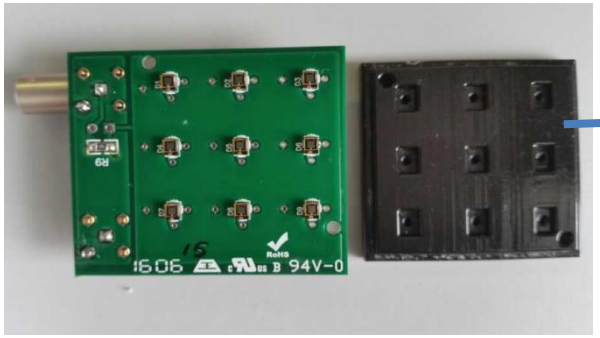
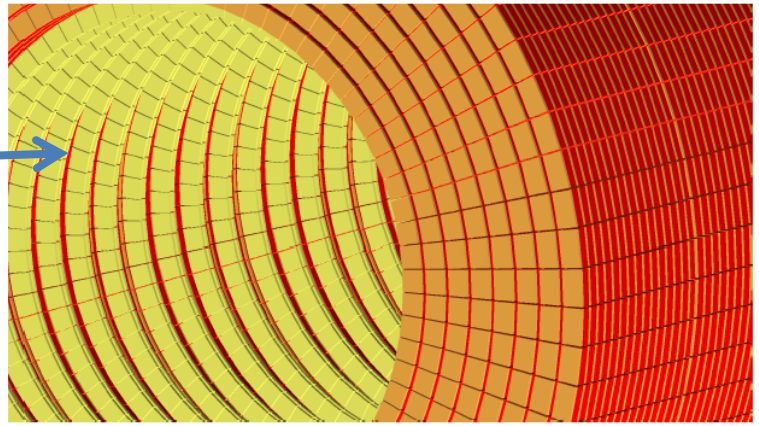
The first steps of ENUBET: working groups and the Expression of Interest

An overview of the ENUBET activities
in the first year of the project (Jun 2016- May 2017)

- From SCENTT to ENUBET
- Working groups organizations and goals
- Agreements with CERN: the Expression of Interest
- Conclusions



2016

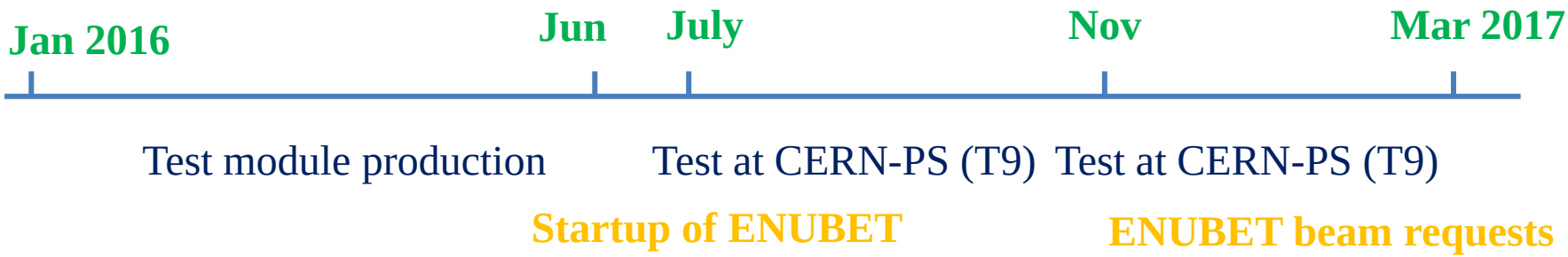


2021

F. Terranova, Univ of Milano Bicocca and INFN

From SCENTT to ENUBET

The SCENTT R&D has been a useful intermediate step toward ENUBET because it allows an early debugging of the technology solutions envisaged for ENUBET. Clearly, the small funding profile (a few tens of kEuro) required focusing on very specific issues, mostly linked with the technology of SiPM readout for shashlik calorimeters (longitudinal segmentation).



During the first year (completion of the SCENTT programme) our goals are to:

1) Demonstrate that the segmented calorimeter is able to perform the e/π separation needed for ENUBET
2) Demonstrate that the baseline option for the photon veto is within the specifications for the ENUBET physics programme

See tomorrow's meeting

The limitations of the SCENTT prototypes

- We are using production techniques that cannot be employed on large scale (e.g. drilling)
- We have not performed precise estimate of SiPM irradiation by neutrons nor irradiation tests to select the photosensors
- Granularity and coverage has been optimized to reduce the pion contamination and not the flux systematics

These issues have to be addressed in parallel before the completion of SCENTT

Working group charge and structure have been tuned to achieve these goals very early in the development of the Project

WP1: Beamline

This is a very critical package because has not been investigated in the framework of SCENTT and most of the information date back to the 2015 EPJ paper

Table 1 Pion and kaon yields for horn focusing at (8.5±1.7) GeV/c. The rightmost column is computed assuming a 500 ton neutrino detector

E_p (GeV)	π^+/PoT (10^{-3})	K^+/PoT (10^{-3})	PoT for a 10^{10} π^+ spill (10^{12})	PoT for 10^4 ν_e CC (10^{20})
30	4.0	0.39	2.5	5.0
50	9.0	0.84	1.1	2.4
60	10.6	0.97	0.94	2.0
70	12.0	1.10	0.83	1.76
120	16.6	1.69	0.60	1.16
450	33.5	3.73	0.30	0.52

Aims:

1) Envisage a proton extraction scheme compatible with the repetition rates of the SPS and the Main Ring, providing the integrated protons on target for the cross section measurement
2) Define the optimal emittance (i.e. decay tunnel acceptance) in order to have only large angle particles from Kaon decays at the tagger
3) Define whether a horn based focusing system is stricly mandatory
4) Design the transfer line

Sinergy with SHIP

Sinergy with NUSTORM

One person (Art. 36) full time on WP1, possibly based at CERN

WP2: Tagger prototype

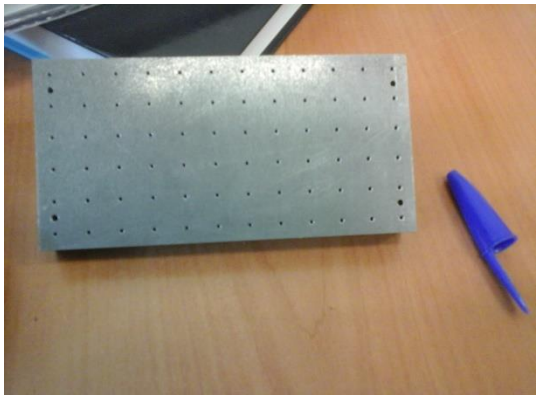
This is the field that has been explored by SCENTT more in depth and is the one that is most relevant for the budget of ENUBET

1) Define the production technology for the iron steel. Drilling is not an option and either casting (baseline) or water jet drilling (backup) should be considered
2) Define the production technology for the scintillator tiles: injection moulding seems the only viable option but expertise only among russian groups
3) Optimal choice for scintillators and fibers (linked with production technology)
4) Integration with SiPM holder and cabling

Sinergy with SHIP

[Other: More aggressive: hybrid system (cherenkov + calorimeter) for e/π separation below 1 GeV]

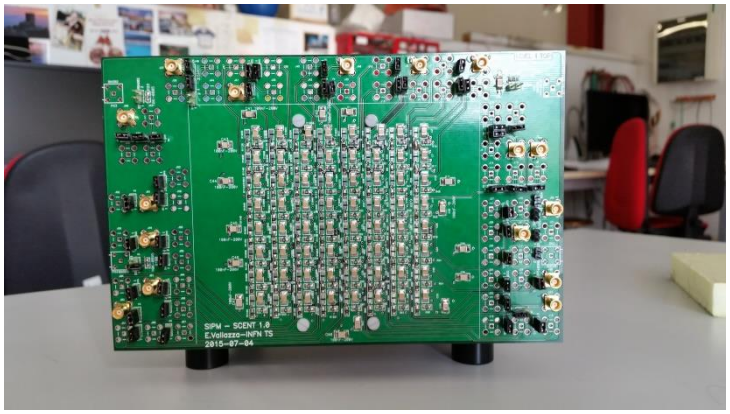
We need mechanical engineers and technicians + the expertise on calorimetry and plastic scintillators



WP3: SiPM and front-end electronics

This is a package that has been partially explored by SCENTT. Crucial because readout in triggerless mode is the only viable option for any extraction scheme and cost effective solutions will pave the way to a real experiment

1) Choice of the SiPM: recovery time, spectral matching with WLS fibers, dynamic range from mip to shower maximum
2) Radiation hardness tests
3) Development of the holders (PCB) and front-end boards
4) Development of custom electronics (waveform digitizers) scalable to 10^5 channels
5) Estimate of bandwidth, data reduction and storage for full size experiment



Sinergy with CALICE and the Neutrino Platform

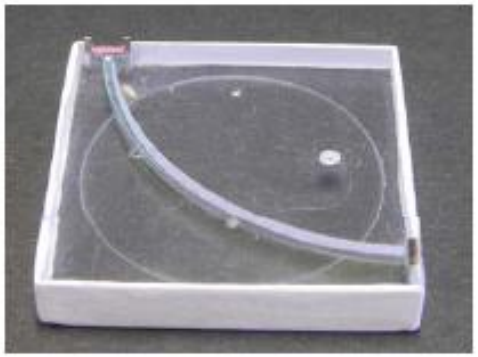
One person (Art. 36) full time on WP3+4 and possibly 1.0 FTE contract from overhead

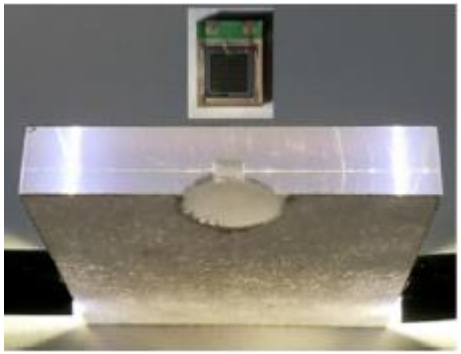
WP4: Photon veto

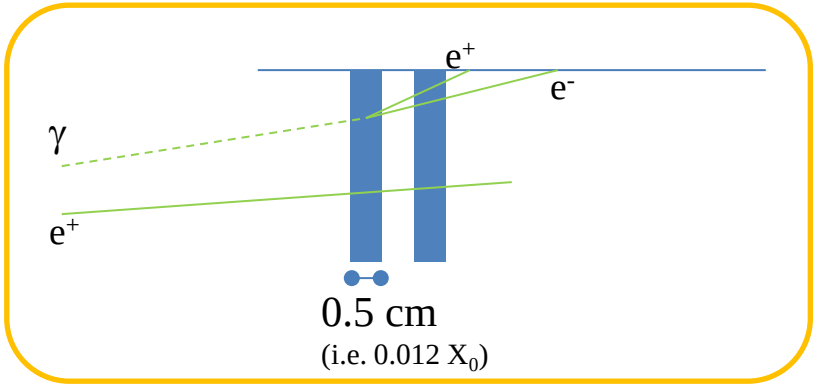
This is a package that has been partially explored by SCENTT. Photon background is claimed to be subdominant: to be demonstrated. If reaches precisions <1 ns pave the way to tagged neutrino beams.

1) Choice of the scintillator granularity and thickness
2) Choice of the light readout system
3) Test at the LNF- BTF (photon beam)
4) Assessment of options different from plastic scintillators (silicon pads)

Sinergy with CALICE and Neutrino Platform







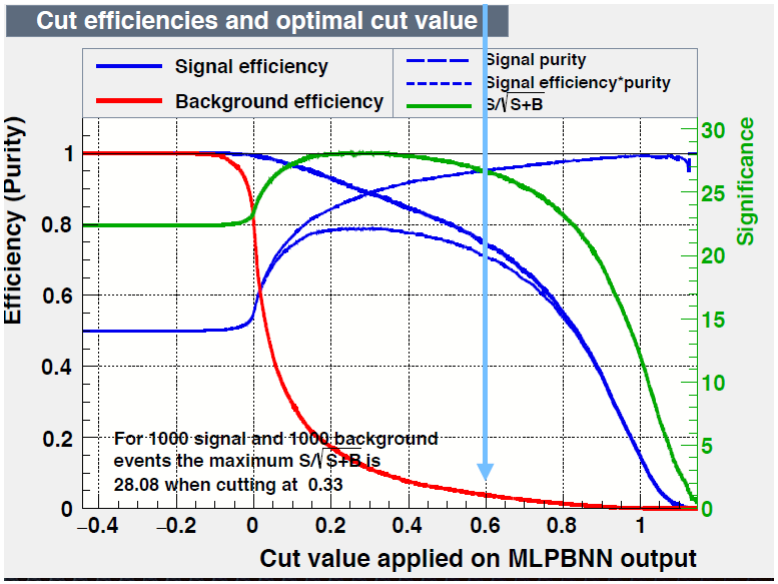
One person (Art. 36) full time on WP3+4 and possibly 1.0 FTE contract from overhead (see previous slide)

WP5: Simulation and assessment of systematics

This Working Package should be operative right now because it answers key questions that will drive the design of WP1-4

1) Full simulation of the decay tunnel based on the input of WP1
2) Systematics assessment:
   - What is the minimum fraction of the decay tunnel that must be instrumented?
   - Systematics related with the lepton monitoring (efficiency, response stability etc)
   - Residual systematics: geometrical efficiency, fiducial volume
3) **Reoptimization of the granularity**
4) **Tackle the non-K related background**

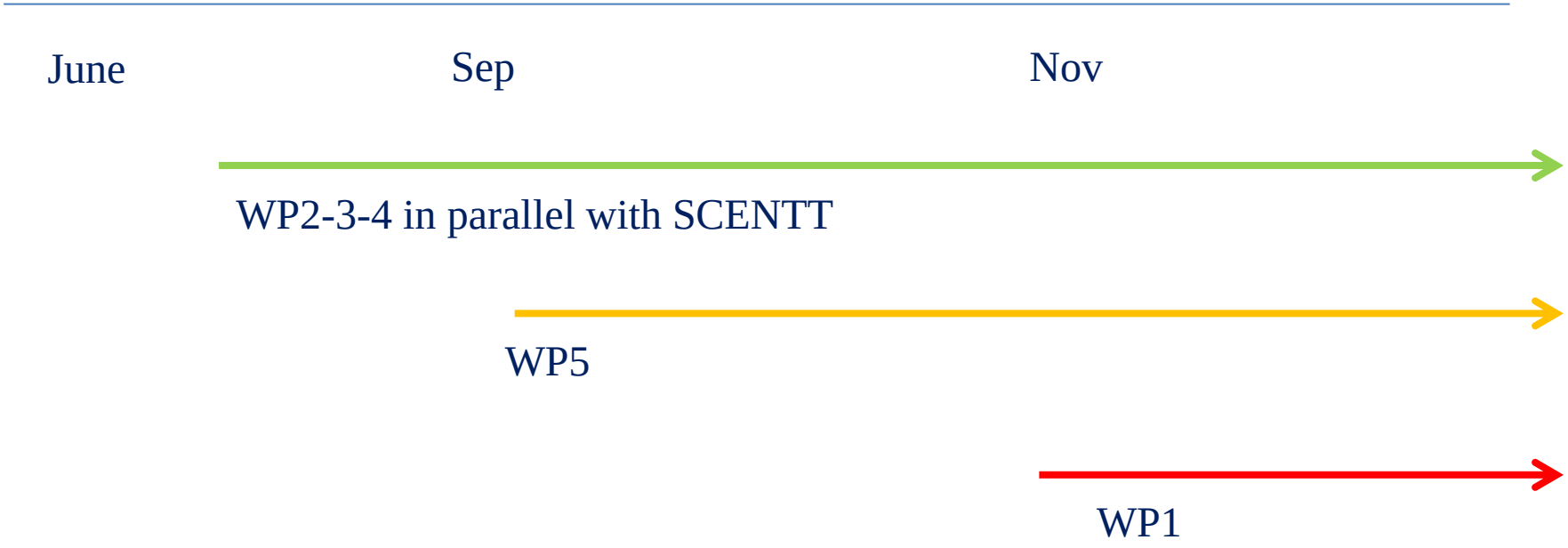
It advanced significantly during SCENTT thanks to the work of A. Meregaglia, A. Longhin and A. Berra (photon simulation)



One person (Art. 36) full time on WP5

Practical issues

- Collect interest of people in the Working Package (July - August) in parallel with the completion of the Expression of Interest (see below)
- Define the deliverables of the WP (July-August)
- Nominate the WP leaders (Sept 2016)
- Embed the WP activities in the ENUBET Master Plan
- Startup of regular WP activities and (bi-weekly) meetings



Expression of Interest

The Expression of Interest is our main tool to present the Project and collect people that are willing to join the Project. The final version will be presented to CERN in order to setup the collaboration with the accelerator division (WP1) and be officially recognized by CERN

Some issues to be settled:

1) Should be submitted to SPSC?
    1) No special resources required (testbeams within standard procedures, T9, nTOF)
    2) Agreement with CERN-ATS possible within INFN bilateral agreement
2) General plan of the Project and compatibility with Long Shutdown 2 (2019-2020)
3) Links with the CERN Neutrino Platform

Expression of Interest

Enabling precise measurements of flux in accelerator neutrino beams: the ENUBET Project

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Abstract

The imperfect knowledge of the initial flux in conventional neutrino beams represents the main limitation for a precision (1%) measurement of ν_e and ν_μ cross sections. The progresses in fast and radiation hard detectors offer an unprecedented opportunity to monitor lepton production in the decay tunnel of conventional neutrino beams and, hence, reduce the flux uncertainty by about one order of magnitude. The opportunities and challenges of this novel approach are the focus of the ENUBET Project, which has been recently approved by the European Research Council (ERC Consolidator Grants 2015, Grant Agreement 681647). In this Expression of Interest we discuss the ENUBET physics programme with

Expression of Interest: next steps

- You will get the latest version after the kick-off meeting
- 1° round of comments collaboration-wide in July
- Final version ready for September's meeting of INFN Commissione II
- Submission to SPSC or CERN - RE Committee in October

Please circulate the draft to people potentially interested
We are available to give seminars/presentations to advertise the Project and seek for new collaborators, especially outside INFN

Conclusions

- Even if the idea behind ENUBET is pretty new (2015), thanks to INFN Commissione V we are working to test the basics of the principle since June 2015
- The **SCENTT R&D** is already providing key information for ENUBET

- The very first priorities for ENUBET are:
  - Complete the calorimetric programme of SCENTT (photon veto activities foreseen in 2017 will be embedded in ENUBET)
  - Set up the deliverables and charges of the Working Packages:
    - **WP1 Beamline**
    - **WP2 Tagger prototype**
    - **WP3 SiPM and readout electronics**
    - **WP4 Photon Veto**
    - **WP5 Simulation and Systematics assessment**
  - Start as soon as possible the activities of WP5 and (in the SCENTT framework WP 2-4)
  - Set up a formal collaboration with CERN (Expression of Interest)