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# BSM INPUT TO EUROPEAN STRATEGY

# HOW WE GOT TO THE TEXT

- ▶ Two meetings: first introductions, then discussion
- ▶ Following those, some iterations among the participants
  - ▶ More could happen if needed or desired
- ▶ Live-notes: <https://docs.google.com/document/d/1gDNCzfSIWyUeCvgpr0NVgAy5o896fWC13D8TsgjSpDs/edit#heading=h.ip9bqtp3e69f>
- ▶ Current text (summarized in next slides) has the following shortcomings:
  - Too long (but shorter than others...)
  - Theory inputs is not yet clear (provocative: after reading this one may ask why we need theorists and model-builders)
  - Left out some specific models mentioned (e.g. leptoquark, monopoles...)
  - Needs better connections to BSM part of neutrino strategy / experiments
  - Would like to tie it more to strategic choices, but given space limitations and scope this necessarily means we would have to prioritize (by leaving things out)

# DARK MATTER

- ▶ Shortcoming of the SM, empirical evidence
  - ▶ it's there, but is it a particle? if so does it interact with the SM?
- ▶ Many possible theories, roughly grouped and ordered by mass / magnitude of interaction with SM
  - ▶ **WIMP**
    - ▶ Can and will be addressed by colliders (HL/HE-LHC, FCC-ee, FCC-hh), direct detection (XENON1T, IceCube and future upgrades), indirect detection
  - ▶ **Dark sector / light DM mass models**
    - ▶ Can be addressed by the above, but better sensitivity with dedicated experiments (LDMX, SHIP, HIBEAM/NNBAR)
  - ▶ **Axions and ALP**
    - ▶ Need dedicated facilities [no one talked about this in Sweden]
- ▶ Crucial to link ECFA and APPEC on these (and other) topics

## HIGGS

- ▶ Newly discovered particle → new chance to probe sectors connected to it
  - ▶ First time in history of particle physics that we start to be sensitive to scalar particles with Yukawa-like couplings
  - ▶ Start exploration at HL-LHC
- ▶ Higgs precision searches could lead to indirect discoveries
  - ▶ Links with SM strategy
- ▶ Di-Higgs production could be enhanced
  - ▶ Best sensitivity at future colliders (FCC-ee, HE-LHC/FCC-hh)
  - ▶ Importance of being above  $t\bar{t}$  threshold for ILC

# SUSY AND OTHER BSM

- ▶ SUSY still appealing albeit not as natural (“solve 2 out of 3 problems”) and not around the corner
  - ▶ Can keep pushing energy frontier for strong production (HE-LHC/FCC-hh)
  - ▶ Emphasis on rare (direct EW production) and difficult (long-lived) signatures
    - ▶ This point is valid for all BSM and all machines: design detectors and trigger systems accordingly
    - ▶ FCC-ee best suited for direct EW production
- ▶ Complementarity between indirect precision (B-factories) and direct discoveries
  - ▶ Do not close the door to machines at the energy frontier (HE-LHC/FCC-hh)
    - ▶ especially if informed by hints in B-factories
  - ▶ Serendipitous discoveries are also important (e.g. muon, tau)

