“Beyond collider” and intensity experiments

European strategy 2025

Israeli town-hall

Outline

- Belle II (SuperKEKB)
- FASER (LHC)
- E320 (SLAC)
- LUXE (Eu XFEL)
- MATHUSLA (LHC)
- NA60+

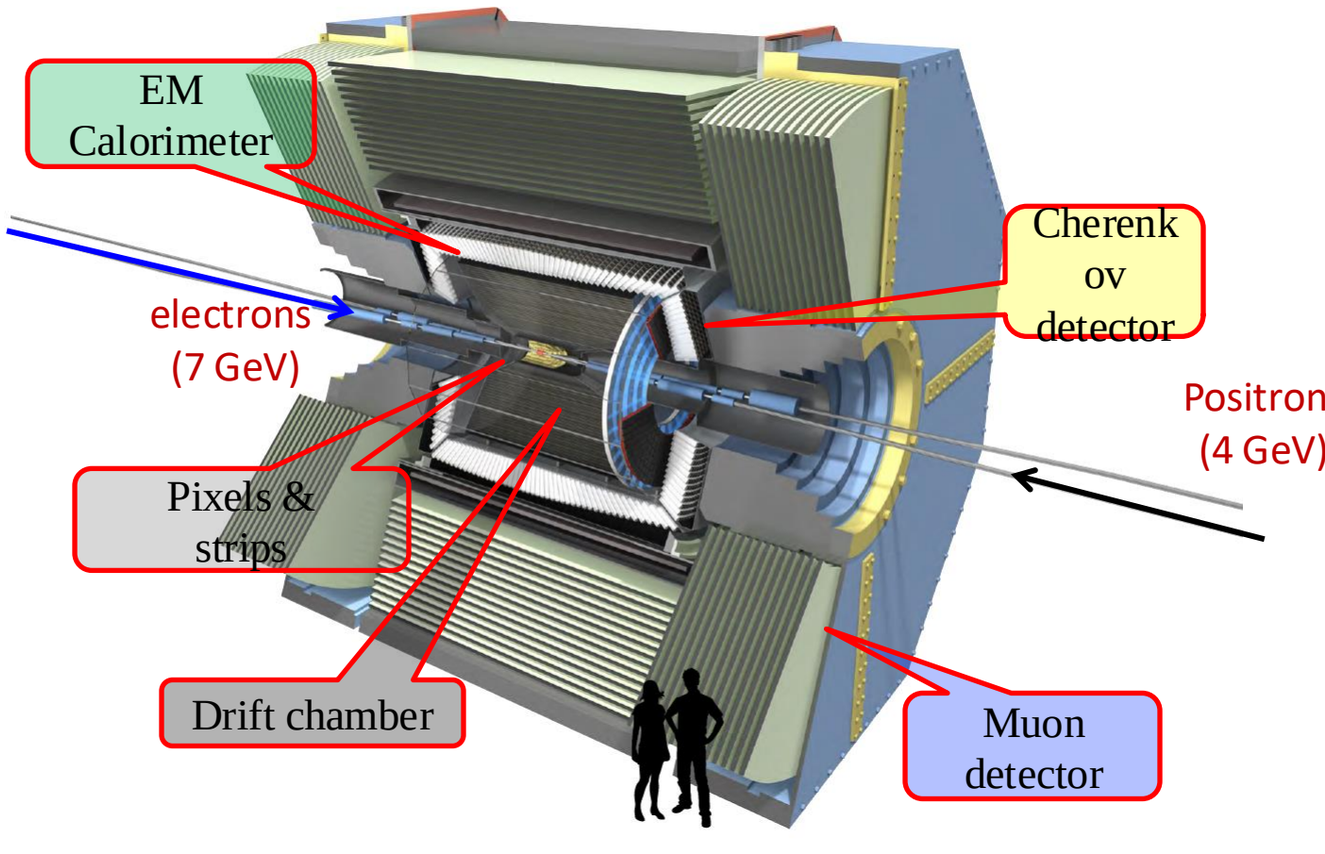
Belle II (TAU)

- An upgrade of the Belle detector: improved
  tracking, vertexing, hadron ID,
  faster readout
- Higher luminosity than at Belle:
  - $\times 30$ planned: $\times$ **2 achieved so far**
  - Various challenges, mostly related to aging infrastructure and rising power cost,
    not to fundamental technology
  - Involvement of other labs welcome
  - Technology proof for FCC-ee
- Physics goals:
  - High precision b, c, τ physics
  - O(GeV) BSM particle searches
  - QCD (e.g., input for $g_\mu - 2$)
  - Exotic hadrons

Physics:BSM, Exotics hadrons

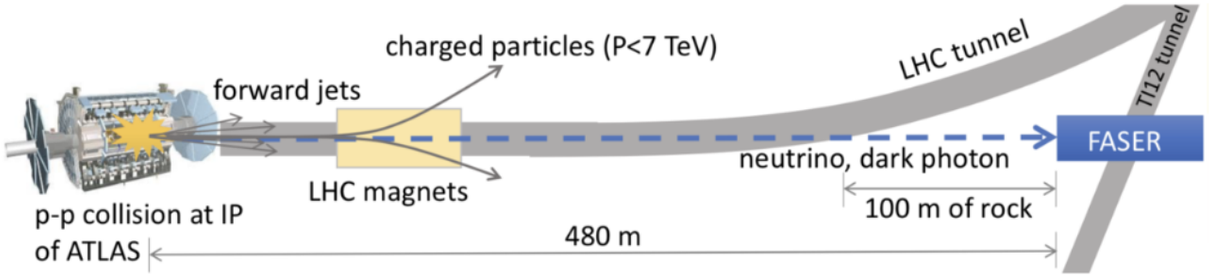
Technical/performance:Early signals, efficiency measurements, vertex+kinematic constraints, ML background suppression

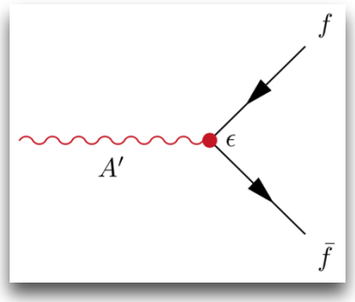
Management

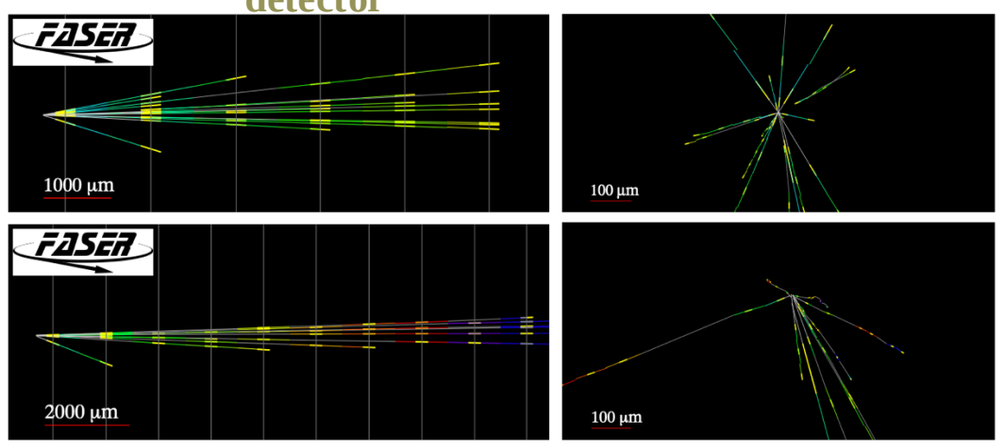


FASER (Technion, WIS)

- Dark Sector mediators could be light (produced in LHC) and feebly interacting (long lived)
- **FASER**: optimized to detect these mediators in their decay to SM particles:
  - ~500 m from ATLAS's IP with a direct line of sight
  - About 10^{17} π_0's pointed towards FASER's window:
    - can produce e.g. lots of dark photons, *A'*
  - Backgrounds (debris from LHC collisions) are shielded by LHC's magnets and the rock
- **FASERν**: very large number of high-energy neutrinos are produced at the LHC from hadron decays.
  - An emulsion detector placed in front of FASER
  - ~1K tungsten layers - total 1.2 tones
  - Each layer has 180 nm spatial resolution, resulting in 0.06 mrad angular resolution between two layers
  - Can measure x-sections, PDFs, NP searches…

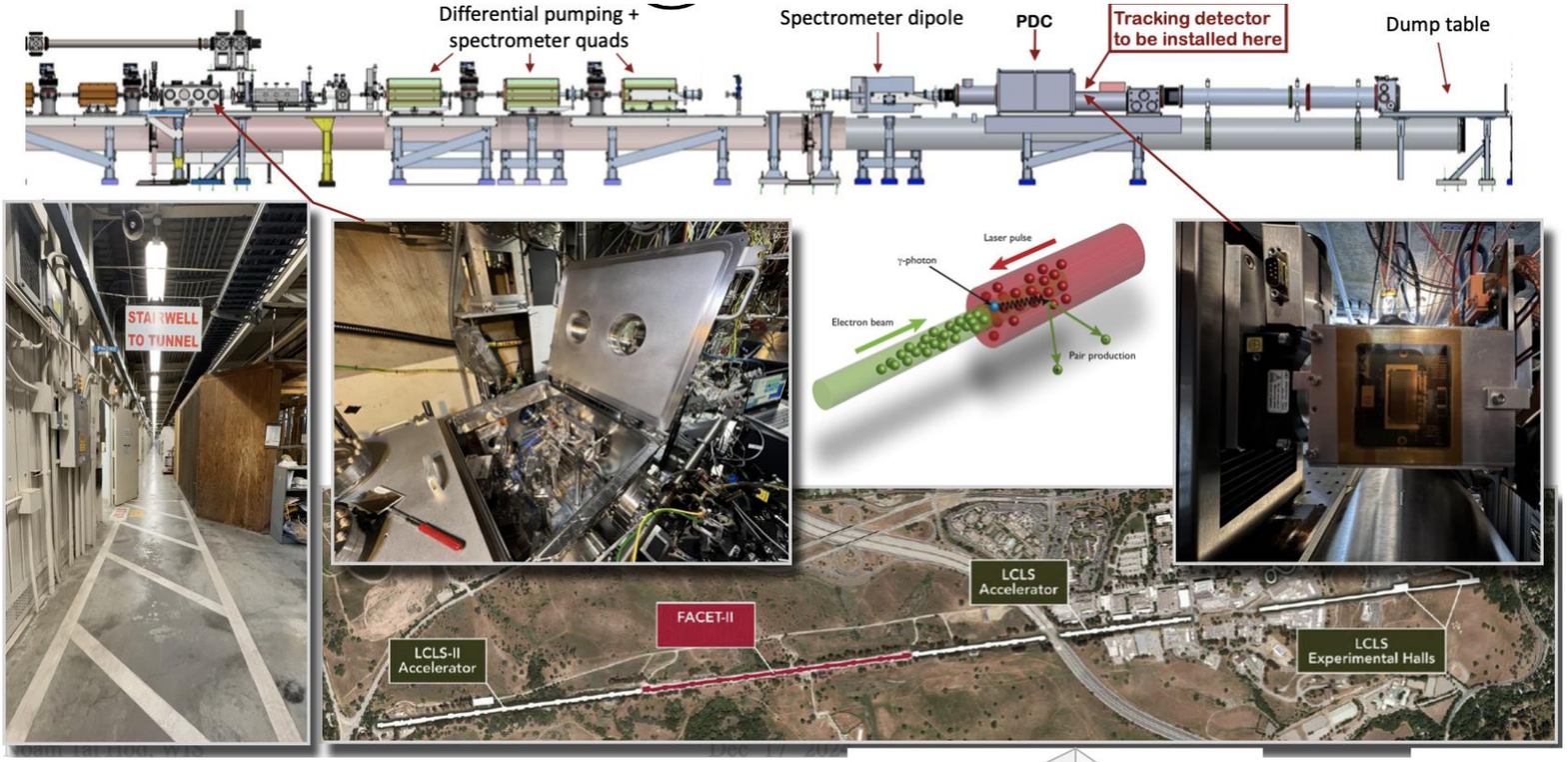


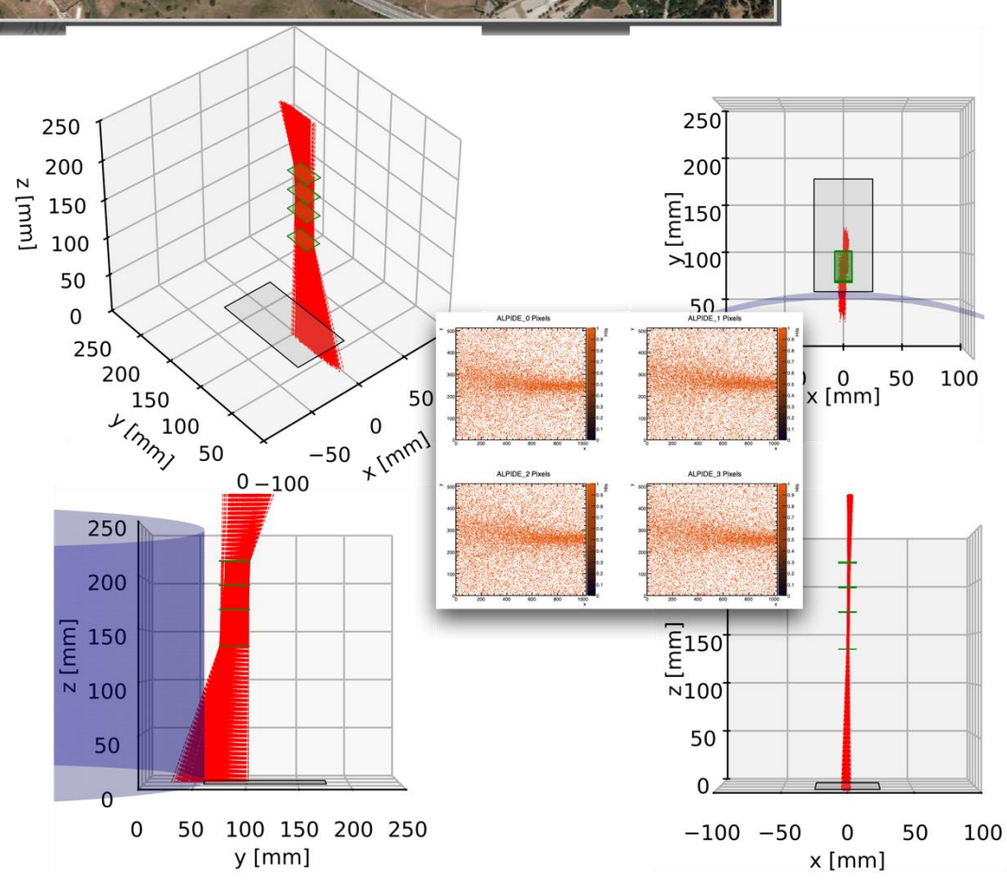




FASERν: Neutral vertex candidates from pilot run

E320 (WIS)


Differential pumping +
spectrometer quads
Spectrometer dipole
PDC
Tracking detector
to be installed here
Dump table
STAIRWELL
TO TUNNEL
Laser pulse
γ-photon
Electron beam
Pair production
LCLS
Accelerator
FACET-II
LCLS-II
Accelerator
LCLS
Experimental Halls


z [mm]
y [mm]
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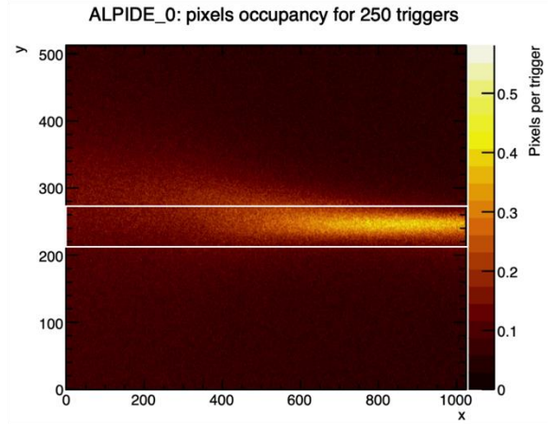
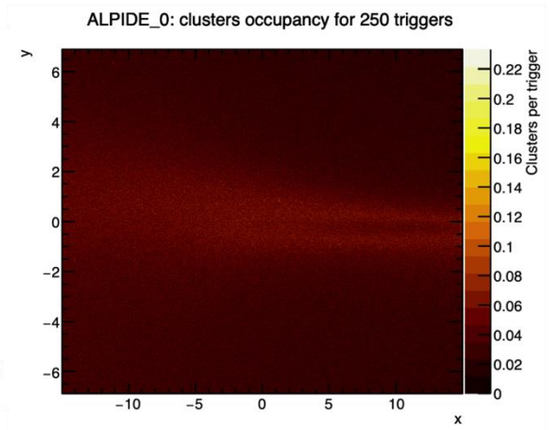
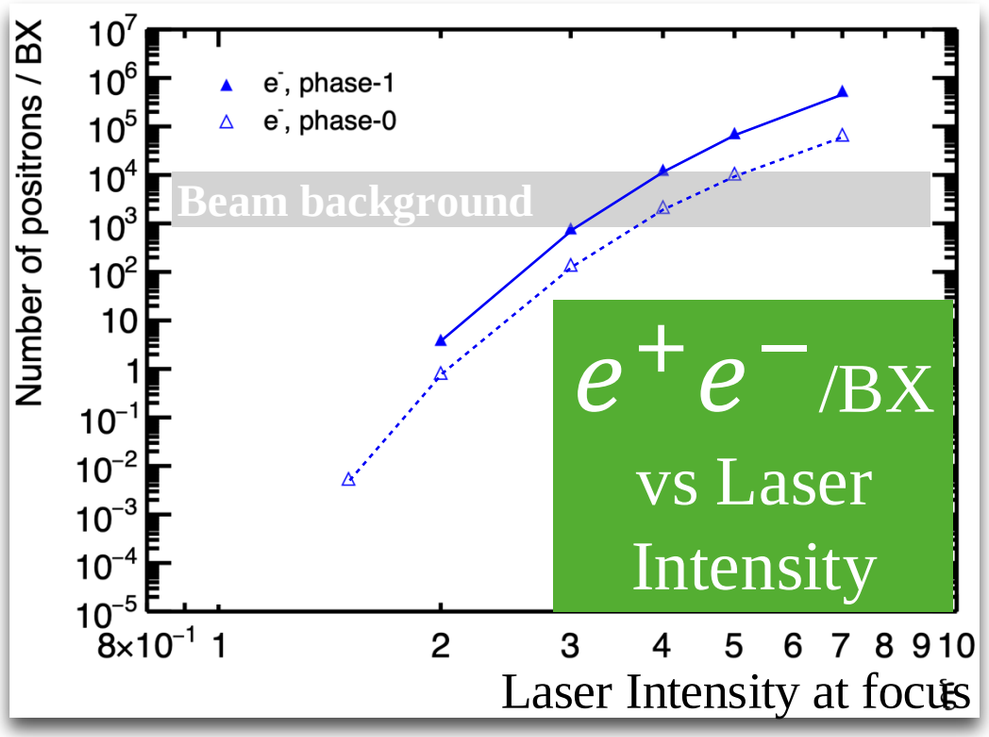
ALPIDE_0 Pixels
ALPIDE_1 Pixels
ALPIDE_2 Pixels
ALPIDE_3 Pixels


ALPIDE_0: pixels occupancy for 250 triggers
Pixels per trigger


ALPIDE_0: clusters occupancy for 250 triggers
Clusters per trigger



LUXE

WIS

γ_{ALPs} detector (TBD)

ALPs

γ dump

Backscattering calorimeter

Shielding

γ-profiler

Scint. screen

e^+ e^-

Dipole magnet 2

Shielding

Electron beam dump

γ-converter

Compton γ's

e_C^-

Cherenkov counter
behind a Scint. screen

TAU

Calorimeter

WIS

Pixel tracker

e^+ e^-

Laser pulse

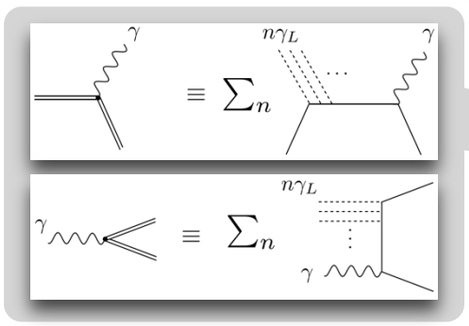
Dipole magnet 1

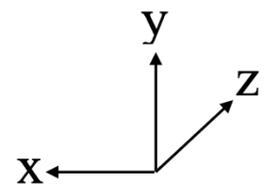
Electron beam
from the XFEL

IP

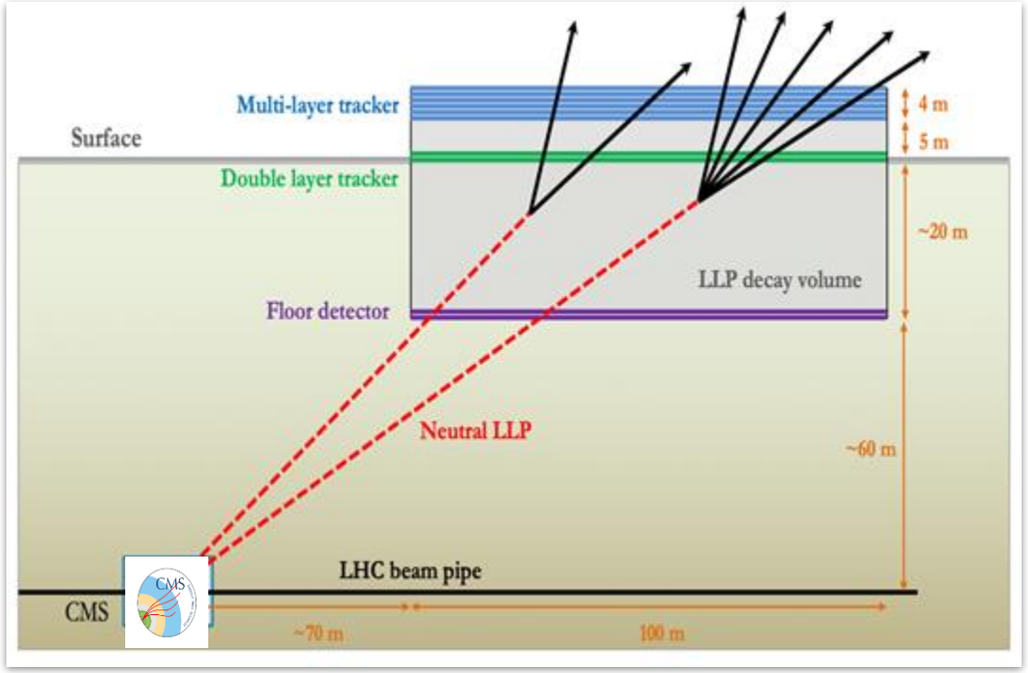
TAU

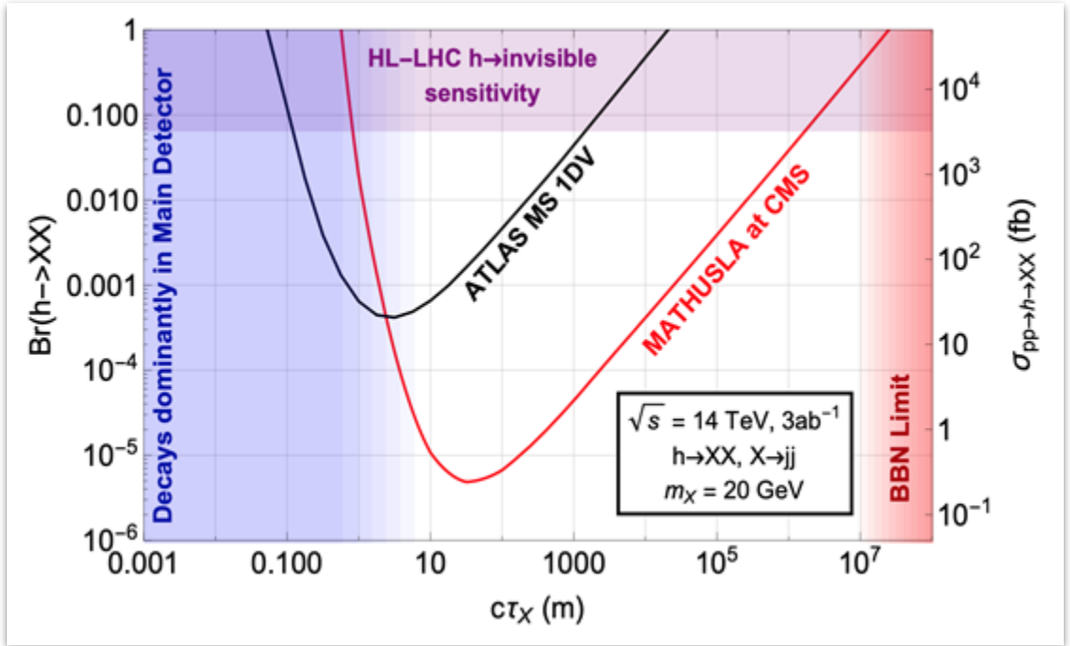
$\theta = 17^0$





Mathusla (TAU)



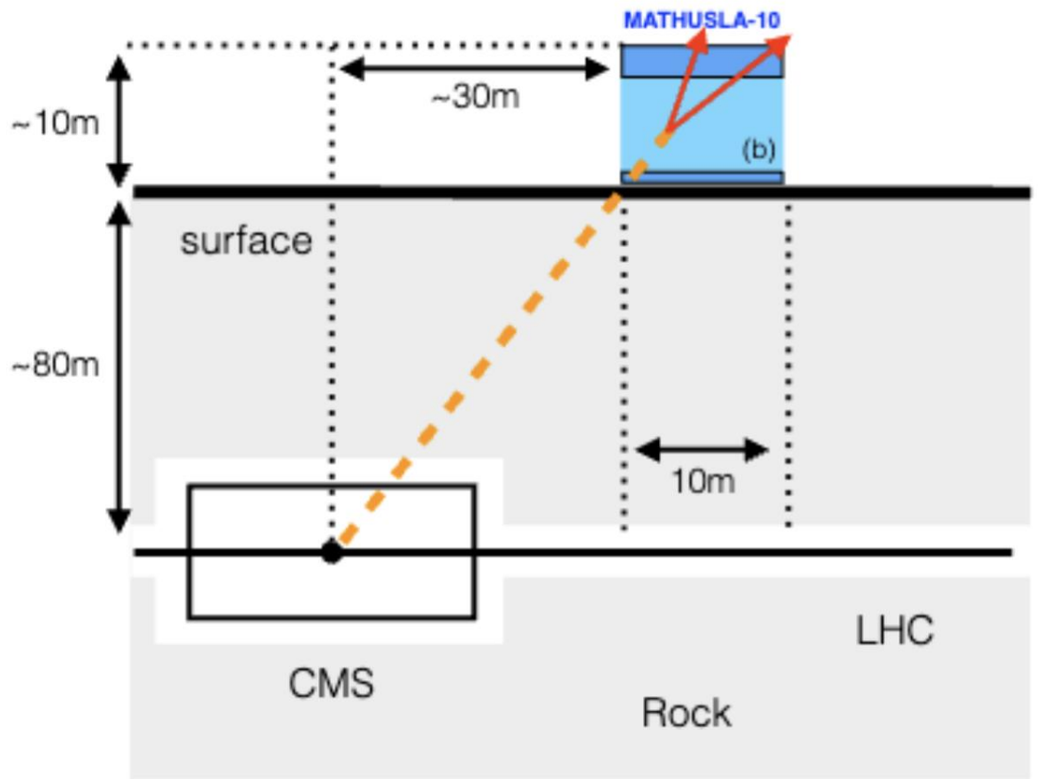


Proposal for **MATHUSLA-10** (Canada)

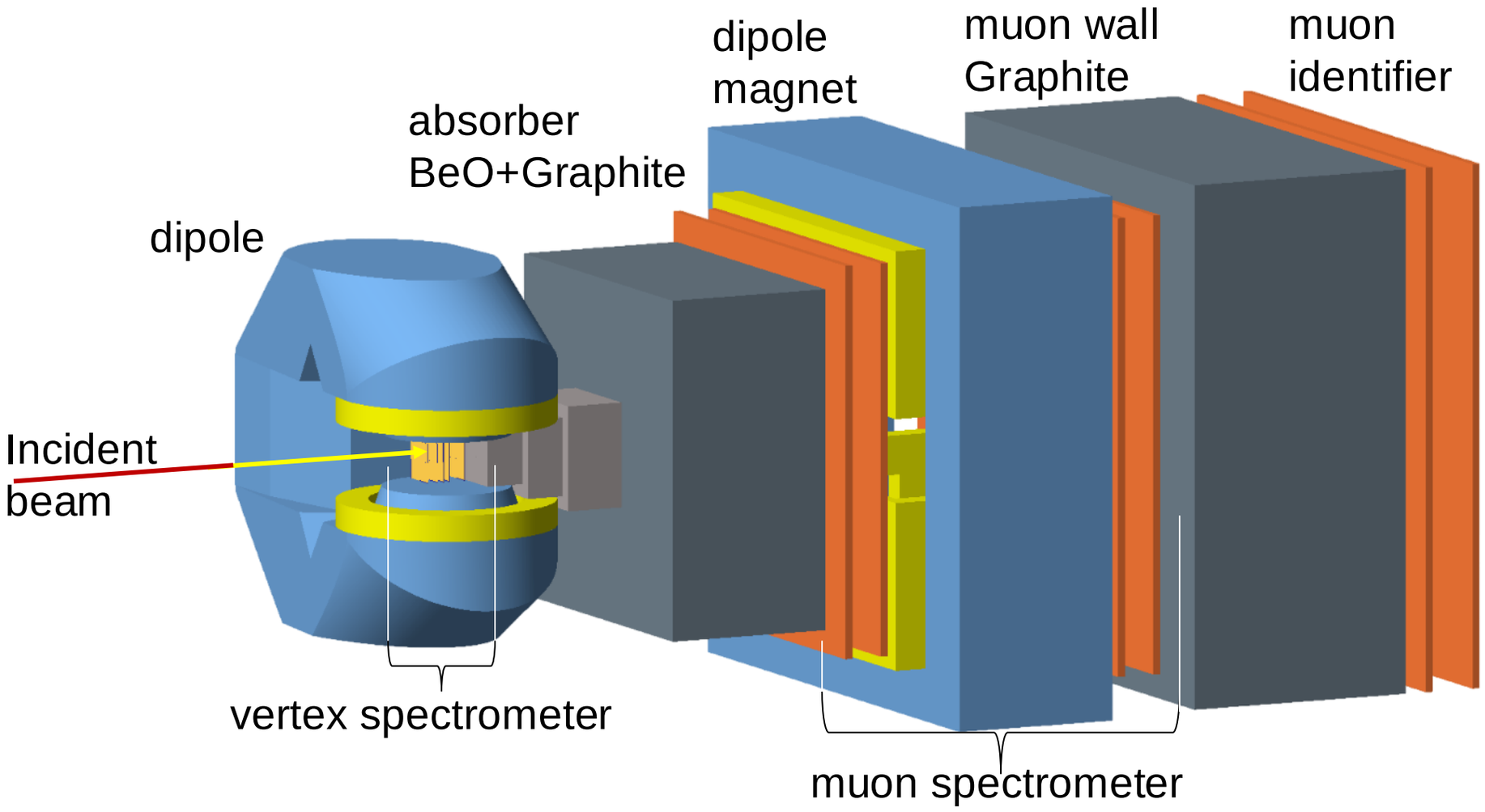
Dimensions **~10 x 10 m², H~flexible**

Prototype for the detector technology

To be placed above CMS, and even as a st
module can extend the LHC reach for LLP



NA60+ (WIS)



NA60+ is a ‘classic’ muon experiment consisting of two spectrometers:

Vertex spectrometer is based on MOSS technology, developed for ALICE upgrade

Muons spectrometer uses well-established MWPC

Muon spectrometer is the WIS responsibility

The MNP33 magnet (currently part of NA62) identifies all key elements for the new facility

Proposal in 1st half of 2025

Summary

- Big interest from the community in taking part in a wide range of smaller experiments (and more in other talks) – interesting questions, interesting techniques, interesting detectors
  - Groups contribute in tandem to the “big” experiment
- Personal opinion: Balances the challenges of working within the big experiments (big collaboration, long timelines, over-specialization) – keeps the joy of experimental particle physics alive
  - Very important for the health of the field and the community
  - Opportunity (and necessary) for cultivating the younger generations in the arts of experimental particle physics