GSI Run Plan

LAT CU Heavy Ion Beam Test at GSI - Run Plan

Motivations

The CU Beam Test at GSI is part of the general beam test program of the GLAST LAT CU.
The main goal of the program is to support the LAT Instrument Calibration by providing direct measurements of the physical processes taking place in the CU detector when exposed to different beams, by comparing the obtained measurements with Monte Carlo predictions and by eventually validating the full LAT MC code used to provide instrument calibrations and background rejection strategies.

The first part of the program took place at CERN using a variety of different particle beams (e, e+, p, pions, photons) and ranging in energies from tens of MeV up to hundreds of GeV.
The second part of the program exploits the high energy heavy ion beams available at GSI to measure the response of the CU to such radiation. Heavy ions are an important component of primary cosmic rays, and the LAT plans to use them to calibrate the CAL and ACD subsystems during flight operations. Therefore the GSI test is primarily meant to verify the on-orbit calibration procedure for the CAL, which uses also the ACD and TKR subsystems for triggering and tracking.
The CU beam test at GSI is also a first test with heavy ions for the TKR subsystem.

List of measurements

Below is a partial list of topics of interest, grouped per subsystems

TKR: saturation effects from heavy ions on ToT signal, tracking performance, instrument deadtime
CAL: verification of quenching factors (measured at GSI 2003), test on-orbit calibration procedure and code
ACD: verification of CNO trigger, verify ACD dynamic range

General overview of the run

The run at GSI is scheduled between november 15 and november 20, with beam avaialble between november 18 8AM and november 19 8PM.
Installation and debug will take place on november 15, 16, 17.

Below is a table summarizing the standard operating mode agreed with GSI. Specific run conditions can be agreed and must be defined beforehand (see detailed run schedule)

Run period	Operation mode	Ions	Energy	Rate
18/11-8AM 19/11-8PM	parasitic mode to therapy for daytime (approx 20 min irradiation with 20 min break), timesharing with other experiment overnight	C, Xe (probably on 19 anytime)	1.5GeV/n	O(100)Hz /cm^2

The beam focus can be moved from a few meters upstream the detector down to the CU location, in order to enlarge or squeeze the beam spot. This feature can also be used to decrease/increase particle density.

Trigger considerations

Since the allocated beam time is not very much, we should exploit the capability of operating the CU with multiple trigger engines. Moreover, effects like pedestal drift and different investigations to be performed, suggest that we run in such mode to cover more topics in a short data-taking time.
Multiple trigger engines worked with the CU both at CERN-SPS and at INFN with CR tests.
Such operation will be verified again at GSI, with CR and beam, to make sure that the CU operates in the expected way and we can proceed with the test in such mode.

The CNO trigger, in combination with TKR and CAL triggers will be the main trigger for the test. Some runs will be taken with external trigger, others will be taken with standard internal trigger made with TKR and CAL primitives. Please note that without external trigger we will have some contamination from CR.
A periodic trigger, with variable frequency, will be in parallel to the main particle trigger all the runs, in order to sample the hardware status with random triggers.
All these requestes are implemented through the specific multiple trigger engines defined below, each of which mapped to a specific BT configuration. Here is a list of the configurations used.
Any of the EXTERNAL, CNO, TKR, CAL-LO, CAL-HIGH, PERIODIC signal can open the trigger window.

List of runs

Below is a list of specific run requests. Plese update the table and notify Luca so that a proper run schedule can be developed and agreed with GSI

Purpose	preferred schedule	Ion	Energy	Rate on CU	Beam focus	Trigger	notes	reference
Test multiple trigger engines prior to beam	nov 16-17	NA	NA	NA	NA	all BTs	change CNO thresholds, periodic frequency	luca
Test multiple trigger engines w beam	nov 18	C	1.5Gev/n	100Hz	any	all BTs	change CNO thresholds, periodic frequency	luca
Monitor beam rate and conditions	nov 18	C	1.5Gev/n	10-1000Hz	play with focus to change beam intensityon CU	BT52, BT53	to be repeated shortly per configuration change	luca
Rate scan	after multiple engine work	C	1.5Gev/n	10-1000Hz	play with focus to change beam intensity on CU	BT50, BT51, BT54	vary periodic trigger frequency to induce pedestal drift	luca, eric g

Tracking performance	nov 18	C,Xe	1.5Gev/n	10-1000Hz	far and near focus	BT50, BT51, BT52	investigate tracking at different rates and angles (0,30,45,60 TBD), scan tower3 w/o ACD tile with ext trigger	leon, INFN
Tracking saturation	nov 18	C,Xe	1.5Gev/n	10-1000Hz	far focus	BT50, BT51	scan different angles (0,30,45,60 TBD), scan tower3 w/o ACD tile with ext trigger	leon, INFN
CAL calibration	nov 18	C,Xe	600MeV/n, 1GeV/n, 1.5GeV/n	100Hz	far and near focus	BT50	verify quenching factors, CAL calibrations, ACD partial calibration	CAL team
CAL calibration comparison with previous results	nov 18	C,Xe	1.5GeV/n	100Hz	far and near focus	BT50, BT51	beam on tower1 to avoid TKR in the line	CAL team
Energy scan	nov 19	C,Xe	600MeV/n - 1.5 GeV/n in steps	10-1000Hz	far and near focus	BT51	attempt to simulate different ions by varying ionization energy	nicola
Secondary ions with target	nov 19	Xe	1.5GeV/n	10-1000Hz	far and near focus	BT50	attempt to get different ions by shooting beam through a target - need verification with GSI people	benoit
Charge injection in CAL with beam	nov 19	C	1.5GeV/n	10-1000Hz	far and near focus	BT50	check pedestal restoration with beam ON, explore different beam rates; can use existing CalibGenCAL script	sasha
Charge injection in TKR with beam	nov 19	C	1.5GeV/n	10-1000Hz	far and near focus	BT50	check rate effect in TKR signal; must identify CI script and plots to monitor	leon, TKR team
scintillation measurement in CDE	nov 19	C, Xe?	1.5GeV/n	100Hz		NA	place another detector upstream and monitor signal pulse	benoit