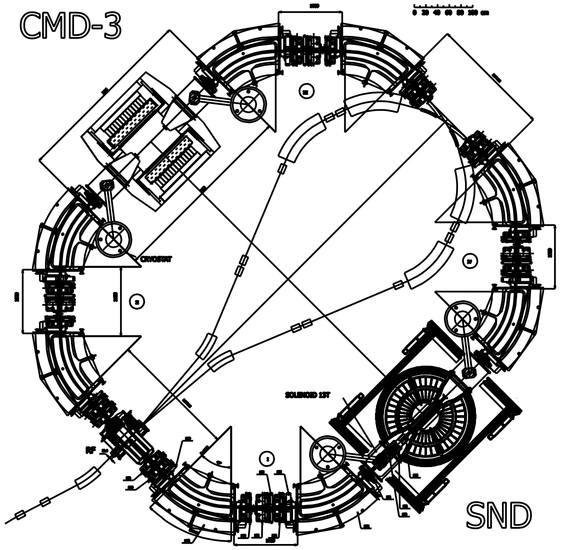
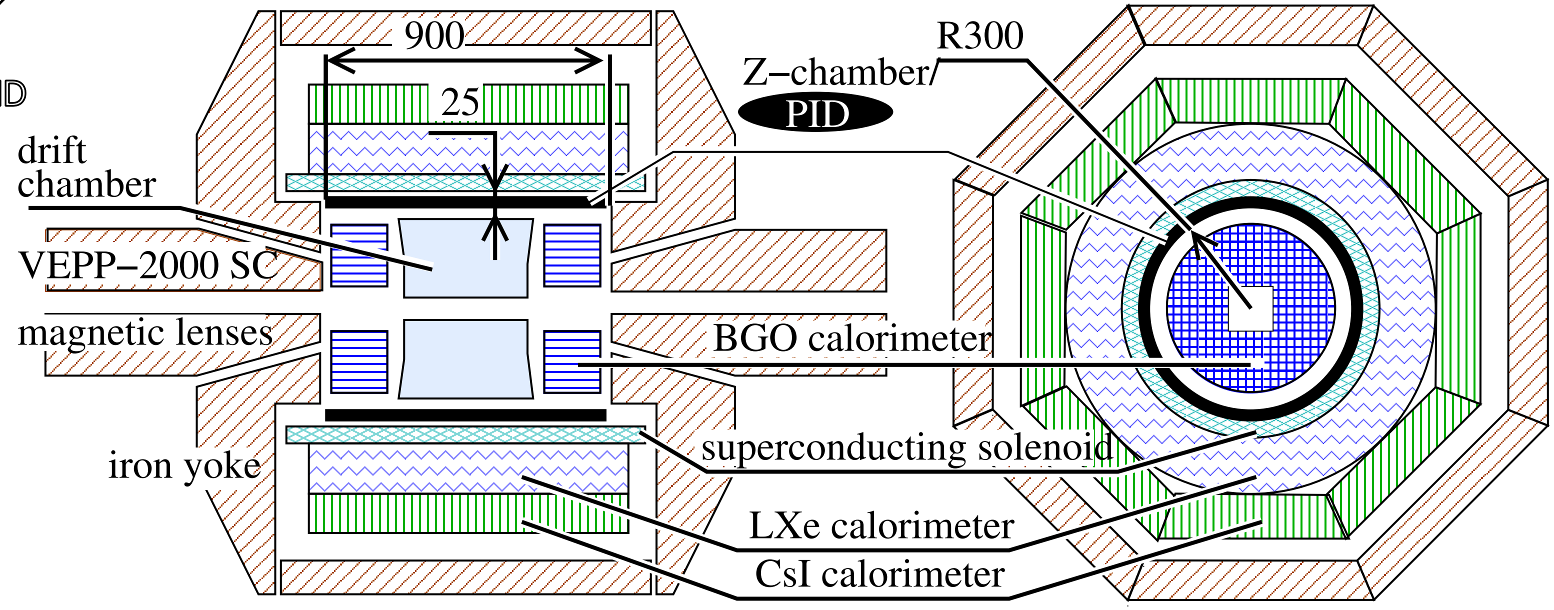
Charged kaon identification system for the CMD–3 detector

Maxim Nikulin



VEPP-2000 e^+e^- collider
at the Budker Institute of Nuclear Physics
Novosibirsk, Russia



CMD–3
magnetic
general purpose
detector

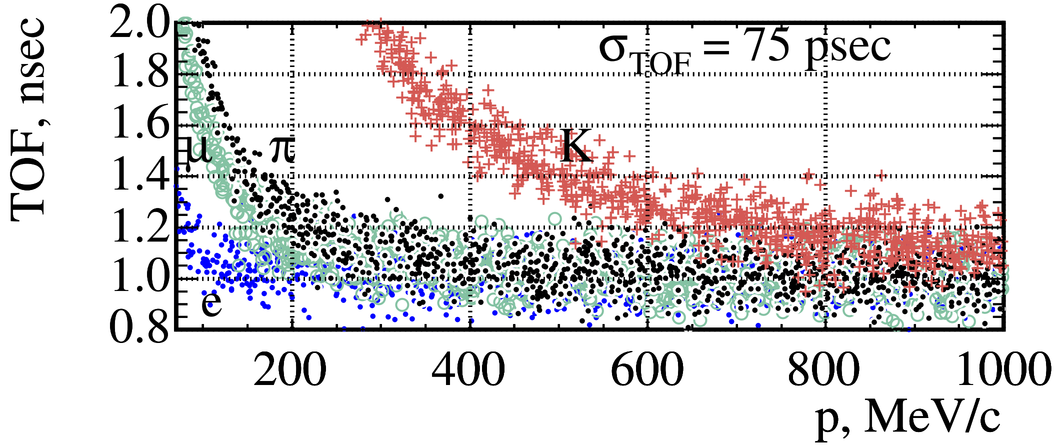
VEPP-2000 Parameters

Maximum beam energy	1.0 GeV
Luminosity	10^{32} cm^{-2}s^{-1}
Bunch dimensions	$\varnothing$125 μm $\times$ 4 cm length
Particles per bunch	16×10^{10}
Bunches per ring	1 e^+ and 1 e^-
Average beam current	300 mA each
Circumference	24 m (80 nsec period)
Interaction regions	2 (CMD–3 and SND detectors)

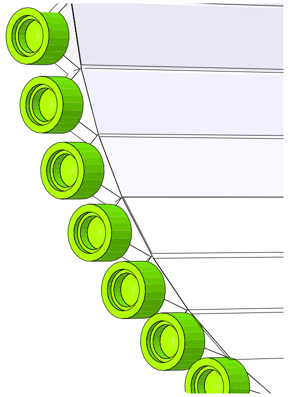
Physics program

- Precise measurements of e^+e^- annihilation cross section into hadrons (for variety of dispersion calculations, e.g. vacuum polarization and muon anomalous magnetic moment)
- QCD at low energy
- Study of ρ, ω, φ excitations, their parameters measurement

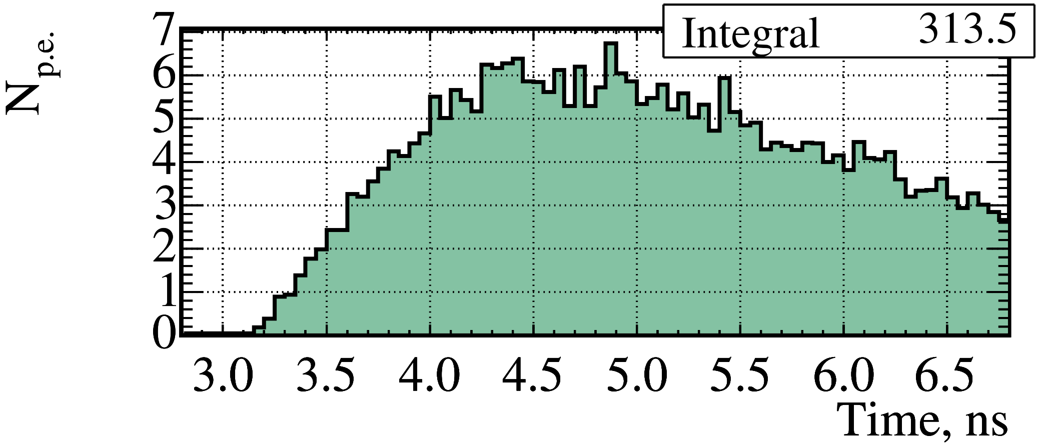
PID variant
Scintillation time of flight counters



TOF for different types of particles if their direction is perpendicular to the beam axis.

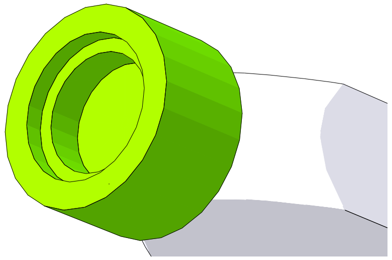


Geant4 simulation results



Distribution of the photons arrival time to the PMT

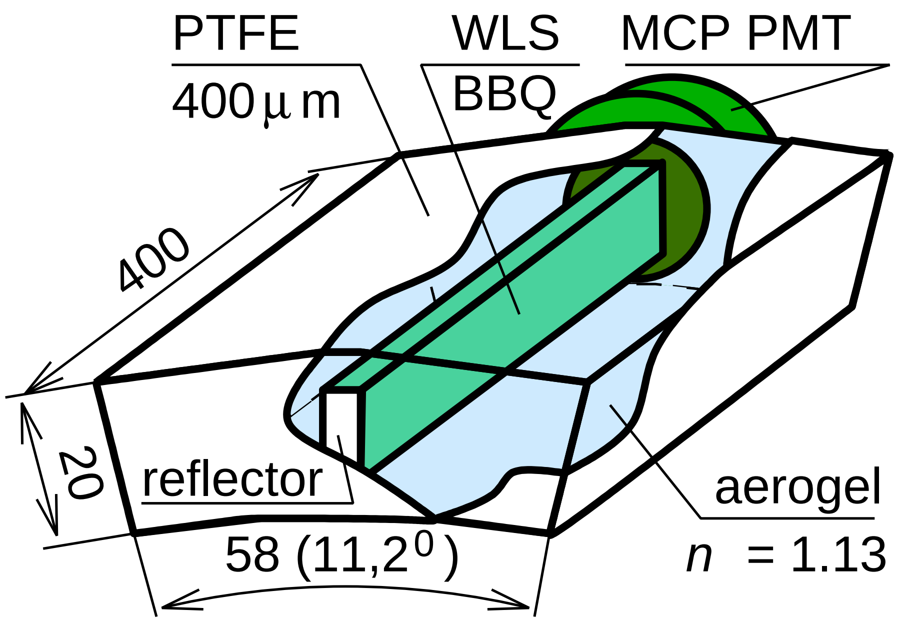
$800 \times 40 \times 2$ mm^3 BC-404 scintillator slabs (48 total).



PID variant
Aerogel Cherenkov counters with wavelength shifters

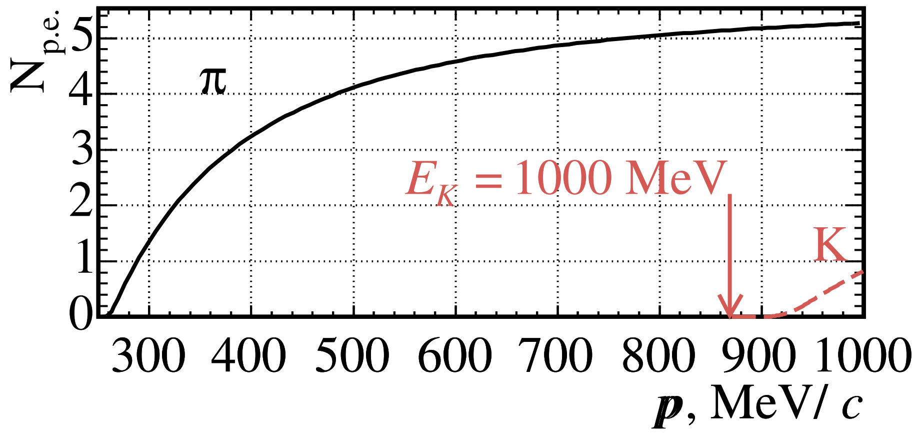
ASHIPH type, like in the KEDR detector
(*M.Yu. Barnykov et al.* Nucl. Instrum. Meth. A419: 584-589, 1998)

64 counters (2 along z and 32 φ-sectors)



Light collection efficiency simulation results

Minimal photoelectron number



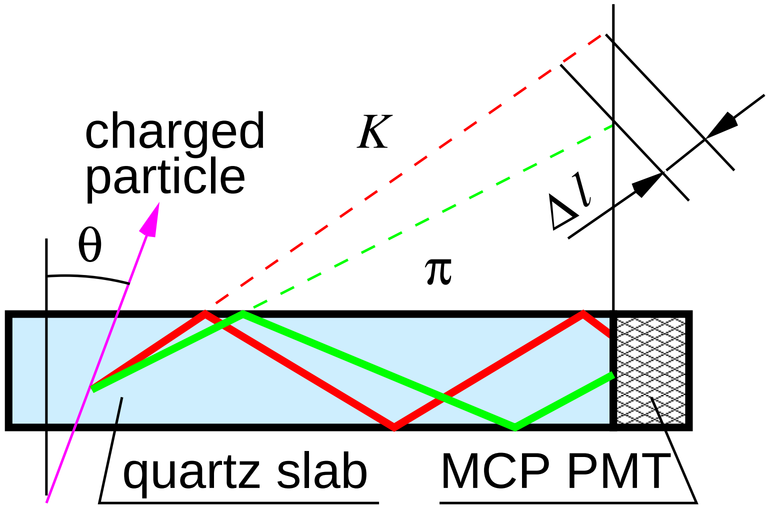
Probability (W)
to pass through a wavelength shifter
(identification inefficiency)

p, MeV/c	θ, °	W %
850	90	6,7
400	45	10,0

PID variant
Cherenkov correlated timing technique

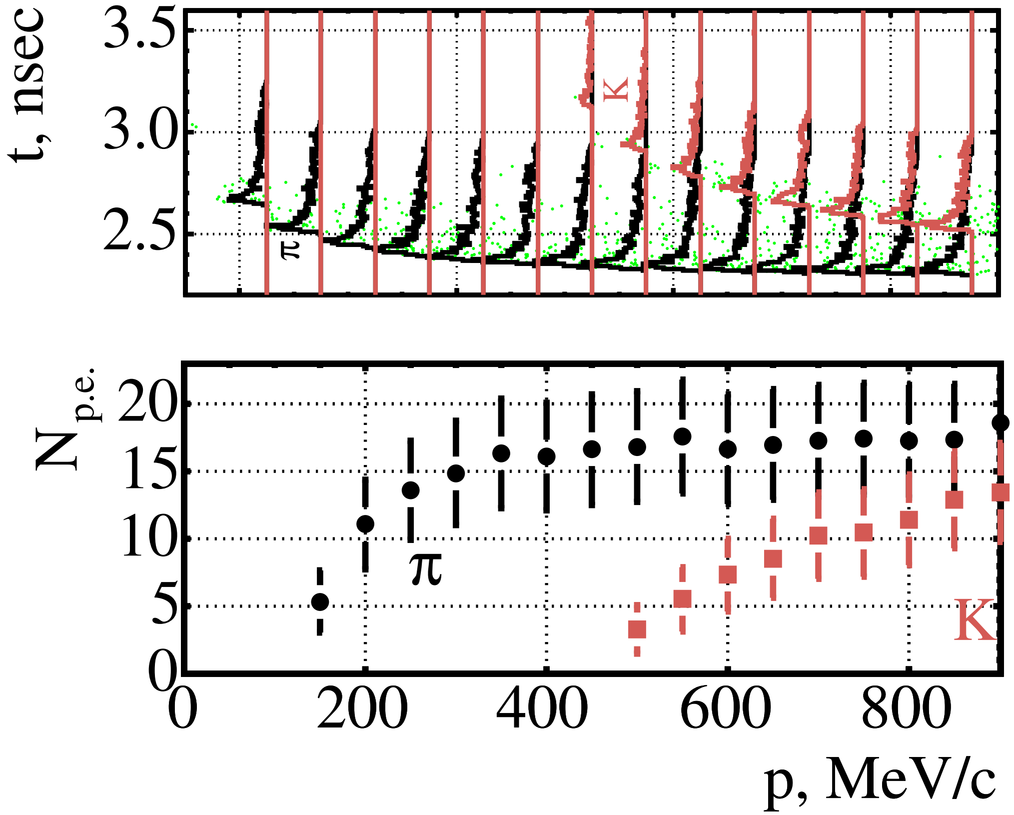
(*K. Honscheid et al.* Nucl. Instrum. Meth. A343:306-310, 1994)

Principles



Slab thickness 7 mm.

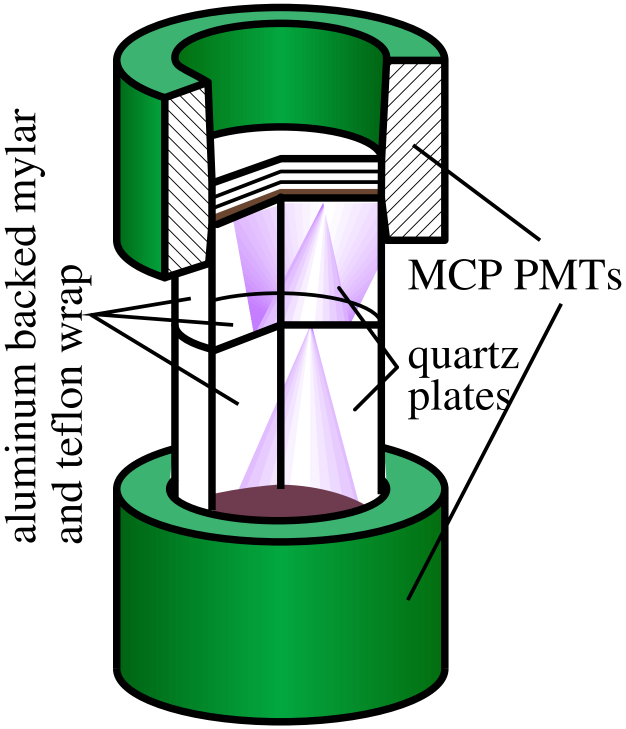
Simulation results

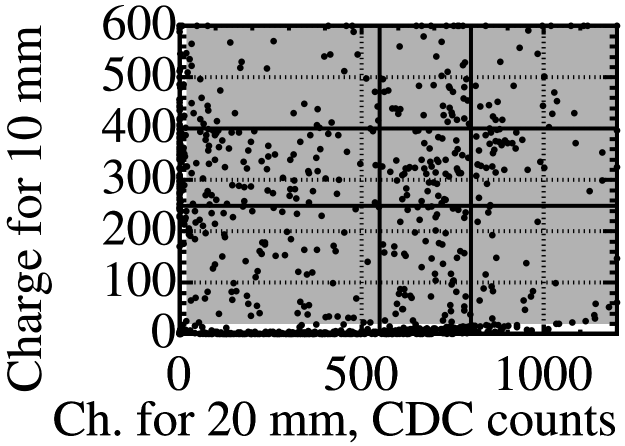


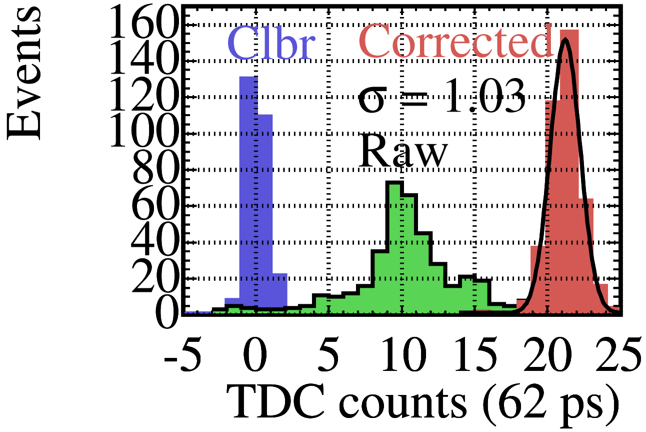
$\theta = 60^{\circ}$

Tests of microchannel plate photomultipliers

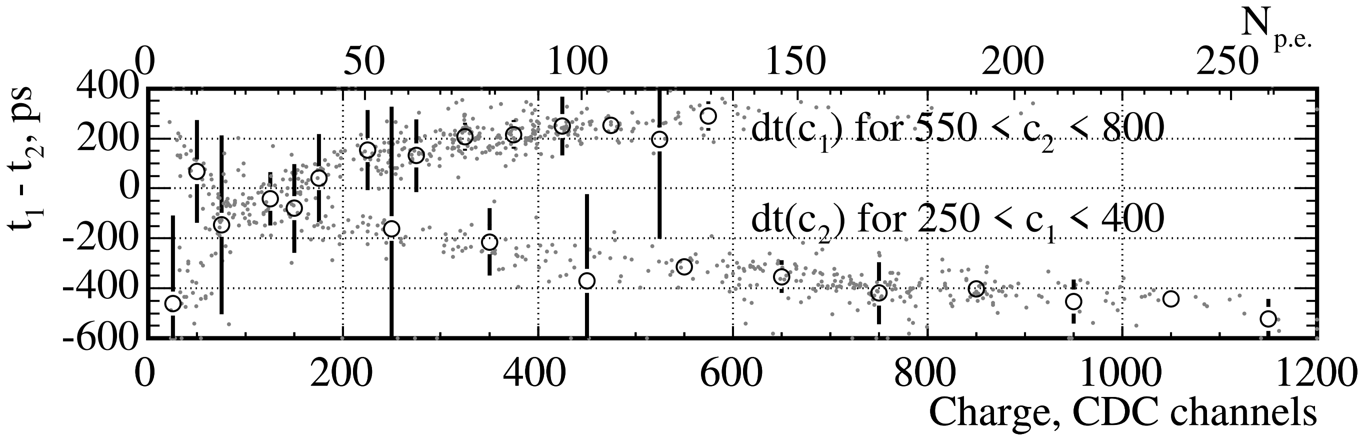
Cosmic ray muons produce Cherenkov light in the quartz plates.
Pulses form PMT's start and stop the time to digital converter.







Timewalk correction



Conclusion

- 3 PID variants are considered: TOF, ASHIPH (aerogel), CCT (quartz)
- ASHIPH: performed simulation of light collection efficiency
- TOF and CCT: simulation — photon arrival time distributions
- MCP PMT tests: resolution of about 60 psec obtained with quartz plates having thickness of 3–20 mm and scintillator samples

Plans

Simulation

- Electronic response for TOF and CCT
- δ-electrons contribution for ASHIPH and CCT

Tests

- MCP PMT resolution with Cherenkov light radiating in the PMT window
- TOF prototype
- Electronics developing and optimization