

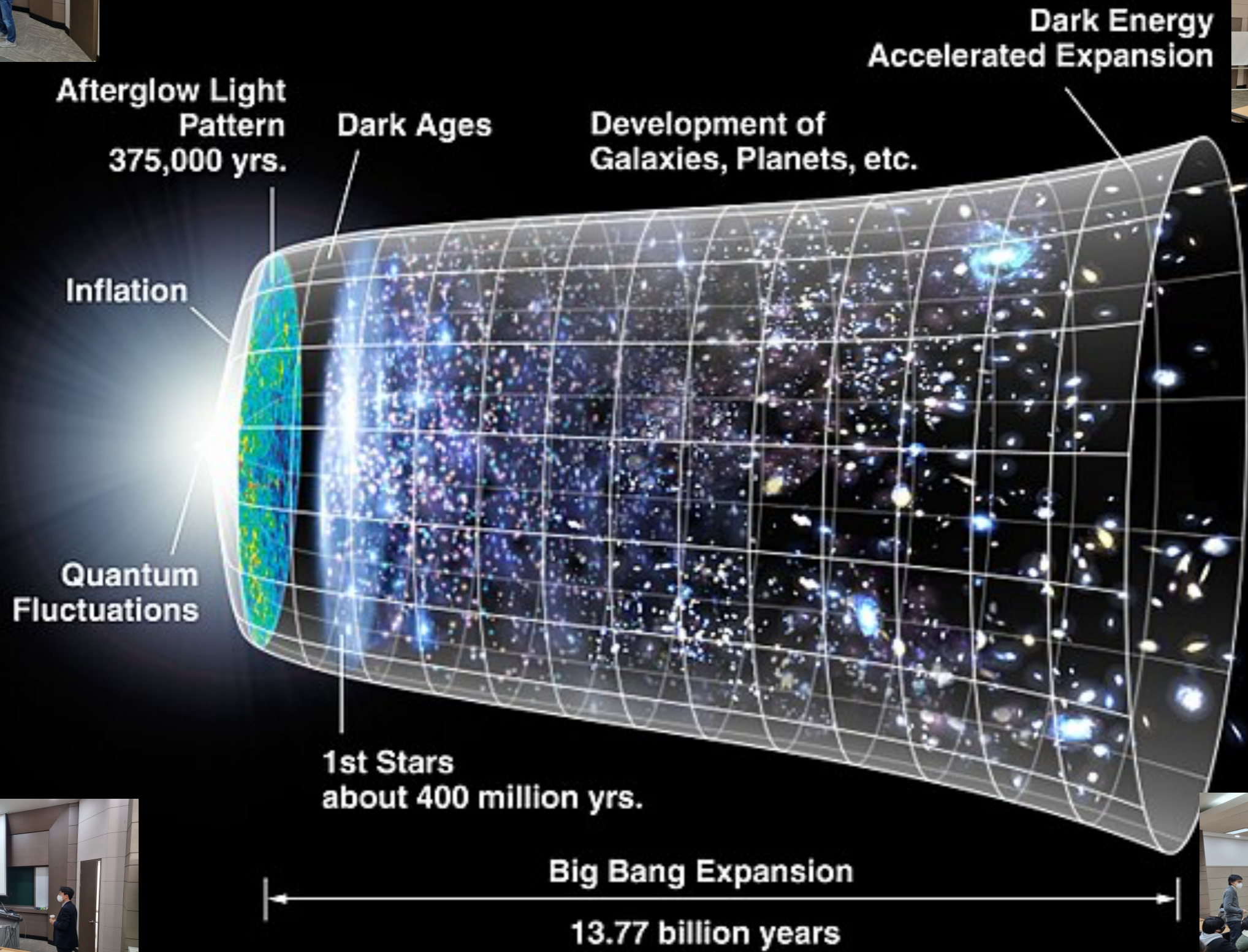


Particle Detection

Hwidong Yoo
Yonsei University

Origins meeting
12 January, 2022

Previously



Today



THE
DEVIL IS IN
THE
DETAILS

time.com

ID 171950510 © Michalsuszycki

Experimental Side

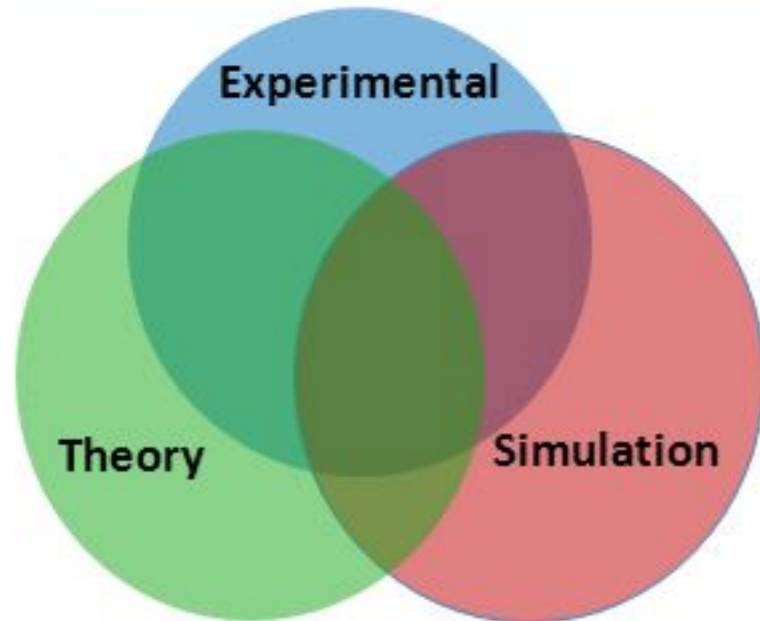
How to detect (observe)



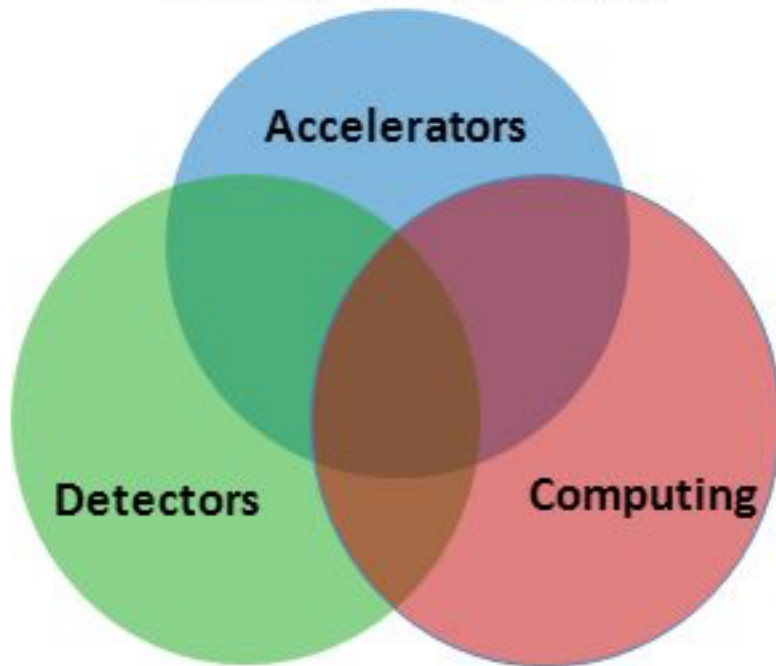
How to analyze



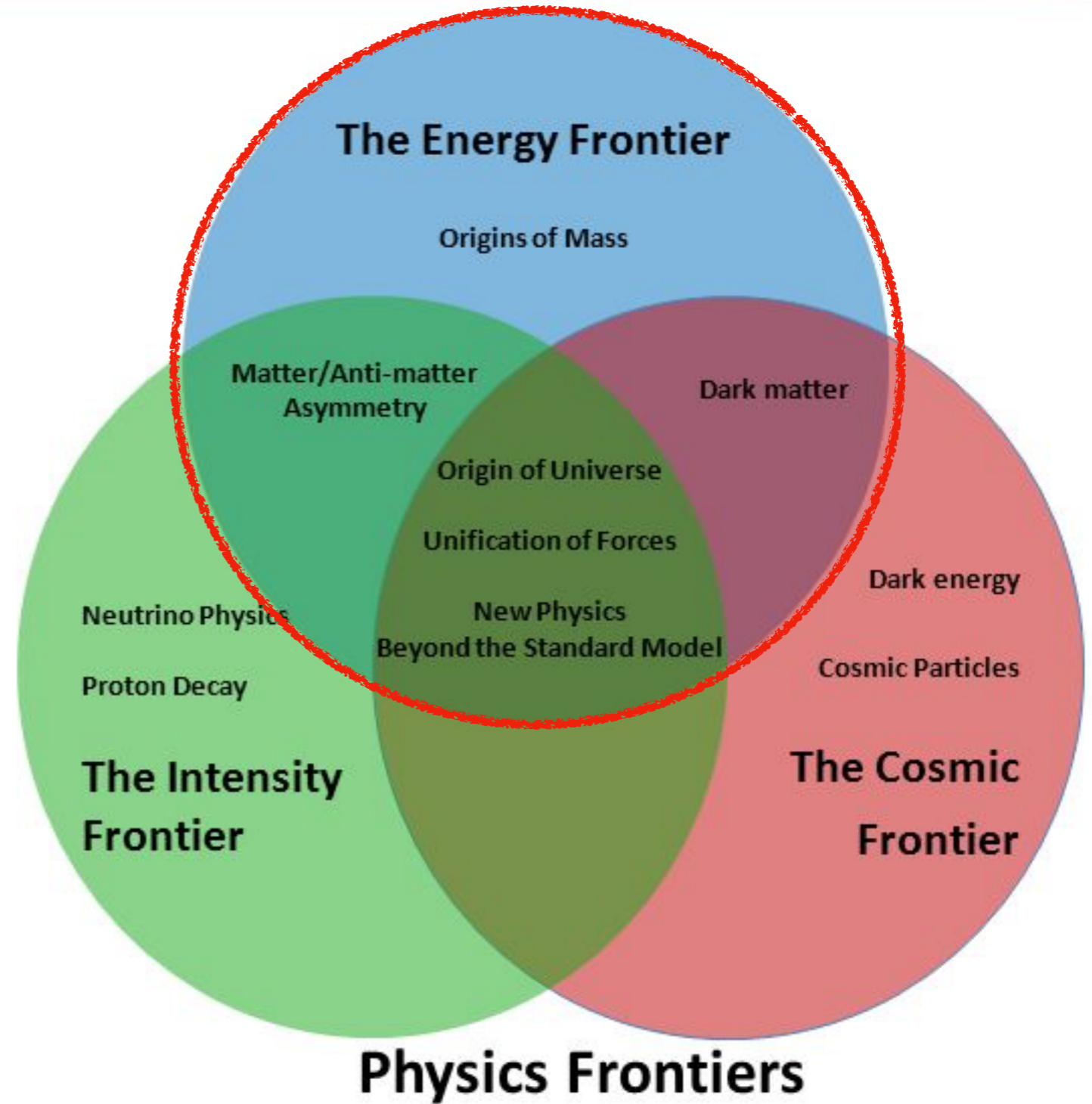
Frontiers in HEP



Along Three Paths

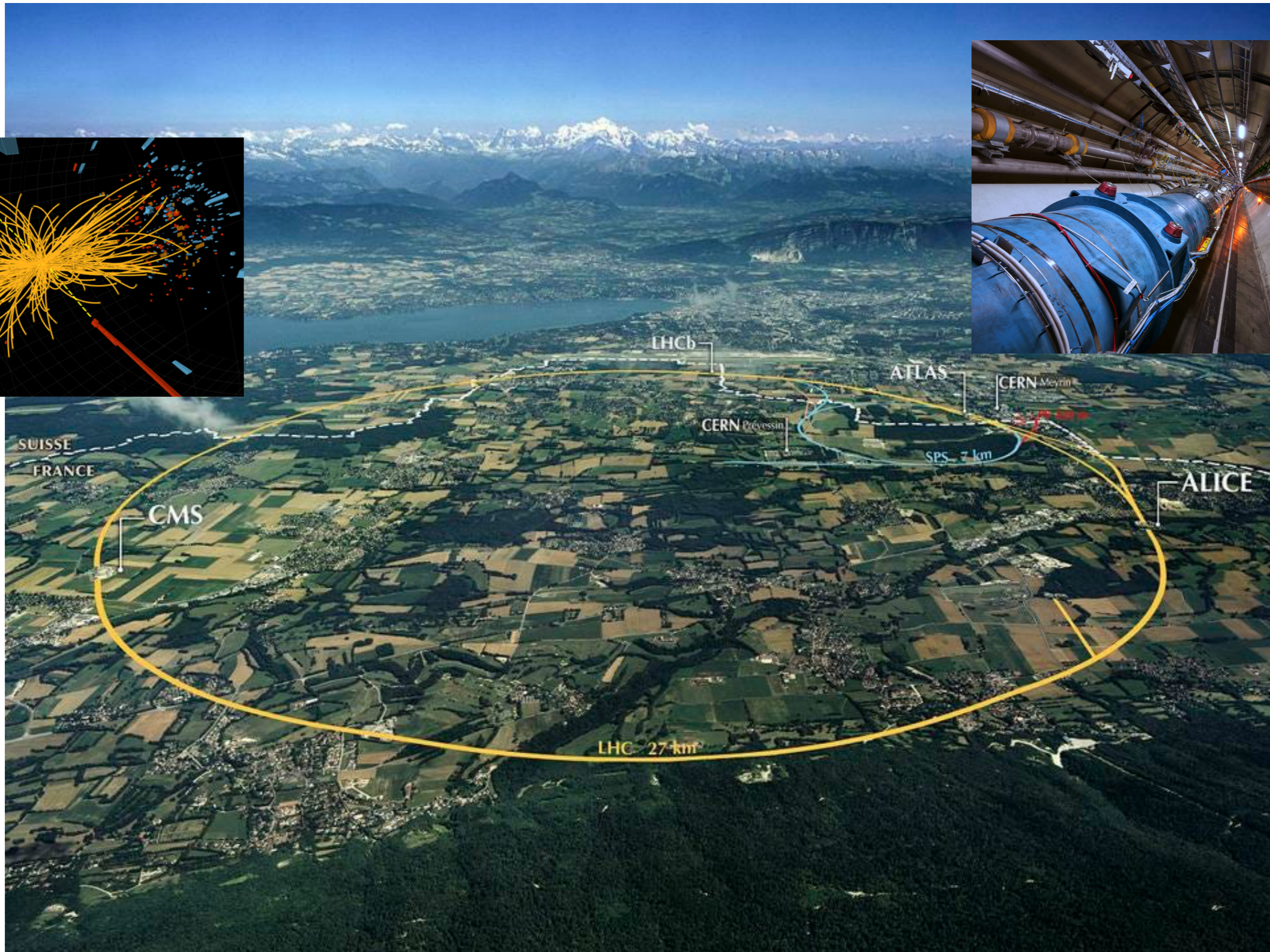
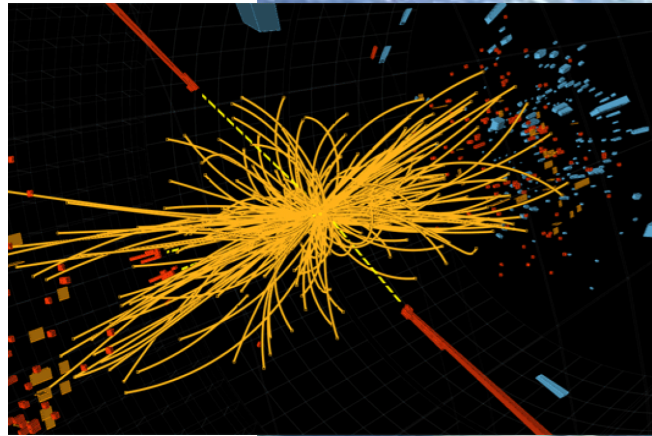


Enabled by
Advanced Technologies in:

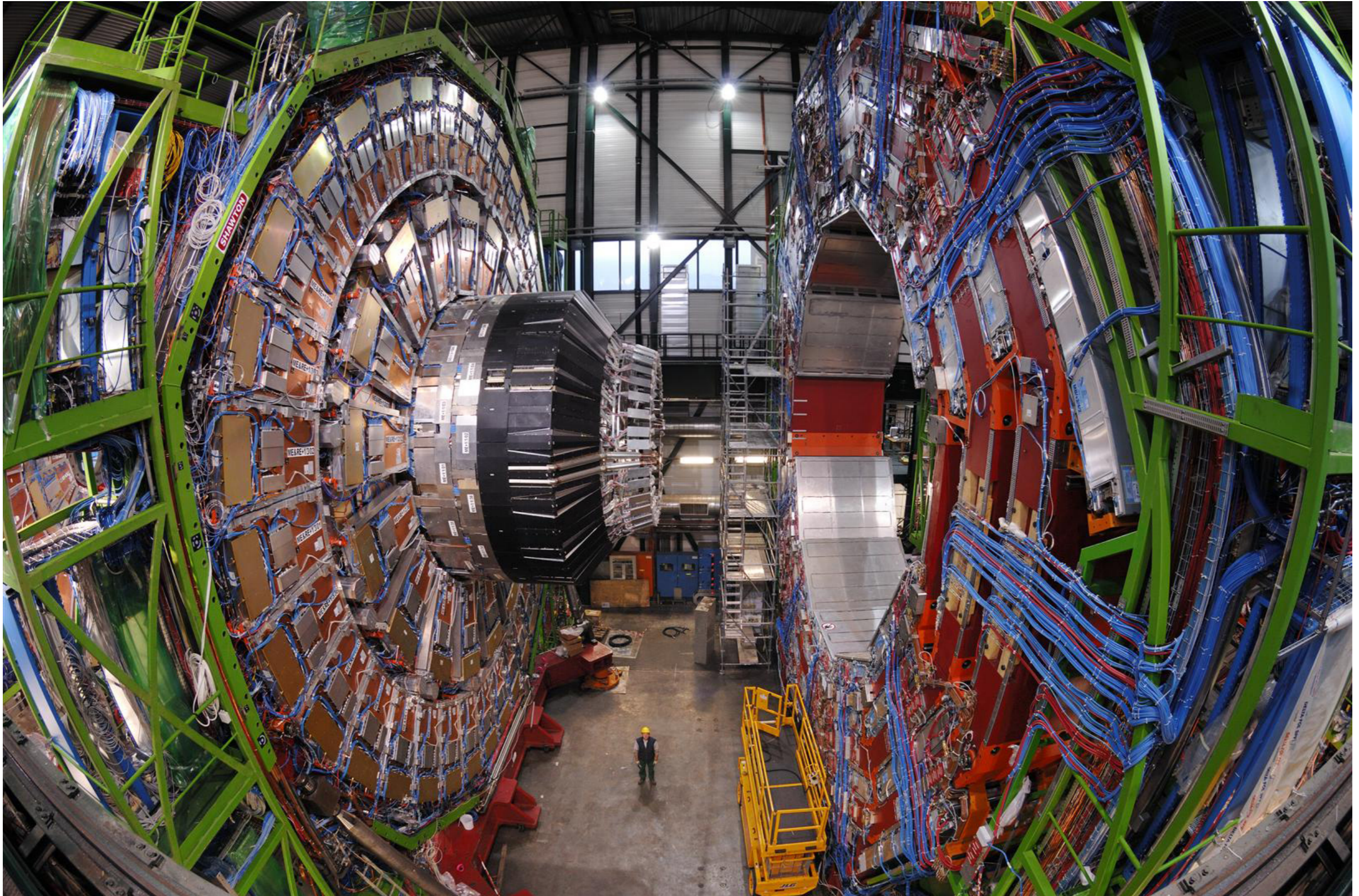


Physics Frontiers

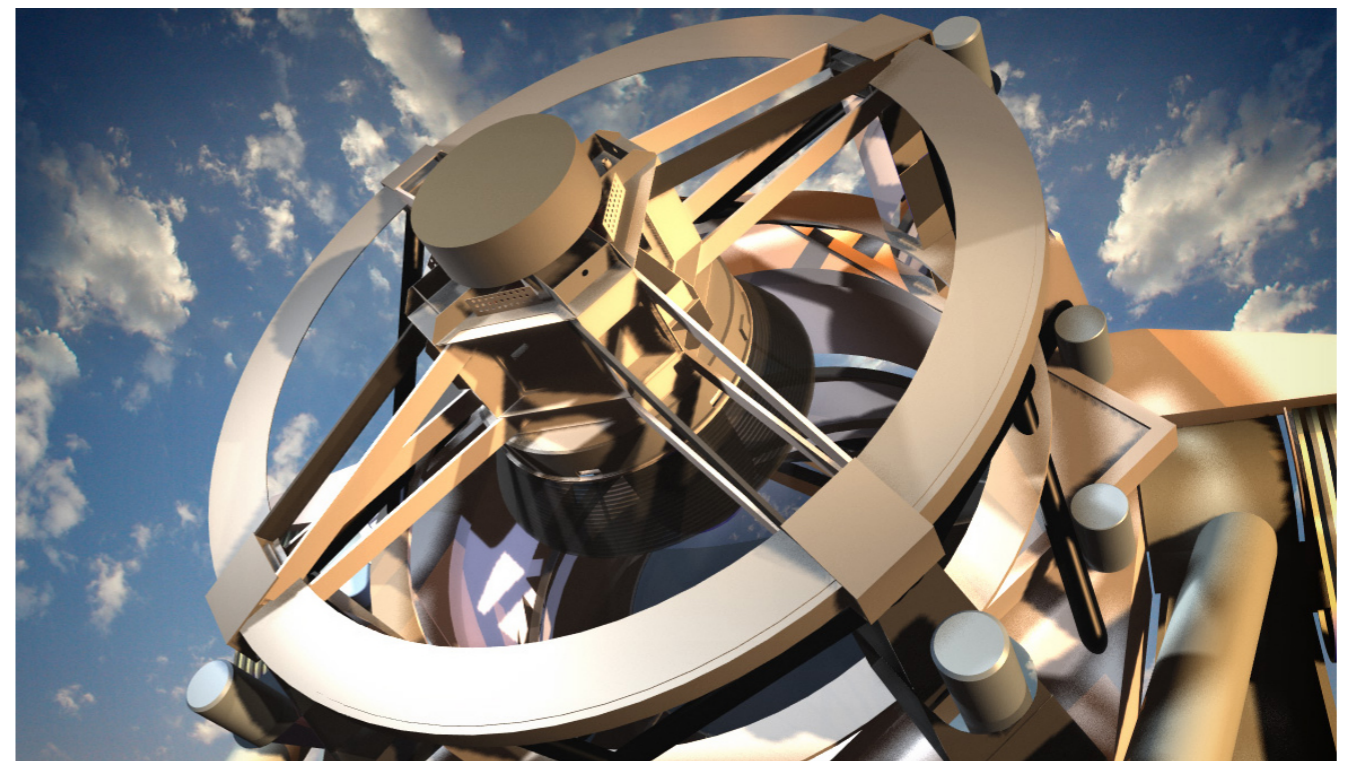
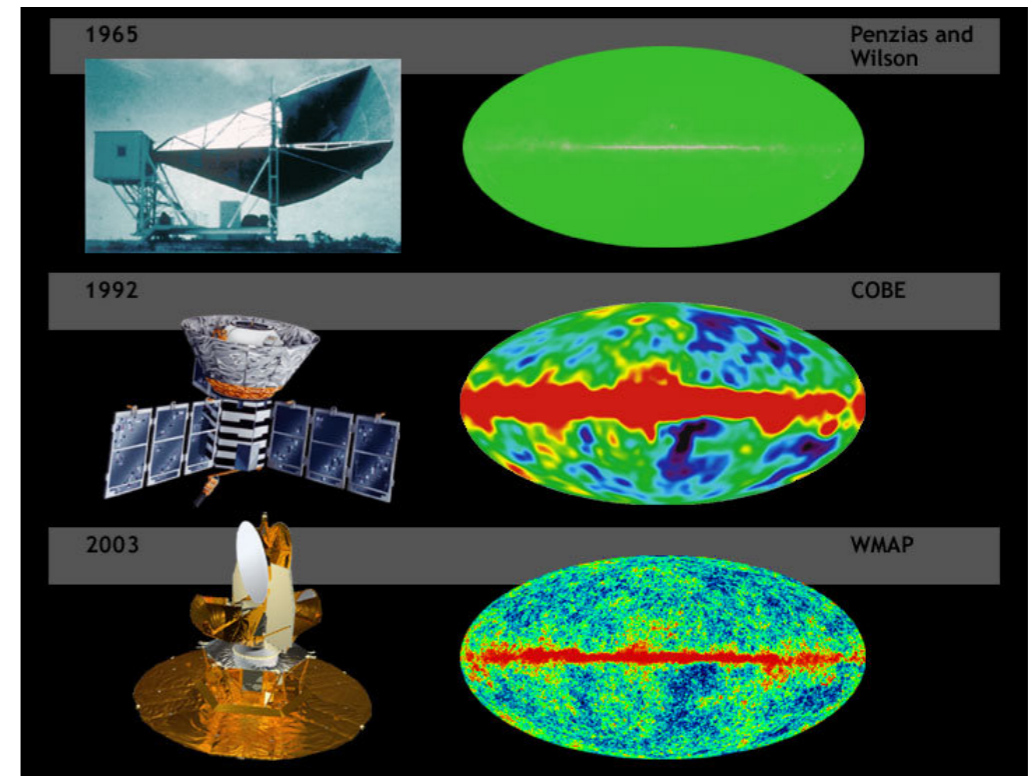
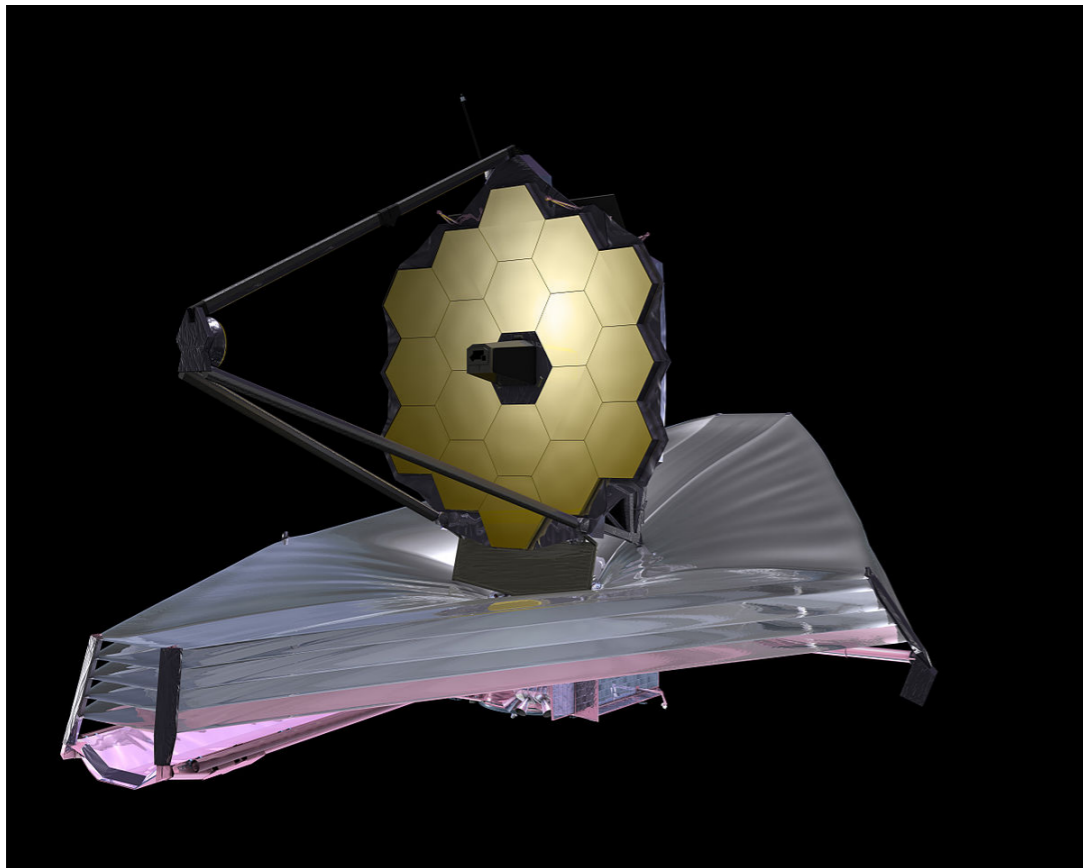
Collider



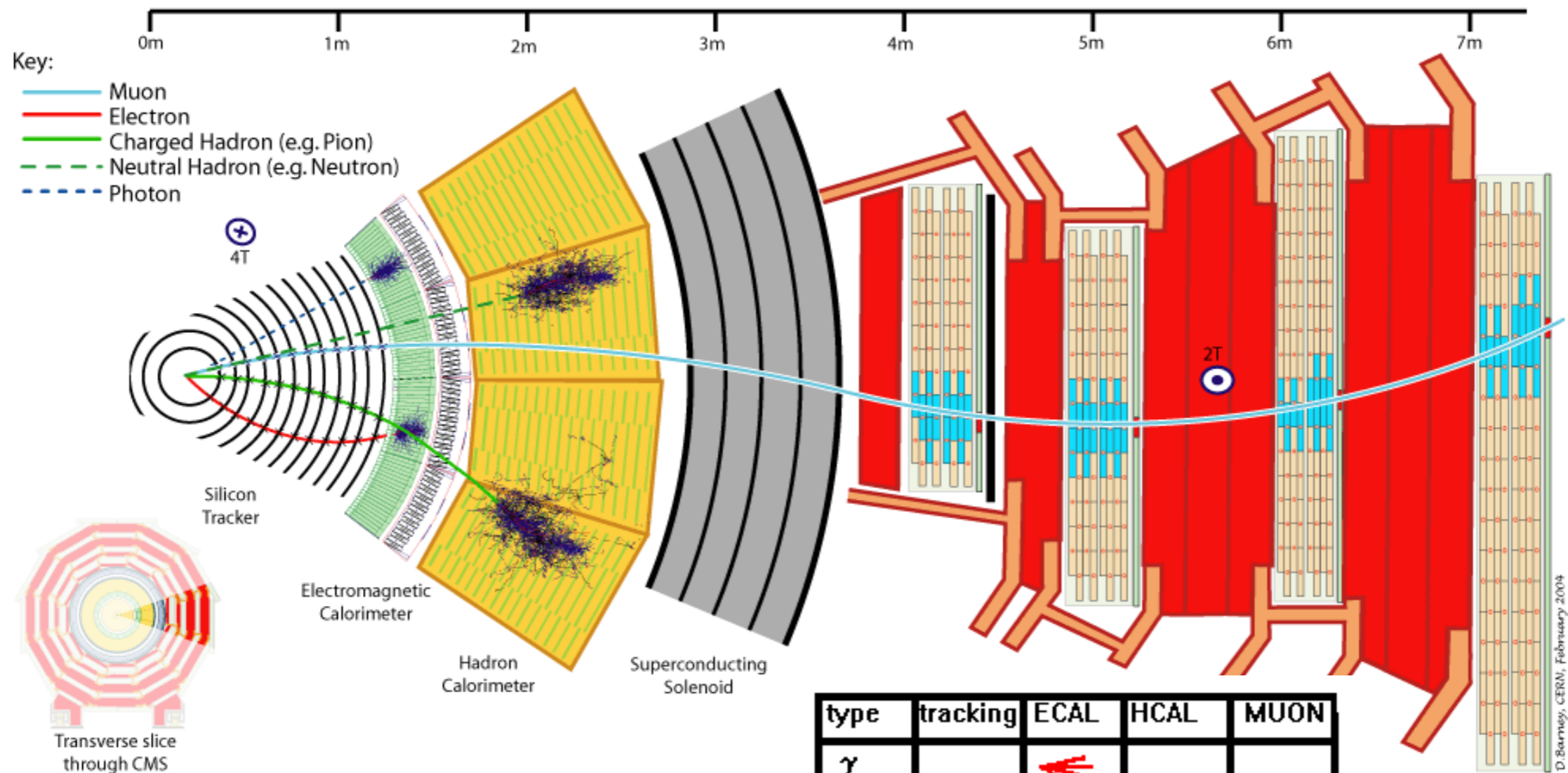
Detector



Astronomy

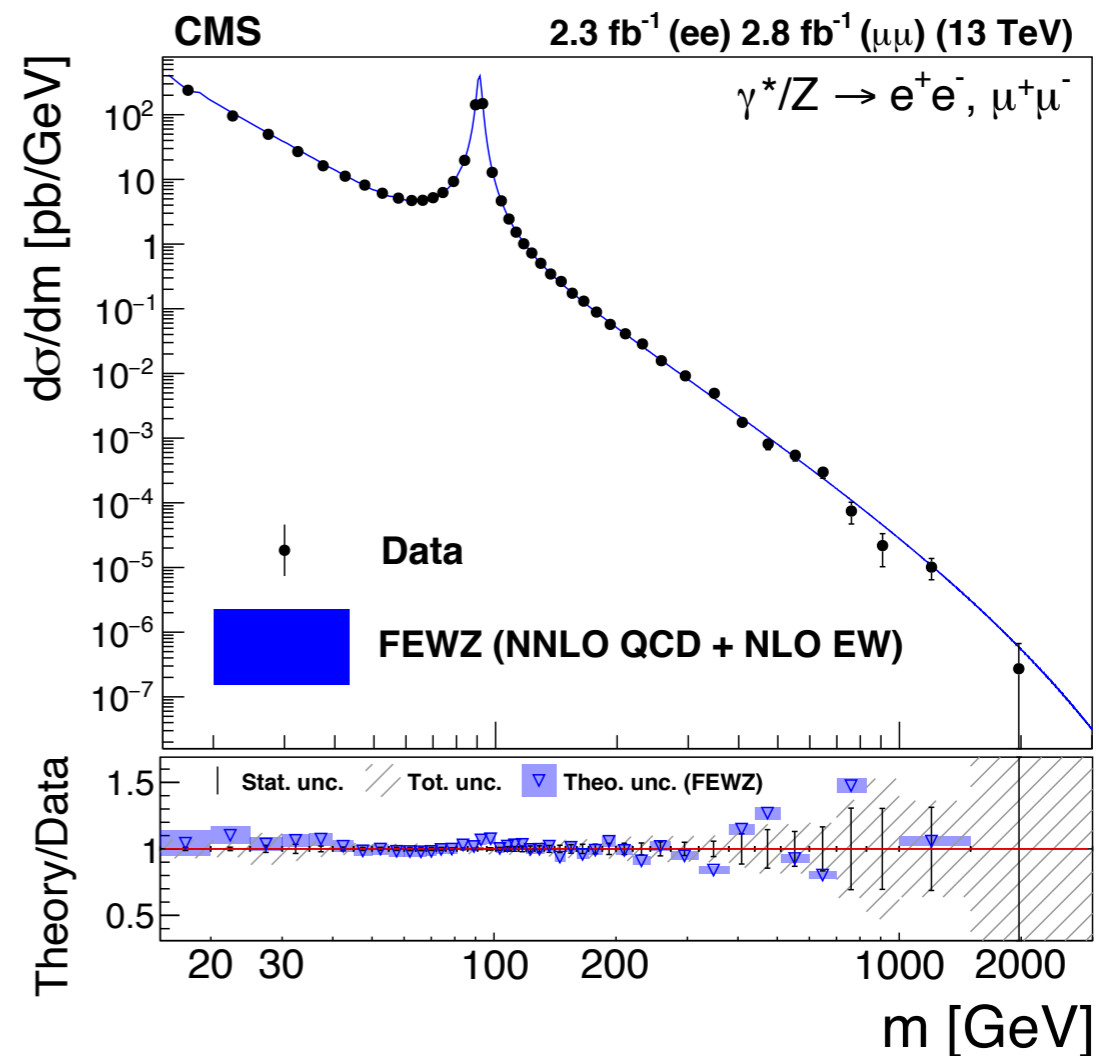
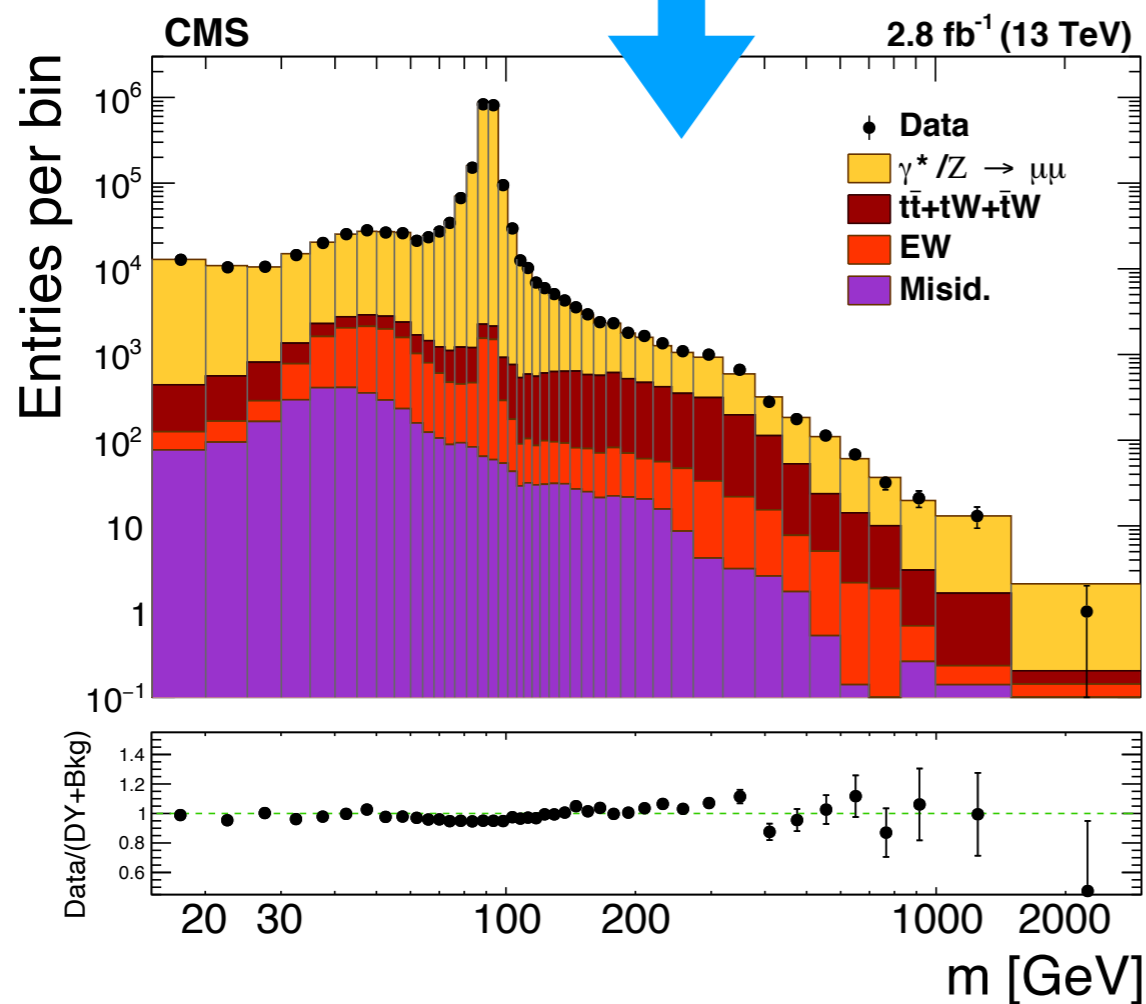
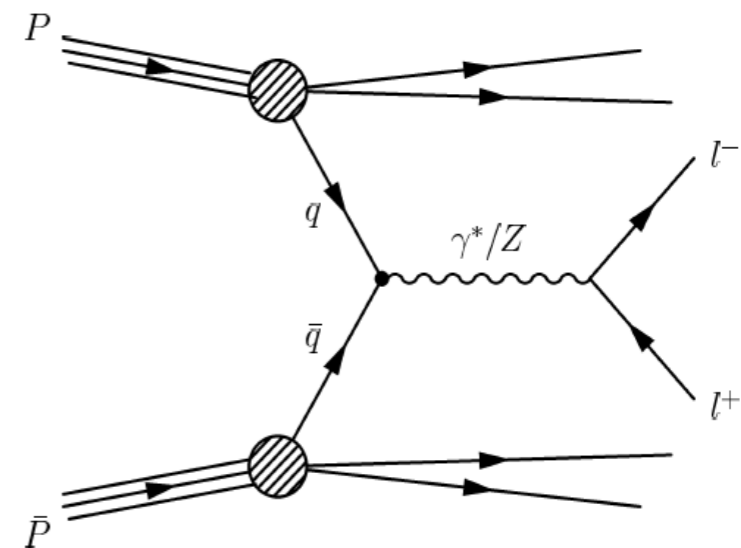
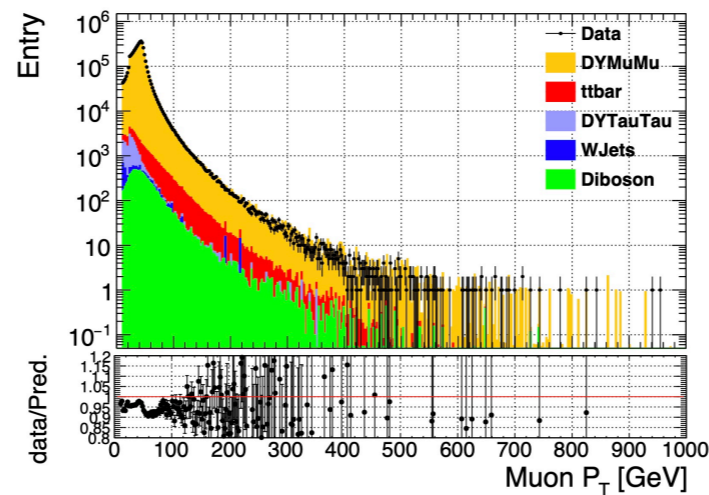
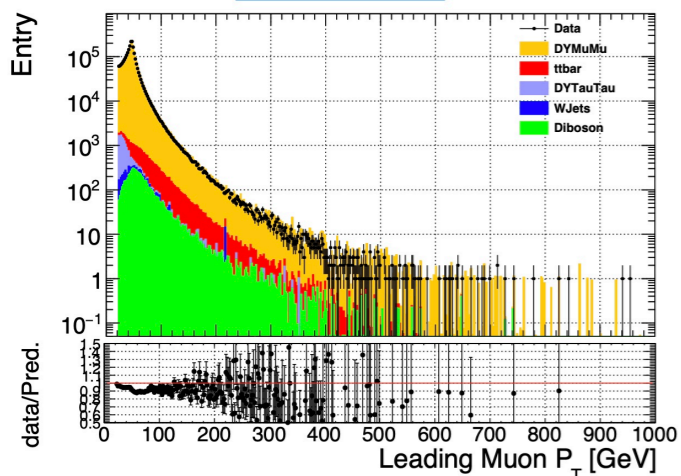


Detection

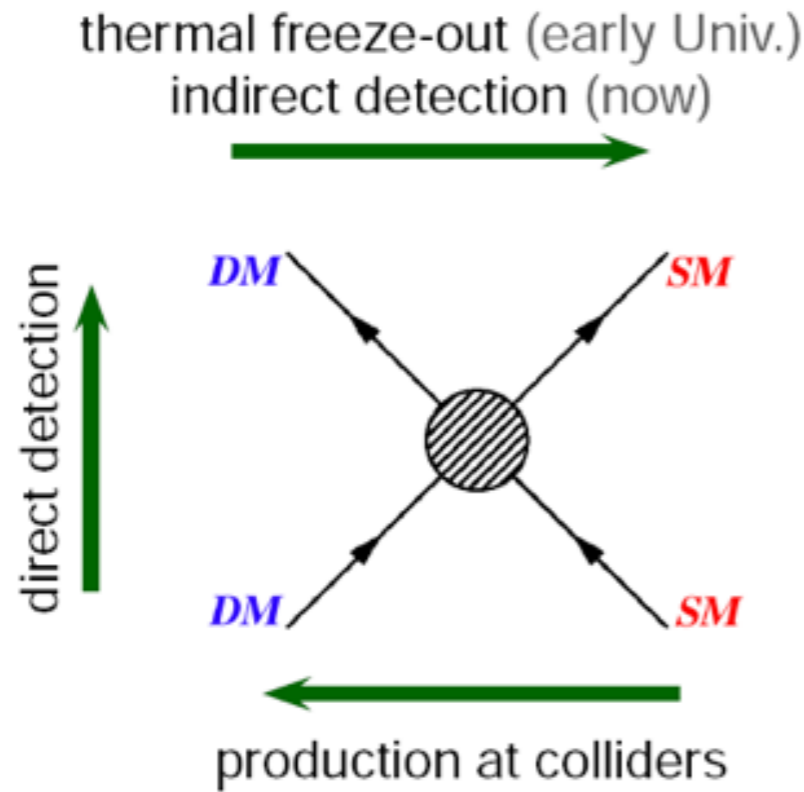


type	tracking	ECAL	HCAL	MUON
γ				
e				
μ				
Jet				
Et miss				

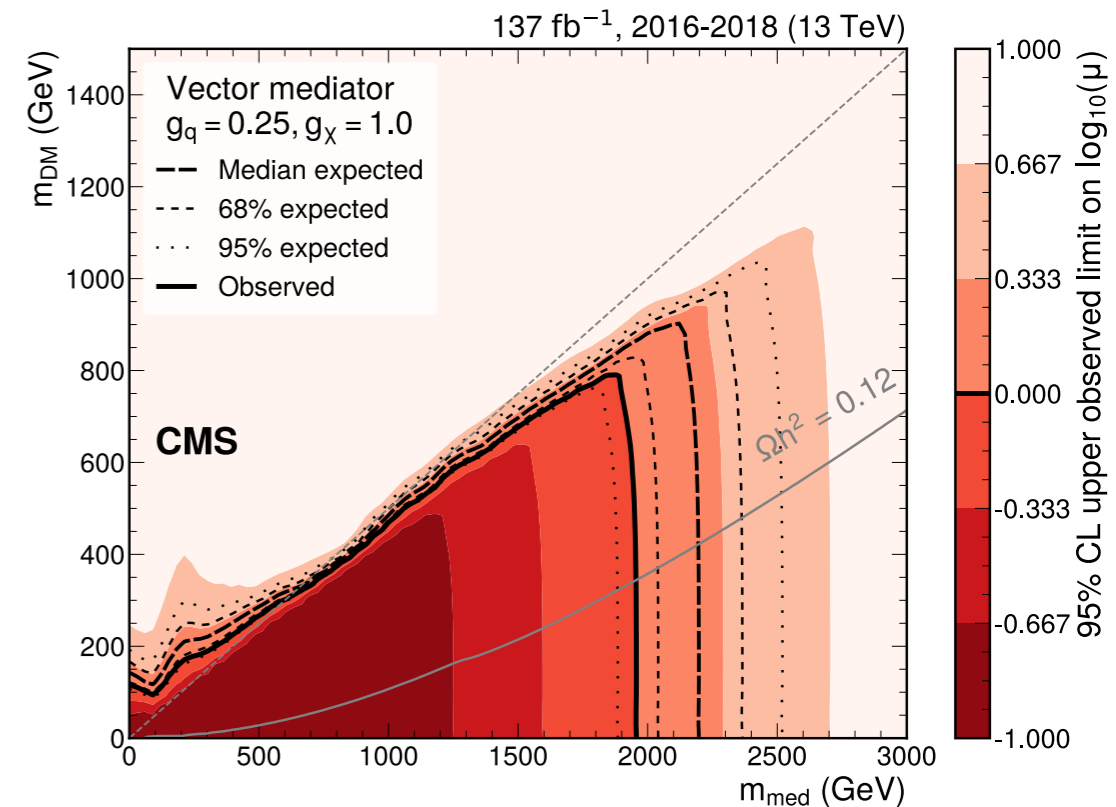
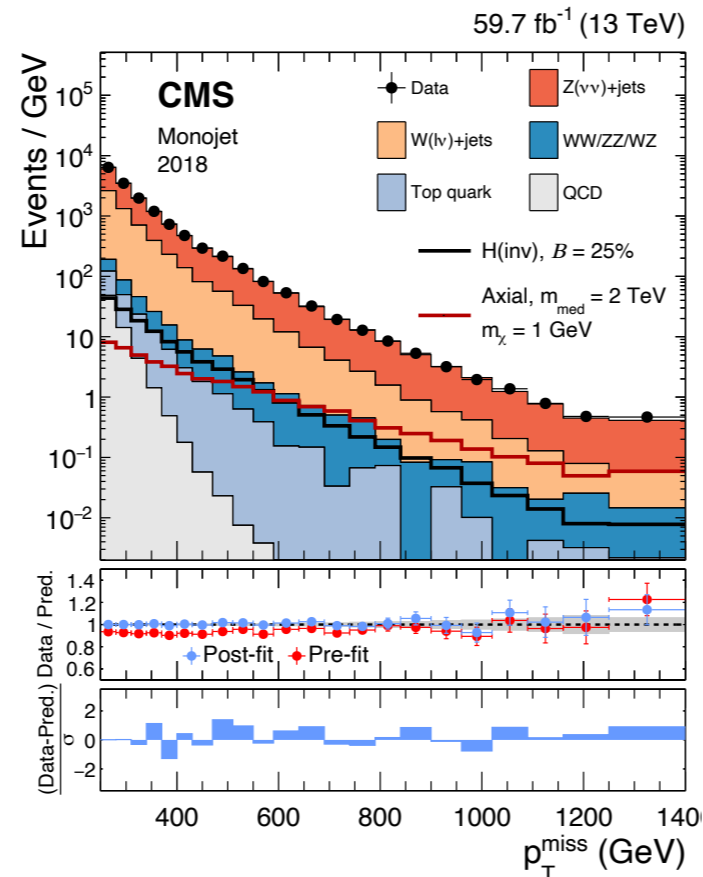
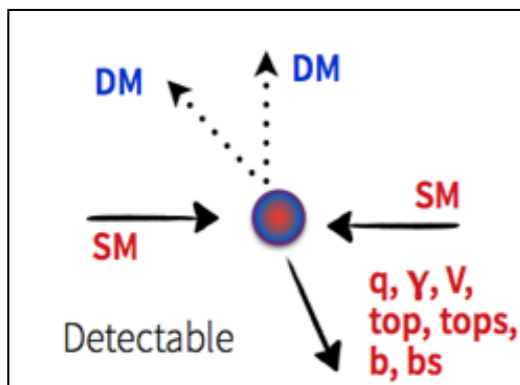
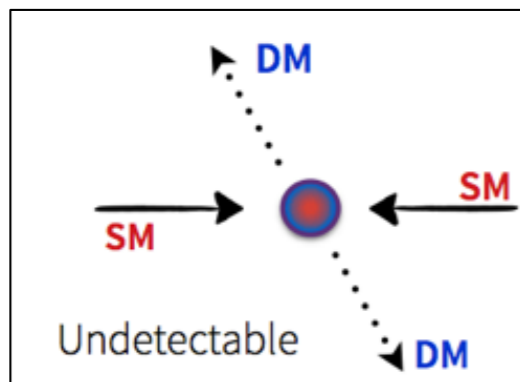
Reconstruction



Dark Matter



Chandra X-ray Observatory

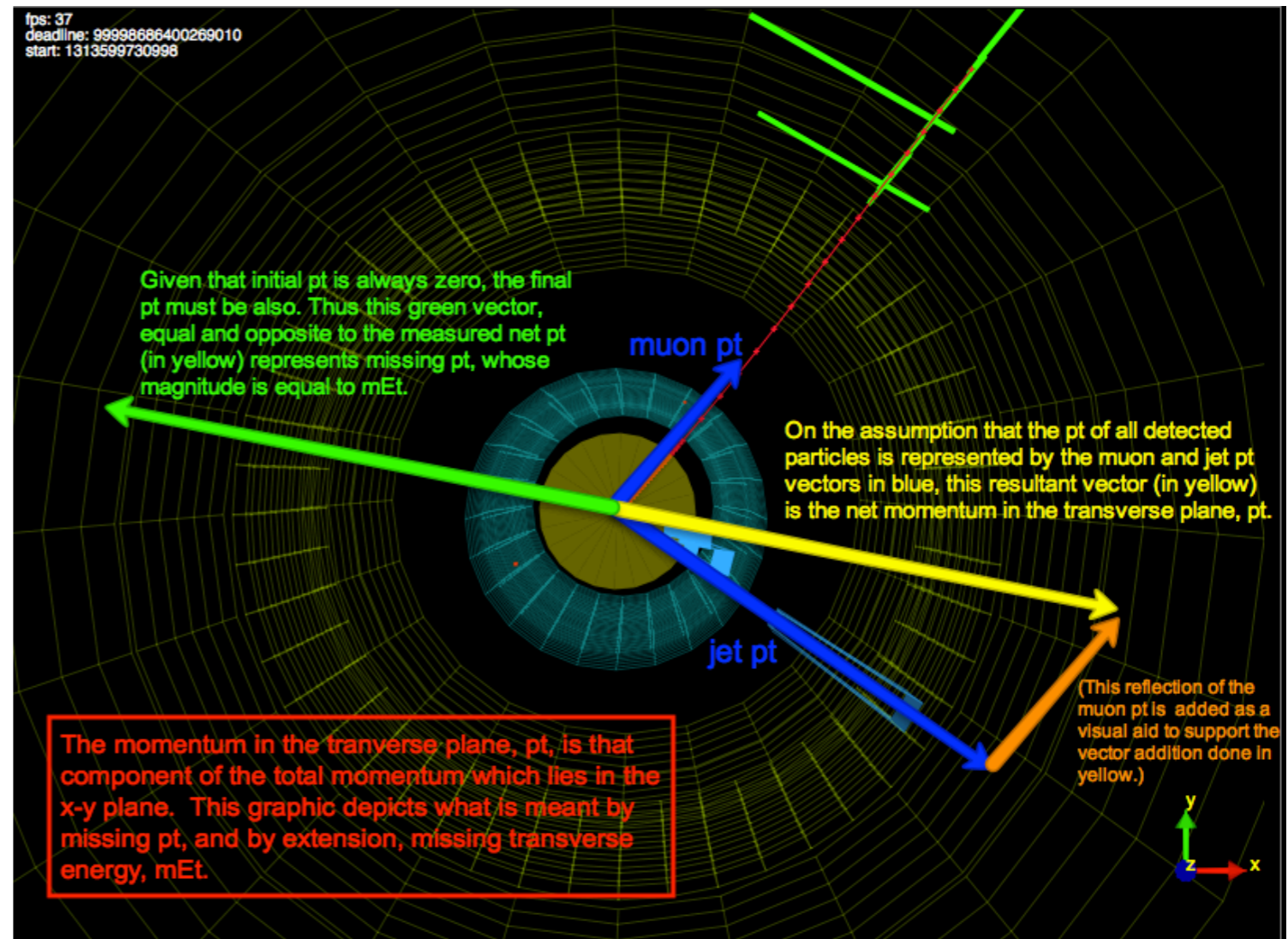
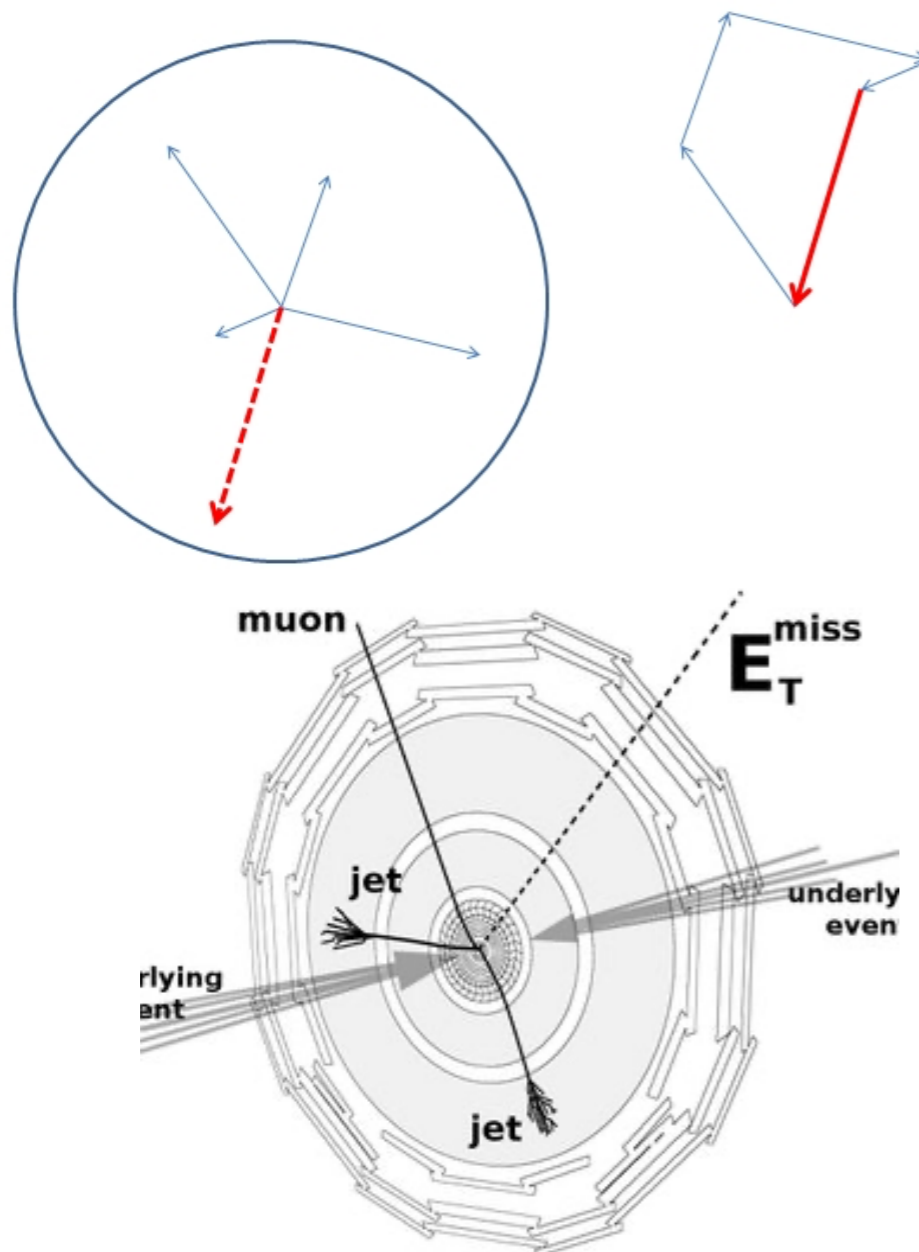


Detection for Anomaly

- Case 1: no interaction with detector materials
 - Missing Transverse Energy (MET)
- Case 2: non-conventional decay under heavy backgrounds
 - Fast timing resolution
- Case 3: complex signature
 - Machine learning application

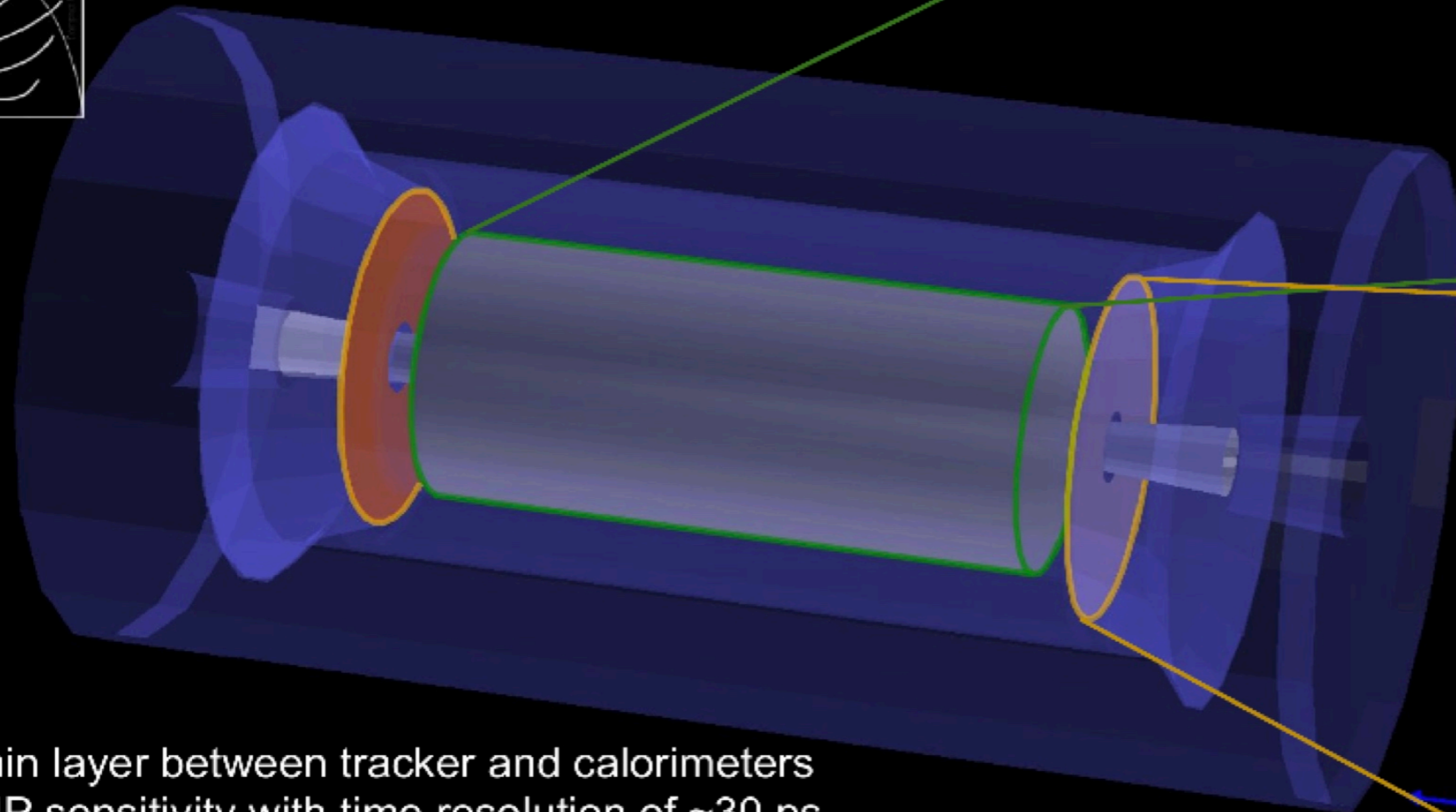
Missing E_T

- No interaction: ex) neutrino, dark matter
- MET: use the principle of momentum/energy conservation

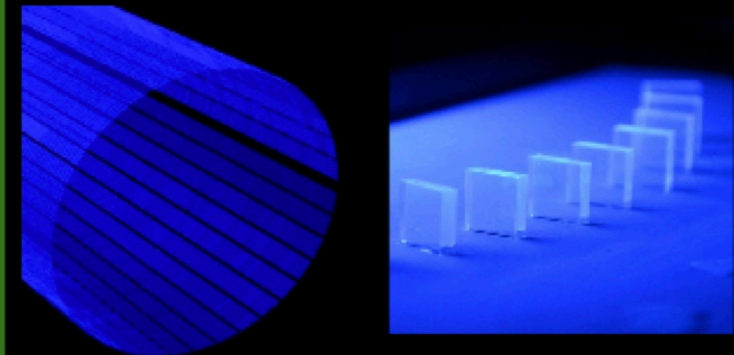


Fast Timing

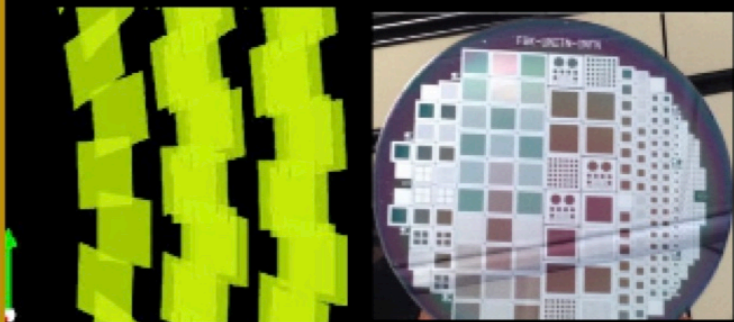
MTD design overview



BARREL
TK/ECAL interface ~ 25 mm thick
Surface ~ 40 m²
Radiation level ~ 2×10^{14} n_{eq}/cm²
Sensors: **LYSO crystals + SiPMs**



ENDCAPS
On the CE nose ~ 42 mm thick
Surface ~ 12 m²
Radiation level ~ 2×10^{15} n_{eq}/cm²
Sensors: **Si with internal gain (LGAD)**



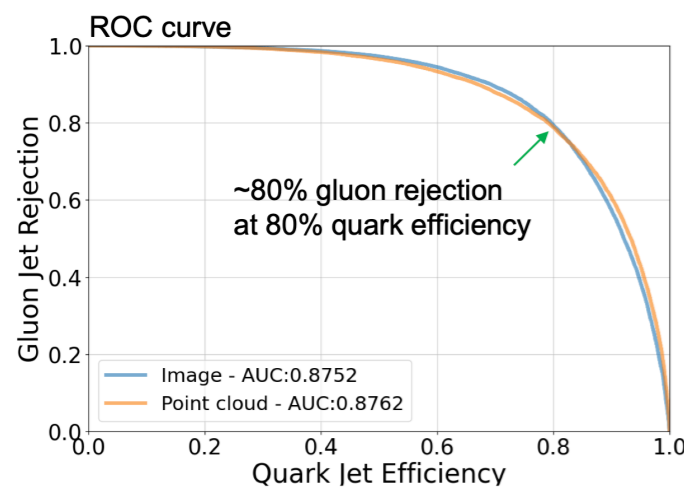
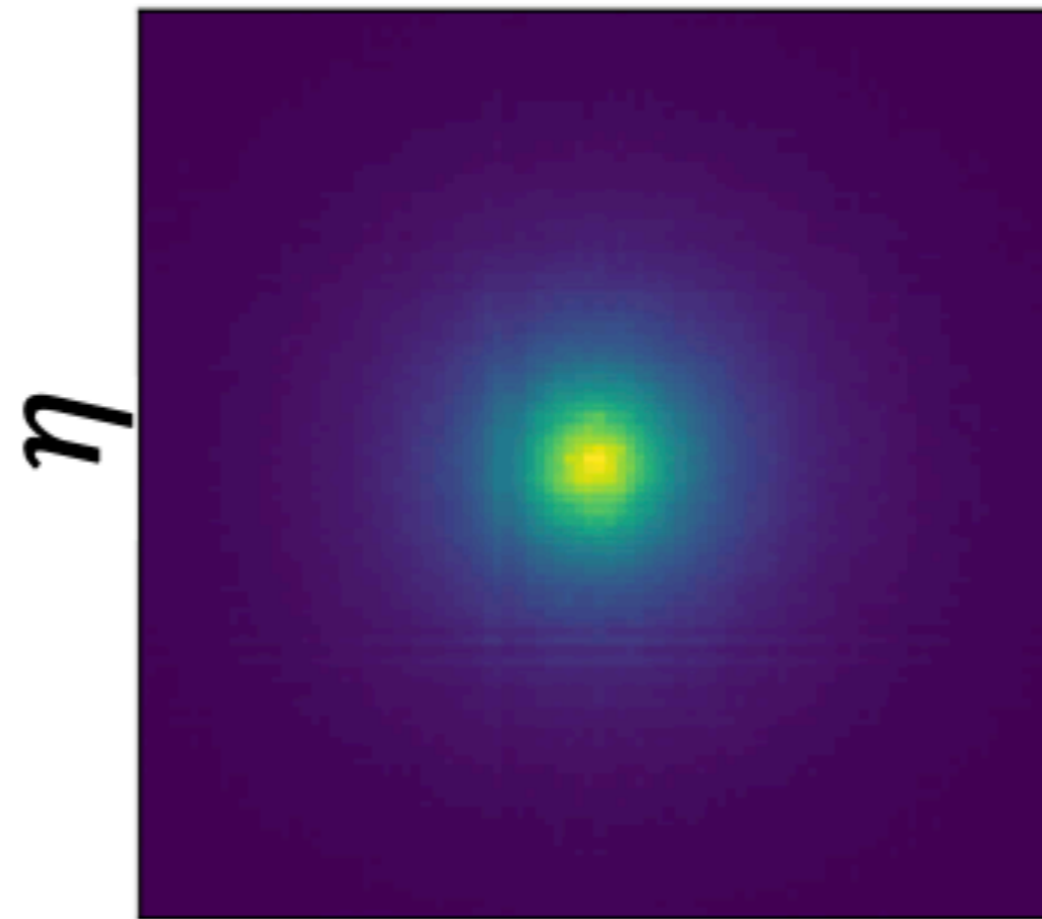
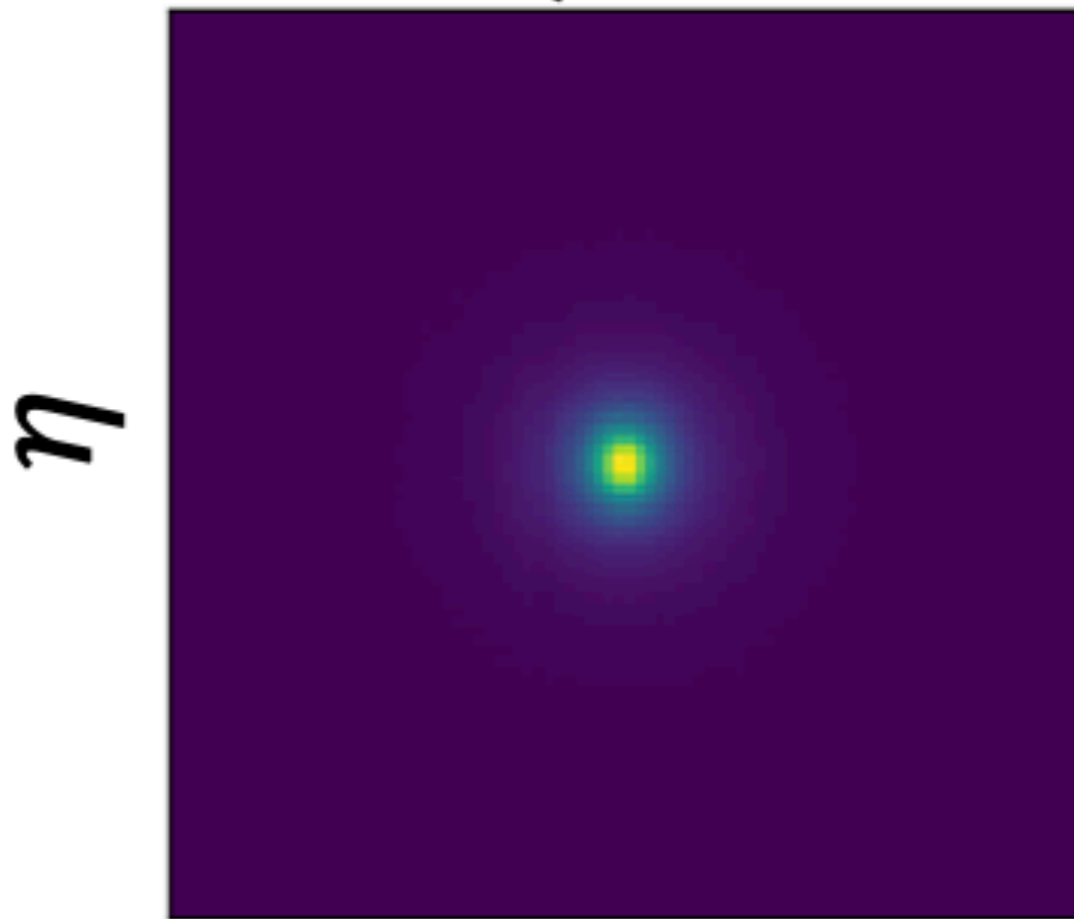
- Thin layer between tracker and calorimeters
- MIP sensitivity with time resolution of ~30 ps
- Hermetic coverage for $|\eta| < 3$

ML Application

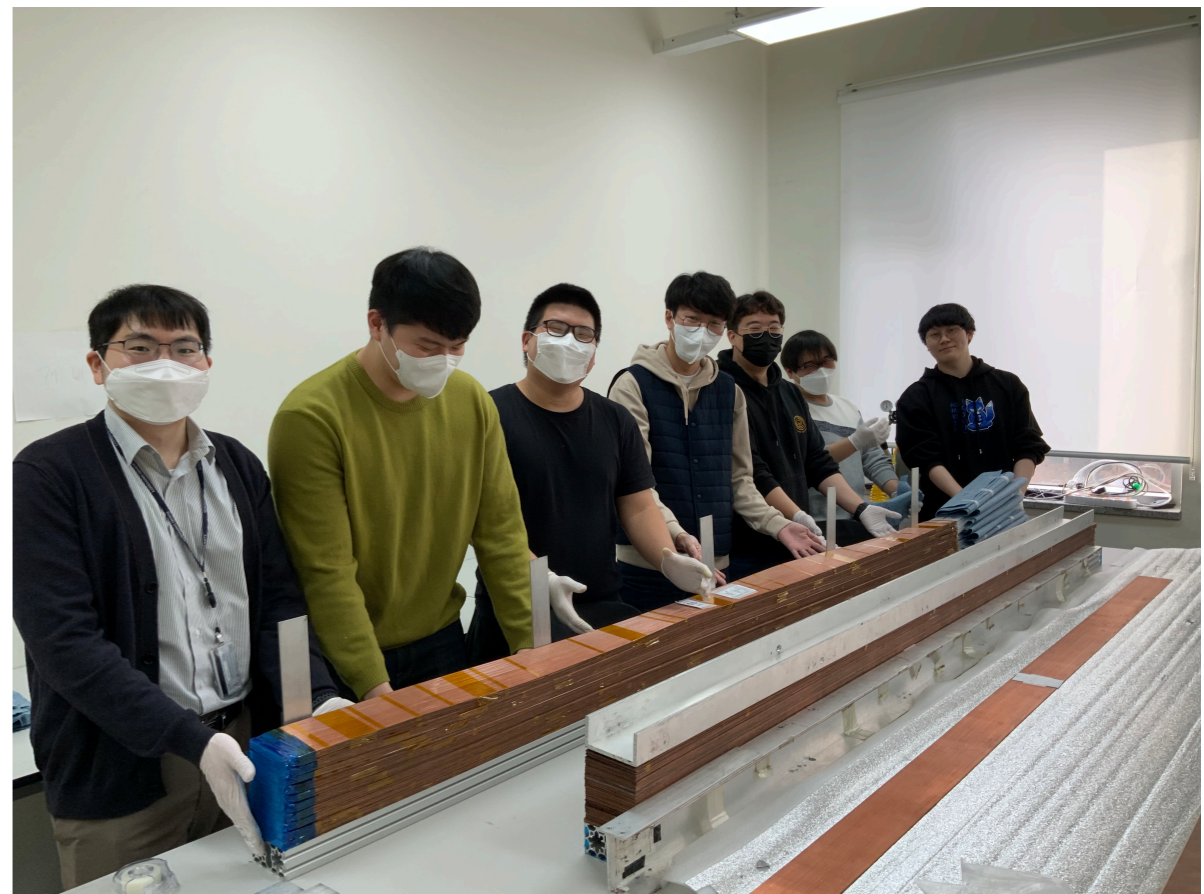
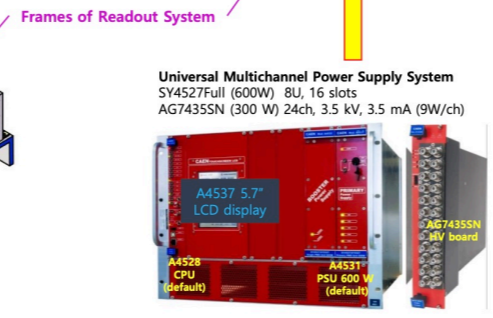
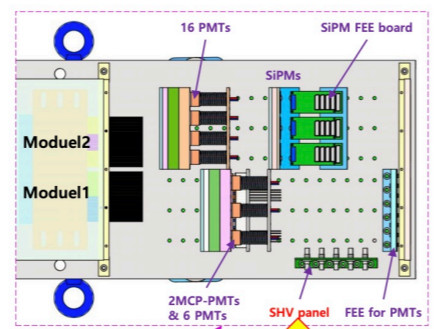
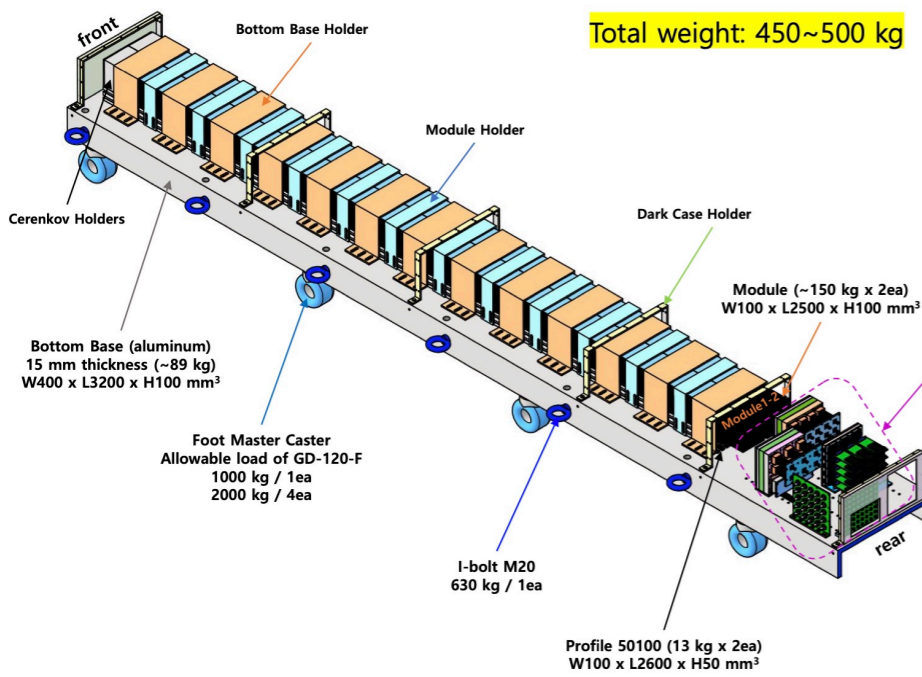
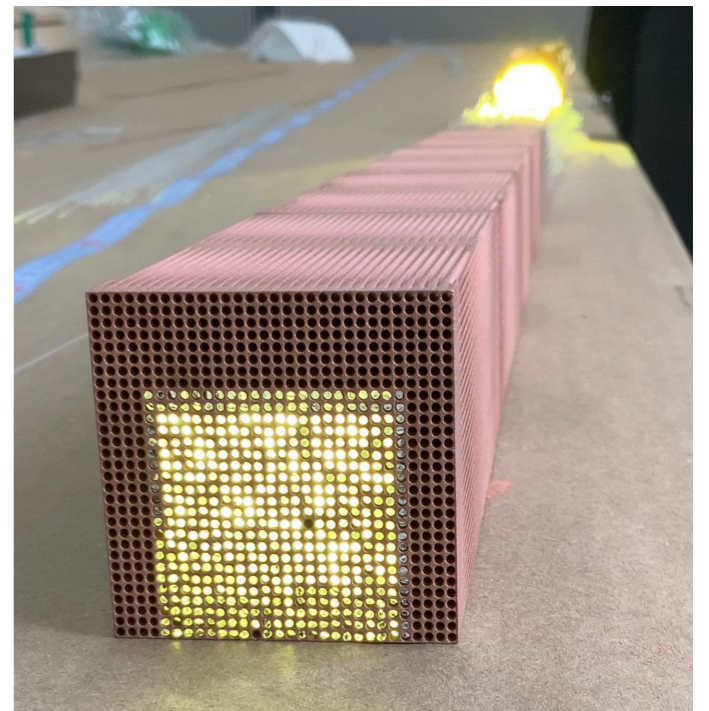
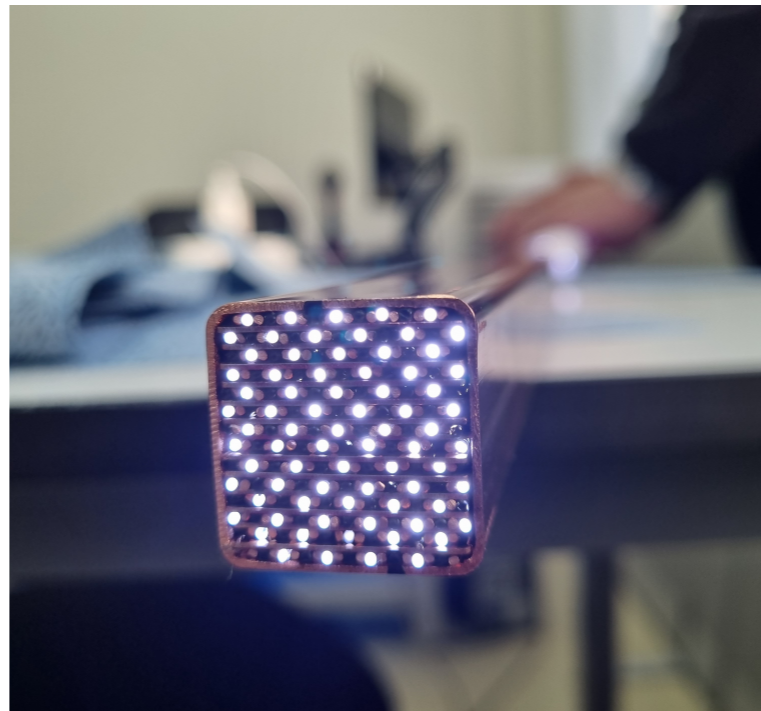
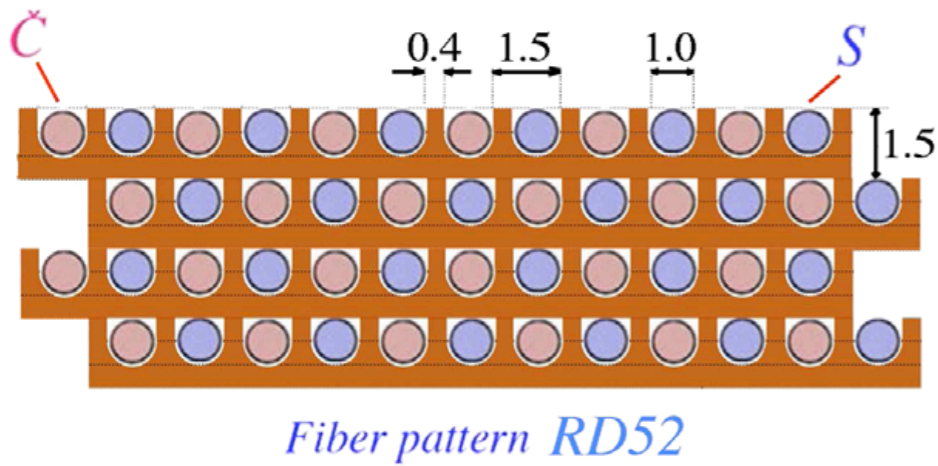
Average scintillation energy images

Quark

Gluon

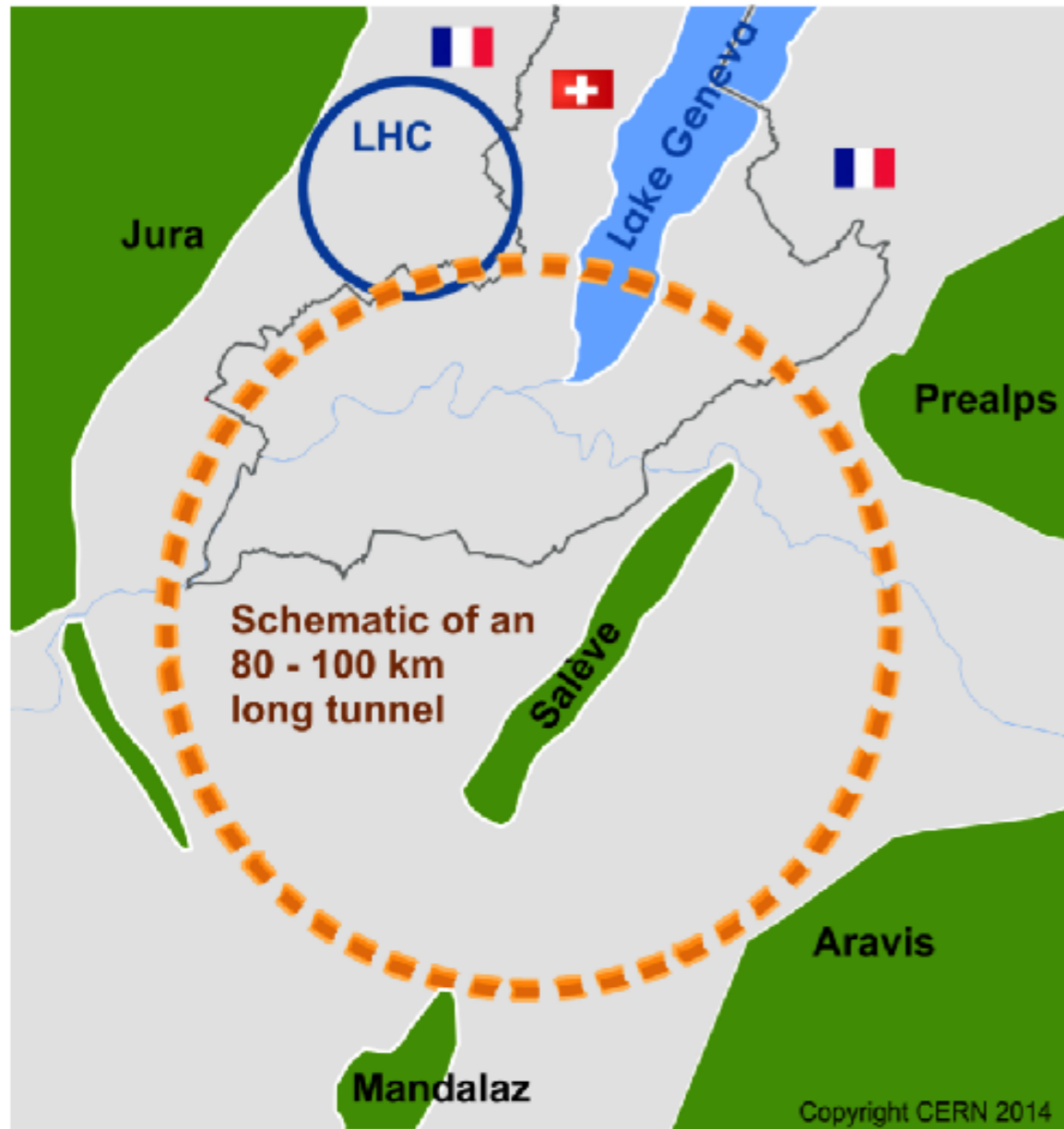


Dual-Readout Calorimeter

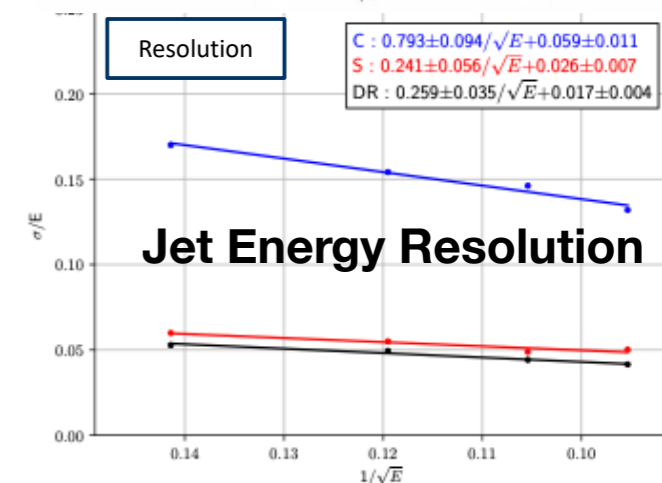
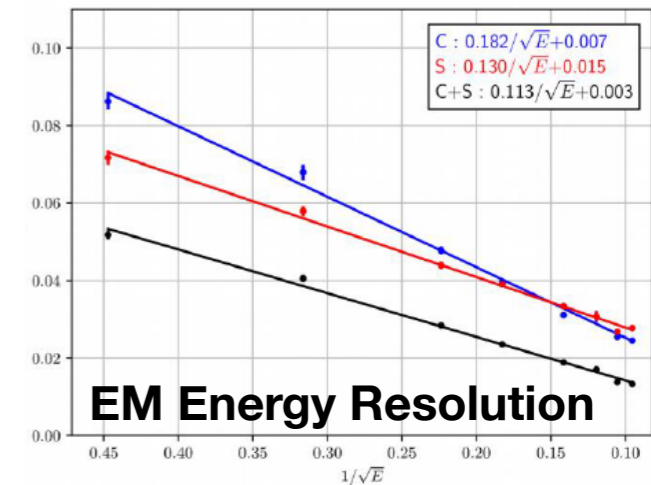
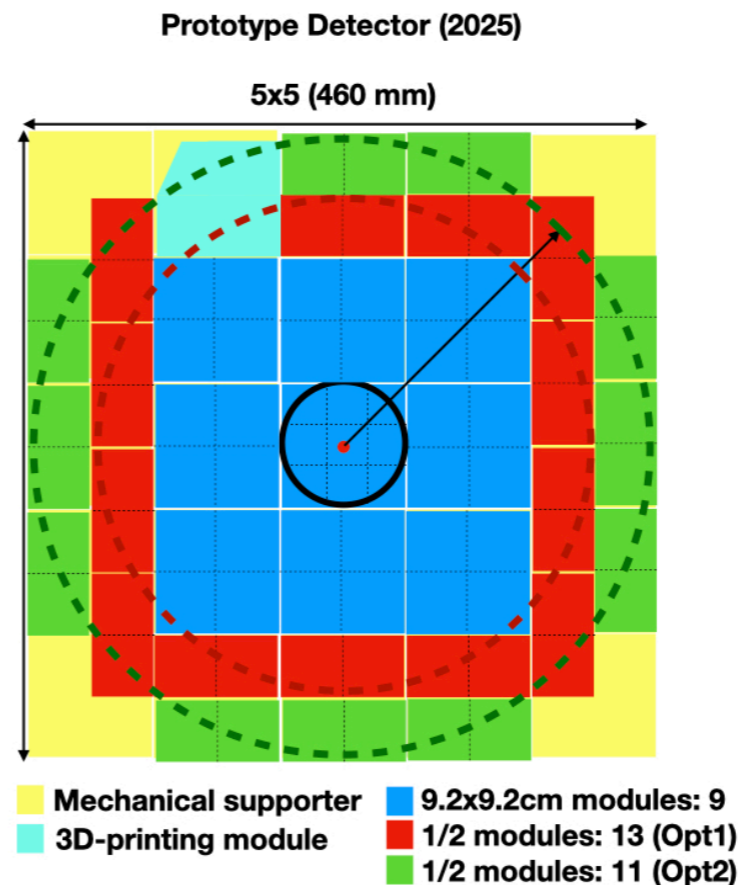
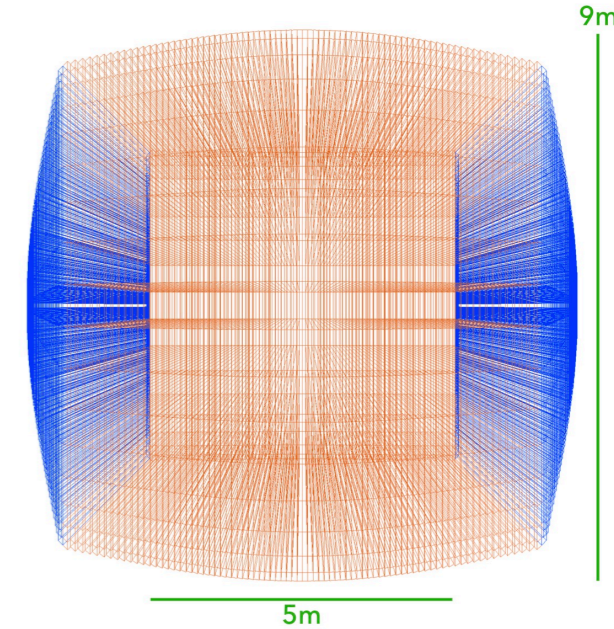
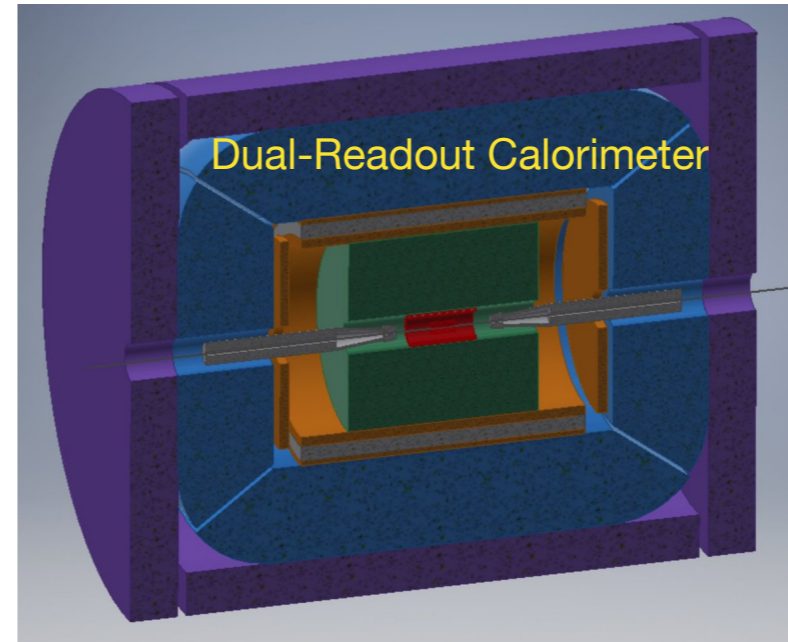


Future Collider & DRC

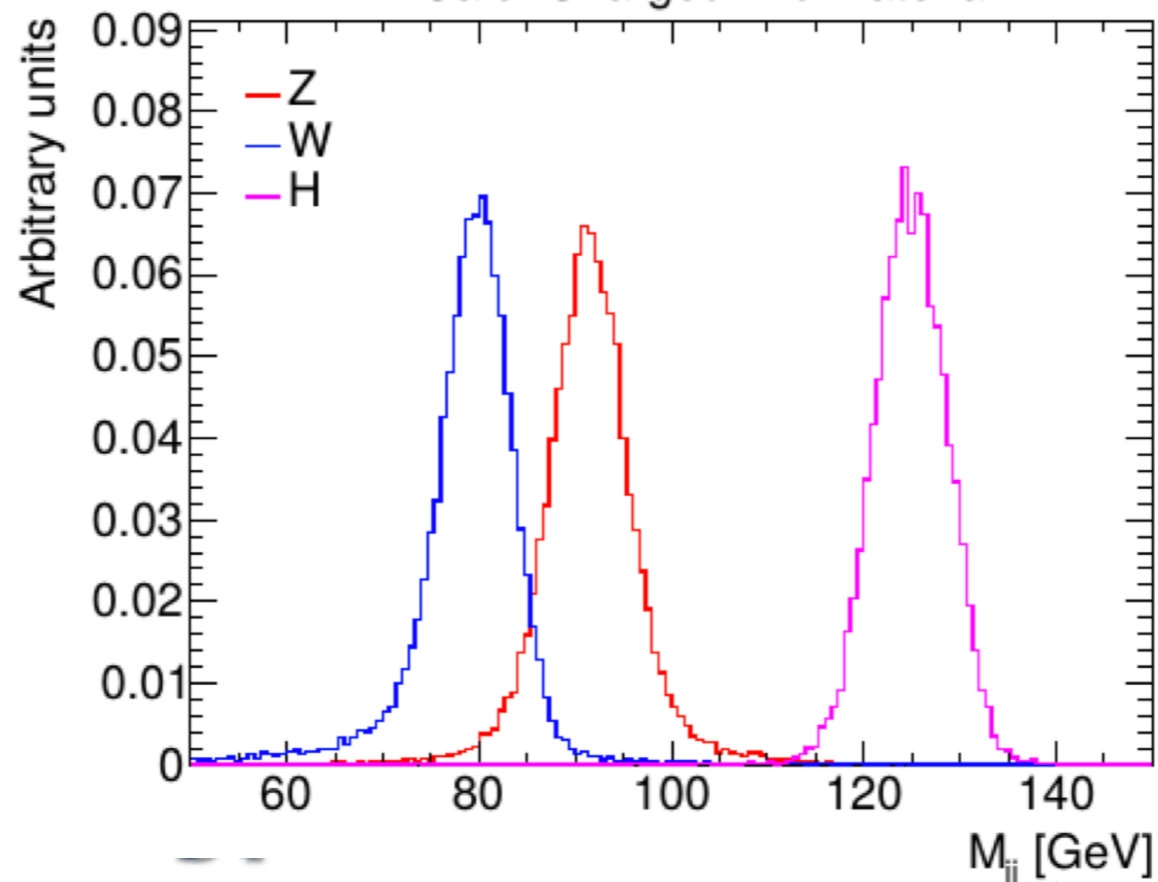
Toward world best calorimeter ever built in history



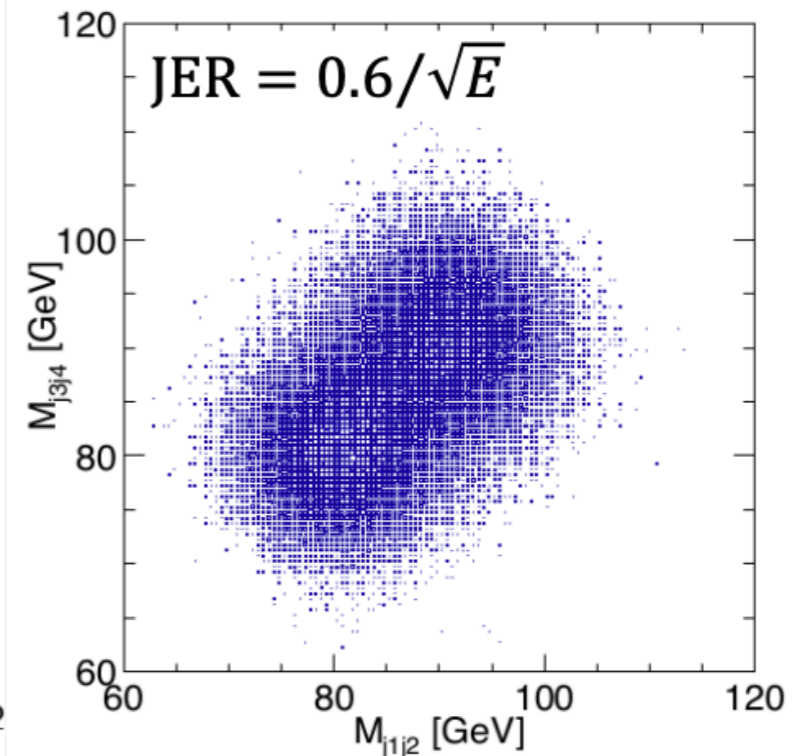
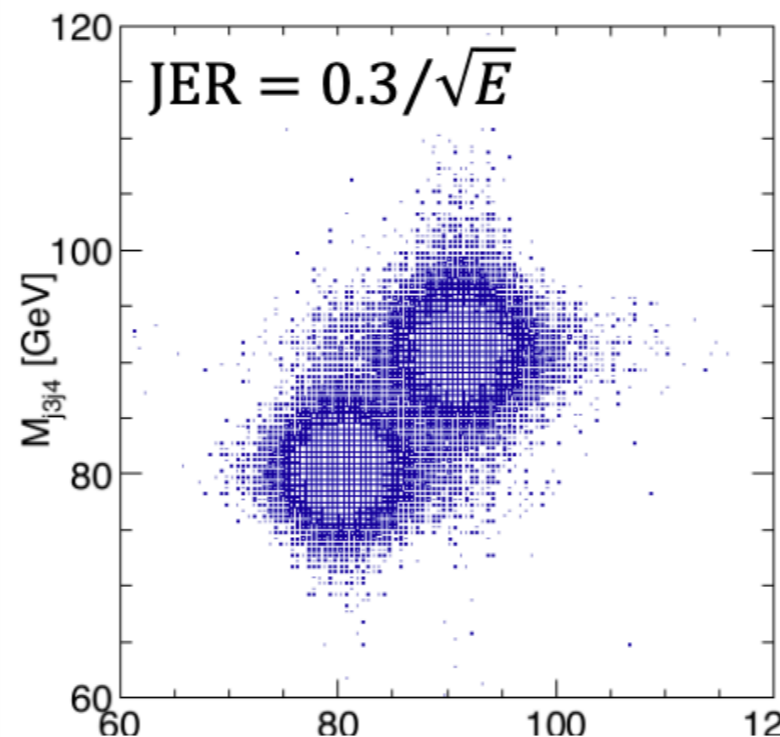
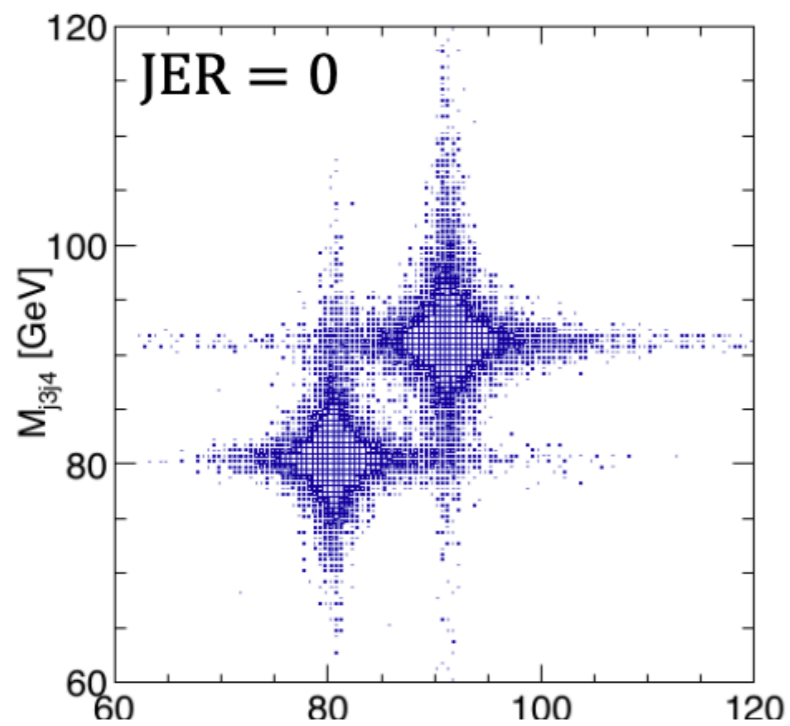
For next 40 years!



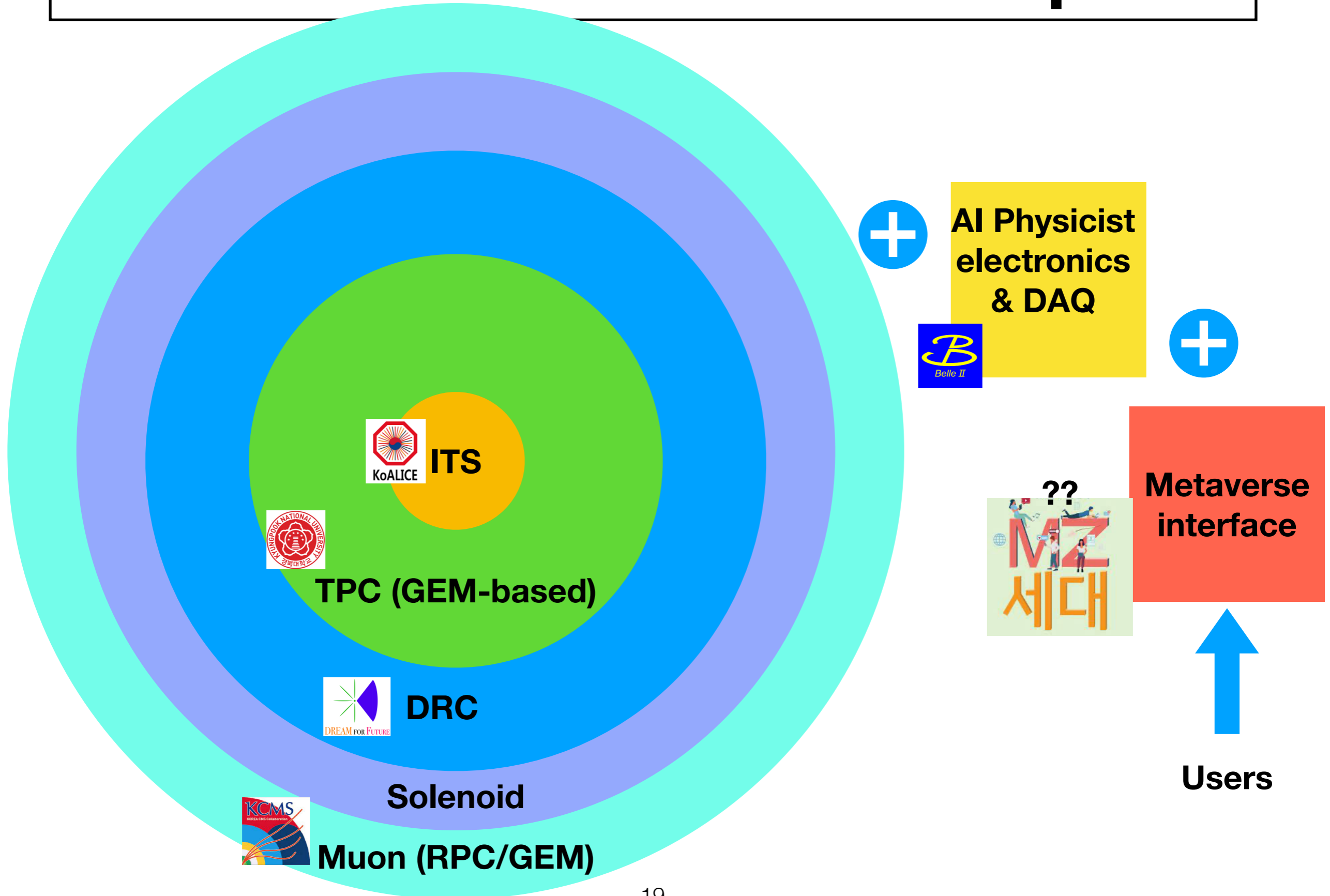
Calorimeter Resolution



Never distinguish among W, Z, Higgs in hadronic channel



New Detector Concept



... Then ...

Understand our universe better

