

IceCube Neutrino Observatory is the world's largest neutrino detector, located at the geographic South Pole, close to the Amundsen-Scott South Pole Station.

IceCube consists of 5160 optical sensors deployed deep in the Antarctic Ice, covering a volume of 1 km<sup>3</sup>. On top of this, 81 IceTop detector stations spread over 1 km<sup>2</sup> are located on the Antarctic plateau.

DeepCore 8 strings with a denser spacing.

Eiffel Tower

UGent members:

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# Cosmic rays

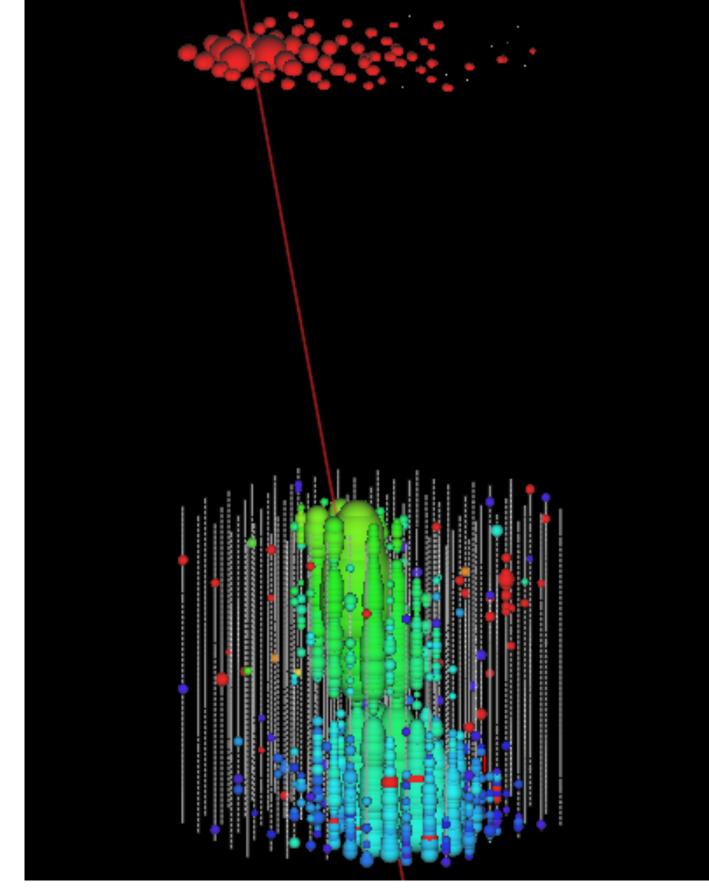
Cosmic ray air shower detection with energies from (1 - 1000) x 10<sup>6</sup> GeV

Hybrid detection technique:

- Ultra relativistic cosmic ray interacts with atmosphere → secondary particles
- Energy reconstruction using particle density distribution seen by IceTop
- Many relativistic muons can reach the detector simultaneously → muon bundle
- Mass sensitivity from high-energy muon bundle through IceCube
- Multiple hadronic interaction models used in air showers are inconsistent

#### Thesis subjects

- IceTop + InIce: influence of hadronic interaction models used in air shower simulations
- IceTop: Calibration of the absolute energy scale of the IceTop detector.



Bedrock

Cosmic ray event

Time scale

## IceCube Gen 2

Increased InIce volume  $1 \text{ km}^3 -> 10 \text{ km}^3$ 

Additional new surface detectors:

- Scintillators above snowed-in IceTop tanks
  - → measure ionization losses from charged particles
- Imaging Air-Cherenkov Telescopes
  - → measure Cherenkov radiation of air shower
- Radio antennas
  - → measure radio waves from air showers

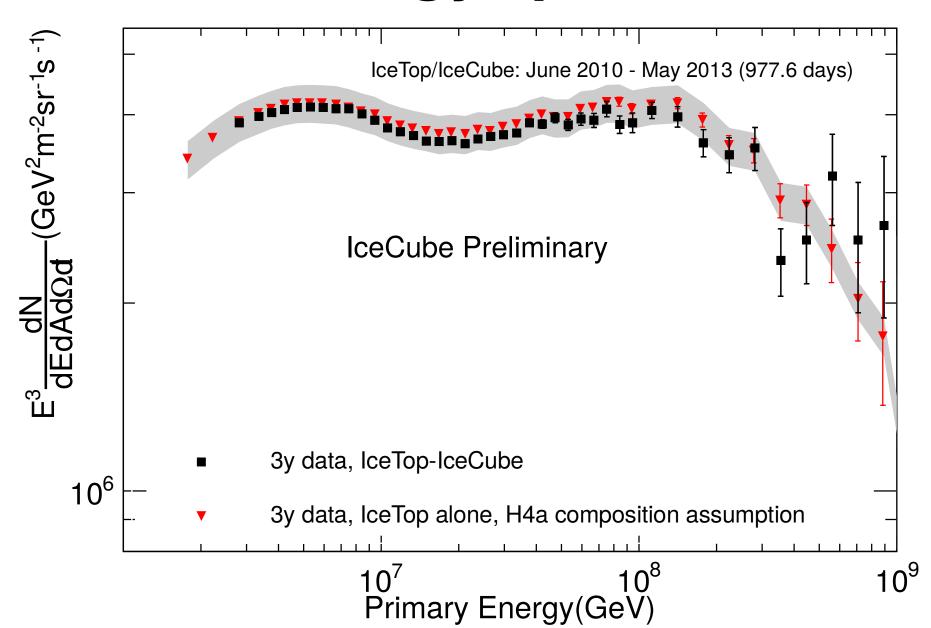
#### Thesis subjects

IceTop + Scintillators

analysis on the muon component in hadronic interaction models with very inclined showers

 IceTop + IceACT + Radio Antennas analysis on the electromagnetic component (e<sup>±</sup> + γ) in hadronic interaction models with multiple detectors

### **Energy spectrum**



#### **Average mass**

