



Geant4 COMMON activity

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Outline

- Introduction
- SND2k software project
- Geant4 geometry description for SND2k
- SND2k experience, suggestions, and plans

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COMMON activity in Geant4

- Contribution to big HEP experiments ATLAS, BaBar, CMS, LHCb, and other (geometry, test beams, comparisons)
- Contribution to electromagnetic and hadronic physics
- Parallelisation for Geant4 (Northeastern University)
- Local projects

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Novosibirsk activity in Geant4

Budker Institute for Nuclear Physics, Novosibirsk

- BaBar (A.Salnikov, A.Byzukaev), ATLAS (A.Soukharev et al.), LHCb (foreseen).
- G4 electromagnetic physics (V.Ivanchenko)
- Application to R&D on medical detectors
- SND2k project
- Geant4 is installed at several local Linux clusters
- In 2001 1 diploma work was 100 % based on Geant4 application

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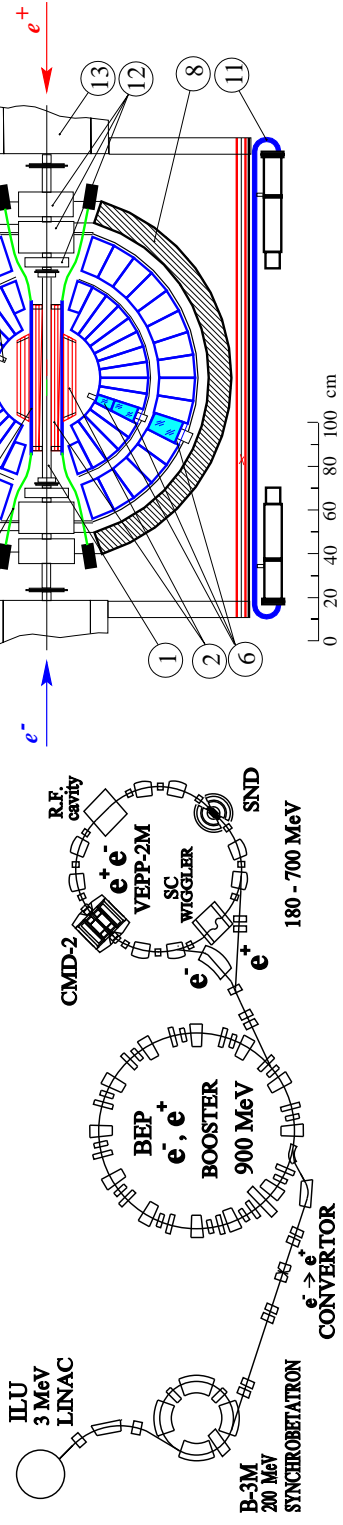
SND2k software project

*M.Achasov, A.Berdugin, D.Bukin, V.Ivanchenko, A.Korol,
L.Maximov, A.Salnikov, V.Shary*

- Main goal: to provide offline software based on OO technology for experiments at VEPP-2000 collider in Novosibirsk
- Start November 2000
- The working prototype is ready now
- The preliminary results will be at CHEP'01
- Geant4 is one of the main components of the new software

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VEPP-2M in Novosibirsk



VEPP-2M energy range $\sqrt{s} = (0.36 - 1.4) \text{ GeV}$

VEPP-2M luminosity $\sim 3 \cdot 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$

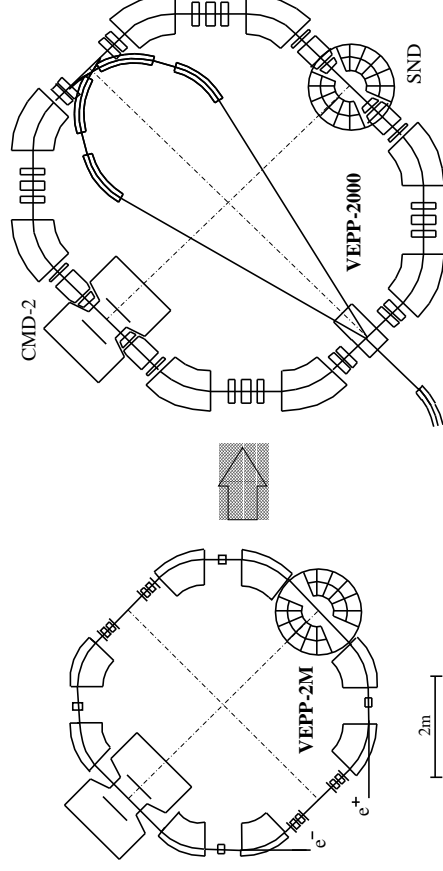
SND + CMD2 integrated luminosity $\sim 60 \text{ pb}^{-1}$

About 100 publications from 1995

Clean samples of $\gamma, e^+, e^-, \pi (\phi \rightarrow 3\pi, K_S \rightarrow 2\pi), K (\phi \rightarrow K_S K_L)$

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Project VEPP-2000



After 25 years of operation VEPP-2M is removed

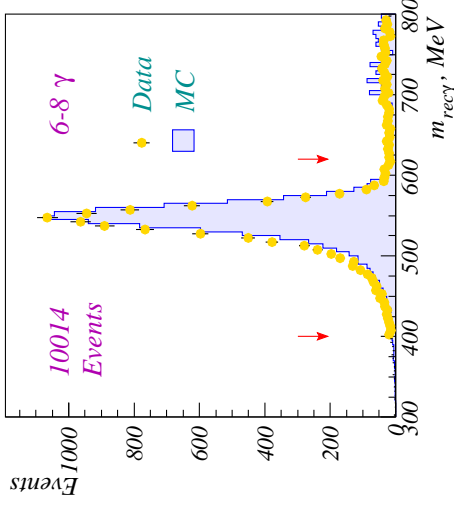
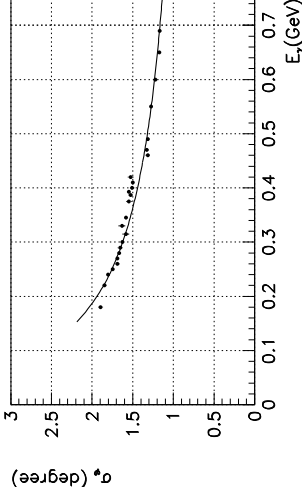
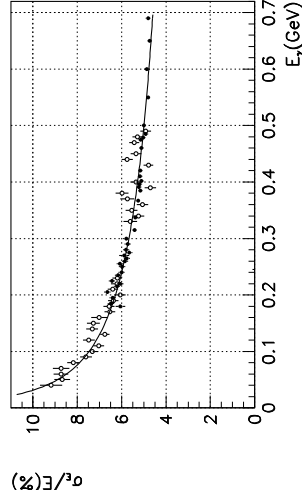
In 2000 VEPP-2000 project have been started

The energy $\sqrt{s} = (0.36 - 2.0) GeV$. The luminosity $\sim 10^{32} cm^{-2} s^{-1}$

Two detectors CMD-2 and SND. Main physics goals: hadron production cross section to 1 % level and spectroscopy

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UNIMOD2 simulation for SND



Electromagnetic physics of UNIMOD2 is equivalent to GEANT3

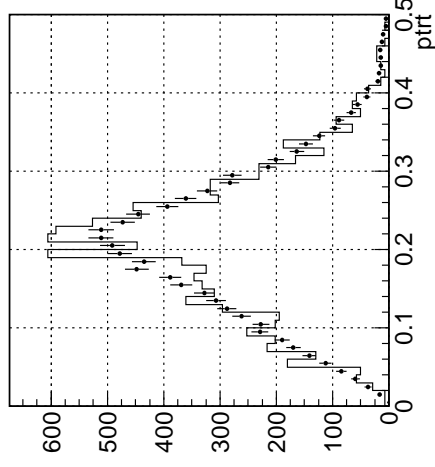
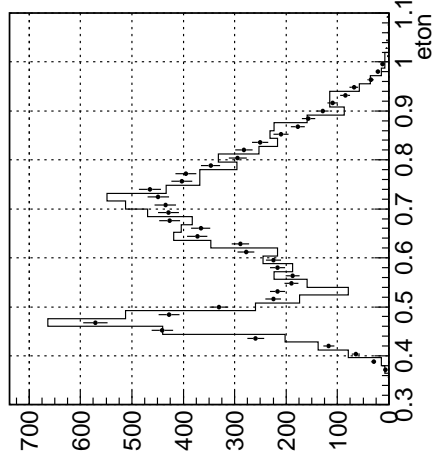
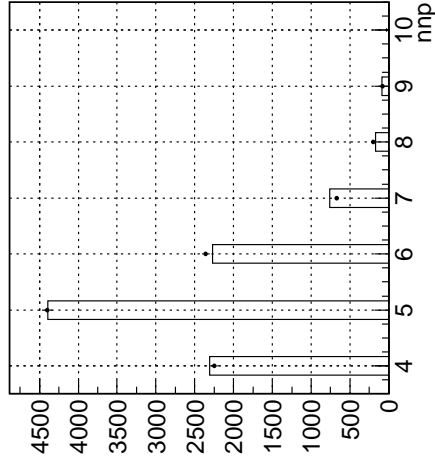
On level of 1 % it reproduce absolute value of energy deposition in

Nai(Tl) crystals

Resolution of the calorimeter is reproduced well

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UNIMOD2 simulation of $\phi \rightarrow K_S K_L$



Modified NUCRIN (part of Geant3 FLUKA package) for hadrons

Cross sections was recalculated

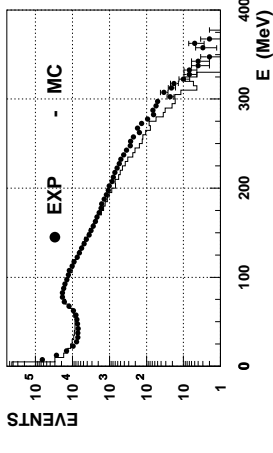
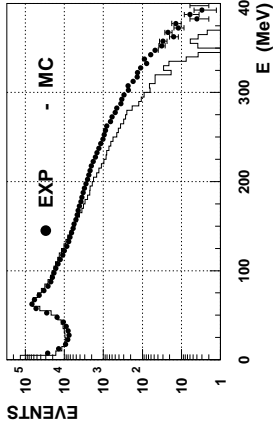
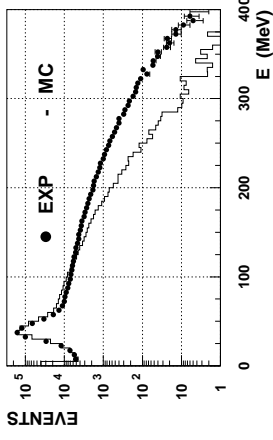
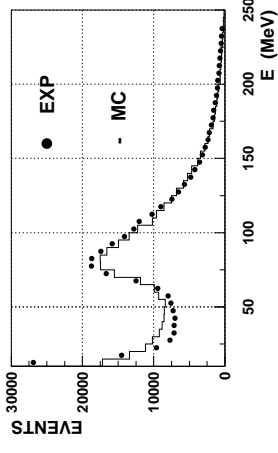
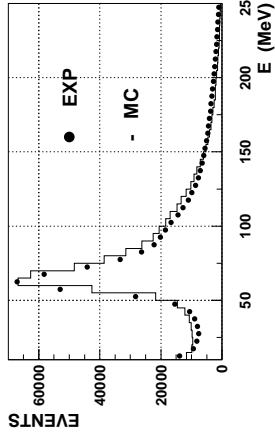
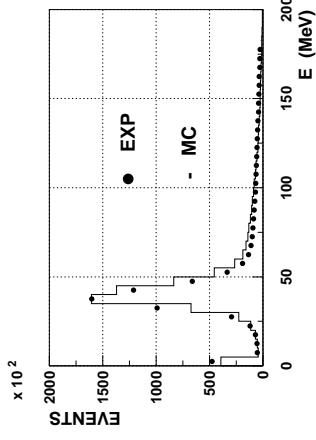
Kaon secondary production mechanism updated

Charge exchange process is included

Interaction of stopping negative particles is included

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UNIMOD2 simulation of $\phi \rightarrow \pi^+ \pi^- \pi^0$



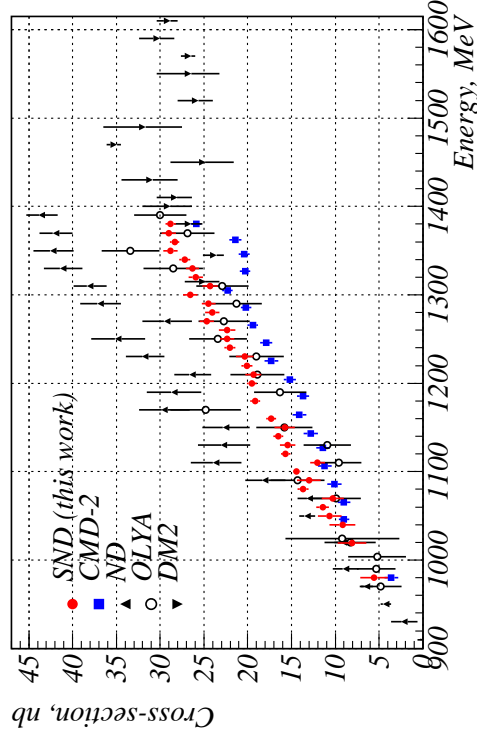
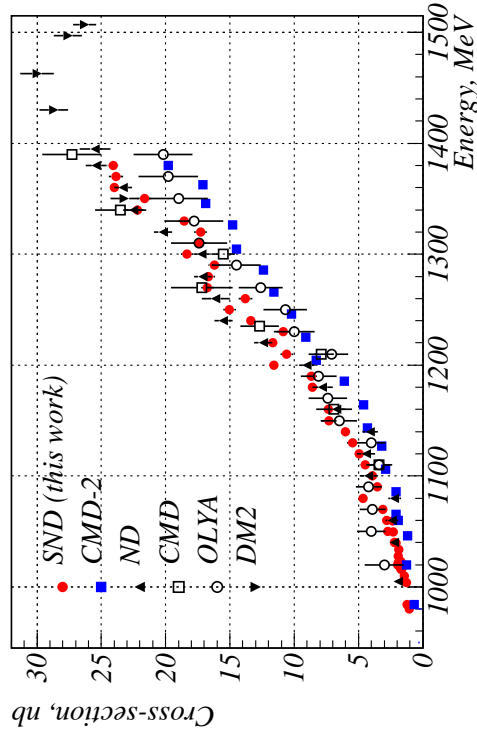
1-st Nai(Tl) layer

2-nd Nai(Tl) layer

3-d Nai(Tl) layer

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Some VEPP-2M results



$$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$$

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

Systematic uncertainty of the results are much higher than statistical ones, because hadronic simulation has not adequate accuracy

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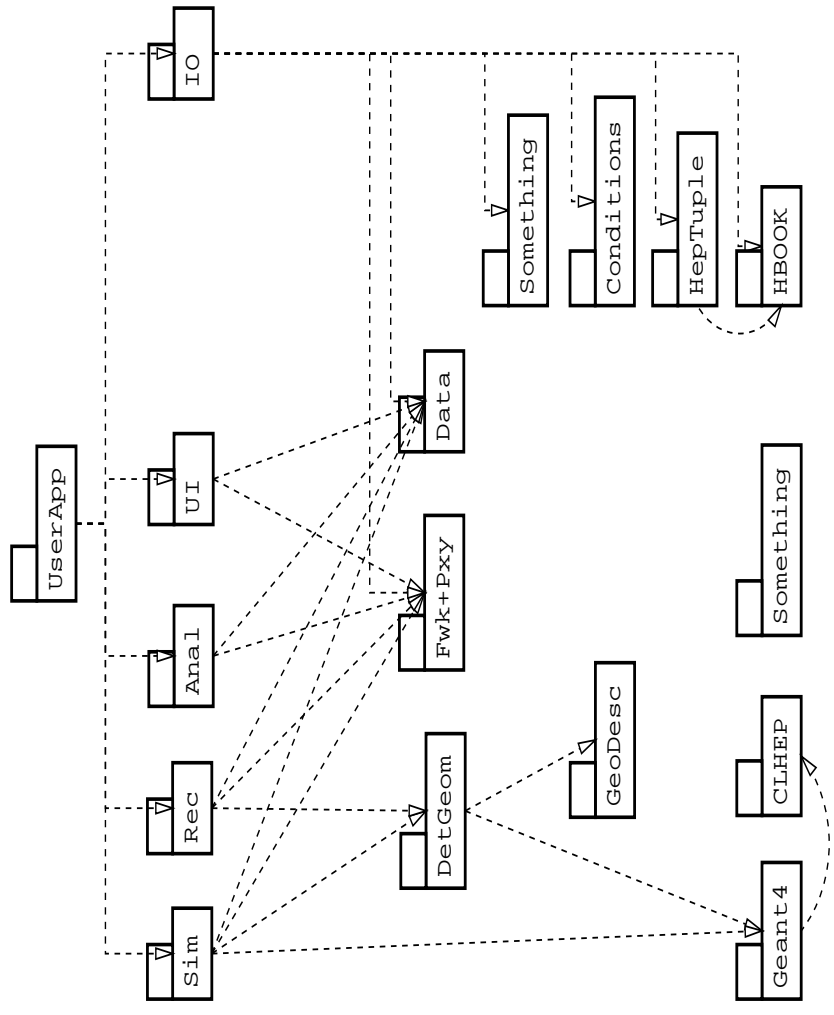
SND2k software

- Common framework for reconstruction and simulation
- Job parametrisation with high-level script
- Common detector description for reconstruction and simulation
- No dependencies on persistency and analysis
- Only licence free software

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SND2k architecture diagram

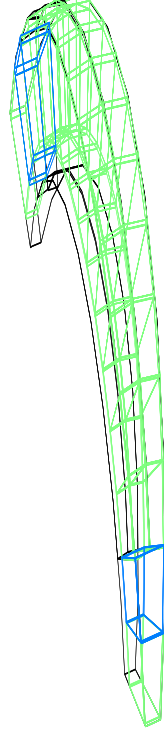
SND2K domains.
08.02.2001



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Geant4 for SND

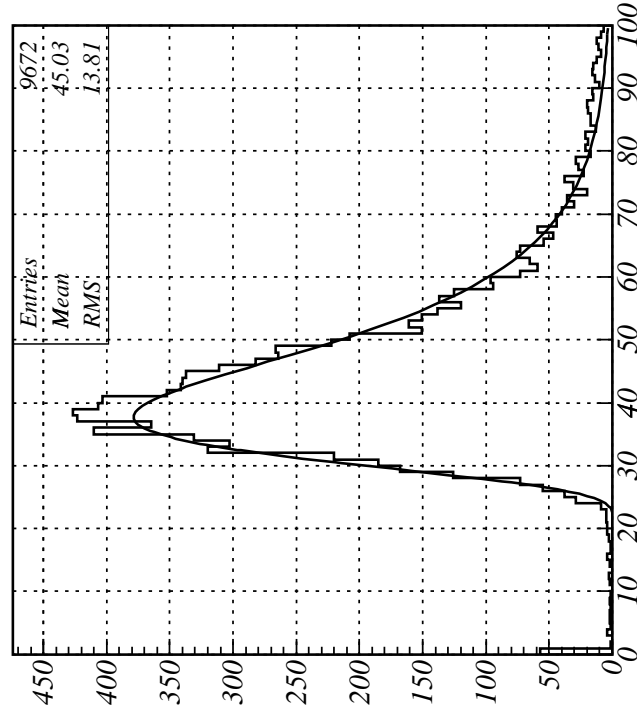
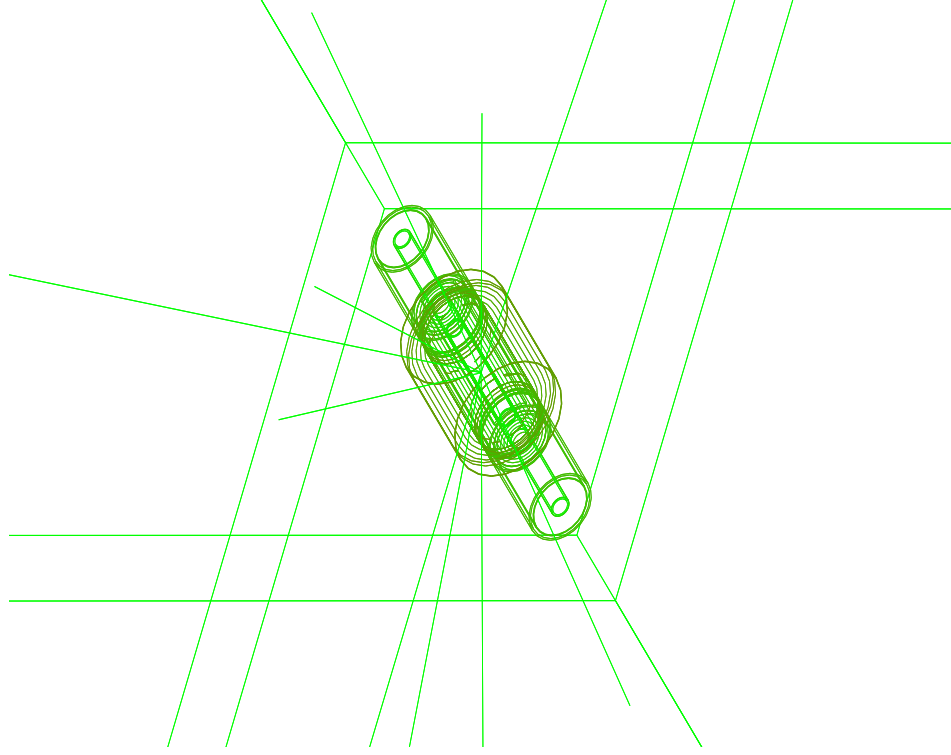
- Coordinate system and calorimeter are described
- Geometry are build using ASCII file with parameters
- **CSG** and **BREP** volumes are used
- Total number of solid and logical volumes about 100 in a contradiction with UNIMOD2 where there are about 10000



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SND geometry



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Prospects for future

- To complete geometry description for upgrade SND (aerogel counters, new coordinate system, muon identifier, dipoles and quadruples of the collider)
- Detail comparison between Geant4, UNIMOD2, and data for electromagnetic physics in order to test geometry and to choose Geant4 parameters
- Comparison between Geant4 and the data of the real experiment for pions and kaons

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Our experience/ suggestions

- Students can easily download Geant4 with or without minimal help from G4 experts
- Students do not want to study any FORTRAN packages but very well accept Geant4
- The robastic tool to debug geometry is required
- The parameter maximum energy in the job can be introduced for all particles
- The different cuts for different subdetector are required
- The short write-up (Geant4 menu) will be very useful for application developers

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