# Nuclear Physics Groups in Poland

*(based on a survey conducted in 2020-2021)*

**ADAM MAJ**

**IFJ PAN KRAKOW**

NuPECC Meeting in Ljubljana

March 16-17, 2023

# Open Meeting of the
# Nuclear Physics Section of the Polish Physical Society
**September 29, 2020 (via zoom)**

Presentation of NP groups and subsequent survey (2020-2021)

# Landcape of Nuclear Physics Groups in Poland

# Warsaw

NUCLEAR PHYSICS DIVISION
UNIVERSITY OF WARSAW


http://zfjwww.fuw.edu.pl/

**Nuclear Physics Division,**
**Institute of Experimental Physics, Faculty of Physics, University of Warsaw**

## Research topics

1. Nuclear structure studies using gamma spectroscopy (W. Urban, T. Rząca-Urban et al.)
2. Total absorption spectrometry (M. Karny et al.)
3. Decays of exotic nuclei with emission of particles (M. Pfuetzner, Z. Janas, A. Korgul, K. Miernik, C. Mazzocchi et al.)
4. Study of hadron matter in high-energy nucleus-nucleus collisions (T. Matulewicz, K. Piasecki)
5. Nuclear physics for hadron therapy (I. Skwira-Chalot)

Staff: 13; Post-docs: 3; PhD: 13.

**Theory**

NSR, HAD, SYM
STA 2
NSR 1, HAD 1, SYM 2

Collaborating Polish physicists from abroad:
R. Grzywacz (University of Tennessee, Knoxville, USA_ (1,2,3)
K. Rykaczewski (Oak Ridge National Laboratory, Oak Ridge, USA) (1,2,3)

# Warsaw

HIL Heavy Ion Laboratory

**Heavy Ion Laboratory, University of Warsaw**

http://slcj.uw.edu.pl

## Research topics

1. Mechanism of nuclear reactions and Coulomb barrier distributions (A. Trzcińska)
2. Nuclear excited states investigated using multi-detector arrays (M. Palacz)
3. Nuclear deformations studied by means of Coulomb excitation method (P. Napiorkowski)
4. Radiobiology and nanodosimetry (U. Kaźmierczak)
5. Properties of medical radioisotopes produced using particle accelerators (J. Choński)
6. Accelerator Physics (P. Gmaj)

Staff: 20; Post-docs: 5; PhD: 5.

**Theory**

NSR
STA 1, PD 1
NSR 1

Collaborating Polish physicists from abroad:

D.Seweryniak (Argonne National Laboratory, Lemont, USA) (2,3)
K. Starosta (Simon Fraser University, Burnaby, Canada) (2,3)
W.H. Trzaska (University of Jyväskylä, Finland) (1)
M. Zielińska (CEA Saclay, France) (3)

# Warsaw

Heavy Ion Laboratory, University of Warsaw

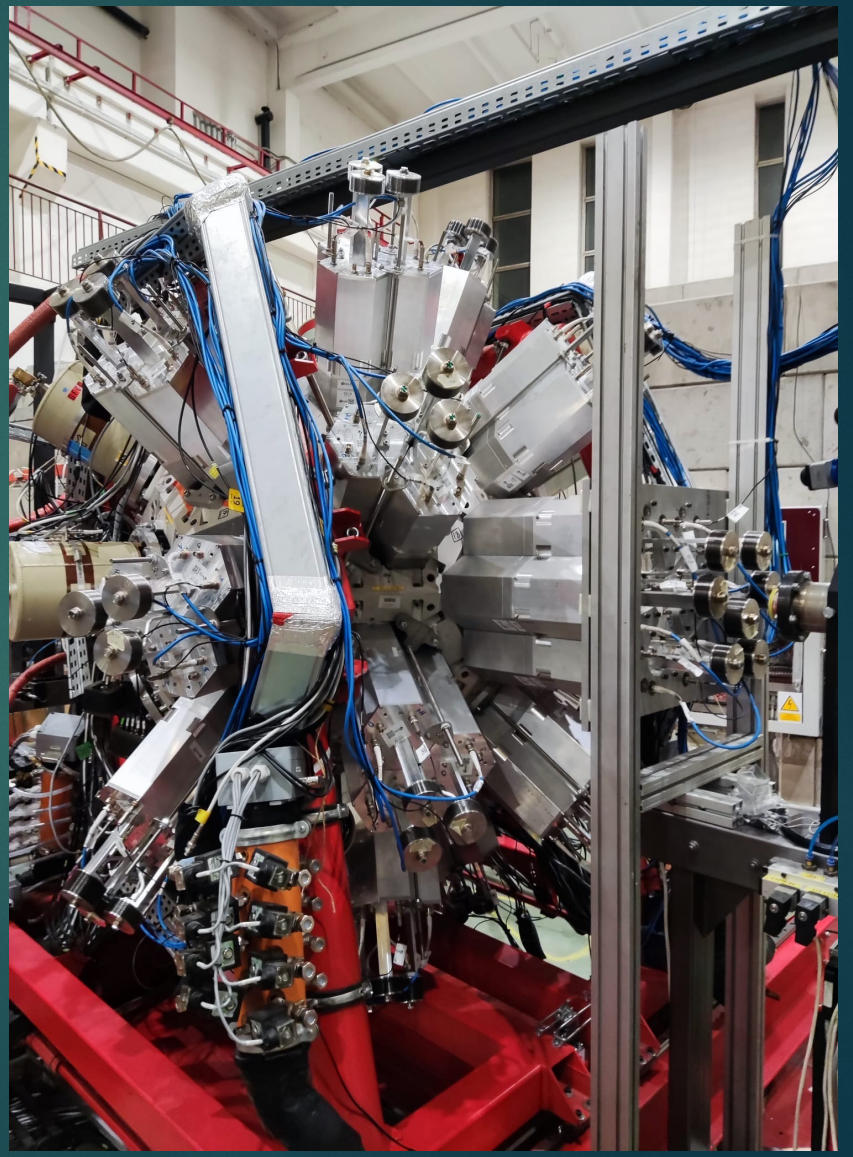
http://slcj.uw.edu.pl

**HIL Facility: Heavy Ion cyclotron U-200P** with K=160
Beams: from He to Ni, up to 10 MeV/u

**TNA facility in the EURO-LABS project**

The main current research program:

- nuclear structure studied by gamma-rays
- spectroscopy, nuclear reaction studies incl. nuclear astrophysics
- measurements of the Coulomb barrier distributions
- radiochemistry and radiobiology
- material science and particle detectors development



# Warsaw

http://fizyka.pw.edu.pl

**Faculty of Physics, Warsaw University of Technology**
**Nuclear Theory Group**

## Research topics

1. Collisions of medium-mass and heavy nuclei (P. Magierski et al.)
2. Induced nuclear fission (P. Magierski et al.)
3. Dynamics of vortices in the neutron star crust (G.Wlazłowski et al.)
4. Quantum turbulence in ultracold gases and neutron stars (G.Wlazłowski et al.)
5. Spin-imbalanced Fermi gases (P. Magierski et al.)
6. Transport through Josephson junction in ultracold gases (G. Wlazłowski et al.)
7. Bose-Fermi mixtures (M. Tylutki et al.)

Staff: 2; Post-docs: 4; PhD: 4.

**Theory**

NSR, NAP
STA 2, PD 4, PhD 4
NSR 2, NAP 2

Narodowe Centrum Badań Jądrowych
National Centre for Nuclear Research
ŚWIERK

instytut kategorii A+, JRC collaboration partner

**Warsaw**

https://www.ncbj.gov.pl

## Research topics

### FUNDAMENTAL RESEARCH

1. Research on mechanisms of nuclear reactions (N. Keeley at al.)
2. Properties of light nuclei (N. Keeley et al.)
3. Possibility of existence/stability/structure of super-heavy nuclei (J. Skalski et al.)
4. Synthesis of SHN - cross-sections calculations & predictions (M. Kowal et al.)
5. Properties of nuclei far from stability (E. Grodner et al.)
6. Nuclear exotic states (third minima, K-isomers, super-deformation) (M. Kowal et al.)
7. Evaluation and analysis of nuclear masses (Z. Patyk et al.)
8. Hadrons and nuclei (L. Szymanowski et al.)
9. Nucleon structure spin functions and spin-dependent effects in collisions of hadrons/lepton (J. Wagner et al.)
10. Participation in the construction of the PANDA detector
11. Analysis of multi-particle production processes in high-energy collisions of hadrons and nuclei
12. Hyper-nuclei, antiprotons, Gamow resonance states, "strange" - particles, - nuclei & - -atoms

Collaborating Polish physicists based abroad:
Krzysztof Piotr Rykaczewski (Oak Ridge)

Staff: 15; Post-docs: 1; PhD: 3.

NSR, HIP, HAD
STA 14, PD 1, PhD 3
NSR 6, HIP 3, HAD 7

Narodowe Centrum Badań Jądrowych
National Centre for Nuclear Research
ŚWIERK

instytut kategorii A+, JRC collaboration partner

Warsaw

https://www.ncbj.gov.pl

## Research topics

**NUCLEAR ENERGY & ENVIROMENTAL STUDIES**

1. Neutron physics analysis of reactor cores with particular stress on research reactors: fuel con-version studies, feasibility and safety of test and irradiation rigs.
2. Calculation of reactor core operational history, operational transients and core composition for various types of reactors, including GEN IV.
3. Activities related to development Gas Cooled Reactor Technology.
4. Activities related to nuclear cogeneration.
5. Development of models of phenomena, development and validation of computational tools.
6. Analyses of failures within extended design conditions and severe accidents: phenomena oc-curring in the core and the reactor vessel& in containment; assessment of radioactive sub-stances from power reactors, storages – source term quantification.
7. Nuclear fuel cycle analyses: Spent fuel recycling, transmutation Fuel properties studies.
8. Probabilistic safety analyses of nuclear reactors.
9. Advanced computer modelling of physical processes, in particular computational fluid dynamics and, transport and dispersion of dangerous substances in environment.

Staff: 14; Post-docs: 4; PhD: 1

Narodowe Centrum Badań Jądrowych
National Centre for Nuclear Research
ŚWIERK

instytut kategorii A+, JRC collaboration partner

Warsaw

https://www.ncbj.gov.pl

## Research topics

### MARIA- NUCLEAR REACTOR

1. Development and testing of nuclear measuring and diagnostic systems and subassemblies.
2. Neutron doping of semiconductor materials.
3. Neutron modification of materials.
4. Physical and neutronographic examinations.

### RADIONUCLIDES & MEDICAL APPLICATIONS

1. Radionuclides for therapeutic applications with high specific activity, generated by irradiation with neutrons.
2. Development of methods for obtaining new tracers for diagnostics and isotope therapy.
3. Technologies of obtaining radionuclides in cyclotrons.
4. Novel Methods of Producing Tc-99m and Tc-99m Generators in Poland.
5. The CERAD project - Centre for Design and Synthesis of Molecularly Targeted Radiopharma-ceuticals.
6. The NOMATEN module: Novel radiopharmaceutical materials for medical applications.

Staff: 8; Post-docs: 4; PhD: 1.

# Institute of Nuclear Chemistry and Technology

Warsaw

http://ichtj.waw.pl

## Research topics

1. Free radical studies by nanosecond pulse radiolysis and nanosecond laser flash photolysis (K. Bobrowski et al.)
2. Spectroscopy, molecular modeling and structure determination (J. Cz. Dobrowolski et al.)
3. ESR free radical studies (J. Michalik et al.)
4. Nuclear material studies (W. Starosta et al.)
5. Radiation technological dosimetry (M. Walo et al.)
6. Irradiated food detection (G. Liśkiewicz et al.)
7. Neutron activation analysis (R. Dybczyński et al.)
8. Radiobiology and biological dosimetry (M. Kruszewski et al.)
9. Synthesis of medical radioisotopes produced by accelerators and nuclear reactors (A. Bilewicz et al.)
10. Electron accelerator physics and applications (Z. Zimek et al.)
11. Electron accelerator environmental applications (A. G. Chmielewski et al.)
12. Radiation gas phase chemistry (Y. Sun et al.)
13. Food preservation with electron beam (W. Migdał et al.)
14. Membrane processes at nuclear industry (G. Zakrzewska-Kołtumiewicz et al.)
15. Nuclear chemistry (J. Ostyk-Narbutt et al.)
16. Radiotracer industrial applications (J. Kraś et al.)

Collaborating Polish scientists from abroad:
Ireneusz Janik (Notre Dame Radiation Laboratory, USA) (1)
Małgorzata Siwek (University of Huddersfield, UK) (10)

Staff: 26; Post-docs: 20; PhD: 15.

# Krakow

http://www.zzfj.if.uj.edu.pl/

## Institute of Physics, Jagiellonian University

**Cluster of Nuclear Physics Departments** (P. Moskal) http://www.zzfj.if.uj.edu.pl/

A. Department of Hadron Physics (P. Salabura)
B. Department of Theory of Nuclear Systems (J. Golak)
C. Department of Experimental Particle Physics and Applications (P. Moskal)

D. Department of Experimental Computer Physics (G. Zuzel) http://zdfk.if.uj.edu.pl/
E. Department of Hot Matter Physics (J. Brzychczyk) https://www.zefir.if.uj.edu.pl/

## Research topics

1. Investigations of hadrons' structure and interactions (P. Salabura et al.)
2. Few-body nuclear systems and their dynamics (J. Golak, S, Kistryn et al.)
3. Tests of fundamental symmetries in nuclear, hadron and lepton systems (P. Moskal et al.)
4. Experimental studies of neutrinos (G. Zuzel, J. Zejma)
4. Study of nuclear and hadronic matter in heavy ion collisions (M. Wójcik et al.)
5. Study of nuclear reactions (J. Brzychczyk, P. Staszel et al.)
6. Searches for the dark matter (A. Wieloch et al.)
7. Development of nuclear radiation detectors and techniques
8. Applications of nuclear physics in medicine and homeland (P. Moskal et al.)

9. Quark-gluon plasma (W. Florkowski et al.)

Staff: 28; Post-docs: 16; PhD: 36.

**Theory**

NSR
STA 4, PD 0, PhD 4
NSR 4

**Henryk Niewodniczański Institute of Nuclear Physics**
**Polish Academy of Sciences, Kraków**

http://www.ifj.edu.pl

**Krakow**

http://www.ifj.edu.pl

## Research topics

1. Properties of highly excited and fast rotating nuclei (A. Maj, M. Kmiecik et al.)
2. Nuclear structure studies using multinucleon transferprocesses (B. Fornal et al.)
3. High-spin phenomena in nuclei investigated with discrete gamma-ray spectroscopy (P. Bednarczyk et al.)
4. Properties of Giant, Pygmy and M4 Resonances studied with proton beam at CCB IFJ PAN (M. Kmiecik et al.)
5. Construction of the Photon Array for studies with Radioactive Ion and Stable beams (PARIS) (A. Maj, M. Ciemała et al.).
6. Few-nucleon system dynamics investigated with proton-deuteron collisions (A. Kozela et al.)
7. Properties of nuclear matter with heavy-ion beams at in-termediate energies (J. Łukasik, I. Ciepał et al.)
8. Fundamental symmetry tests with neutrons (BRAND and nEDM experiments) (A. Kozela, K. Pysz et al.)
9. The NA61/SHINE experiment at CERN - study of electromagnetic effects in collisions of atomic nuclei (A. Rybicki et al.)
10. The ALICE experiment at LHC@CERN (M. Kowalski et al.)
11. Theoretical investigations of the dynamics of nuclear many-body systems (A. Szczurek et al.)
12. Shell-Model in the Continuum (J. Okołowicz)
13. Neutron and gamma spectroscopy for nuclear fusion research: IFMIF-DONES and ITER (W. Królas et al.)
14. Range and Relative Biological Effectiveness uncertainties in proton therapy (A. Ruciński, P. Olko et al.).
15. Dosimetry of primary beam and scattered radiation in proton therapy (J. Swakoń, P. Olko et al.).

Collaborating Polish physicists based abroad:
J. Dudek (IPHC Strasbourg) (1,2,3); M. Górska (GSI) (3)
M. Lewitowicz (GANIL) (1,2,4,5); W. Nazarewicz (FRIB) (12)
M. Płoszajczak (GANIL) (12), K. Sieja (IPHC Strasbourg) (3)

Staff: 28; Post-docs: 8; PhD: 6.

**Theory**

NSR, NAP, HIP, HAD, SYM
STA 18, PD 7, PhD 7
NSR 2, NAP 1, HIP 10, HAD 15, SYM 3

# Krakow

**Henryk Niewodniczański Institute of Nuclear Physics**
**Polish Academy of Sciences, Kraków**

http://www.ifj.edu.pl

http://www.ifj.edu.pl

**2 cyclotron facilities:**

- **CCB: Cyclotron Center Bronowice:** 230 MeV protons for protontherapy (mainly) and research
- **AIC-144:** 60 MeV protons for irradiation of materials and detectors

**Both are as TNA in the EURO-LABS project (WP2 and WP4)**

The main current research program:

- investigations of gamma decay from high-lying states and giant resonances excited via (p,p'γ) reaction
- dynamics of few-nucleon systems
- study of high-lying single-particle states
- investigation of the mechanism of proton-induced fission and spallation
- in-beam testing of detectors constructed for the nuclear physics experiments in European facilities
- irradiations of different samples with high-intensity protons

UNIVERSITY OF SILESIA
AUGUST CHEŁKOWSKI
INSTITUTE OF PHYSICS

**Institute of Physics, University of Silesia Katowice**

**Katowice**

https://us.edu.pl/en/in-ifiz

## Research topics

1. Studies of few nucleon systems (E. Stephan et al.)
2. Studying the properties of neutrinos in long-baseline experiments (J. Kisiel et al.)
3. Study of heavy ion collisions at high and intermediate energies (S. Kowalski et al.)
4. Mössbauer spectroscopy (M. Kądziołka-Gaweł et al.)
5. Nuclear spectroscopy in environmental and medical research (B. Kozłowska et al.)

Staff: 7; Post-docs: 6; PhD: 11.

Silesian University of Technology

**Silesian University of Technology**

**Institute of Physics – Centre for Science and Education**
**Division of Geochronology and Environmental Isotopes**

**Gliwice**

https://www.polsl.pl/en/

## Research topics

**Radiocarbon and Mass Spectrometry Laboratory:**

1. Radiocarbon measurements with various techniques (LSC, AMS) (N. Piotrowska et al.)
2. Light stable isotope determinations (HCNO) with IRMS (N. Piotrowska et al.)

**Luminescence Dating Laboratory**

3. Dosimetric dating methods (OSL, TL) (A. Bluszcz et al.)
4. Radioisotope measurements (α and β spectrometry, e.g. 137Cs, 210Pb) (A. Bluszcz et al.)

Staff: 11; Post-docs: 3; PhD: 0.

# Szczecin

https://elbrus.usz.edu.pl

**University of Szczecin**

**Group of Nuclear, Plasma and Medical Physics, Institute of Physics and Centre for Experimental Physics "eLBRUS", University of Szczecin**

## Research topics

1. Nuclear reactions at extremely low energies (K. Czerski)
2. Experimental nuclear astrophysics (N. Targosz- Ślęczka)
3. High temperature plasma physics (M. Ślęczka)
4. Radiobiology and nuclear tracks (A. Kowalska)
5. High temperature nuclear reactors (K. Czerski)
6. Development of the ultra high vacuum accelerator system (M. Kaczmarski)
7. Radiospectroscopy Laboratory – Nuclear Magnetic Resonance (M. Olszewski)

Staff: 2; Post-docs: 4;  PhD: 8.

WYDZIAŁ FIZYKI
i INFORMATYKI STOSOWANEJ
Uniwersytet Łódzki

**Department of Nuclear Physics and Radiation Safety,**
**Faculty of Physics and Applied Informatics, University of Lodz**

**Łódź**

https://www.wfis.uni.lodz.pl

## Research topics

1. Precise determination of cross sections for the reactions induced by neutrons which are important for nuclear astrophysics or nuclear technology (J. Andrzejewski et al.)
2. Study of the K isomers with using gamma rays and internal conversion electrons spectroscopy. (J. Perkowski et al.)
3. Estimation exposure of medical staff and patients to ionizing radiation and application of new types of dosimetry in radiation protection (M. Wrzesień et al.)

Staff: 2; Post-docs: 3;  PhD: 0.

# Lublin

Department of Theoretical Physics
Maria Curie-Skłodowska University

http://kft.umcs.lublin.pl

http://kft.umcs.lublin.pl

## Research topics

1. Nuclear decays: fission, cluster and light particle emission, super-heavy nuclei (K. Pomorski et al.)
2. K-isomers, tetrahedral nuclei, point group symmetries in nuclear physics and nuclear shapes (A. Góźdź et al.)
3. Neutrinoless double-beta decay (W.A. Kamiński et al.)

Staff: 5; Post-docs: 2; PhD: 3.

**Theory**

NSR, SYM
STA 5, PD 1, PhD 4
NSR 5, SYM 1

Collaborating Polish physicists from abroad:

1. W. Nazarewicz, FRIB Michigan State University (1,2)

# Lublin

**Department of Materials Science**
**Maria Curie-Skłodowska University**

http://kfm.lublin.pl

http://kfm.lublin.pl

## Research topics

1. Studies on tissues and organic materials using positron annihilation (B. Jasińska, B. Zgardzińska)
2. Positron porosimetry (R. Zaleski)
3. Collaboration in creating J-PET positron tomography on plastic scintillation detectors (B. Jasińska)
4. Development of Tao-Eldrup model (R. Zaleski, B. Zgardzińska)
5. Nuclear methods in material studies (R. Zaleski, B. Zgardzińska)
6. Mössbauer spectroscopy (M. Budzyński)
7. Ion sources for nuclear spectroscopy, ion implantation (J. Żuk)

Staff: 9; Post-docs: 8; PhD: 2.

Collaborating Polish physicists from abroad:
H. Krzyżanowska, Vanderbilt University
S. Prucnal, HMDR, Drezno-Rossendorf


**Institute of Theoretical Physics (IFT), University of Wrocław**

**Wrocław**

https://www.ift.uni.wroc.pl/main

## Research topics

1. Neutron Starts their formation and mergers (D. Blaschke et al.)
2. Phenomenology of the Quark Gluon Plasma (QGP) (K. Redlich et al. )
3. Effective QCD, chiral dynamics, transport coefficients and hadron spectrum (C. Sasaki et al.)
4. Chromomagnetic Gluons in QCD thermodynamics (C. Sasaki et al.)
5. Massive supernovas as messengers of extreme state of nuclear matter (T. Fischer et al.)
6. The phase structure of QCD from Lattice QCD (K. Redlich et al.)
7. Correlations and fluctuations as the signature of the chiral symmetry restoration and deconfinement in QCD and in HIC (K. Redlich et al.)
8. Energy dependence of pion production in A-A collisions (M. Naskręt et al.)
9. Heavy flavor and strangeness production in HIC (K. Redlich et al.)
10. QCD matter in strong magnetic field (C. Sasaki et al.)
11. Kinetics of heavy flavor production in QGP (C. Sasaki et al.)
12. Matter under extreme conditions in heavy ion collisions and in neutron stars (D. Blaschke et al.,)

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# Wrocław

**Institute of Theoretical Physics (IFT), University of Wrocław**

https://www.ift.uni.wroc.pl/main

## Research topics

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13. S-matrix approach to QCD thermodynamics (Pok Man Lo et al.)
14. The NA61/SHINE experiment at the SPS accelerator at CERN - study of particles production in pp and AA collisions (L. Turko, M. Lewicki et al.)
15. NICA project @ Dubna (D. Blaschke et al.)
16. The ALICE experiment at the Large Hadron Collider (LHC@CERN) (K. Redlich et al.)
17. Quantum kinetics of particle production in strong fields (D. Blaschke et al.)
18. Phenomenology of cold nuclear matter with chiral symmetry restoration and application to astro-physics (M. Marczenko et al.)
19. Unified description of quark-hadron matter within density functional approach (N.U. Bastian et al.)

Staff: 7; Post-docs: 3; PhD: 4.

**Theory**

STA 7, PD 3, PhD 4
NAP 3, HIP 7, HAD 2

University of Zielona Góra

Institute of Physics

http://www.if.uz.zgora.pl

UNIWERSYTET ZIELONOGÓRSKI

Zielona Góra

http://www.if.uz.zgora.pl

## Research topics

1. Modeling of fission and other decays of heavy nuclei (P. Jachimowicz)

Staff: 1; Post-docs: 0; PhD: 0.

**Theory**

NSR
STA 1
NSR 1

# Jan Kochanowski University of Kielce

# Kielce

https://fizyka.ujk.edu.pl

***Mainly High Energy physics***

## Nuclear physics research topics

1. Theory of Quark-gluon plasma (M. Mrówczyński et al.)
2. Ultrarelativistic collisions, NA49, NA61/SHINE (M. Gaździcki et al.)
3. Hadron physics (W. Broniowski et al.)

Staff: 12; Post-docs: 1; PhD: 4.

**Theory**

NSR, HIP, HAD, SYM
STA 12, PD 1, PhD 4
NSR 3, HIP 10, HAD 6, SYM 2

University of Rzeszów

# Rzeszów

https://www.ur.edu.pl/en/home

## Research topics

1. Hadron physics theory (M. Łuszczak et al.)
2. Theoretical investigation of proton-proton collisions (N. Łuszczak et al.)

Staff: 2; Post-docs: 0; PhD: 1.

**Theory**

HIP, HAD
STA 2, PD 0, PhD 1
HIP 1, HAD 2

# Summary

1. There are 14 scientific insitutions in Poland with Nuclear Physics Groups working (in theory or/and experiment) in low energy nuclear physics, hadron physics and applications of nuclear physics
2. There are about 210 *(68 - theory)* staff members, 95 *(18)* post-docs and 115 *(27)* PhD students *(as per 2021!)*
3. There are 2 centres with User Facilities (HIL Warsaw and IFJ PAN Krakow), recognized as TNA
4. Strong collaboration of the polish groups with such large infrastructures as CERN, GSI/FAIR, GANIL/SPIRAL2, LNL/LNS, MSU/FRIB, ELI-NP/IFIN-HH and RIKEN, as well as the medium size facilities: Orsay, Grenoble, Jyvaskylla, RCNP Osaka and others