Simulation Meeting 1

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Agenda

Proposed Agenda

- Geometry modifications and workload distribution
- Simulation technicalities
- Deadlines !
- Next meeting

Geometry Modifications

At present we have the following modifications on the basis of M7 to assess:

- Thicker DSSDs in the lower part of the tracker (?)
- Light coded mask to improve the angular resolution at very low energies (IJCLab)
- CZT-layer on top of the CsI(Tl) calorimeter (DTU?)
- Switch out CsI for CeBr3 (Mainz)
- Astropix tracker (Mainz/Desy/KIT?)
- Heavy coded mask (Desy)
- Coded side mask (SRON?)

Can you perform the modifications?
Do you have sufficient computational resources available that you could divert to the simulation effort?
Can you also dedicate one person that can run the simulations and do the analysis for your proposed changes?

Simulations

'Proper' Trade Study (excluding heavy Coded Mask, since this is more of a redesign):

	Default D1	Astropix	light CM	Thick DSSD	Side CM
CsI	We have this!	TBS	TBS	TBS	TBS
CZT	TBS				
$CeBr^3$	TBS				

The very least: We check modified D2 against default D1, and mod. D1 against default D2. Everything that looks promising enough can be tested against the other options.

If we want to go that route, please make your changes in such a way, that we can swap out parts easily!

Rules

In order to stay comparative, we should employ rules for the modifications:

- You can only modify the detector you are working on. If you need to find mass, you need to find it there!
- If you need to modify the Anti Coincidence Detector, we could agree of adding no more than x percent to its mass without penalizing the module you are working on. If your design shrinks the height of the ACD, you can use the gained mass for your modification.
- The geometries should end up in the gitlab group. Every member has the right to create 100 projects with 10GB of space each in the group. This would also help trouble-shooting problems with other people or discussing implementations in general.

The purpose of these rules is not to filter ideas, but to keep sensitivities comparable!

Boundary Conditions

Takeaway from the ESA M8 briefing:

Don't try to shrink your detector mass into a shared launch. You have a Vega-C or A62, use it!

Stay at M7 for now and increase the mass for proposal configuration?
We should reuse the M7 orbit for now in order to have the sims comparable to the default option.

Software

We propose to use MEGAlib version 3.06 for the Compton regime and also use the 3-step method with MEGAlibV3 to generate the activation background.

Do you have this version available?
If not, is it possible for you to change the version?
For higher energies we would ask to use BoGEMMS.

How do we want to run the simulations?

To compare the different geometries, we need to decide on:

- Which performance metrics are we interested in? How do we define them?
- Which type of sources? (point sources, area sources)
- Which spectra? How many energy lines? What type of continuum spectrum?
- Which incident angles and energies do we want to simulate for a first impression? (In the proposal: $\theta = 0$ deg for Compton, binning see table)
- Assuming we want to simulate the pair regime, how can we combine MEGAlib and BoGEMMS simulations?

For the sake of consistency we should set up the background sources in a separate repository for everyone to pull.

Past: M7 Continuum

E (MeV)	ΔE[a] (MeV)	Effective area before event selection (cm^2)	Angular selection[b]	Effective area after select.[c] (cm^2)	Background rate after selection[d] (count s^{-1})	Sensitivity (ph. cm^{-2} s^{-1})	Notes
0.15	0.1 – 0.2	318	7.9°	97	16	1.2×10^{-4}	Without e⁻ tracking
0.3	0.15 – 0.45	410	4.9°	143	9.7	6.5×10^{-5}	Without e⁻ tracking
0.5	0.25 – 0.75	464	2.8°	136	2.4	3.4×10^{-5}	Without e⁻ tracking
1	0.5 – 1.5	440	1.7°	100	0.65	2.4×10^{-5}	Without e⁻ tracking
2	1.0 – 3.0	349	1.3°	35	0.040	1.7×10^{-5}	With e⁻ tracking
5	2.5 – 7.5	228	1.2°	31	0.016	1.2×10^{-5}	With e⁻ tracking

E (MeV)	ΔE spectrum[a] (MeV)	PSF[b]	Effective area[c] (cm^2)	Inner Galaxy Backgr. rate (count s^{-1})	Inner Galaxy Sensitivity (ph cm^{-2} s^{-1})	Galactic Center[d] Sensitivity (ph cm^{-2} s^{-1})	Extragal. Backgr. rate (count s^{-1})	Extragal. Sensitivity 3σ (ph cm^{-2} s^{-1})
10	7.5 - 15	14.5	128	2.4×10^{-1}	1.1×10^{-5}	2.0×10^{-5}	7.1×10^{-2}	6.2×10^{-6}
30	15 - 40	6.5	347	6.2×10^{-2}	2.1×10^{-6}	3.7×10^{-6}	9.3×10^{-3}	8.3×10^{-7}
50	40 - 60	4.1	519	2.8×10^{-2}	9.6×10^{-7}	1.7×10^{-6}	3.1×10^{-3}	3.2×10^{-7}
70	60 - 80	3.2	568	1.3×10^{-2}	6.0×10^{-7}	1.1×10^{-6}	1.2×10^{-3}	1.8×10^{-7}
100	80 - 150	2.2	616	5.1×10^{-3}	3.5×10^{-7}	6.0×10^{-7}	3.7×10^{-4}	9.4×10^{-8}
300	150 – 400	1.4	708	1.5×10^{-3}	1.6×10^{-7}	2.8×10^{-7}	3.7×10^{-5}	2.6×10^{-8}
500	400 – 600	0.8	700	3.8×10^{-4}	8.3×10^{-8}	1.5×10^{-7}	5.8×10^{-6}	1.0×10^{-8}
700	600 – 800	0.6	698	1.8×10^{-4}	5.7×10^{-8}	9.9×10^{-8}	2.0×10^{-6}	7.2×10^{-9}
1000	800 – 2000	0.4	726	6.2×10^{-5}	3.3×10^{-8}	5.7×10^{-8}	5.6×10^{-7}	6.9×10^{-9}
3000	2000 - 4000	0.25	714	6.9×10^{-6}	1.1×10^{-8}	1.9×10^{-8}	4.6×10^{-8}	7.0×10^{-9}

Continuum sensitivity for point source with power-law spectrum and index 2 at $\theta = 0$ deg in the Compton regime (left) and $\theta = 30$ deg pair regime (right). $T_{obs} = 10^6$s

Note:

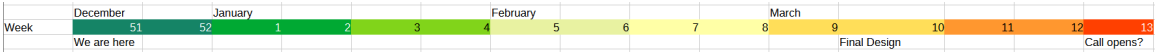
- We have effective area before and after selection for Compton, but not for pair
- The spectra are power-laws, reported is the middle of the bin
- We should definitely work on unifying the appearance.

Past: M7 Lines

E (keV)	FWHM (keV)	Origin	SPI sensitivity (ph cm^{-2} s^{-1})	COSI-SMEX sensitivity (ph cm^{-2} s^{-1})	ASTROGAM sensitivity (ph cm^{-2} s^{-1})	Improvement factor[(a)]
511	1.3	Narrow line component of the Galactic e+/e- annihilation radiation	2.0×10^{-5}	8.0×10^{-6}	2.1×10^{-6}	3.8
847	35	^{56}Co line from thermonuclear supernovae	2.3×10^{-4} (b)	3.3×10^{-5} (b)	7.3×10^{-6} (b)	4.5
1157	15	^{44}Ti line from core-collapse supernova remnants	3.7×10^{-5}	4.2×10^{-6}	1.7×10^{-6}	2.5
1275	20	^{22}Na line from classical novae of ONe type	4.3×10^{-5}	4.5×10^{-6}	1.9×10^{-6}	2.4
1809	3	^{26}Al line tracing stellar ejecta in the interstellar medium	1.6×10^{-5}	2.0×10^{-6}	7.8×10^{-7}	2.6
2223	20	Neutron capture line from accreting neutron stars	4.3×10^{-5}	3.3×10^{-6}	9.1×10^{-7}	3.6
4438	100	^{12}C line from Galactic cosmic-rays in the interstellar medium	4.4×10^{-5}	6.9×10^{-6}	6.5×10^{-7}	10.6

Science line sensitivities (no angular resolution)

Timeline



- We should aim for beginning of March (Week 10) to converge to a final configuration!
- What intermediate steps do we want to set?

Next Steps

- Find the date for the next meeting
- Set up a mailing list to be able to reach people quicker without going through the [mev]-list
- Send around and upload minutes of the meeting