2.70e6	2.52e6
SPD_LA (>0.3)	5.18e6	4.90e6
SPD_LA (>0.75)	2.56e6	2.35e6

For SPD, EM is dominating

Occupancy Result: EC

- The table shows
  - For EC_FA: sum of ~1300 channels
  - For EC_LA: sum of ~500 channels

Occ(kHz)	BeamOnTarget	BeamOnTargetEM
EC_preshower_FA (>0.4)	5.32e6	5.00e6
EC_preshower_FA (>0.8)	3.89e6	3.65e6
EC_shower_FA (>6)	1.72e6	1.40e6
EC_shower_FA (>12)	4.38e5	2.07e5
EC_preshower_LA (>0.4)	1.87e6	1.64e6
EC_preshower_LA (>0.8)	1.17e6	0.99e6
EC_shower_LA (>6)	4.89e5	1.92e5
EC_shower_LA (>12)	2.26e5	0.07e5

For shower, EM and hadron contribute half and half
For preshower, EM is dominating

Result Summary A

- All values from “BeamOnTarget”

	Max Occ(kHz/channel) low cut	Max Occ(kHz/channel) high cut	Average Occ(kHz/channel) low cut	Average Occ(kHz/channel) high cut	Number of channel	Total Occ(kHz) low cut	Total Occ(kHz) high cut
LGC	954	503	606	294	270	16.4e4	7.95e4
HGC	372	272	303	210	480	14.5e4	10.1e4
SPD_FA	24.1e3	17.5e3	15.2e3	11.3e3	240	3.65e6	2.70e6
SPD_LA	89.4e3	44.4e3	86.3e3	42.7e3	60	5.18e6	2.56e6
EC_preshower_FA	10087	7650	4092	2992	~1300	5.32e6	3.89e6
EC_shower_FA	9337	2344	1323	337	~1300	1.72e6	4.38e5
EC_preshower_LA	12806	8119	3740	2340	~500	1.87e6	1.17e6
EC_shower_LA	6562	1894	978	452	~500	4.89e5	2.26e5
Total					4650	18.5e6	11.2e6

Result Summary B

- All values from “BeamOnTarget”

	Max Occ(kHz/channel)	Average Occ(kHz/channel) low cut	Number of channel	Total Occ(kHz)
GEM 1			906*30	
GEM 2			1020*30	
GEM 3			1166*30	
GEM 4			1404*30	
GEM 5			1040*30	
GEM 6			1280*30	
MRPC		1210	33*50*2	4e6
Total			207780	

J/ψ GEM occupancies

Plane	Total strip number (u+v) per sector	Raw Occupancy (%)	Noise filtered Occupancy (%)
1	906	7.68	4.65
2	1020	14.4	9.28
3	1166	8.82	5.49
4	1404	7.00	4.30
5	1040	5.92	3.78
6	1280	4.58	2.95

Other thoughts

- So far all hit rates and particles rate are based on detector response from individual particles.
- Some detector like SPD and EC have high rate. There are many particles entering them within their integration time windows. If we consider this, the hit rate, occupancy cut value, occupancy rate could be different