Strategic Plan of the long-term development of JINR Particle Physics and Astrophysics



Dmitry V. Naumov (DLNP JINR) On behalf of the committee

The Committee



V.Bednyakov



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H. Stoecker

The Plan for next 20 years in 15 minutes

- Major results
- Major Particle Physics Challenges
- Mid-term plan
- Long-term strategy
- Sector Expertise to be developed
- Attractiveness of work here

Major results

4

GeoNeutrinos

BOREXINO experiment with the leading role of JINR



Higgs boson discovery

- Hadron calorimeter (1/2) (PLNP JINR)
- Muon system (1/4) (PLNP JINR)
- Electromagnetic calorimeter: design, electronics, radiation tests (LHEP JINR)
- Transition Radiation Tubes tracking system: design, assembling (LHEP JINR)
- Magnetic system: design (PLNP JINR)
- Assembling & Commissioning
- Calibrations, Analyses, Maintenance
 - JINR played the leading role

Neutrino Oscillation and Discovery of non-zero θ_{13} With Daya Bay

- Production of wavelength shifter PPO for the LS
- Data analysis (2016 result based on Dubna analysis)

7

JINR played a leading role

Breakthrough Prize in Fundamental Physics 2016



M. Gonchar



Yu. Gornushkin



D. Naumov



/ I. N



I. Nemchenok A. Olchevski



V. Matveev



B.Popov

₈ E. Yakushev



Major Particle Physics Challenges

9

Physics beyond the SM

- Search for properties of the Higgs beyond the SM
- Search for flavor violation
- Matter-antimatter asymmetry of the Universe
- Dark matter of the Universe
- Dark energy of the Universe
- The Universe evolution

 Physics beyond the SM
 Search for properties of the Higgs beyond the SM Search for flavor violation 0 Matter-antimatter asymmetry of the Universe 0 Dark matter of the Universe 0 Dark energy of the Universe 0 The Universe evolution Sources of ultra-high energy neutrino and gamma 0 Multi-Messenger astronomy 0 Relic neutrino observation 0 **Diffusive neutrino observation** 0 Gravitational waves 0 11

Mid-term plan till 2030

ATLAS

Phase I 0.1 MCHF 32 quadruplets for New Small Wheel 0 LAr CMOS electronics, tests 0 Tile calorimeter: commissioning, tests 0 Phase II **3.6 MCHF** TDAQ 0 LAr: Preamp-Shaper, Optical Link, FEB2, Front-end 0 Power Distribution System, LAr signal Processor Tile calorimeter: LV services 0 MUON: RPC chambers, FE electronics, Gas System, 0 Power System HGTD

JUNO



JINR is THE Major Collaborator in JUNO Powering JUNO. 2 M\$

High Voltage Units for 20k LPMTs and 18k sPMTs: design, production, tests, calib, installation

 Muon Veto. 1.25 M\$ design, production, tests, calibrations, installation

PMT tests.
 O.1 M\$
 design, production, tests, methods, calibrations, installation



TAO (near det).
 1 M\$
 SiPM purchase, design, tests, methods, calibrations

With JUNO before 2030

- Mass Ordering determination (3-4 σ)
- Lepton mixing better than in the quark sector
- Largest dataset of geo-neutrinos
- Solar neutrino
- If lucky:
 - SuperNOVA with 10000 events
 - Proton decay
 - Diffused SN neutrino
 - And much more

BAIKAL GVD





3D Array of photo-sensors Now: 0.25 km3 Phase I: 0.4 km3 (by 2021) 0 Phase II: 1.5 km3 (by 2027) 6 Flagship Experiment of JINR Hardware Software Everything

JINR is the leading institute
Aim to identify sources





DarkSide 0 Edelweiss

0



Dark matter

x

x

- NOVA: MO, CP-violation 0
- Kalinin PP: magnetic moment, coherent, sterile 0
- TAIGA: 100 TeV gamma 0
- GERDA, SuperNEMO: $0\nu\beta\beta$ 0

Long-term plan after 2030

Long-term plan after 2030

NOvA

DUNE : Scintillation light R0 in LAr TPC
(now)OrHyperK : Yet to be determined

21

- BAIKAL GVD
- JUNO
- ATLAS High Luminosity

Bonus: Gravitational waves interferometers: LIGO/ VIRGO or interferometer @DUBNA

Expertise to develop

- Application Specific Integrated Circuit (ASIC)
- FPGA Electronics
- Robotics
- Quantum computing
- General Relativity and gravitational interferometry
- Project management
- Follow modern technologies

Attractiveness of JINR

- World class Neutrino Physics and expertise
- Top level in detection technologies
- New technologies (laser inclinometer, HPGe, ...)
- Mechanical workshop with modern machines (50 numerical machines available)
- Excellent engineers and modern equipped labs
- World class ultra cold technologies
- Unique world class home experiments:
 BAIKAL GVD, Kalinin PP, TAIGA, ...
- Young, dynamic and open-minded team

Gravitational interforometer Invona