Long-lived particles at Belle II

RF6-2 Letter of Interest

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on behalf of all LOI authors

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RF6-2 Letter of Interest (LOI): Long-lived particles at Belle II

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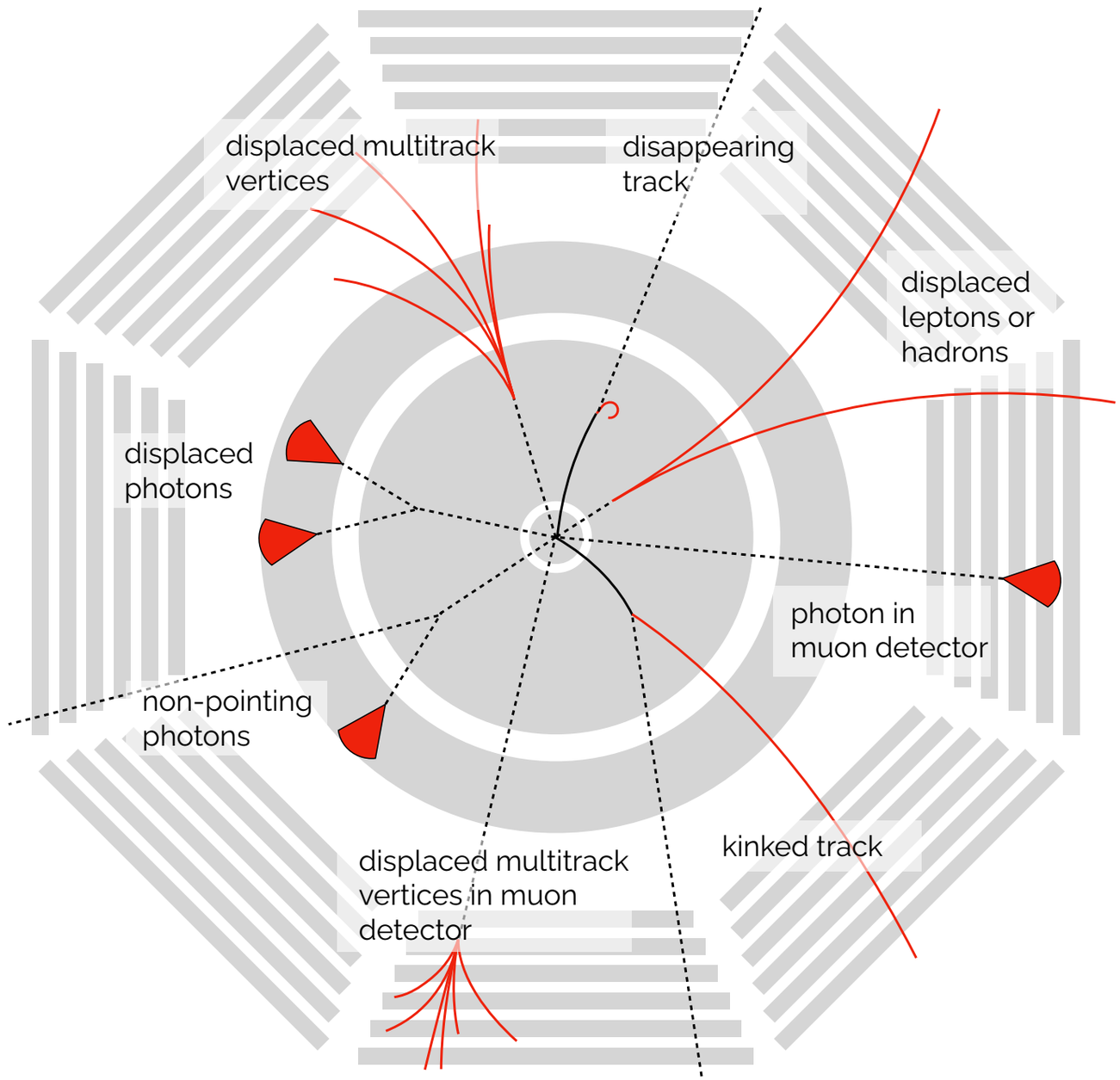
We plan to explore the full potential of Belle II to search for GeV-scale hidden sectors with long-lived particles. This requires the development of new search strategies for charged and neutral final states, including new reconstruction algorithms and optimized triggers. Motivated by the particle dark matter hypothesis, we plan to define simple models as representatives of a mechanism that sets the relic abundance in the early universe, like co-scattering or freeze-in. Based on these models, we predict typical signatures with long-lived particles that guide the new searches at Belle II. In addition we plan to explore the reach of a dedicated long-lived particle project called GAZELLE. This detector would be placed $\mathcal{O}(10\,\mathrm{m})$ away from the Belle II interaction point.

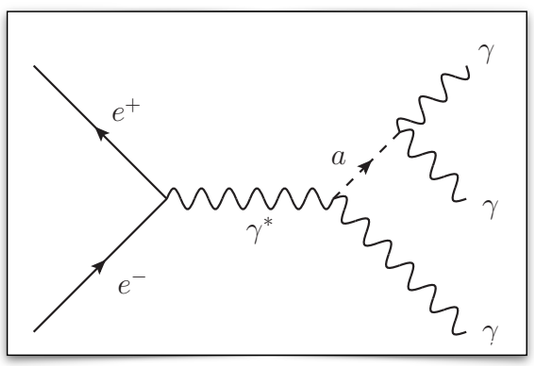
also: LOI *Dark sector studies at Belle II* (Kevin Flood later today)

Signals of long-lived particles at Belle II

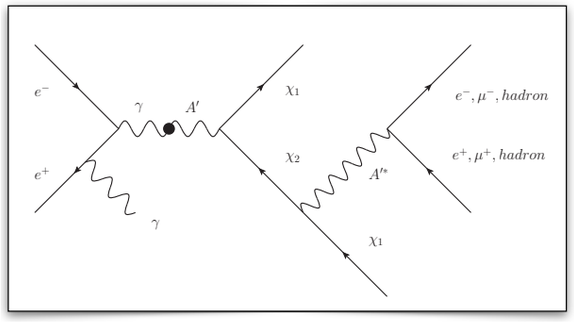


Goal: Explore Belle-II's full potential to search for LLPs.

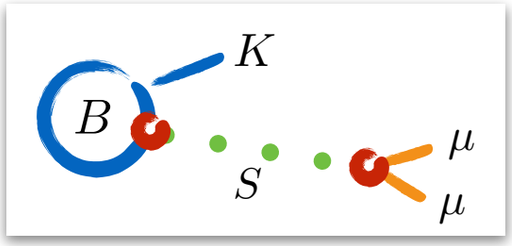
… and where they come from



long-lived ALPs

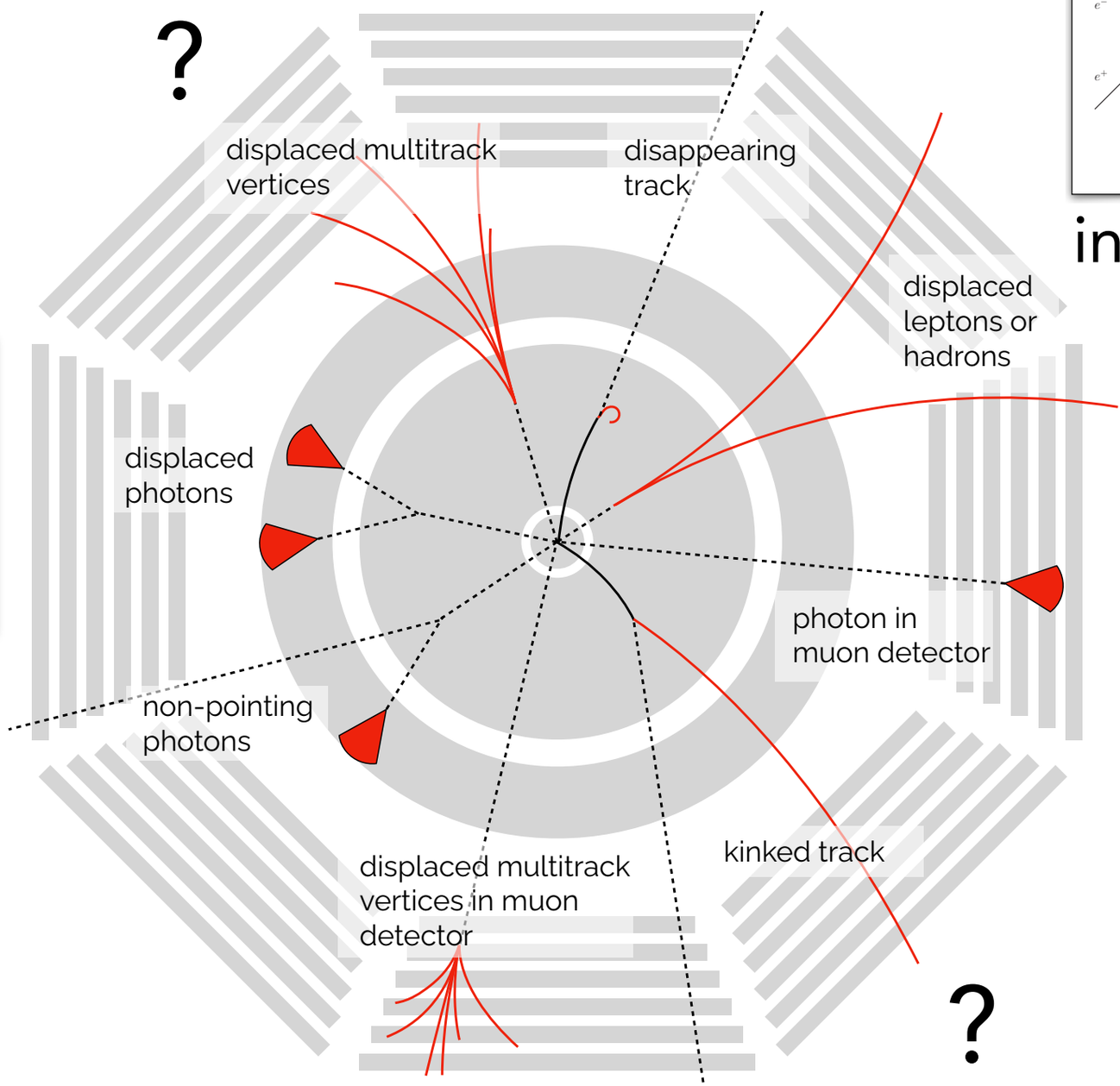


inelastic dark matter



long-lived scalars

?



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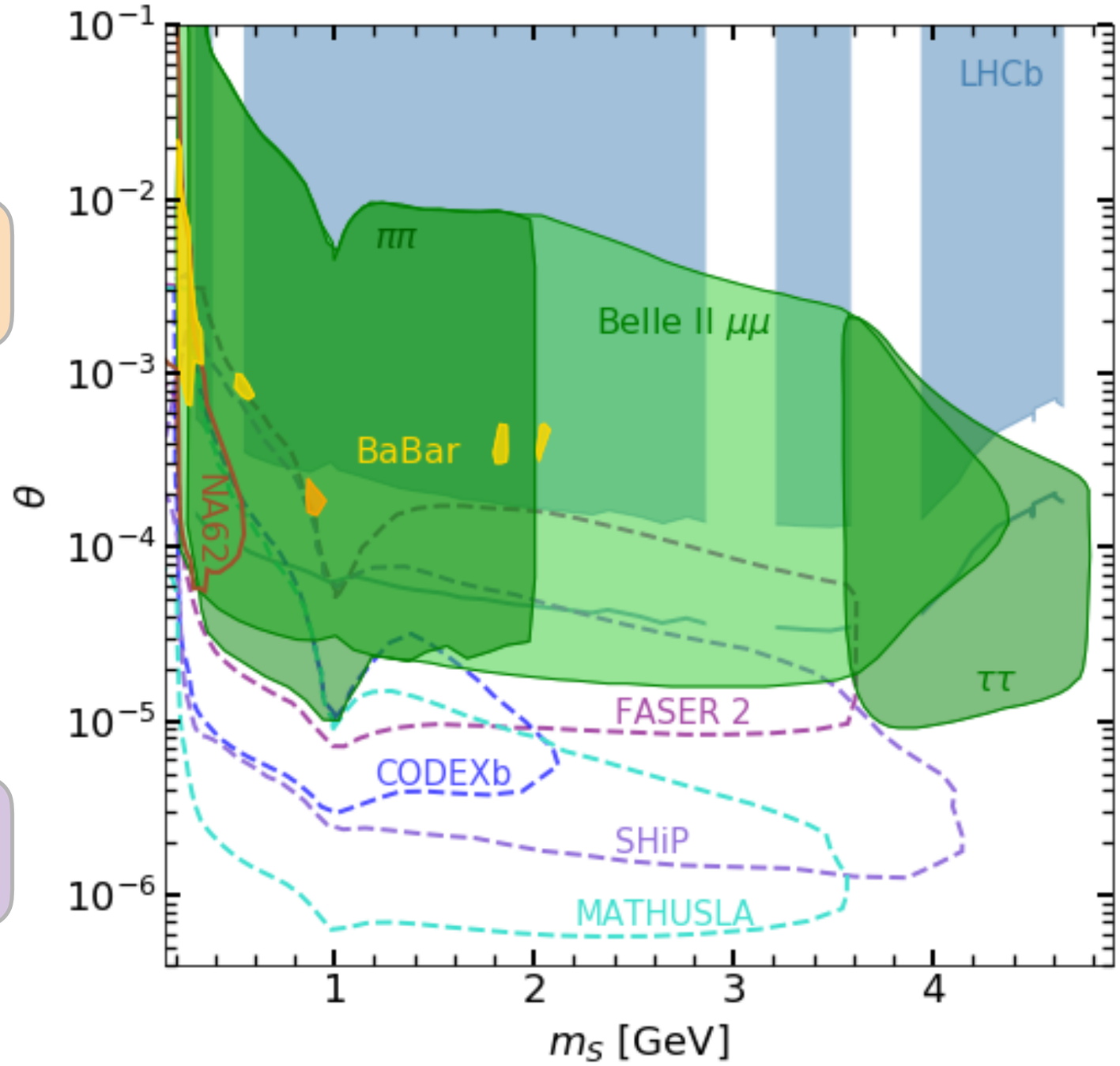
Goal: Study portals to dark sector & dark matter models.

Where Belle II gains

fixed-target

astro, cosmo



LHC

longer decay length

Good at ‚intermediate' lifetimes. Many final states detectable.

example: Higgs-portal scalar - Filimonova, Schaefer, Westhoff 1911.03490

GAZELLE: Belle II's distant sister ?

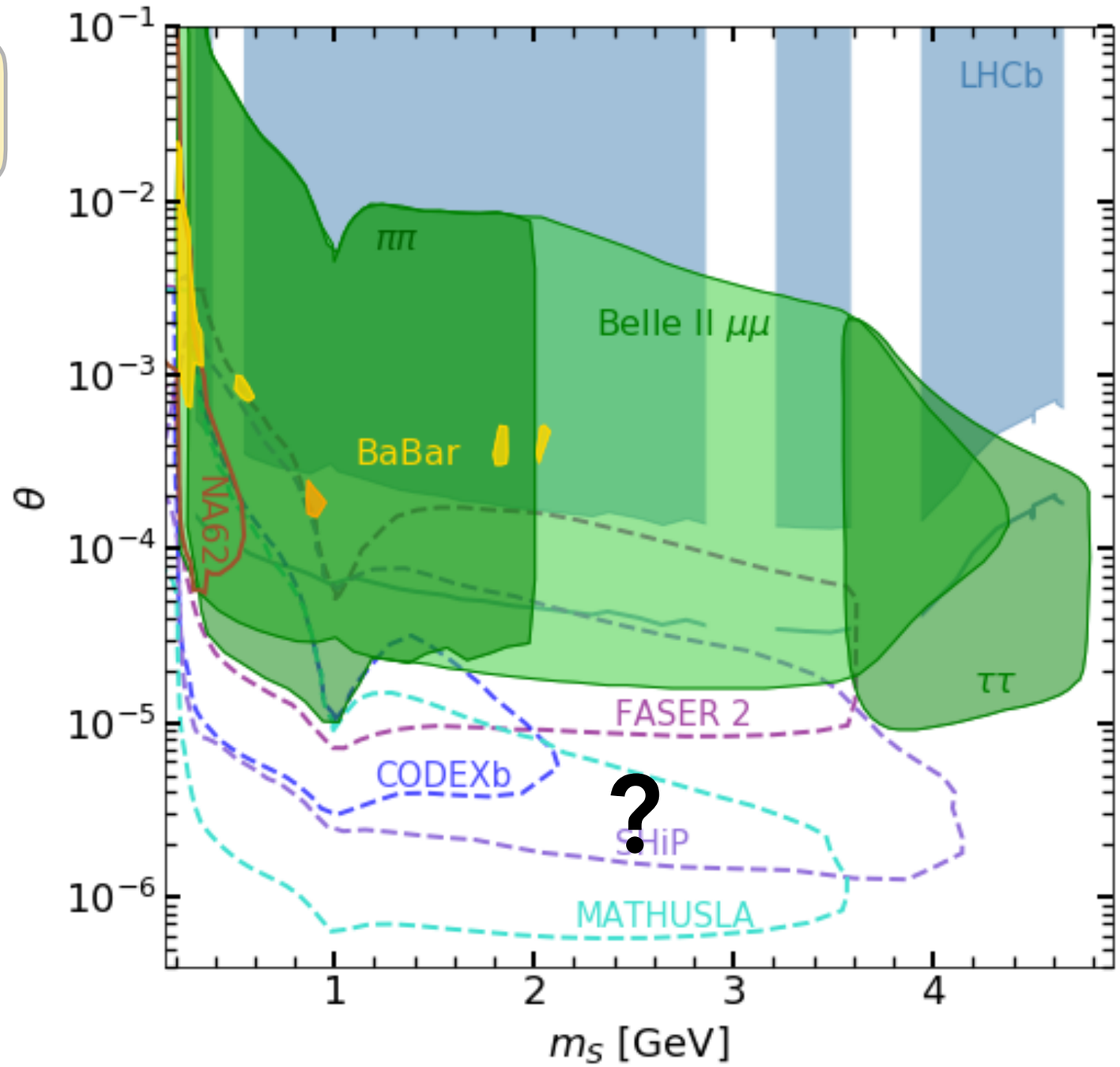
GAZELLE

Belle II

LLP decay before

inside

after



LLP decay prompt

displaced

stable

Goal: Physics potential and design of proposed far-distance detector.

Snowmass goals

Goal 1: Explore new LLP signatures for Belle II

(portals, dark matter models)

Goal 2: Explore the ultimate potential for LLPs at Belle II

(reconstruction, trigger, …)

Goal 3: Physics potential and detector study

of a new LLP detector: GAZELLE

Timescale: will be discussed at LOI meeting on October 12.

Why this is a Snowmass project

Snowmass' cross-frontier synergies

Portals: benchmarks exist - compare with other searches

Snowmass as forum

New signatures: need new (and well-motivated) ideas

Snowmass as platform for exchange

GAZELLE: joint effort by theory and experiment

Questions?
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