

STRUCTURAL BIOLOGY GROUP

dr hab. Maria Górna & dr Katarzyna Bandyra



GoRNA
STRUCTURAL BIOLOGY GROUP

RNA. Proteins. Structures.

ABOUT US

We are a part of the Laboratory for Structural and Biochemical Research (LBSBio) at the Biological and Chemical Research Centre. We study the function and structure of proteins and protein-protein and protein-RNA complexes using structural biology methods such as protein crystallography and electron microscopy, bioinformatics analysis and molecular dynamics simulations, as well as by functional assays both *in vitro* and in cell culture, employing biochemistry, biophysics and molecular biology techniques. Some of our interests include innate immunity, RNA metabolism, infectious diseases, mitochondrial RNA biology, protein engineering and infection diagnostics. We use structural models of proteins to elucidate the molecular mechanisms underlying selected human diseases or to aid drug discovery. We are also interested in proteins for which little structural information is available, so that we can answer vital questions about their activity and function. Through our findings and inventions, we would like to help combat infections or treat human inflammatory disorders.

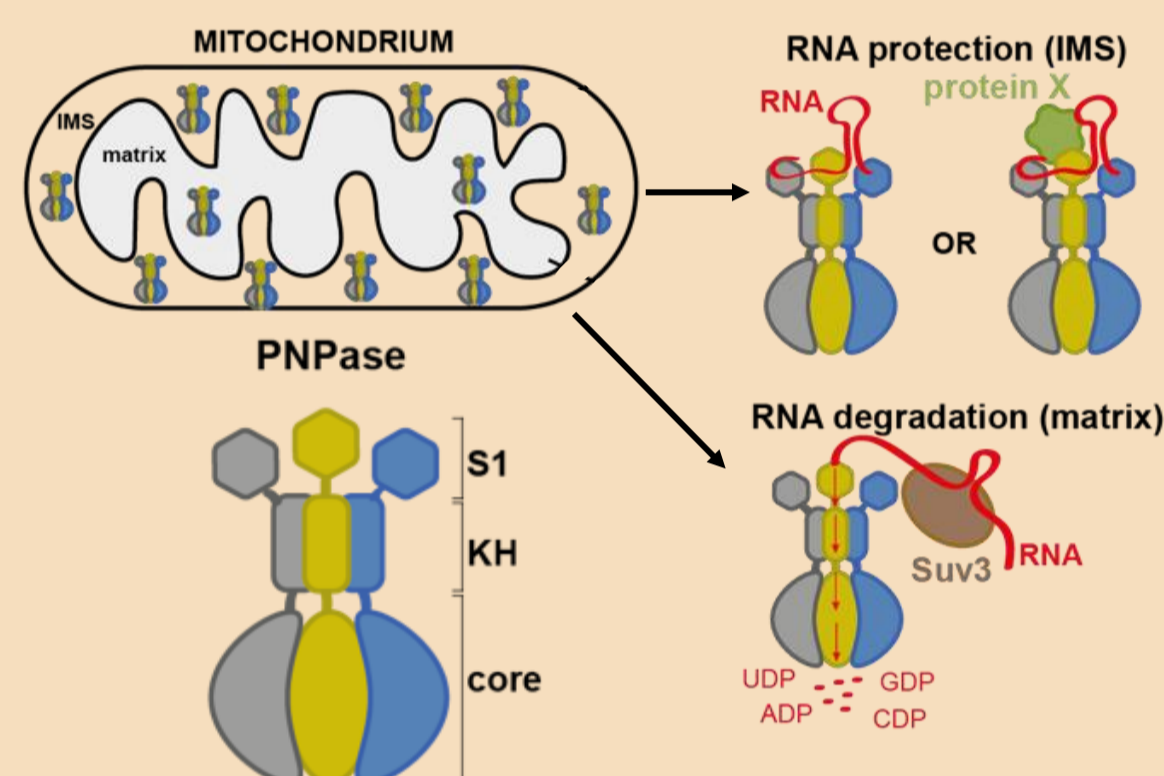


Our team members:
dr hab. Maria Górna
PhD. Katarzyna Bandyra
PhD. Maria Klimecka
PhD. Anna Trzemecka
MSc. Eng. Abhispita De
MSc. Jakub Kowalski
MSc. Dawid Dzadz
MSc. Eng. Ayomide Fasemire
MSc. Madhuri Kanavalli
MSc. Karolina Nowak
MSc. Navid Bakshi
BSc. Artur Bąk
BSc. Natalia Żebrecka

OUR PROJECTS

ROLE OF HUMAN PNPASE IN THE MITOCHONDRIA

Polynucleotide phosphorylase (PNPase) is an evolutionarily conserved exoribonuclease found in organisms ranging from bacteria to humans. While its primary function is RNA degradation, studies have shown that bacterial PNPase can also act as an RNA chaperone. Our goal is to determine whether human PNPase similarly exhibits distinct modes of action on target RNA: both degradative and protective, and to explore its potential roles beyond RNA turnover. Furthermore, we seek to elucidate the role of human PNPase in mitochondrial RNA transport and assess the possibility of delivering external nucleic acids to human mitochondria.

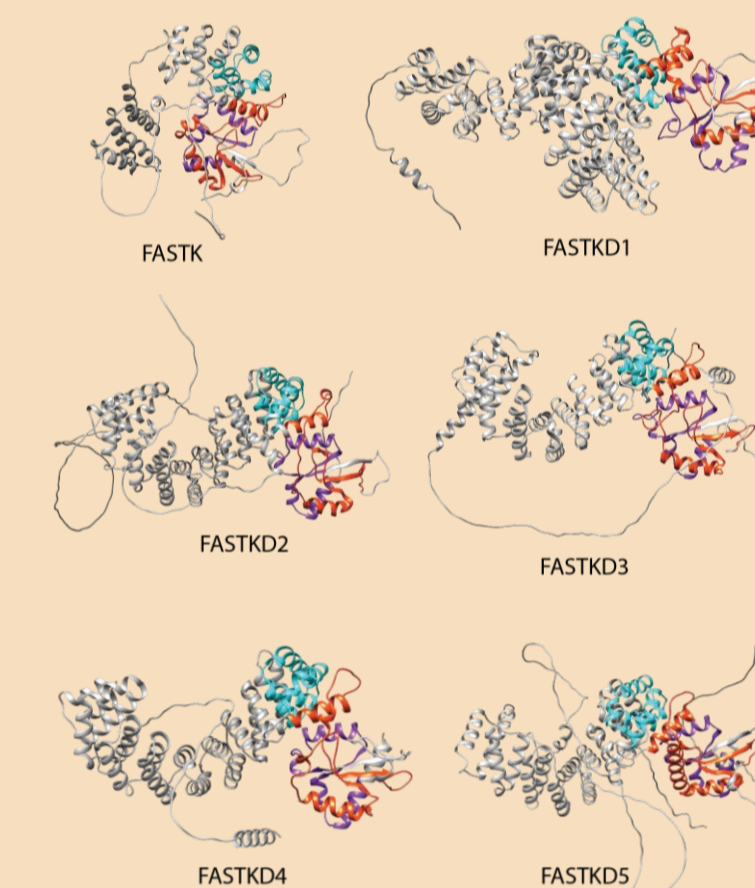


We are looking for two master's students to join this project. A scholarship of 1500 PLN per month is available for a duration of 16 months.



STRUCTURE AND FUNCTION OF HUMAN FAST PROTEIN FAMILY

The FASTK protein family has emerged as a key regulator of mitochondrial gene expression, likely featuring a novel RNA-binding fold. However, little is known about its mechanism of action, interactions with substrates and protein partners, or structural characteristics. In humans, this family comprises six members: FASTK and its paralogs FASTKD1–5. These proteins play a crucial role in human health, with links to cancer, Alzheimer's disease, and various inflammatory conditions. Understanding their molecular function could provide valuable insights into potential therapeutic strategies for disorders arising from their dysfunction. Our goal is to uncover the role of the FASTK protein family in mitochondrial RNA metabolism by investigating their structure, RNA substrates, and interactions with protein partners.

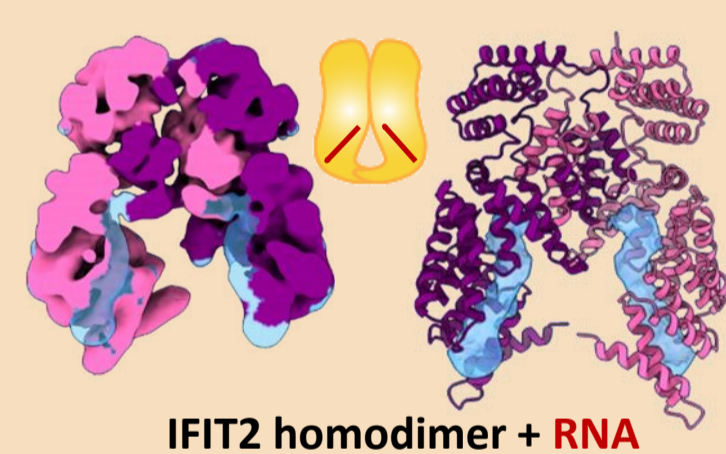


We are looking for a PhD student to join this project. A scholarship of 5000 PLN per month is available for a duration of 48 months.

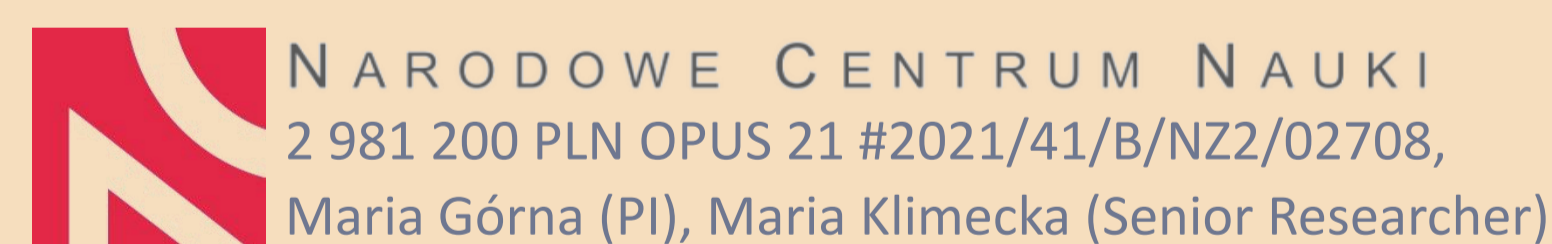
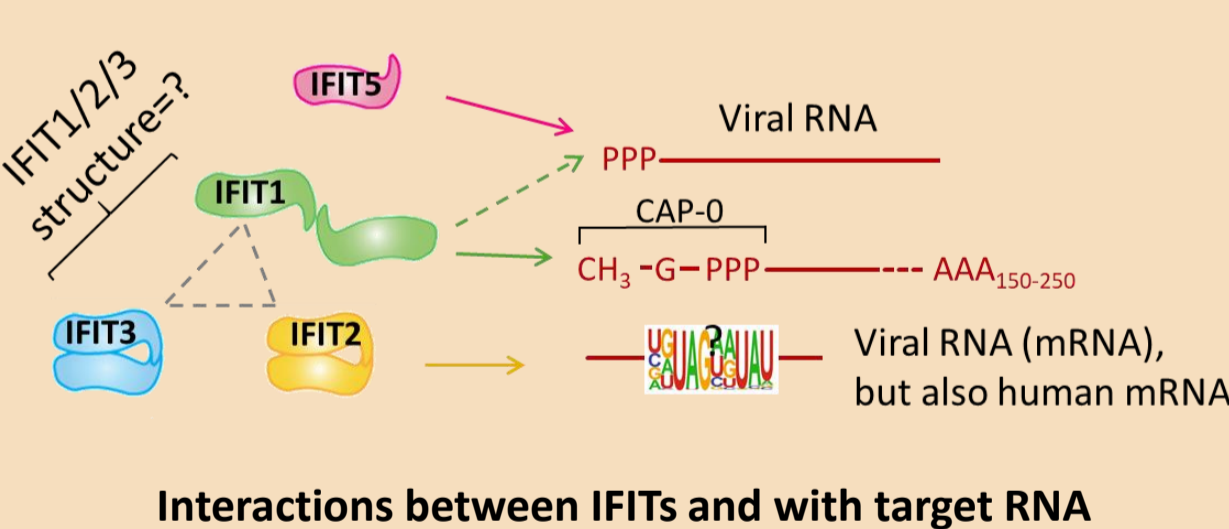


HUMAN ANTIVIRAL IFIT PROTEINS - DETECTION OF PATHOGEN RNA

IFIT proteins are part of the vertebrate innate immune system. IFITs are expressed in virus-infected cells, where they bind viral RNA and prevent its translation. We study the role of IFITs and their complexes in antiviral defense in non-immune cells and in human mRNA metabolism in macrophages in regulation of inflammation.

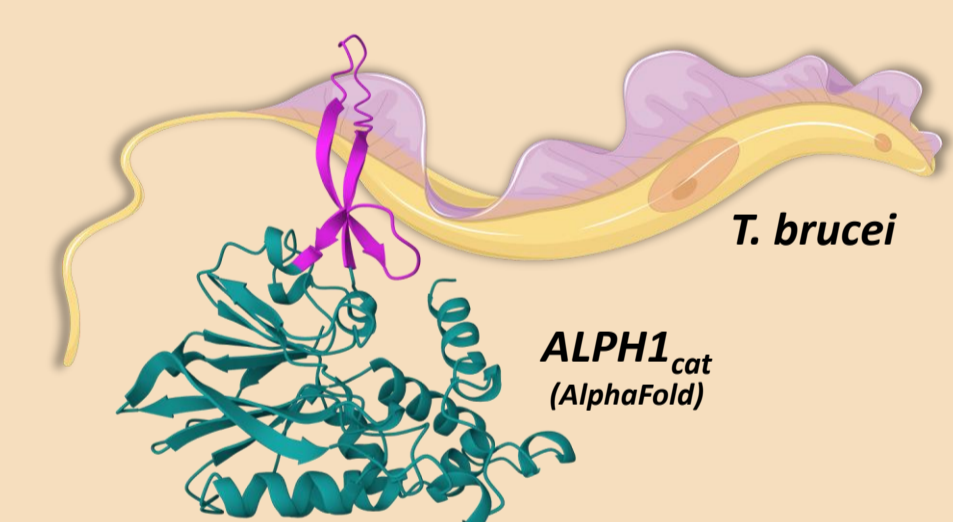


- Characterisation of RNA binding preference by IFIT complexes
- Potential applications in medical diagnostics and biotechnology
- Identification of IFIT protein complexes and RNA targets in cells
- Cryoelectron microscopy of IFIT-RNA complexes

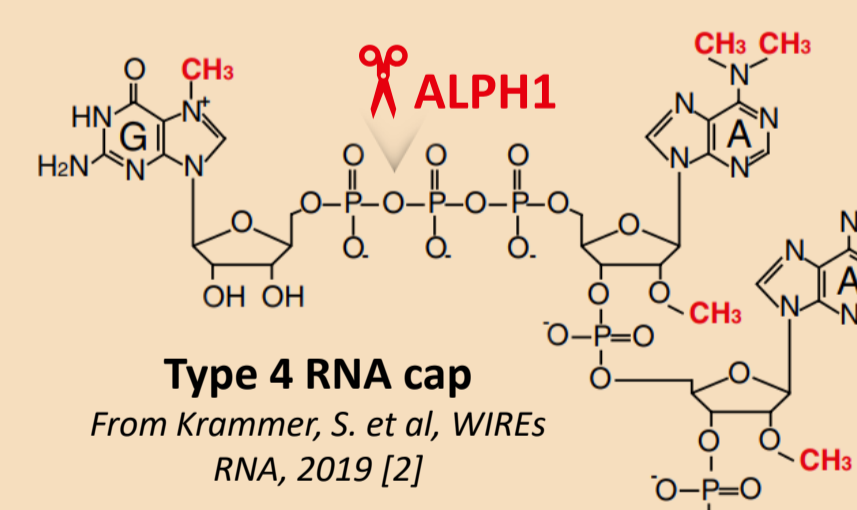
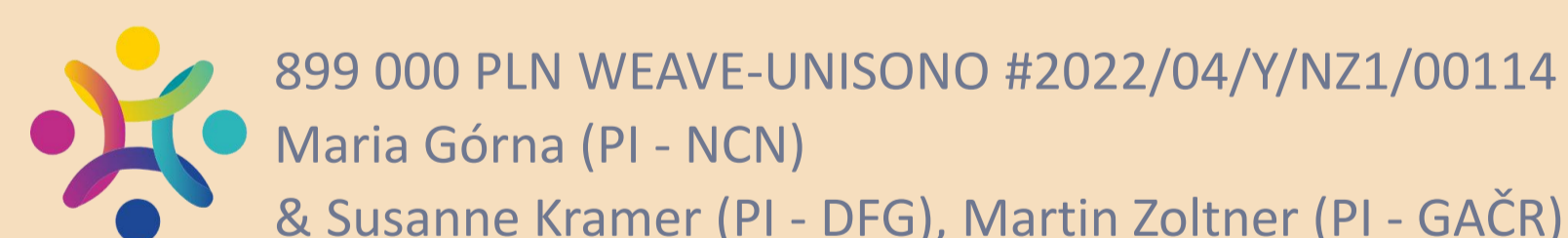


TRYPANOSOMA DECAPPING ENZYME – DRUG TARGET AGAINST TRYPANOSOMIASIS

ALPH1 is a unique mRNA decapping enzyme of worms from Trypanosomatida order (including parasitic ones), which differs from eukaryotic decapping enzyme Dcp2 in the cap cleavage mechanism. This and the fact ALPH1 is absent in eukaryotes means it can be exploited for trypanocidal drug development and novel biotechnology applications. In this joint project of 3 research groups from Warsaw, Würzburg and Prague we aim to:



- Provide essential research tools to study mRNA decapping pathway
- Provide drug candidates for trypanosomiasis with ALPH1 as target
- Employ unique ALPH1 decapping activity in biotech applications



PUBLICATIONS, PATENTS & NEW GRANTS



Methods in Molecular Biology

Nucleic Acids Research

EMBO reports

The FEBS Journal

jpiamr

EMDB

Sposób wzbogacania próbki cząsteczek RNA pochodzenia naturalnego w cząsteczki mRNA
Patent
(PL246461 (05.06.2019) UP RP (published WUP 3.02.2025, registered 28.11.2024)
Górna M., Nowacka M., Izert M., Kowalska M., Karolak N., Klimecka M., Młynarczyk K.

Discovery and Analysis of Repeat and Low-Complexity Architectures in Proteins and Their Conserved Evolutionary Relationships Using Self-Homology Dot Plots
Publication, Protocol in Protein Supersecondary Structures Book
Górna M.W., Merski M.
Methods Mol Biol. 2025;2870:95-116. doi: 10.1007/978-1-0716-4213-9_7

Cooperation of regulatory RNA and the RNA degradosome in transcript surveillance
Publication
Bandyra K.J., Fröhlich K.S., Vogel J., Rodnina M., Goyal A., Luisi B.F.
Nucleic Acids Research (2024) gkae455 https://doi.org/10.1093/nar/gkae455

Towards Targeted Protein Degradation - depletion of the essential GroEL protein in Escherichia coli using CLIPPERS
Preprint, submitted to EMBO Reports
Izert-Nowakowska M.A., Klimecka M.M., Antosiewicz A., Wróblewski K., Bandyra K.J., Górna T.K., Kmiecik S., Serwa R.A., Górna M.W.
bioRxiv 2024.02.29.582761; doi: 10.1101/2024.02.29.582761

Human FASTK preferentially binds single-stranded and G-rich RNA
Preprint, submitted to The FEBS Journal
Dawidziak D.M., Dzadz D.A., Kuska M.I., Kanavalli M., Klimecka M.M., Merski M., Bandyra K.J., Górna M.W.
bioRxiv 2024.07.16.603671; doi: 10.1101/2024.07.16.603671

FunHitDisco: A Fungal Hit Discovery Platform
Grant PLN 1 755 386 JPIAMR-ACTION Call 2024 #2024/06/Y/NZ1/00176
Maria Klimecka (PI), Maria Górna (Senior researcher) & Lindon Moodie (Coordinator - Sweden), Luke Robertson (Sweden), Seino Jongkees (Netherlands), Francesca Bugli (Italy)

GroEL with bound GroTAC peptide. PDB 8532 | EMD EMD-19687
Protein structure deposits (the first ever cryoEM deposit fully obtained at UW!)
Wróblewski K, Izert-Nowakowska MA, Goral TK, Klimecka MM, Kmiecik S, Gorna MW

IMPORTANT EVENTS



Mechanisms of RNA Decay Conference, Portugal 18-22th August 2024

Talk
"A cooperative PNPase-HFQ-RNA Carrier complex facilitates bacterial riboregulation"
Bandyra K.

Poster, Flash-Talk
"ApaH-like phosphatase ALPH1, the unusual decapping enzyme of Trypanosoma brucei"
Górna M., Dzadz D., Klimecka M., Karolak N., Pereira L., Warmiński M., Bednarczyk M., Kowalska J., Jemielity J., Zoltner M., Kramer S.



Protein Degradation in Focus, University of Dundee, UK, 19-22th May 2024

Poster
"Towards targeted protein degradation in Escherichia coli – essential protein depletion using Clp-Interacting Peptidic Protein Erasers (CLIPPERS) brings antimicrobial effects"
MA. Izert-Nowakowska, MM. Klimecka, A. Antosiewicz, K. Wróblewski, K. Bandyra, T. Górna, S. Kmiecik, R. Serwa, MW. Górna



24th Drug Design & Development Seminar (DDDS), Würzburg, Germany, 12-15th March 2024

Poster
"Structure-function studies of the mRNA decapping enzyme of Trypanosoma brucei"
D. Dzadz, M. Klimecka, N. Karolak, J. Zawada, M. Warmiński, J. Kowalska, J. Jemielity, M. Zoltner, S. Kramer, M. Górna



Institute Seminar & Career Development Day, IBB PAN, Warsaw, 19th November 2024

Talk
"A multitasking biochemist: from RNA binding proteins in innate immunity to antimicrobial drug discovery"
Górna M.



CryoEM and 3D image processing, EMBO practice course, Bangalore, India, 30-7th July 2024

Poster, Short Talk
"Decoding unknown role of hPNPase in intermembrane space of mitochondria"
Kanavalli M., Bandyra K.



Lab retreat, Lisna, Poland 10-12th July

