

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



L. Cifarelli



M. Jezabek



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E. Rabinovici



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N. Russakovich



M. Spiro



H. Stoecker

The Plan

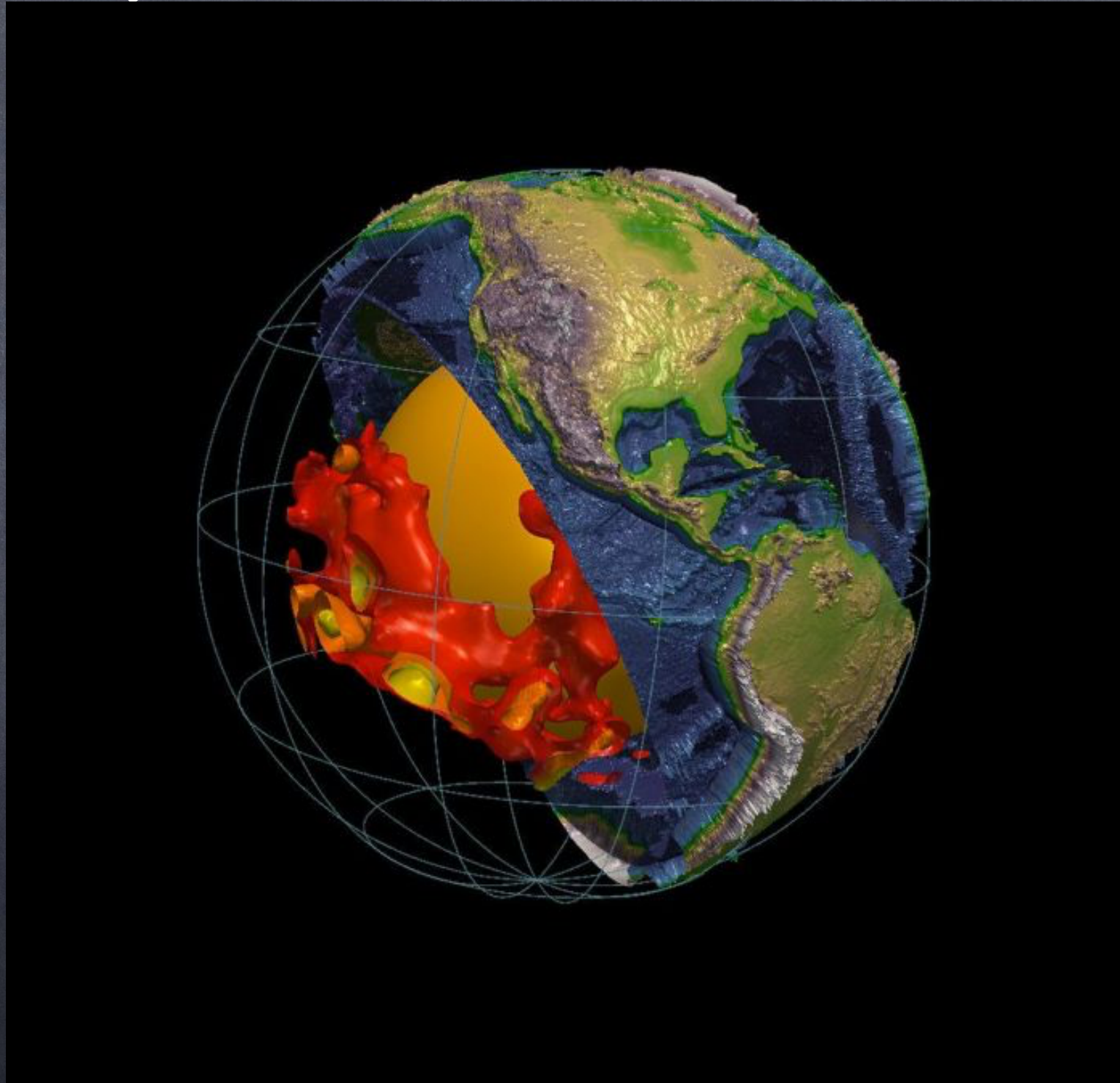
for next 20 years in 15 minutes

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

Major results

GeoNeutrinos

- BOREXINO experiment with the leading role of JINR



Higgs boson discovery

- Hadron calorimeter (1/2) (DLNP JINR)
- Muon system (1/4) (DLNP JINR)
- Electromagnetic calorimeter: design, electronics, radiation tests (LHEP JINR)
- Transition Radiation Tubes tracking system: design, assembling (LHEP JINR)
- Magnetic system: design (DLNP 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)
- JINR played a leading role

Breakthrough Prize in Fundamental Physics 2016



M. Gonchar



Yu. Gornushkin



D. Naumov



I. Nemchenok



A. Olchevski



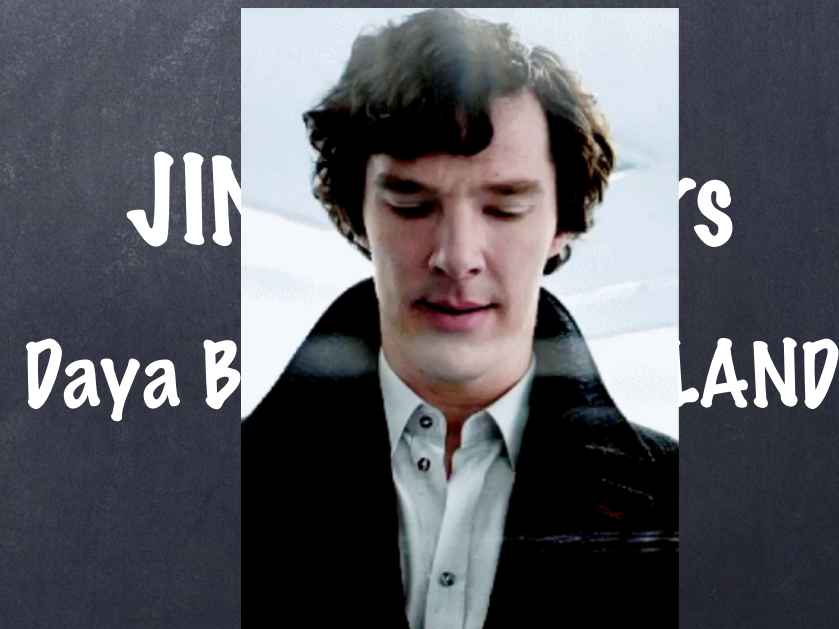
V. Matveev



B. Popov



E. Yakushev



JIN
Daya B. JIN
LAND

Major Particle Physics Challenges

- **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**

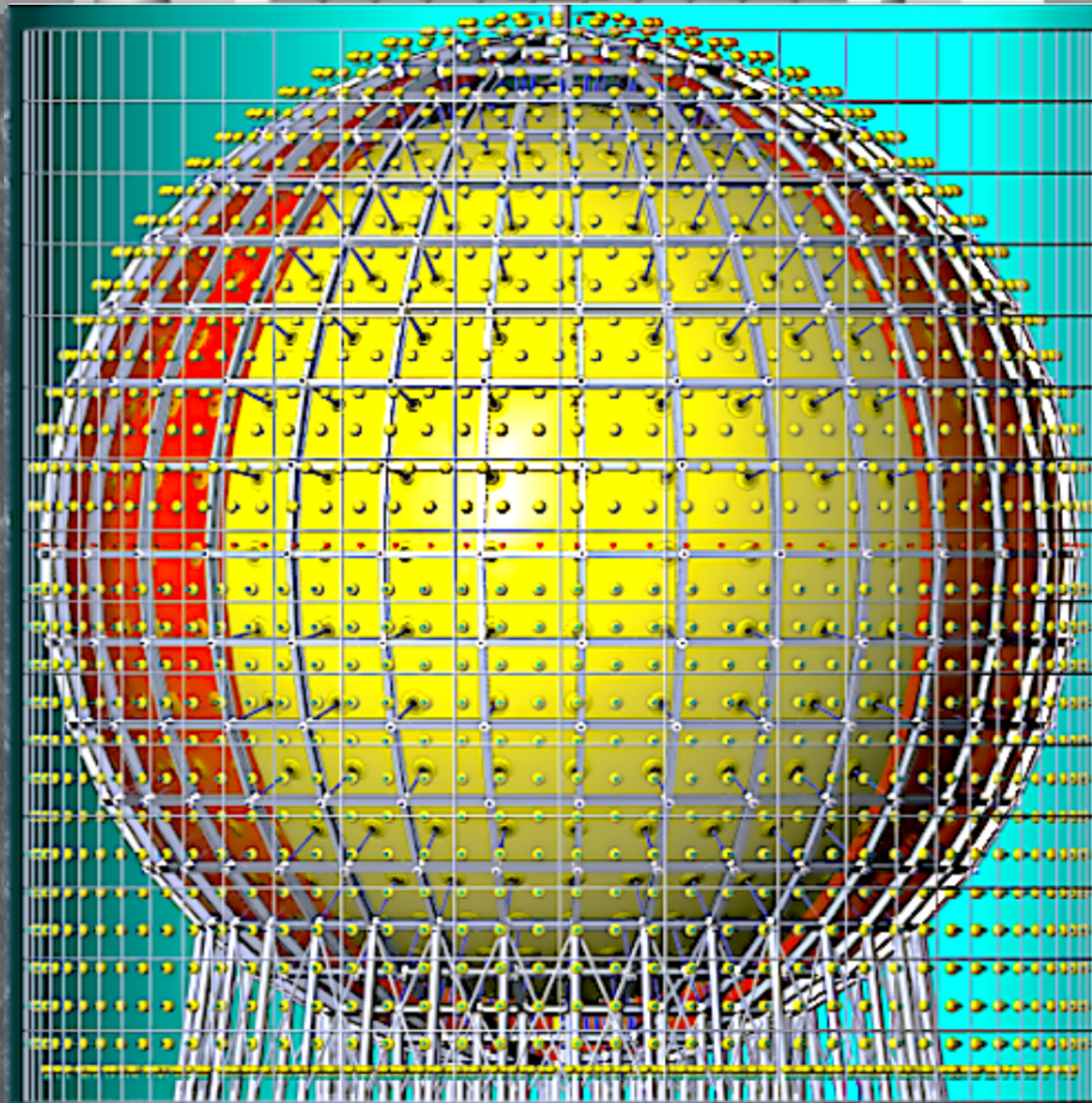
- **Physics beyond the SM**
 - Search for properties of the Higgs beyond the SM
 - Search for flavor violation
 - Matter-antimatter asymmetry of the Universe
 - Dark matter of the Universe
 - Dark energy of the Universe
- **The Universe evolution**
 - Sources of ultra-high energy neutrino and gamma
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

Mid-term plan till 2030

ATLAS

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

JUNO



JINR is THE Major Collaborator in JUNO

- Powering JUNO. **2 M\$**

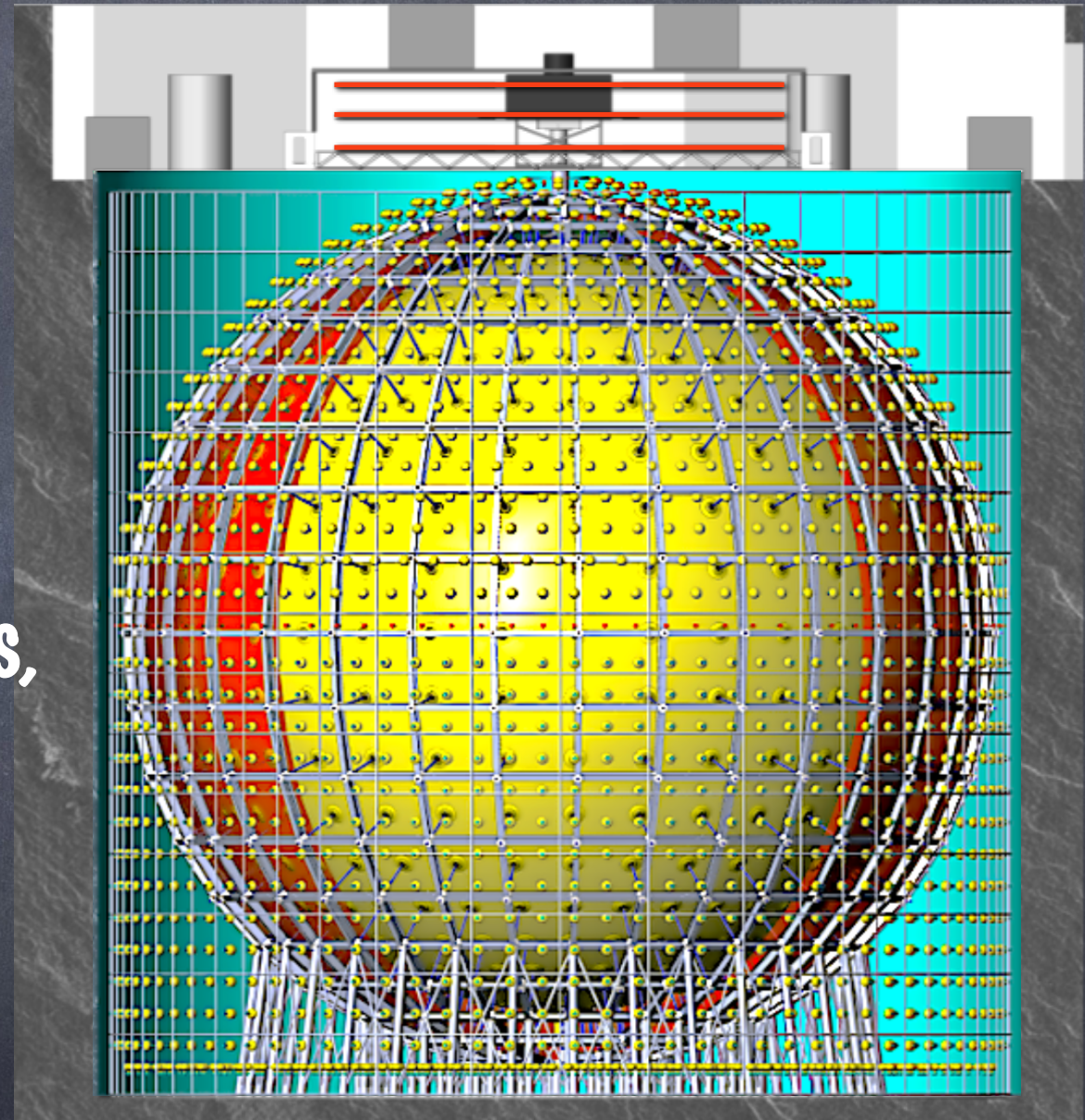
High Voltage Units for
20k LPMTs and 18k sPMTs: design,
production, tests, calib, installation

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

- PMT tests. **0.1 M\$**
design, production, tests, methods,
calibrations, installation

- TAO (near det). **1 M\$**

SiPM purchase, design, tests, methods, calibrations



Total: 4.35M\$

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)
- Phase II: 1.5 km³ (by 2027)

- Flagship Experiment of JINR

- Hardware
- Software
- Everything



- JINR is the leading institute
- Aim to identify sources




- DarkSide
 - Edelweiss
- } Dark matter
- NOvA: $M0$, CP-violation
 - Kalinin PP: magnetic moment, coherent, sterile *
 - TAIGA: 100 TeV gamma *
 - GERDA, SuperNEMO: $0\nu\beta\beta$

*= home experiment

Long-term plan after 2030

Long-term plan after 2030

- NOvA 
 - DUNE : Scintillation light RO in LAr TPC (now)
 - Or
 - HyperK : Yet to be determined
- 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 interferometer
FOCUS
И ДУБИНА