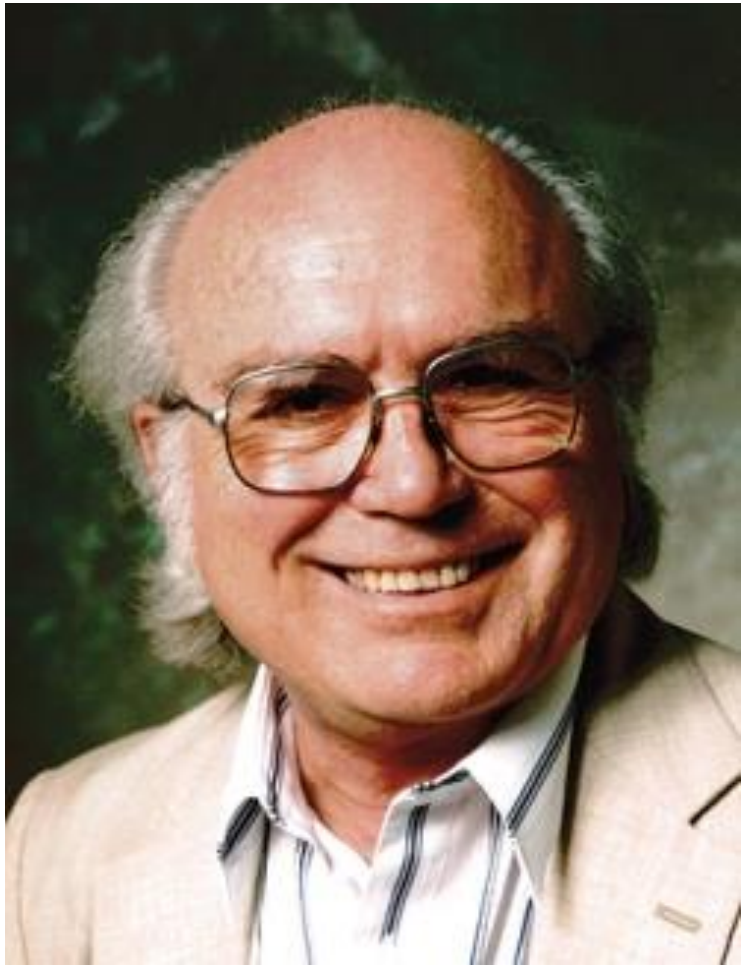
PANEL:
NEW CAPACITIES FOR THE LHC EXPERIMENTS

SEARCH 2025, CERN

Jonathan Feng, UC Irvine, 21 October 2025

MY PERSPECTIVE

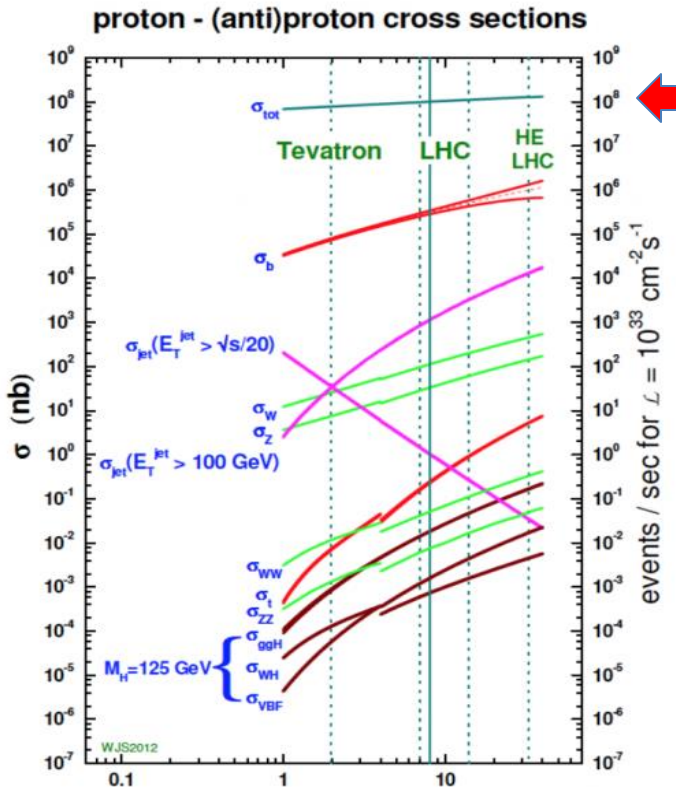


"I never thought it was going to be this hard."

Bruno Zumino, c. 1996

NEW CAPACITIES FOR THE LHC: FORWARD DETECTORS

- ATLAS and CMS are nearly hermetic in θ, but not in η.
- The total pp cross section is 0.1 barns, and transverse detectors miss almost all of it.
- Given the enormous remaining integrated luminosity of the LHC, we should view this as unacceptable. Especially if we aim to carry out a broad search for new particles, we are missing a lot of discovery potential.



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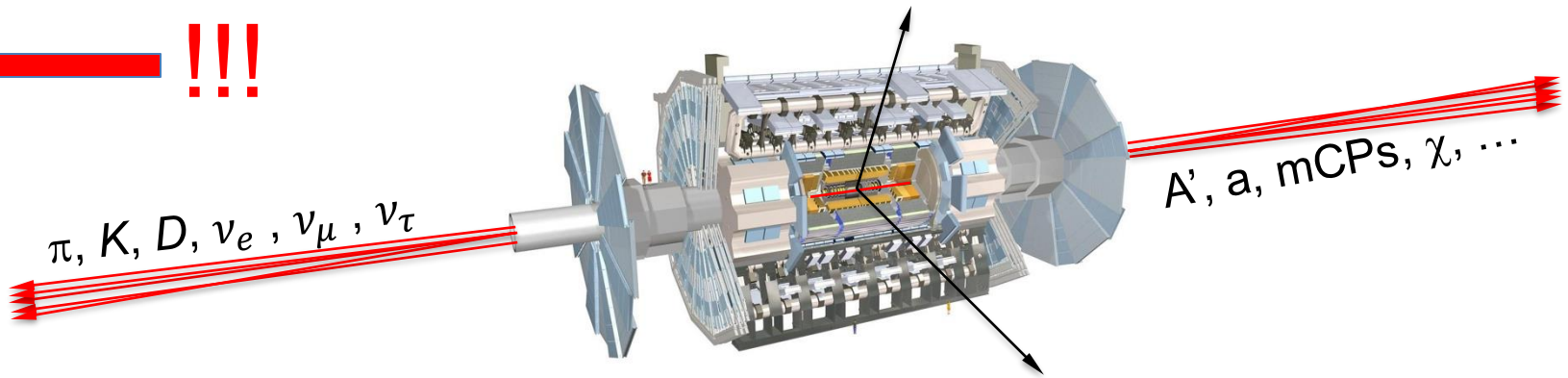


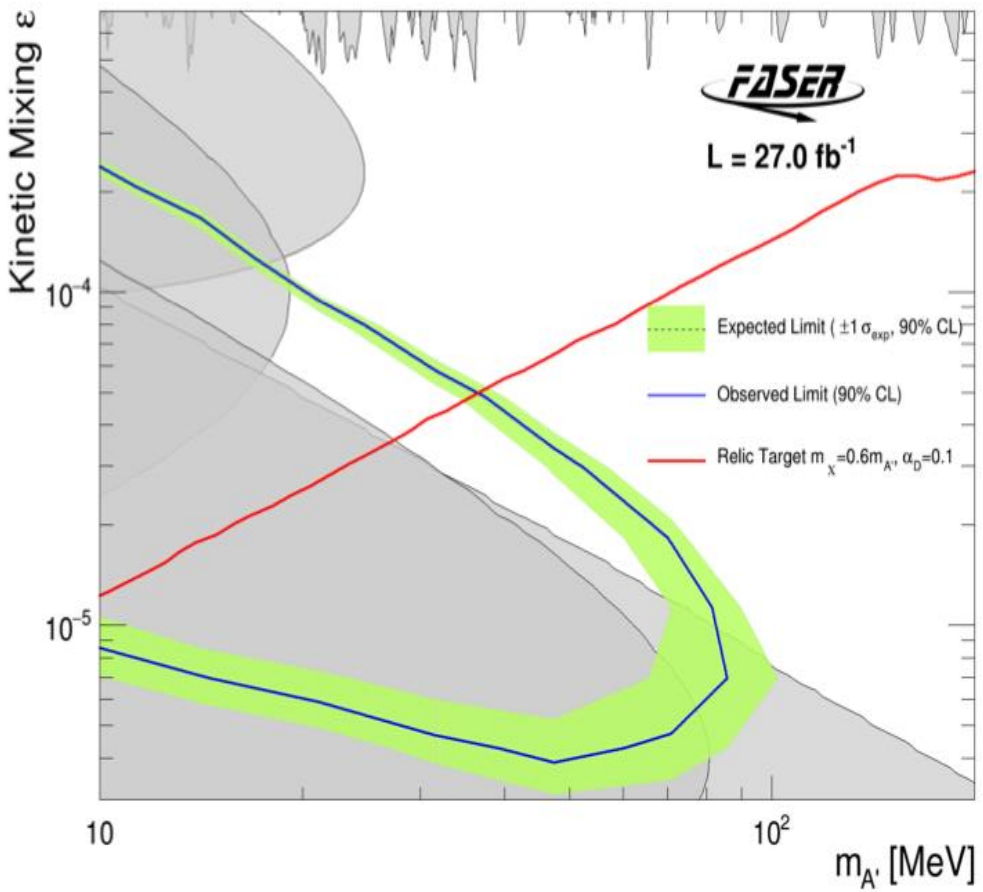
FASER and SND@LHC have been running since Run 3 started in 2022.

Planned upgrades for FASER and SND@LHC in Run 4, and additional detectors (FASER2, FASERν2, FLArE, FORMOSA) at the FPF.

LIGHT NEW PHYSICS

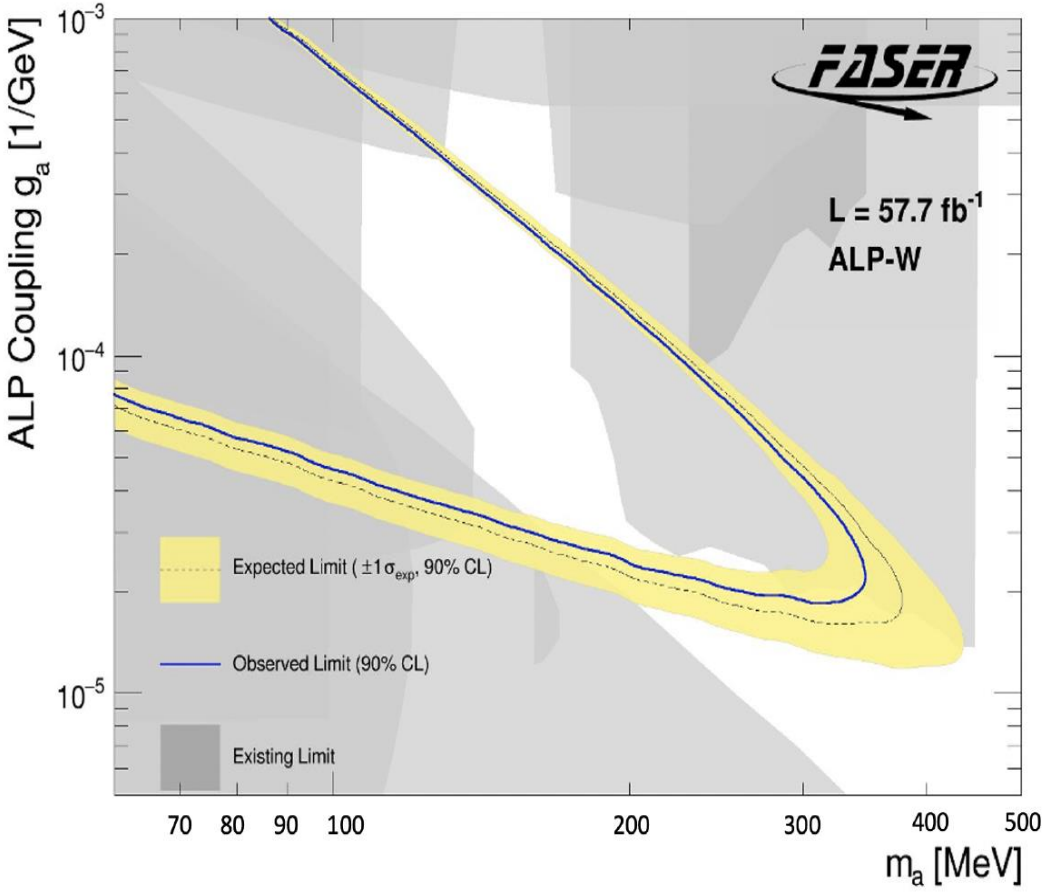
To find new light particles, look where the existing light particles are.

Dark Photons



FASER, 2308.05587

Axion-Like Particles

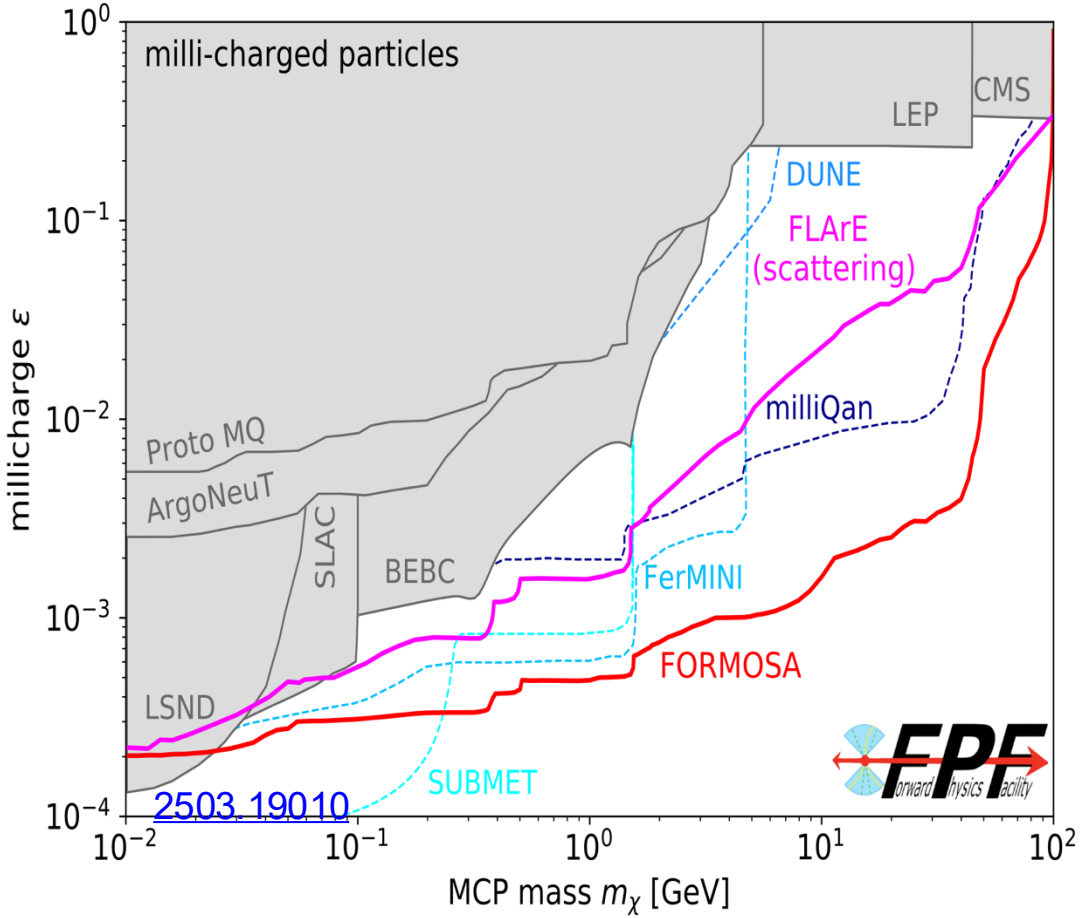


FASER, 2410.10363

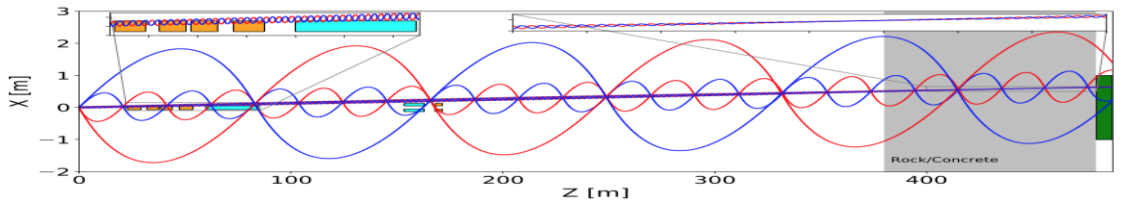
HEAVY NEW PHYSICS

The dark or hidden sector may have its own gauge forces: Abelian or non-Abelian.

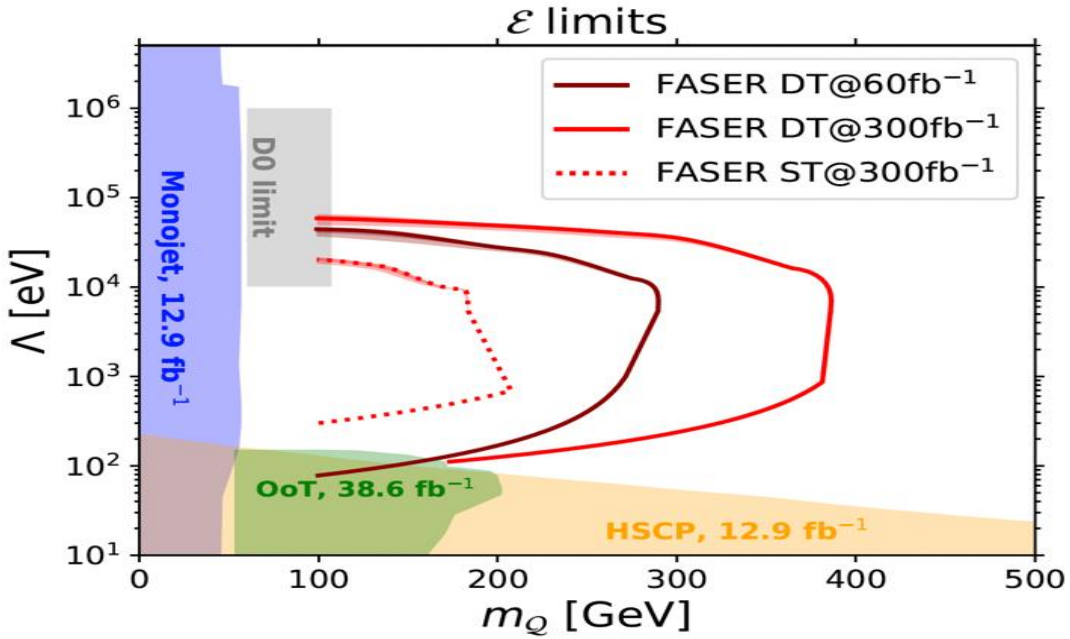
Abelian: Milli-charged particles, ~10 MeV – 100 GeV



Non-Abelian: Quirks, ~100 GeV - TeV

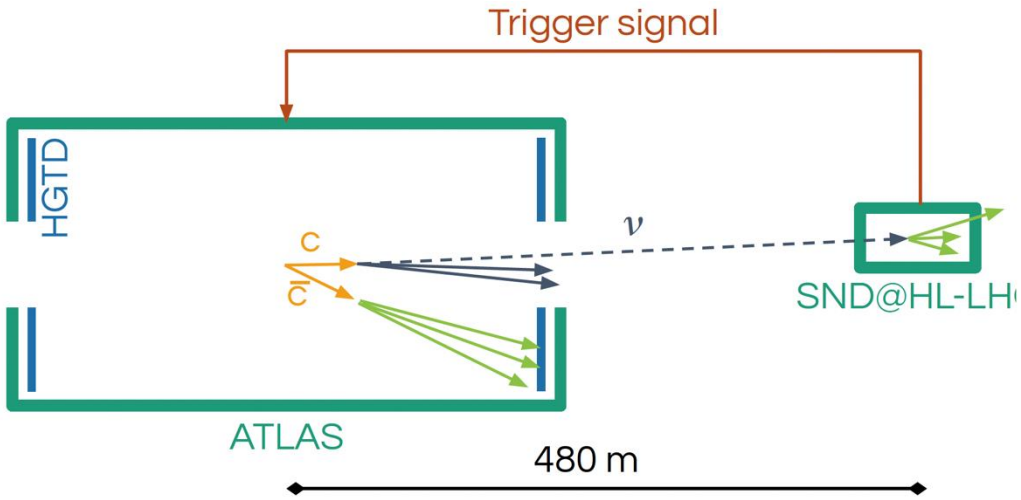


Li, Pei, Ran, Zhang, 2108.06748

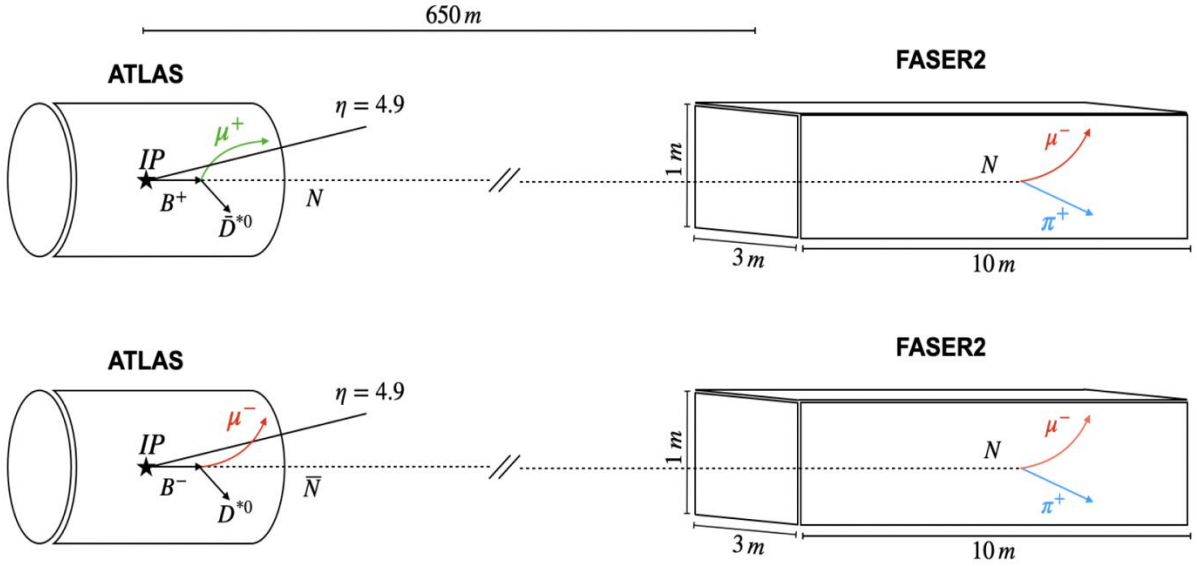


FORWARD DETECTORS AS TRIGGERS

- Multi-faceted complementarity between forward and transverse detectors: direct searches *and* precision measurements, BSM physics *and* SM physics, charged particles *and* neutrinos, …
- Maybe even on an ”event-by-event basis”! We have already detected ~1000 TeV neutrinos, FPF will see thousands *per day*. What can we do with these?



SND@LHC, 2503.24233



Feng, Hewitt, La Rocco, Whiteson, 2510.16107 (today)