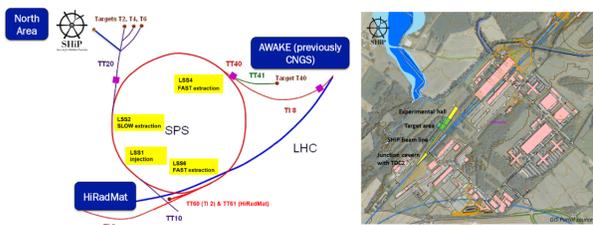
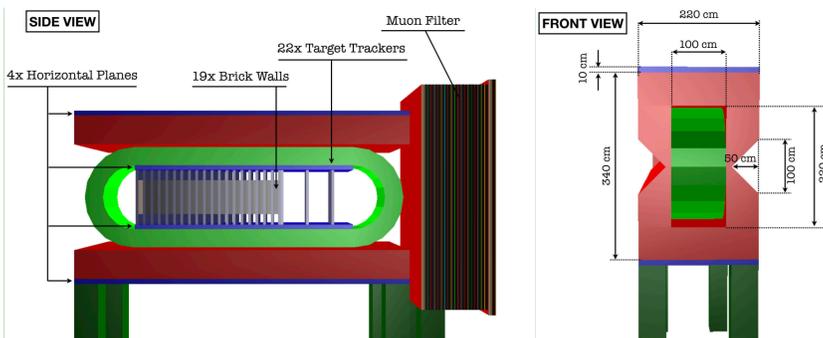


## The SHiP Beam Dump Facility



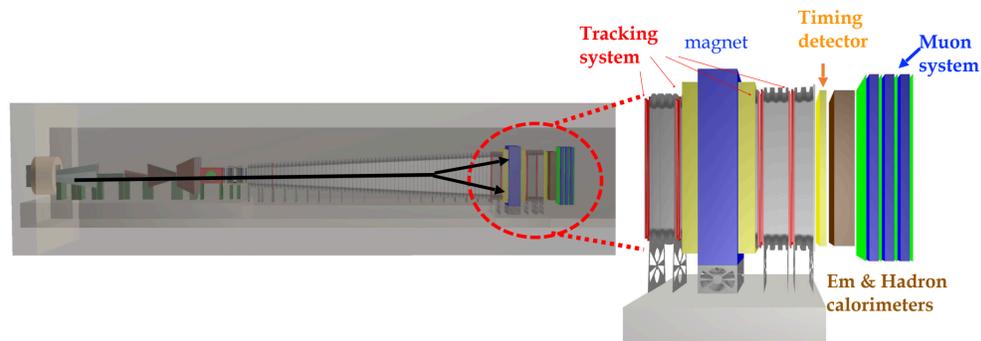
Design based on minimal modifications to the existing SPS complex. Same extraction and transfer line as the other North Area facilities.

## The iSHiP detector



High neutrino flux is expected. Opportunity to study  $\nu_\tau$  in detail, and to discover the  $\bar{\nu}_\tau$ . The target is composed by high-resolution emulsion films and timing tracker planes, followed by a spectrometer and muon filter. Detector ideally suited to detect Light Dark Matter (LDM) scattering on the target.

## The Hidden Sector detector

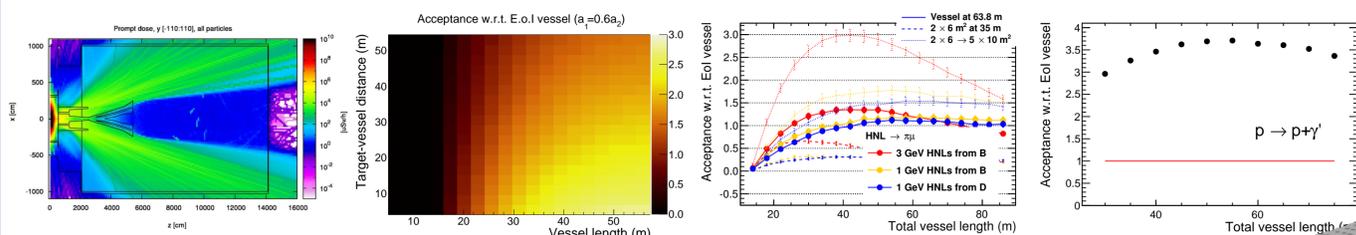


Hidden particles are expected to decay inside the 60 m long vacuum vessel. This is surrounded by 30 cm of liquid scintillator tagger for its whole length, and preceded by two veto stations, to tag background from outside. The visible decay products are then tracked and identified by means of a straw spectrometer, electromagnetic and hadronic calorimeters, and a muon system. A timing detector suppresses combinatorial background.

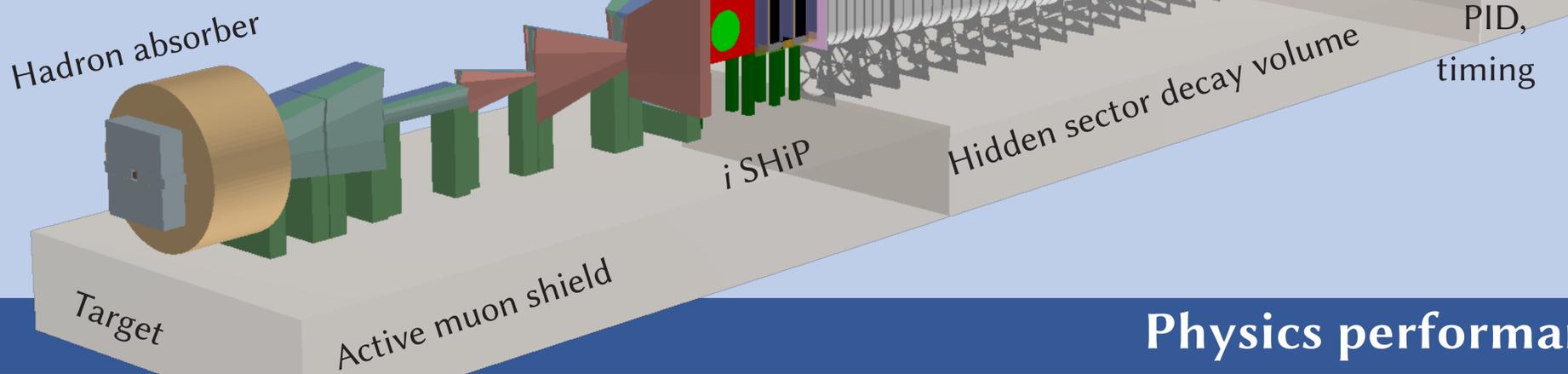
## References

- [1] M. Anelli *et al.* (SHiP collab.) "A facility to Search for Hidden Particles (SHiP) at the CERN SPS". arXiv: 1504.04956 [physics.ins-det]
- [2] S. Alekhin *et al.* "A facility to Search for Hidden Particles at the CERN SPS: the SHiP physics case". arXiv: 1504.04855 [hep-ph]

## Detector design optimisation



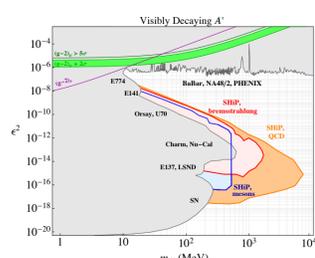
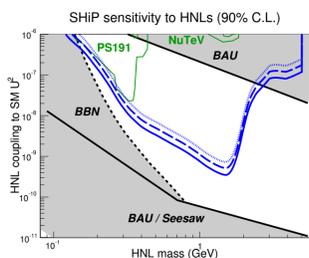
The design of the muon shield and the shape of the decay vessel are optimised using machine learning and detailed acceptance studies.



## Physics performance

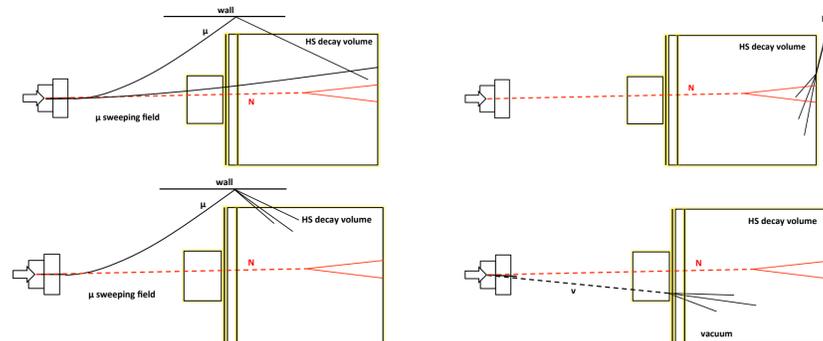
### HNLs

Three Generations of Matter (Fermions) spin 1/2		
mass	charge	name
2.4 MeV	2/3	u
1.732 GeV	1/3	c
173.2 GeV	1/3	t
4.2 MeV	1/3	d
194 MeV	1/3	s
4.2 GeV	1/3	b
0.511 MeV	0	e
105.7 MeV	0	$\mu$
1.777 GeV	0	$\tau$



Heavy Neutral Leptons can simultaneously explain dark matter, the asymmetry between matter and antimatter, and the oscillations of SM neutrinos. SHiP will improve the present sensitivity to HNLs and other long-lived particles by several orders of magnitude.

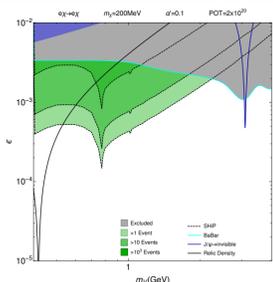
### Background strategies



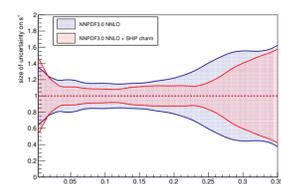
Liquid scintillator surrounds the whole HS decay volume, which is depleted. Timing controls combinatorial BG, and upstream taggers isolate SM  $\nu$  events. The rest is... reconstruction & topology!

### $\chi e \rightarrow \chi e$ with iSHiP

- Detect dark matter from dark photon  $\gamma'$  decay
- Elastic scattering on target electrons
- Signature: vertex with only  $e^-$  coming out
- BG from  $\nu$  scattering  $< 300/5$  years
- Complements search for  $\gamma' \rightarrow \ell\ell, \gamma' \rightarrow q\bar{q}$



### Physics with $\nu_\tau$



- First observation of the  $\bar{\nu}_\tau$ !
- $\nu_\tau/\bar{\nu}_\tau$  cross-section measurements
- First evaluation of the  $F_4$  and  $F_5$  structure functions
- PDF improvements with  $\nu$ -nucleon DIS: strange sea