THE **ENUBET** ERC PROJECT FOR AN INSTRUMENTED DECAY TUNNEL FOR FUTURE NEUTRINO BEAMS

ELISABETTA PAROZZI ON BEHALF OF THE ENUBET COLLABORATION
UNIVERSITÀ DEGLI STUDI DI MILANO - BICOCCA
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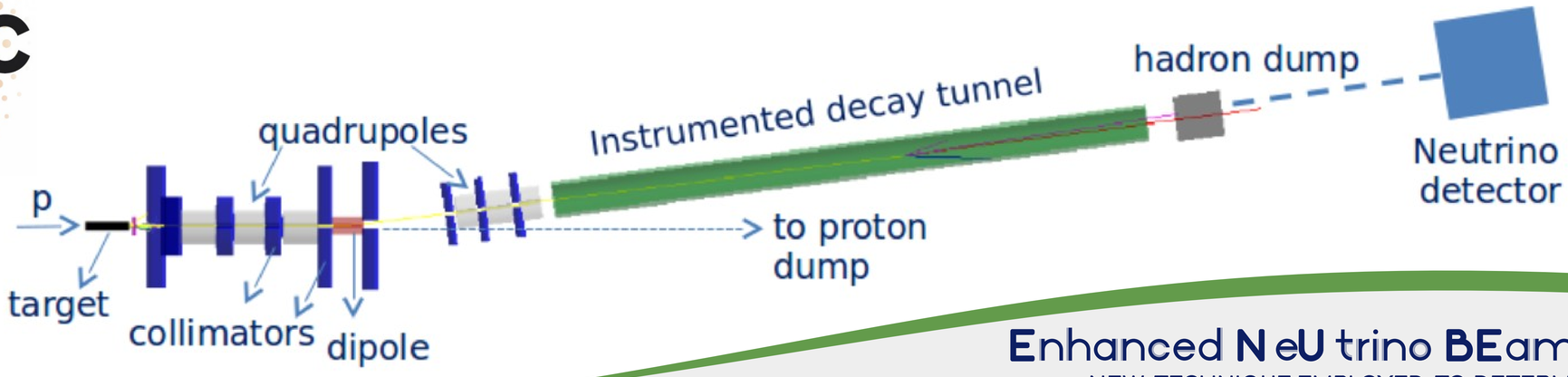
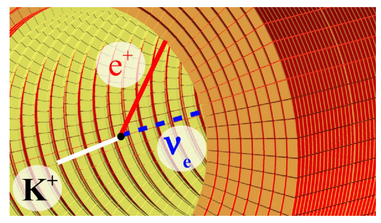




Enhanced NeU trino BEams from kaon Tagging

NEW TECHNIQUE EMPLOYED TO DETERMINE THE ABSOLUTE ν_e FLUX BASED ON THE RECONSTRUCTION OF LARGE ANGLE POSITRONS IN THE INSTRUMENTED DECAY TUNNEL FROM THREE-BODY $K+ \rightarrow e+ \pi_0 \nu_e$ DECAYS.

REDUCTION OF THE SYSTEMATIC UNCERTAINTIES ON THE KNOWLEDGE OF THE INITIAL NEUTRINO FLUX TO O(1%) LEVEL.

PHYSICS PROGRAMME:

IMPROVEMENT BY ONE ORDER OF MAGNITUDE THE MEASUREMENT OF ν_e AND ν_e CROSS SECTIONS.

HIGHLY BENEFICIAL FOR TACKLING THE MAIN OPEN NEUTRINO-RELATED ISSUES: LEPTONIC CP VIOLATION, MASS HIERARCHY, θ_{23} OCTANT.

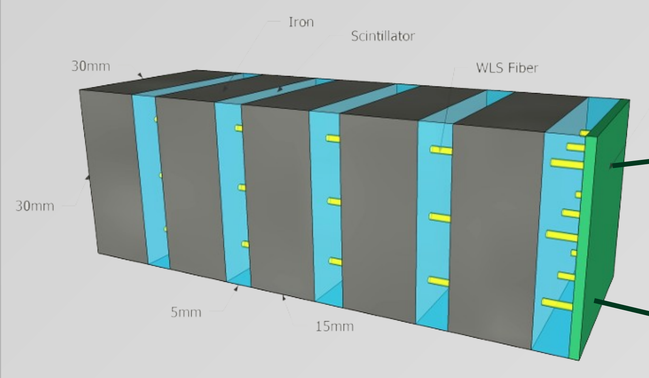
FIRST STEP TOWARDS A TIME TAGGED NEUTRINO BEAM: DIRECT PRODUCTION/DETECTION CORRELATION.

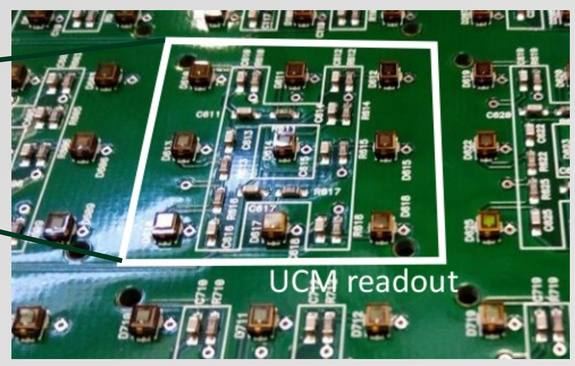
ULTRA-COMPACT CALORIMETER PROTOTYPES

SHASHLIK WITH INTEGRATED READOUT.

BASIC SHASHLIK CALORIMETER: STACK OF ALTERNATING ABSORBER AND SCINTILLATOR MATERIALS, PIERCED BY A WAVELENGTH SHIFTING FIBER (WLS) PERPENDICULAR TO THE ABSORBER AND SCINTILLATOR TILES.

ULTRA-COMPACT SHASHLIK CALORIMETER: BASIC SHASHLIK PROTOTYPE WHERE EACH WLS FIBER IS READOUT BY ONE SIPM.



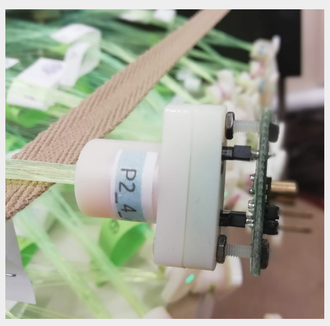


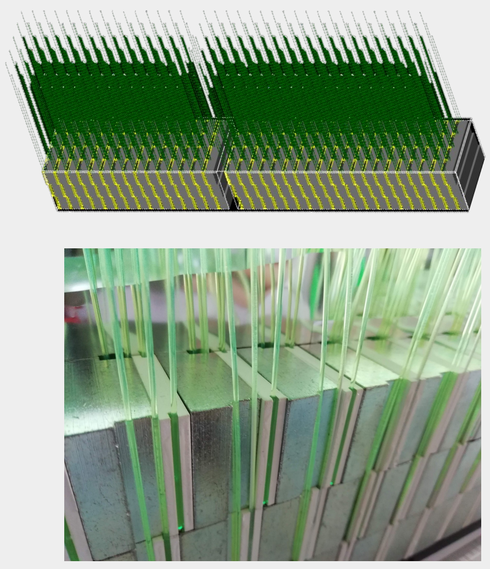
LATERAL SCINTILLATION LIGHT READOUT CALORIMETER:

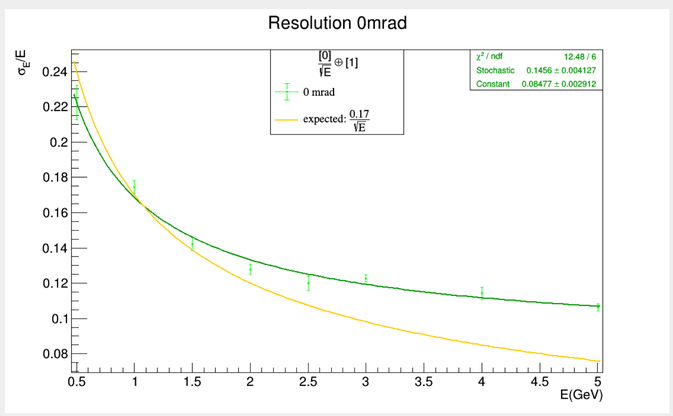
LIGHT COLLECTED FROM SCINTILLATOR SIDES AND BUNDLED TO A SINGLE SIPM READING 10 FIBERS (5 SCINTILLATORS).
SIPM ARE NOT EXPOSED IN THE HADRONIC SHOWER, THUS LESS COMPACT DESIGN.

OTHER CHARACTERISTICS:
- MUCH REDUCED NEUTRON DAMAGE: **LARGER SAFETY MARGINS.**
- **BETTER ACCESSIBILITY.**
- **SAFER WLS-SIPM COUPLING.**

UNIFORMITY RESPONCE,, E/π SEPARATION. IN PROGRESS.

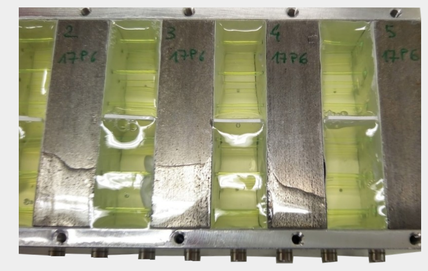


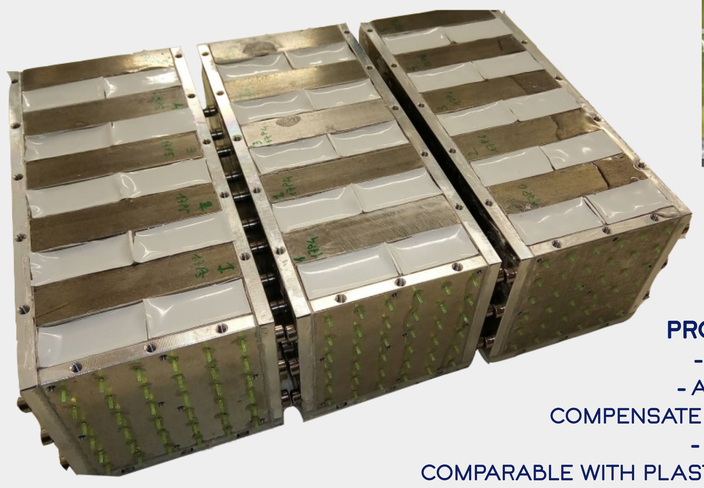




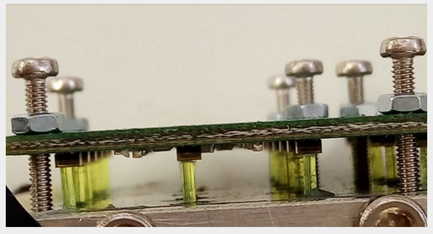
POLYSILOXANE SHASHLIK CALORIMETERS:

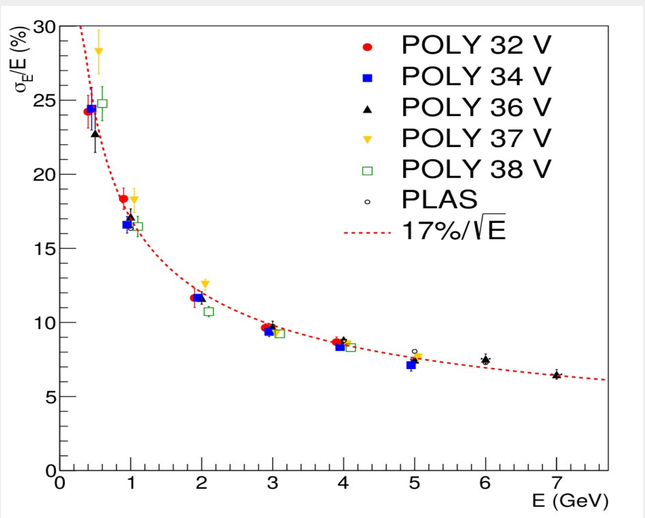
FIRST USE IN HEP, ELASTOMETRIC MATERIAL WITH INTERESTING PROPERTIES:
- **SUPERIOR RADIATION HARDNESS:** TRANSPARENT AFTER 10 KGY DOSE EXPOSURE)
- **EASIER FABRICATION PROCESS:** INITIAL LIQUID FORM POURED AT 60°.
NO DRILLING OF THE SCINTILLATOR.
- **GOOD OPTICAL CONTACT WITH FIBERS.**





PROTOTYPE TESTED AT CERN (PS-T9)
- 12 UCMS: 3 (BEAM DIRECTION) X 2 X 2
- ACTIVE LAYER 3 TIMES THICKER: 15 MM
COMPENSATE 30% LOWER LIGHT YIELD W.R.T. EJ200
- ENERGY RESOLUTION: **17% / $\sqrt{E(GEV)}$**
COMPARABLE WITH PLASTIC SCINTILLATOR BASED PROTOTYPE
- GOOD LINEARITY: < 3% IN THE 1-5 GEV
- FIBER-SCINTILLATOR COUPLING AFTER POURING IS COMPARABLE TO THAT OBTAINED FROM INJECTION MOLDING OF CONVENTIONAL SCINTILLATORS



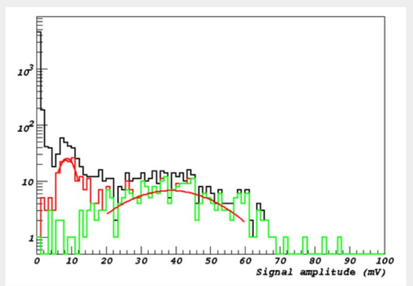


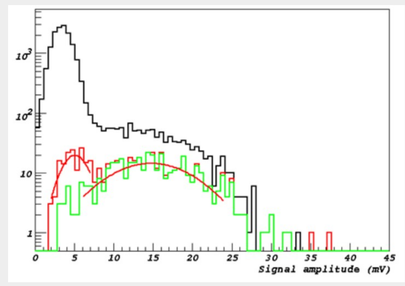
TEST OF SIPM RADIATION-HARDNESS

IN ENUBET, THE USE OF COMPACT CALORIMETRIC MODULES IS A VERY EFFECTIVE SOLUTION BUT RESULTS INTO EXPOSING THE SIPMs TO FAST NEUTRONS PRODUCED BY HADRONIC SHOWERS.

-VAN DE GRAAFF CN ACCELERATOR AT LABORATORI NAZIONALI DI LEGNARO
p (5 MeV) + ^{9}BE → N + X (p CURRENTS < 1 μA, n -> 1-3 MeV)
- TEST BEAM @ CERN PS-T9

- **LOSS OF SINGLE P.E SENSITIVITY AFTER** $3 \cdot 10^9$ 1 MeV-EQ n/CM^2
- **CONSTANT MIP-PEAK/E-PEAK**: GAIN LOSS RECOVERED WITH AN INCREASED OVER-VOLTAGE.





MORE INFORMATION: ENUBET.PD.INFN.IT

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- **A HIGH PRECISION NEUTRINO BEAM FOR A NEW GENERATION OF SHORT BASELINE EXPERIMENTS**, F. ACERBI ET AL. E PRINT: ARXIV:1901.04768

-**IRRADIATION AND PERFORMANCE OF RGB-HD SILICON PHOTOMULTIPLIERS FOR CALORIMETRIC APPLICATIONS** F. ACERBI ET AL. ARXIV:1901.08430 [TO APPEAR IN JINST]

-JINST 13 (2018) P01028 ARXIV:1801.06167, **TESTBEAM PERFORMANCE OF A SHASHLIK CALORIMETER WITH FINE-GRAINED LONGITUDINAL SEGMENTATION**. G. BALLERINI ET AL.

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