

UK Nuclear Physics

NPAP update

January 2020

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Public webpage:

<http://www.stfc.ac.uk/about-us/how-we-are-governed/advisory-boards-panels-committees/nuclear-physics-advisory-panel/>

NPAP Activity

- Minor update to Roadmap September 2019
- Provided minor update on the NP Priority Projects to STFC
- Input on briefing for Science on the landscape of neutrinoless double beta decay
- Computing Capacity Resources for Nuclear Physics
- UK Community meeting(s) inc NPF meetings

The Nuclear Physics Strategy document

- Scope and range of Physics
- Current projects
- Future projects
- Other issues
- 10 year horizon

- Last revision Oct 2019



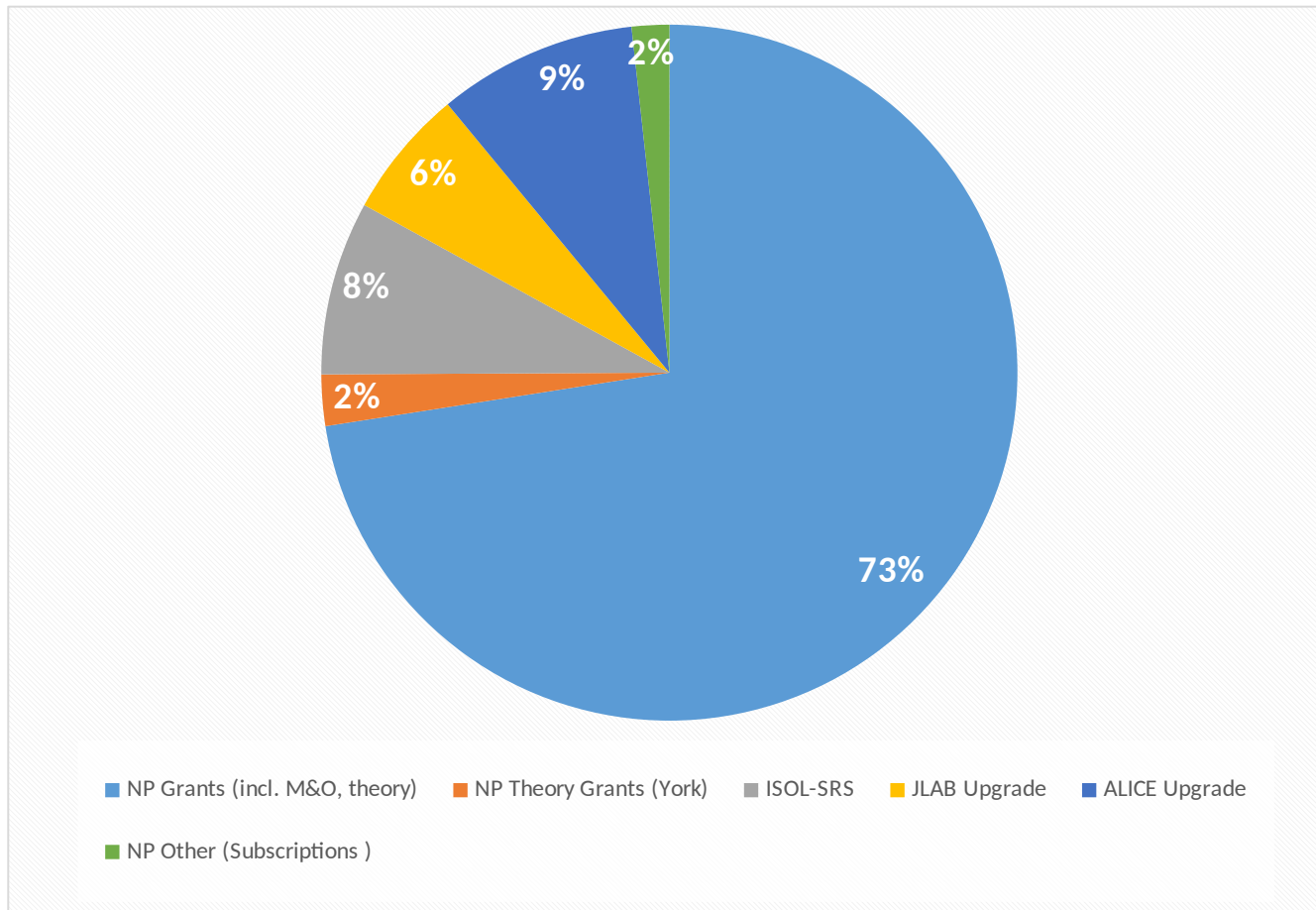
<https://stfc.ukri.org/about-us/how-we-are-governed/advisory-boards-panels-committees/nuclear-physics-advisory-panel/>

Key Science Questions

- What governs the structure and behaviour of atomic nuclei?
- What is the origin of the elements?
- What is the nature of nuclear matter?
- How do the properties of hadrons and the quark-gluon plasma emerge from fundamental interactions?

The first three questions are associated with “nuclear structure and nuclear astrophysics” and the final one “hadronic physics”

Balance of existing programme



$\frac{3}{4}$ Exploitation, $\frac{1}{4}$ Projects going forward

Size of the UK community

- There are 68 academic/faculty staff @ 11 institutions carrying out nuclear physics research
 - Number has been growing with recent new appointments
 - All (except 3 at STFC Daresbury) are University funded
- There are 60 Research and Professional staff supporting the academic staff
- There are 90 Research students working with the academic staff
- Approximately 48 funded by STFC

NUCLEAR PHYSICS ROADMAP

Roadmap for existing projects and future opportunities

	2019/20	2020/21	2021/22	2022/2023	2023/24	2024/25	2025/26	2026/27	
Hadronic Physics	ALICE upgrade (LHC)		ALICE exploitation						
			Jlab 2						
		EIC R+D					EIC		
							2032	
							Electron Ion Collider NG ALICE		
	2019/20	2020/21	2021/22	2022/2023	2023/24	2024/25	2025/26	2026/27	
Nuclear Structure & Astrophysics	ISOL/SRS								
	NuSTAR at FAIR							FAIR SRS	
	AGATA					AGATA 4pi & exploitation			
						STAR			
		ACPA@ELI				Exploitation at ELI			
		DRACULA FRIB							
				Instrumentation@JYFL					
								2032
							Future ISOL/EURISOL NuSTAR UG		
	2019/20	2020/21	2021/22	2022/2023	2023/24	2024/25	2025/26	2026/27	
Nuclear Theory		Neutrino-nucleus							
		Fission							
		ongoing		future		exploitation		horizon	
				PRD		exploitation at other facilities inc GSI			

Future projects and opportunities

Near-term

- Advance charged-particle array (ACPA@ELI)
 - Silicon based granular array with a focus on **ELI-NP** Gamma-beam applications
- DRACULA
 - Direct Reaction Array for the Core Understanding of Light-nuclei and Astrophysics
 - Silicon based granular array with a focus on **FRIB** for use with GRETA
- AGATA upgrade
 - Beyond 1pi
 - Additional gamma detectors and optimisation of signal decomposition
 - Focus on **SPES** and **FAIR** (HISPEC)

Future projects and opportunities

Mid-term

- Jlab 2
 - Kaon Flux Monitoring apparatus as part of the high intensity and clean neutral kaon beam (Klong@**JLAB**) development
- Instrumentation@Jyväskylä
 - Instrumentation to enhance the core physics programme at **JYFL**
 - MARA Low Energy Branch (LEB)

Horizon

- NuSTAR 2: DEGAS Ge, Schottky pickup for storage ring, MAPS
- EIC / NG ALICE
- EURISOL

Future projects and opportunities

Mid-term (PRD)

- Scintillator tracking array (STAR)
 - SiPM based highly granular gamma-ray array for ISOL facilities
- EIC
 - R+D to support the future UK contribution to the EIC. Bid likely to follow CD0 decision.

Proposed Theory project

- Neutrino-nucleus interactions
 - Use modern ab-initio methods and effective field theory. Calculate experimentally-crucial cross-sections with greater precision and sophistication than most currently-used codes.
- Theoretical studies of spontaneous and induced fission
 - Leadership hub for theoretical studies of spontaneous and induced fission.

Proposed User facility

- UK Accelerator Driven Neutron Facility

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KEY TECHNOLOGIES

Key technologies and technology development

- Miniaturisation of discrete readout electronics (JFET based PAs) for germanium detectors. CMOS readout. Germanium ASIC and associated mounting of the digital processing chain on the detector.
- MAPS (DMAPS)
- Photo-sensors with sub-picosecond timing resolution
- SiPM (position sensing)
- Key engineering and design support
- **Recommendation:** PRD line should be re-instated when possible

GENERAL COMMENTS

General comments

- **PDRAs have reached a level too low to properly support the programme**
- **Recommendation from the previous BoP exercise related to the number of PDRA posts supporting the core science programme**
 - no additional money was available
 - funding was reallocated from the projects line to support PDRA numbers.
- **Although welcome in the short term, this has had two unfortunately consequences.**
 - The PDRAs allocated vary in length (are shorter than the CG period) and therefore continuity has been lost in most science themes
 - Support for the projects line has been impacted which will have long term negative consequences
- **The nuclear physics community therefore regard the current level of funding for the whole programme as critically low.**

IMPACT

- The science programme was endorsed in the recent STFC IMPACT report (2017) which ranked our community **second in the world by measure of impact and citations.**

Nuclear physics	2010	2011	2012	2013	2014	2015	2016
Number of publications	347	296	489	496	476	393	520
UK position	7	7	7	7	7	7	7
Citation Impact (CI)	6.74	13	16	15.4			
UK position	2	2	1	1			
Normalised Citation Impact (NCI)	1.62	1.72	5.12	3.1	2.6	1.8	1.6
UK position	2	2	1	2	2	1	2

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