Em Calorimetry in KLOE

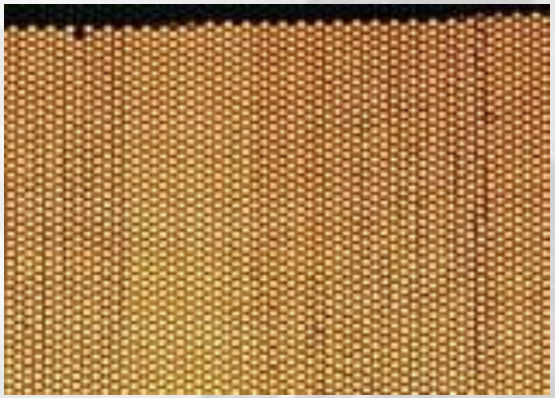
Sergio Bertolucci
University of Bologna and INFN

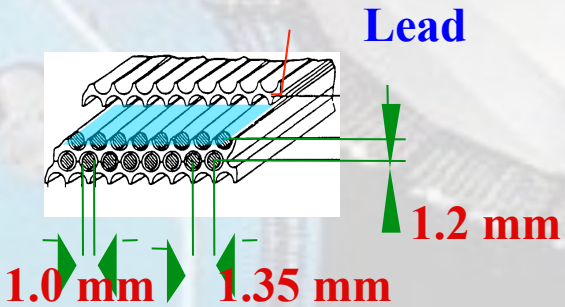
The KLOE calorimeter

KLOnE
KLOe Neutron Efficiency

Pb - scintillating fiber sampling calorimeter:

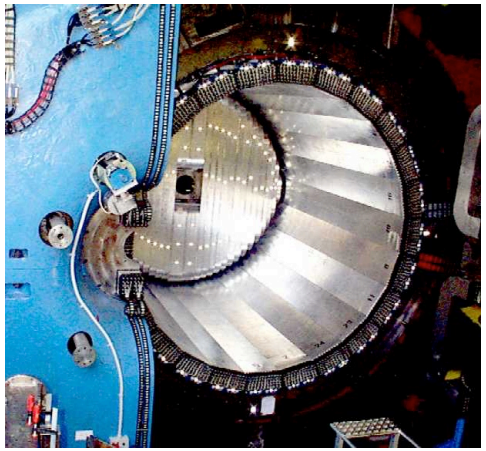
- 1 mm diameter sci.-fi. (Kuraray SCSF-81 and Pol.Hi.Tech 0046)
  - Core: polystyrene, ρ =1.050 g/cm^3, n=1.6, λ_{peak} ~ 460 nm
- 0.5 mm groved lead foils
- Lead:Fiber:Glue volume ratio = 42:48:10
- X_0 = 1.6 cm ρ=5.3 g/cm^3
- Calorimeter thickness = 23 cm
- Total scintillator thickness ~ 10 cm

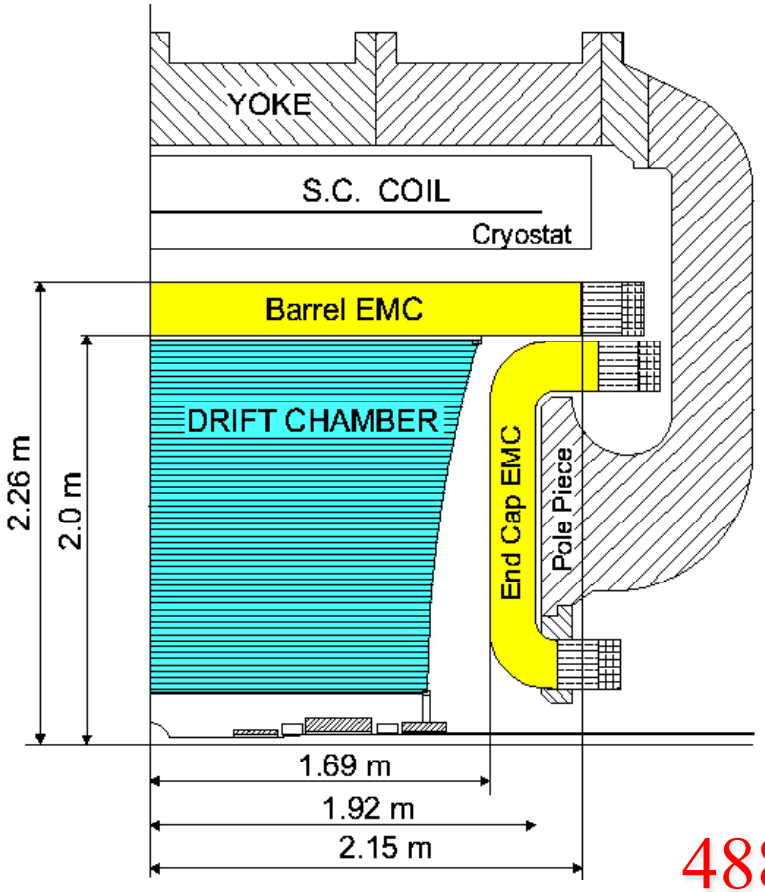




Electromagnetic calorimeter

24 barrel modules
60 cells (5 layers)
4.3m length

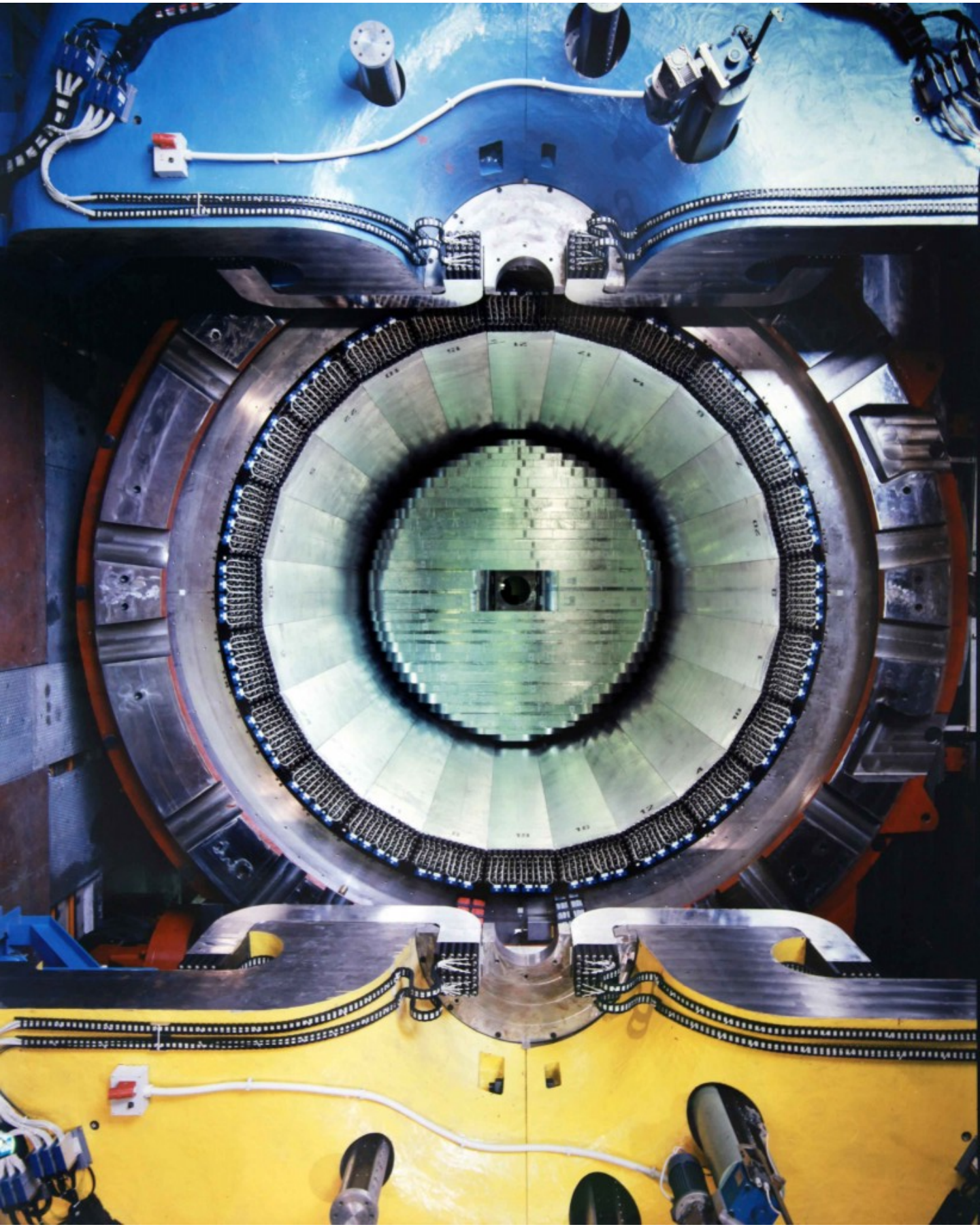




2 × 32 endcap modules
10/15/30 cells

2440 cells total

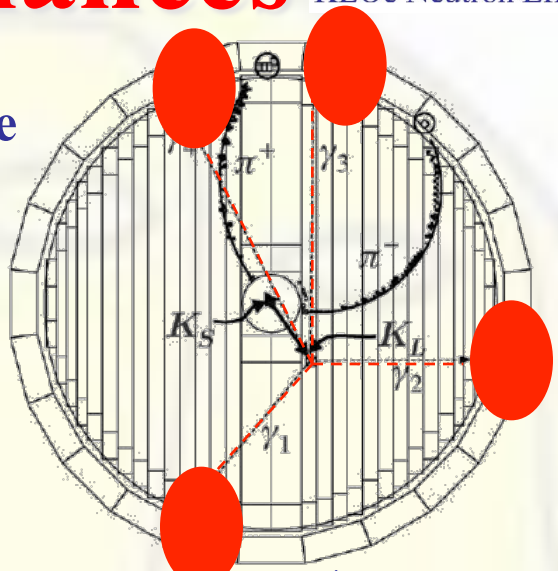
4880 channels



Calorimeter performances

KLOnE
KLOe Neutron Efficiency

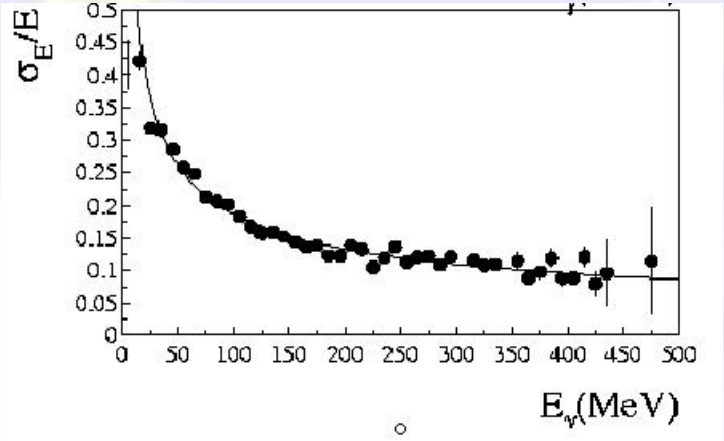
- Operated from 1999 to now with good performance and high efficiency for electron and photon detection, and also good capability of $\pi/\mu/e$ separation



$(\phi \rightarrow K_S K_L;\ K_S \rightarrow \pi^+\pi^-;\ K_L \rightarrow 2\pi^0)$ → 4γ

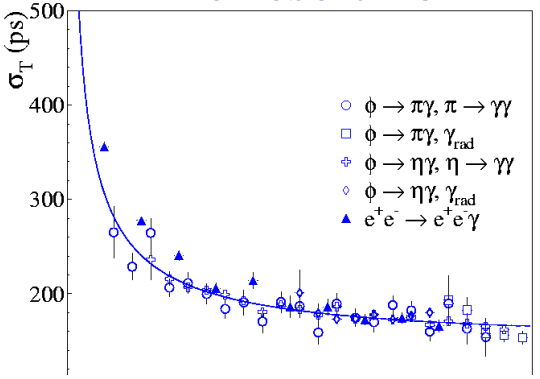
Energy resolution:

$\sigma_E/E = 5.7\%/\sqrt{E(GeV)}$



(see KLOE Collaboration, NIM A482 (2002),364)

Time resolution



$\sigma_t = 54\ ps/\sqrt{E(GeV)} \oplus 50\ ps$

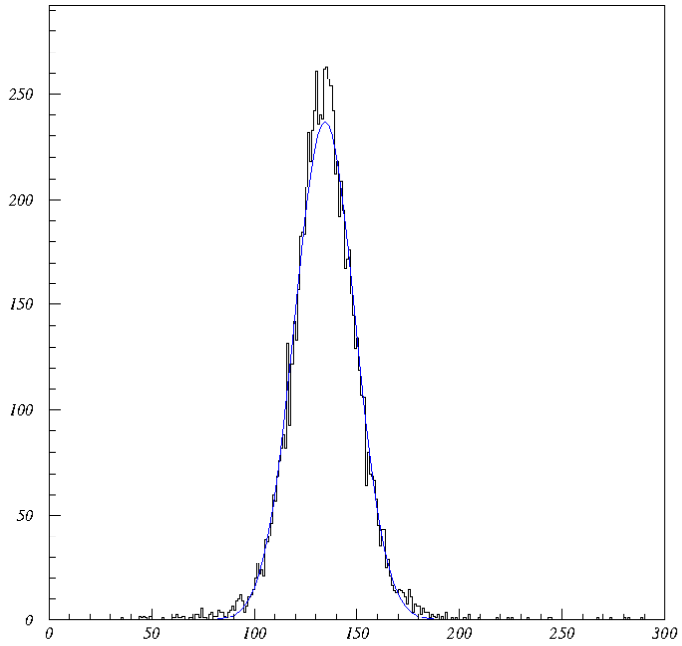
EMC mass reconstruction

$\phi \rightarrow \pi^+\pi^-\pi^0$

$M(\pi^0 \rightarrow \gamma\gamma)$

$M = 134.5$ MeV

$\sigma_M = 14.7$ MeV



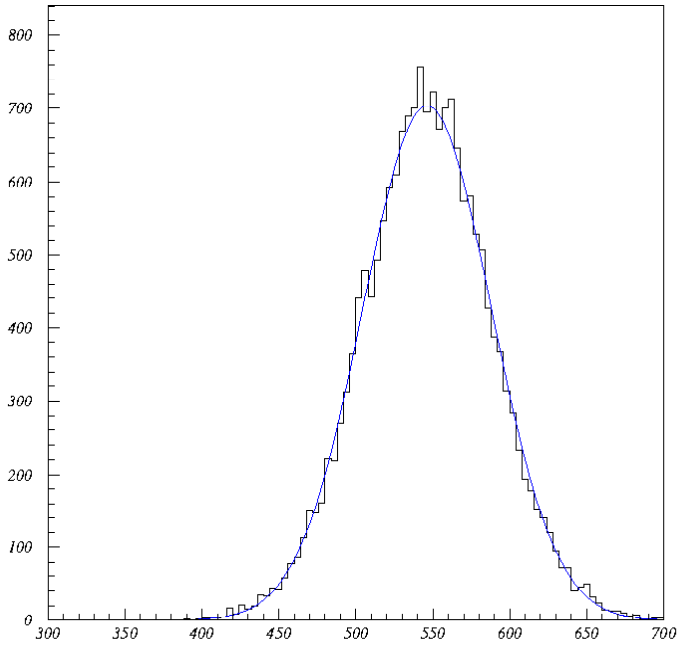
MeV

$\phi \rightarrow \eta\gamma$

$M(\eta \rightarrow \gamma\gamma)$

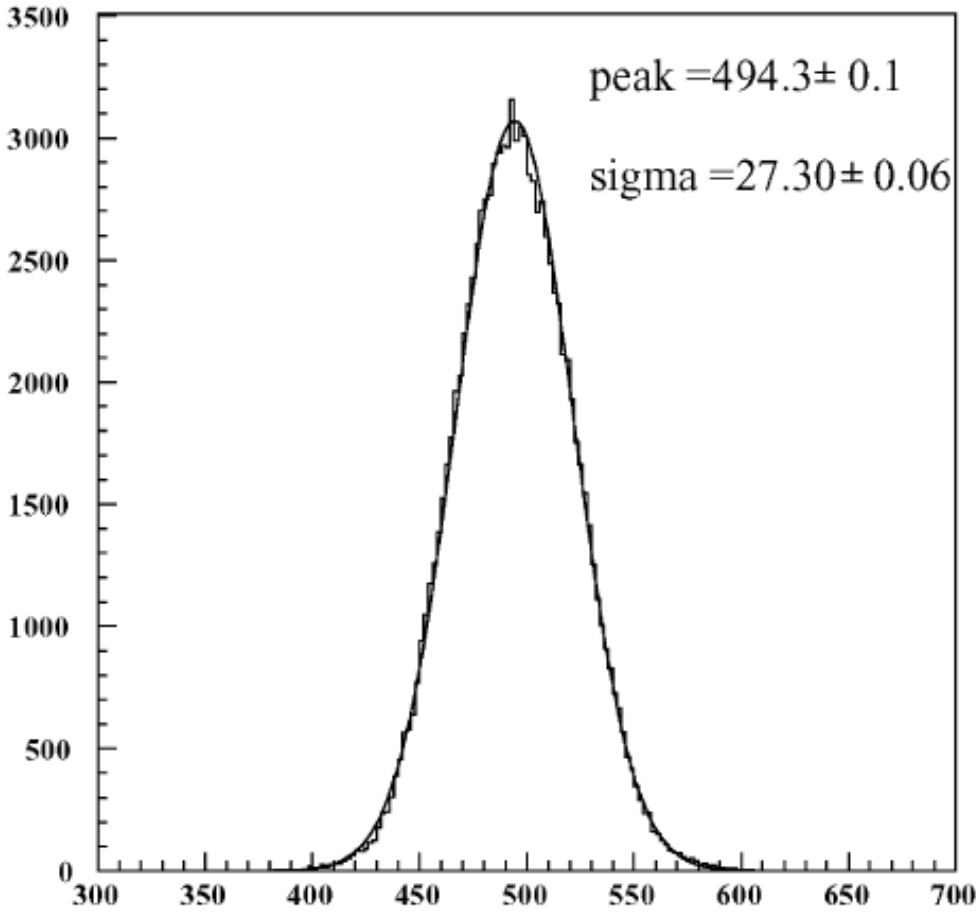
$M = 546.3$ MeV

$\sigma_M = 41.8$ MeV



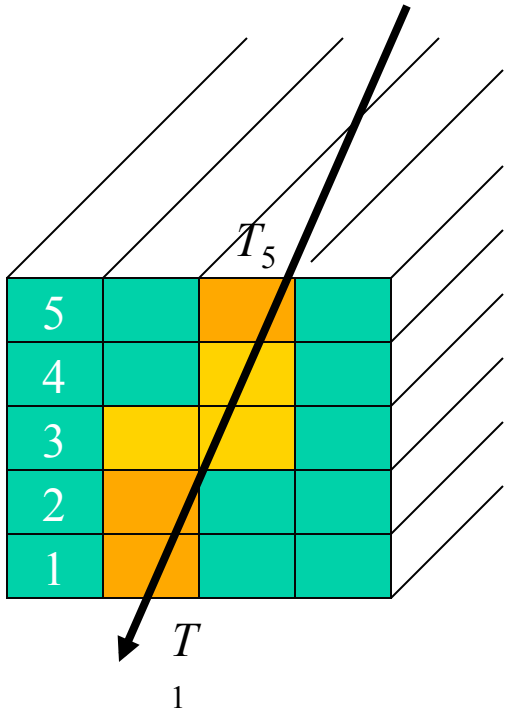
MeV

EMC mass reconstruction



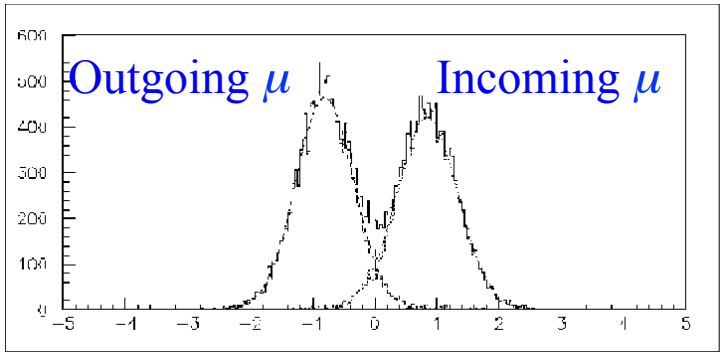
K_S mass from photon energies in $K_S \to \pi^0\pi^0$ events.

EMC time-of-flight measurement



T_1-T_5 distribution can distinguish incoming/outgoing μ's

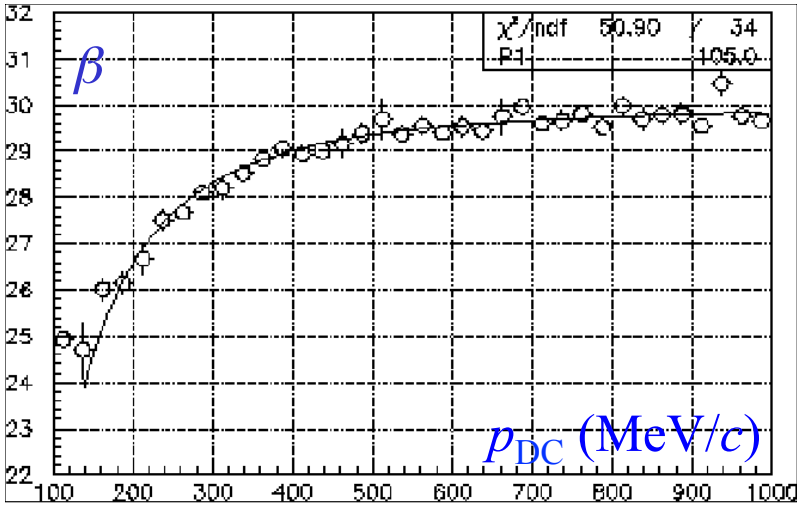
Used to reject cosmic rays



μ mass from TOF

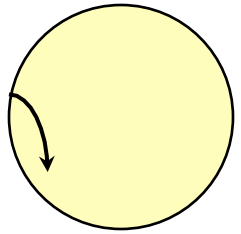
Fit to β vs p_{DC} gives

$m_\mu = 105$ MeV/c^2

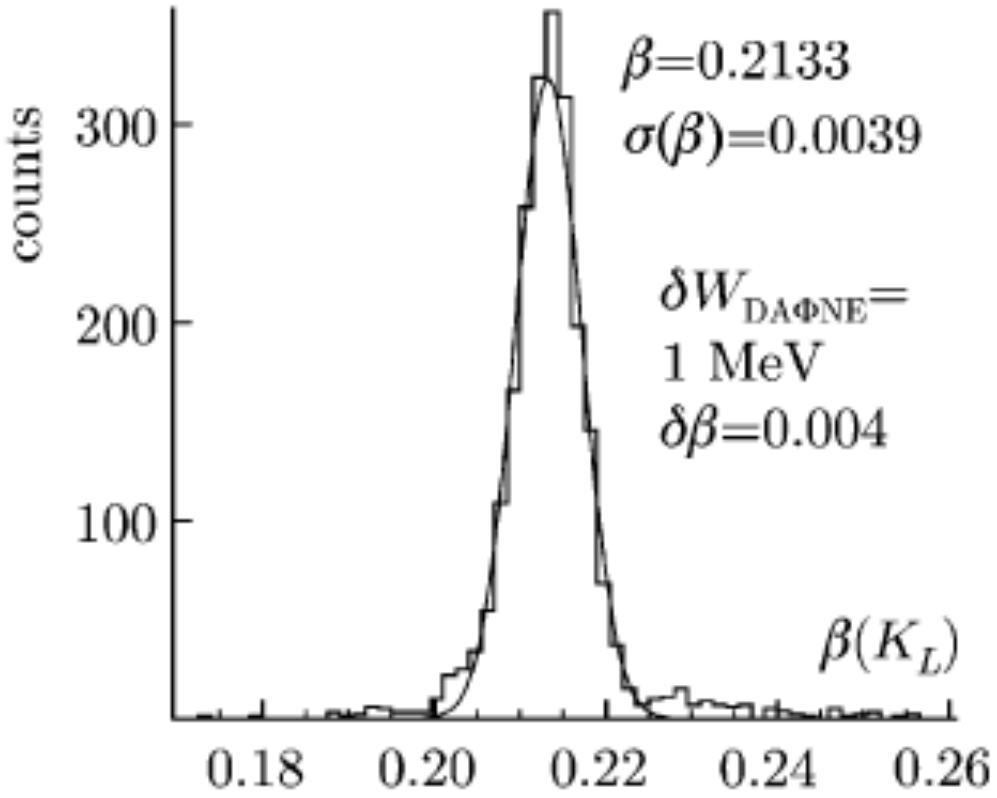


$\beta = L/\Delta T$

L from DC



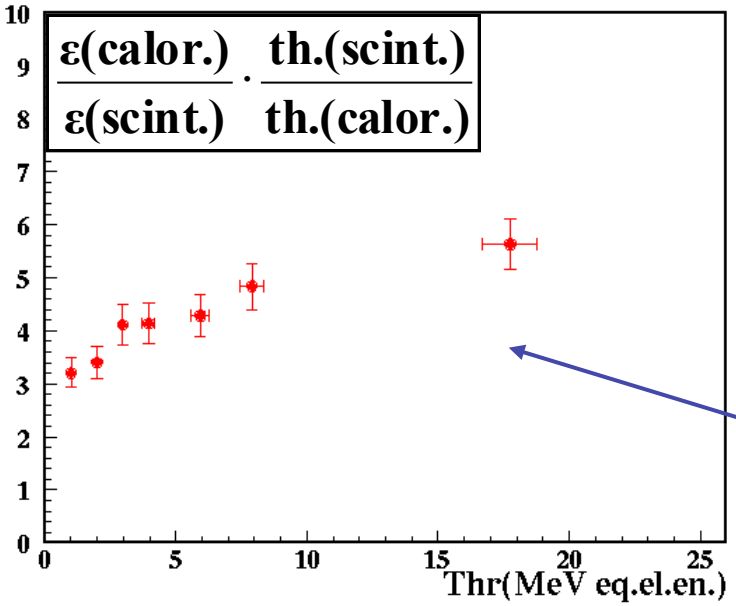
EMC timing performances

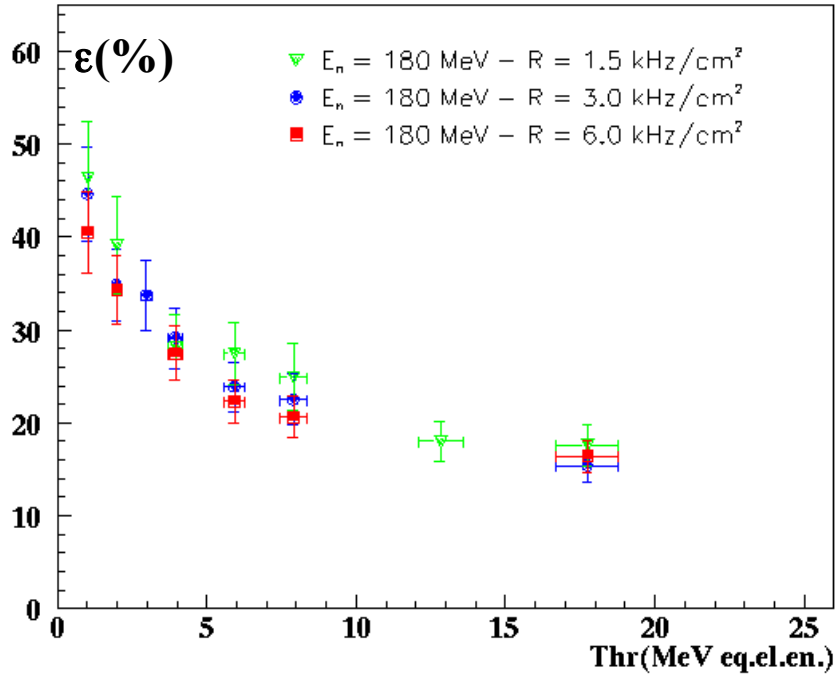


β of K_L interacting in the calorimeter

Neutron efficiency

- E_{peak} = 180 MeV
- Stable for different run conditions
- Very high efficiency w.r.t. the naive expectation (~ 10% @ 2 MeV thr.)





Comparison with our scintillator normalized to the same active material thickness

ND study

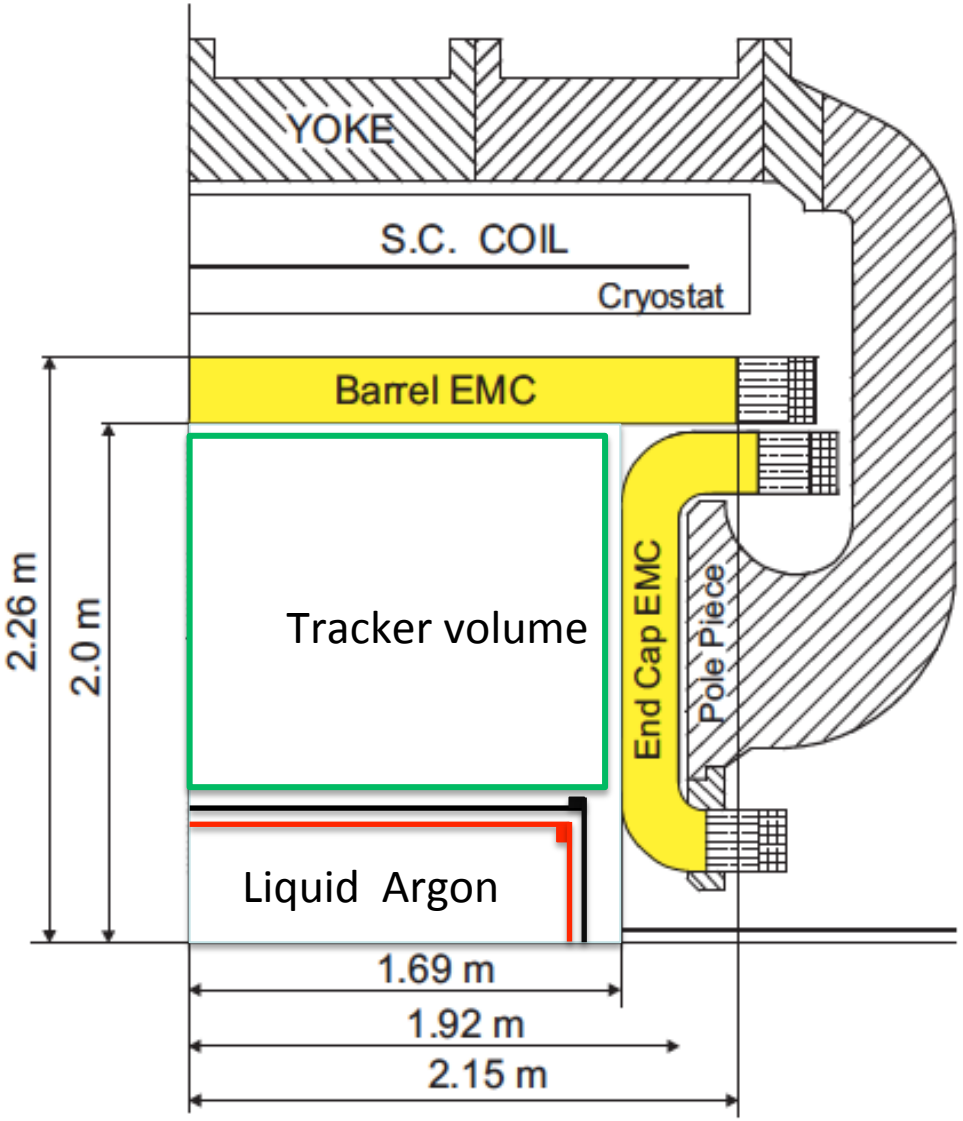
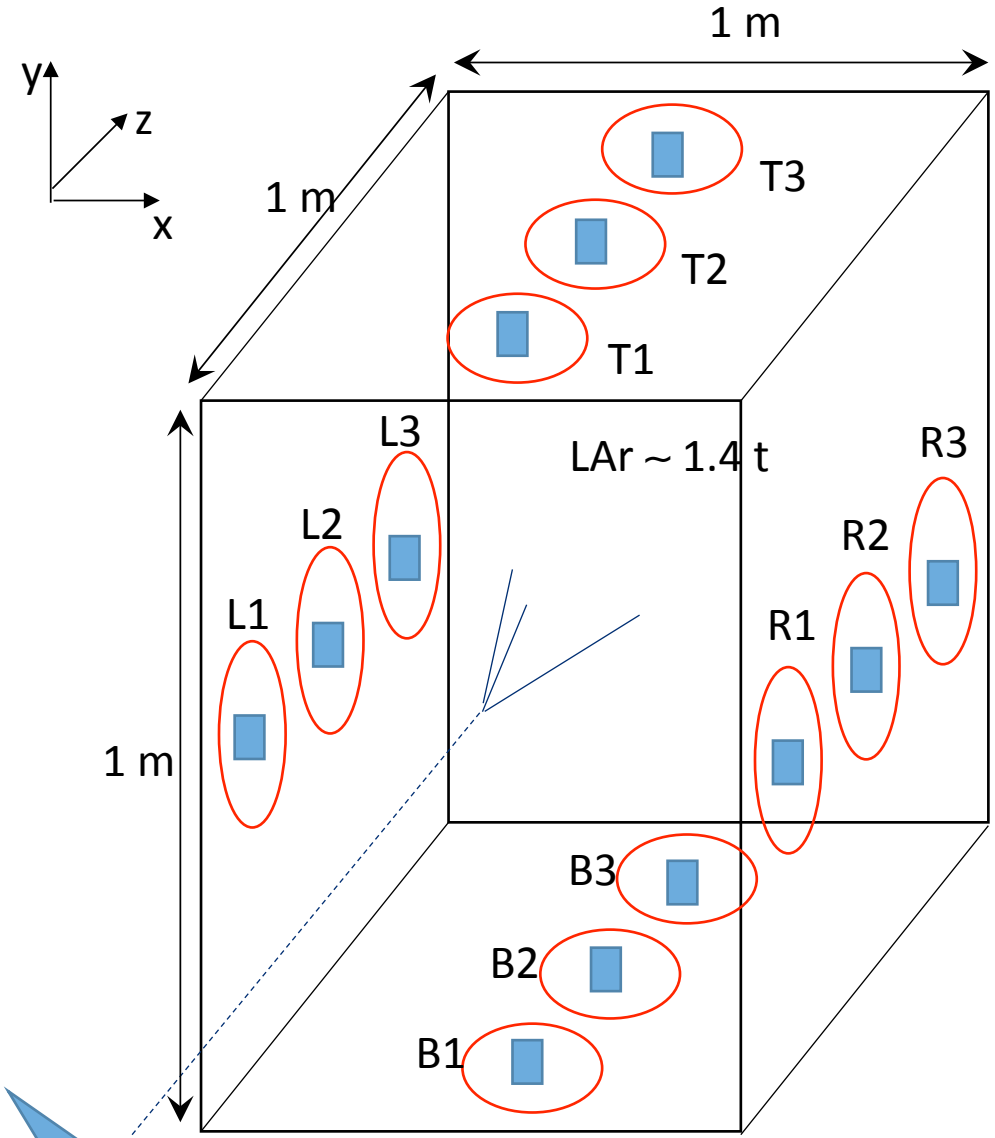
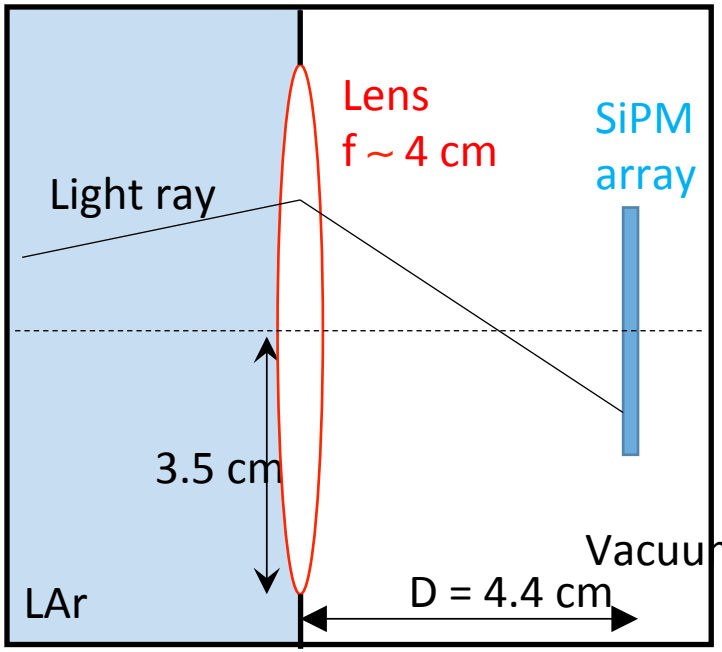


Figure 1: Schematic view of the KLOE detector

R&D on a new detector concepts

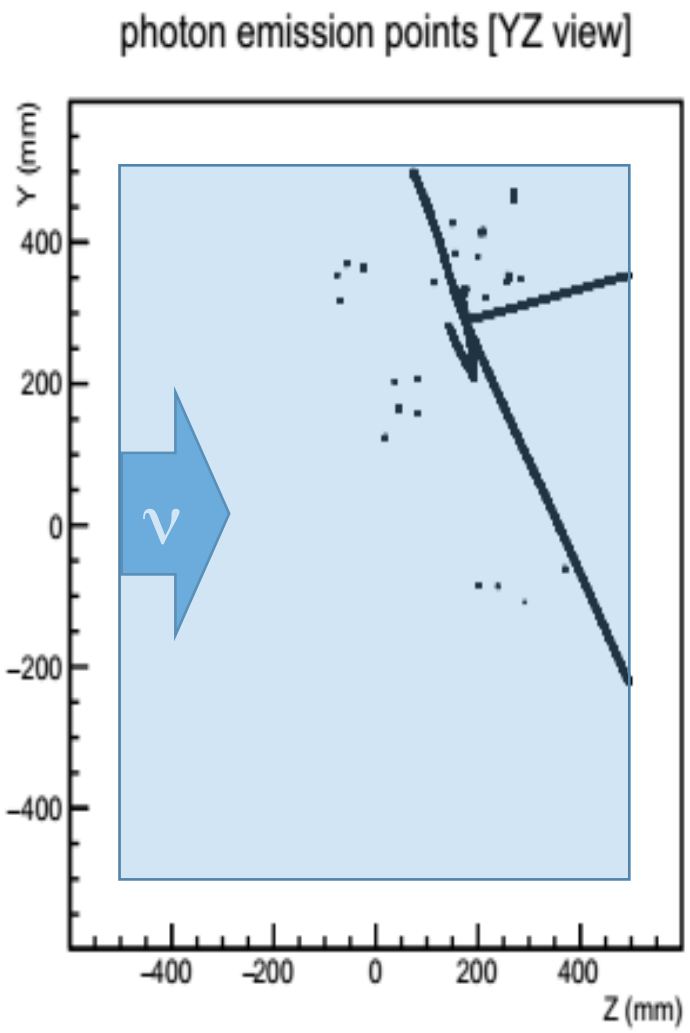


Lens + SiPM array

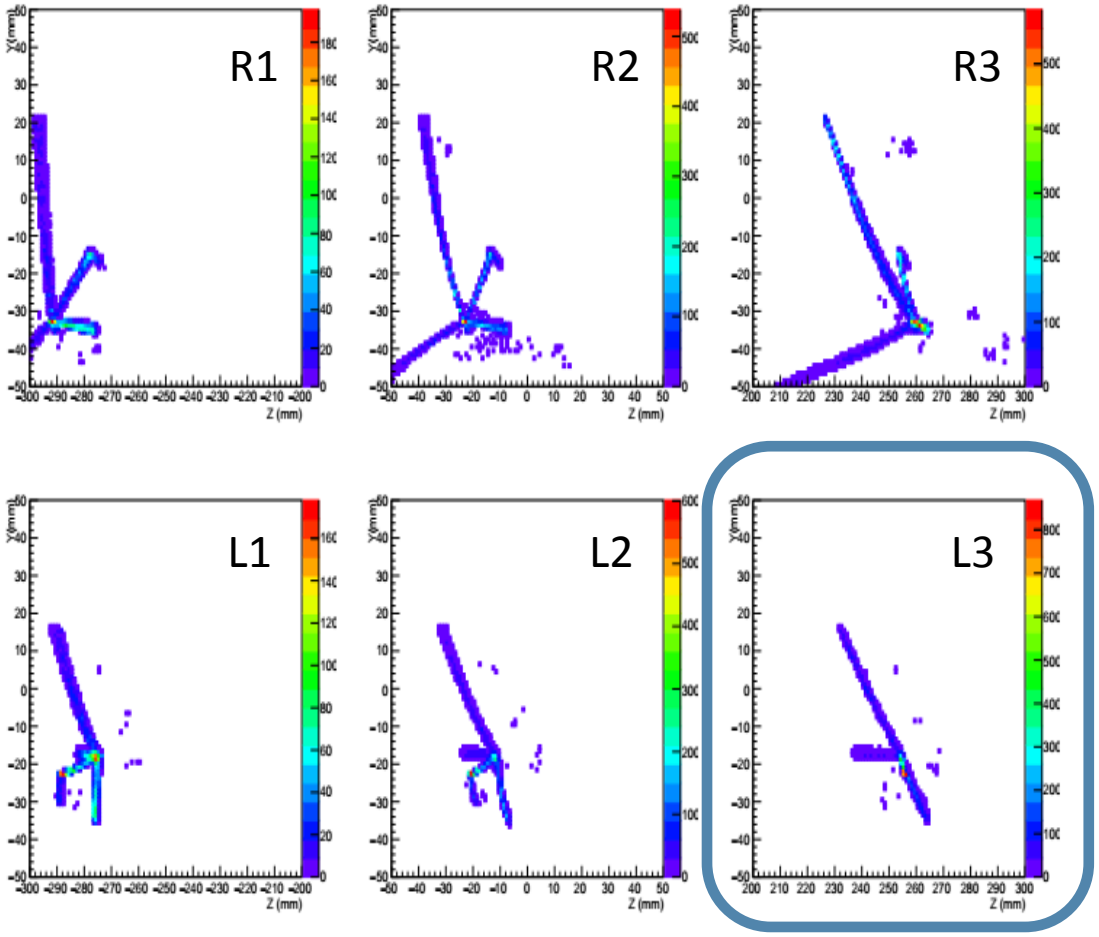


Matteo Tenti
Nicoletta Mauri
Michele Pozzato

Example: ν_μCC with E_ν = 2.44 GeV [YZ view]



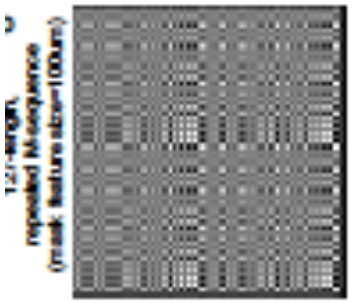
n. of photons/SiPM



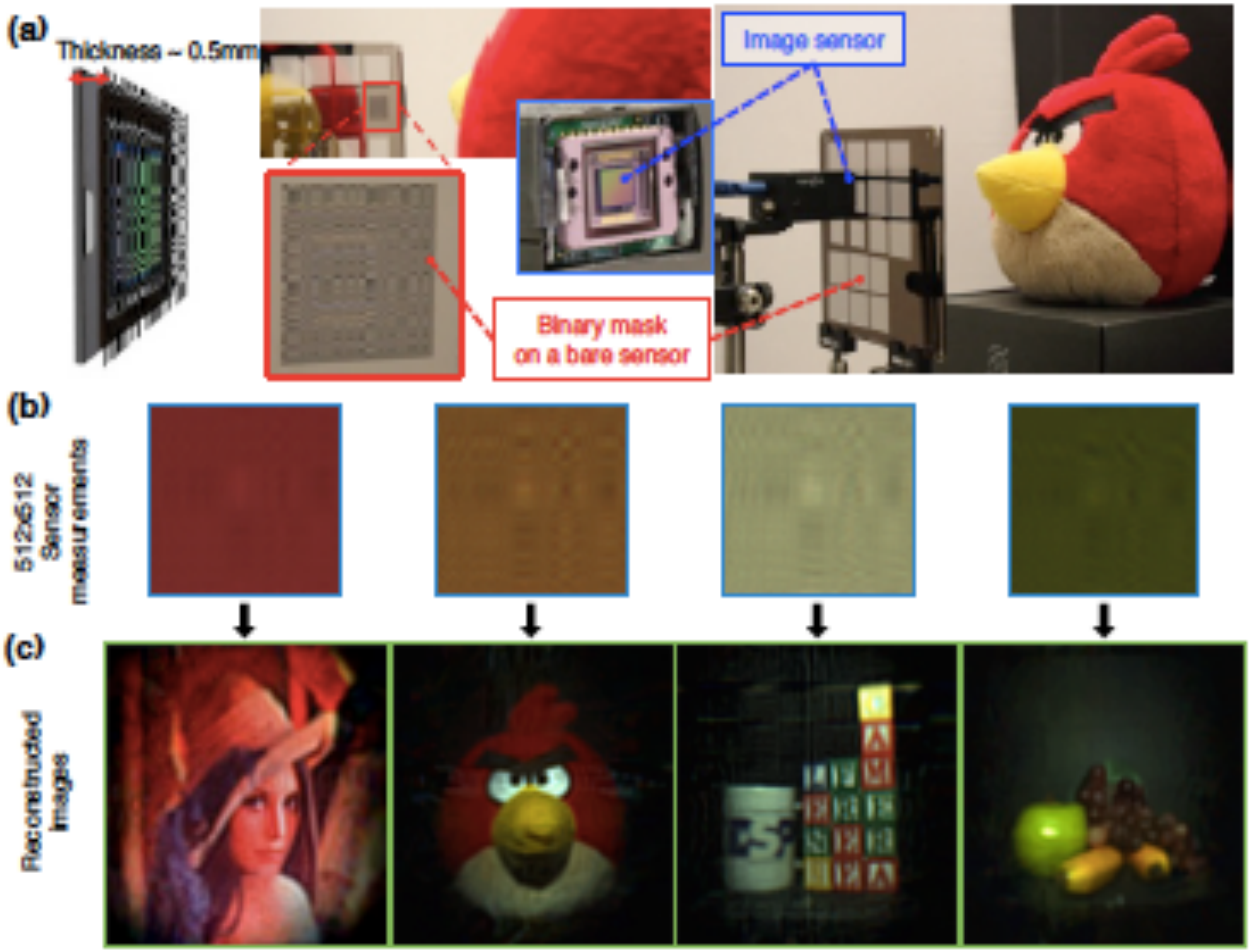
SiPM size: 1 x 1 mm^2

Distance between lens and SiPM plane: 4.4 cm

Coded Aperture Imaging



MURA mask



M. Salmnan Asif et al
arXiv:1509.00116

Underway or in the near future

- Detailed simulation studies of the ND concept
- Detailed simulations of the LAr detector with optical readout
- Construction of a demonstrator
- Continue R&D for smaller feature SiPMs
- Data driven assessment of the aging of the KLOE calorimeter in the last 20 years.
- Assessment of the lifetime cycle of the KLOE Coil (with Oxford Instruments)

THANK YOU