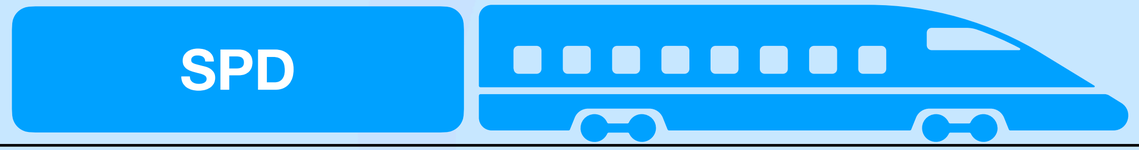
Particle physics at DLNP in 2024

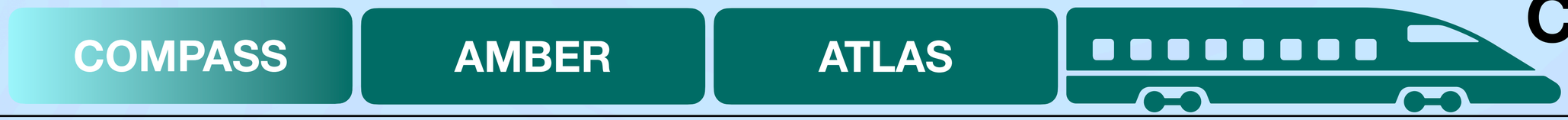
A. Guskov

26.12.2024

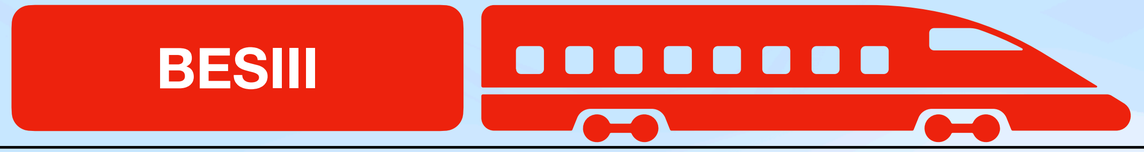
Particle Physics at DLNP



JINR



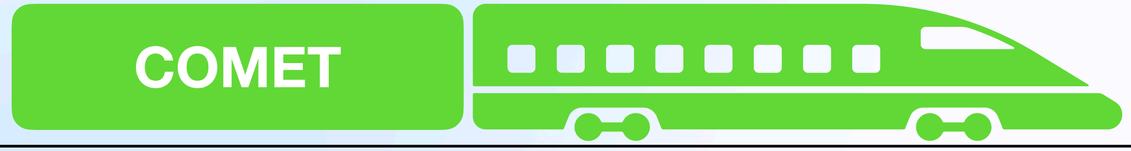
CERN



China

Russia

Germany



Japan

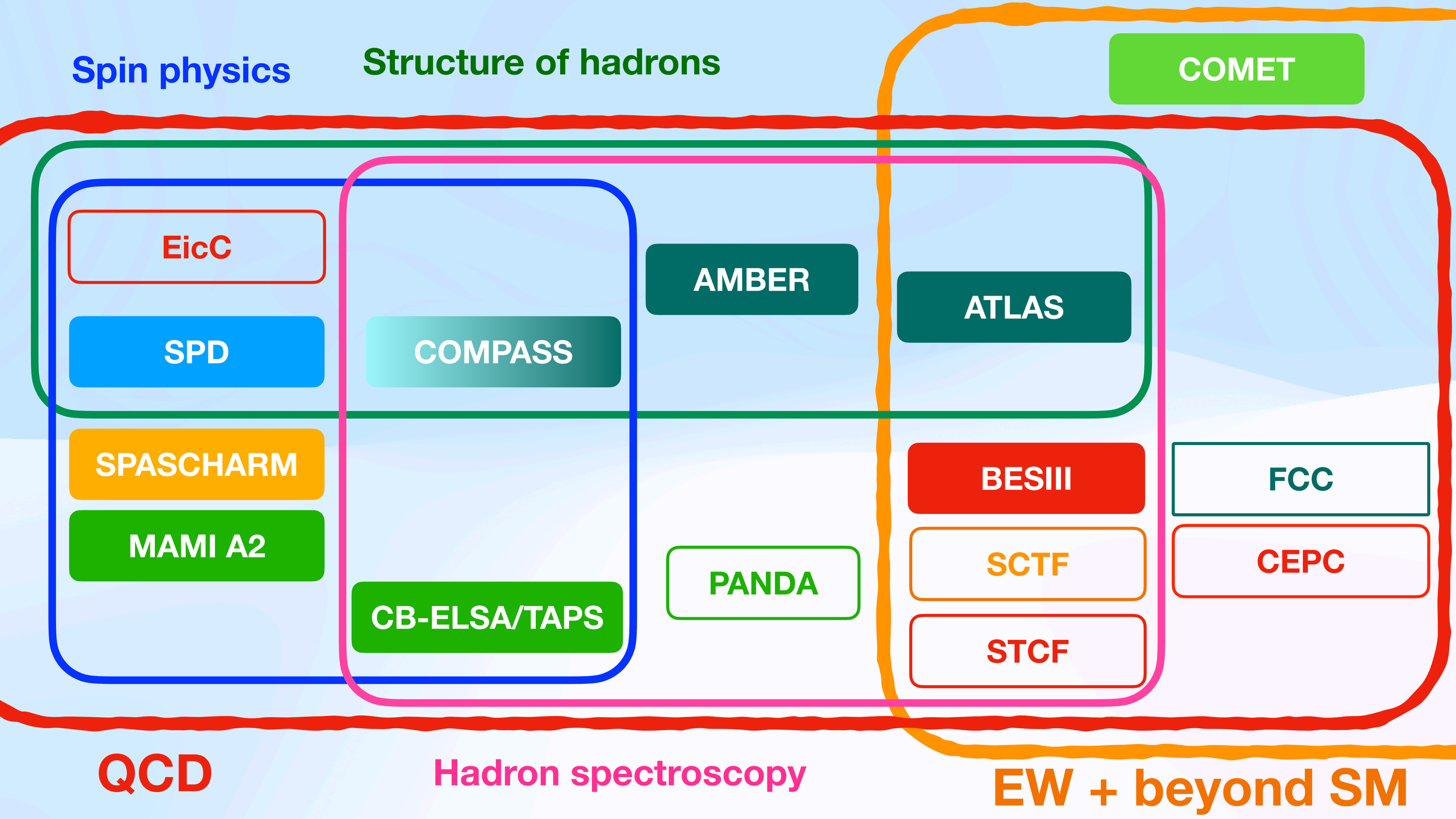
SCTF

FCC

CEPC

STCF

EicC


Spin physics
Structure of hadrons
COMET
EicC
SPD
COMPASS
AMBER
ATLAS
SPASCHARM
MAMI A2
CB-ELSA/TAPS
PANDA
BESIII
SCTF
STCF
FCC
CEPC
QCD
Hadron spectroscopy
EW + beyond SM

SPD

on the way to building the detector

- SPD Technical Design Report is finalized, approved and **published**
- Transition from the R&D phase to the construction of the detector
- Growth of cooperation with Russian and foreign research centers
- MoU with Havana University, iThemba LABS and BINP
- Two collaboration meetings: in Almaty and Dubna

NATURAL SCIENCE REVIEW 1 1 (2024)
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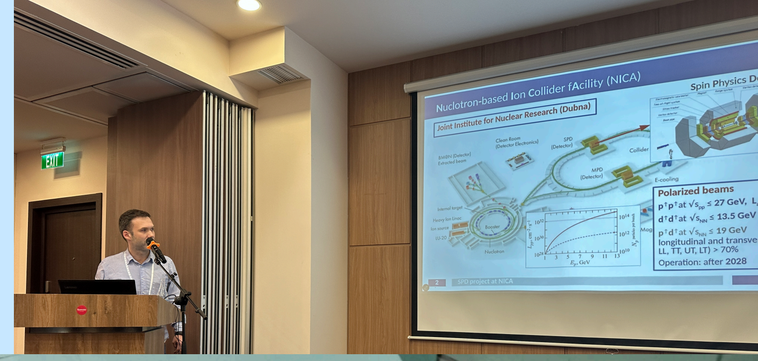
Technical Design Report of the Spin Physics Detector at NICA

V. Abazov[1], V. Abramov[2], L. Afanasyev[1], R. Akhunzyanov[1], A. Akindinov[3], I. Alekseev[3], A. Aleshko[4], V. Alexakhin[1], G. Alexeev[1], L. Alimov[5], A. Allakhverdieva[1], A. Amoroso[6], V. Andreev[7], V. Andreev[8], E. Andronov[9], Yu. Anikin[10], S. Anischenko[11], A. Anisenkov[12], V. Anosov[1], E. Antokhin[12], A. Antonov[13], S. Antsupov[13], A. Anufriev[5], K. Asadova[1], S. Ashraf[14], V. Astakhov[1], A. Aynikeev[4], M. Azarkin[7], N. Azorskiy[1], A. Bagulya[7], D. Baigarashev[1,15], A. Baldin[1], E. Baldina[1], N. Barbashina[16], A. Barnyakov[12], S. Barsov[17], A. Bartkevich[11], V. Baryshevsky[11], K. Basharina[1], A. Baskakov[5], V. Baskov[7], M. Batista[18], M. Baturitsky[19], V. Bautin[1], T. Bedareva[12], S. Belokurova[9], A. Belova[1], E. Belyaeva[1], A. Berdnikov[13], Ya. Berdnikov[13], A. Berezhnoy[4], A. Berngardt[10], Yu. Bespalov[1], V. Bleko[1], L. Bliznyuk[19], D. Bogoslovskii[1], A. Boiko[13], A. Boikov[1], M. Bolsunovskya[13], E. Boos[4], V. Borisov[1], V. Borsch[10], D. Budkouski[1], S. Bulanova[17], O. Bulekov[16], V. Bunichev[4], N. Burtebayev[15], D. Bychanok[11], A. Casanova[18], G. Cesar[18], D. Chemezov[1], L. Chen[20], A. Chepurnov[4], V. Chmill[1], A. Chukanov[1], A. Chuzo[16], A. Danilyuk[21], A. Datta[1], D. Dedovich[1], M. Demichev[1], G. Deng[20], I. Denisenko[1], O. Denisov[6], T. Derbysheva[12], D. Derkach[22], A. Didorenko[1], M.-O. Dima[1], A. Doinikov[13], S. Doronin[16], V. Dronik[23], F. Dubinin[16], V. Dunin[1], A. Durum[2], A. Egorov[17], R. El-Kholy[14], T. Enik[1], D. Ermak[11], D. Erofeev[10], A. Erokhin[12], D. Ezhov[13], O. Fedin[17], Ju. Fedotova[11], G. Feofilov[9], Yu. Filatov[1,24], S. Filimonov[10], V. Frolov[1], K. Galaktionov[9], A. Galoyan[1], A. Garkun[25], O. Gavrishchuk[1], S. Gerasimov[1], S. Gerassimov[7], M. Gilts[23], L. Gladilin[1,4], G. Golovanov[1], S. Golovnya[2], V. Golovtsov[17], A. Golubev[3], S. Golubykh[1], P. Goncharov[1], A. Gongadze[1], N. Greben[1], A. Gregoryev[16], D. Gribkov[4], A. Gridin[1], K. Gritsay[1], D. Gubachev[1], J. Guo[20], Yu. Gurchin[1], A. Gurinovich[11], Yu. Gurov[16], A. Guskov*[1], D. Gutierrez[18], F. Guzman[18], A. Hakobyan[26], D. Han[27], S. Harkusha[19], Sh. Hu[20], S. Igolkin[9], A. Isupov[1], A. Ivanov[1], N. Ivanov[1,26], V. Ivantchenko[10], Sh. Jin[20], S. Kakurin[1], N. Kalinichenko[9], Y. Kambar[1], A. Kantsyrev[3], I. Kapitonov[1], V. Karjavine[1], A. Karpishkov[1,5], A. Katcin[12], G. Kekelidze[1], D. Kereibay[1], S. Khabarov[1], P. Kharyuzov[1], H. Khodzhibagiyan[1], E. Kidanov[23], E. Kidanova[23], V. Kim[17], A. Kiryanov[17], I. Kishchin[23], E. Kokoulina[1], A. Kolbasin[7], V. Komarov[1], A. Konak[1], Yu. Kopylov[1], M. Korjik[11], M. Korotkov[16], D. Korovkin[1], A. Korzenev[1], B. Kostenko[1], A. Kotova[1], A. Kotzinian[26], V. Kovalenko[9], N. Kovyazina[1], M. Kozhin[1], A. Kraeva[16], V. Kramarenko[1,4], A. Kremnev[12], U. Kruchonak[1,19], A. Kubankin[23], O. Kuchinskaia[10], Yu. Kulchitsky[1,19], S. Kuleshov[28,29], A. Kulikov[1], V. Kulikov[12], V. Kurbatov[1], Zh. Kurmanaliev[1,15], Yu. Kurochkin[19], S. Kutuzov[1], E. Kuznetsova[17], I. Kuyanov[12], E. Ladygin[1,2], V. Ladygin[1], D. Larionova[13], V. Lebedev[1], R. Lednicki[1], M. Levchuk[19], P. Li[20], X. Li[20], Y. Li[27], A. Livanov[1], A. Lobanov[13], A. Lobko[11], K. Loshmanova[1], S. Lukashevich[8], E. Luschevskaya[3], A. L'vov[7], I. Lyashko[1], V. Lysan[1], V. Lyubovitskij[10], D. Madigozhin[1], V. Makarenko[11], N. Makarov[9], R. Makhmanazarov[10], V. Maleev[17], D. Maletic[30], A. Malinin[16],

SPD

on the way to building the detector



- Micromegas tests in Dubna and at CERN
- DAQ prototype at MLIT
- Range system module tests at the SPD test zone at Nuclotron
- Works on ECal prototype (including FEE)
- Contacts with USTC about electronics
- Software: from SPDroot to Shampo
- > 10 talks at international conferences
- …

Collaboration with CERN

extended but with conditions

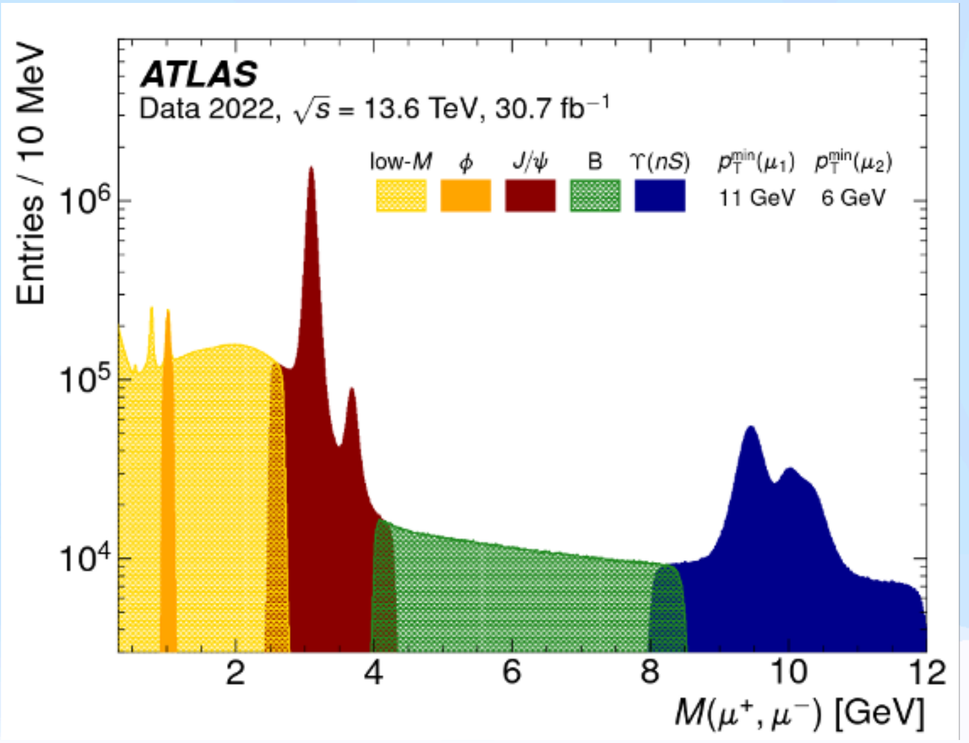
- +5 years
- no new members
- no new agreements

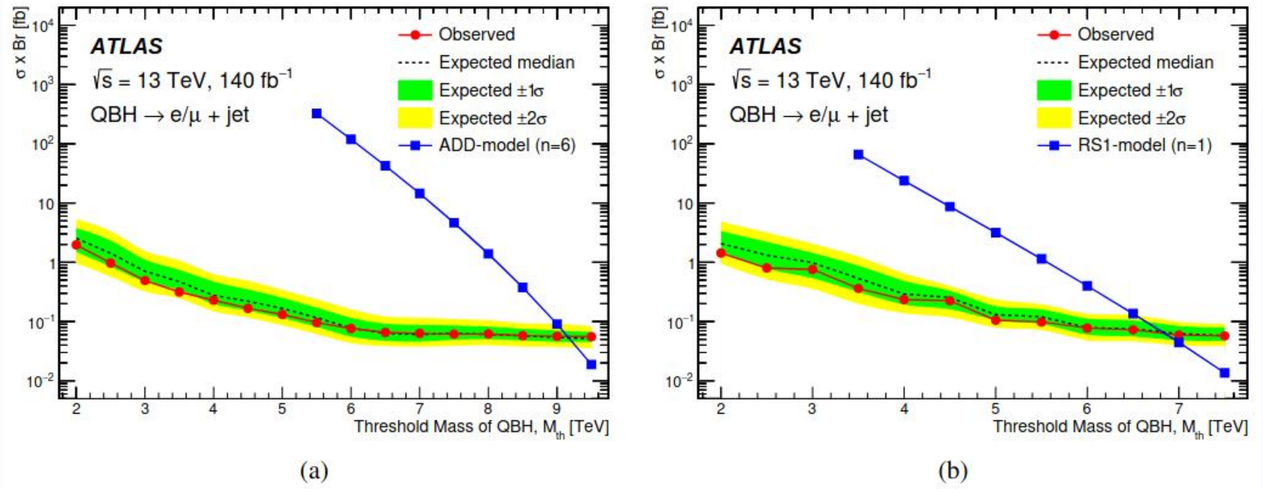
We currently have a sufficient number of young colleagues for whom continued co-operation offers an excellent opportunity!

ATLAS

timeless classic

- Experimental data with lepton+jet in the final state have been analyzed. Potential contribution from quantum black holes of masses over 2 TeV is estimated
- ATLAS trigger software development and trigger efficiencies measurement in Run 3. Contribution to the measurement of electron and photon reconstruction efficiencies in ATLAS Run 2 data
- Studies of the ATLAS calorimeter response are performed using the SPS Test Beam. As a result of these works two DLNP physicists obtained authorship of the ATLAS Collaboration.
- Commitments w.r.t. RPC-panels production and delivery to CERN has been fulfilled. DLNP physicists are taking active part in designing and construction of the HGTD (High Granularity Timing Detector) for ATLAS.



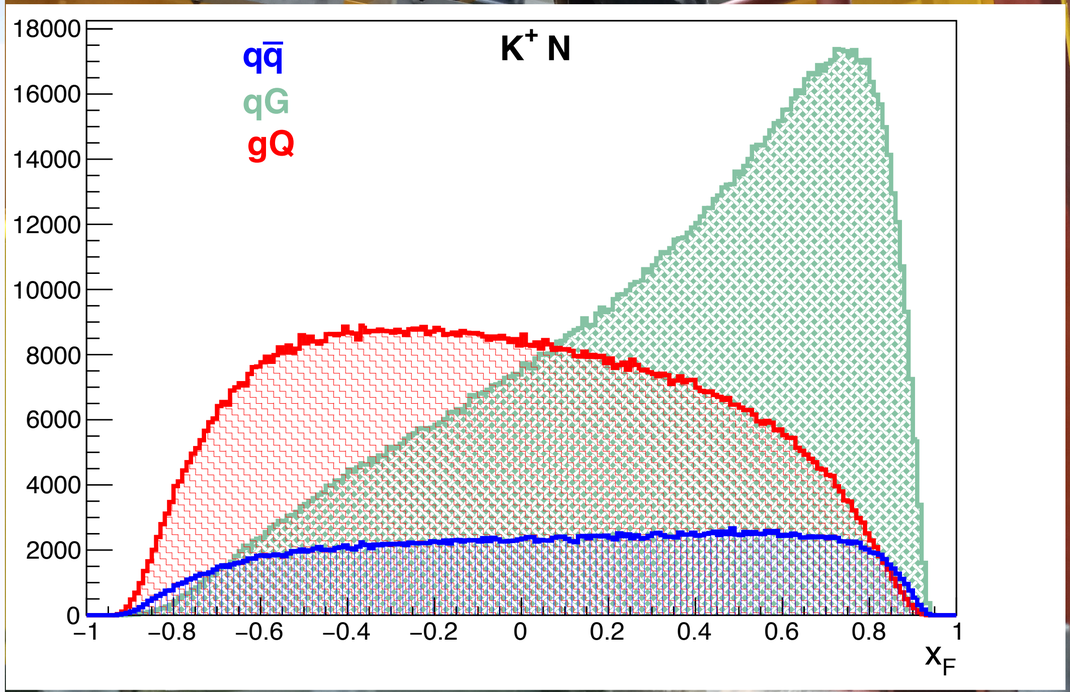


AMBER

Apparatus for Meson and Baryon Experimental Research

at the beginning of the trip

- Data taking for antiproton yield for astrophysical search for DM
- Shifts, Muon Wall 1 maintenance, DAQ support
- Proposal from Dubna group to study the parton structure of kaon in the production of prompt photons with high p_T (AMBER phase-2)
- R&D for bulk Micromegas detectors



COMPASS

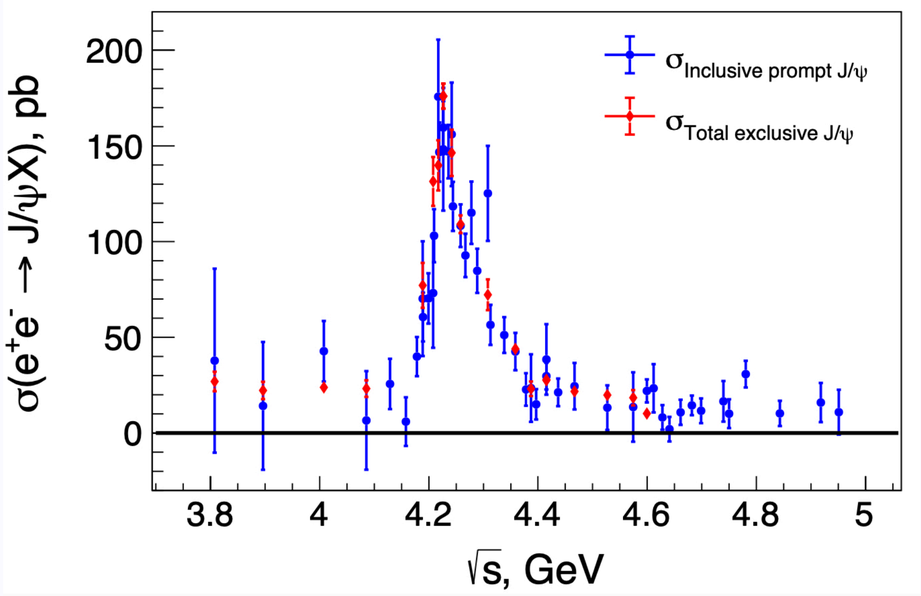
receding over the horizon

- COMPASS is 27 years old
- Still a huge storage of unexplored experimental data
- Chiral anomaly paper ($\gamma \rightarrow 3\pi$): drafting committee is formed
- COMPASS setup handed over to AMBER

BESIII

old dragon

- Remote shifts
- Our paper “Measurement of the prompt inclusive J/ψ and ψ(3686) production cross section at collision energies from 3.808 GeV to 4.951 GeV. In the analysis, the first measurement of the inclusive production of J/ψ and ψ(3868)” is submitted to the PRD journal
- Our analysis “The relative phase between the amplitudes of the strong and electromagnetic interaction in the decay of J/ψ → ϕη” at the final stage of review in the Collaboration
- New analysis “Amplitude analysis of the radiative ψ(3686) decay to $\pi^0\pi^0$” has been presented at the BESIII Collaboration meeting



SPASCHARM

long start

- JINR-IHEP contract for the creation of the new cryostat for polarized target
- Hard run at U-70 in November
- Abramov et. al, SPASCHARM collaboration. «Observation of the Polarization of Λ Hyperons Produced in the Interaction of K– Mesons with Nuclei». JETP Letters - Fields, Particles, and Nuclei - Vol.120. - 2024. - pp. 381-387

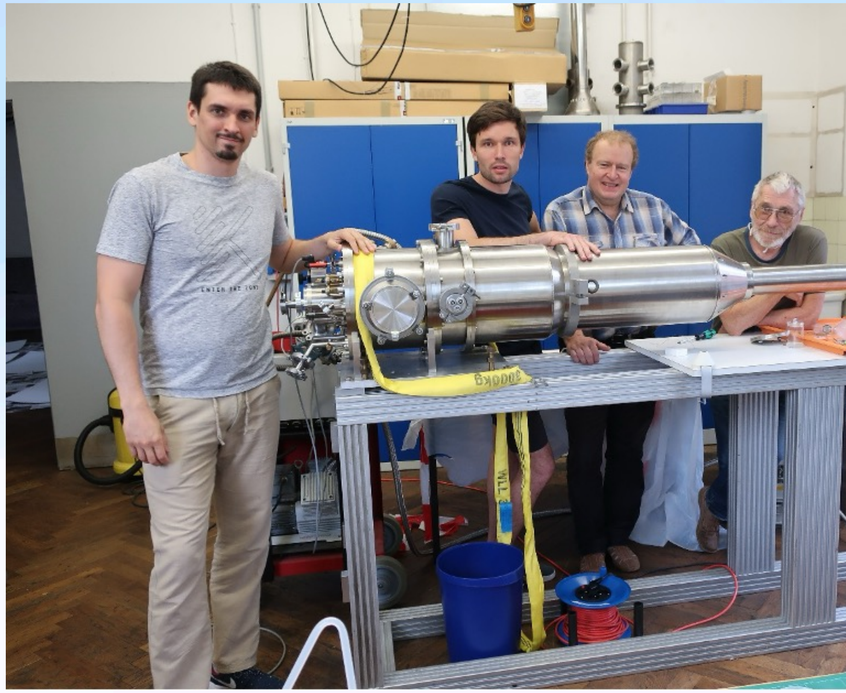
MAMI A2 & CB-ELSA/TAPS

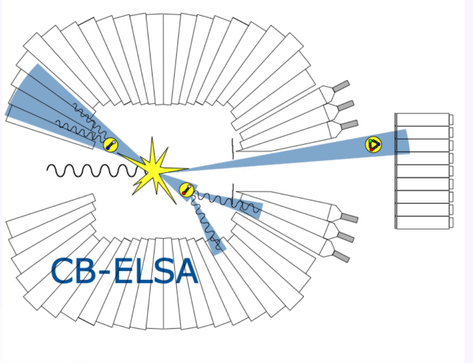
- A2:
  "First Measurement Using Elliptically Polarized Photons of the Double-Polarization Observable E for $\vec{\gamma}\vec{p} \rightarrow p\pi^0$ and $\vec{\gamma}\vec{p} \rightarrow n\pi^+$". Physical Review Letters 132,121902.

  "Evaluation of the E2/M1 ratio in the N→Δ(1232) transition from the $\vec{\gamma}\vec{p} \rightarrow p\pi^0$ reaction". Physical Review C 109,55201

- CBELSA/TAPS:

  "Measurement of polarization observables T, P, and H in π^0 and η photoproduction off quasi-free nucleons. Eur.Phys.J.A 59 (2023) 10, 232





PANDA

PANDA has turned its back on us for now

😕

Theoretical support for experiments

within the ARIEL activity

Further development of the **ReneSANCe** MC generator:

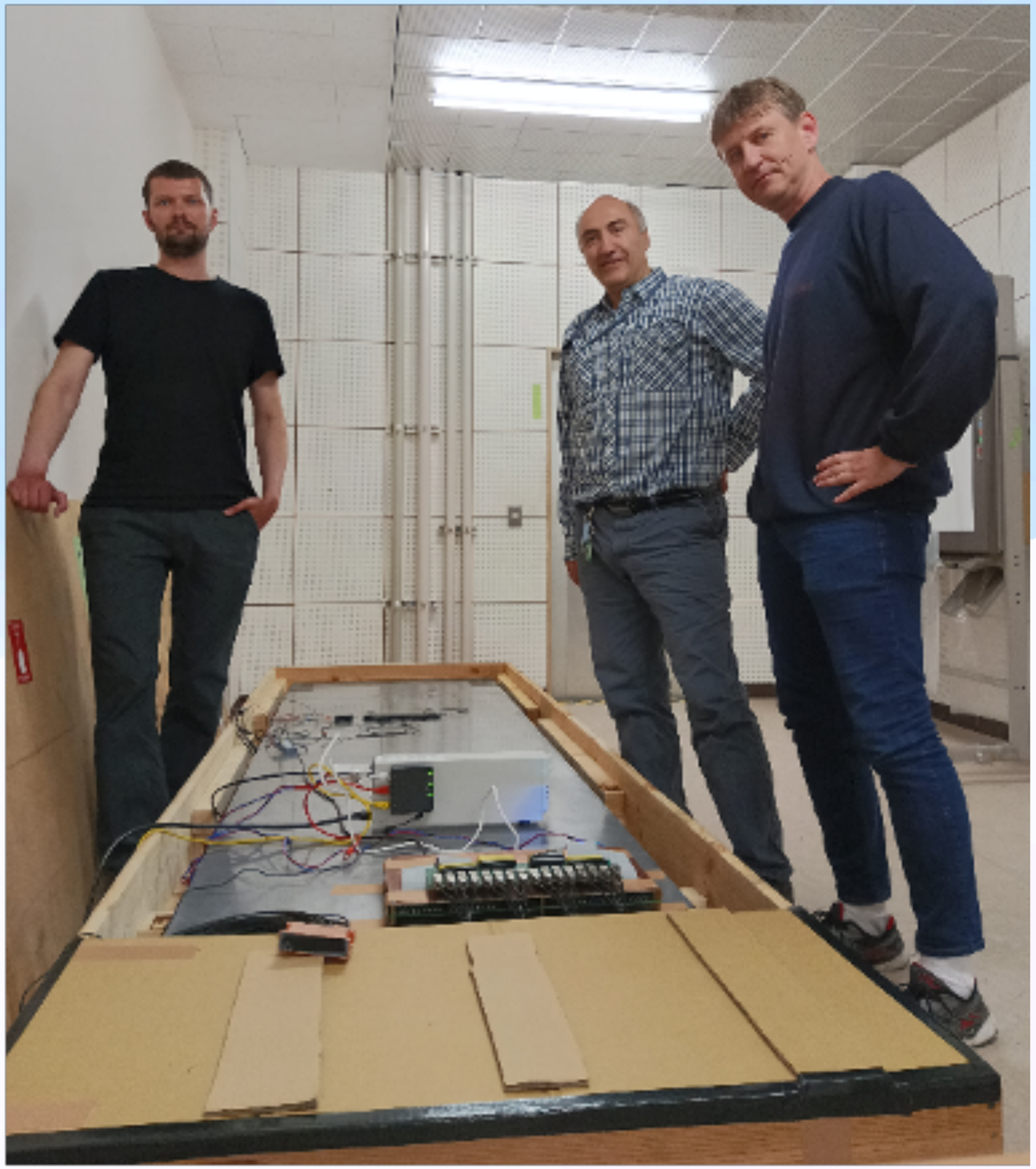
- arbitrary polarization of the initial state
- γγ mode of the initial state
- γγ→γγ beyond the 1-loop approximation
- EW corrections and pollarization effects in $e^+e^- \to ZZ, Z\gamma, e^+e^-$ processes

6 publications in: Phys.Rev.D (Q1), Chin.Phys.C (Q1), JETP Lett. (Q2), 2-Phys.Part.Nucl. (Q3), Pisma Zh.Eksp.Teor.Fiz.(Q3)

COMET

one more dragon

- Creation of the cosmic muon veto system
- Analysis of LYSO crystals measurements
- Manufacturing of straw tubes for tracker, tests & prototyping.

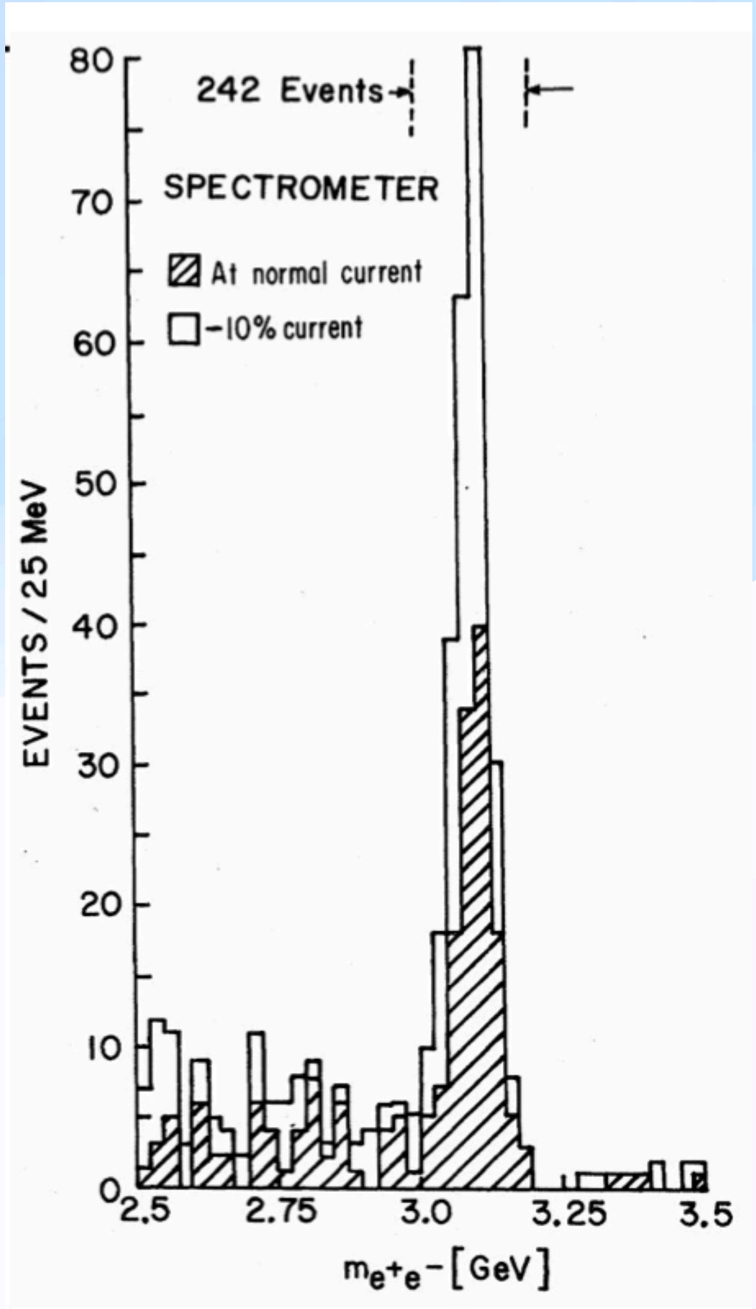


Future projects

- **CEPC** - Circular Electron Positron Collider (China)
- **FCC** - Future Circular Collider (CERN)
- **STCF** - Super Tau-Charm Factory (China, Hefei)
- **SCTF** - Super Charm-Tau Factory (Russia)
- **EicC** - Electron-Ion Collider in China (HIAF-based facility)

50th anniversary of the J/ψ

December, 2 1974



SUMMARY

- Despite the difficult geopolitical situation, the high energy physics at DLNP is in pretty good shape
- The current year, we have had significant scientific achievements
- We have coherent long-range plans