Summary and re-optimized Performance Document

Nico Serra
University of Zurich

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SHiP is sailing very fast
And changing a lot!
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- SHiP is sailing very fast
- And changing a lot!
- The idea is to write a document for the re-optimisation phase
First iteration (Intermediate document):
- Geometry: dimensions of the decay volume, starting and ending point, shape, ...
- Vacuum VS He: Looks like the driving parameter here is the cost
- PID performances: As Gaia pointed out we should have a strategy to decide on the requirements

We need to do performance studies with the re-optimized SHiP and updated cost -> “progress report” to the SPSC

These studies will be the input to a more advanced/longer document which will include all sub detector details
Current Status of Background Studies

Iaroslava studied the impact of neutrino in the air.

- Fully reconstructed signal $N \rightarrow \mu \pi$: $O(1)$ bkg events with or without veto.
- Partially reconstructed signal: 40 events without veto, 4 with the veto, zero with the PID (see also Behzad).
- Take these numbers with care: we only studied in details HNLs, we cannot afford to narrow down our physics case.
Status of Signals

- We are shifting from a paradigm where we had 0.1 expected total bkg, to a paradigm where we study exclusive final states.

- This is good, but we need to study the implications for all signals, in collaboration with the people studying the various signals.

- Old plot in the addendum should be updated with the re-optimized geometry and the new paradigm.
Status of Signals

- R-parity neutralino (implemented in FairSHiP by Kostas)
- Dark Scalar (work in progress by Gaia)
- Axino (one presentation by Ki Young Choi, but very slow or no progress)
- ALPs (background studies from Walter), need implementation
- Dark Photon is one of our main channels, no FairSHiP implementation
- Dirac goldstino (Alexey/Oleg did studies with toys, we need FairSHiP implementation)

- ......
"New" Signals

Photophobic Dark Photon :-(

Evidence for a Photophobic Fifth Force from $^8$Be Nuclear Transitions

Jonathan L. Feng, Bartosz Fornal, Iftah Galon, Susan Gardner, Jordan Smolinsky, Tim M. P. Tait, and Philip Tanedo

$^1$Department of Physics and Astronomy, University of California, Irvine, California 92697-4575 USA
$^2$Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506-0055 USA

We should understand what is our sensitivity since they cite SHiP in their paper

Strongly interacting Dark Matter

The SIMPllest Miracle

Yonit Hochberg, Eric Kuflik, Hitoshi Murayama, Tomer Volansky, and Jay G. Wacker

$^1$Ernest Orlando Lawrence Berkeley National Laboratory, University of California, Berkeley, CA 94720, USA
$^2$Department of Physics, University of California, Berkeley, CA 94720, USA
$^3$Department of Physics, LePT, Cornell University, Ithaca NY 14853, USA
$^4$Kavli Institute for the Physics and Mathematics of the Universe (WPI), Todai Institutes for Advanced Study, University of Tokyo, Kashiwa 277-8583, Japan
$^5$Department of Physics, Tel Aviv University, Tel Aviv, Israel
$^6$Quora, Mountain View, CA 94041 USA and
$^7$Stanford Institute for Theoretical Physics, Stanford University, Stanford, CA 94305 USA

Beautiful idea predicts 1GeV particles of the type we are looking AND Dark Matter copiously produced in SHiP
Dark Matter Searches

- Several models predict large DM fluxes in SHiP-like experiments

- Andrey, Giovanni, Yandex are studying the idea of using the emulsion spectrometer for these searches

- This would be a major addition to our physics case

- Remember that if the mediator of the Dark Sector couples with DM and if DM particles are light enough the Dark Sector particles will not reach out detector
Re-optimization

- We need to update all background studies in the re-optimization configuration:
  - Muon inelastic (how about interaction in He?)
  - Cosmic muons
  - Neutrino scattering in the material
  - Combinatorial

- These backgrounds were not studied with the same details as the bkg neutrino in the air

- We should have a strategy to actually prove with data
Summary

- We are in the re-optimization phase and we need to have answer about Geometry, He/Vacuum, PID requirements

- We should make performance evaluation studies in the re-optimized scenario (also we should get on with these studies to make the decisions)

- Prepare a short 30ish page document spring next year with updated sensitivities and background