



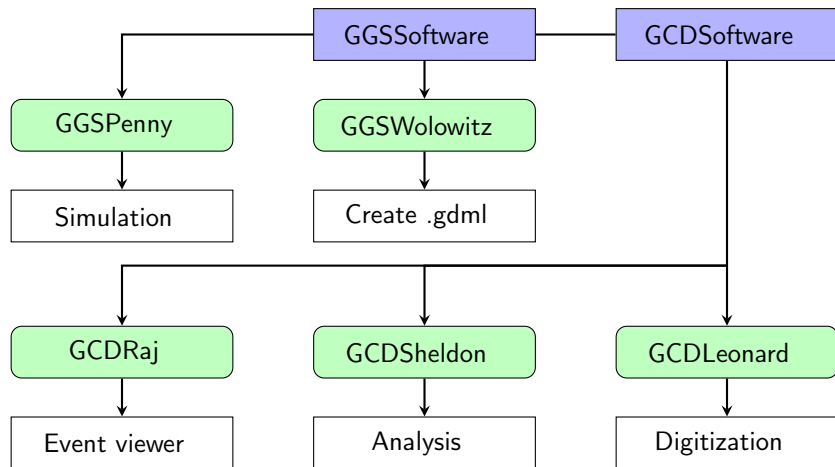
GAMMA-400 Workshop

## Simulation Studies of GAMMA-400

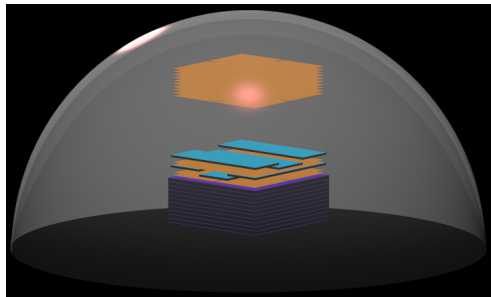
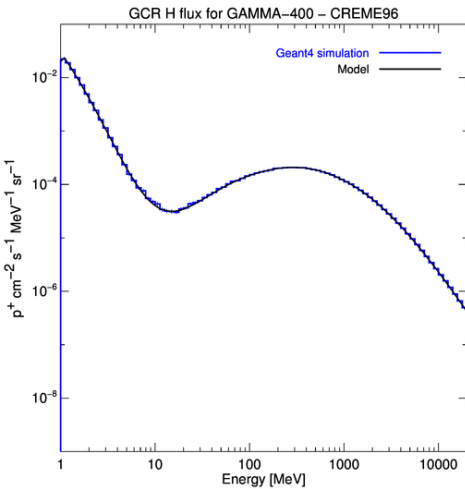
Dr. Paolo Cumani

- 1 GAMMA-400 Framework
- 2 Reconstruction using only the Calorimeter/Preshower
- 3 Silicon Hat
- 4 Conclusions

# Framework

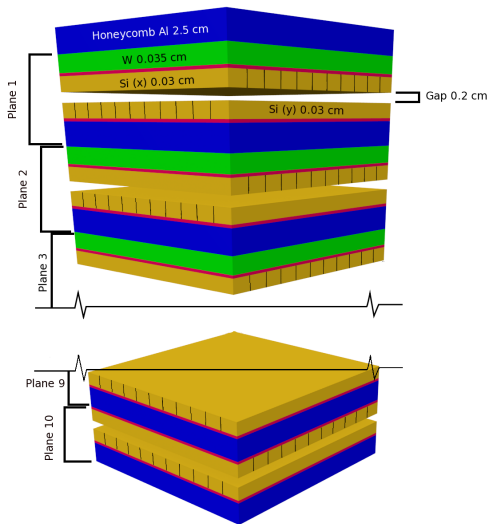


# Simulations: Geant4



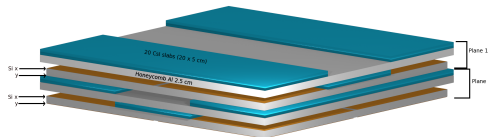
## Analysis: Direction Reconstruction

- Tracker (+ Preshower and Calorimeter at high energies)
- Preshower
- Calorimeter



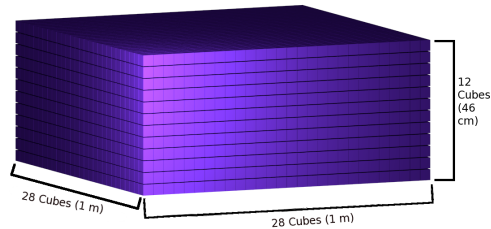
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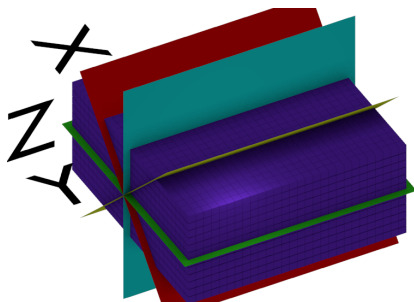


## Calorimeter only reconstruction

- Requirements: 3 planes hit
- Reconstruction of the direction of particles coming also from the side of the detector
- Need to define the inclination of the planes:
  - Fit using the 3 cubes with the highest energy release
  - Definition of planes as perpendicular to the identified direction with  $\pi/4$  steps



## Calorimeter only reconstruction

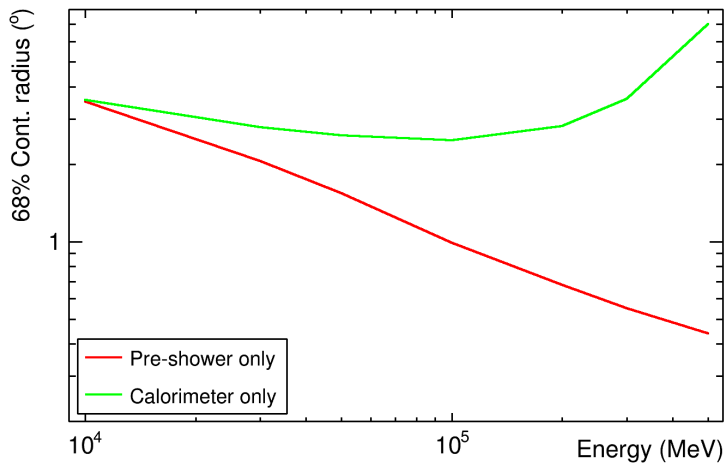


- Weighted average to find the barycenter on each plane
- Fit using the identified points
- Exclusion of the points outside a cylinder around the reconstructed direction
- Iteration reducing the cylinder radius

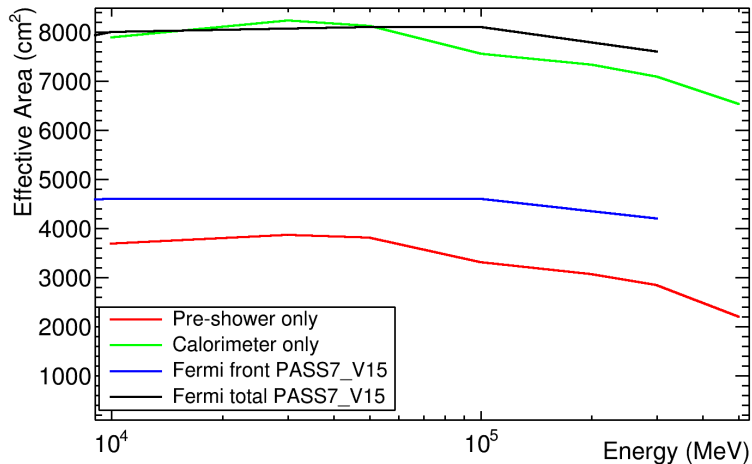
## Preshower only reconstruction

- Requirements: hit on both planes
- Weighted average on each plane to find the barycenter
- Fit using the identified points
- Exclusion of the points outside a cylinder around the reconstructed direction
- Iteration reducing the cylinder radius

## PSF



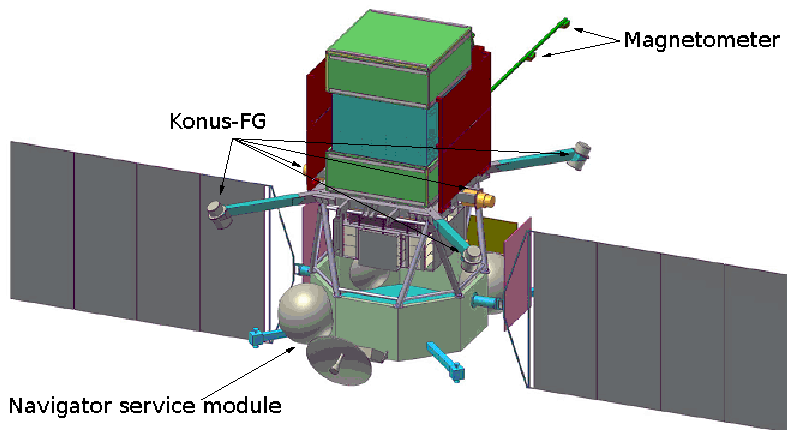
# Effective Area



## Why reconstruct the direction with the Calorimeter/Preshower?

- Trigger for transient observation with Cherenkov telescopes
  - Fermi will end (sooner or later)
  - CTA will be operational
- Wide FOV
- Big effective area

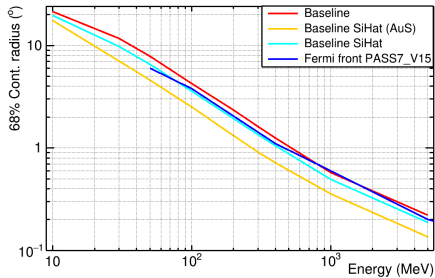
# GAMMA-400



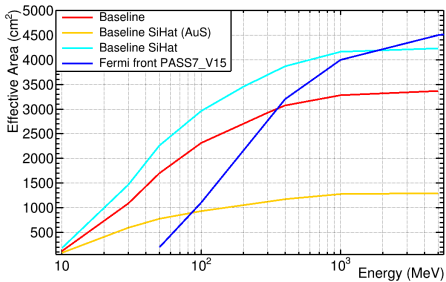
# Silicon Hat

## 13 Si planes on top of the Baseline TRK

PSF



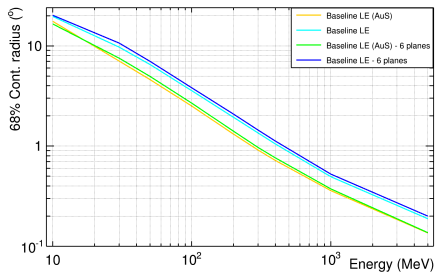
Effective Area



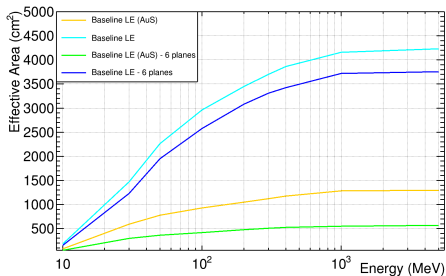
# Silicon Hat

## 6 Si planes on top of the Baseline TRK

PSF



Effective Area





## Conclusions: Calorimeter Reconstruction

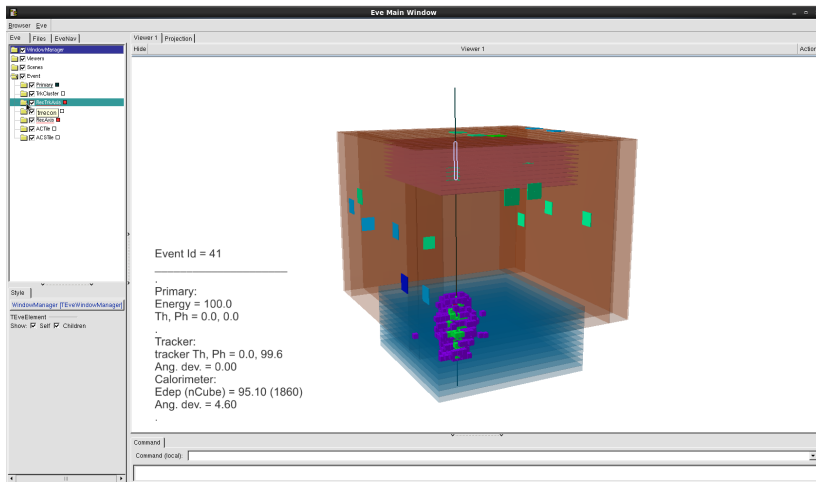
- Direction reconstruction using only the calorimeter is possible.  
It can provide a trigger for observation from the ground
- A specific transient trigger is needed (rate of events?)

## Conclusions: Si Hat

- Adding Si planes on top of the tracker
- Improve low energy performance
- High energy performance unchanged

## SPARE SLIDES

# Event Viewer



The screenshot displays the 'Eve Main Window' interface. On the left, a 'Browser' pane shows a tree view of the event structure, with 'Intracore' selected. Below the browser is a 'Style' pane with options for 'TEveElement' and 'Show Self Children'. The main 'Viewer 1' area shows a 3D visualization of a detector volume with a central track and energy deposits. A data panel on the left of the viewer displays the following information:

Event Id = 41

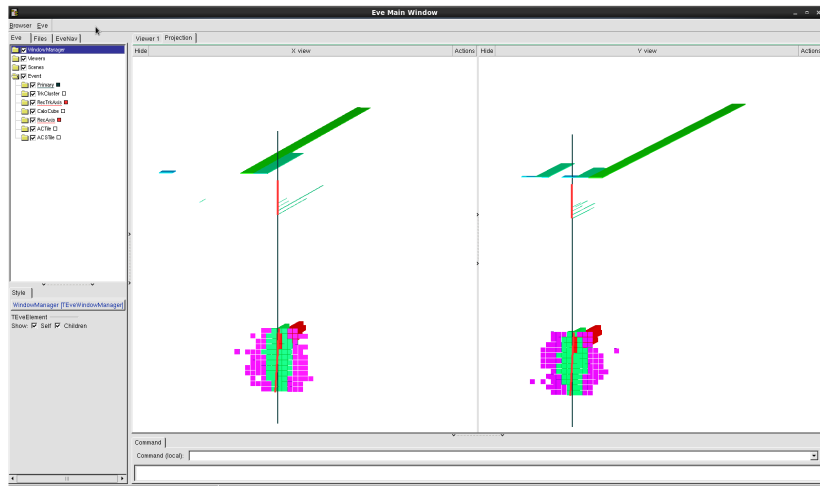
Primary:  
Energy = 100.0  
Th, Ph = 0.0, 0.0

Tracker:  
tracker Th, Ph = 0.0, 99.6  
Ang. dev. = 0.00

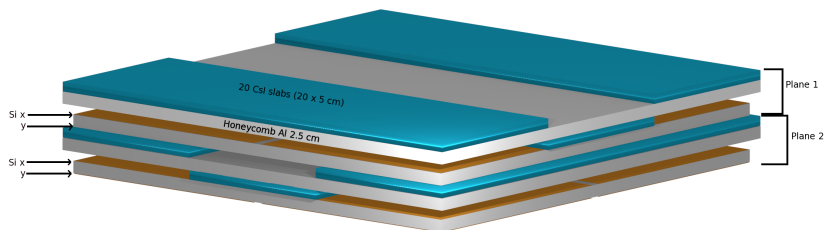
Calorimeter:  
Edep (nCube) = 95.10 (1860)  
Ang. dev. = 4.60

At the bottom, there is a 'Command' field and a 'Command (local)' dropdown menu.

# Event Viewer



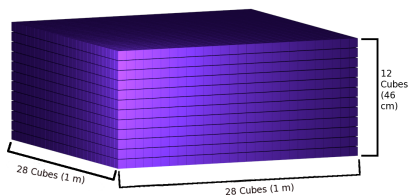
# GAMMA-400: Preshower



## Preshower (Si-Csl(Tl))

Si pitch	0.12 mm
Size	$1 \times 1 \times 0.04 \text{ m}^3$
R.L.	$2 X_0$
I.L.	$0.1 \lambda_I$

# GAMMA-400: Calorimeter



## Calorimeter (CsI(Tl))

$L_{cube}$ (cm)	3.6
R.L. ( $X_0 \times X_0 \times X_0$ )	$54.6 \times 54.6 \times 23.4$
I.L. ( $\lambda_I \times \lambda_I \times \lambda_I$ )	$2.5 \times 2.5 \times 1.1$
Mass (kg)	$\sim 1900$
$GF_{planar}$ ( $m^2sr$ )	9.5
$GF_{eff0.1-1TeV}$ ( $m^2sr$ )	$\sim 3$

## Fermi LAT Tracker

16 towers, 18 planes:

- 16 planes with W:
  - 14 with 3%  $X_0$  W
  - 2 with 18%  $X_0$  W
- 18 x-y Si planes

