Outcome of νSTORM and EnuBET Discussion

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Introduction

- Very fruitful joint νSTORM and EnuBET session this morning
- Idea is to have them in the same facility at CERN
- There are different design challenges to overcome if we are going to do this
- Those integration discussions have just started but there is synergy in the scientific goals

Motivation

Demonstrator/accelerator science facility for Muon Colliders

Will also help DUNE and HyperK

Francesco's presentation to the PBC

The rationale of

To extract the most physics from DUNE and Hyper-Kamiokande, a complementary programme of experimentation to determine neutrino cross-sections and fluxes is required. Several experiments aimed at determining neutrino fluxes exist worldwide. The possible implementation and impact of a facility to measure neutrino cross-sections at the percent level should continue to be studied. Other important

European Strategy for Particle Physics Deliberation document (pag. 5)

ENUBET and nuSTORM (see also the European Strategy Physics Briefbook, arXiv:1910.11775)

ENUBET, in particular is aimed at

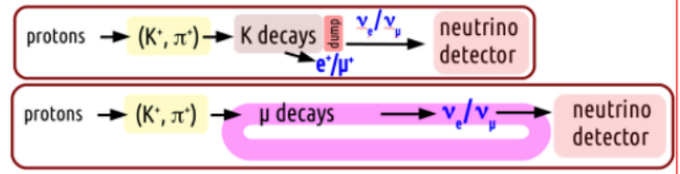
- Designing a narrow band neutrino beam at the GeV scale and measure at 1% the **flux, flavor** and (at 10%) the **energy of the neutrinos** produced at source

NuSTORM: offers an **unprecedented statistics of ν_e** and a major leap toward Neutrino Factories and **the muon collider**

It is the core technology for

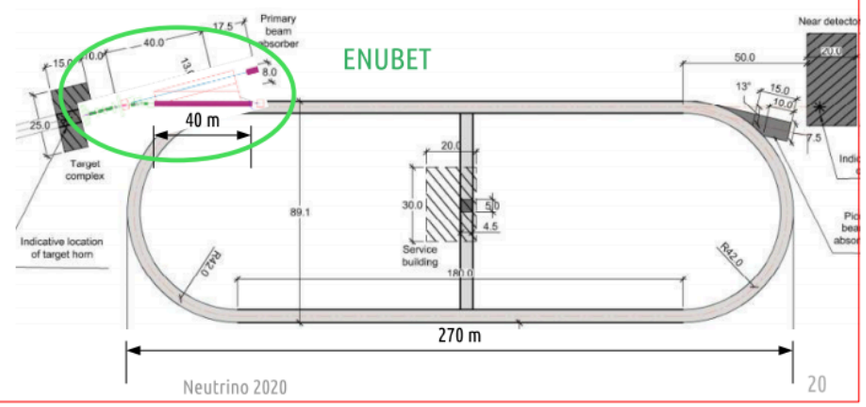
- A new generation of short-baseline experiments to achieve a 1% precision on the **ν_e and ν_μ cross sections** and **remove all the biases** due the ν energy reconstruction
- It is essential to lower <3% the systematic budget of **DUNE and HyperK** and enhance remarkably their discovery reach
- Is the most natural follow-up of the previous generation of x-sect experiments (including the possibility to upgrade **the ProtoDUNE** or **the SBN physics programme**)

nuSTORM & ENUBET



	Decay region	Hadron dump	Proton extraction	Target, sec. transfer line, p-dump	Neutrino detector
ENUBET	~40 m. Instrumented.	Yes. Dumps muons in addition preventing a (small) ν_e pollution to K_{e3} - ν_e	Slow, 400 GeV (flexible)	Yes, similar	~100 m (some flexibility)
nuSTORM	Replaced by straight section of the ring (180 m).	No. Muons are kept: the most interesting flux parents.	Fast, 100 GeV	Yes, similar	> 300 m from target (ring straight section)

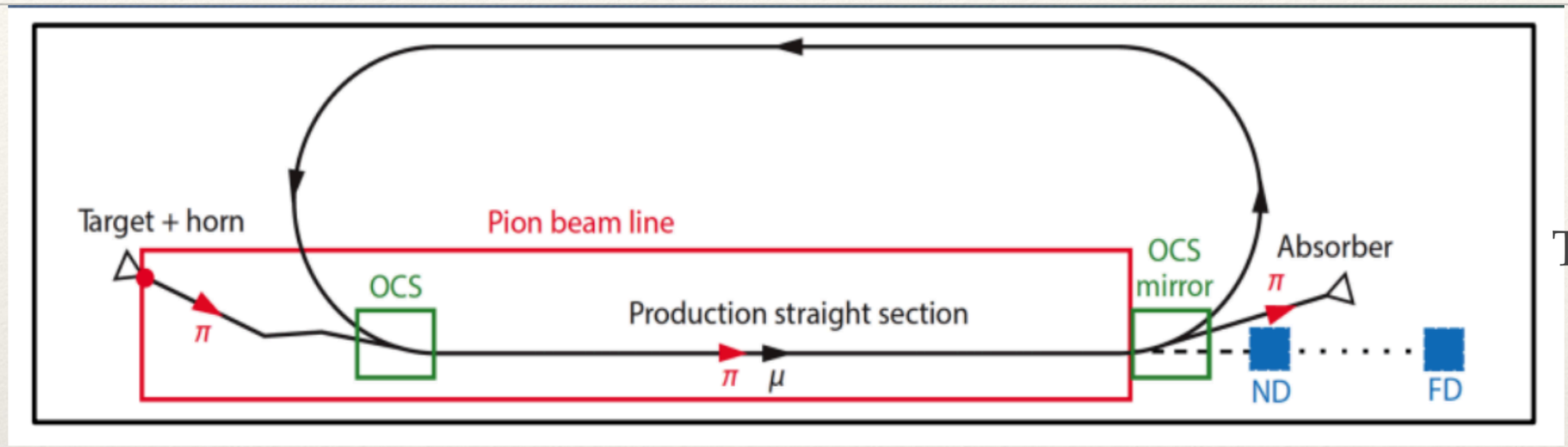
- Different concepts, budget, geometry.
- Main synergy: target facility, 1st stage of meson focusing, proton dump.



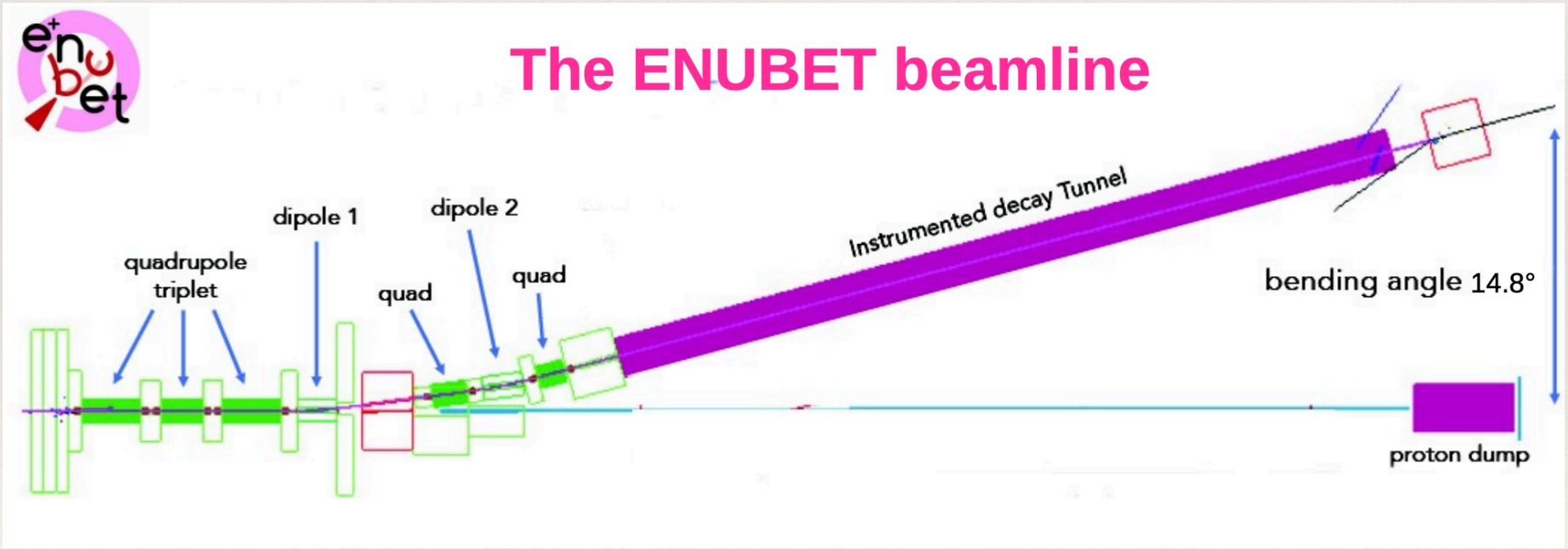
A. Longhin — Neutrino 2020 — 20

Ken Long

Synergies



Tiago Alves



Fabio Pipilli

- Integration discussion started but the one thing that is in common is the fact that both experiments need a target

Targets

Marco Calviani

Targetry – applicable examples

- Target and horn development could profit from existing experience and design existing worldwide, from NuMI, CNGS to T2K beamlines
- All applicable for nuSTORM / ENUBET

- Conclusion - a dedicated working group needs to be set up

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Neutrino Flux Simulations

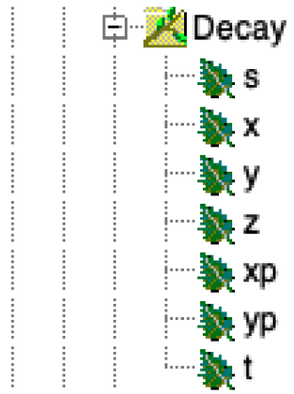
- New neutrino simulations for νSTORM

Data Structure

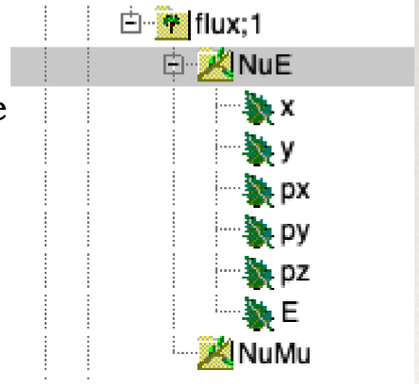
Decay — the muon position and direction at decay

At present the position of the decay in the straight is the same as path length of the muon before decay

time is included but not filled



Flux — position and 4 momentum of the neutrinos as they cross a plane 50m from the end of the straight.



Included to allow easy modelling of detector response and event rates

Position of the plane easy to change

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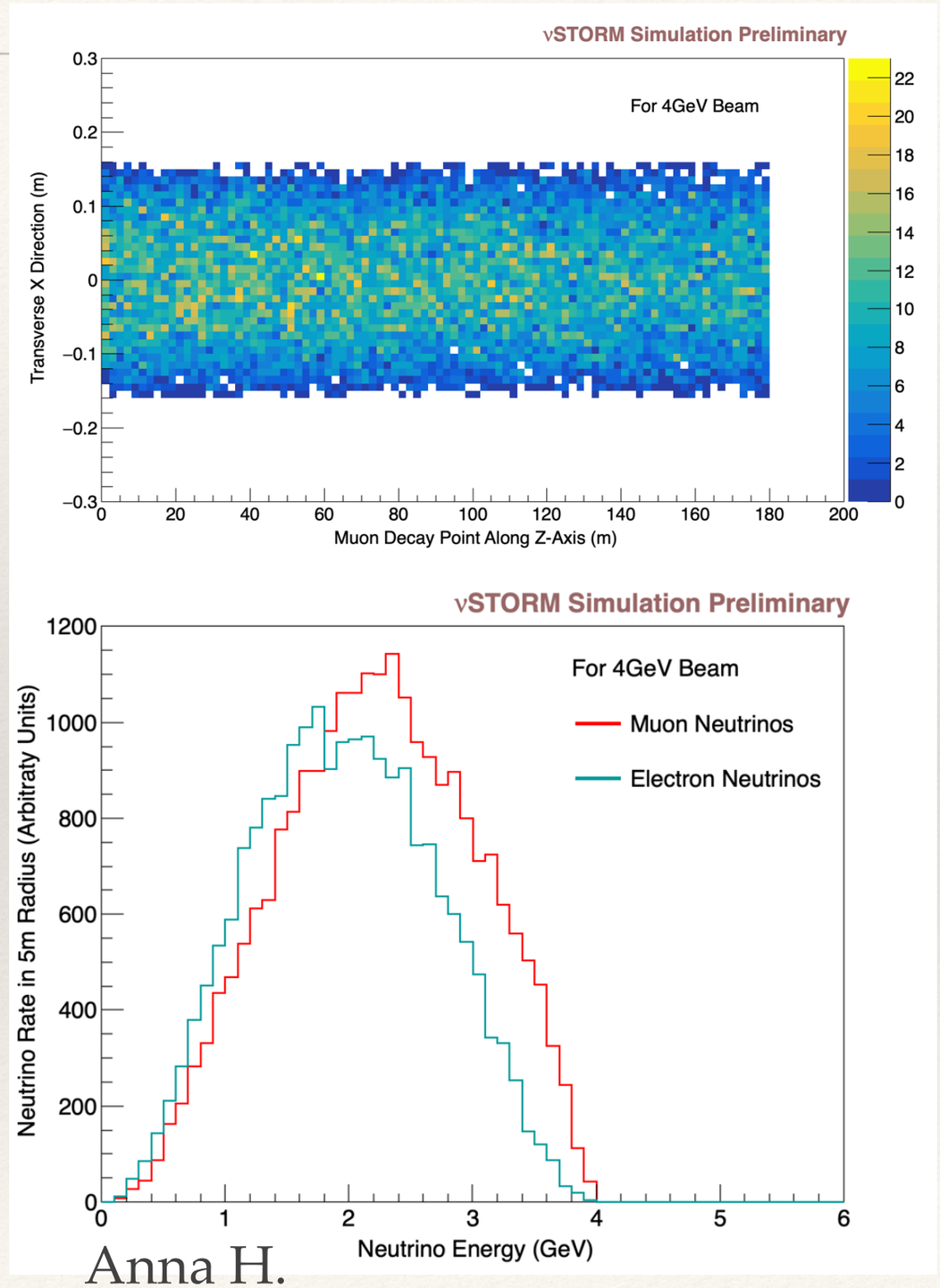
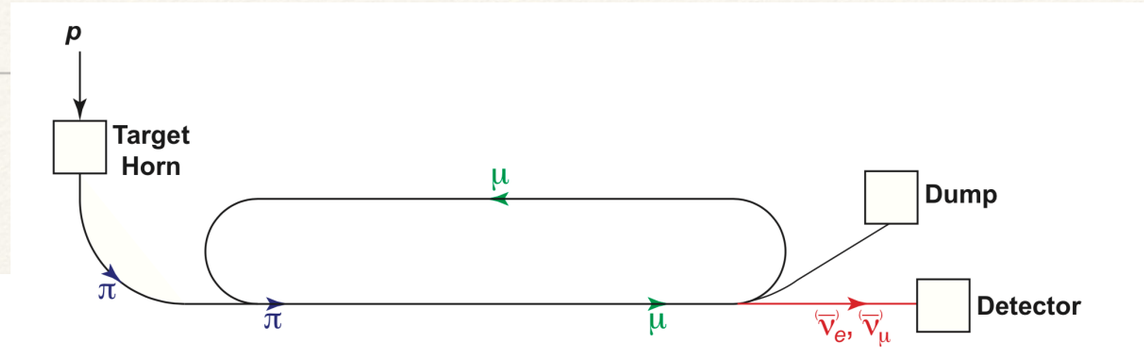
Paul Kyberd

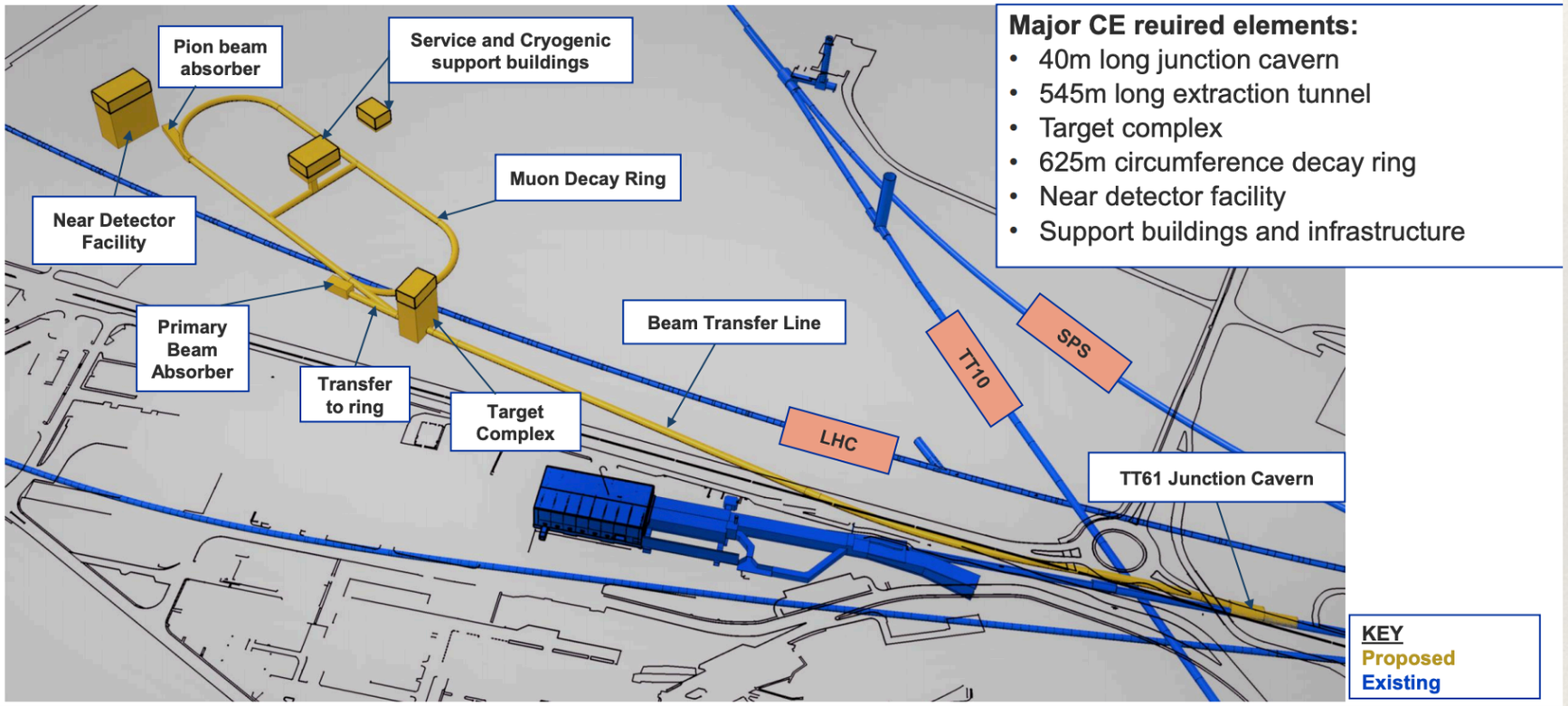


Anna H.

Engineering Considerations at CERN



CE Requirements- Infrastructure needs



- There are no show stoppers from an engineering point of view
- Engineering plans with enough detail, even a possible FD

Discussion Outcome

Programme now to next ESPPU

- **Imperative:**
  - **Arrive at next ESPPU with *single* ENUBET/nuSTORM programme:**
    - **Neutrino science; cross section and BSM**
    - **Muon collider demonstrator and test bed**
    - **Costed, with timeline, project planning, etc.**
- **Need to discuss how to get there:**
  - **Strengthen collaboration and collaborative working**
  - **How to deliver imperative defined above?**
  - **What would *we do* if there were modest, but significant, resources between now and next ESPPU:**
    - **E.g. Target complex to serve ENUBET, nuSTORM and iMC target studies?**
- **Issues:**
  - **Site, safety, technology, power consumption, …**

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Final Takeaway

- νSTORM and EnuBET will now establish regular meetings, likely every 4-6 weeks
- Discussion areas will cover:
  - Science goals
  - Beam + instrumentation
  - Detectors
  - Design study
  - Organisation
- Invigoration of Effort towards building the facility