



# JINR @ JUNO in 2022

Yury Malyshkin on behalf of the JINR team

PostDocs, Junior / Senior Researchers:	14 (FTE 6.5)
Staff:	4 (FTE 3.2)
Engineers:	10 (FTE 3.5)
Undergraduate / PhD Students:	5 (FTE 2.3)
<hr/>	
<b>Total</b>	<b>33 (FTE 15.5)</b>

## Hardware

- LPMT testing
- HV production
- Top Tracker
- SiPM evaluation and purchase
- SiPM mass testing
- SiPM power supply

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## Analysis, Software and Computing

- Oscillation physics
- Fitter development: GNA
- Realistic optical model for PMTs
- Energy resolution from first principles
- Energy reconstruction with ML
- Muon reconstruction
- JINR DCI

## LPMT individual tests (led by Nikolay Anfimov)

- Complete

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## LPMT long-term testing (Denis Korablev)

- Stability tests of 28 PMTs are ongoing
- 4 different modes to emulate normal and accelerated aging
- 430 day accumulated



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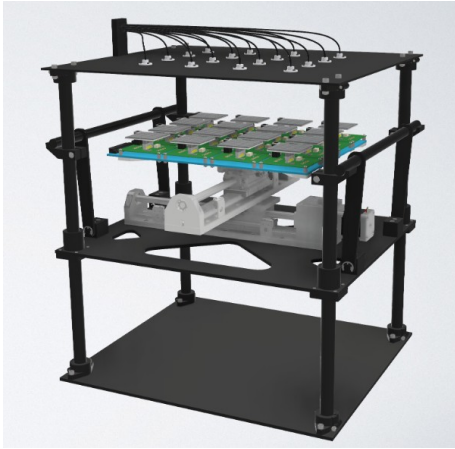
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- 4 different modes to emulate normal and accelerated aging
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## HV production (led by Alexander Olshevskiy)

- HV cells for LPMT underwater boxes produced in 2021
- HV cells are ready for the production of sPMT underwater boxes
- Production of extra 10% of HV cells finished

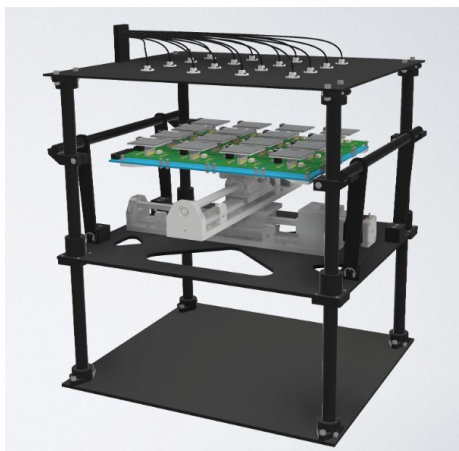




## Mass-testing (led by Arseny Rybnikov)

- Procedure is defined and test-bench design is ready
- Mechanics for the test bench is already produced in China
- Electronics will be produced in China and JINR
- DAQ server is being setup in China now





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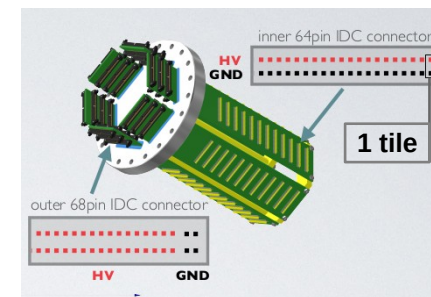
- Samples of Power Supply units produced and sent to China
- 3 feedthrough samples produced
- Development of control software ongoing

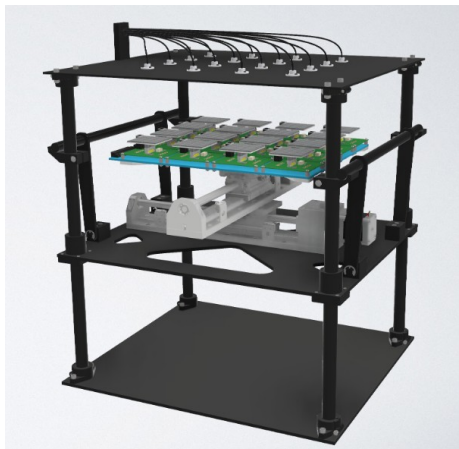


Power Unit



Control Unit





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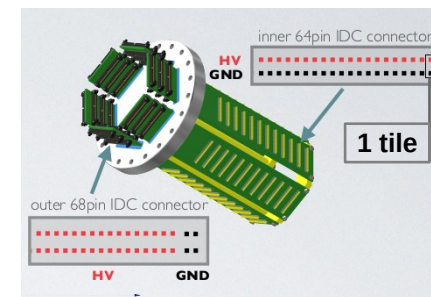
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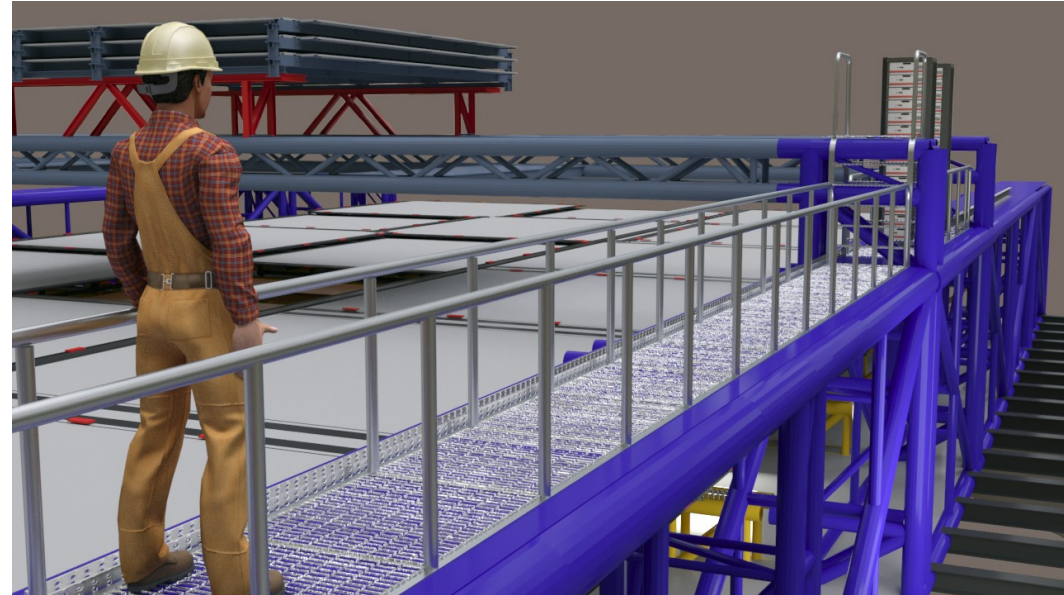


FDR successfully passed in July

- Installation preparation is at final stage:
  - procedure to be tested with a prototype at JINR
  - documentation ready
- DAQ and online control software under development

(led by Yury Gornushkin)

More details in talks by Yu. Gornushkin and D. Korablev on Tuesday

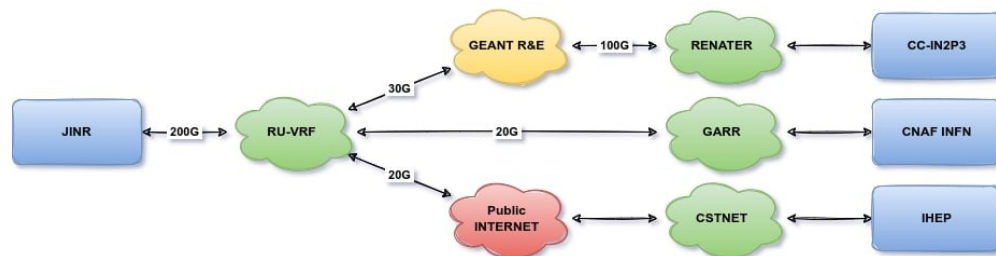


## CPU cluster

- At least 2000 CPUs provided: 48 KHepSpec06, up to 3000 CPUs available
  - 15 GB of RAM per single CPU core (the only JUNO site for jobs with high RAM requirements)
  - The highest number of CPU among JUNO DCI data centers

## Network

- CC-IN2P3 JINR: up to 30 Gb/s
- CNAF JINR: up to 20 Gb/s
- IHEP JINR: before 24.02.2022 was done via GEANT 10 Gb/s, but now the traffic goes through public internet (it means there is no guaranteed network bandwidth and depends on bandwidth and load of each part of the route)



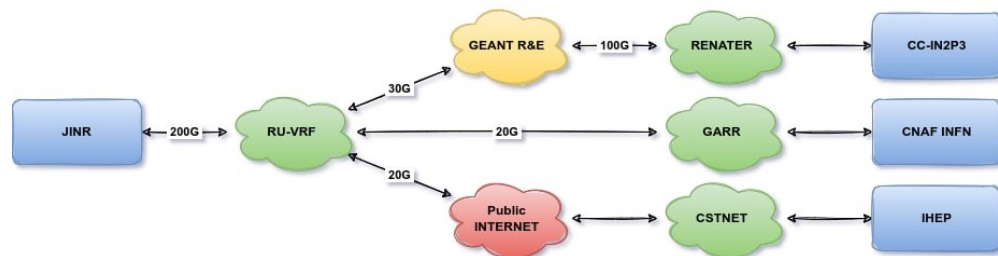
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## Storage

- EOS: increased from 650 TB (92% was used) up to 1 PB (60% is used)
- No tape storage yet

## Services deployed at JINR

- IHEP DIRAC redundancy services (WebApp&ConfigurationService)
- Secondary VOMS (Virtual Organization Membership Service) server for JUNO VO
- Full replica of JUNO CVMFS Stratum-1 repository (/cvmfs/juno.ihep.ac.cn) and /cvmfs/dcomputing.ihep.ac.cn
- Replica of JUNO offline Condition Database

(led by Nikolay Kutovsky)

- MoU has been recently signed by Director of JINR to meet resource requirements
- Storage is the highest priority

JINR	Planned to be pledged*				
	2023	2024	2025	2026	2027
Tape (PB)	5	5	5	5	5
Disk (PB)	5	5	5	5	5
CPU (kHS06 <sup>†</sup> )	36	36	30	20	10

\*numbers are *not* cumulative

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## Plans

- Increase provided resources according to MoU
- Evaluate alternative IHEP JINR network channels  
(IHEP is kindly asked to negotiate construction of high speed channel on Chinese side)
- New NVidia A100 server for machine learning jobs acquired and is to be setup  
(in addition to an available server with NVidia)

- GNA core development (led by Maxim Gonchar)
  - Light pure-Python version is being developed in parallel
  - Initial research of the Julia-based core
- NMO + oscillation parameters (Maxim Gonchar, Dmitry Dolzhikov)
  - Sensitivity with MC is estimated and is consistent with Asimov. Technote is being updated.
  - Sensitivity to NMO with subdetectors: increase by ~0.6%. Additional improvement is yet foreseen considering resolution and LSNL of each subdetector separately.

	One-sided probability ( $n\sigma$ )	
	NO	IO
Asimov	2.94312	2.8425
MC (fit)	$2.87124 \pm 0.0180$	$2.73027 \pm 0.0180$
MC (sample)	2.84749	2.69605

Talk by M. Gonchar on Tuesday and  
talk by D. Dolzhikov on Wednesday

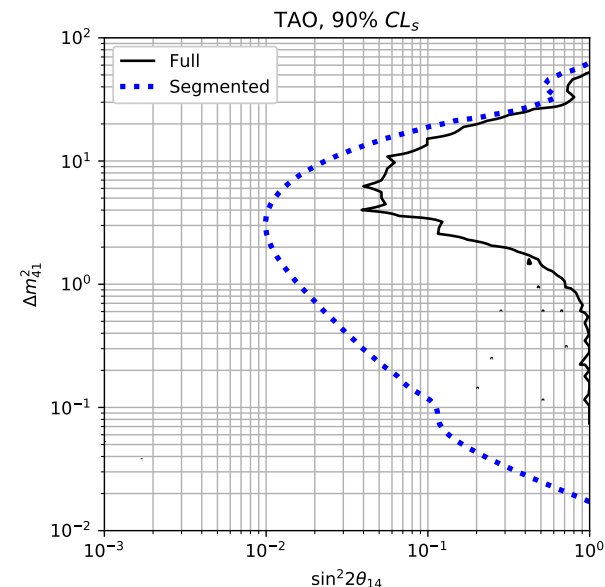


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- Sterile neutrino (Vitalii Zavadskyi)
  - TAO point-like – ready
  - TAO segmented – first implementation
  - Update model to newest model that used NMO analysis – in progress
  - Improvement of the oscillation model for segmented case – in progress
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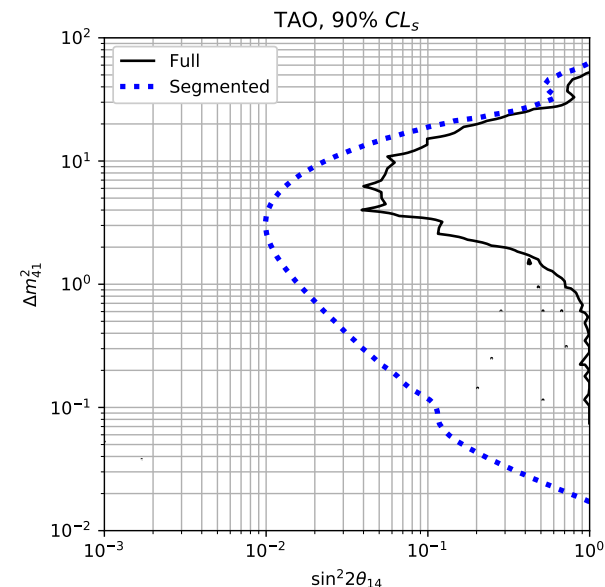
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- Energy resolution model from first principles (Oleg Smirnov)
  - work in progress

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  - Fast and accurate method using aggregated features developed, a subgroup paper submitted to EPJ-C
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- Realistic optical simulation of PMT (Tatiana Antoshkina)
  - Resuming the work started up several years ago

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# Contribution to the Costs



SiPMs	\$ 1M
High voltage for LPMTs and SPMTs: R&D and production	\$ 2M
Power supply for SiPMTs R&D	\$ 500K
TT muon veto (in-kind, from Opera)	\$ 800K
TT support structure design development and production	\$ 200K
LPMT scanning stations: R&D and production	\$ 500K
LPMT characterization	
LPMT mass testing, long-term testing	
SiPM acceptance, mass testing	
PMT Earth Magnetic Field Shielding: R&D and prototypes	
CPU servers with extended memory	\$ 2M
<b>Total</b>	<b>\$ 7M</b>