Monte Carlo simulations for HASPIDE

M. Fabi[1] C. Grimani[1] F. Sabbatini[1] M. Villani[1]

[1]University of Urbino Carlo Bo
INFN Florence

HASPIDE General Meeting, Florence
02-03 February 2023

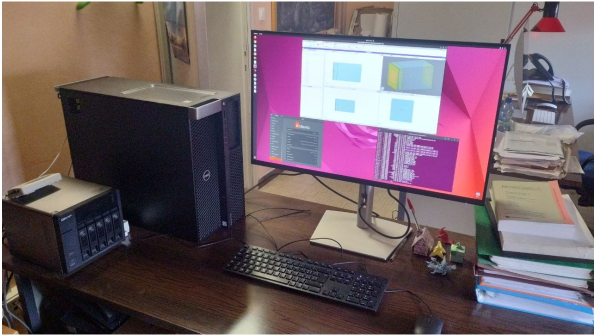
Table of Contents

Table of Contents

cheyenne.fis.uniurb.it

Workstation characteristics:

- Dell Precision 7920 Tower
- Ubuntu 22.04 / Windows 11
- Dual Intel Xeon Gold 3.0 GHz
- 192 GiB System Memory
- NVIDIA RTX A6000
- 1 TB nvme, 8 TB HDD

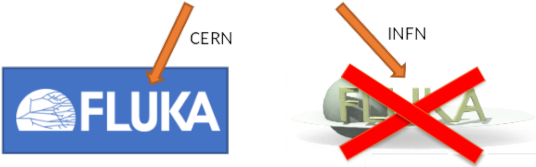


$\sim$ 32 % times faster than our previous machine on single core

Table of Contents

There are actually two Fluka flavours

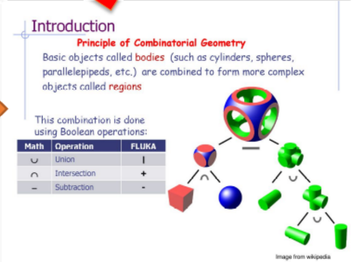
The Monte Carlo software we used:
Same program, two different versions



Graphical **U**ser **I**nterface for the **Monte Carlo:**

flair by CERN

Combinatorial Geometry



Introduction

Principle of Combinatorial Geometry

Basic objects called bodies (such as cylinders, spheres, parallelepipeds, etc.) are combined to form more complex objects called regions

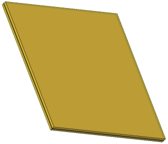
This combination is done using Boolean operations:

Math	Operation	FLUKA
∪	Union	|
∩	Intersection	+
–	Subtraction	-

Image from wikipedia

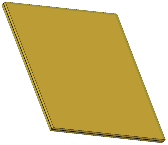
- Make easier to build complex geometries
- Great support from developer team
- ‘Experimental’ procedure for multifile projects

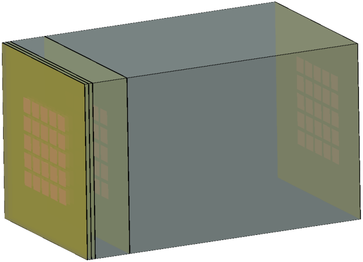
Combinatorial geometries



- 4×4 mm^2 of silicon 10 μm thickness
- two kapton layers, 75 μm thickness

Combinatorial geometries





- $4{\times}4$ mm^2 of silicon 10 μm thickness
- two kapton layers, 75 μm thickness

- Array $5{\times}5$ silicon detectors between two kapton foils on 5 layers, the front plane area is 4.8 cm^2
- Tungsten (W) absorbers of 1 mm, 1 mm, 1 cm, and 2 cm thickness
- different configurations for the last W layer have been considered. Geometries with layer thicknesses of 2, 3.5 and 6.8 cm have been adopted in the simulations
- Total weight ranging from less than 1 kg to 3.5 kg

Simulations performed so far:

Single tile geometry:

beam 4×4 mm^2 $4 \cdot 10^6$ events perpendicular, centered	
protons	3 MeV
electrons	100 keV, 500 keV, 1 MeV, 5 MeV
photons	20 keV, 70 keV
beam 5×5 cm^2, energy spectrum of a gradual SEP event	
electrons	15, 30 and 45 degrees

Silicon 5×5 array tiles on 5 layers:

beam 50×50 cm^2, $4 \cdot 10^6$ events perpendicular, centered	
protons	last slab W thicknesses 2 cm, 3.5 cm, 6.8 cm