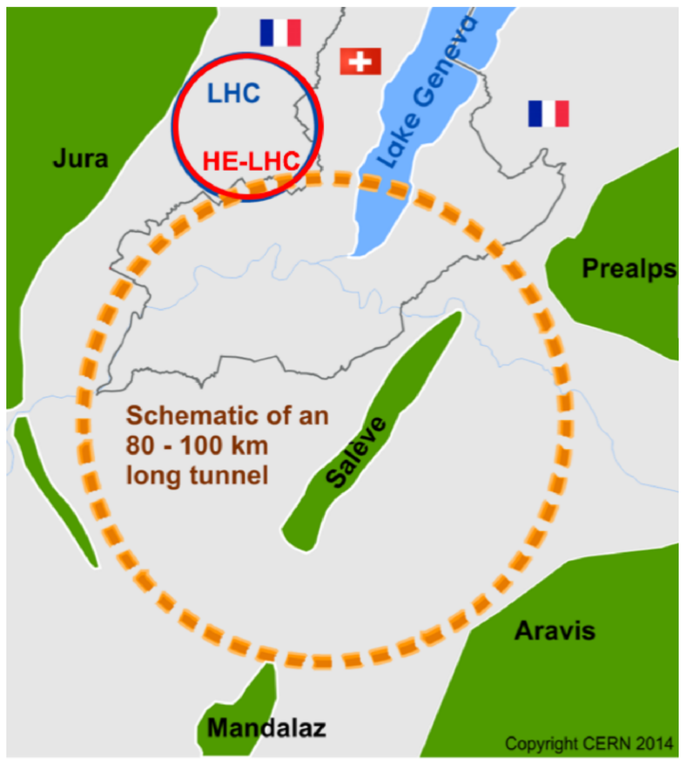
# Design of the FCC-hh Muon Detector and Trigger System

Oliver Kortner, Sandra Kortner, Hubert Kroha, Sergey Podkladkin, Robert Richter

Max-Planck Institute for Physics, Munich, Germany

## The FCC-hh project

### Concept for a future circular pp collider

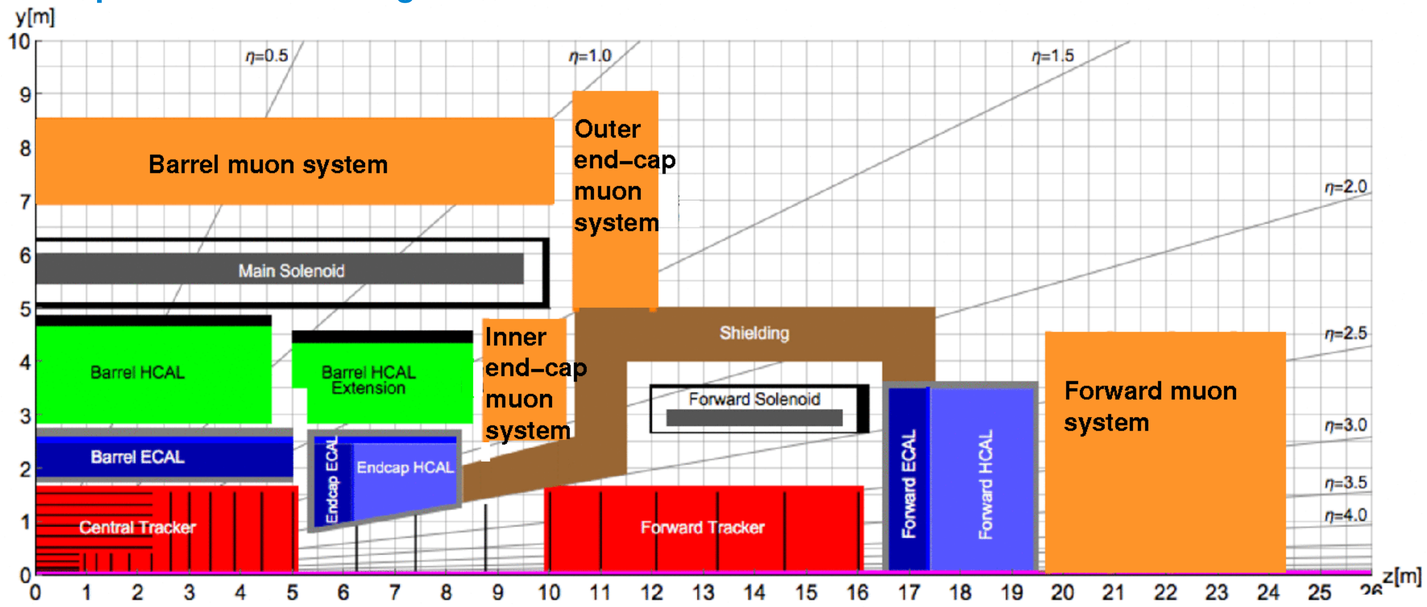



- 16 T dipole magnets in a tunnel of 100 km circumference.

⇒**100 TeV** centre-of-mass energy.

- Peak luminosity: $3 \cdot 10^{35}$ $cm^{-2}s^{-1}$.
- Integrated luminosity: 20 $ab^{-1}$.

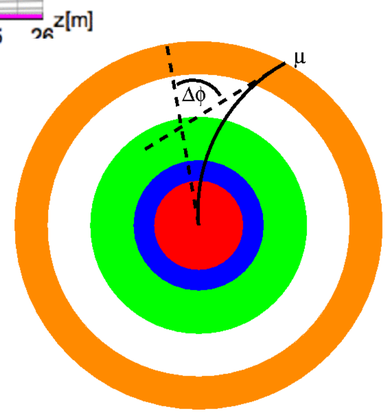
### Conceptual detector design




- 4 T field in the inner detector.

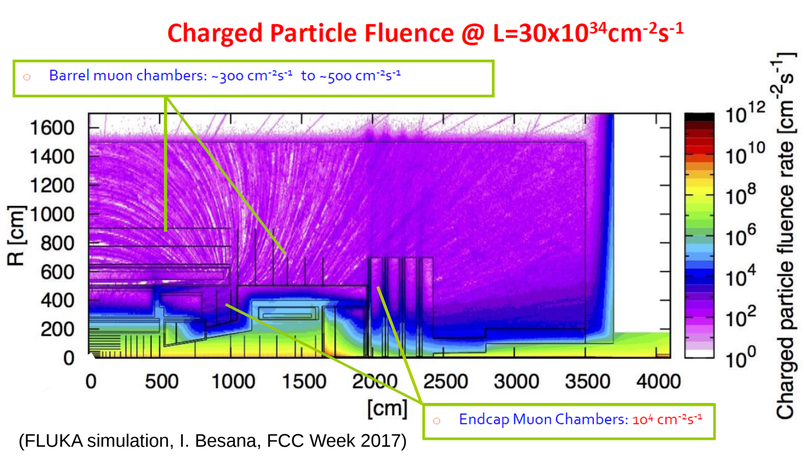
⇒Magnetic field integral up to the barrel muon system: 18 Tm.

- Direction of flight into the muon system is a measure for the muon momentum




## Proposal for the instrumentation of the muon system

### Background rates in the muon system

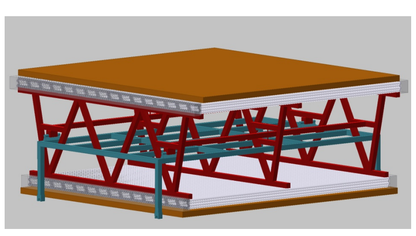


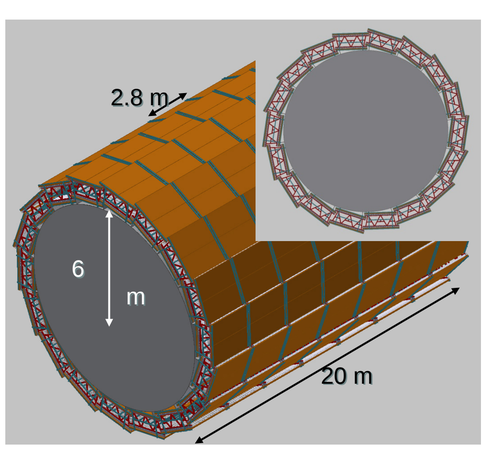

(FLUKA simulation, I. Besana, FCC Week 2017)

- Maximum nominal counting rate <10 kHz/$cm^2$.
- Maximum rate including all safety factors: 25 kHz/$cm^2$.

⇒**Small diameter muon drift-tube (sMDT) chambers** can be operated at these rates.

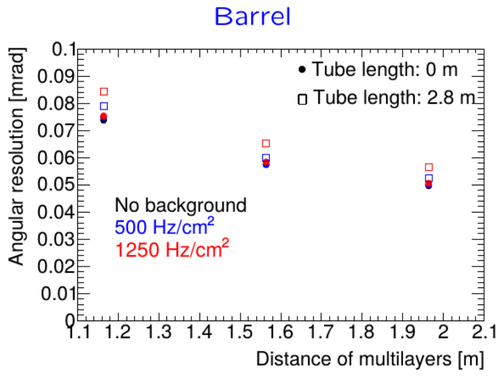
### sMDT chambers for the muon system



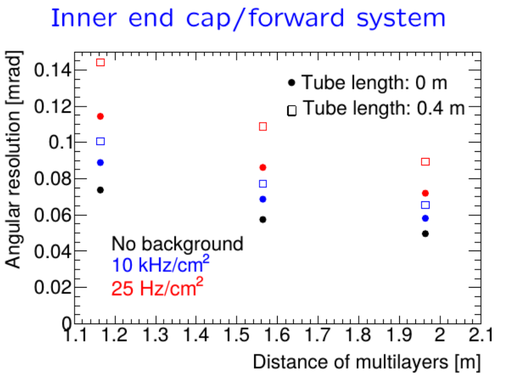



- 2x4 layers of 2.8 m long drift tubes (axial in barrel, radial in outer endcaps) with 1.5 m multilayer distance provide 40 µm spatial resolution, 70 µrad angular resolution, 100% tracking efficiency, 3.5 ns BCID resolution up to the maximum background rates.
- 40 cm long tubes to be used in regions with 25 kHz/$cm^2$ rates.
- Monolithic sMDT construction, no optical alignment of multilayers needed. Chambers well accessible.

Barrel

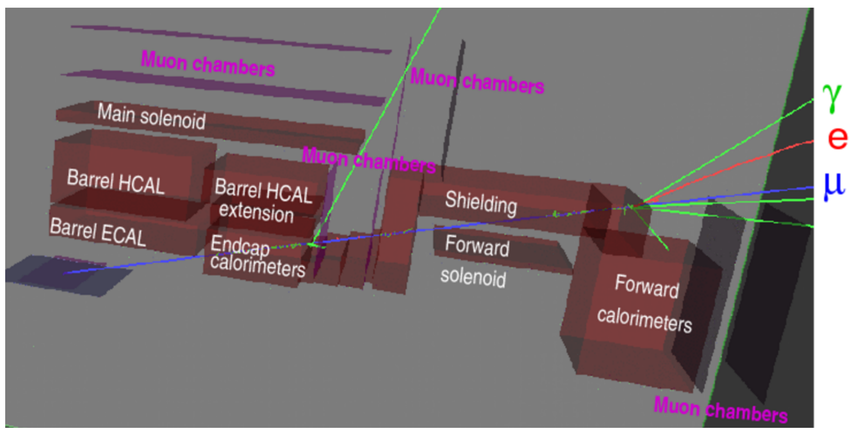



Inner end cap/forward system




## Simulation of the stand-alone muon momentum resolution

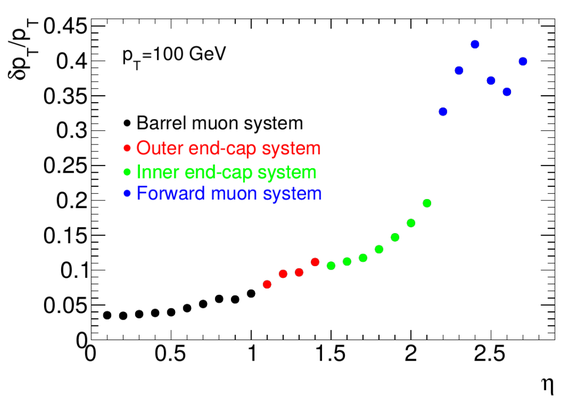
### Simulation framework

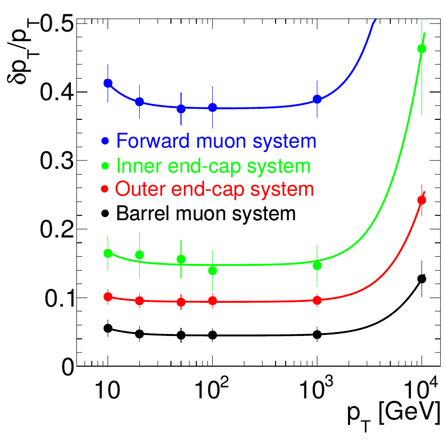



- Simulation using Geant-4.10.04p01.
- Calorimeters and solenoids simulated as homogeneous blocks with the correct average radiation and nuclear interaction lengths.
- Latest FCC magnetic field map used.
- Two simulation modes:

  Muon chambers are two ideal detector layers at 1.5 m distance fromeach other or sMDT chambers.

### Momentum resolution as a function of η for $p_T$=100 GeV




- Momentum resolution dominated by multiple scattering in thecalorimeters and the shielding.
- Momentum resolution:
  - ~5% in the barrel,
  - ~10% resolution in the outer end caps,
  - ~15% resolution in the inner end caps,
  - ~40% resolution in the forward system.

- Error bars reflect the spread of the resolution in the given region.
- Contribution of energy loss fluctuations to the resolution at $p_T$<10 GeV.
- Resolution dominated by multiple scattering up to $p_T$~1 TeV.
- Resolution limited by the angular resolution of the chambers for $p_T$ >1 TeV.