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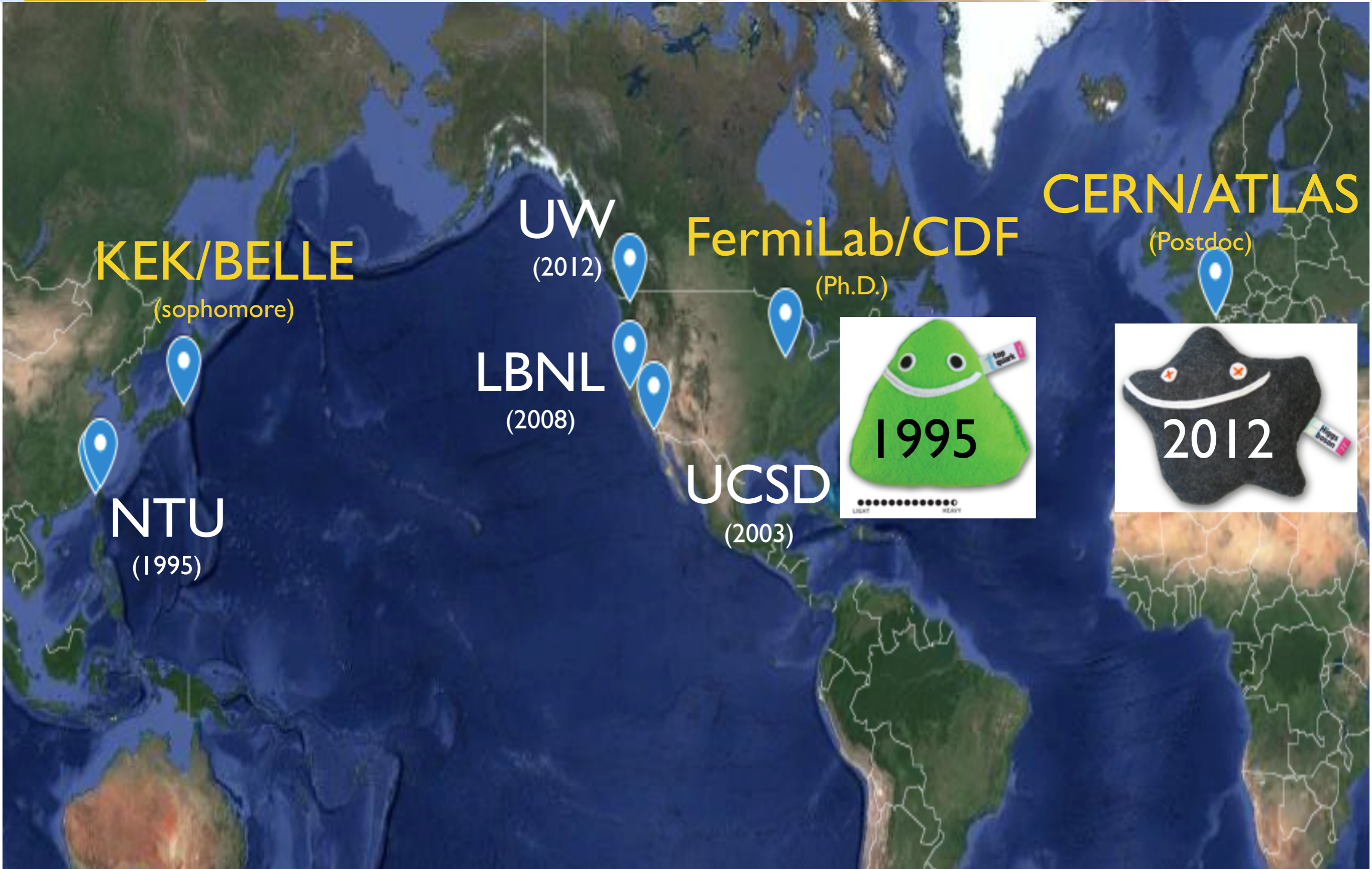
Experimental Particle Physics at UW

Shih-Chieh Hsu
University of Washington Seattle

Aug 17 2018
QuarkNet Workshop



My Journey as a Particle Physicist



KEK/BELLE

(sophomore)

UW

(2012)

FermiLab/CDF

(Ph.D.)

CERN/ATLAS

(Postdoc)

LBNL

(2008)

UCSD

(2003)

NTU

(1995)





Our Mission

To study the **fundamental** building blocks of the matter and their interactions in **the Universe**.

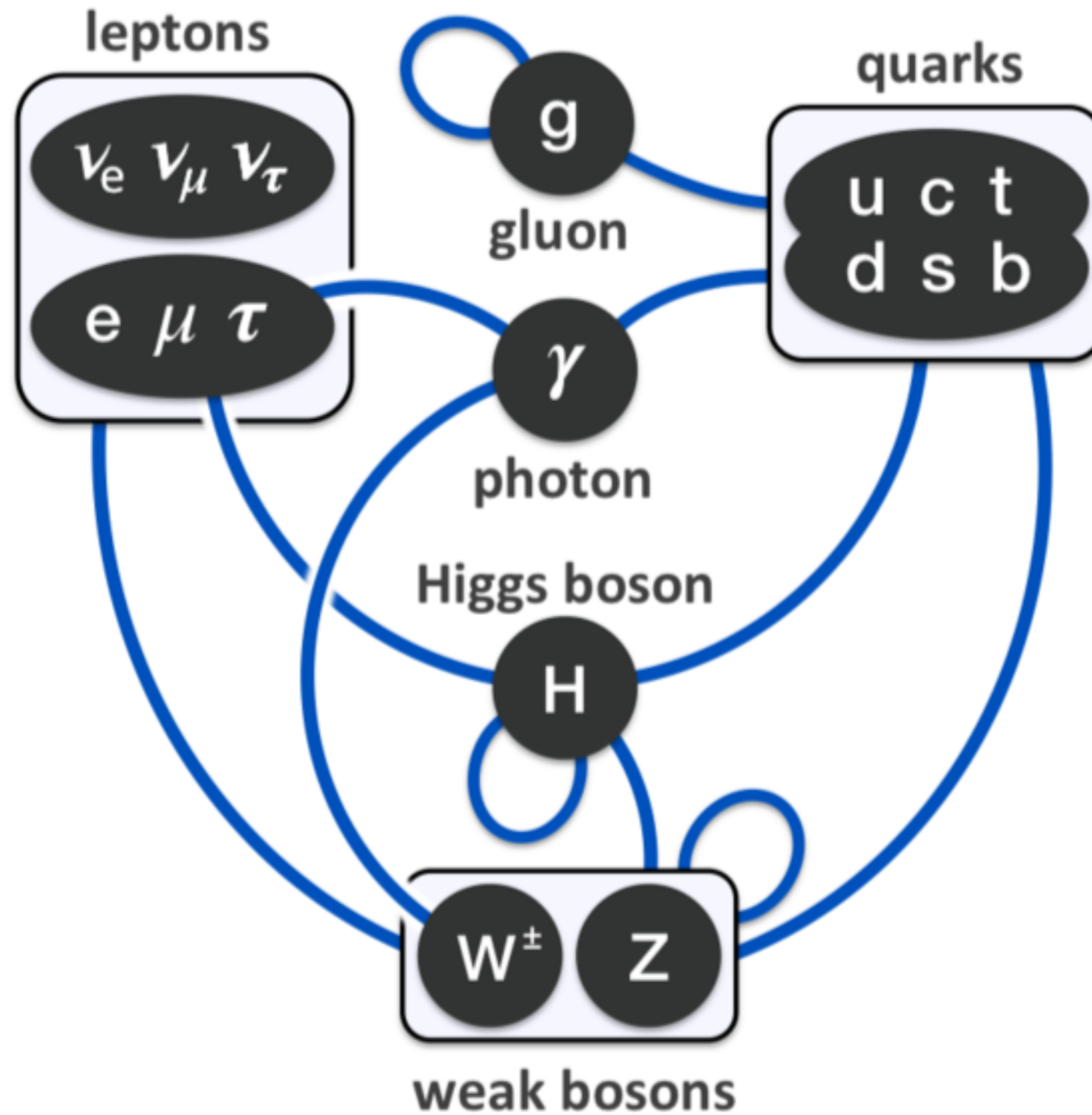


≤ 0.01 m
Crystal

1/10,000,000

What is “fundamental”?

The most simplest form.
No further substructure.
Zero dimension in size

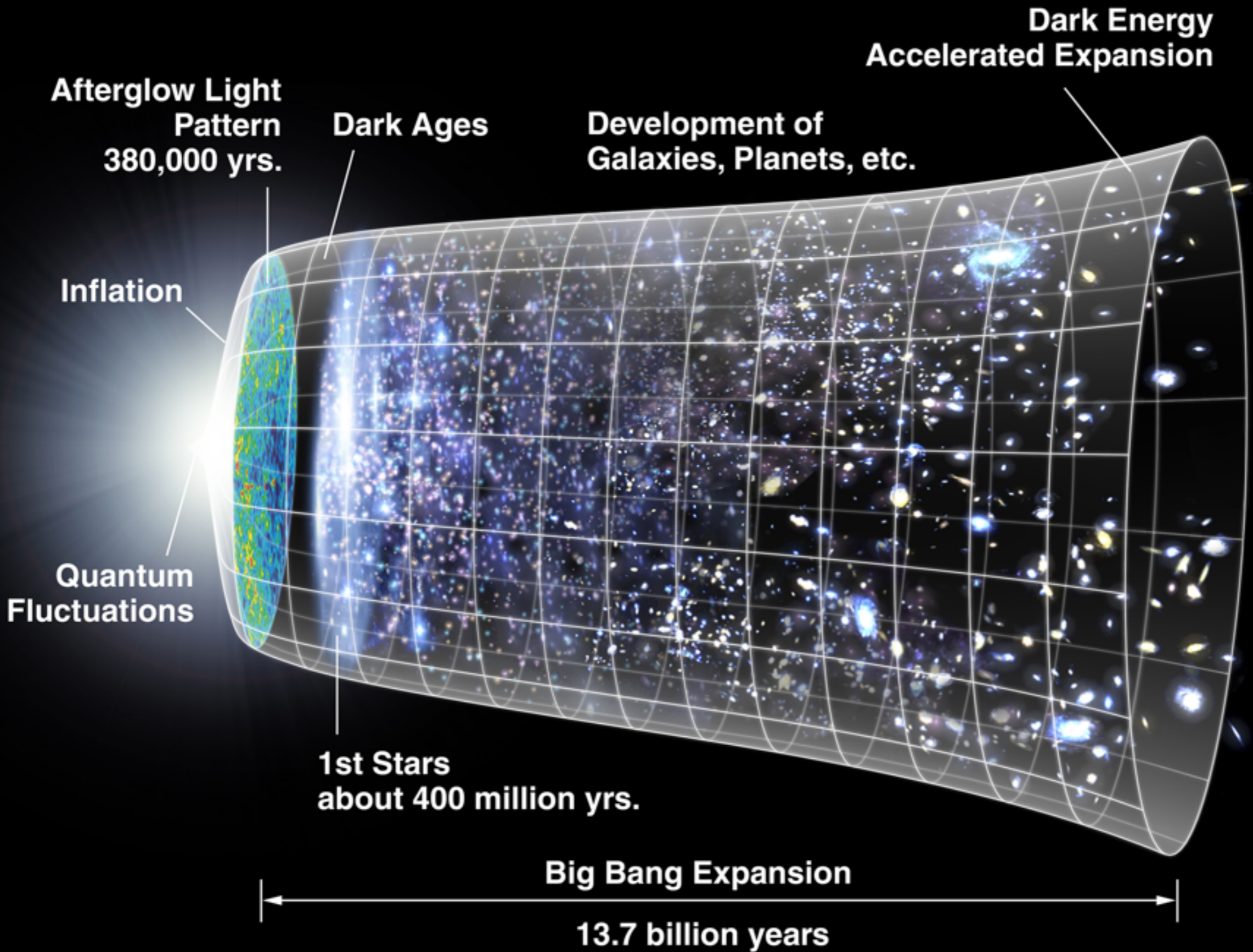


2012

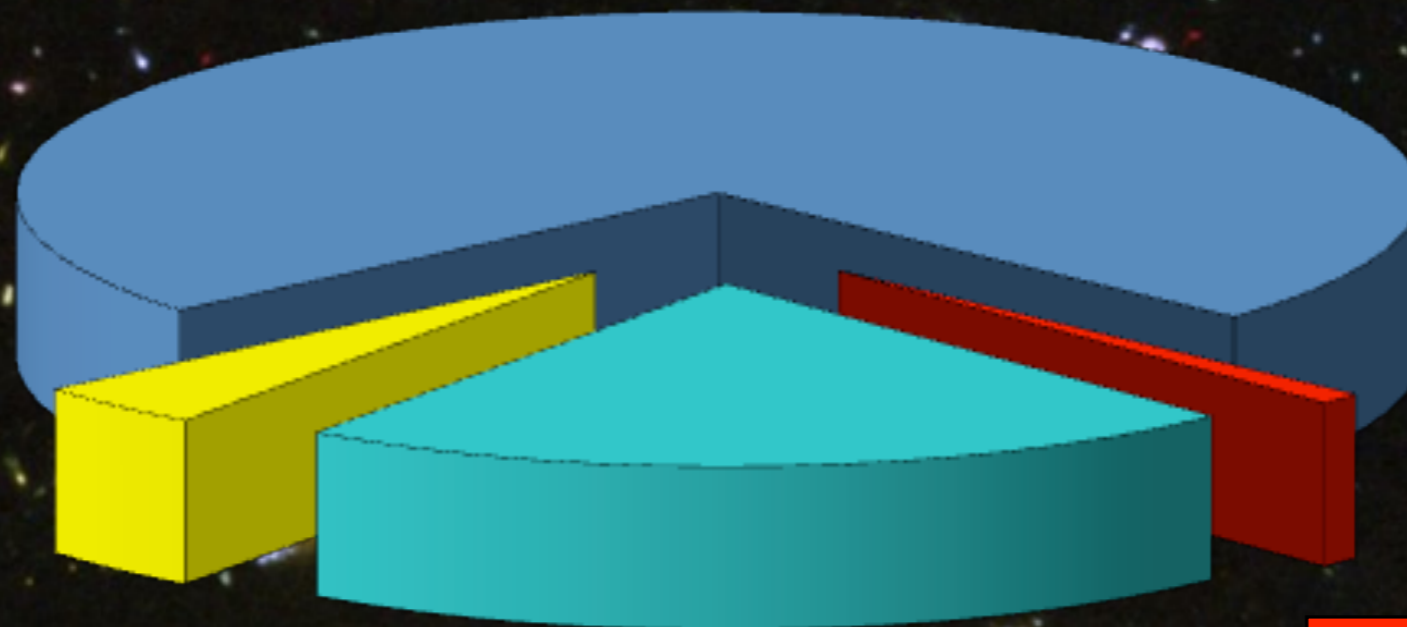
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What do we know about our Universe?



Dark Energy 73%
(Cosmological Constant)



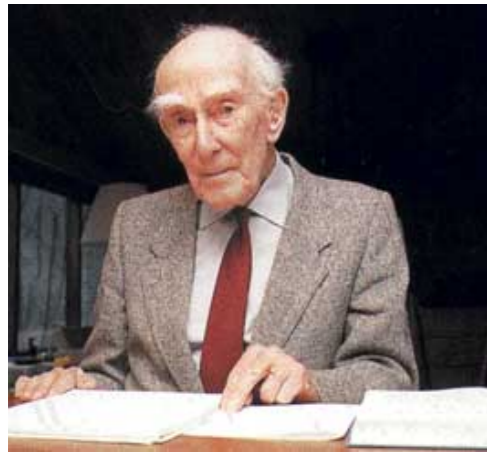
Ordinary Matter 4%
**(of this only about
10% luminous)**

**Dark Matter
23%**

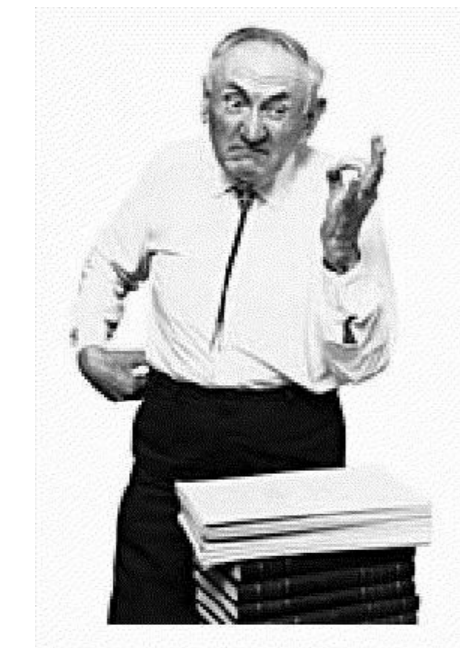
**Neutrinos
0.1-2%**



Dark Matter Evidence since 1930



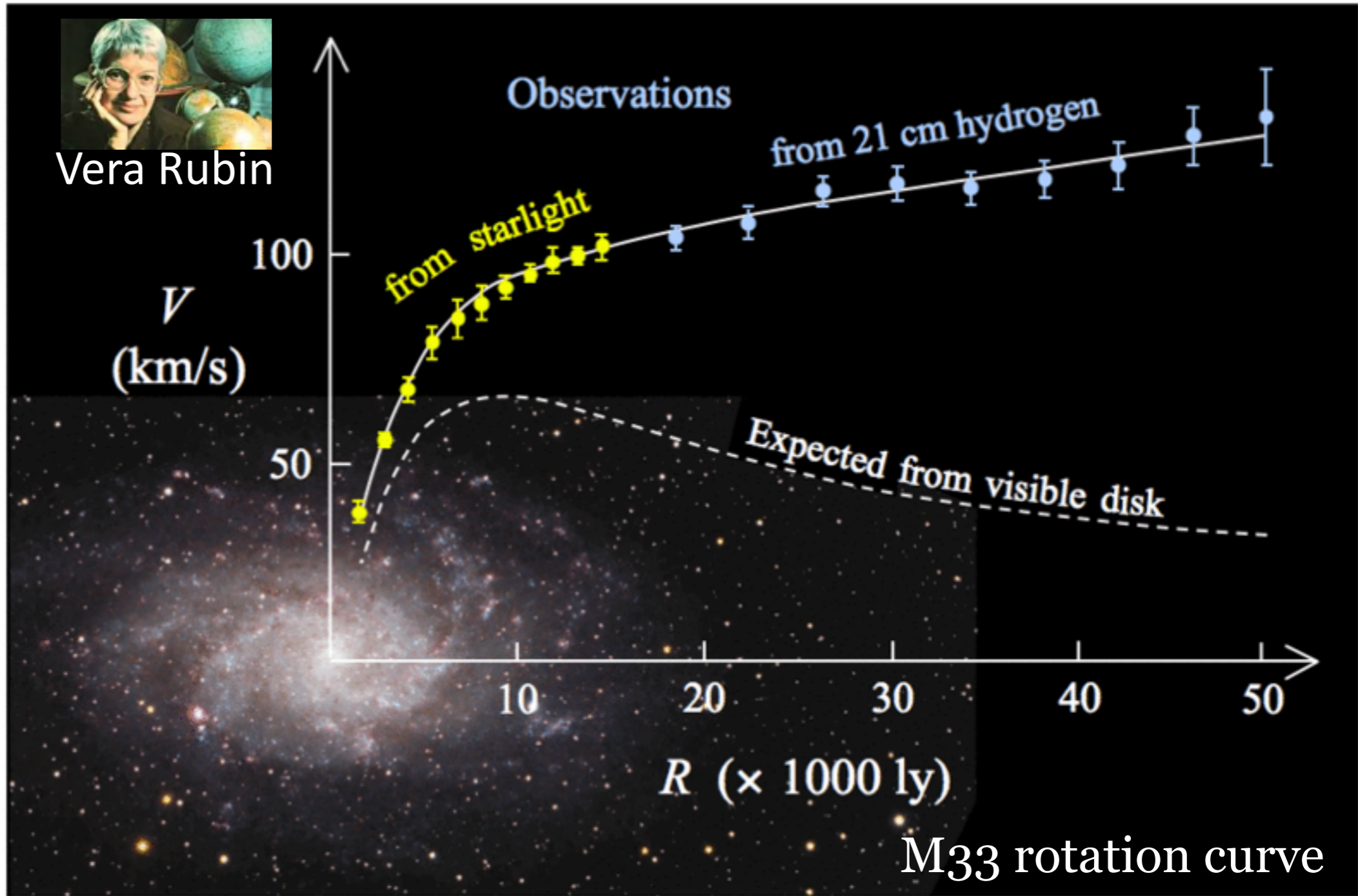
Jan Oort
Milky Way



Fritz Zwicky
Coma cluster



Vera Rubin

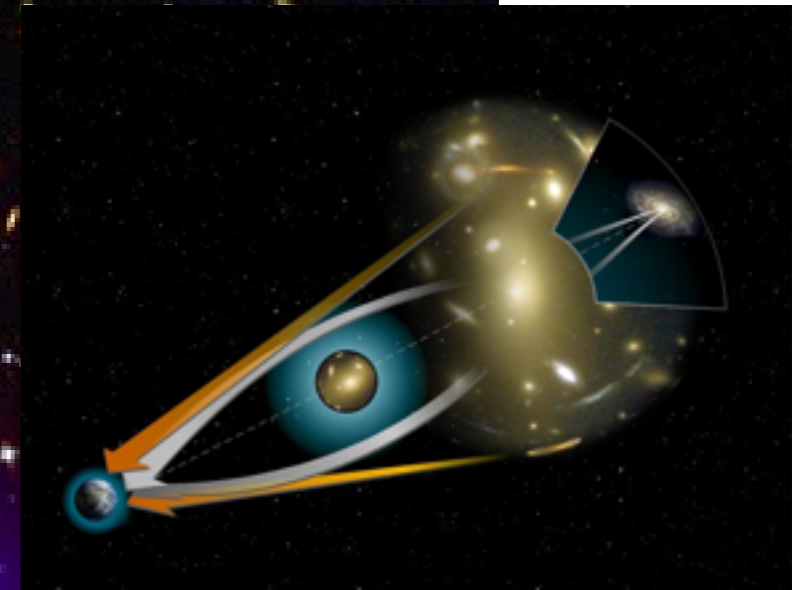
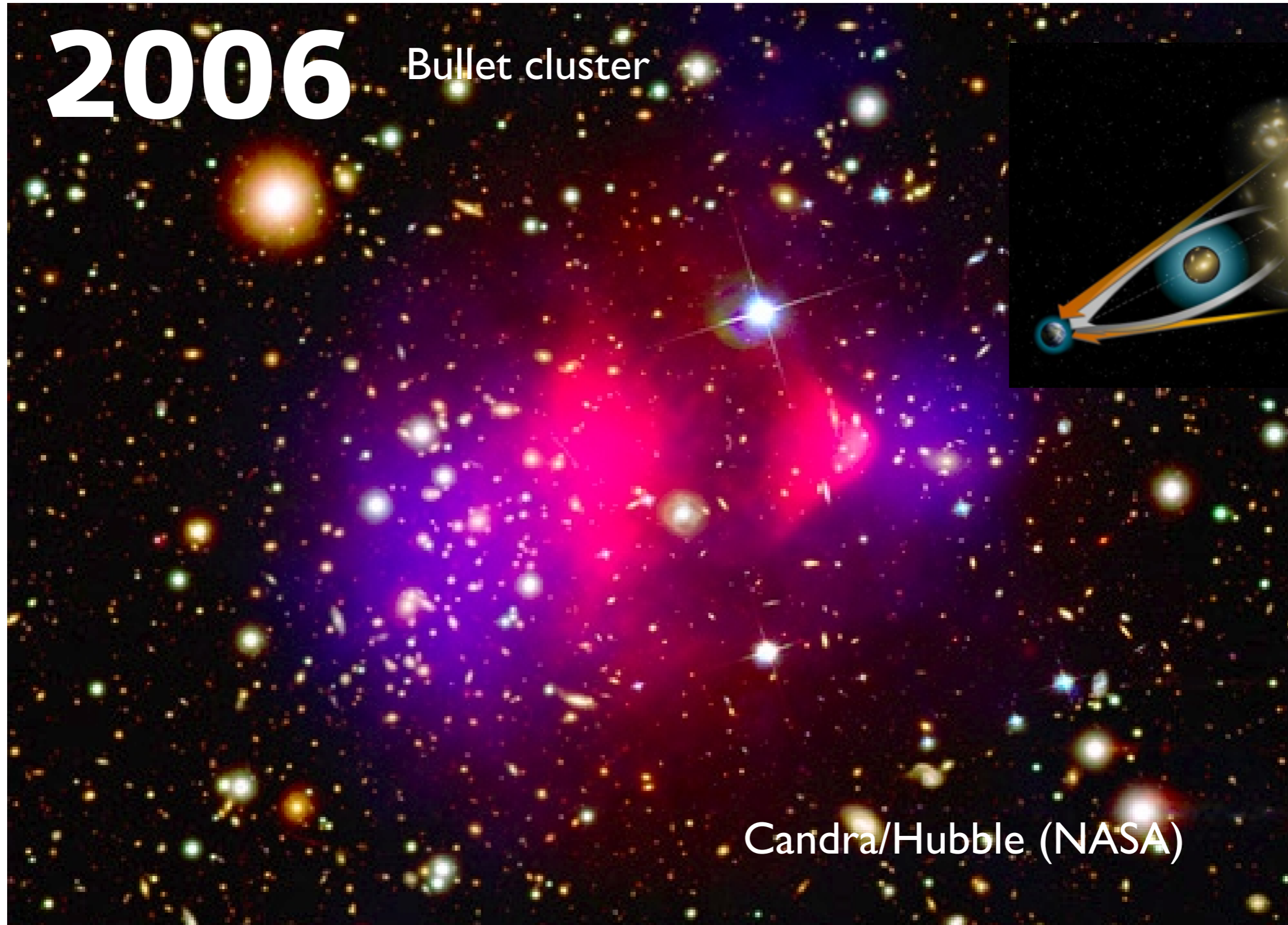


M33 rotation curve



2006

Bullet cluster

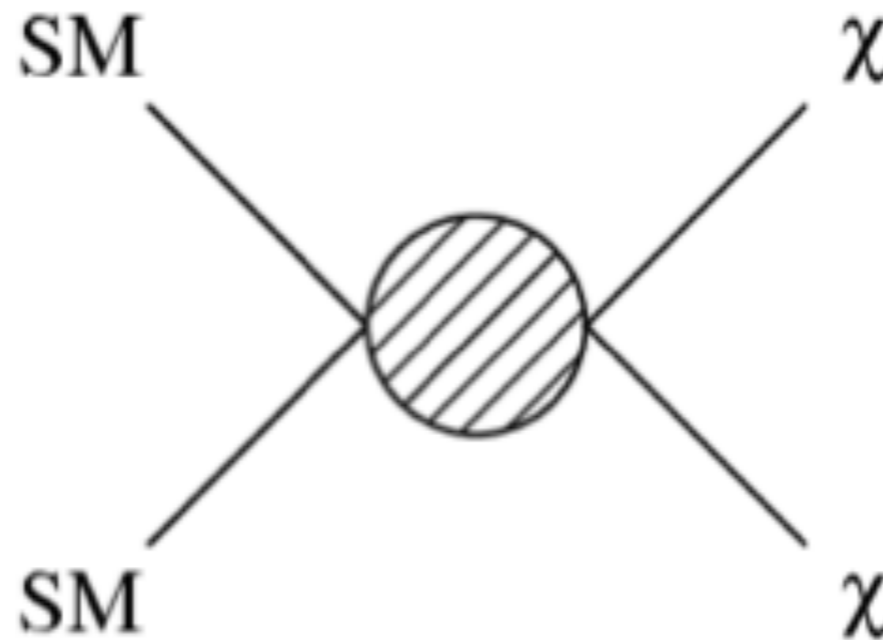


Candra/Hubble (NASA)

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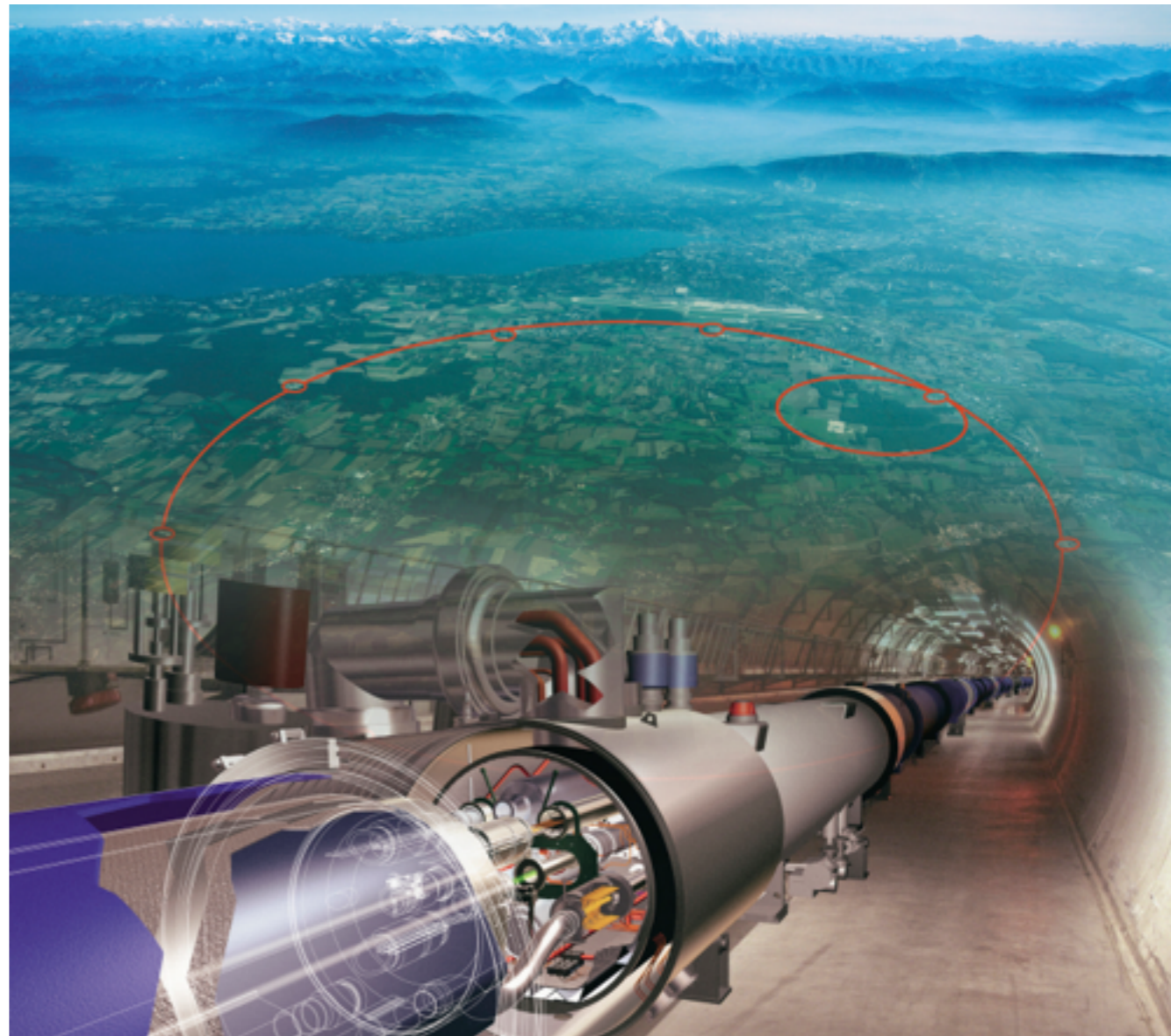
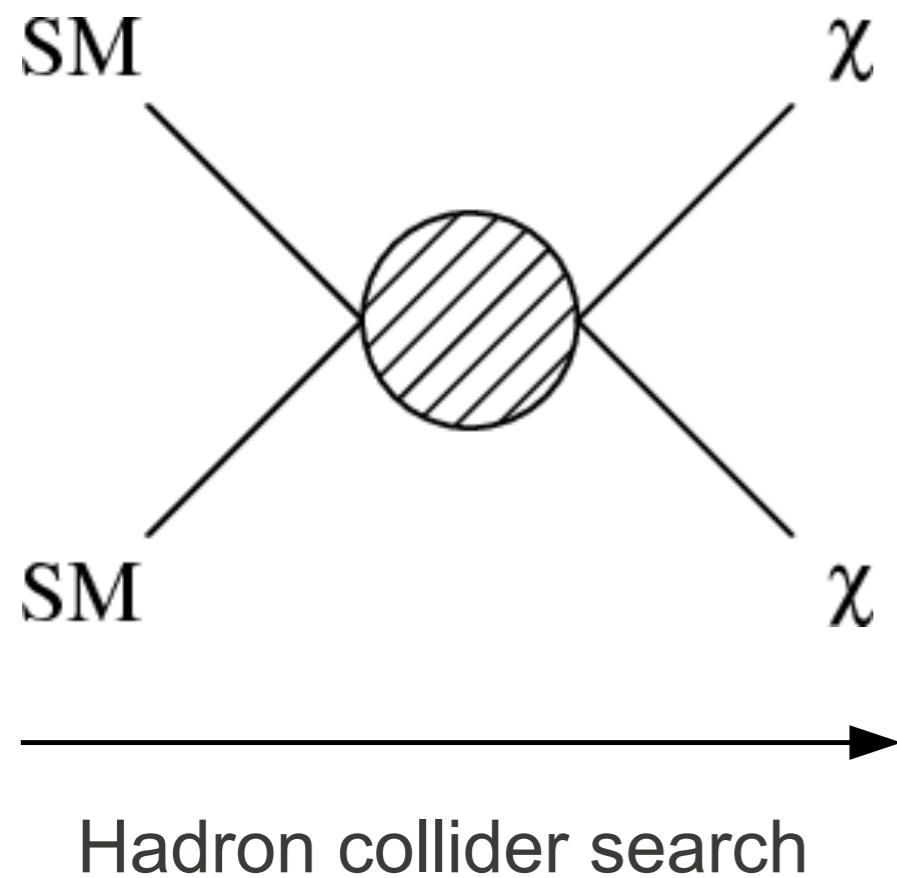


How can we study Dark Matter?

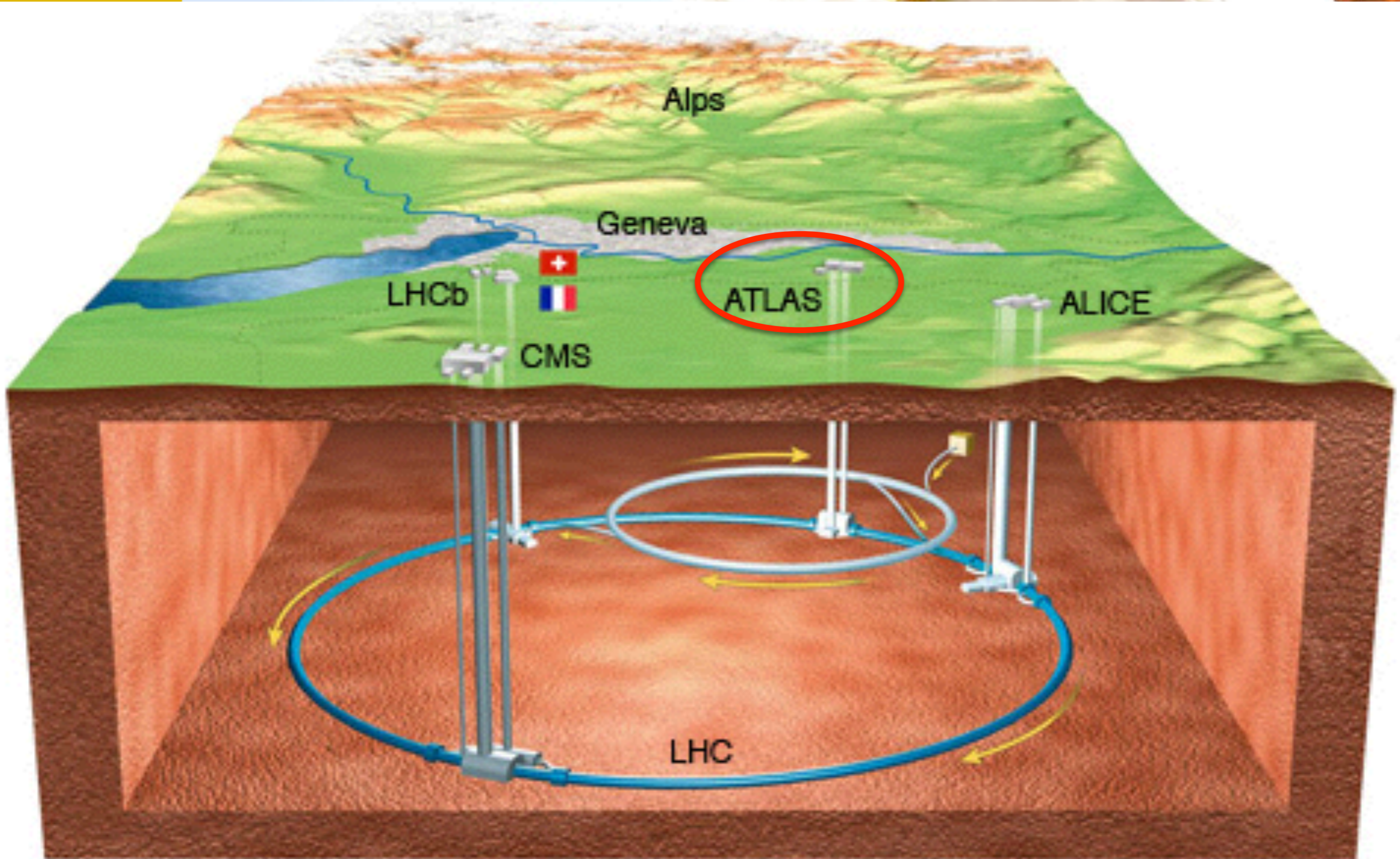




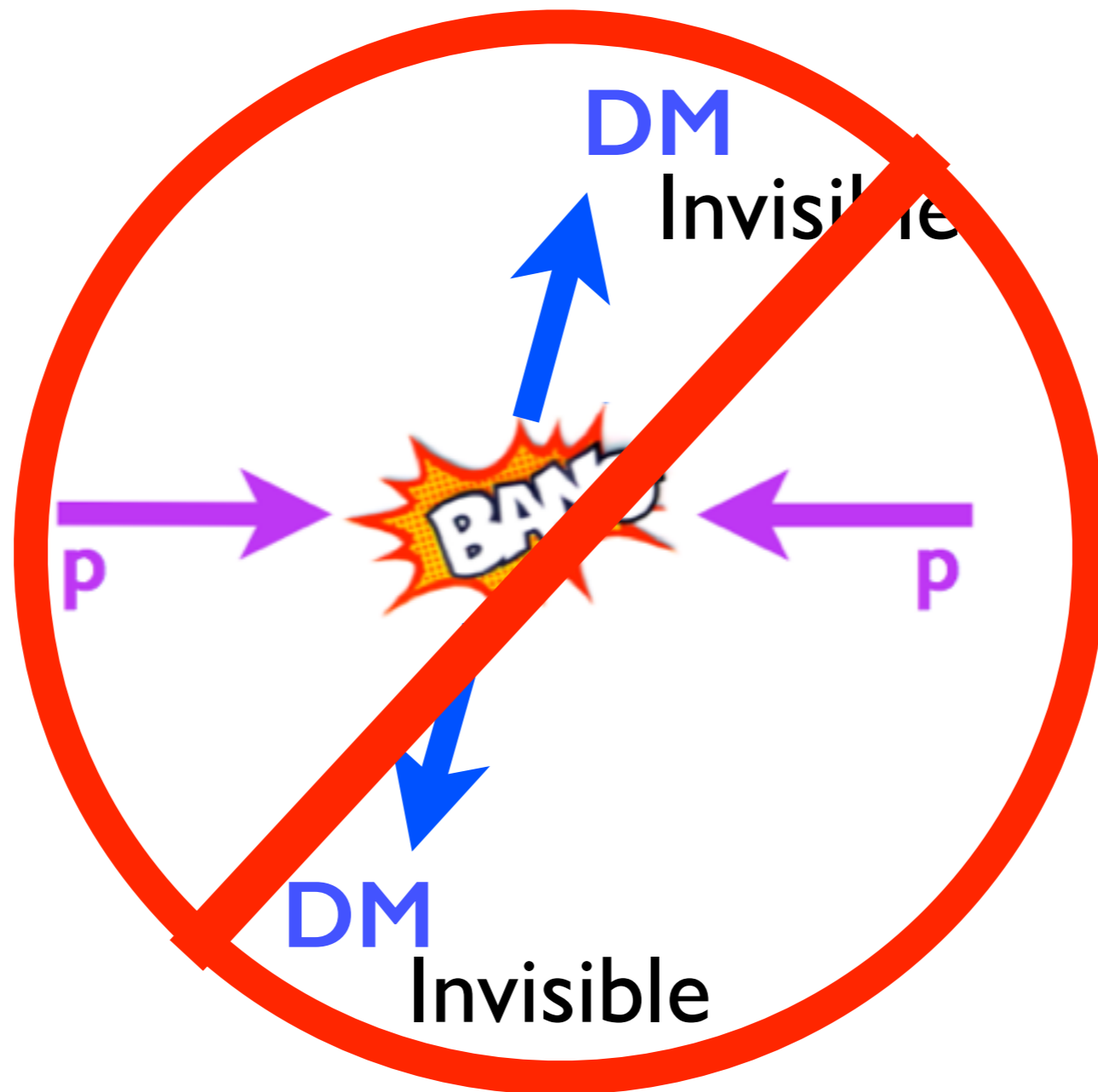
- Search at hadron collider:
 - DM would be seen as missing energy



Large Hadron Collider

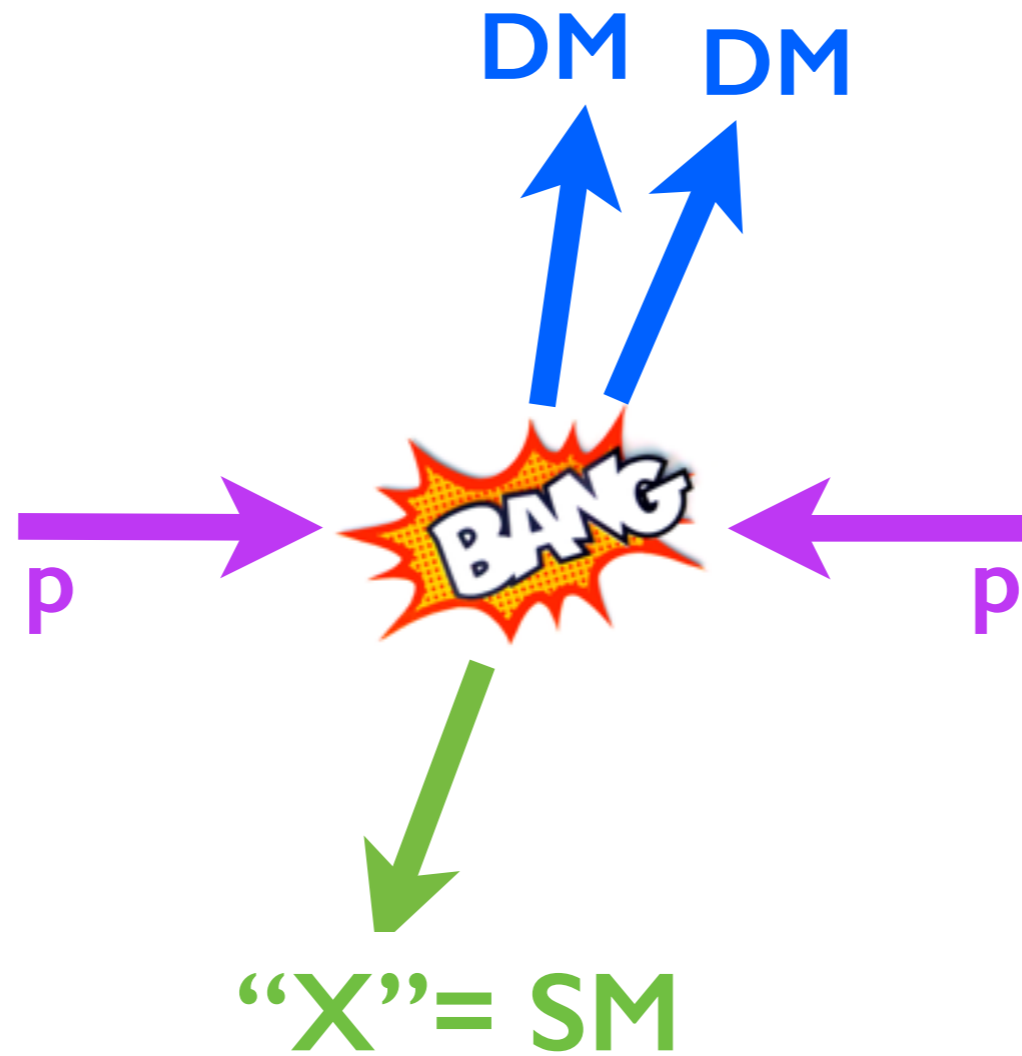


Dark Matter Detection?



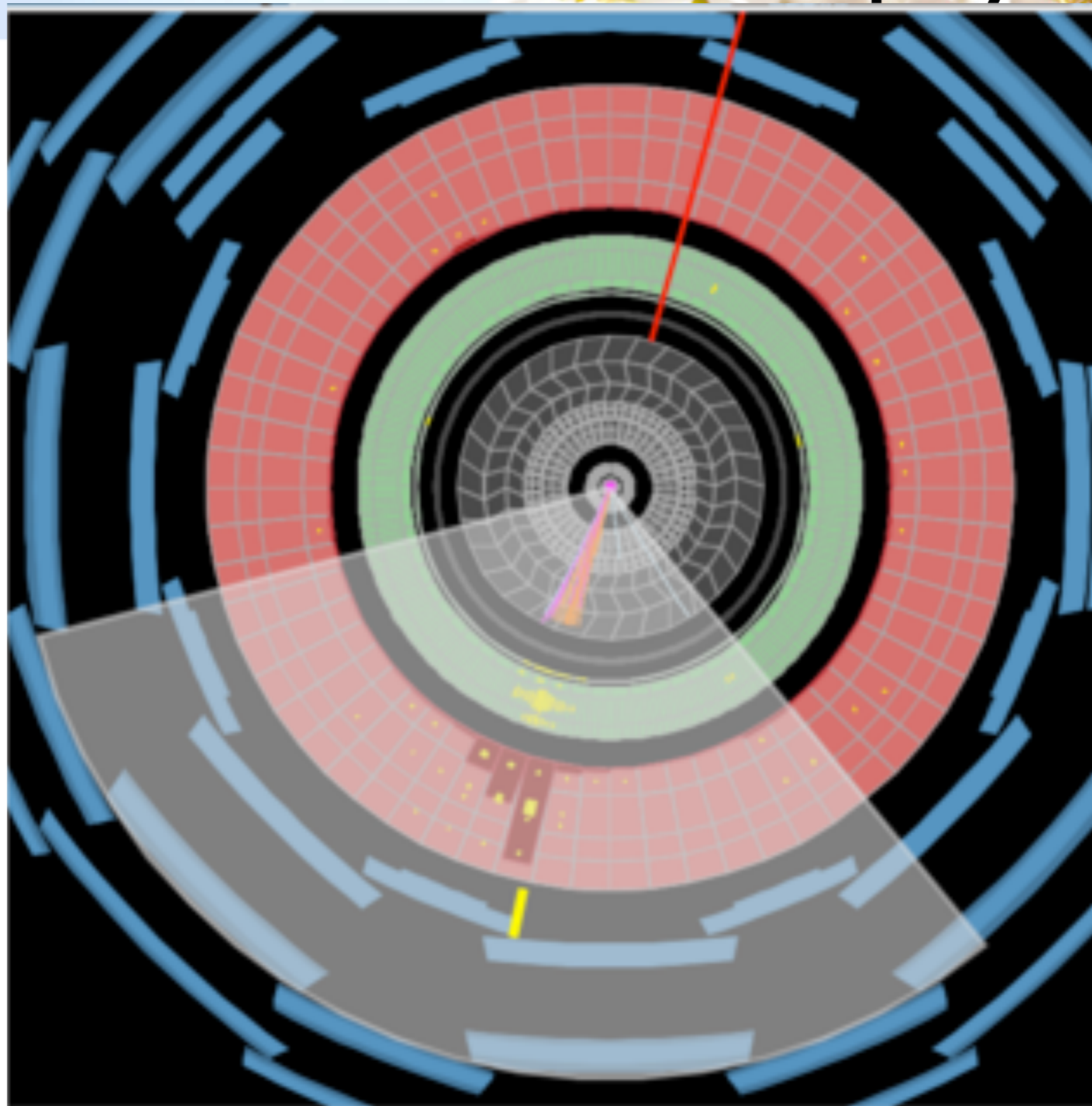
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Dark Matter Detection



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Mono-X Event Display

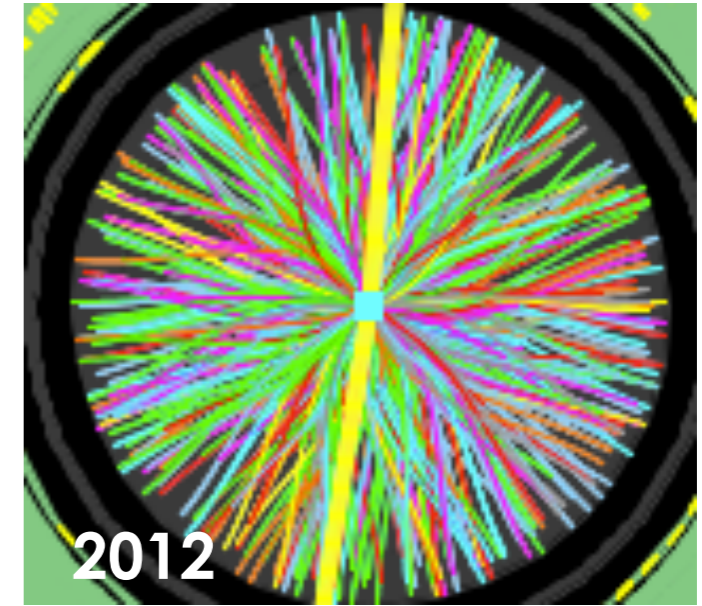
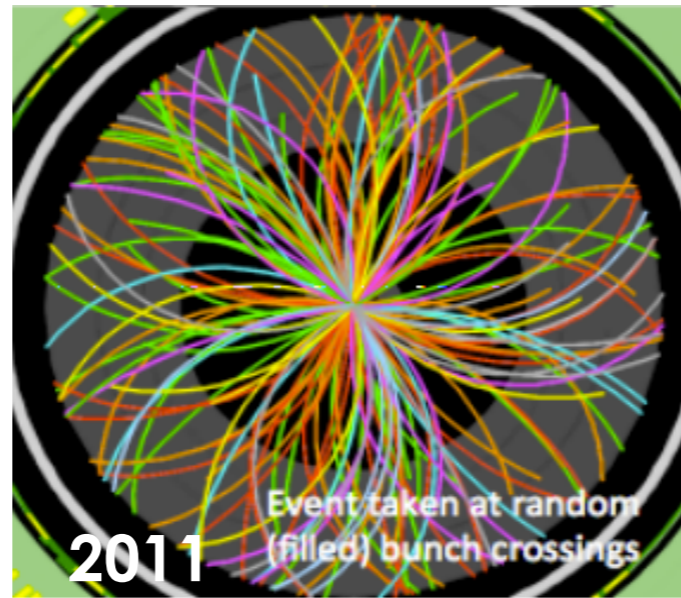
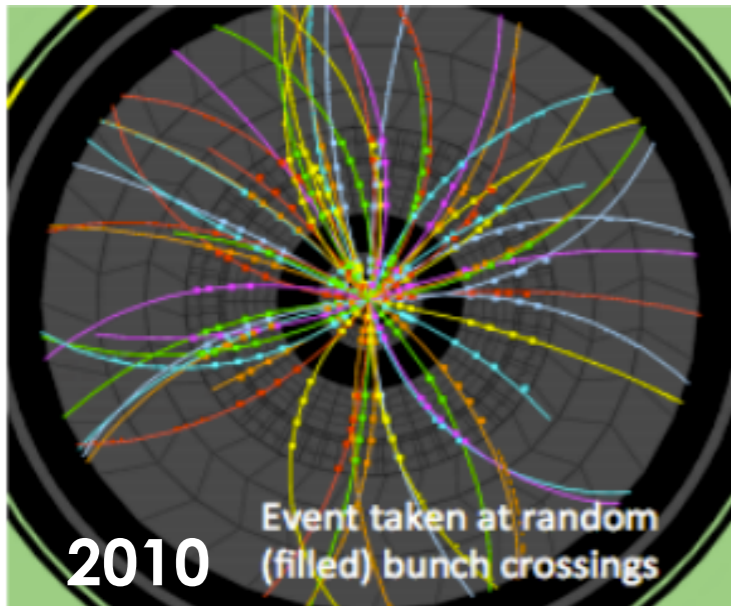




Challenge and Innovation



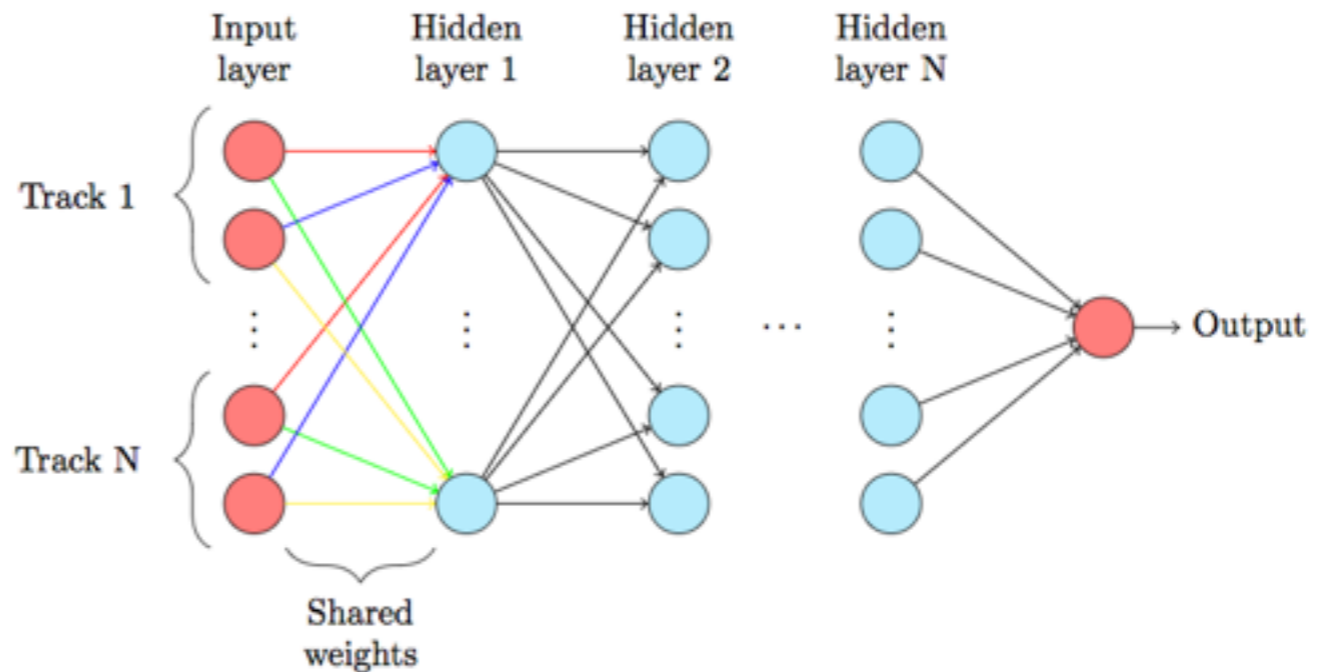
Higher and higher Pile-up



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Deep Learning for Discovery

arXiv:1607.08633





UW ATLAS Group

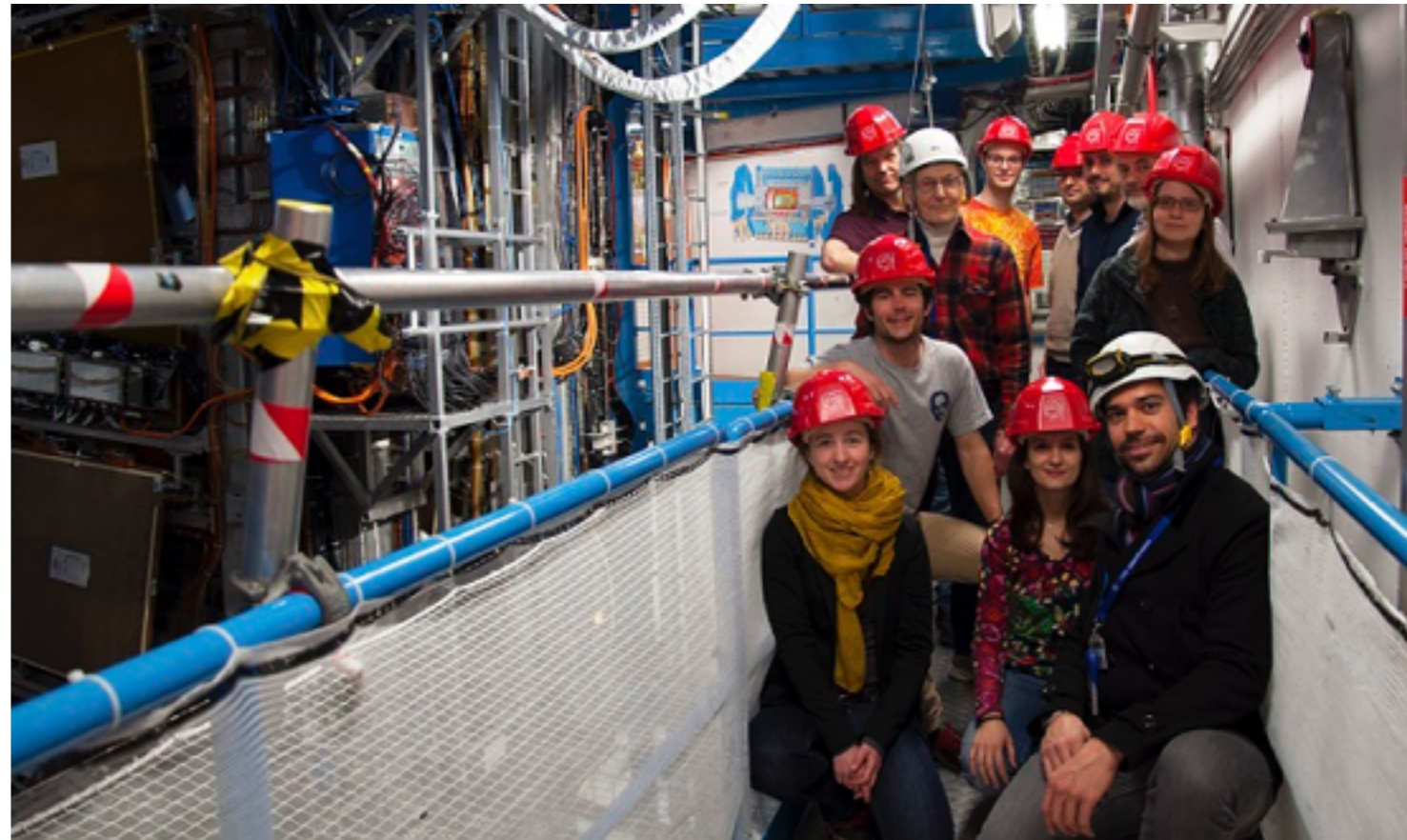


•UW EPE Group at ATLAS

- 4 physics faculties
- 4 postdoc
- 6 graduates (1 EE master/1 Phy. master)
- 3 undergrad (physics/ee/csc major)
- 2 Engineer Professors
- 1 Engineer/1 Computing specialist

•The group involves

- Muon Drift Tubes/Muon QQuality
- IBL Mechanics and IBLDAQ
- Tracking/B-tagging/Tau
- BSM search



Anna
Goussiou



Shih-Chieh
Hsu



Henry
Lubatti



Gordon
Watts



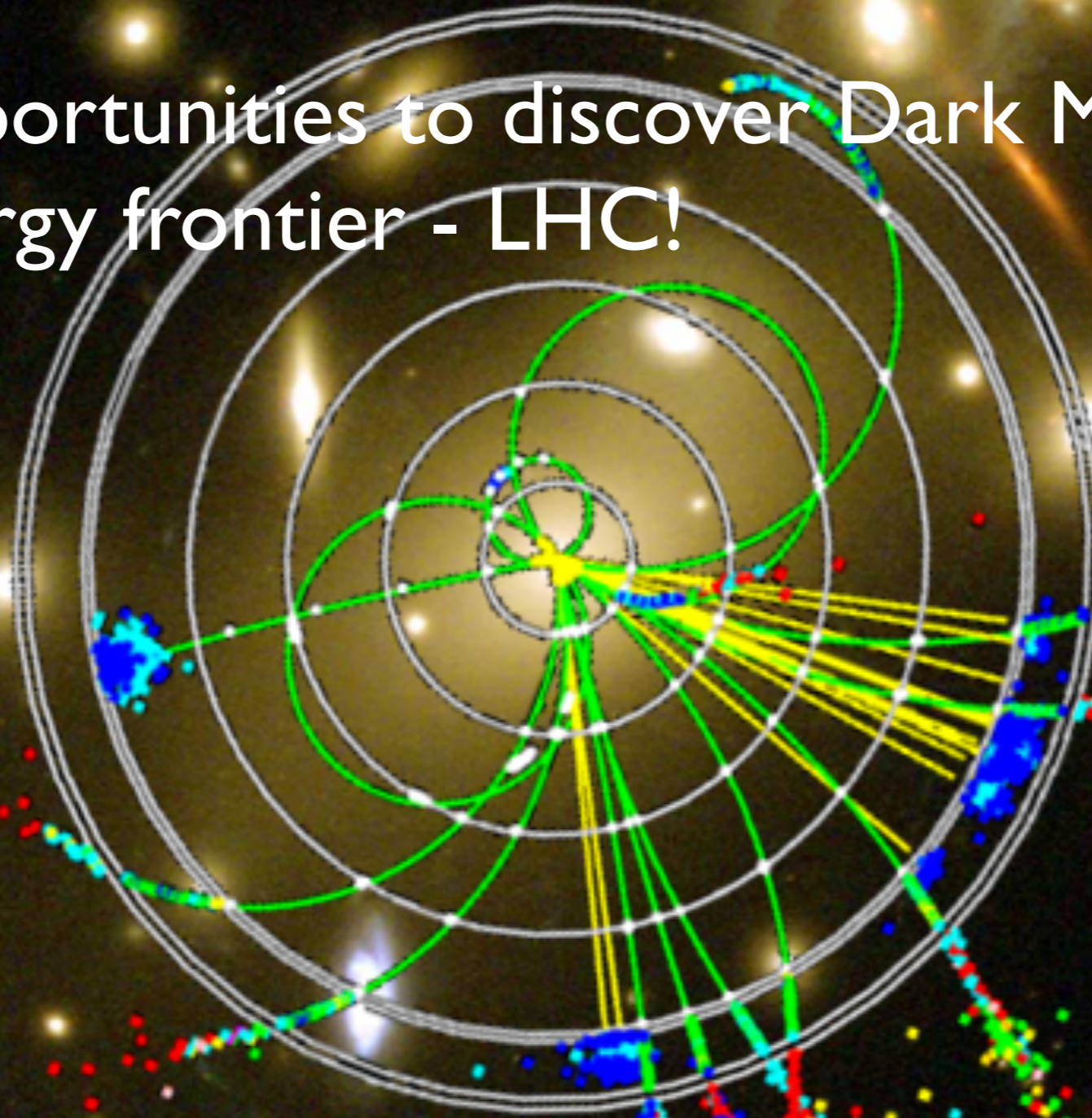
Colin
Daly (ME)



Scott
Hauck(EE)

Summary

- Exciting opportunities to discover Dark Matter at the most energy frontier - LHC!



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ATLAS Muon Chamber



- UW designed and define the build specification of Forward Muon Chamber
- 1/3 of the drift tubes are made by UW (2000-2007)
- An excellent partnership between Physics Professor Henry Lubatti and UW Mechanical Engineer Professor Colin Daly.
- Professor Rothenberg designs the optical alignment system



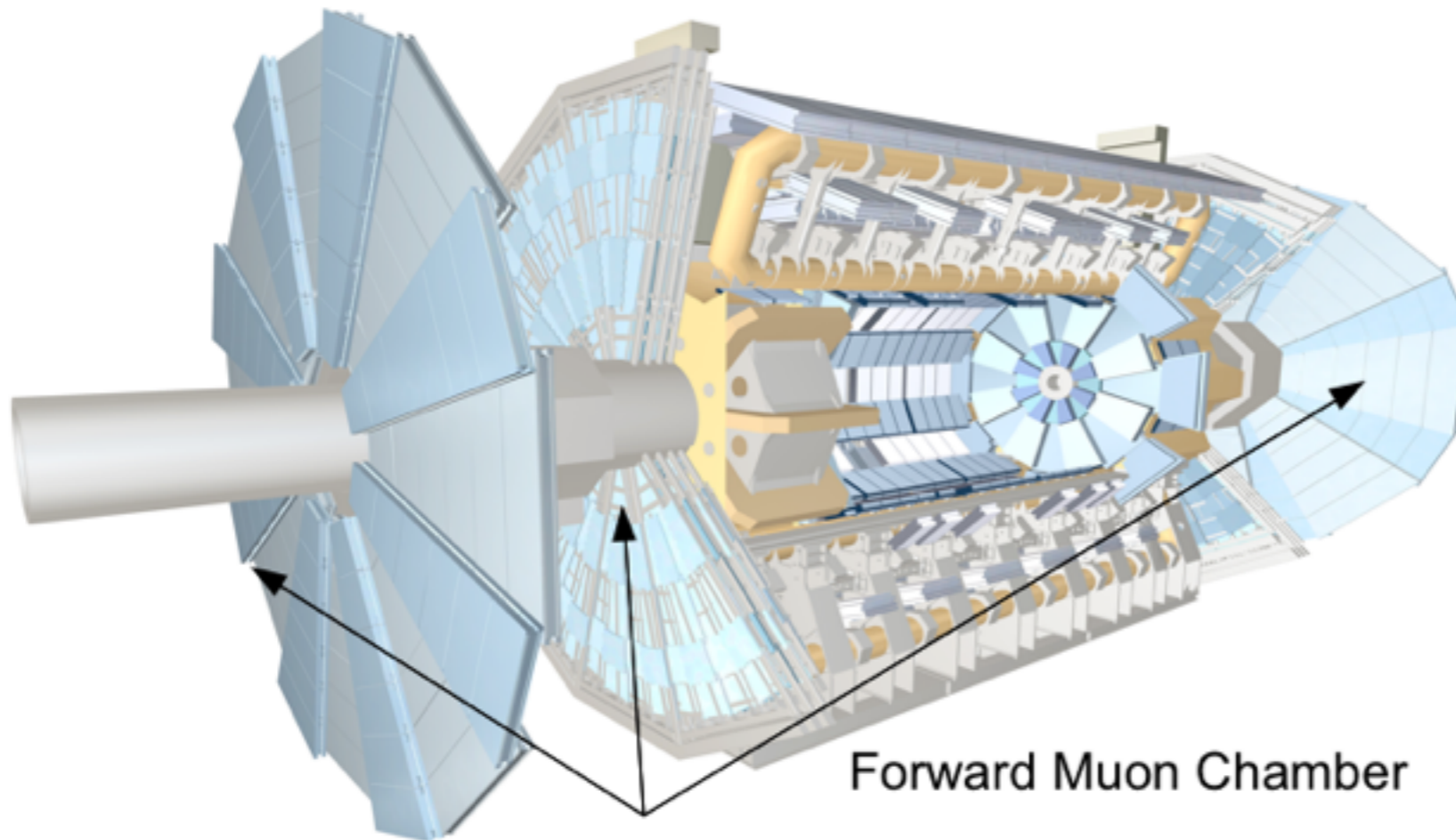
Henry Lubatti



Colin Daly



Joseph Rothenberg



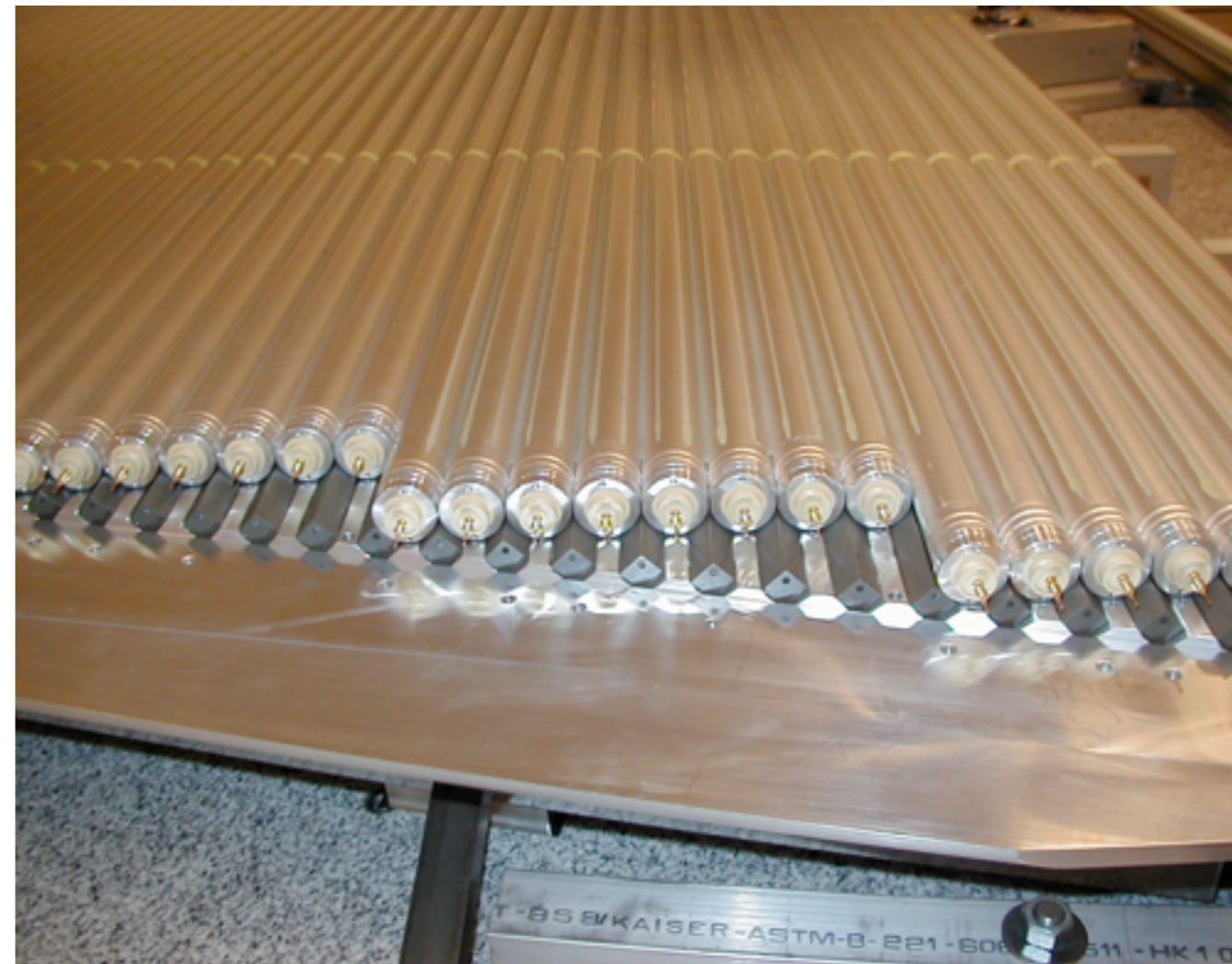
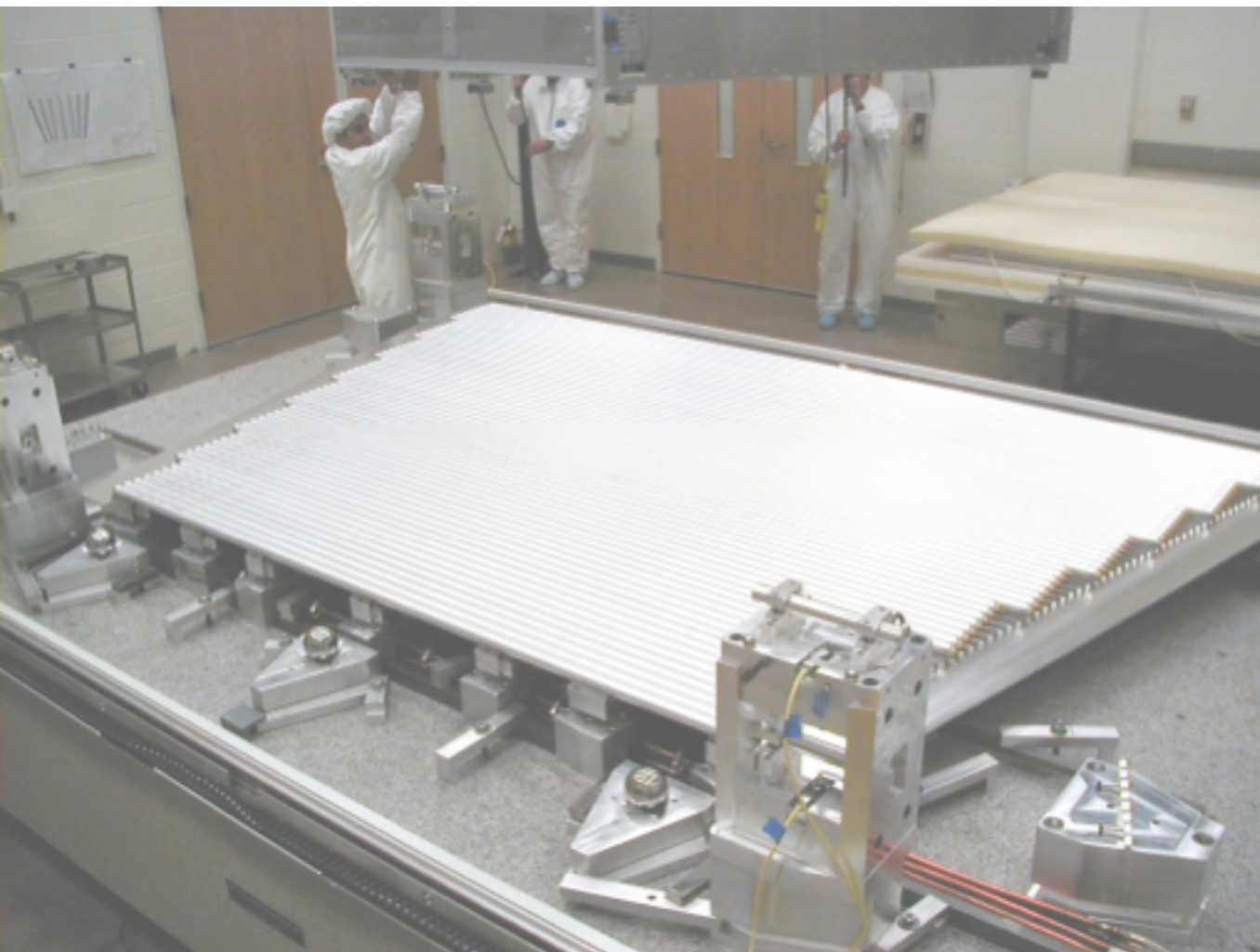
Forward Muon Chamber



Muon Chamber



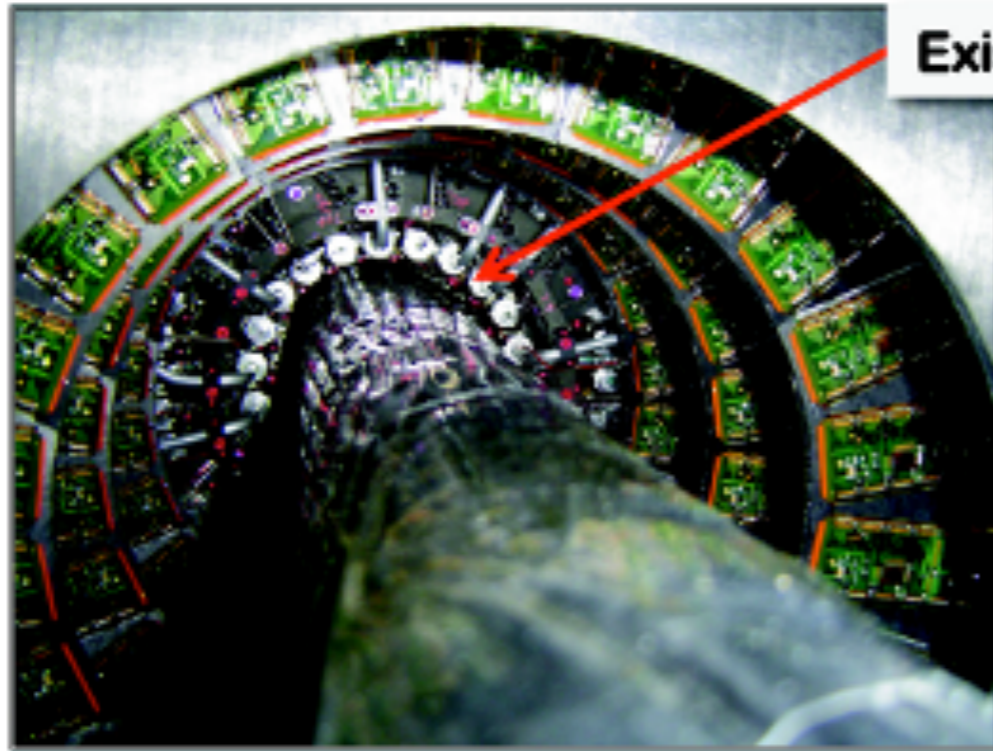
30,000 tubes are made by UW, fitted into 80 chambers and shipped to Geneva



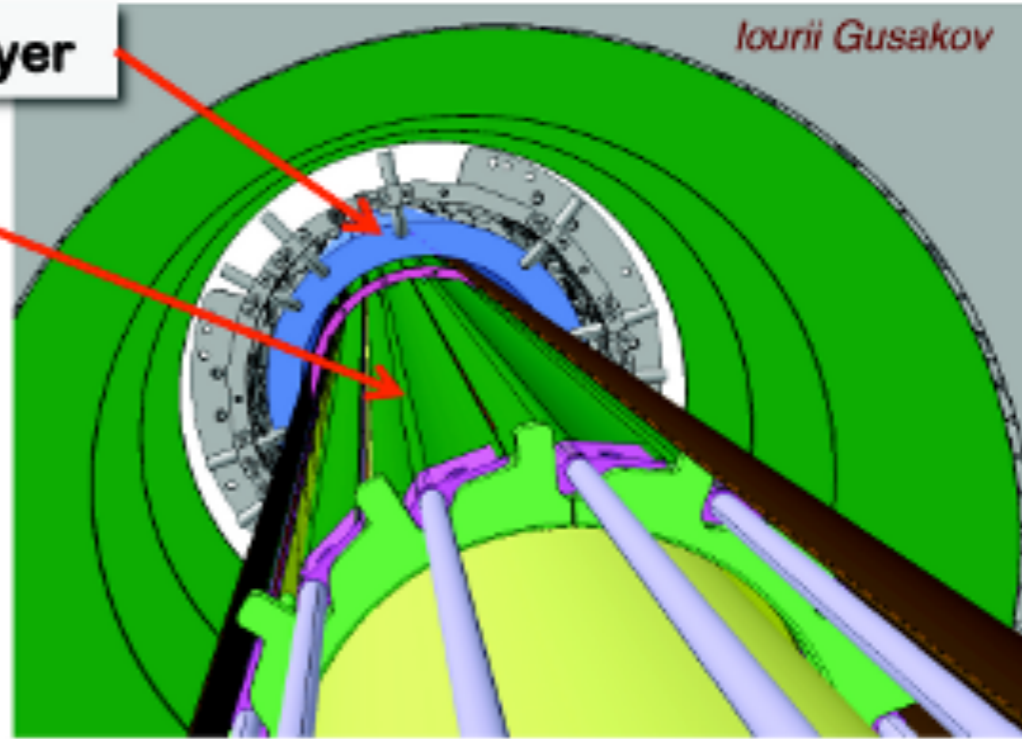
current muon lab



IBL Upgrade

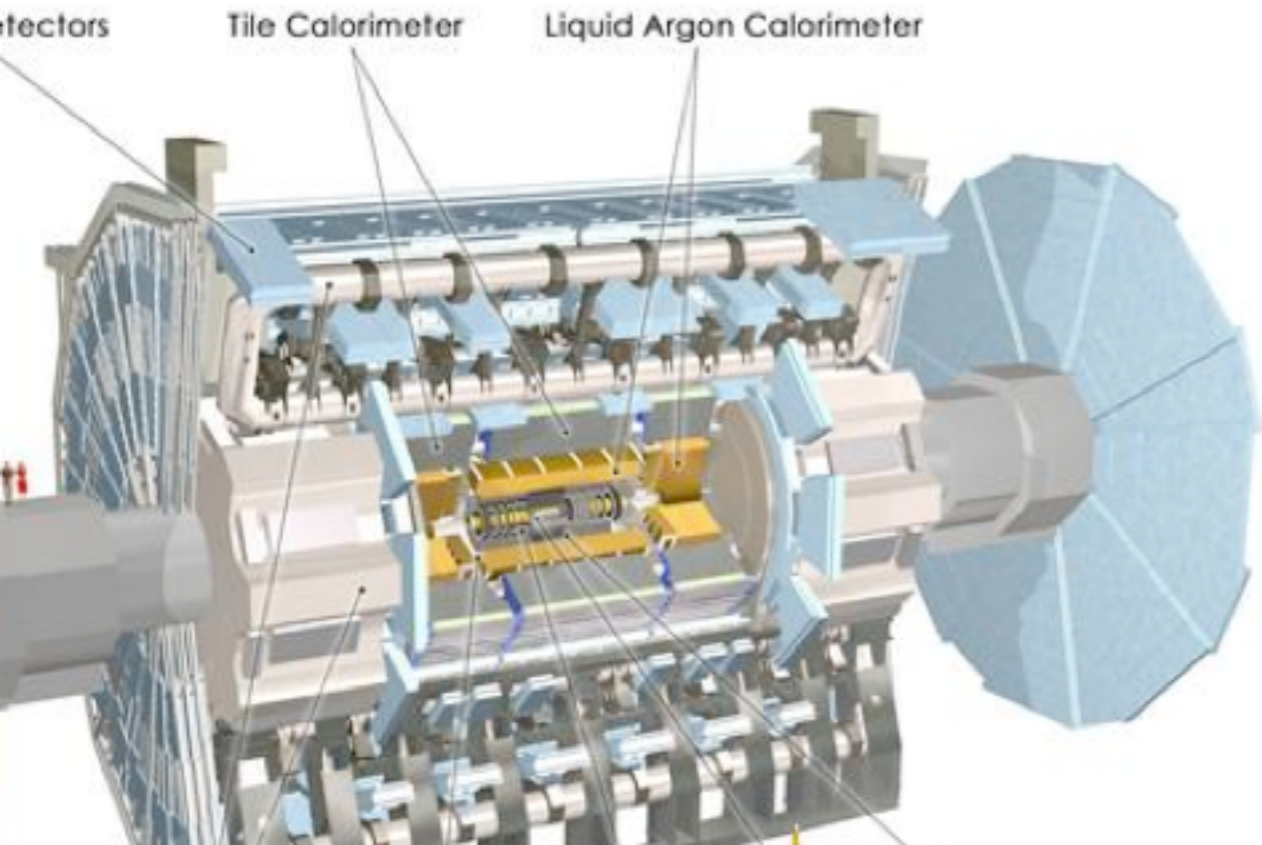


Existing B-Layer



Iouri Gusakov

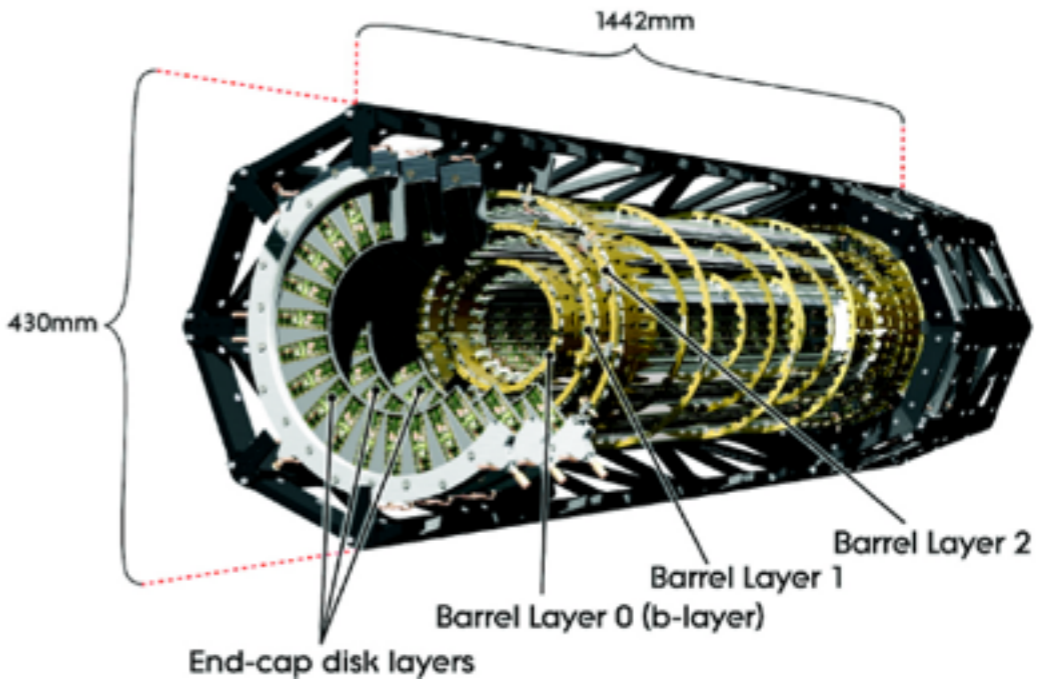
IBL



Detectors

Tile Calorimeter

Liquid Argon Calorimeter



1442mm

430mm

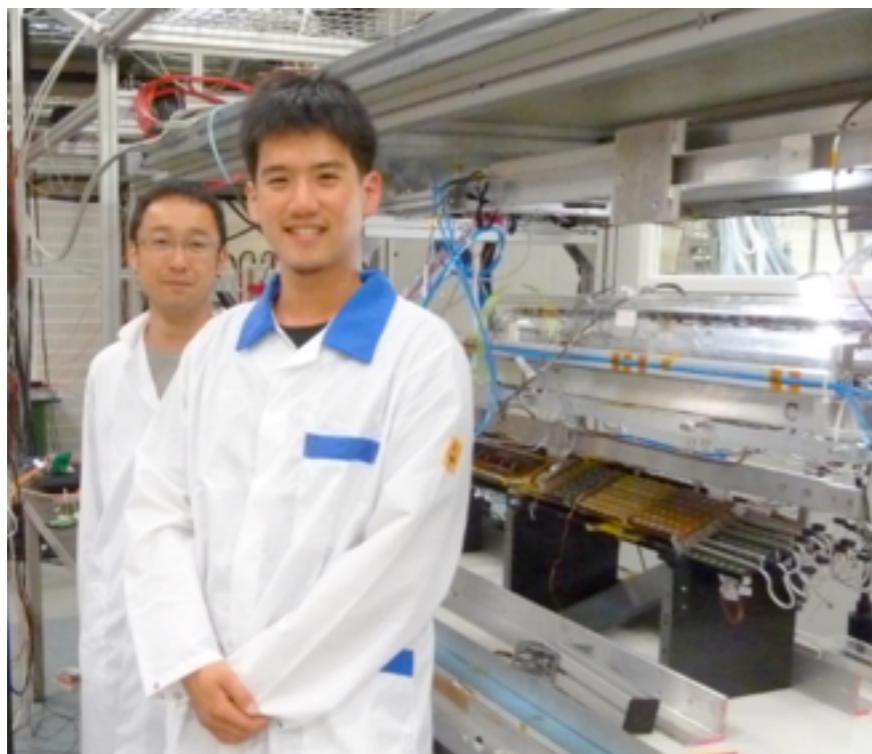
End-cap disk layers
Barrel Layer 0 (b-layer)
Barrel Layer 1
Barrel Layer 2



UW IBL Team



DAQ



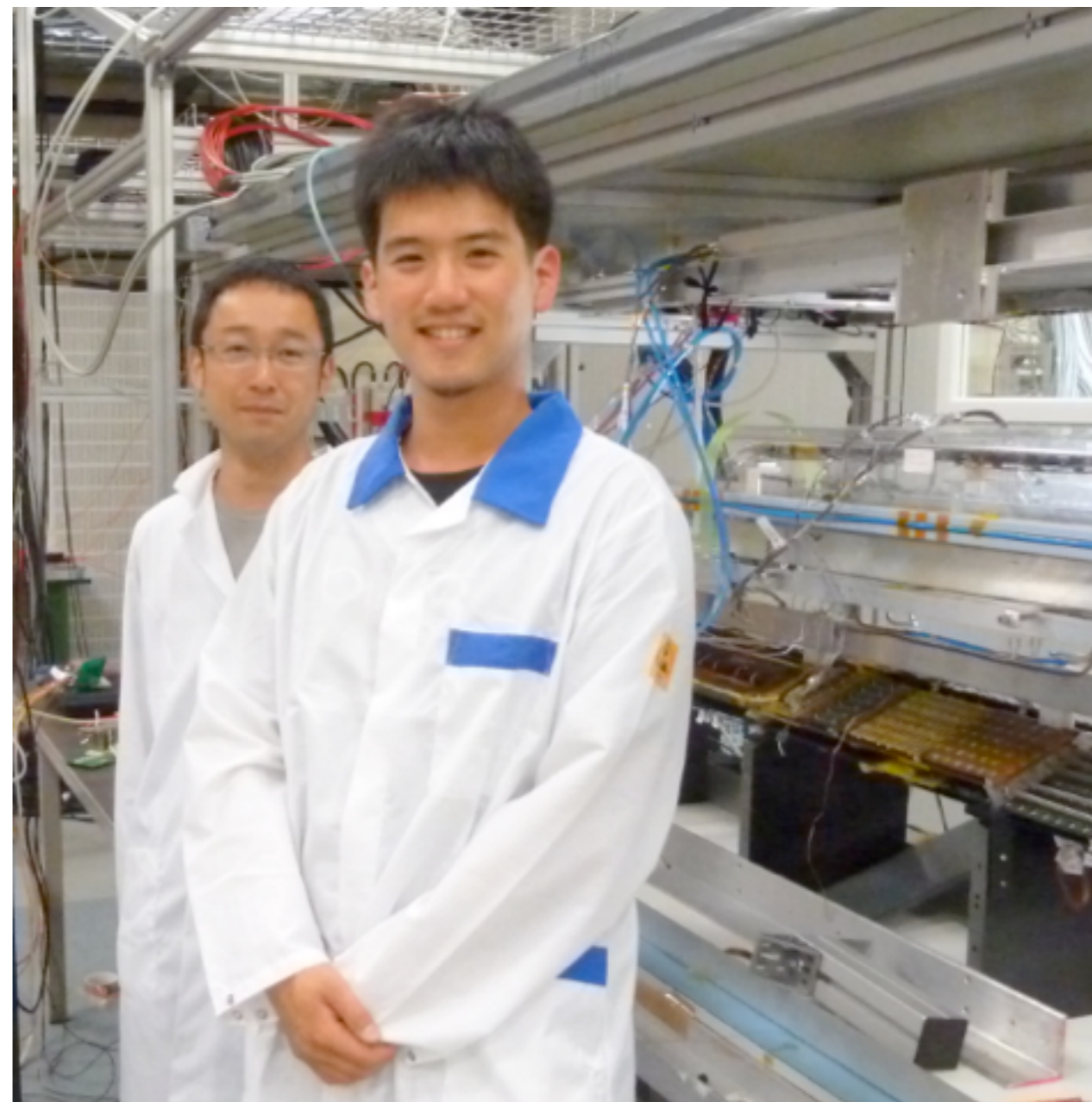
Support Structure

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IBLROD DAQ



Lynn Marx (UW physics postdoc)



Shawpin (Bin) Chen (EE master)