Status Report
- germanium activities

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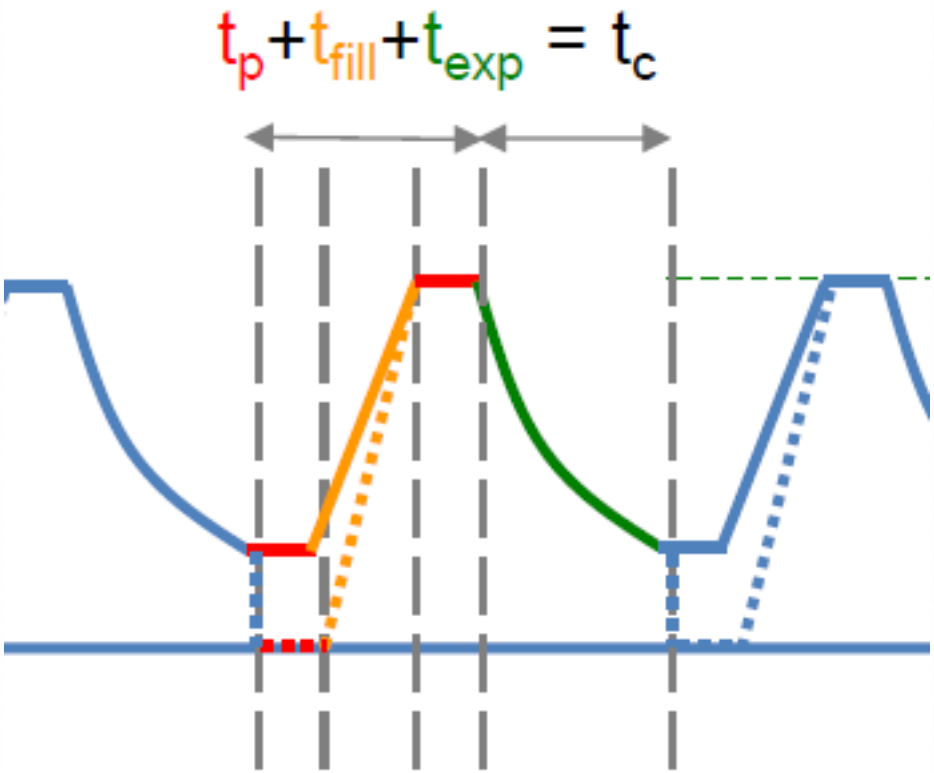
Outline

- Primary target
  - Luminosity calculations
  - Thermal simulation
- Germanium
  - DCS board
  - New geometry
- Hyper atomic experiment

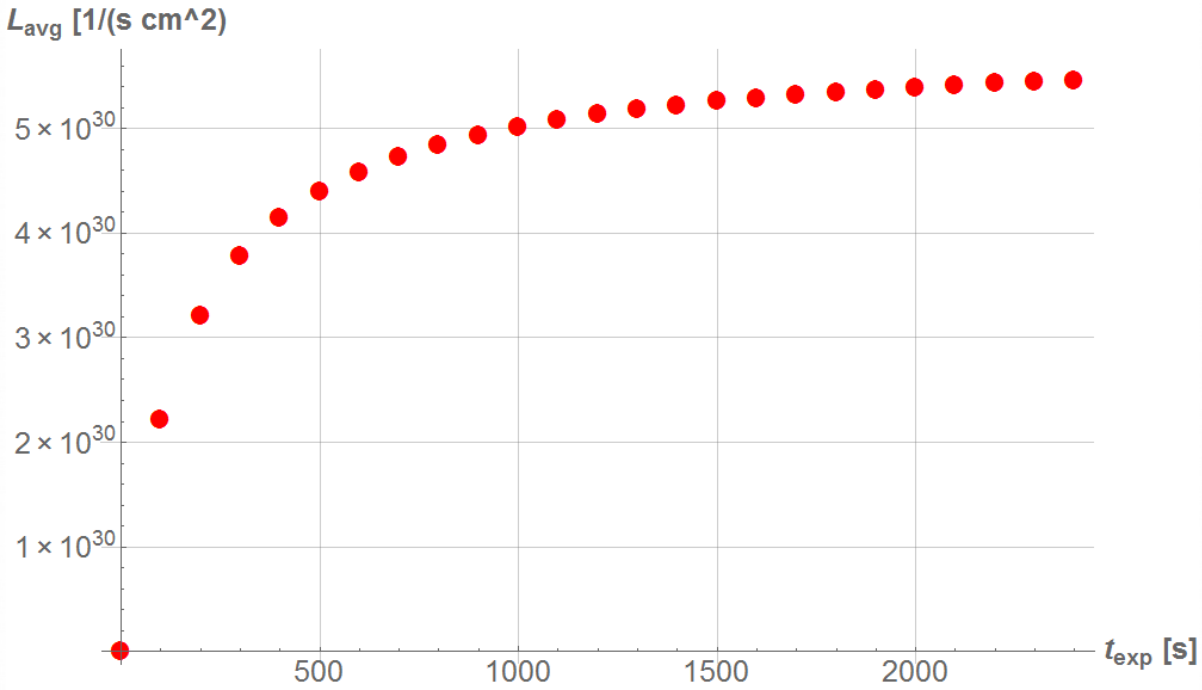
Primary target - Luminosity

- Constant Luminosity by moving the target
- Linear decrease of $\bar{p}$
- Parameters:
  - $N_{\bar{p}max} = 10^{10}$
  - $f_{beam} = 470$ kHz
  - $t_{prep} = 140$ s (2 times, maybe less)
  - Fill rate $5.6*10^{10}$ /s
  - HESRr mode (no dumping)
  - $R_{average} = 2*10^{6}$ /s
- Based on the values of K. Goetzen



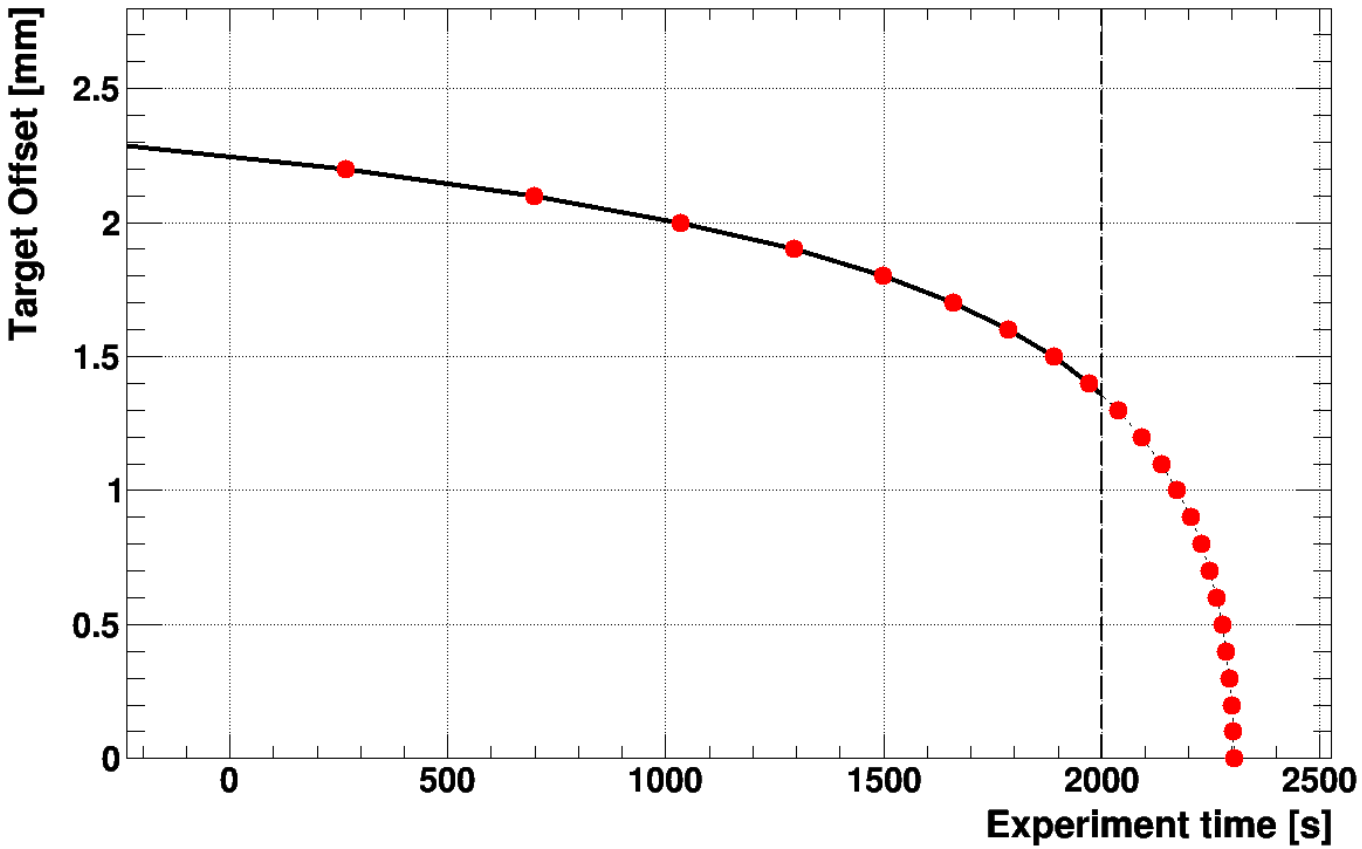
Primary target - Luminosity

- Reaction Rate R = $4*10^6$ /s
- Gaussian beam (σ = 1 mm)
- C fiber target (r = 5 µm)
- $Lumi_{average} \sim R_{average}$
- Duty factor d = t_{exp}/t_{total}



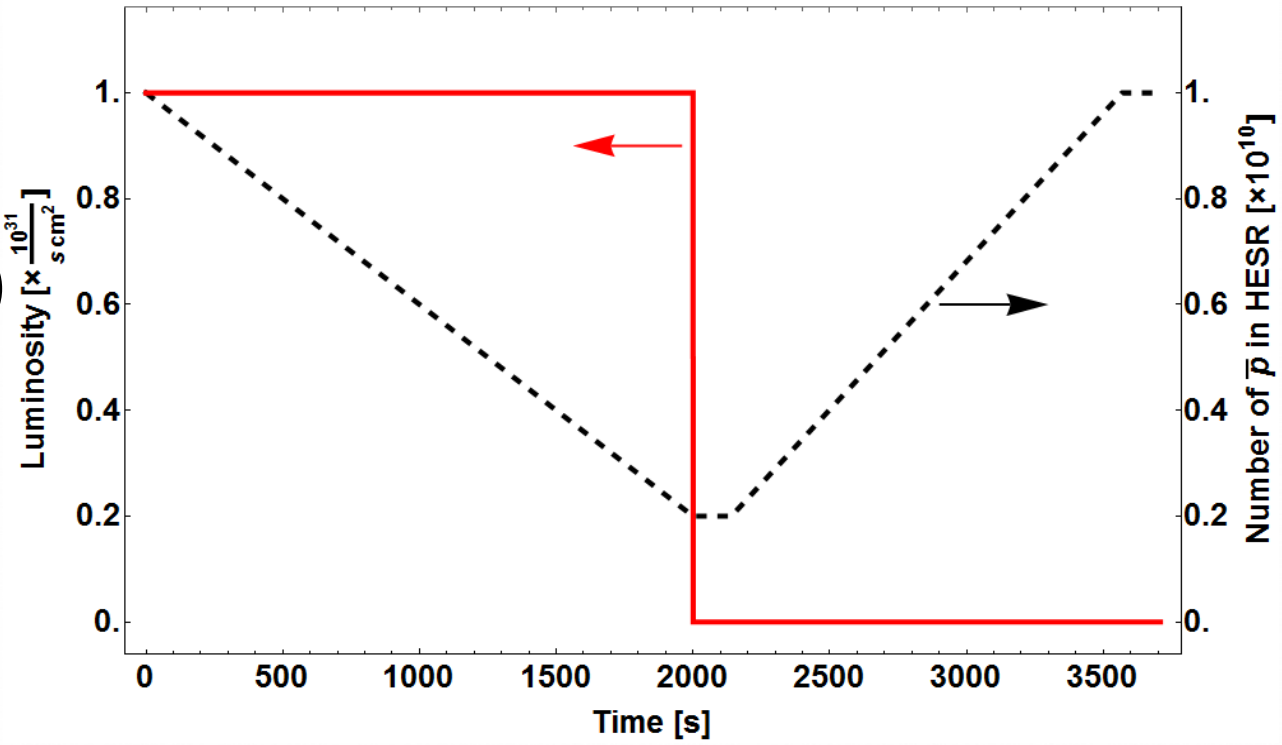
Primary target - Luminosity

- Positioning of the target
- Fast movement after 2000 s
- ~ 1 mm in 2000 s



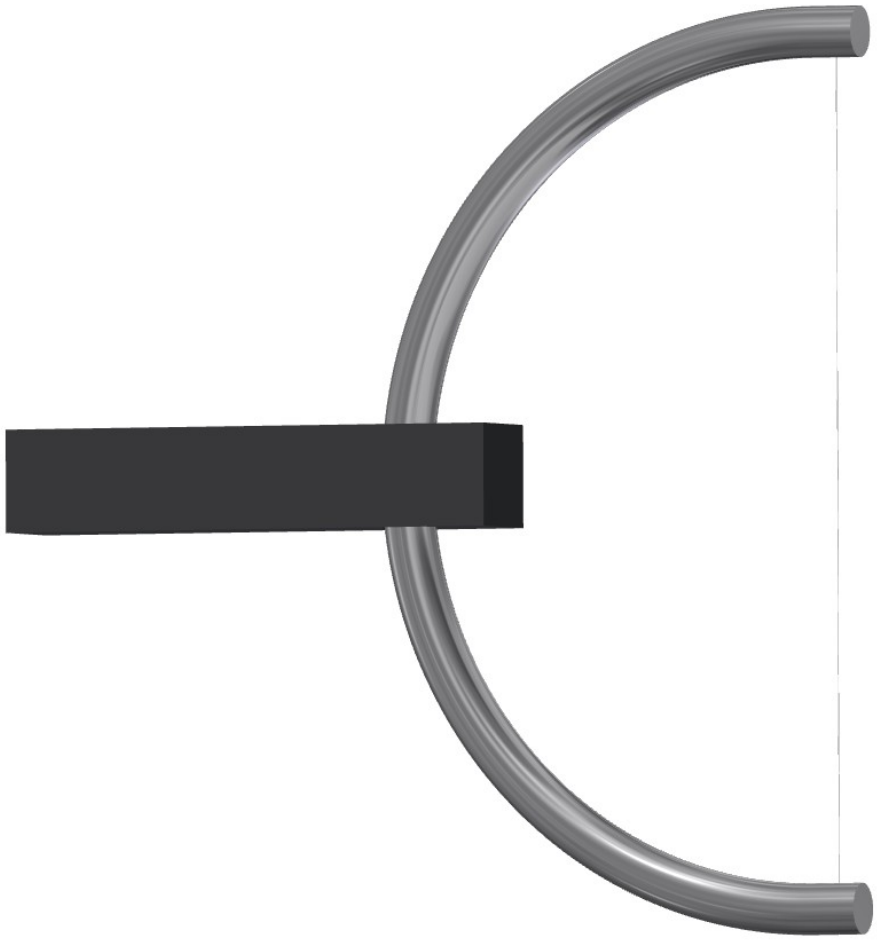
Primary target - Luminosity

- Luminosity and $\bar{p}$ over full cycle
- d = 0.539
- $L_{average}$ = $5.39*10^{30}$ $1/(s*cm^2)$
- $R_{average}$ = $2.16*10^{6}$ $1/s$
- P_{therm} = 0.056 mW



Primary target – Therm. sim.

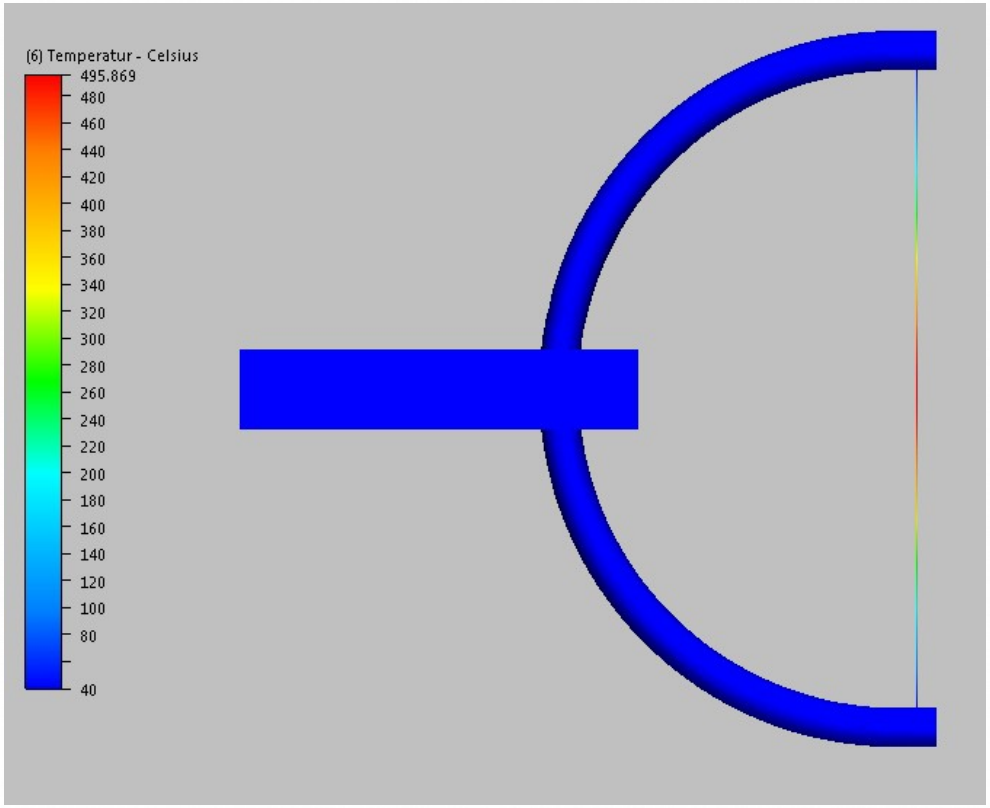
- Simplified CAD model of the prim target
- $r_{out} = 9$ mm
- Autodesk Simulation CFD
- 4 materials
  - Diamond
  - Carbon fiber (DIALEAD)
  - Silicon
  - Titanium



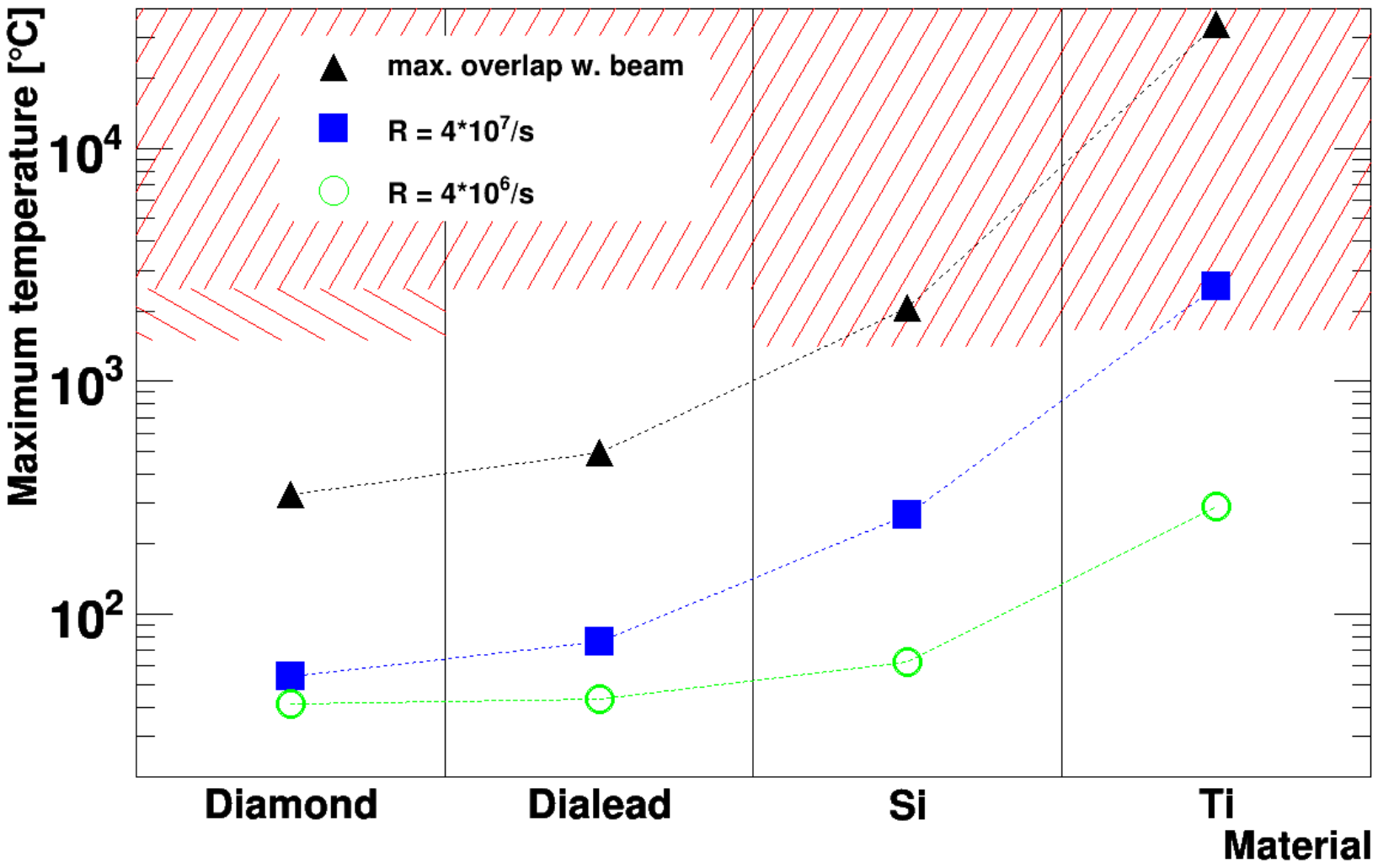
Primary target – Therm. sim.

- 3 scenarios:
  - Normal operation
  - 10*normal operation
  - Beam sweep (max rate)
- Example picture

  DIALEAD (W = 800 W/(m*K)
- Temperature gradient only in the filament



Primary target – Therm. sim.



Primary target – Summary

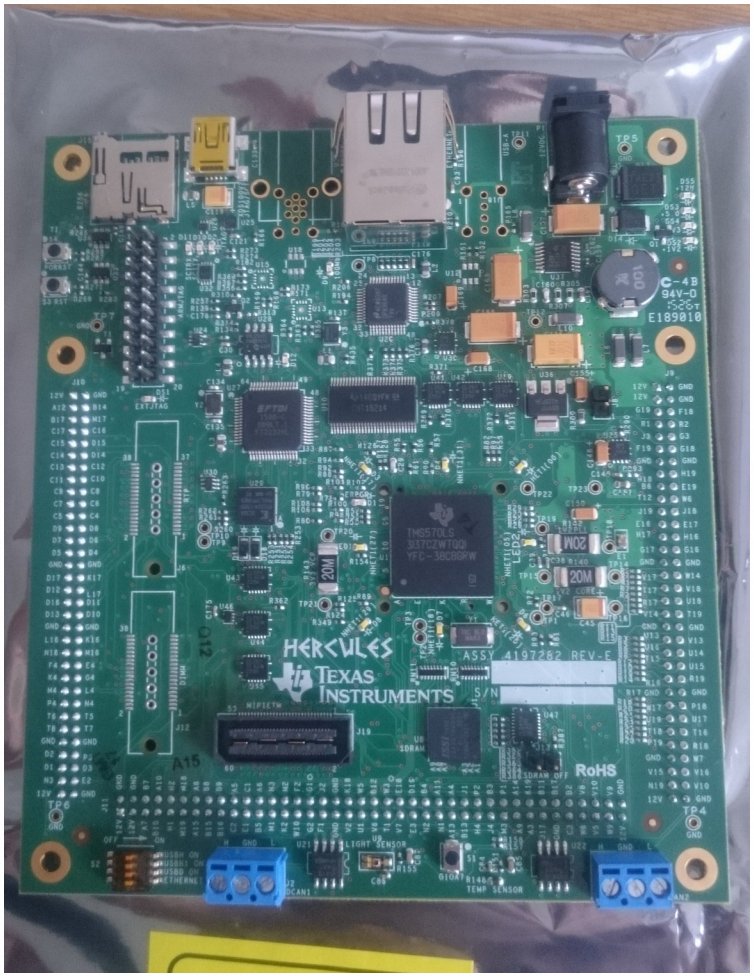
- L_{avg} of $2*10^6$ /s is achievable
- Constant Luminosity
- Steering of the targets doable
- Online feedback from Lumi detector needed
- Beam shape must be improved

- Silicon and Titanium target ruled out by thermal simulations
- Carbon target (diamond or fiber) both possible

Germanium – DCS Board

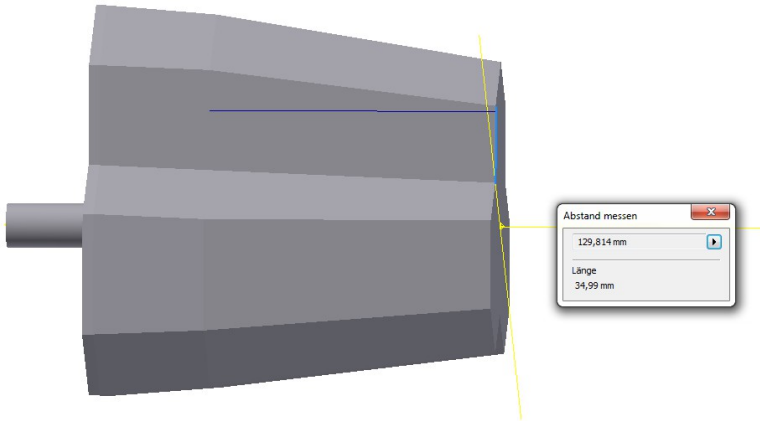
- Radiation hard board based on TI Hercules Chip
- 2 dev boards in Mainz

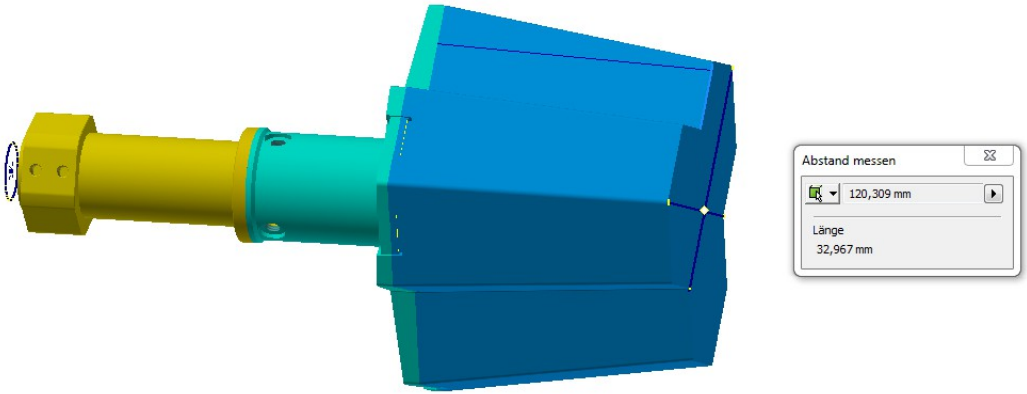
- Board in development in Frankfurt (Antonio Lucio)
- Form factor of Beaglebone Black
- Main board + specialized piggyback boards



Germanium – New geometry

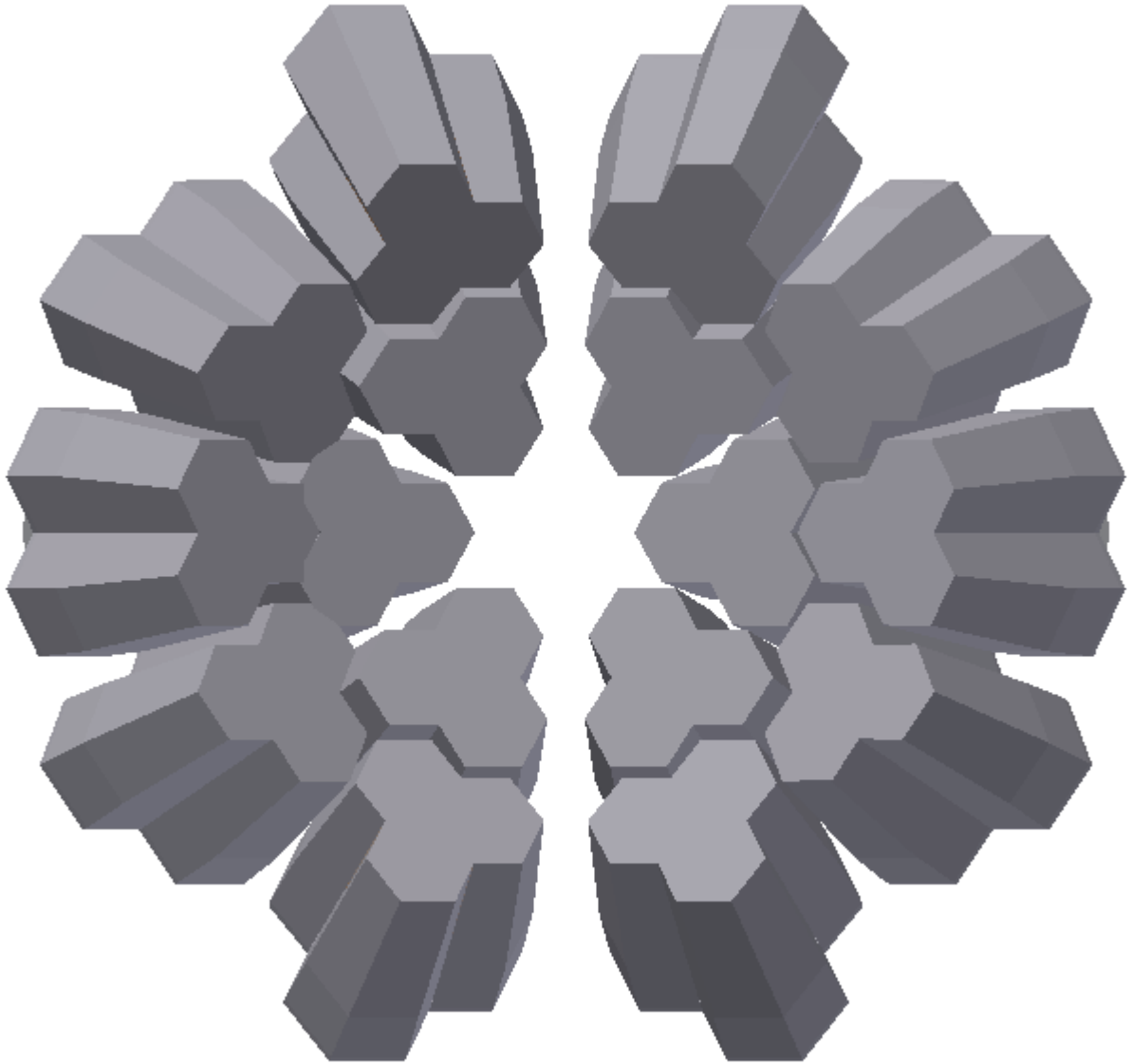
- Updated CAD drawings
- Eletronics shifted to the back
- Smaller detector head
- New layouts possible





Germanium – New geometry

- Old geometry
- 16 triples
- Ball, r = 40 cm
- Offset 20 cm

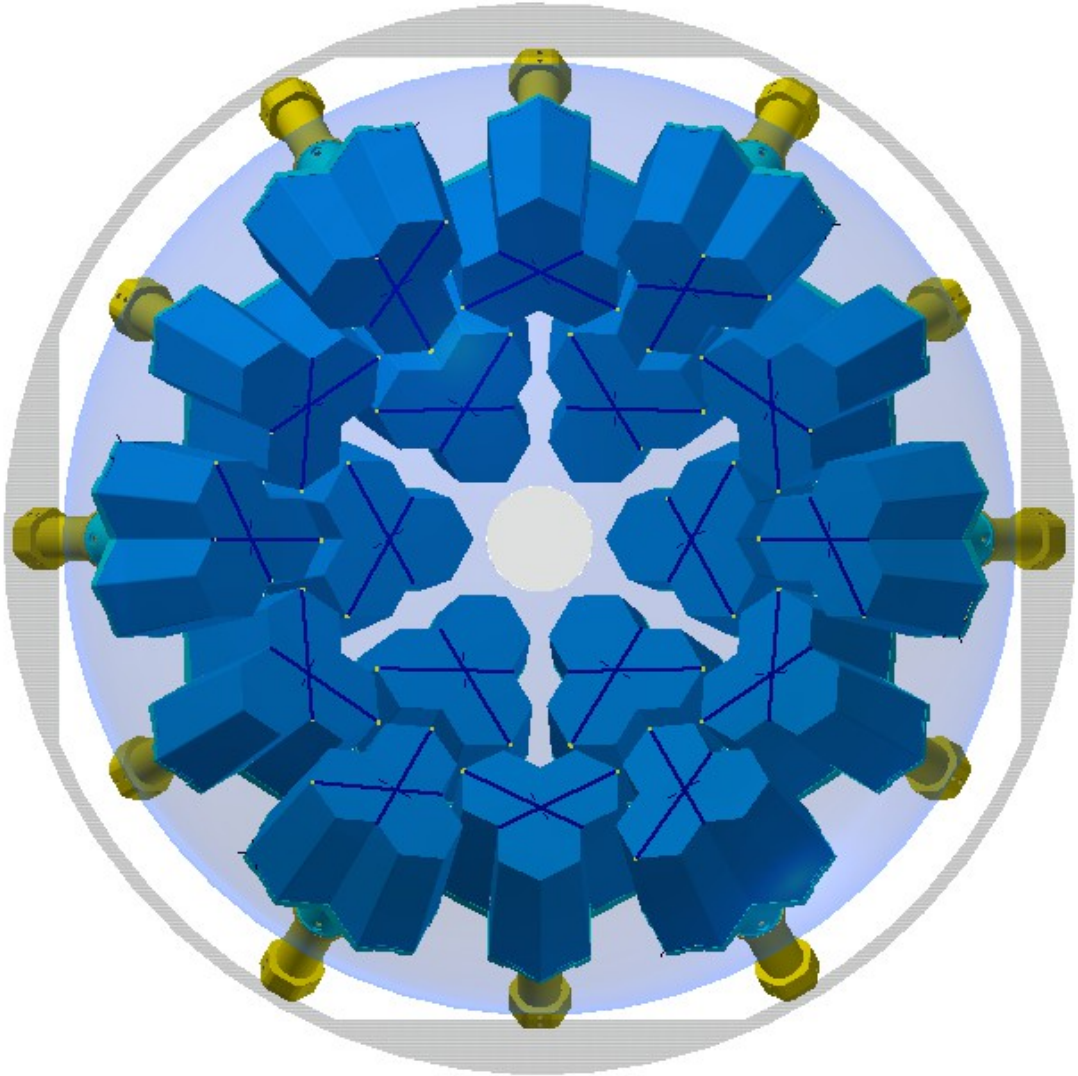


Germanium – New geometry

- New geometry
- 18 triples
- Ball, r = 40 cm
- Offset 20 cm

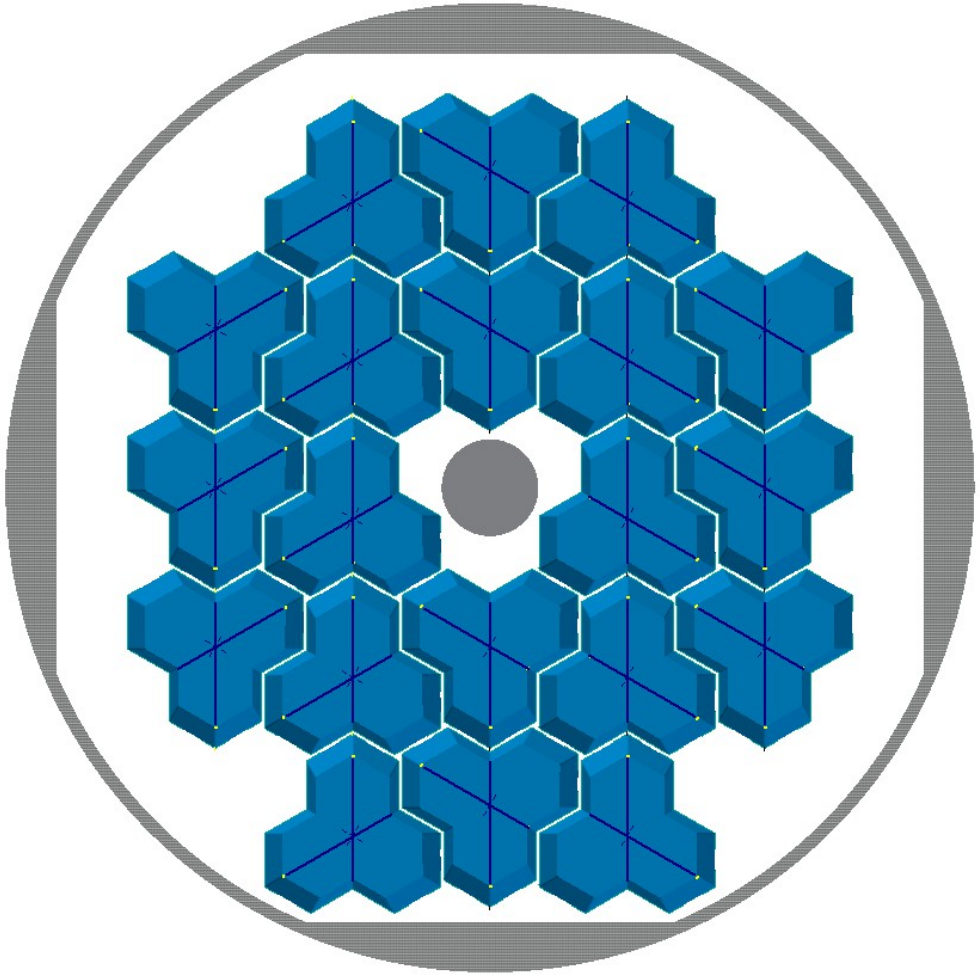
- Flexible detector neck needed

really needed?



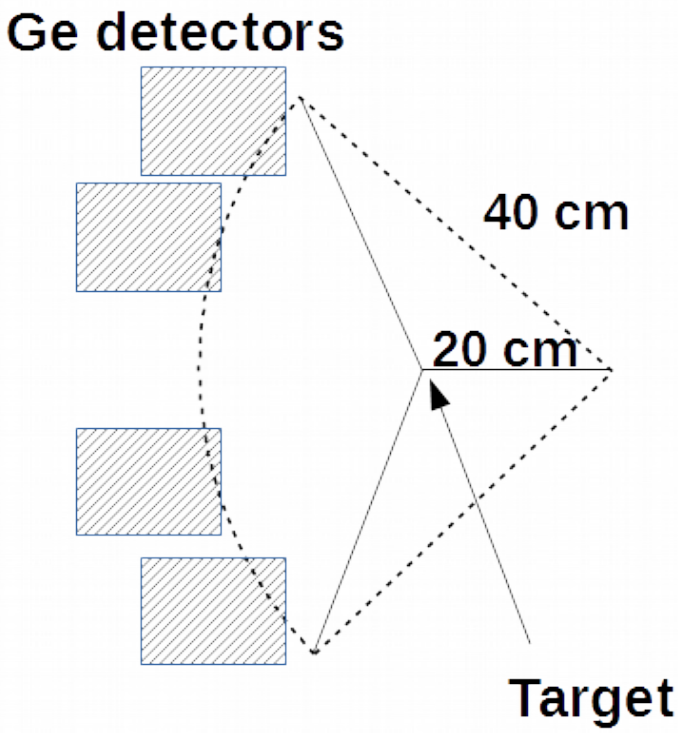
Germanium – New geometry

- Straight detectors
- “wall like” arrangement
- 20 cluster
- Enough space for cabling

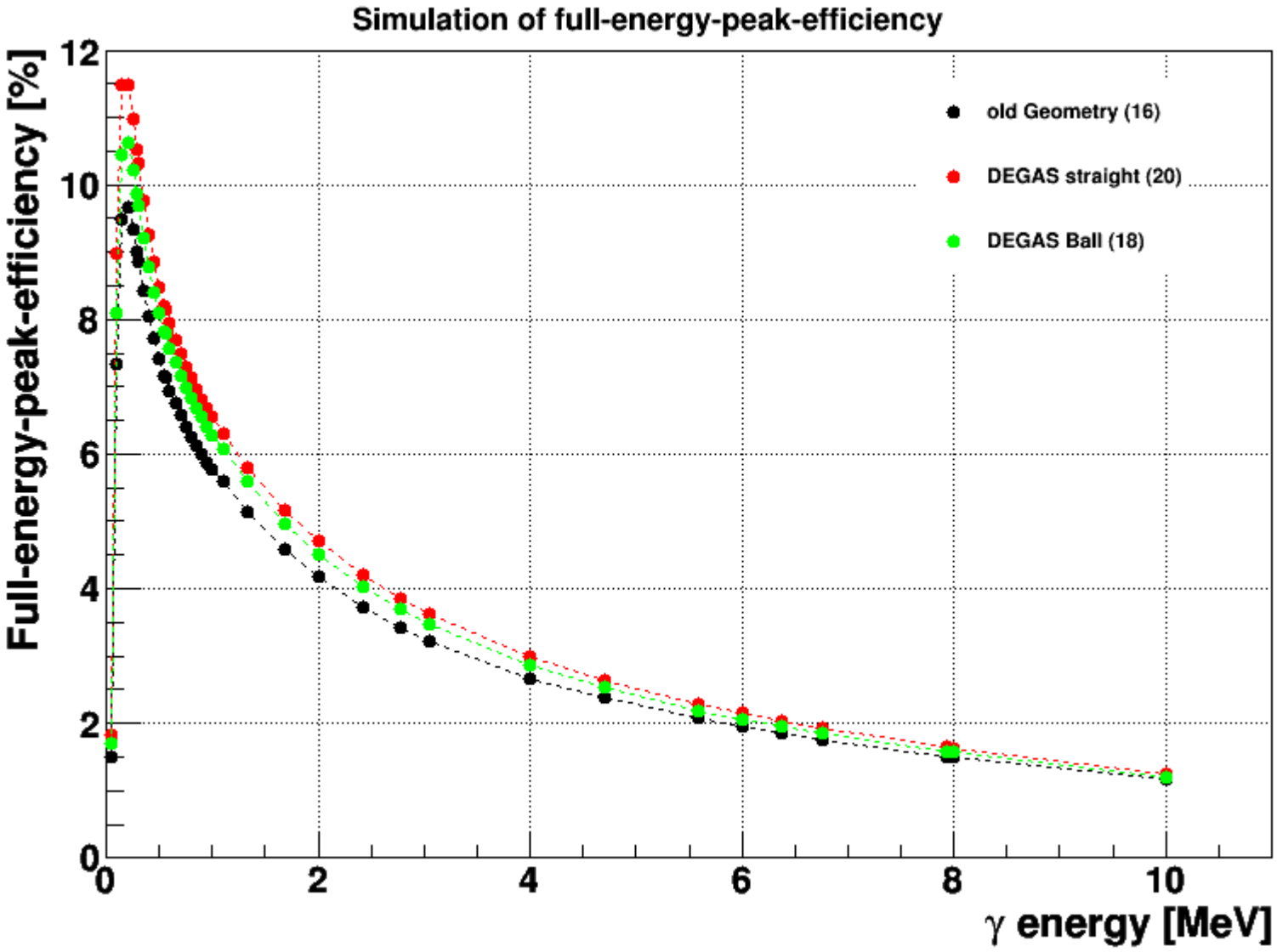


Germanium – New geometry

- cascading detector z positions to achieve spherical layout



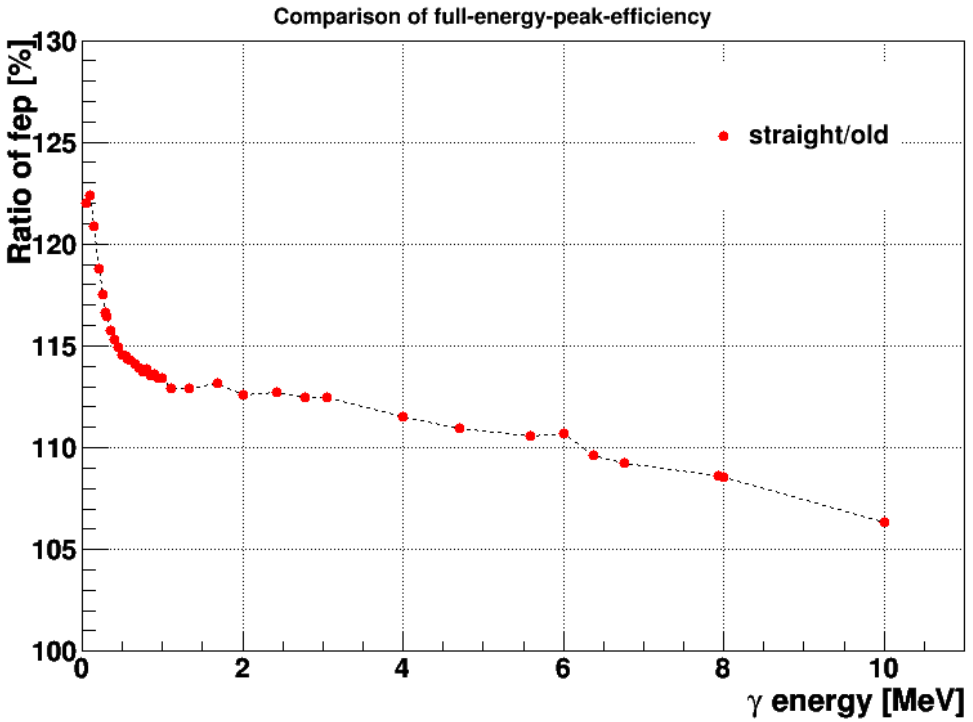
Germanium – New geometry



Germanium – New geometry

- Higher efficiency
- Easier assembly
- Less modifications needed
- Higher flexibility
- Cheaper

- Neutrons have to be taken into account



	Events	Gen	n max Crystal	n avg Crystal
old	500000	urqmd	5859	4479
new ball	500000	urqmd	5719	4331
new straight	500000	urqmd	7620	5002

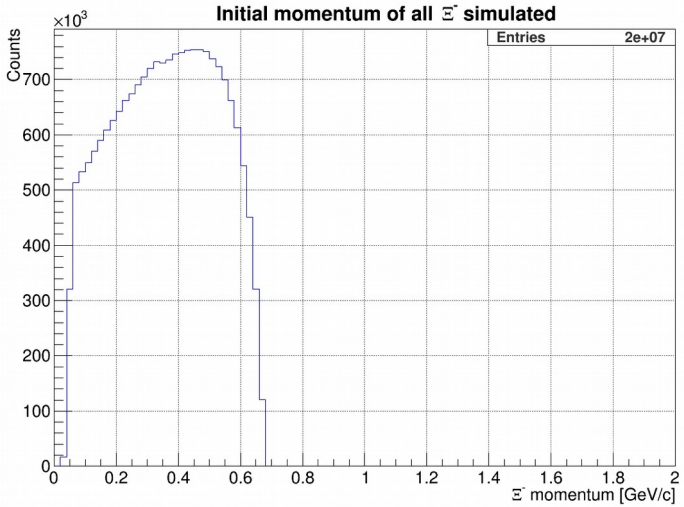
Hyper atoms

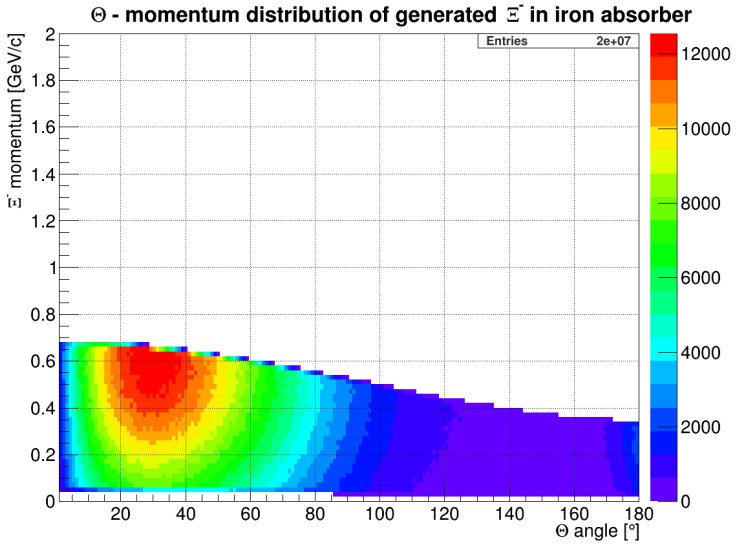
- “early” experiment at $\bar{P}$ANDA
- Absorber with high Z needed
  - X ray photons in measurable range (<1 MeV)
  - Absorption highly increased!
- Compromise between Ξ^- absorption and X ray crossing probability

Target	F	Cl	Sn	I	Pb
Transition	$4F \rightarrow 3D$	$5G \rightarrow 4F$	$8J \rightarrow 7I$	$8J \rightarrow 7I$	$10L \rightarrow 9K$
E_x (keV)	131.29	223.55	420.25	474.71	558.47
Y	0.31	0.37	0.76	0.43	0.58
Shift (keV)	1.56	1.84	0.67	2.79	1.73
Width (keV)	0.99	1.14	0.43	2.21	1.26

Hyper atoms

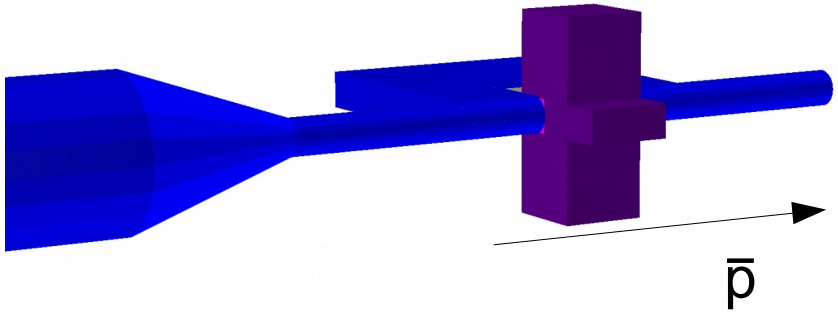
- Not enough statistics with GiBUU events
- Generator written by Alicia
- Ξ^- up to 800 MeV/c

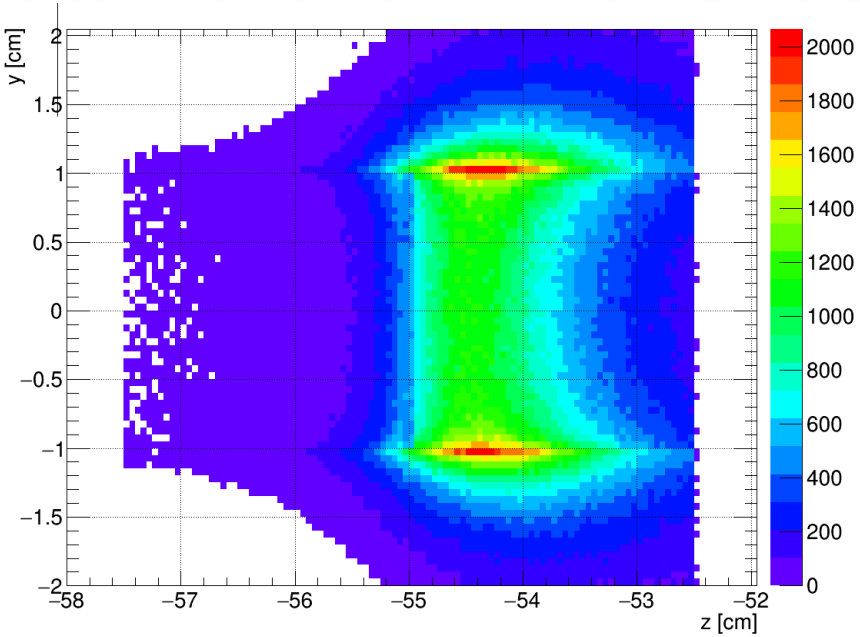




Hyper atoms

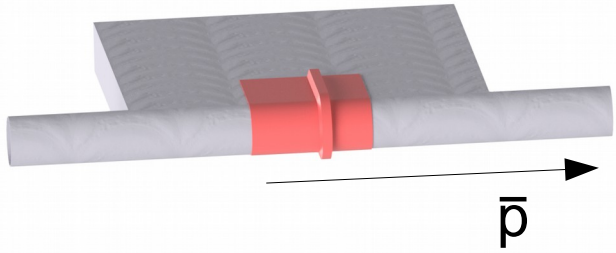
- First tests
- Iron target
- Big target block

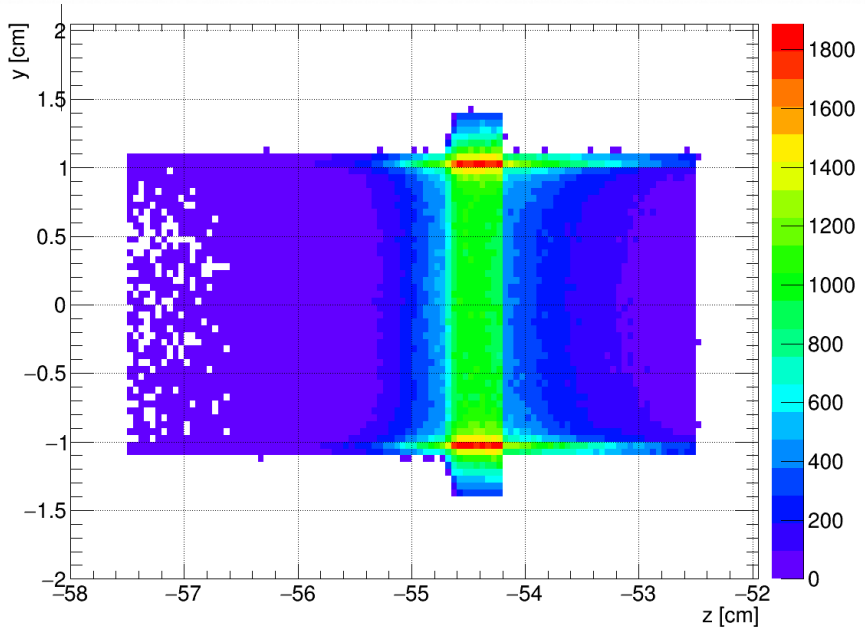




Hyper atoms

- First geometry
- Optimization needed
- Work in progress!
- γ efficiency must be taken into account
- No presentable numbers yet





Germanium - Summary

- Updated Germanium geometries look very promising
- More efficient, more flexible, cheaper
- Very close to DEGAS Detector

- Studies for hyper atomic experiment are in progress

Thanks for your attention

Backup slides

Backup – Thermal Results

Material	P [mW]	T_max [°C]	T_max @ 10*P [°C]	Anteil des Strahls auf dem Targ Full Sweep /Normal		P_full Sweep [mW]	T_FullSweep [*C]
Diamant	0,056	41	54	0,00154801	201,8585151	11,30407685	325
DIALEAD	0,056	43	76	0,00246275	126,8821439	7,105400061	495
Si	0,083	62	268	0,00348988	89,53860878	7,431704529	2077
Ti	0,107	290	2547	0,00229335	136,2543877	14,57921948	34248

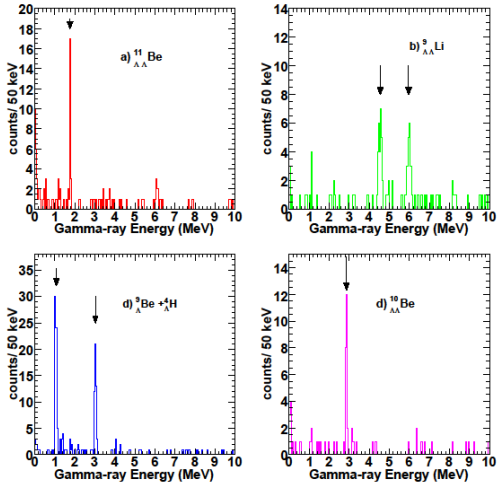
P auf 3 mm T_sink = 40 °C

Maximaler Anteil des Strahl auf dem Target (Full Sweep) [%]
0,312479

Material	Dichte [g/cm³	Wirkungsquer	Wärmeleitfäh	A	Schmelzpunkt [°C]	
Diamant	3,52	400	variabel	12	1500	Umwandlung zu Graphit
DIALEAD	2,2	400	800	12	2500	wird plastisch verformbar
Si	2,3	630	variabel	28	1410	
Ti	4,5	840	22	48	1668	

Hypernuclei and hyperatoms

- Exited states of ΛΛ hypernuclei
- 2 step production
- γ energy range ~ 1–10 MeV



- States of hyper atoms
- γ cascading in the atomic shell
- γ energy range < 1 MeV
- Similar setup

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C. J. Batty, E. Friedman, and A. Gal, Phys. Rev. C 59, 295

Changes in the PANDA Setup

- Removal of target, MVD and backward endcap
- New beam pipe, prim. and sec. target, Germanium Array