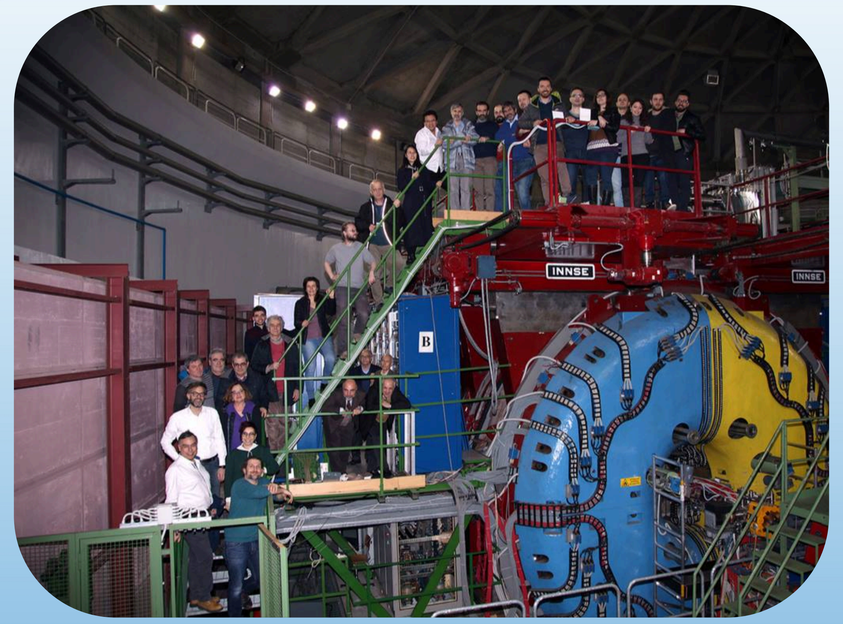
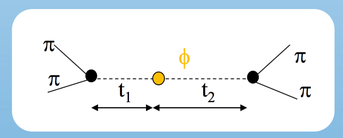
KLOE-2 THESIS PROPOSALS
LABORATORI NAZIONALI DI FRASCATI

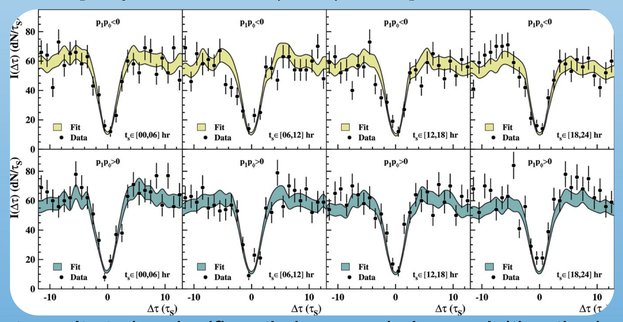
The KLOE-2 experiment just completed its data taking campaign at the upgraded e^+e^- DAϕNE collider of the INFN Laboratori Nazionali di Frascati, collecting more than 5 fb^{-1} at the center of mass energy of the ϕ-meson. KLOE-2 physics program is mainly focused on K_S, η and η′ meson rare decays as well as on Kaon Interferometry, Fundamental Symmetry tests and Physics Beyond the Standard Model, including searches for new exotic particles that could constitute the Dark Matter.



Towards testing Quantum Mechanics with neutral kaons at KLOE-2

A unique feature of the ϕ-factory is the production of neutral kaon pairs in a pure quantum state so that we can study quantum interference effects and tag pure monochromatic K_S and K_L beams. The neutral kaon doublet is one of the most intriguing systems in nature.
The entanglement in the neutral kaon pairs produced at the DAϕNE ϕ-factory is a unique tool to test discrete symmetries and the basic principles of quantum mechanics, strongly motivating the experimental searches for violation of CPT symmetry and Lorentz invariance which would unambiguously signal a New Physics framework.
Using the decay $\phi \to K_S K_L \to \pi^+\pi^-\pi^+\pi^-$ the most precise measurements in the quark sector of the Standard Model Extension was obtained with 1.7 fb^{-1} of data collected by the KLOE experiment [Phys. Lett. B730 (2014) 89-94]





KLOE-2 additional 5 fb^{-1} integrated luminosity will allow present results to be significantly improved also exploiting the insertion of a dedicated GEM-based tracking detector. KLOE-2 is indeed the first high-energy experiment using GEM technology with a cylindrical geometry, a novel detector developed at LNF exploiting kapton properties.
Both neutral kaons will decay within few cm from the interaction point, therefore detector performance in terms of spatial resolution and its stability along data taking are essential to better isolate signal selection and improve signal to background rejection. Activity will include dedicated algorithms to select 4-pion final states and the measurement of tracking and vertexing performance by studying event topologies and signatures in the KLOE-2 detector.
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Hadron Physics at KLOE-2

Radiative decays of the ϕ-meson will provide the largest data set of η meson: 3×10^8 will be produced in 8 fb^{-1}. This data will be used to improve existing limits on η violating modes and the knowledge of η decays in four charged particles.
With about 2.4×10^{10} ϕ-meson collected by KLOE and KLOE-2 collaborations, the data sample is the largest of its type in the world. The first evidence of the $\phi \to \eta\pi^+\pi^-$ and $\phi \to \eta\mu^+\mu^-$ decays are expected at KLOE-2. Currently, both decays have been searched by the CMD-2 experiments, that set an upper limit of:
$BR(\phi \to \eta\pi^+\pi^-) < 1.8 \times 10^{-5}$ @ 90% C.L., $BR(\phi \to \eta\mu^+\mu^-) < 9.4 \times 10^{-6}$ @ 90% C.L.
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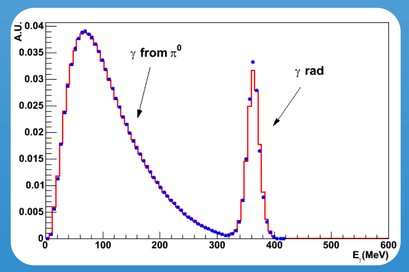

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Light dark matter searches with the KLOE-2 detector

The possibility to detect light dark matter in the sub-GeV regime through the decay of a light dark sector mediator is a unique opportunity for KLOE-2.
A possible signature of the process is the presence of events with a monochromatic photon and missing energy. KLOE-2 collected about 2 fb^{-1} integrated luminosity with a Single Photon Trigger, with tagged events selected and recorded in a special data stream.
Activity will include Monte Carlo simulation of the signal, study of advanced algorithms to suppress beam background and analysis of the streamed data.
KLOE-2 dataset could also be used to search for the B-boson, a possible mediator of Dark Matter and Standard Model (SM) particles interaction. To this extent more than 5 fb^{-1} of data are available.
The B-boson decay mimics the Standard Model known decays, therefore representing a challenge in analysis techniques to achieve a precise measurement of the upper limit on the coupling between Dark and SM sectors in the sub-GeV mass range.
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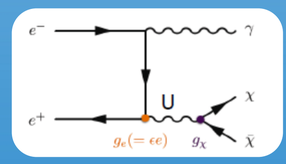
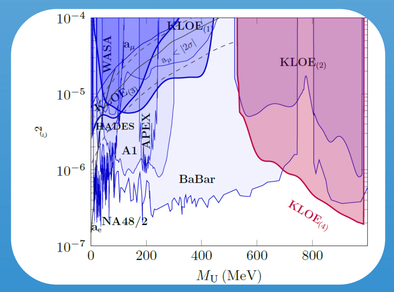


Phys.Lett. B757 (2016) 356-361



KLOE-2 Useful References:

1. **Precision Kaon and Hadron Physics with KLOE [La Rivista del Nuovo Cimento (2008), 531-623]**
2. **Physics with the KLOE-2 experiment at the upgraded DAϕNE [EPJC 68 (2010), 619-681]**
3. **KLOE-2 Workshop on e e- Collision Physics at 1 GeV [EPJ Web of Conferences Volume 166 (2018)]**