

Searches for long-lived particles at the LHC

Workshop of the LHC LLP
Community

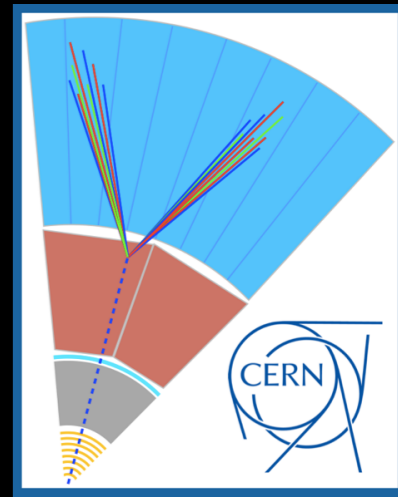
24 - 26 April 2017

Welcome

LHC LLP Community Workshop

https://indico.cern.ch/e/LHC_LLPApril2017

CERN EGroup: lhc-llp



Welcome and practicalities

- Workshop structure

- **Monday**

- Morning, talks, here in 3-4-006
 - Afternoon, working groups
 - WG1 in 304-1-001
 - WG2 in 40-R-C10
 - 5:20 PM — Capstone talks, back here

- **Tuesday**

- Morning, talks, here in 3-4-006
 - Afternoon, working groups
 - WG3 in 104-R-A10
 - WG4 in 3150-R-002 [may change]
 - 5:20 PM — Capstone talks, back here

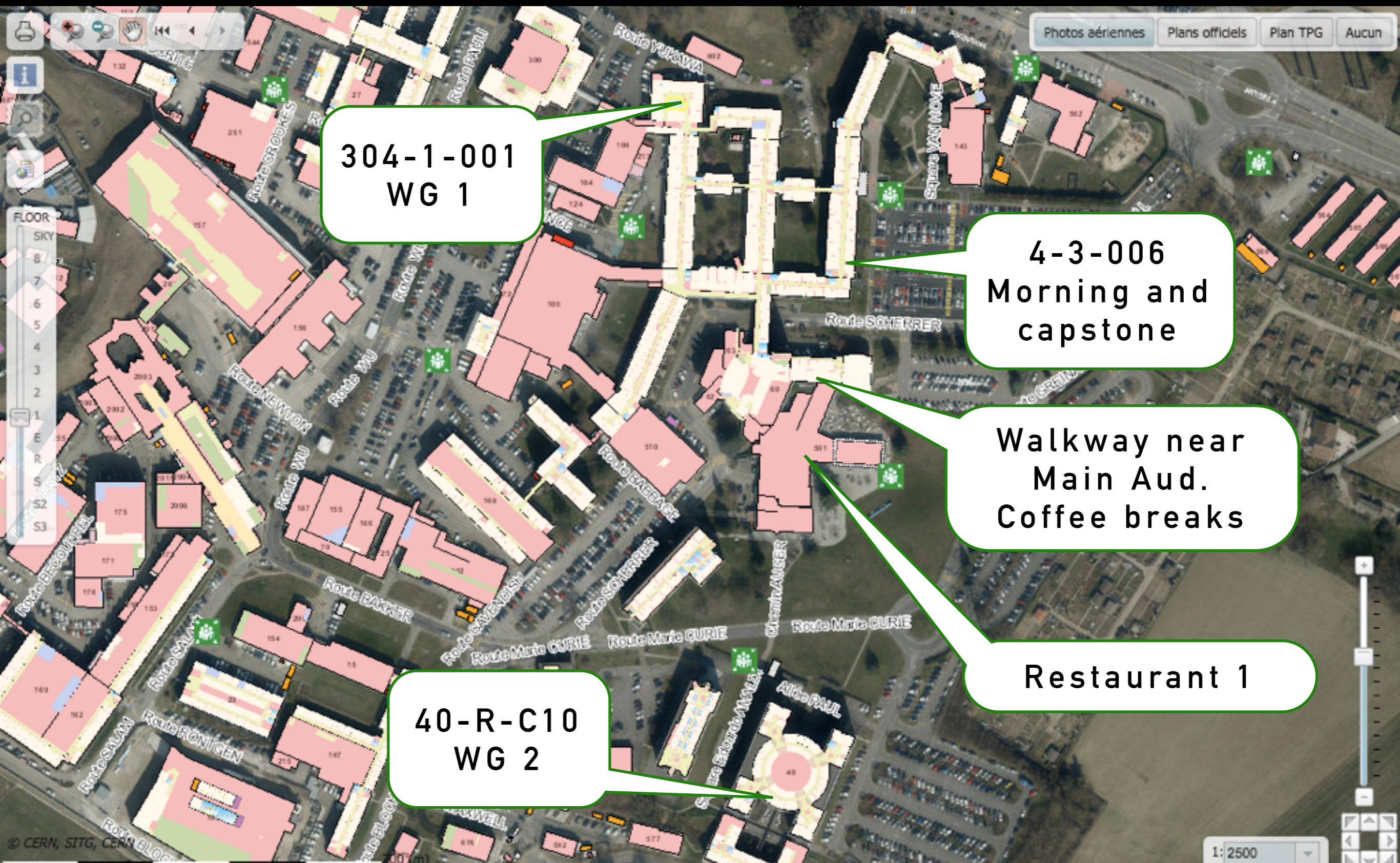
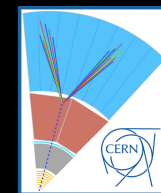
- **Wednesday**

- Morning, WG reports, here in 3-4-006
 - Afternoon, Lightning Round and summary, in Main Aud.

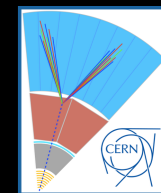
- Workshop dinner

LHC LLP Community Workshop

Monday — <https://maps.cern.ch/>



LHC LLP Community Workshop



Tuesday — <https://maps.cern.ch/>



104-R-A10
WG 3

4-3-006
Morning and
capstone

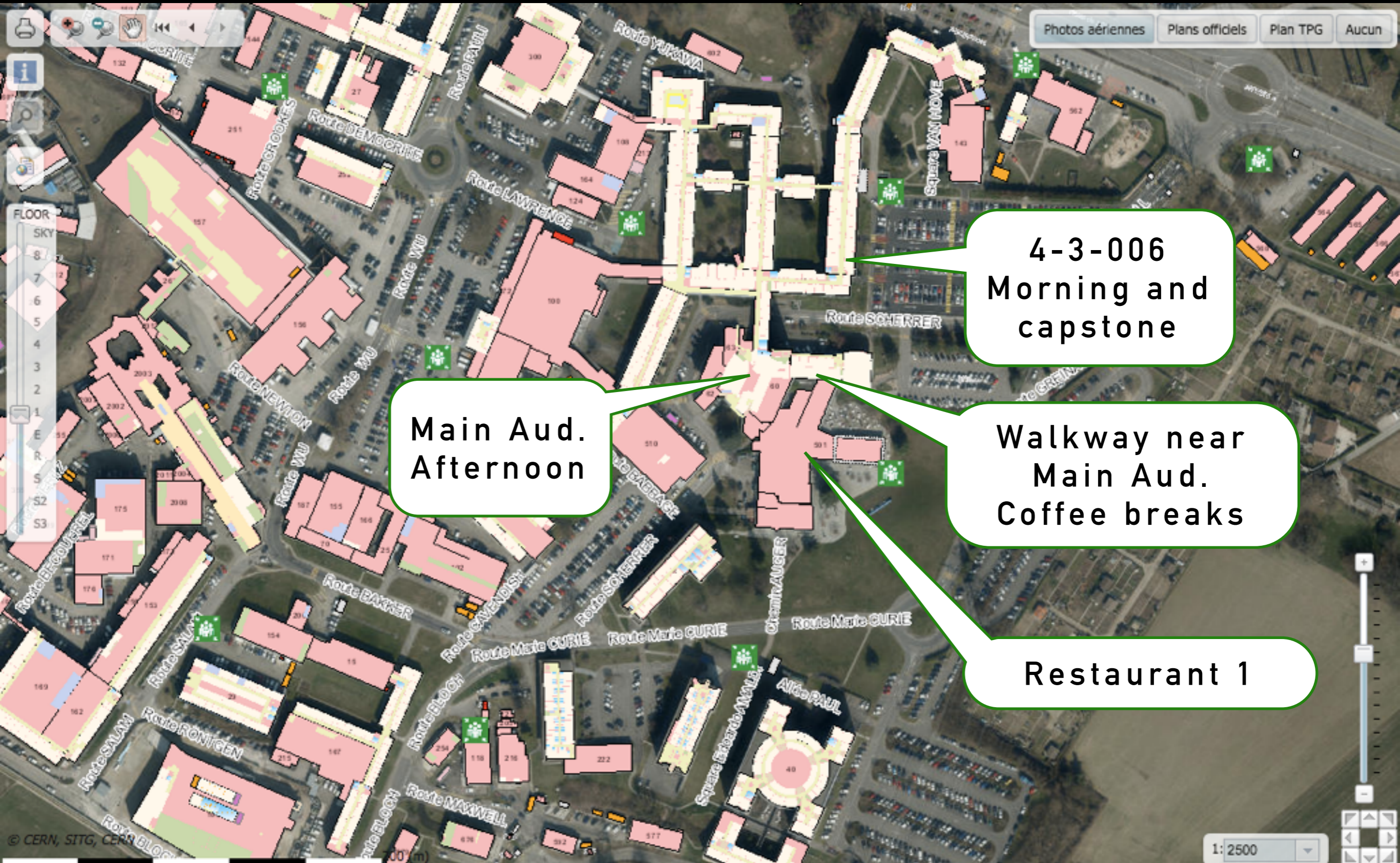
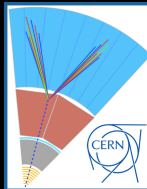
160-R-009
WG 4

Walkway near
Main Aud.
Coffee breaks &
welcome drink

Restaurant 1

LHC LLP Community Workshop

Wednesday — <https://maps.cern.ch/>



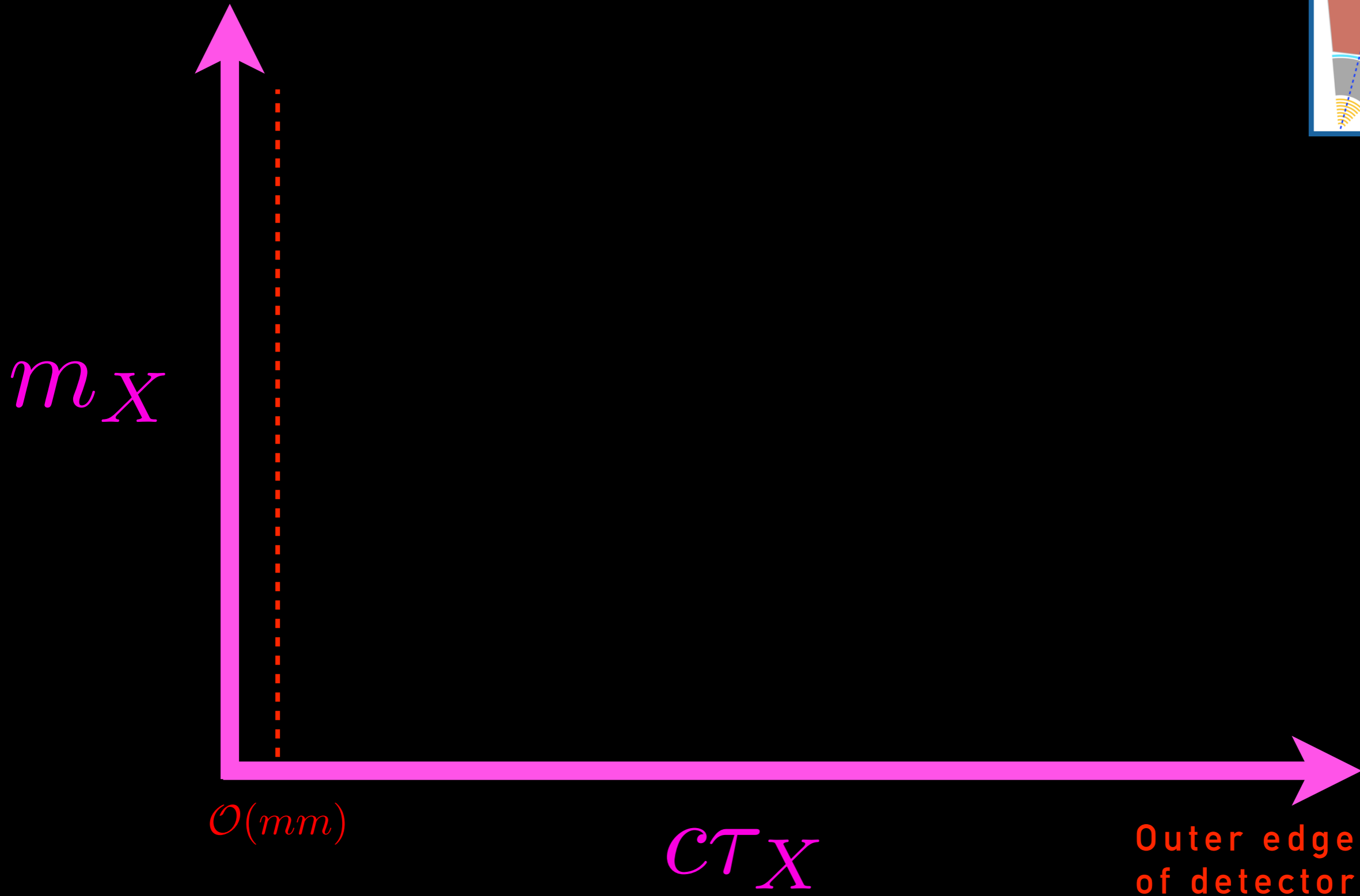
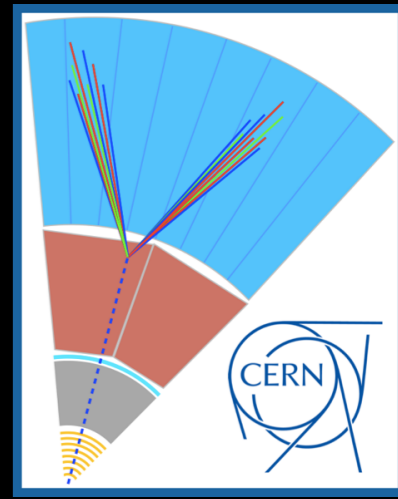
4-3-006
Morning and
capstone

Main Aud.
Afternoon

Walkway near
Main Aud.
Coffee breaks

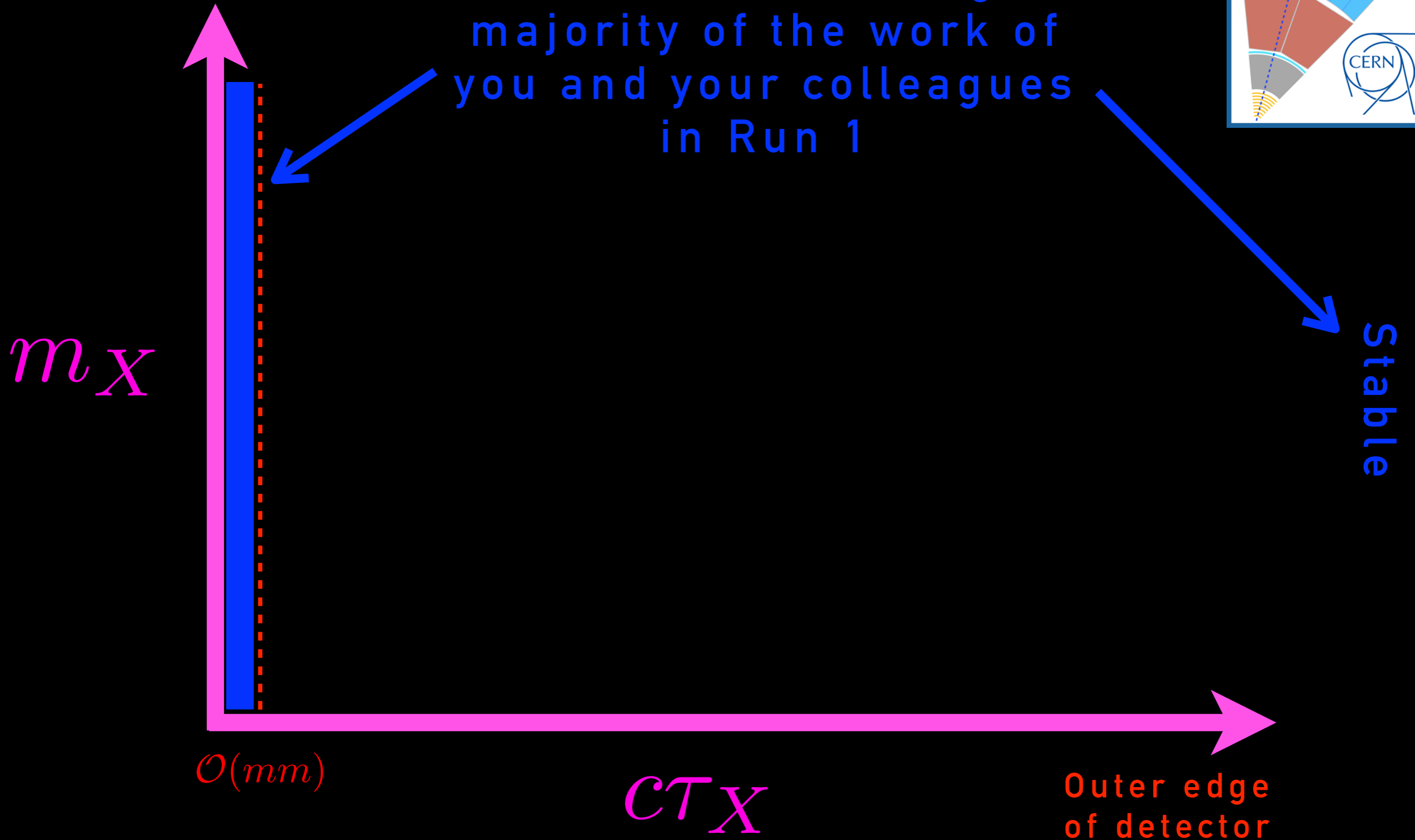
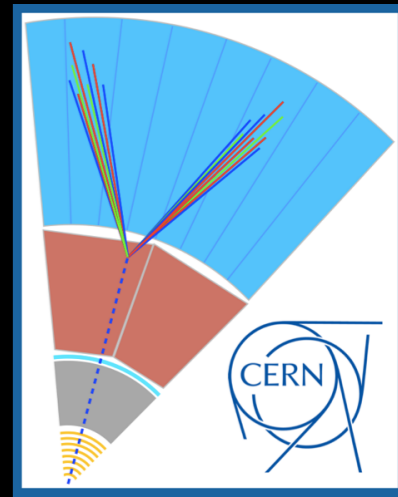
Restaurant 1

New physics X at the LHC



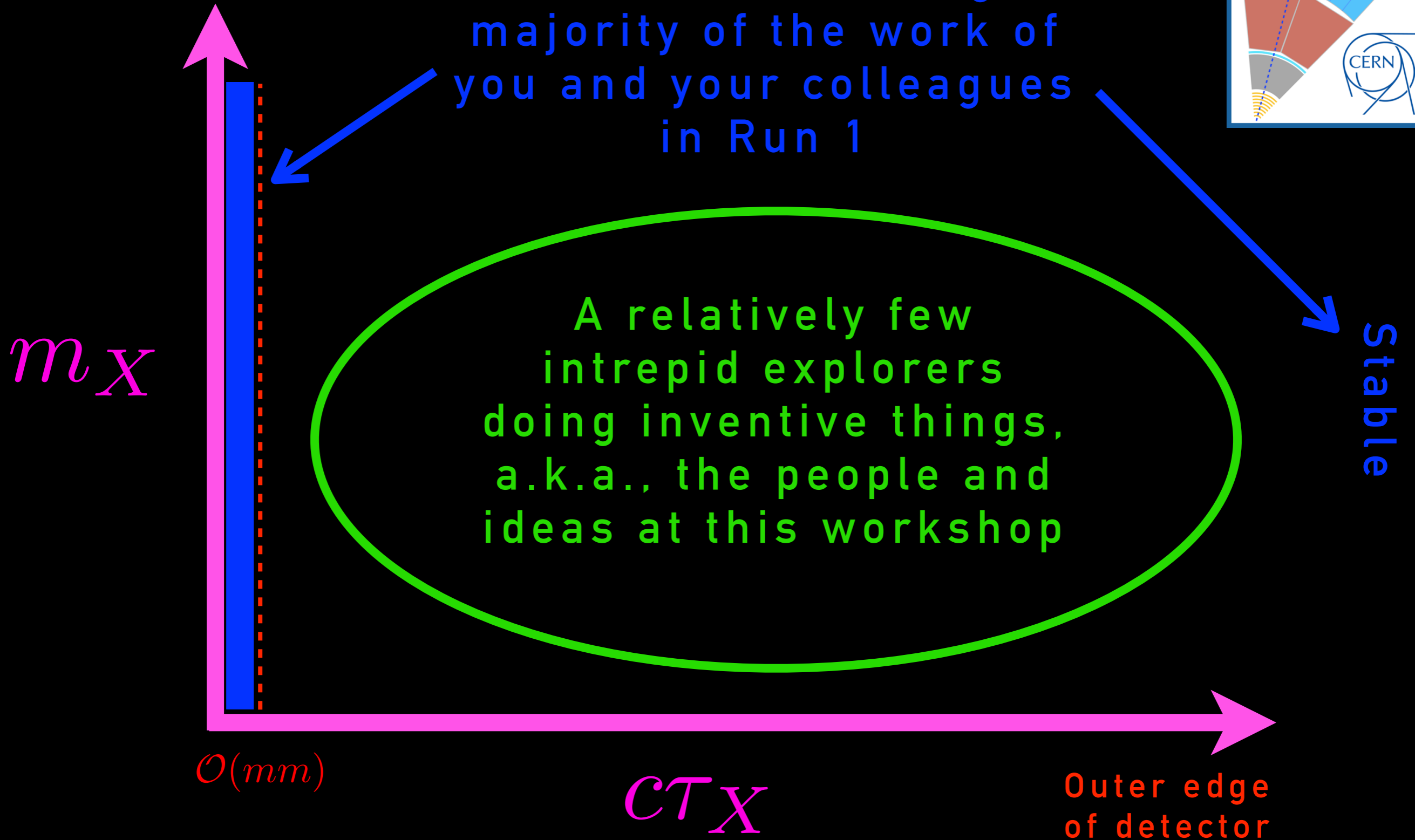
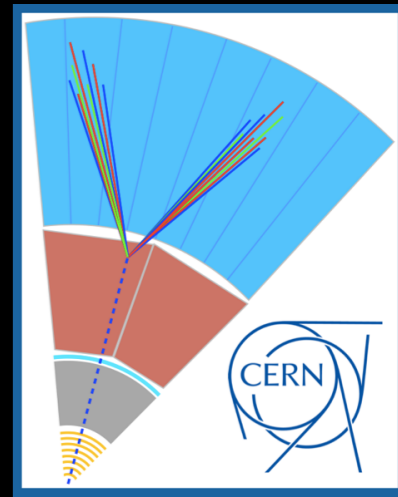
New physics X at the LHC

The overwhelming majority of the work of you and your colleagues in Run 1

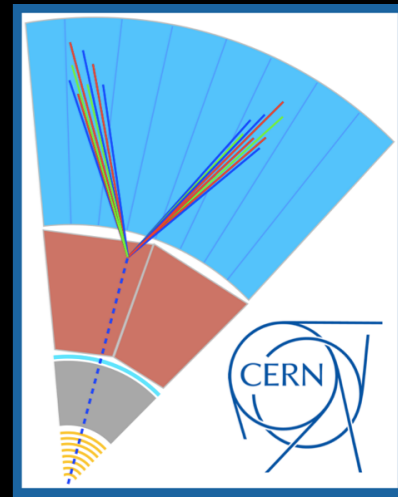


New physics X at the LHC

The overwhelming majority of the work of you and your colleagues in Run 1



LHC Long-Lived Particle Community



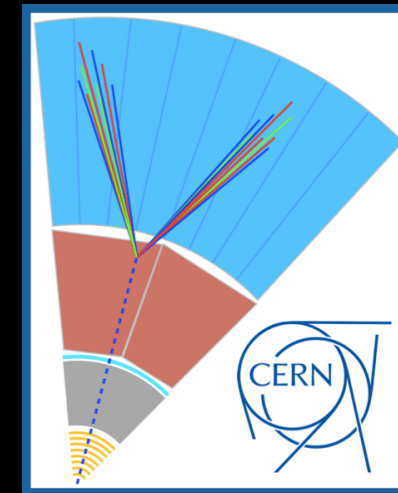
...in collaboration with the theory/pheno community and MoEDAL, SHiP, milliQan, MATHUSLA, etc., enthusiasts

Overall goal is to address one question:

How do we best ensure that we don't miss BSM LLP signatures for the remainder of the LHC program?

Current focus is producing a **white paper** to organize our thinking in this direction, and to hold **two workshops** to this end

LHC LLP Community Workshop



The LHC LLP Community initiative collects efforts from many workshops and conferences over the last year and a half

- “Long-Lived Particle Signatures Workshop”, U. Mass, Amherst, November 2015
- “Searching for Exotic Hidden Signatures with ATLAS in LHC Run 2”, Cosenza, Italy, March 2016
- “Experimental Challenges for the LHC Run II”, Kavli Institute for Theoretical Physics, May 2016
- “LHC Long-Lived Particles Mini-Workshop”, CERN, May 2016

Community focus: Producing an LHC LLP white paper

- From skeleton, now (first workshop) to completion by October (second workshop)

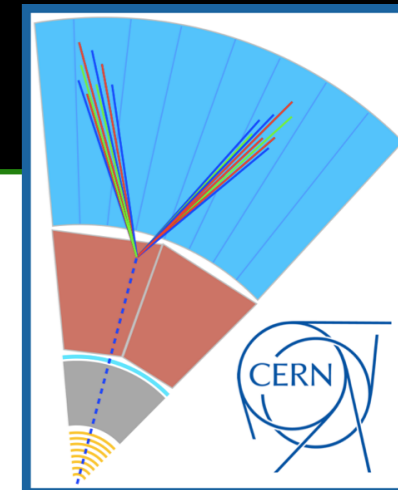
LHC LLP Community White Paper

Long-lived particle searches at the ATLAS, CMS and LHCb experiments at the Large Hadron Collider at CERN

March 22, 2017

Emmy Noether Bryn Mawr College, Pennsylvania, USA

Contact editors: lhc-llp-admin@cern.ch



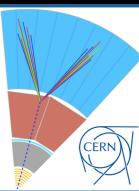
Motivations chapter
organized around LLP
production mode: Higgs
or other SM particle
decays, direct production
through SM gauge
interactions (SUSY-like),
Hidden valley, etc.

Overview of why these
searches are challenging
from the experimental
standpoint

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LHC LLP Community White Paper



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LONG-LIVED PARTICLE SEARCHES AT THE ATLAS, CMS AND LHCb EXPERIMENTS AT THE LHC

HADRON COLLIDER AT CERN 5

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Bulk of paper structured around experimental signatures rather than specific models

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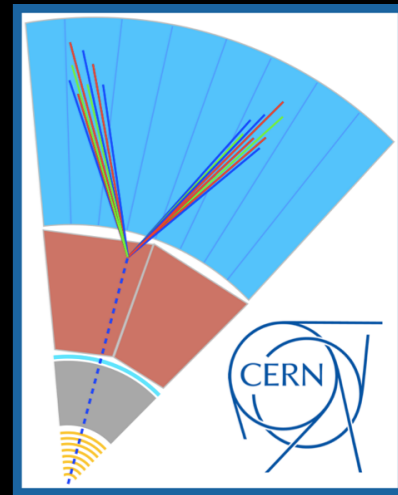
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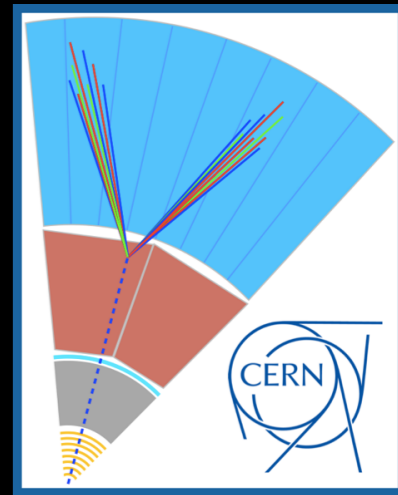
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Workshop goals

- Set of high-priority recommendations for the experiments
 - Presentation of LLP search results
 - Simplified models for LLP searches
 - Analyses to be included in the RECAST framework
 - Trigger studies
- More comprehensive picture of how to address backgrounds for LLP searches
- Better understanding of dark showering sectors

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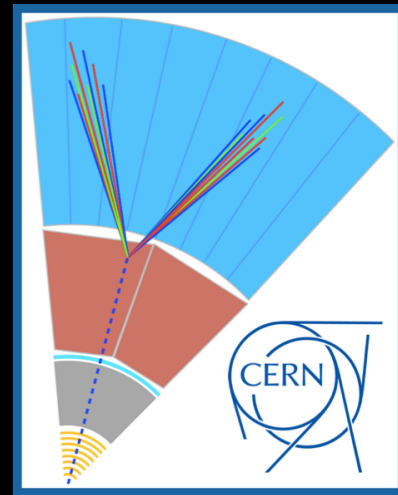
Breakout working groups here at the workshop

- **WG1:** Simplified models / MC / RECASTing and reinterpretation
 - How do we ensure the published searches retain usefulness?
- **WG2:** Backgrounds for LLP searches
 - Challenges of low/non-standard background searches, past work, limitations, new ideas
- **WG3:** Triggering strategies for LLP searches
 - Blue-sky discussion to emerge with some recommended studies that the experiments should do over the summer
- **WG4:** Dark showers
 - One of the major outstanding questions in designing a search program for displaced objects is how to design a simple and flexible basis of models for showering dark sectors

LHC **LLP** Community Workshop

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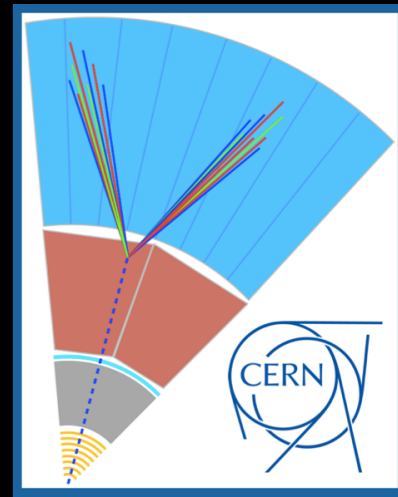
After the workshop

- Spring and summer homework/projects
 - Write white paper sections
 - Take high-priority recommendations for trigger studies back to experiments to be performed and hopefully made public by the end of the summer
 - Implement recommendations for presentation of search results
 - Include high-priority, already-published analyses in the RECAST framework
 - Collect code library of simplified models
- Autumn workshop in Trieste
 - 18-20 October 2017

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Here's to a
productive
workshop!