

Snowmass Summary on

Non-collider/ALPs/Forward Facility

April 3rd 2023

Felix Kling



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accelerator / dark sectors / FPF

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Warning!

There were a huge number of meetings during the Snowmass process, most of which I didn't attend.

There are also a huge number of Snowmass documents, most of which I didn't read.

This report is therefore a subjective summary based on what I have seen. It is not comprehensive. Many topics are missing.

I will mainly report on efforts in the **energy frontier**, **neutrino frontier** and **rare process frontier**. Dark matter was also covered in the cosmic frontier, but I didn't follow these discussions and therefore won't cover it here.

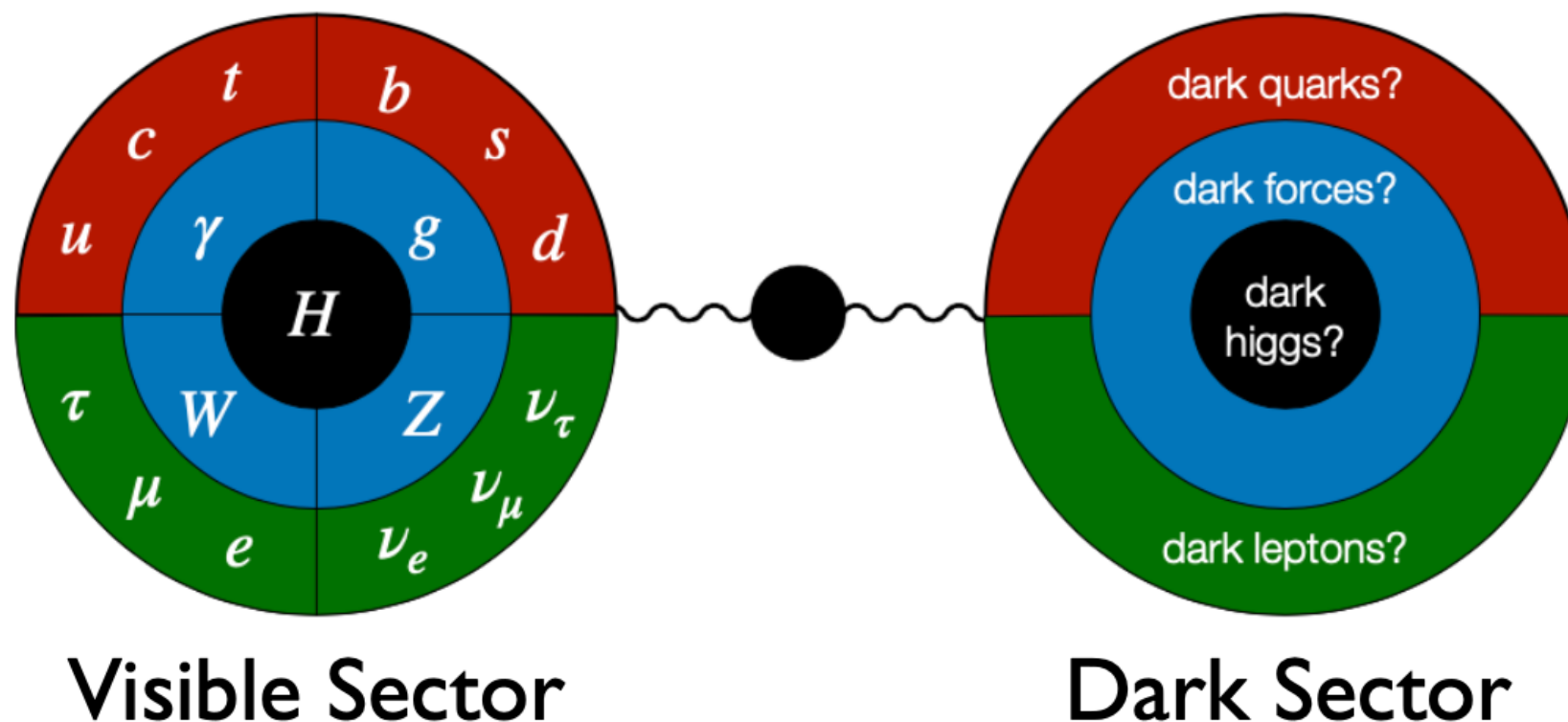
Physics: Dark Sectors

What is a dark sector?

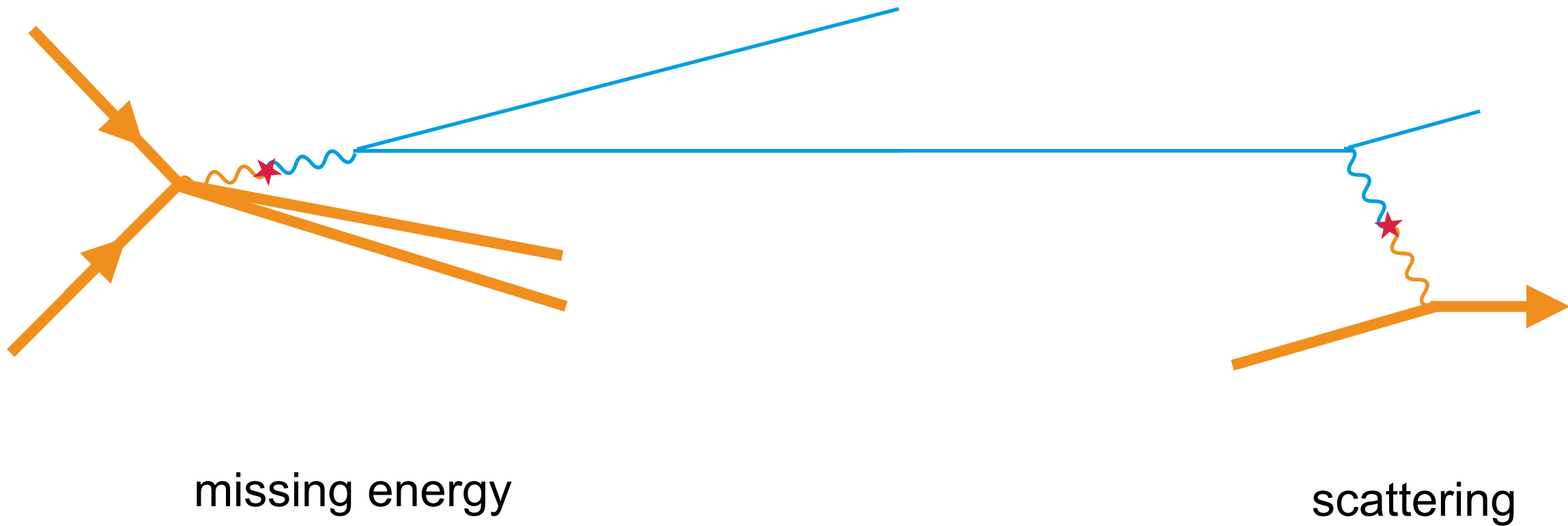
Definition from Snowmass RF6 group: *Dark Sector Studies at High Intensities*
see Brian Batell's talk at [Seattle Snowmass Summer Meeting 2022](#)

set of new particles, which do not experience known forces

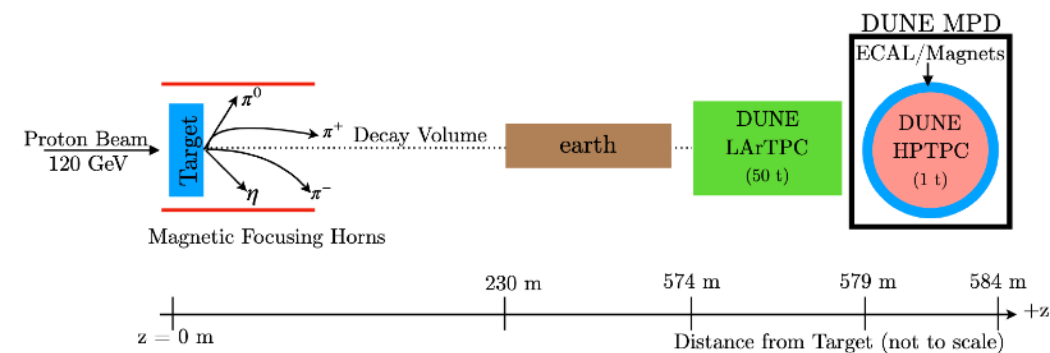
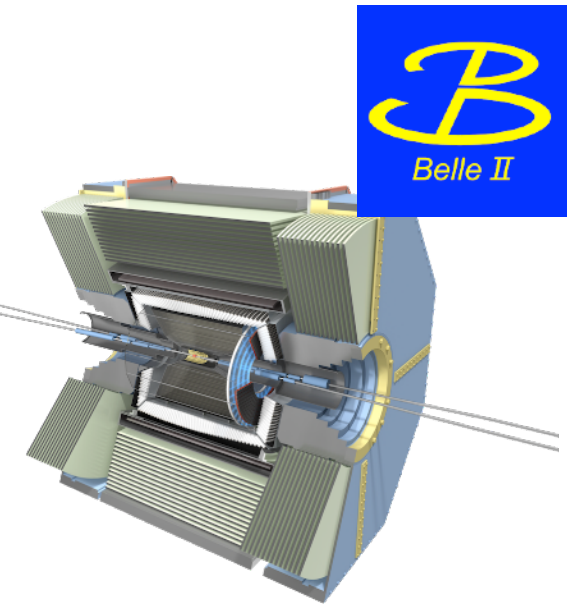
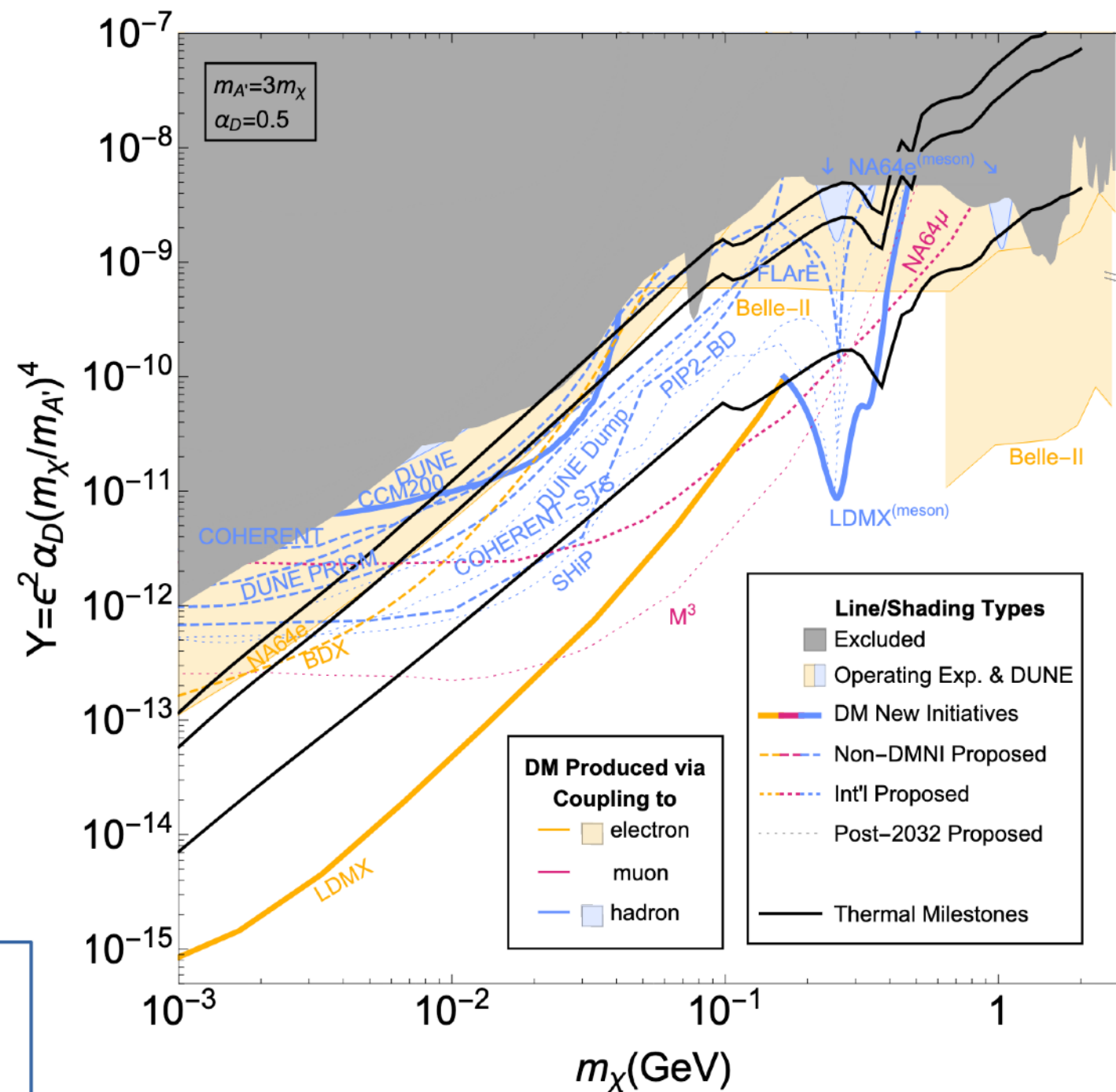
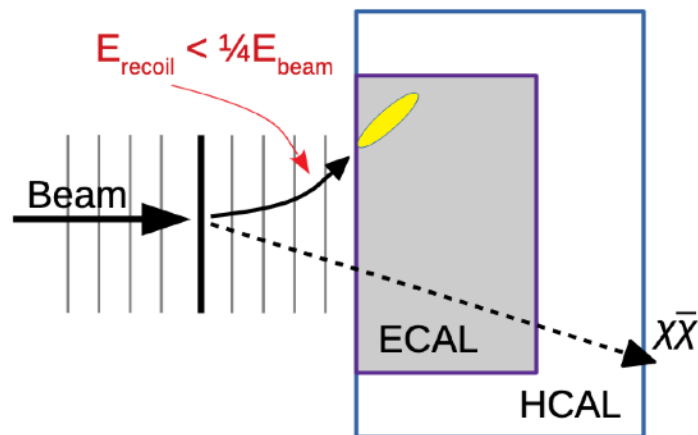
weakly coupled to visible sector through a mediator or “portal”



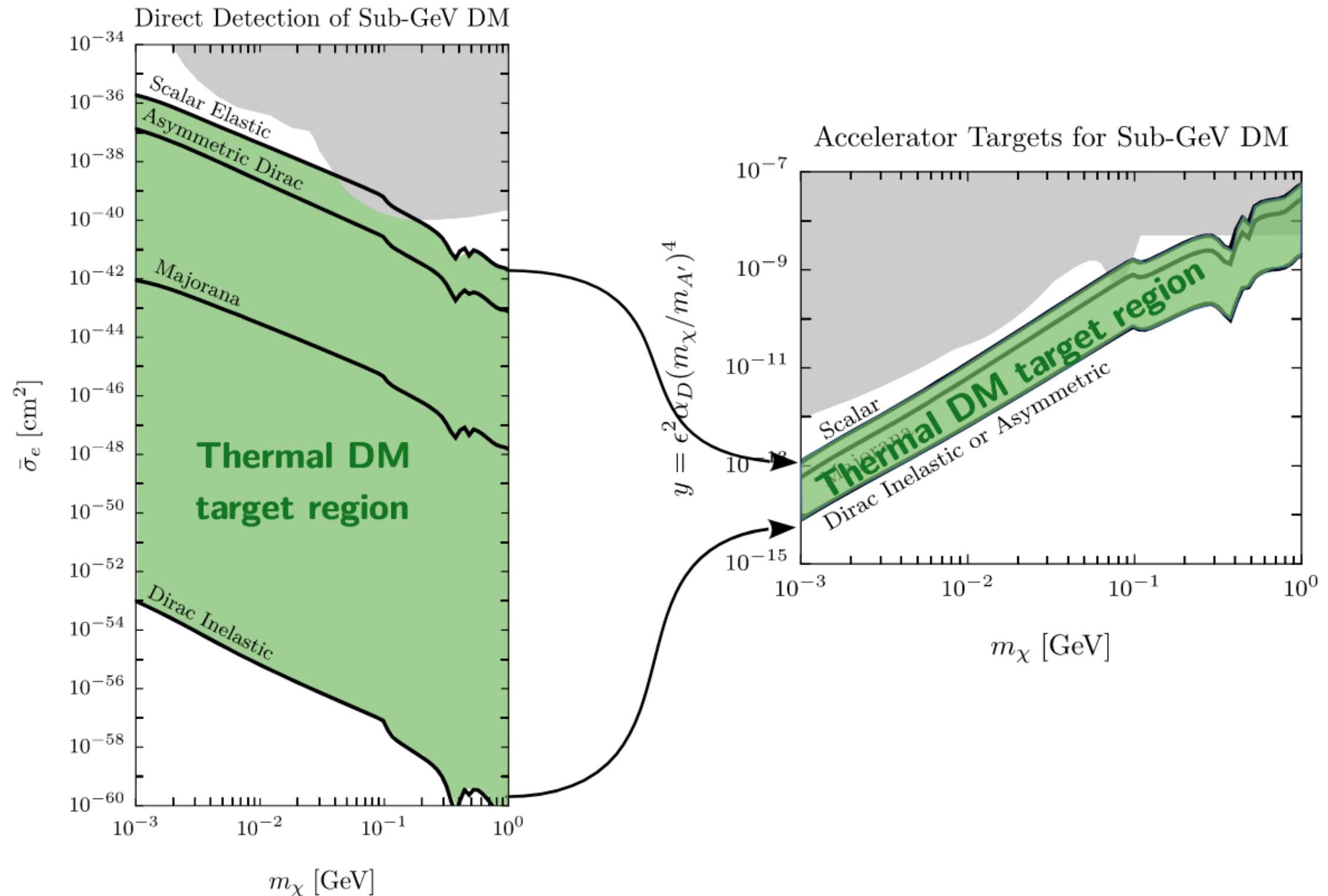
Signature with invisible decays.



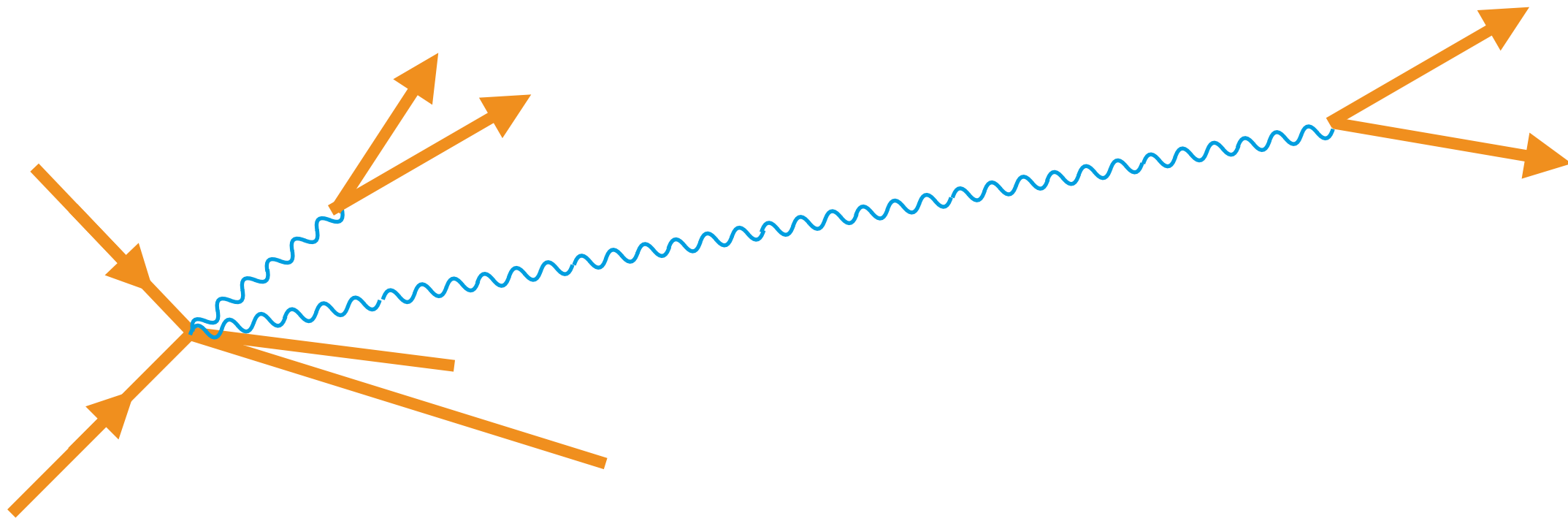
Signature with invisible decays.



Complementarity to Direct Detection.



Signature with visible decays.



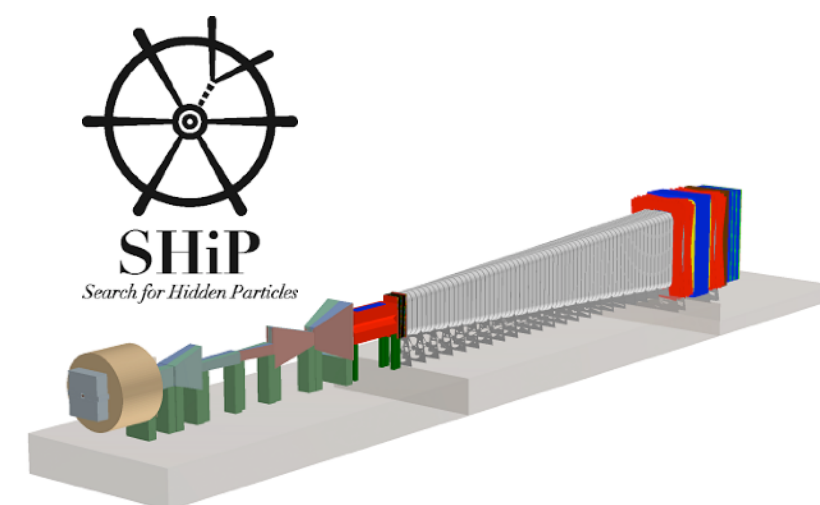
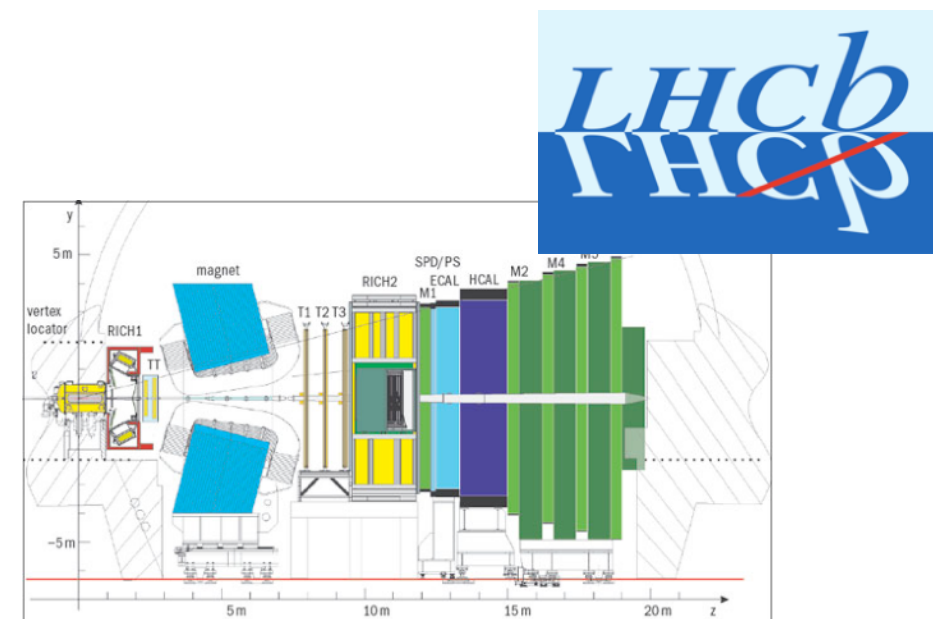
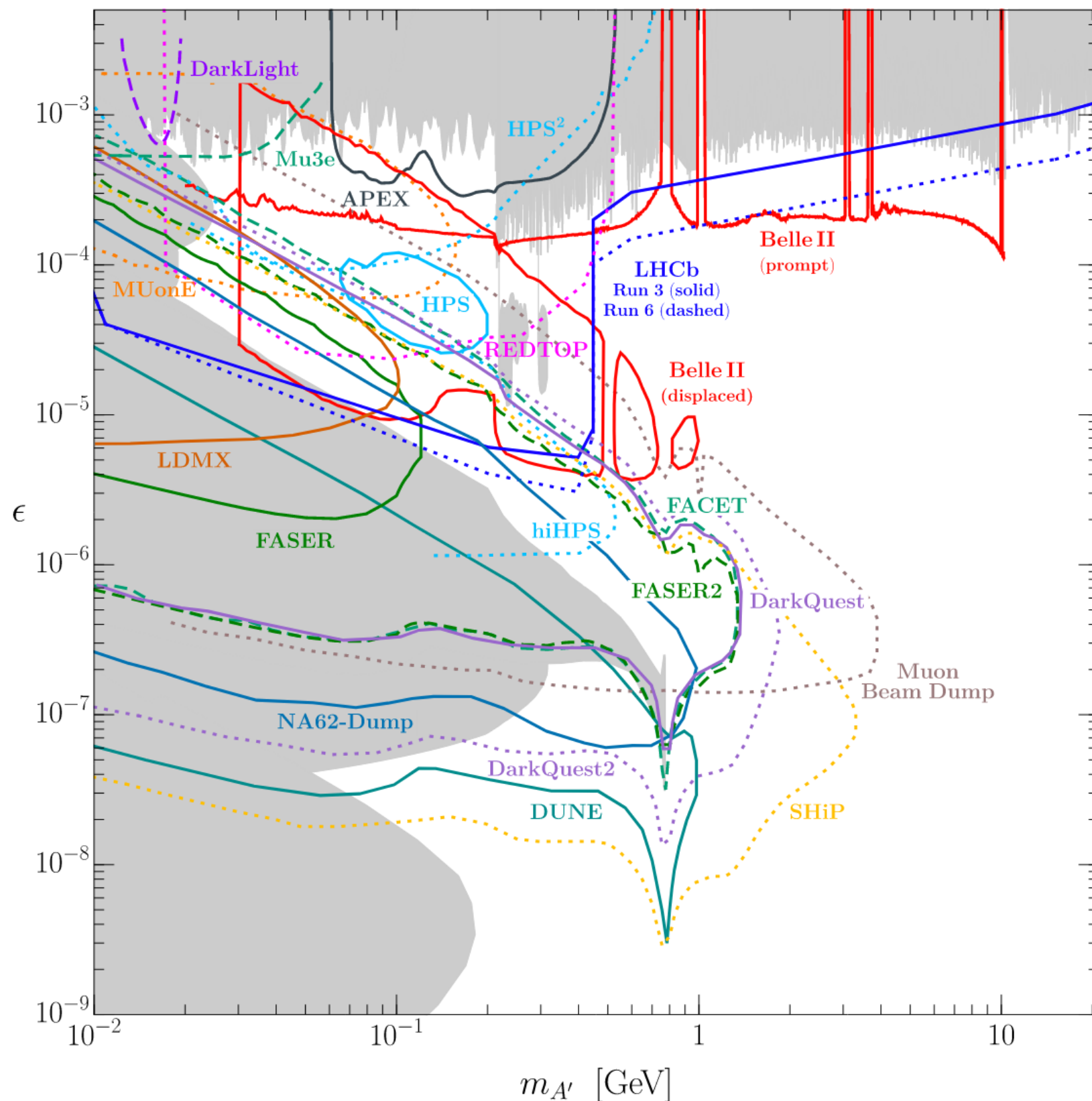
prompt resonances

$ct \ll m$

long-lived particle

$ct \gg m$

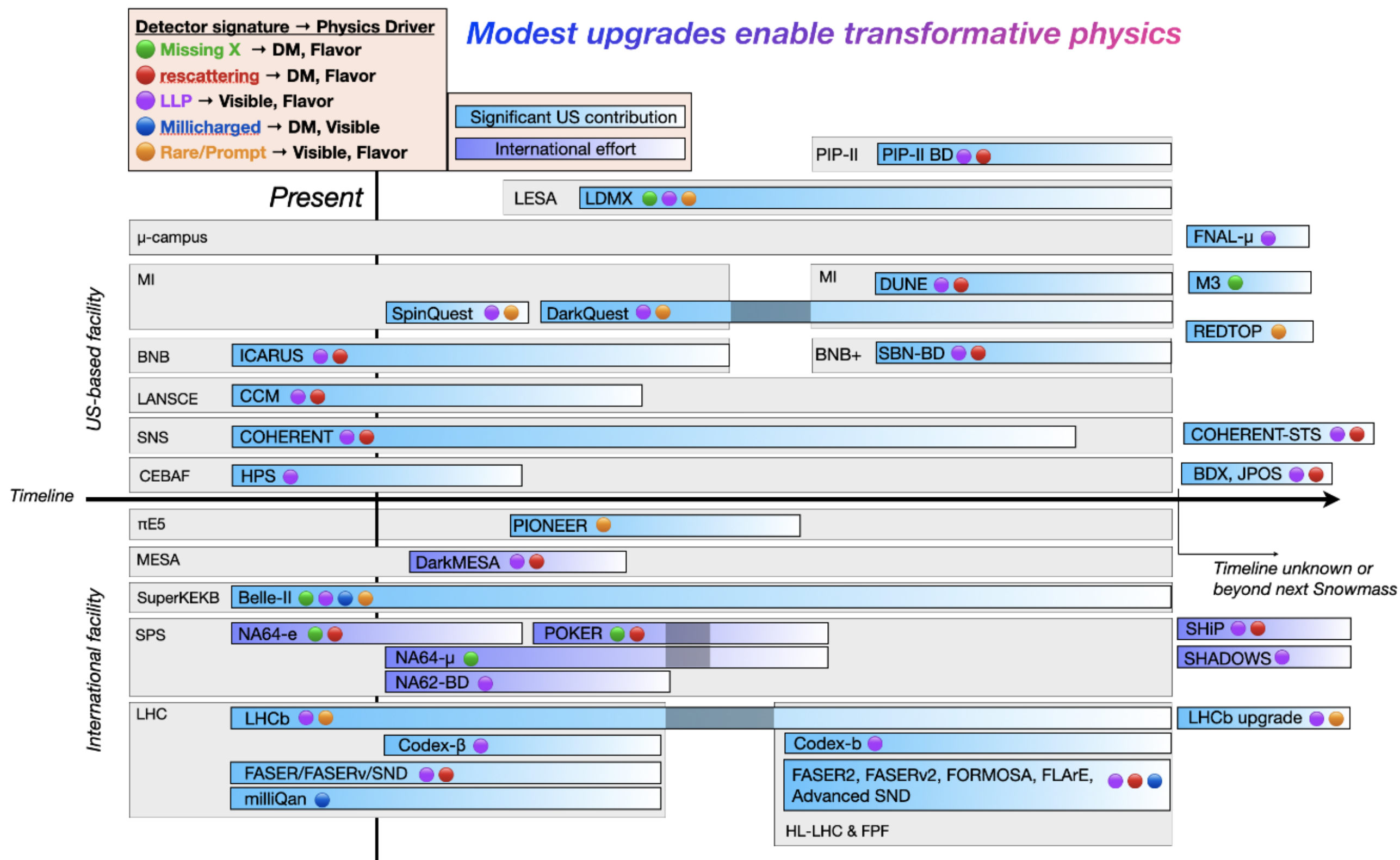
Signature with visible decays.



[Snowmass RF6, *Exploring Dark Sector Portals with High Intensity Experiments*: [2207.06905](#)]

Probed: Accelerator Experiments

Experiments and Facilities



DESY FH FIPs Task Force.

The topic of feebly interacting particles (FIPs) was also discussed in the DESY FH FIPs task force with the goal to identify possibly interesting projects for DESY FH.

Report almost ready ...

Feebly Interacting Particle Task Force Report

Friederike Januschek, Felix Kling, Federico Meloni,
Andreas Meyer, Klaus Moenig,
Kai Schmidt-Hoberg, Marcel Stanitzki

fh-tf-fip@desy.de

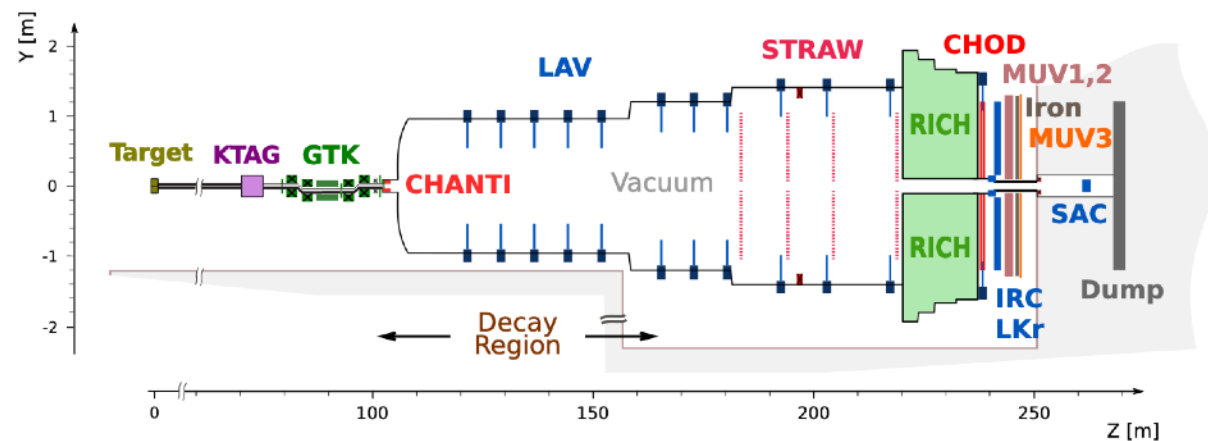
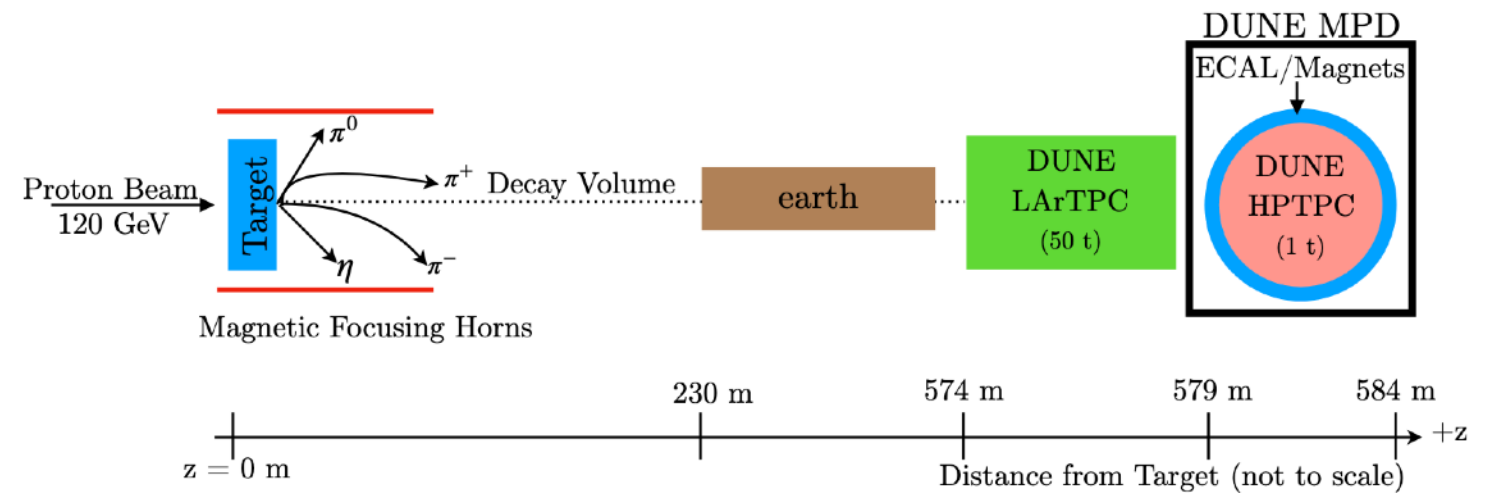
Neutrino and feebly interacting particles are key areas of fundamental research. The discovery of neutrino oscillations prompted a broad program to understand the origin of neutrino masses and to measure the associated parameters. While searches for new particles at the weak scale, such as WIMP DM, have so far yielded null results, there is growing interest in the search for particles that are light and feebly interacting. This document reports the findings of a DESY-FH task force dedicated to exploring opportunities for DESY to invest in this area of research in the period following the construction of the HL-LHC detector upgrades.

Existing Facilities

Neutrino Physics: DUNE, SBN

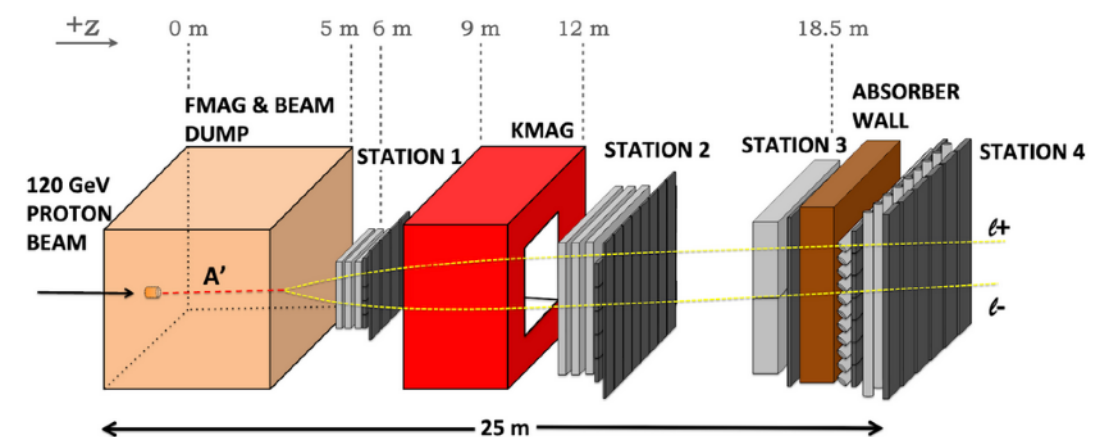
NF03: 2209.10362

NF02: 2209.05352



Flavor Physics: Belle2, LHCb, NA62

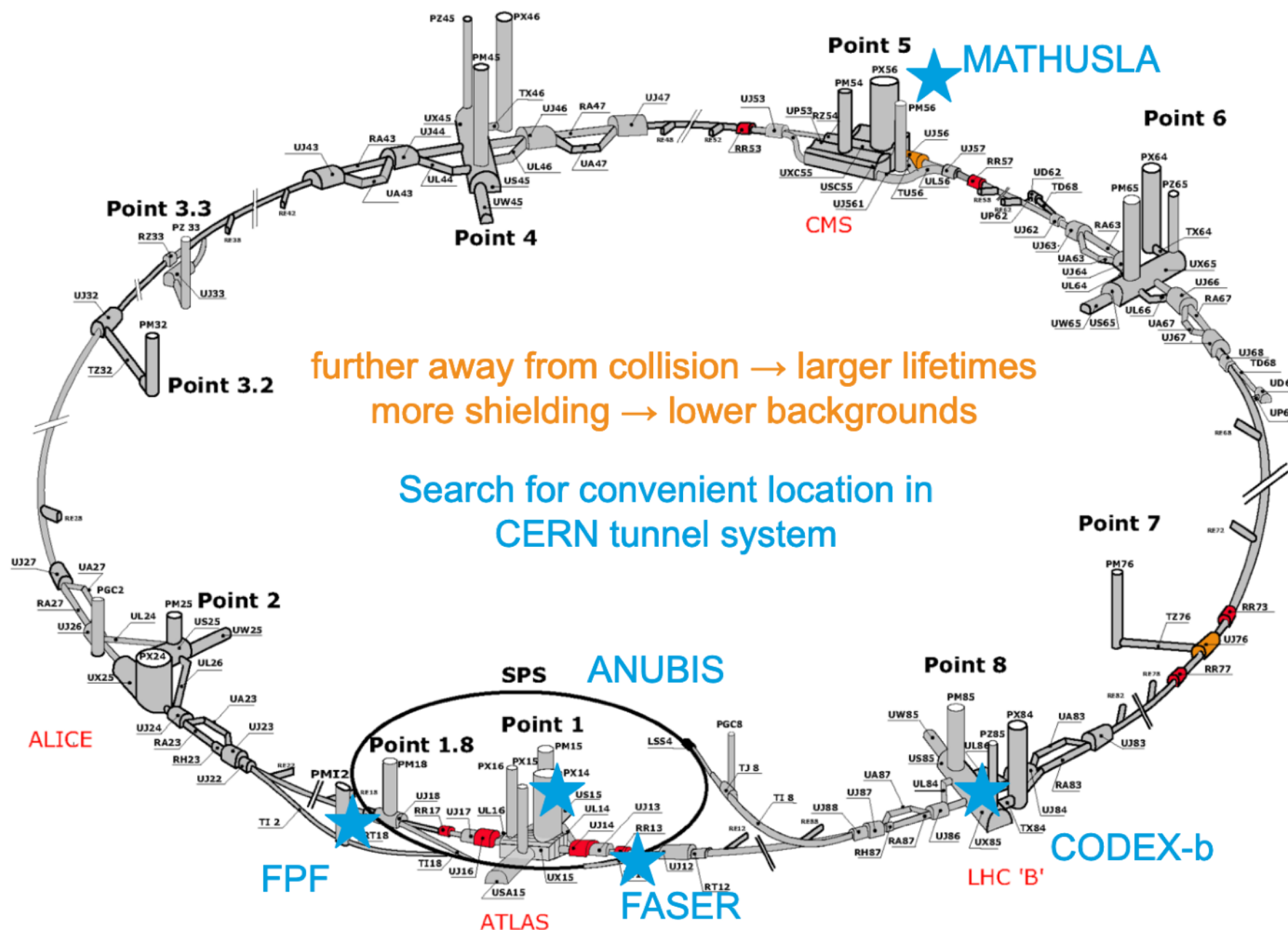
Nuclear Physics: SeaQuest



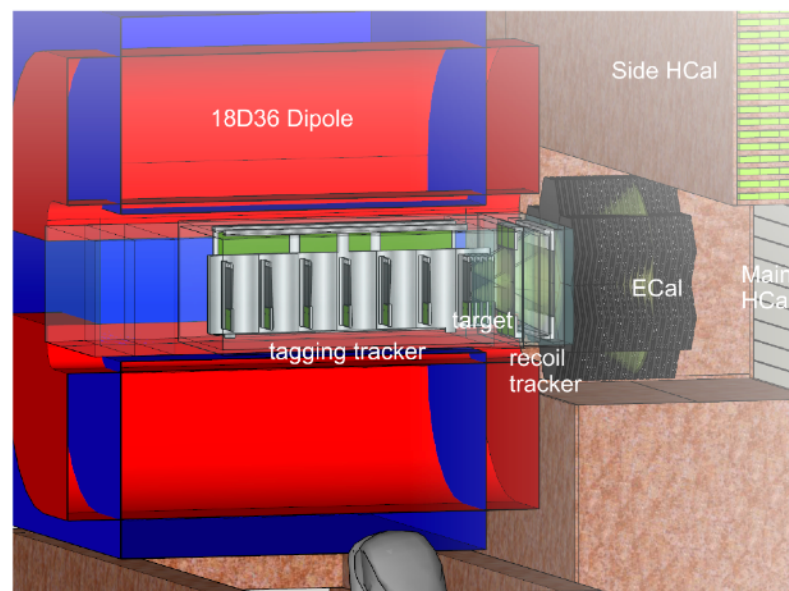
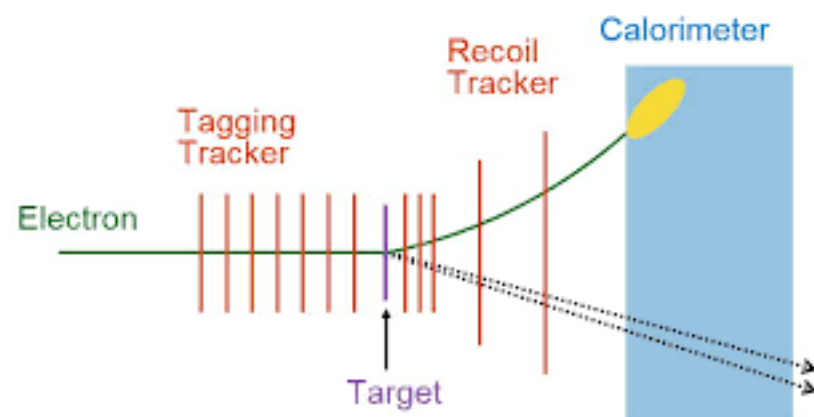
Auxiliary Experiment at LHC

From Snowmass 10-page executive summary ([link](#)):

*A new aspect of the proposed LHC program is the emergence of a variety of auxiliary experiments that can use the interactions already occurring in the existing collision regions ... to explore regions of discovery space that are not currently accessible. These typically involve observing particles in the **far forward direction or long-lived particles** produced at larger angles but decaying far outside the existing detectors. ... **The EF supports** continued strong U.S. participation in the success of the LHC, and the HL-LHC construction, operations, and physics programs, **including auxiliary experiments**.*

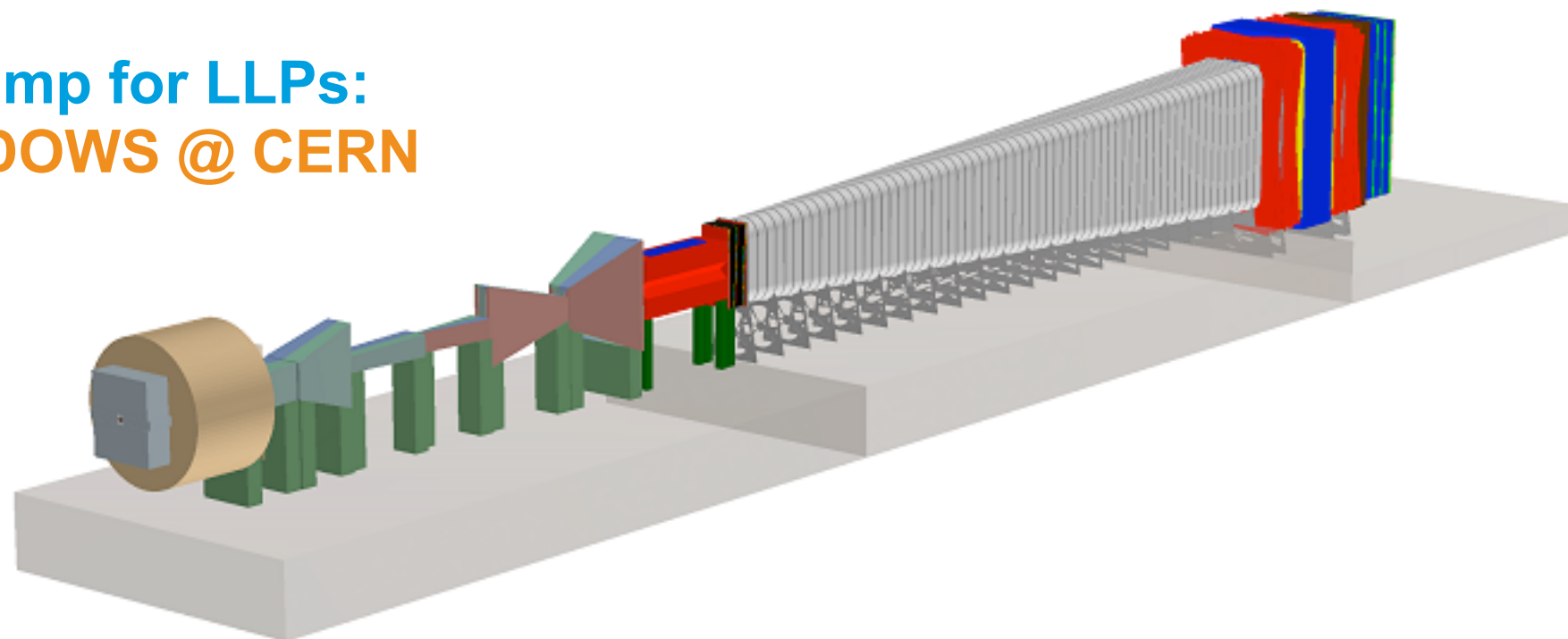


Further Dedicated Facilities



Missing Energy:
LDMX @ SLAC

Beam Dump for LLPs:
SHIP/SHADOWS @ CERN



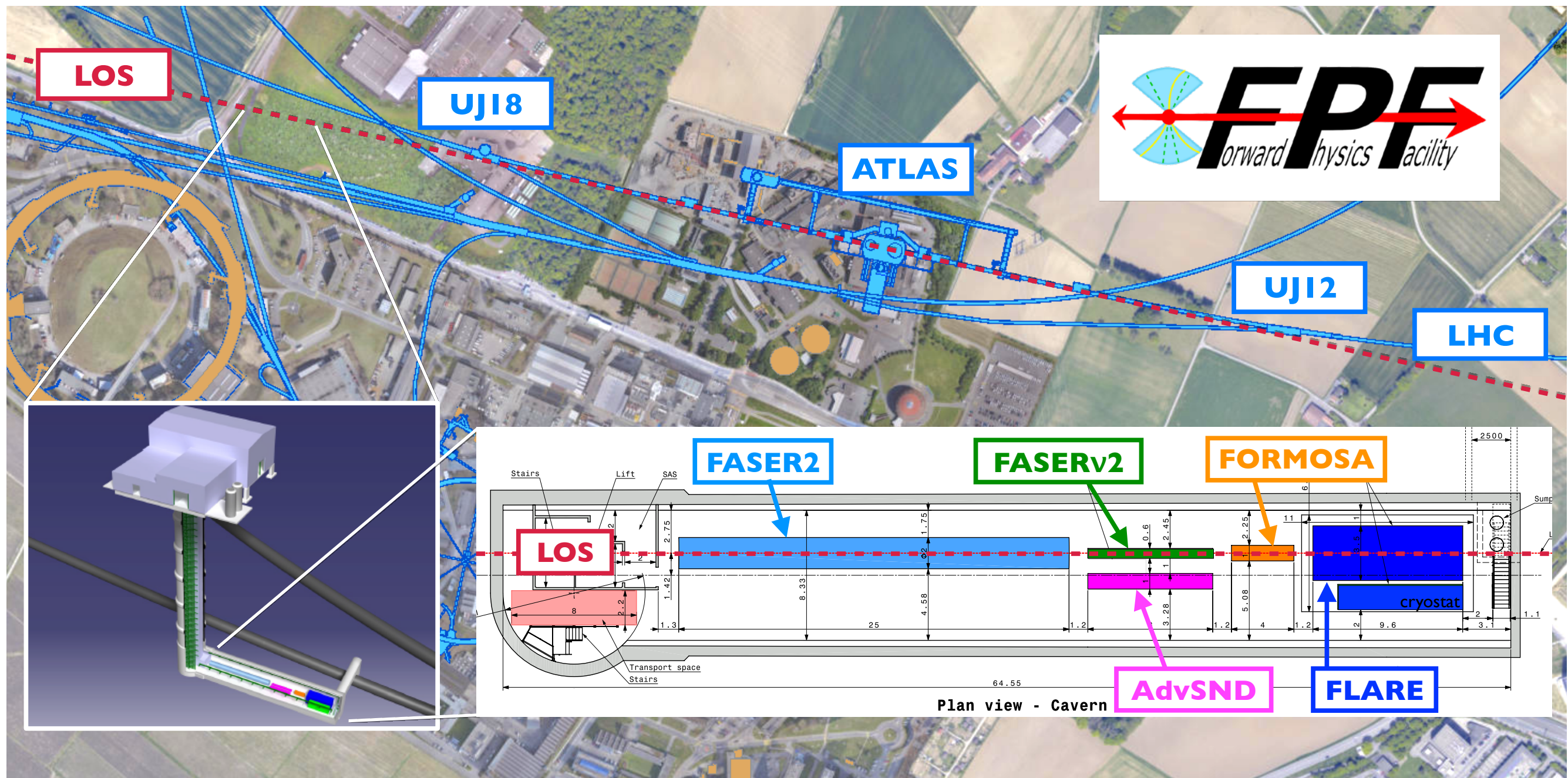
Forward Physics: FPF

FPF: Idea.

LHC provides huge flux of hadrons in forward direction.

This leads to beam of TeV energy neutrinos and possibly also FIPs along LOS.

FPF proposed to use this opportunity: several dedicated experiments.



The Forward Physics Facility.

FPF workshop series:

[FPF1](#), [FPF2](#), [FPF3](#), [FPF4](#), [FPF5](#)

FPF Paper:

[2109.10905](#)

~75 pages, ~80 authors

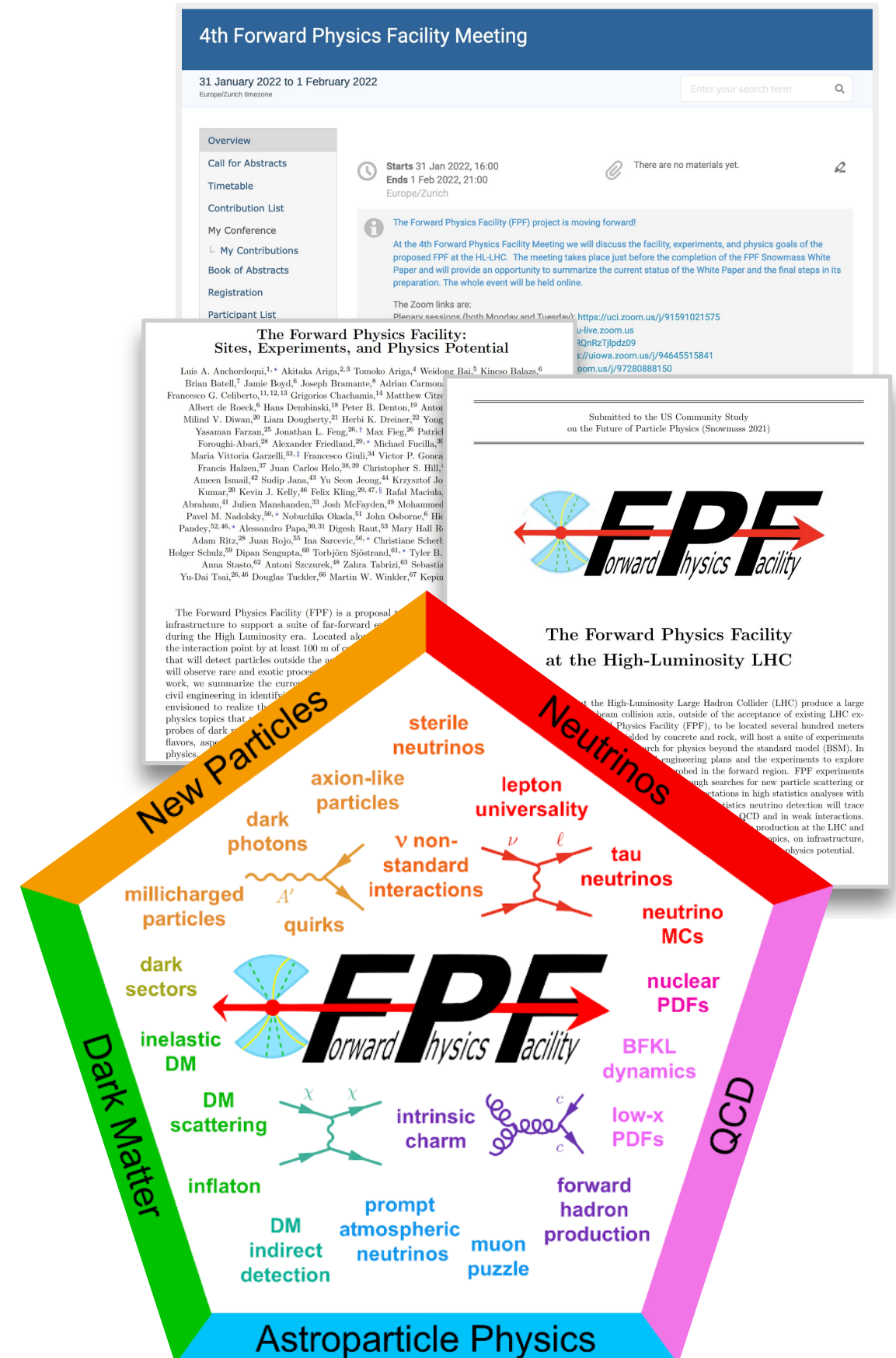
Snowmass Whitepaper:

[2203.05090](#)

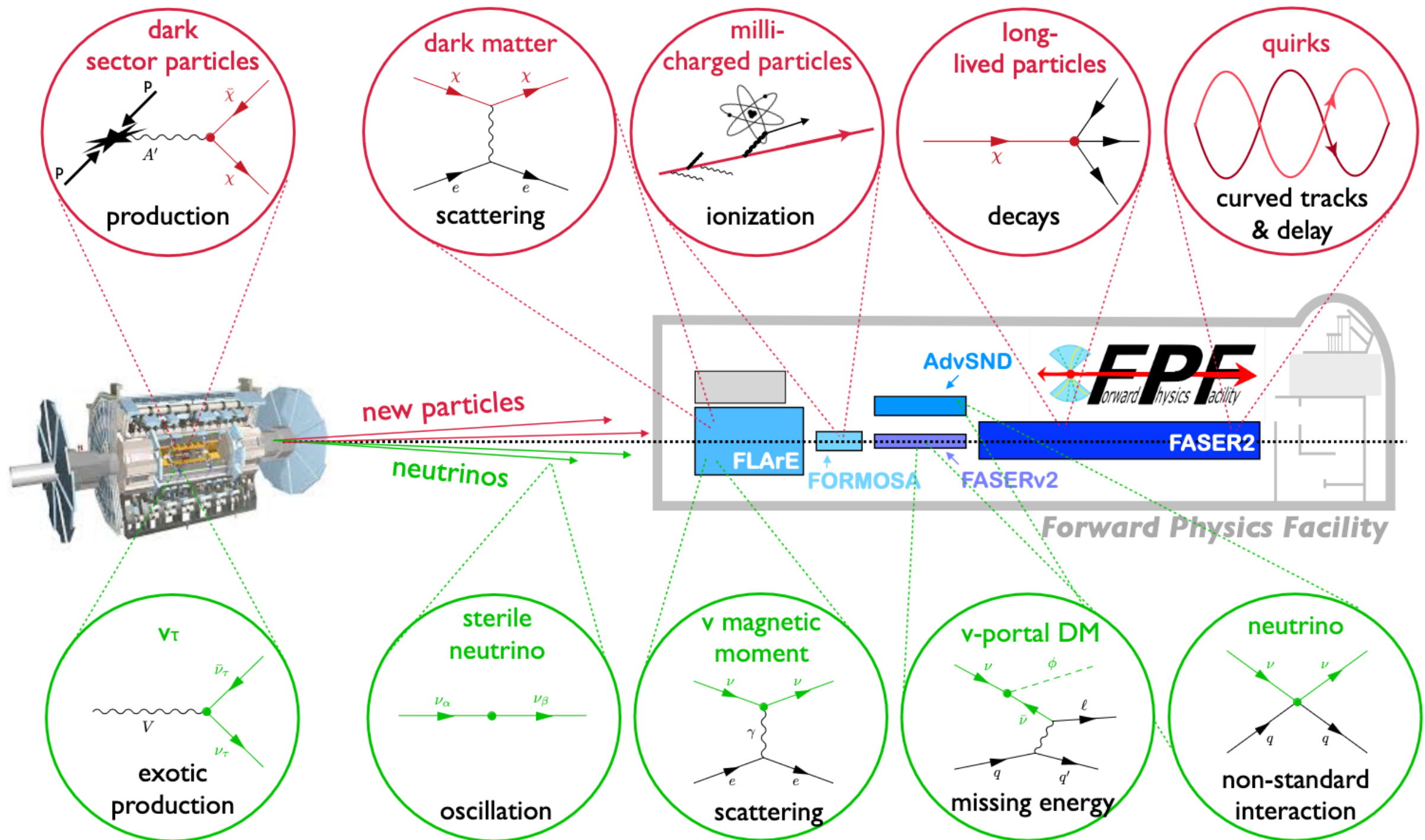
~450 pages, ~250 authors

Broad Physics Potential:

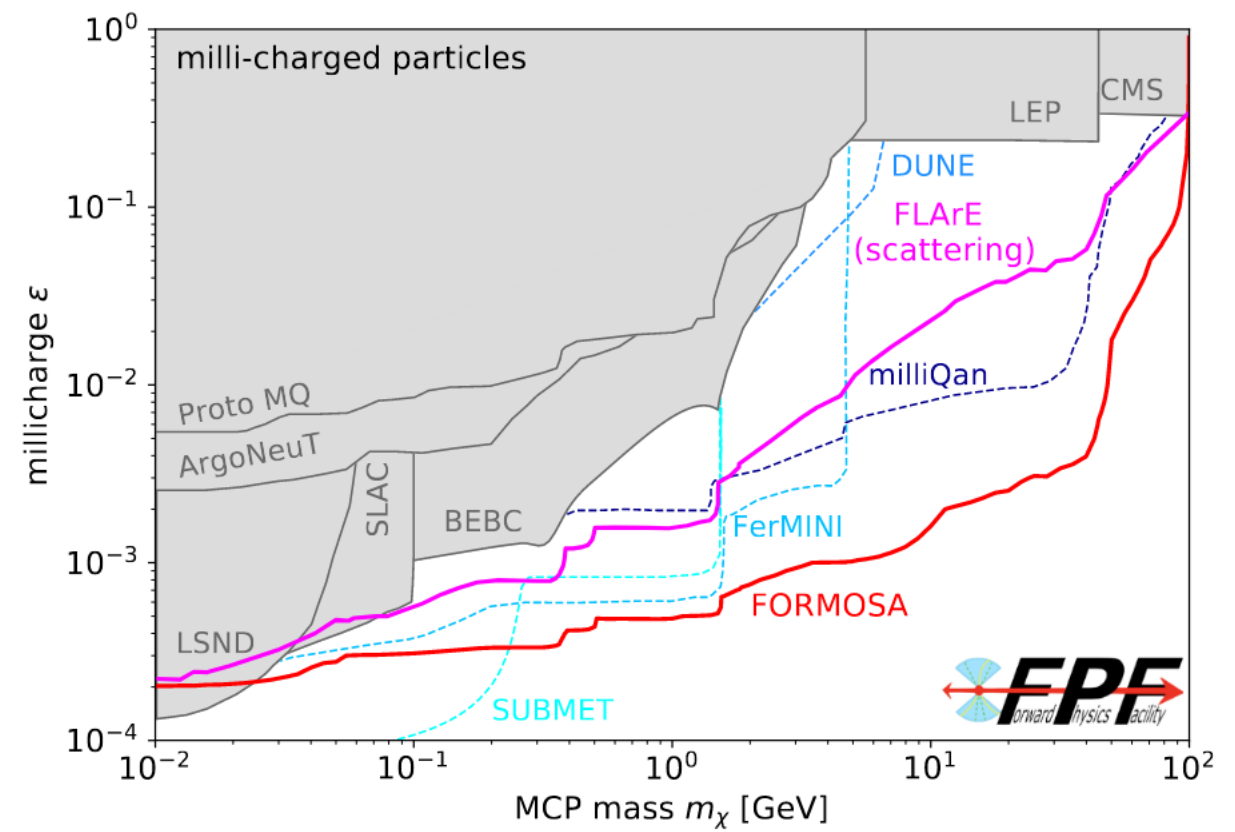
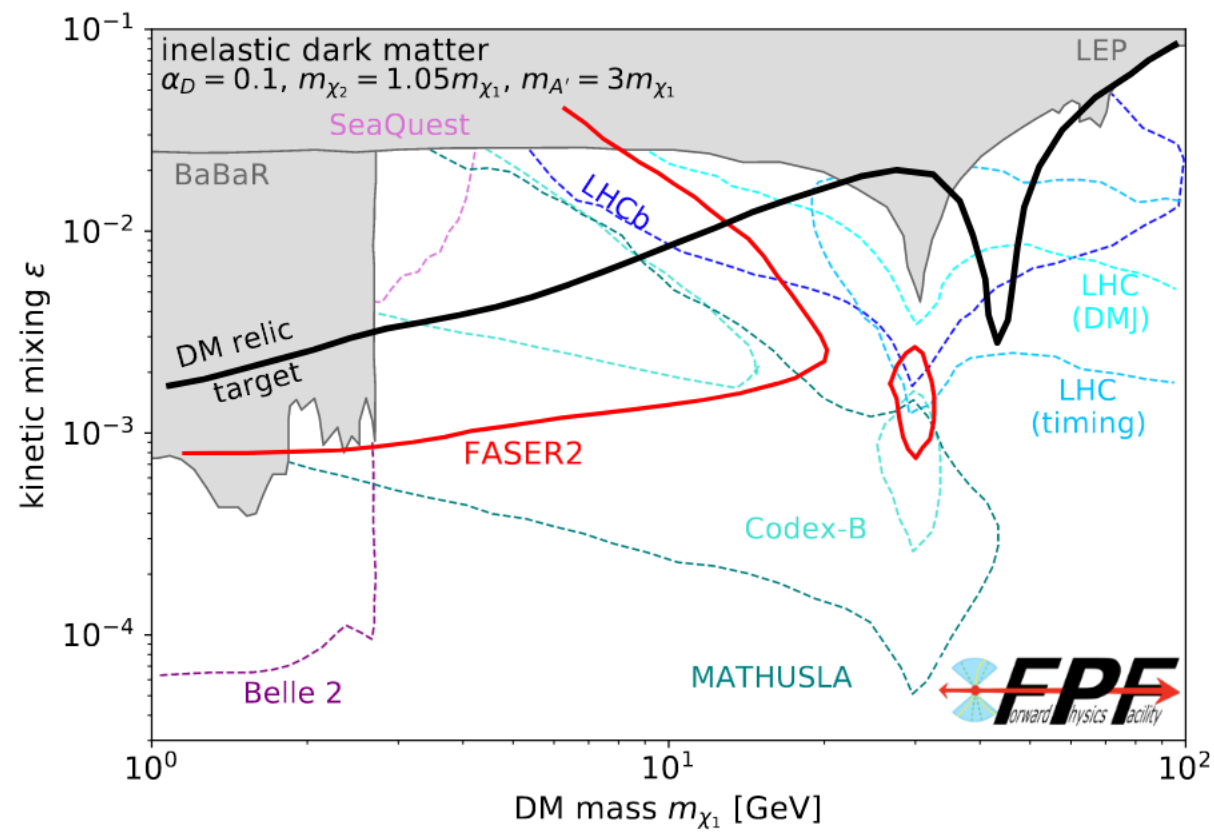
BSM searches,
neutrino physics, QCD



BSM Physics Searches



BSM Physics Searches



SM Physics Measurements

Last week, first
observation of collider
neutrinos: 2303.14185

News

News from the DESY research centre

2023/03/21

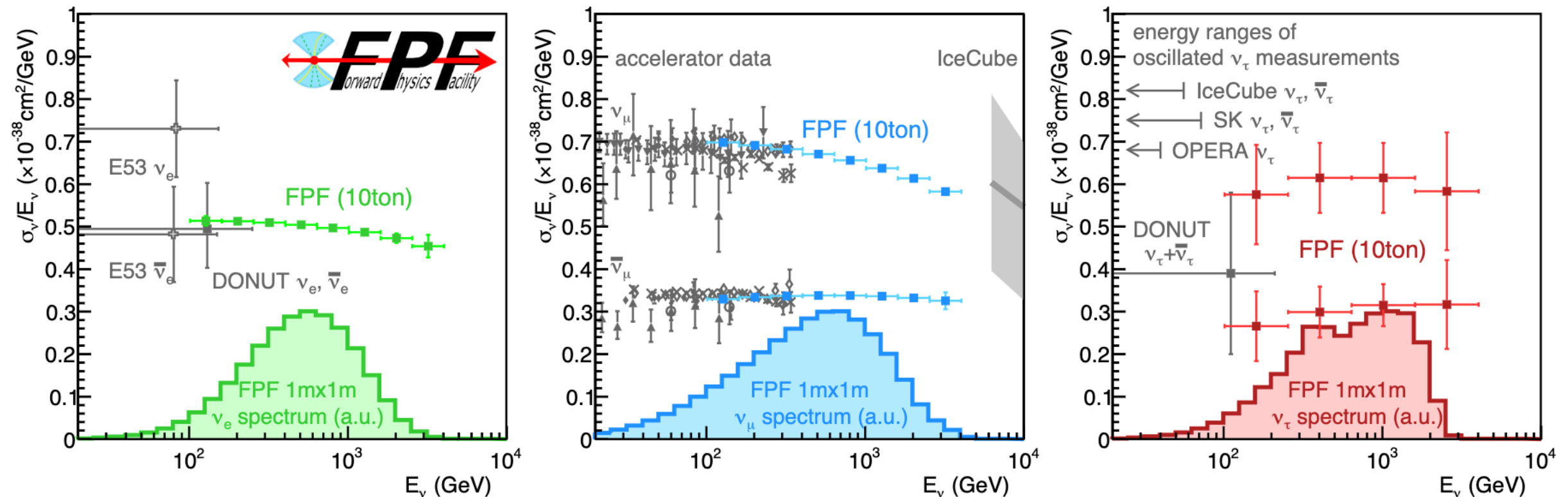
[Back](#)

Research team detects first neutrinos made by a particle collider

The discovery promises to help physicists understand the nature of the elusive particle

An international research team at the FASER experiment at the Large Hadron Collider LHC in Geneva has for the first time detected subatomic particles called neutrinos created by a particle collider. The discovery promises

FPF will see millions of TeV energy neutrinos.



SM Physics Measurements

