XSEN project

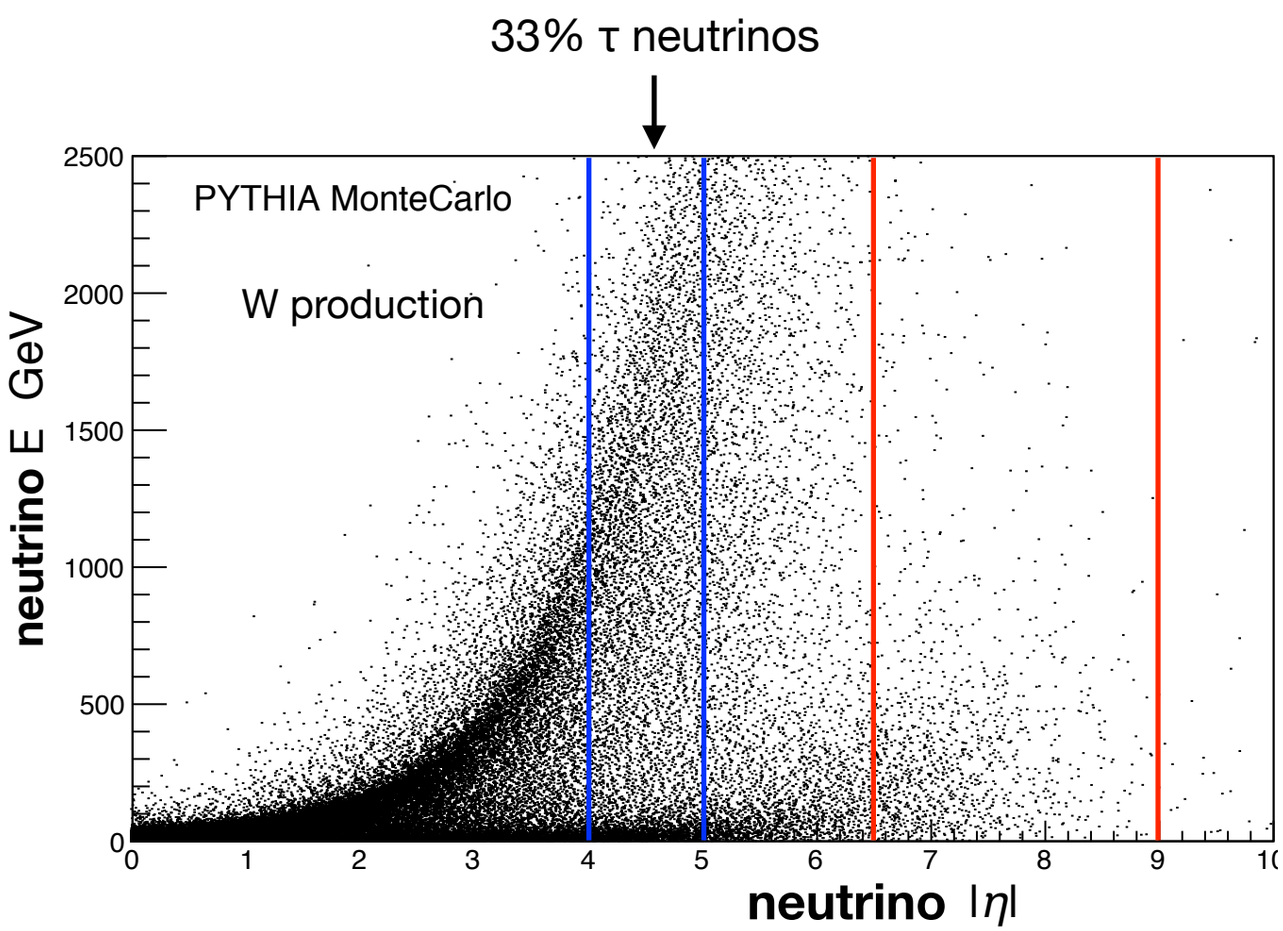
(X-Section of Energetic Neutrinos)

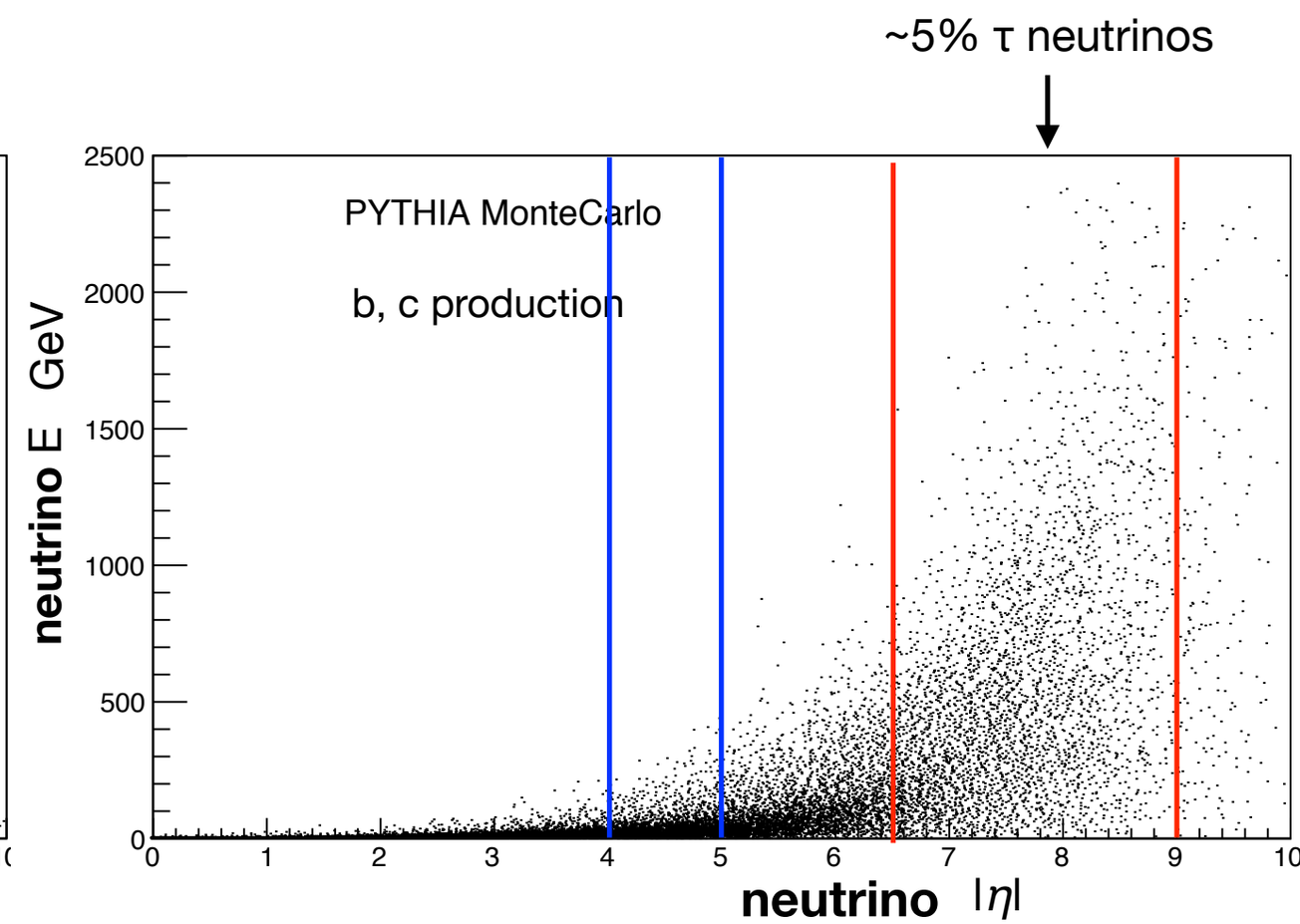
Assemblea di Sezione, July 17, 2019, Marco DV

- http://arxiv.org/abs/1903.06564 “Physics Potential of an Experiment using LHC Neutrinos” March 5, 2019 (accepted for publication on J. of Phys. G)
- https://edms.cern.ch/ui/file/2022399/1.0/LHC-XSEN-EC-0002-1-0.pdf September 5, 2018
- http://arxiv.org/abs/1804.04413 April 12, 2018
- https://edms.cern.ch/ui/file/1908776/1.0/LHC-XSEN-EC-0001-1-0.pdf March 19, 2018.

WHY

LHC IP1 and IP5 are intense sources of neutrinos (all flavours, tau included)

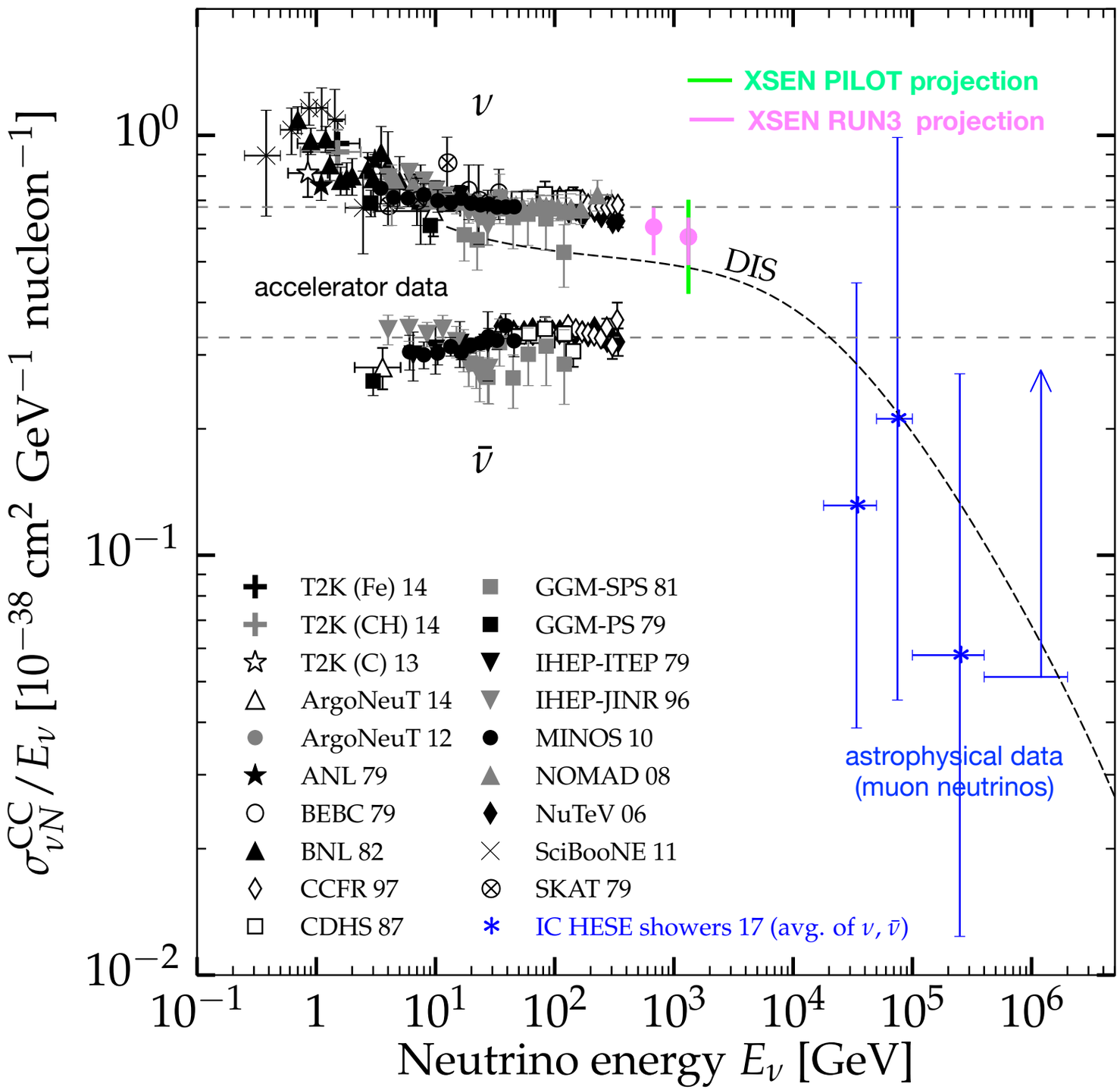




WHAT

—> LHC is a unique laboratory for measuring for the first time the νN Xsections in the 500 GeV - 2 TeV range

Bustamante M., Connolly A., arXiv:1711.11043, Jan. 12, 2019



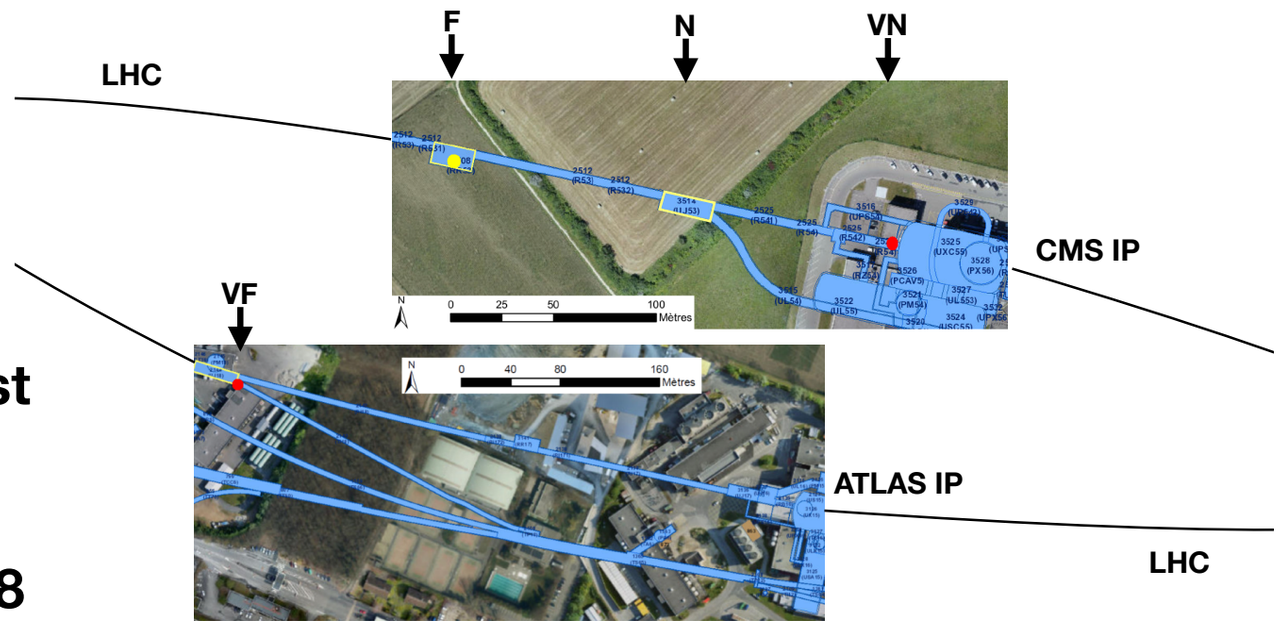
+ a ν_τ measurement

SMALL DETECTOR:
2 ton @ 1 TeV = 200 ton @ 10 GeV

WHERE a site with low machine backgrounds exists

—> studied sites Very Near, Near, Far, Very Far from IP5, IP1

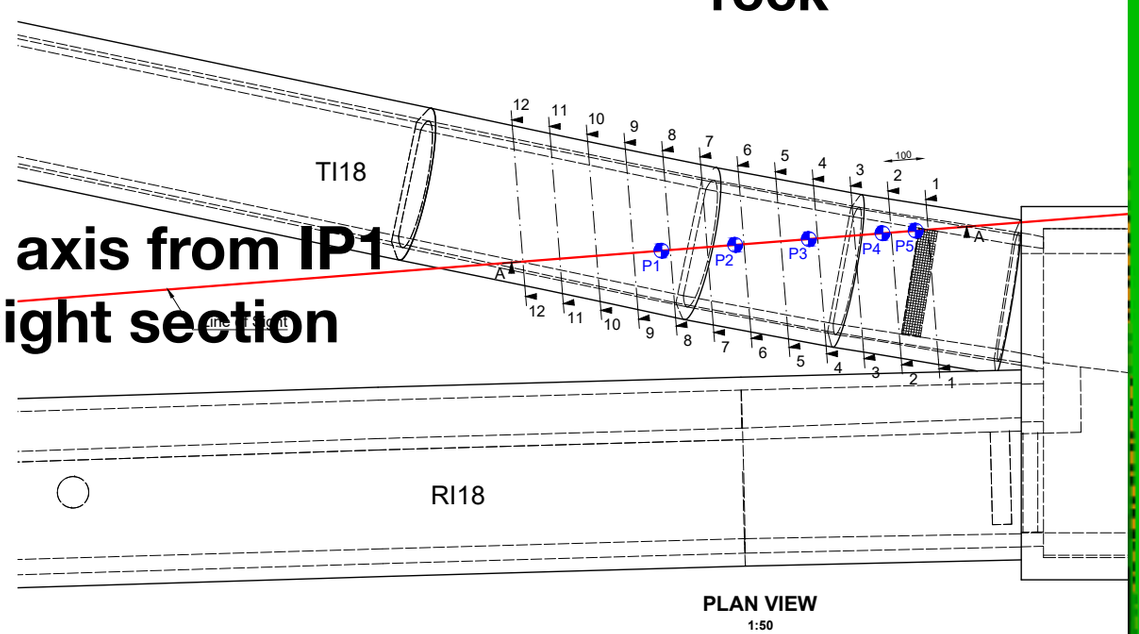
VF qualifies as host for a neutrino detector: at junction of the TI18 unused tunnel with LHC

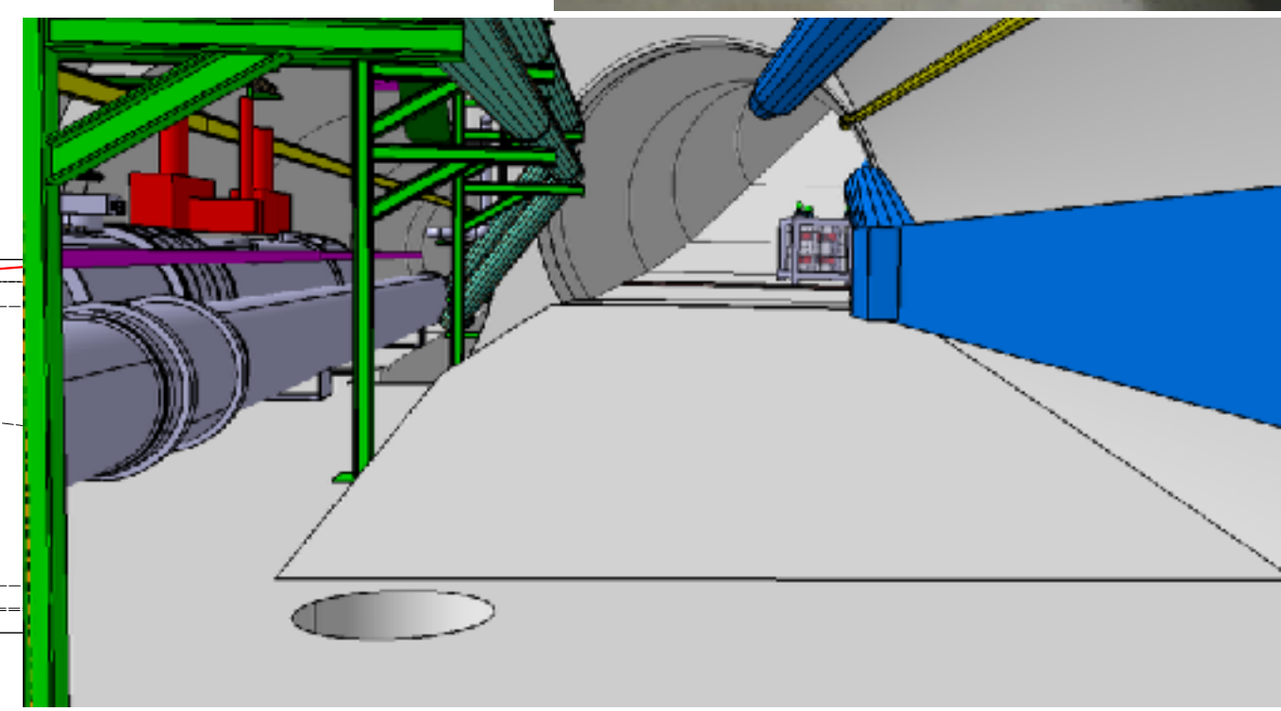


TI18 tunnel cavern

advantage of LHC magnetic bend and of a 100 m layer of rock

beam axis from IP1 straight section





WHEN XSEN proposal for LHC Run3

- Even when scaling down to a smaller detector and to an integrated lumi of 150 /fb, the expectations are excellent

- Phase 1 (PILOT run): 2021, 0.4 ton detector for characterisation of the background, and set-up and tune emulsion handling infrastructure and analysis for 2022-23,

    - 1 ton of lead fits in 1 meter length of 30x30 cm2 Xsection

- Phase 2: 2022-23(24), 1.5 ton detector, 2 sections covering η ranges with different average energy (0.7, 1.2 TeV)

- with 150 /fb can record up to 2000 HE neutrino interactions, up to 100 ν_tau

WHO

- EoI received and discussed at the LHCC closed session in June. Positive outcome. Referees assigned:Francesca Di Lodovico (coordinator), Katja Krüger, Michelangelo Mangano, David Waters.

- presented at INFN CSN1 , July 8

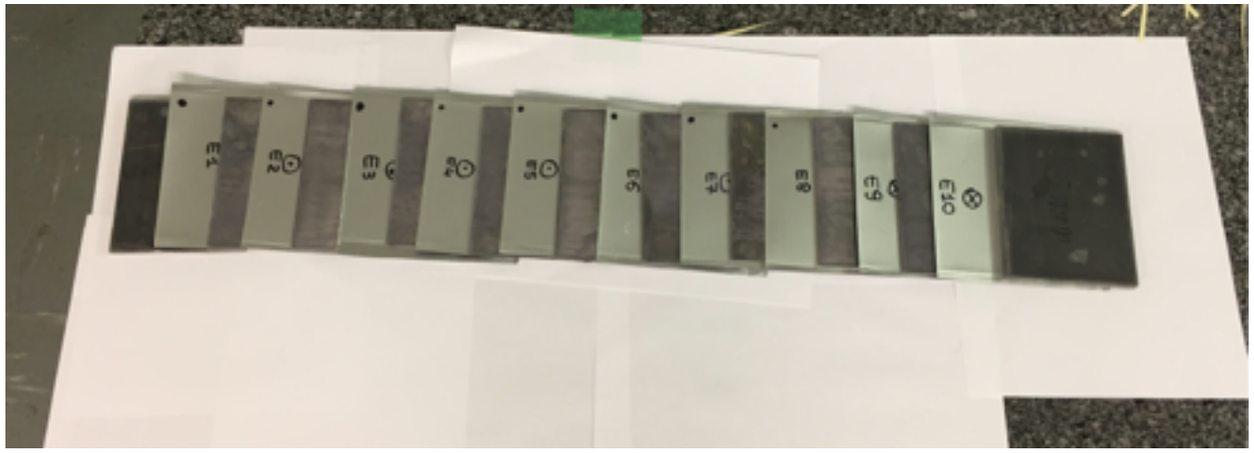
- LoI by mid July for discussion in September. **Collaboration is being formed**. INFN so far: Bologna, Naples.

    - urgent: flux calculations with Pythia, detector interaction simulation with fluka/geant

- Phase 1 (PILOT run) for 2021, because of its very small size, on an accelerated path (similar to our test measurement along the LHC tunnel) : reviewed by TREX on June 26, expect approval by LMC at the end of July.

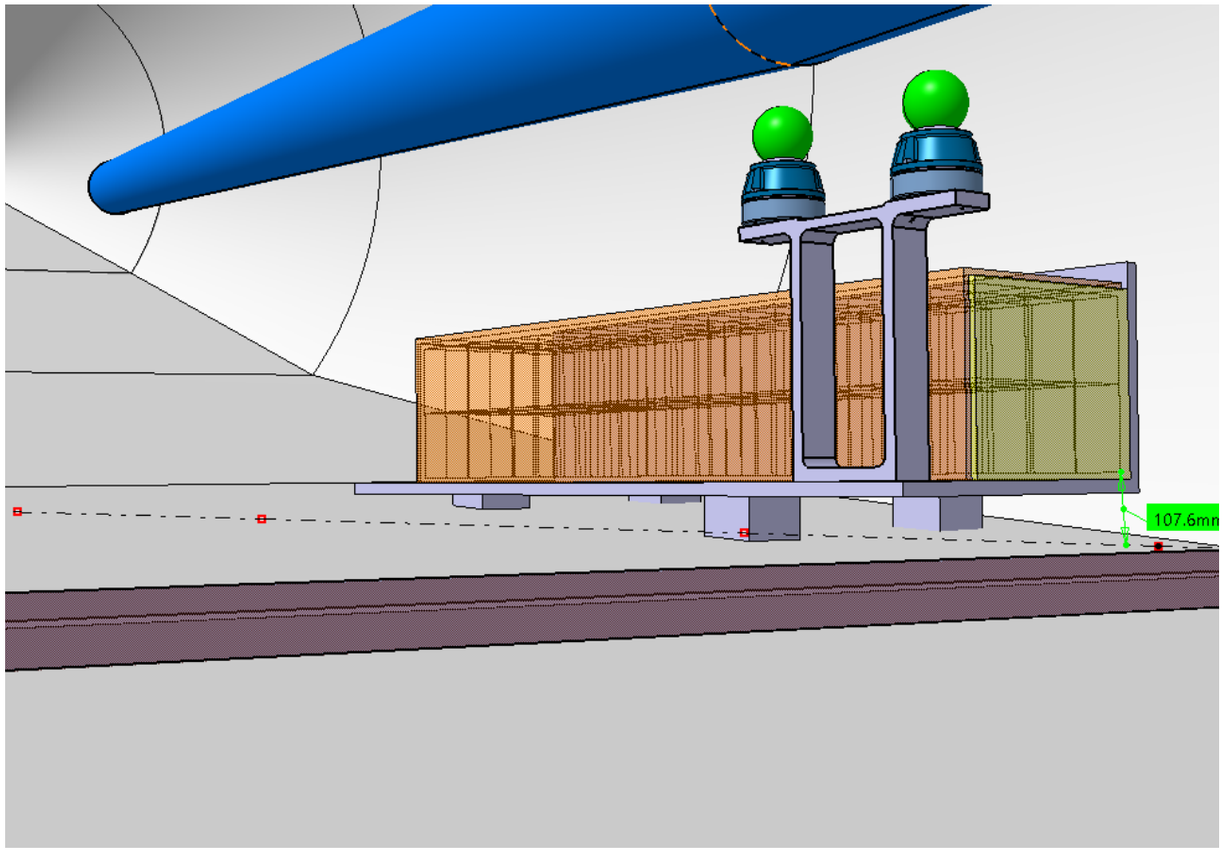
HOW

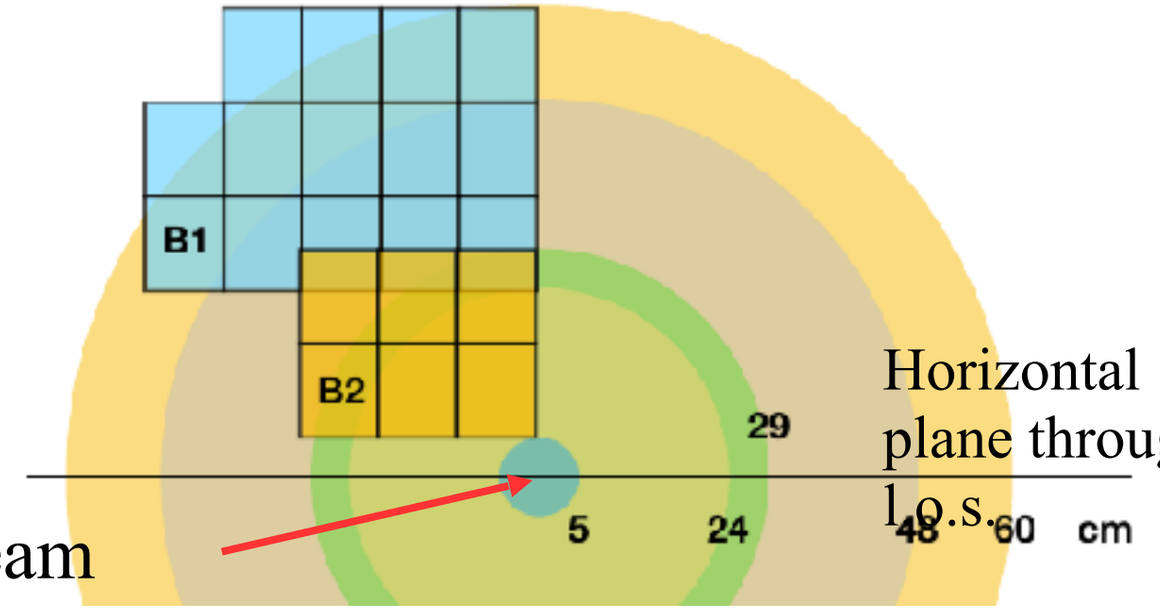
We will use the modular design developed for OPERA: the emulsions interleaved with thin layers of lead will be packed together into “bricks” for easier handling.



The photograph shows one of the bricks used for the background measurements. Our current baseline is to use bricks 12.5 cm wide, 10 cm high and 7.5 cm thick with ~5.6 cm lead. Such bricks would weigh ~8.3 kg, making them easy to handle manually.

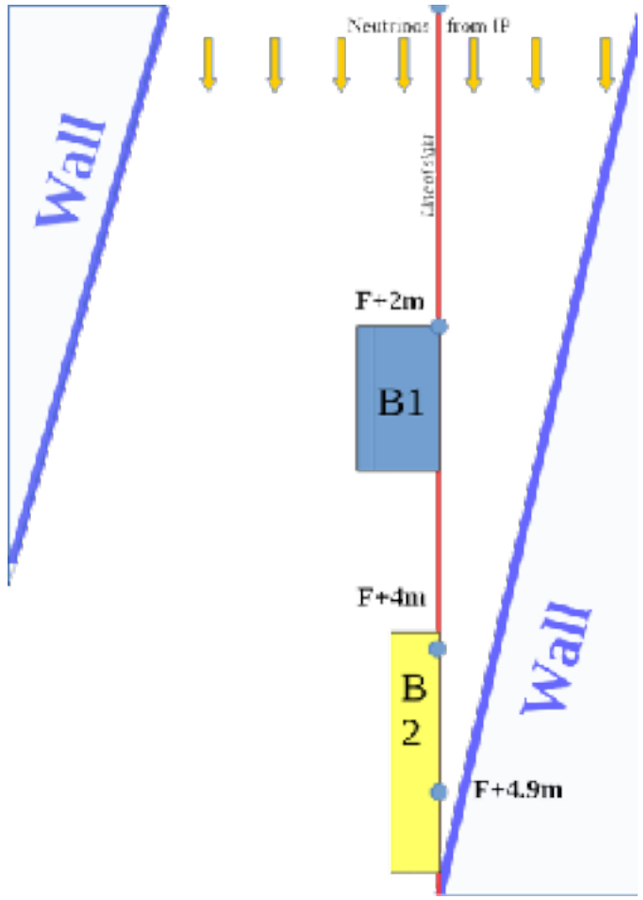
The line of sight of the colliding beams is under the surface of the tunnel, which is actually an advantage: we can split the detector into two sections covering two ranges of pseudorapidity while simplifying mechanical support structure.





Horizontal plane through l.o.s.

Beam l.o.s.



What we need for PILOT run:

material:

-- purchase 17m2 of emulsions. ~50K. INFN 50% max (25K) sub judice

-- **restart 3 scanning tables in Bo, upgrade** optics for one 20K

-- lead sheets, recycle from opera, 0K

-- installation (to do before LHC goes cold, in october-december 2020). 0K, detector supports provided by cern

-- boron carbide protection. procured by cern (alternative borated polyethylene, but inflammable, should be covered by aluminum) TBD

travel money:

-- tests for optimising the detector configuration. travel money for Italy and cern. difficult to evaluate

-- restart cern tools for brick assembly and emulsion development. And manpower for assembly and development shifts. ~9-12 menweeks

-- installation. Cern personnel takes care.