

# Wigner Scientific Computing Laboratory

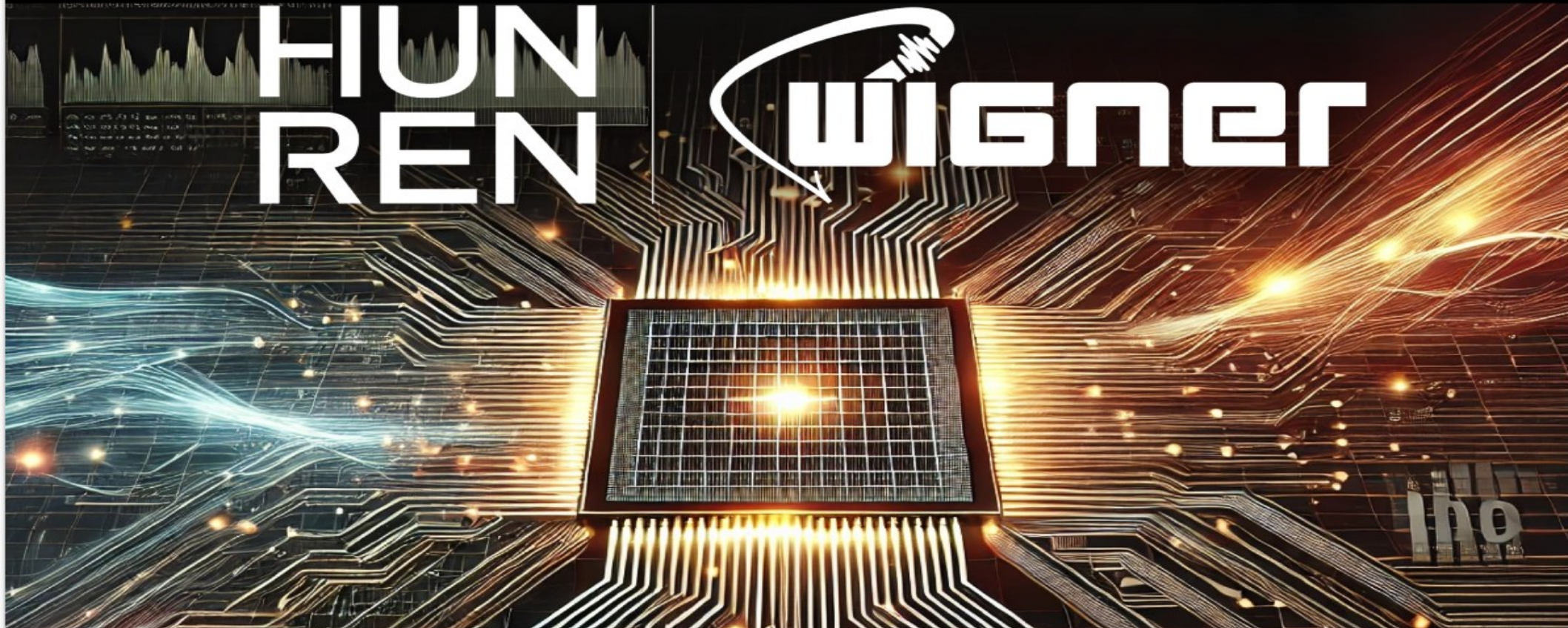
## 16<sup>TH</sup> GPU DAY

### Massive Parallel Computing For Science And Industrial Application

# HUN REN



# WIGNER



**HUN-REN**  
Hungarian Research Network

**HUN  
REN**

**WIGNER**

**WSCLAB**  
Wigner Scientific Computing Laboratory



**lombiq**

**STREAM  
HPC**

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# THE FUTURE OF MASSIVE PARALLEL AND QUANTUM COMPUTING

EMERGING ACCELERATOR PLATFORMS

IMAGE PROCESSING, COMPUTER VISION, AND RECONSTRUCTION

INDUSTRIAL APPLICATIONS

GRAPHICS, RENDERING, AND IMAGE SYNTHESIS

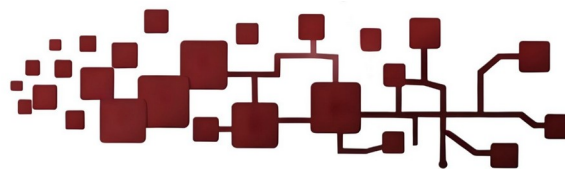
COMPUTING AND VISUALIZATION IN EDUCATION

QUANTUM COMPUTING SIMULATION

MACHINE LEARNING, NEURAL NETWORKS, FEATURE RECOGNITION

MANY-CORE COMPUTING IN PHYSICS AND OTHER FIELDS OF SCIENCE

# Gener8



**WSCLAB**

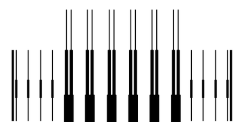
Wigner Scientific Computing Laboratory



## One Lab – Many Project Review of the WSCLAB



**Gergely Gábor Barnaföldi**  
**WSCLAB, HUN-REN Wigner Research Centre for Physics**



MTA  
Centre  
of Excellence



**ROLE>\_**

# WSCLAB's origin

16 YEARS IN PARALLEL COMPUTING (WIGNER GPU LABORATORY) & HPC @ WDC

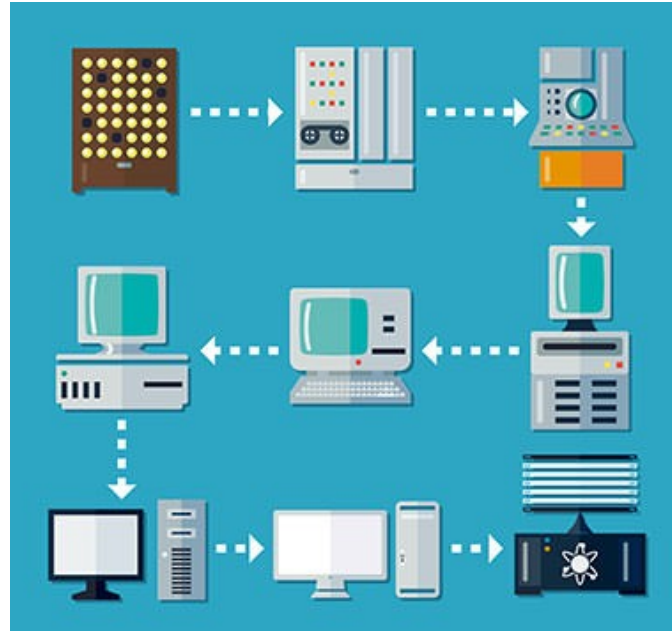


The aim of the Wigner GPU Laboratory is to provide support for any fields in science in sense of parallel computing techniques, especially for faster numerical calculations in gravitational and high-energy physics, astronomy, astrophysics, material sciences, and detector simulations. We have started with GPU technologies in 2009, but later our aim was improved to any kind of parallel computing technology. Today, many- and multi-core, GPU, FPGA, Xeon Phi technologies are all available in the laboratory. Beside the academic environment and other institutes, we have connections to industrial partners as well.



# WSCLAB's role

15 YEARS IN PARALLEL COMPUTING (WIGNER GPU LABORATORY) & HPC @ WDC



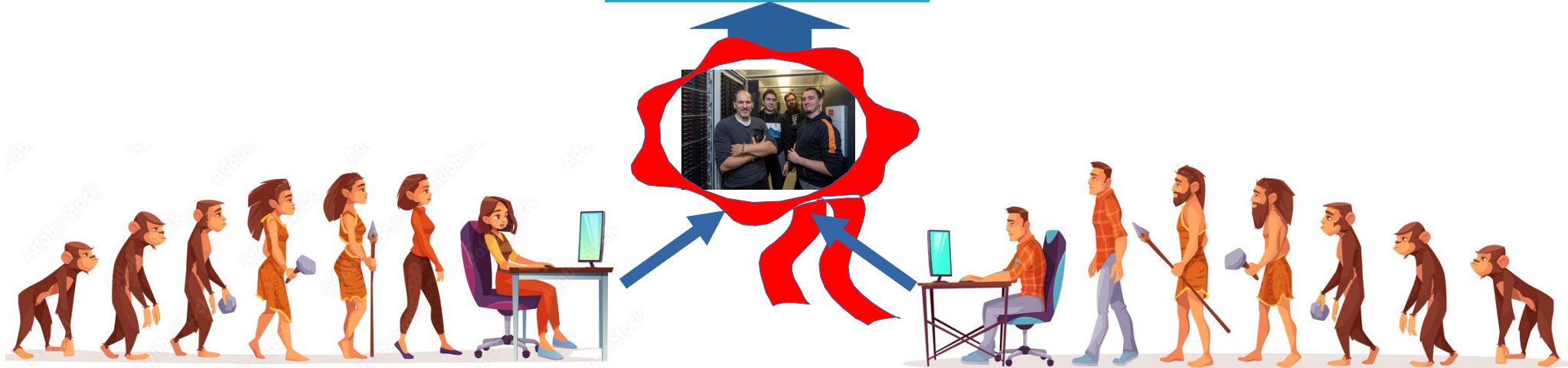
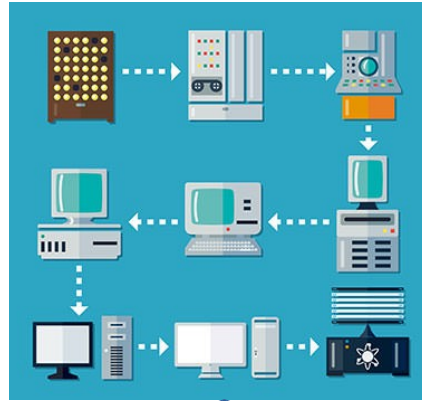
# WSCLAB's role

15 YEARS IN PARALLEL COMPUTING (WIGNER GPU LABORATORY) & HPC @ WDC



# WSCLAB's role

15 YEARS IN PARALLEL COMPUTING (WIGNER GPU LABORATORY) & HPC @ WDC



# The History of WSCLAB's Wigner GPU Laboratory

- **2005-2008 Early years: idea of using GPU in HEP calculations**

Starting of the WLCG Grid (ALICE & CMS) Tier-2 at the Wigner

- 2009 Discussion with GGB & P. Lévai & G. Debreczeni

2 main direction: HEP & Gravity

- **2010- 1<sup>st</sup> GPU Day & formation of the Wigner GPU Laboratory**

Students: M. F. Nagy-Egri & D. Berényi

- 2010- GPU Day series

- 2016- Lectures on Modern Computing in Science series

- 2016- Wigner GPU Lab Fellowship

- **2021- Wigner Scientific Computing Laboratory (NKFIH TOP50 RI)**



# WSCLAB @ NKFIH TOP50 Research Infrastructure

START: 17<sup>TH</sup> DECEMBER 2021.



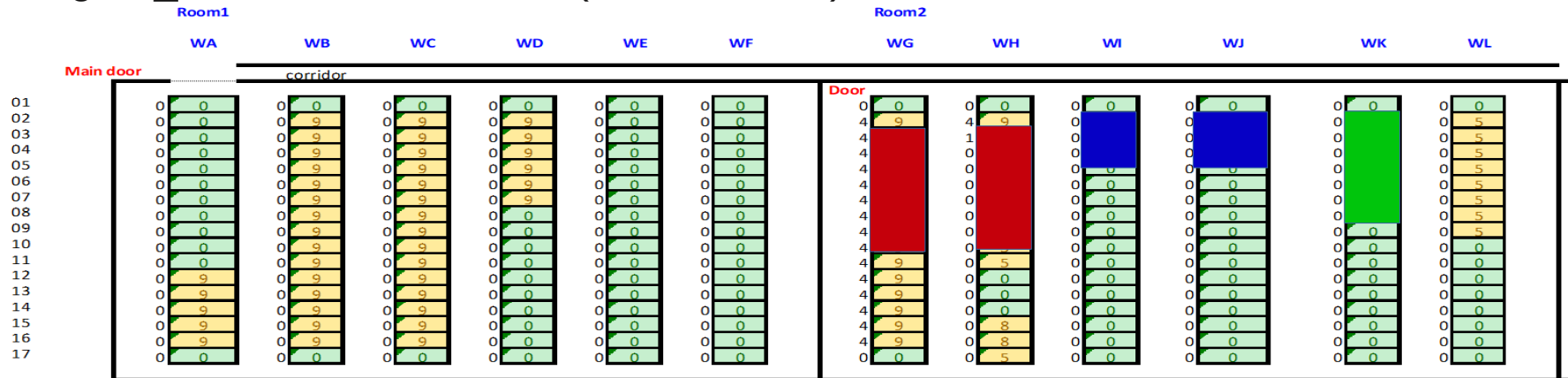


**HARDWARES>\_**

# WSCLAB @ WDC

## THE PLACE

- ✓ Wigner Analysis Facility (Wigner AF)
- ✓ Wigner GPU Laboratory
- ✓ Wigner\_KFKI WLCG T2 Grid (ALICE+CMS)







**EVENTS>\_**



# THE FUTURE OF MASSIVE PARALLEL AND QUANTUM COMPUTING

EMERGING ACCELERATOR PLATFORMS

IMAGE PROCESSING, COMPUTER VISION, AND RECONSTRUCTION

INDUSTRIAL APPLICATIONS

GRAPHICS, RENDERING, AND IMAGE SYNTHESIS

COMPUTING AND VISUALIZATION IN EDUCATION

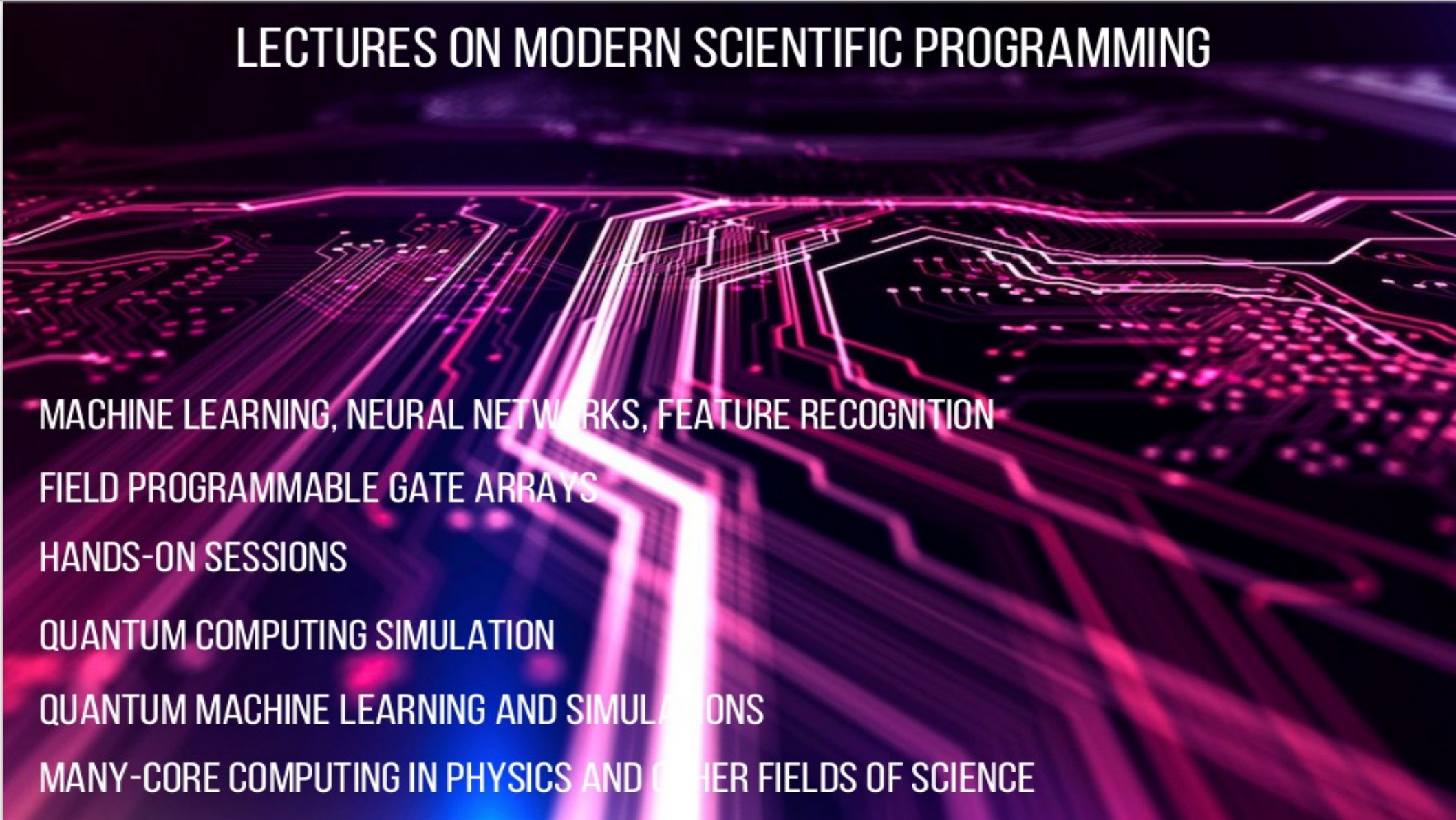
QUANTUM COMPUTING SIMULATION

MACHINE LEARNING, NEURAL NETWORKS, FEATURE RECOGNITION

MANY-CORE COMPUTING IN PHYSICS AND OTHER FIELDS OF SCIENCE



# LECTURES ON MODERN SCIENTIFIC PROGRAMMING



MACHINE LEARNING, NEURAL NETWORKS, FEATURE RECOGNITION

FIELD PROGRAMMABLE GATE ARRAYS

HANDS-ON SESSIONS

QUANTUM COMPUTING SIMULATION

QUANTUM MACHINE LEARNING AND SIMULATIONS

MANY-CORE COMPUTING IN PHYSICS AND OTHER FIELDS OF SCIENCE

# WSCLAB'S EDUCATIONAL MATTERS

Why GitHub? Team Enterprise Explore Marketplace Pricing Search Sign In Sign up

**wigner GPU Lab**  
Research group centered around massively parallel scientific calculations.  
Budapest, Hungary <http://gpu.wigner.mta.hu/>

Repositories 6 Packages People Projects

## OpenCL-Primer

Documentation on how to get started with OpenCL programming

BSD-3-Clause 0 0 0 0 Updated on Sep 26, 2019

## SYCL-PRNG

A pseudo random number generator library written against the SYCL API.

C++ 1 4 1 0 Updated on Jun 11, 2019

## Teaching

Material used for teaching.

C++ 8 43 6 (1 issue needs help) 0 Updated on Jun 7, 2019

## HaladoAlkProg

Code samples for the "Haladó Alkalmazott Programozás" course

C++ MIT 0 0 0 Updated on May 15, 2019

## LOMSP

Sample codes from the Lectures On Modern Scientific Programming series

C++ 1 1 0 0 Updated on Feb 14, 2018

## SchwarzschildRaytracer

Raytracer in the Schwarzschild metric for visualization

C++ 1 0 0 0 Updated on Jun 2, 2017

**wigner GPU Lab** 54 subscribers SUBSCRIBE

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# GitHub

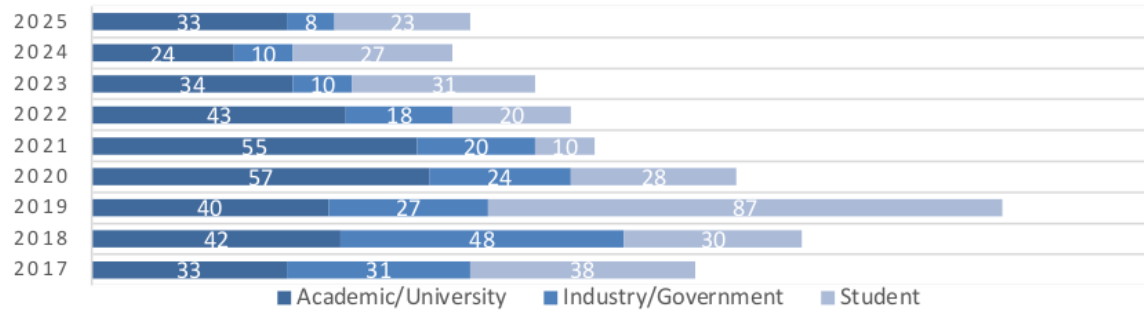


# PROJECTS>\_

# WSCLAB in numbers

KNOWLEDGE HUB: GPU DAY.COM

## ✓ 16 GPU Days



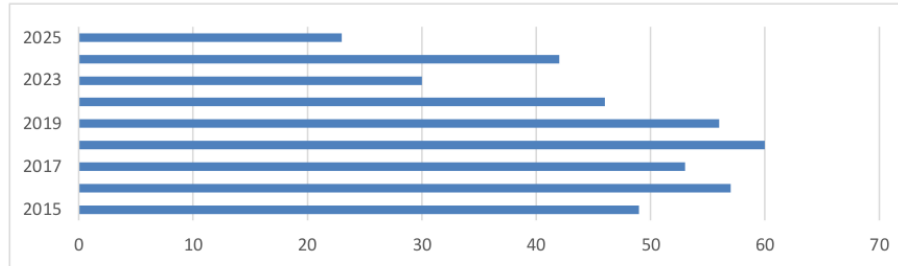
- ✓ 10 Lectures in Modern Computing in Science
- ✓ 70+ WSCLAB (Wigner GPU Lab) Fellowship
- ✓ 42+ industrial & academic partners (Lombiq LTD, Ericsson, 999999, Khronos, CERN, Qnexus, NTT...)
- ✓ 100+ scientific publications and program codes

# WSCLAB in numbers

KNOWLEDGE HUB: GPU DAY.COM

- ✓ 15 GPU Days
- ✓ 10 Lectures in Modern Computing in Science

Lectures on Modern Scientific Programming Participants



- ✓ 70+ WSCLAB (Wigner GPU Lab) Fellowship
- ✓ 42+ industrial & academic partners (Lombiq LTD, Ericsson, 999999, Khronos, CERN, Qnexus, NTT...)
- ✓ 100+ scientific publications and program codes

# WSCLAB's SCIENTIFIC RESULTS

## BASED ON THE PROJECTS

### ✓ Finished Projects from various fields

- Astronomy & Astrophysics (24)
- Physics (45)
- Biochemistry (9)
- Life & Medical Sciences, Etology/Ornitology (10)
- Computational Sciences, Imaging, Simulations (21)
- Quantum Computing (22)

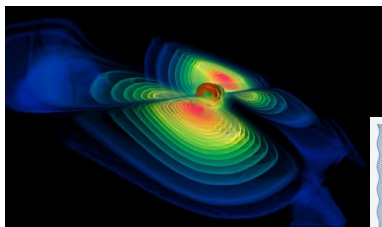
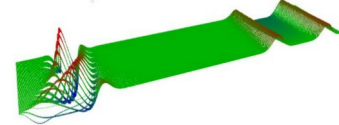
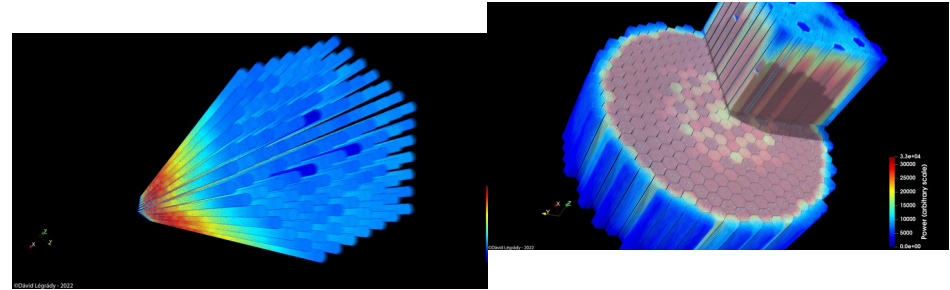
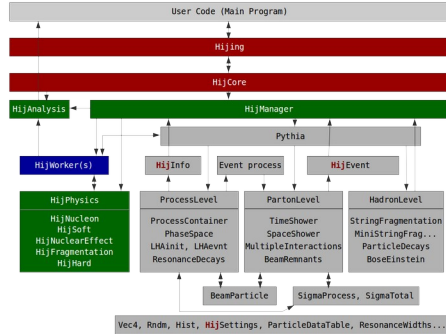


### ✓ List of Publications

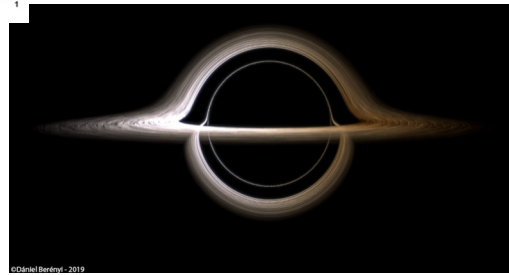
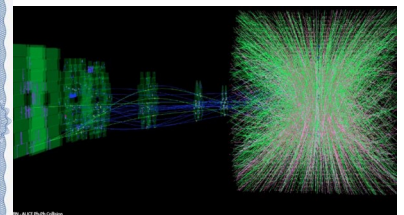
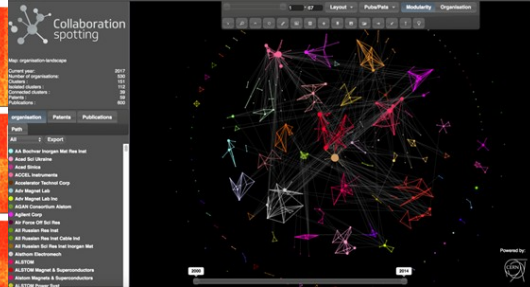
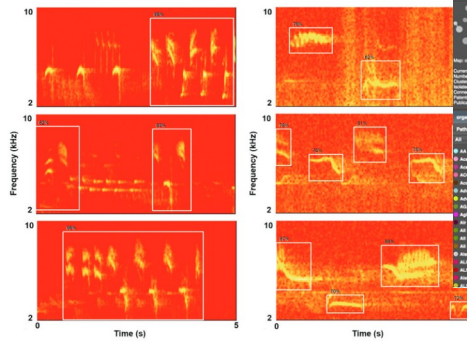
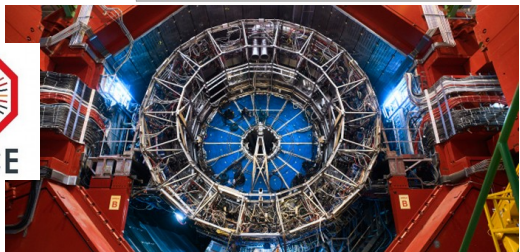
- More than 100 publications & public codes

# WSCLAB'S SCIENTIFIC PROJECTS

## FEW SELECTED ONES



ALICE





**FUTURE>\_**

# WSCLAB's FUTURE IS IN YOUR HAND

## ✓ What are the WSCLAB services

- Knowledge hub for scientific computing solutions
- Dedicated GPU & FPGA server hosting & services
- Quantum Computing simulations
- Tutorial series & teaching
- Advising highly-parallel computing
- PhD/PostDoc projects

## ✓ How to apply

- Visit [wsclab.wigner.hu](http://wsclab.wigner.hu)


Grant Opportunity

The GPU-Lab wishes to provide an opportunity for researchers to produce academic output with the Lab's monetal, infrastructural and technical support. Applications must always aim on publishing the achieved results.

APPLICATION WE OFFER

The application must contain a CV with emphasis on the scientific field knowledge and the programming experiences and a detailed plan of the proposed research project in not more than 2 pages detailing the following points:

- Project title and abstract in English
- Short introduction to the scientific problem
- Weekly plan breakdown
- CPU/GPU and FPGA time and development/user support needs
- Knowledge and experience in programming languages and parallel computing technologies
- Publication and other scientific outcome of the project



# WSCLAB's FUTURE

## PLANS FOR THE FUTURE

### ✓ Short timescale

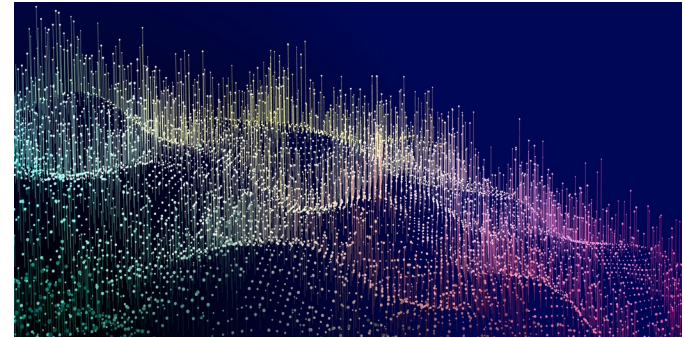
- New WSCLAB Grants for young scientists for 2026
- GPU Day 2026 series (28-29 May 2026)
- Lectures on Modern Computing in Science series (in fall 2026)

### ✓ Intermediate timescale

- Further local HW developments & cloud solutions
- GINOP+

### ✓ Long range plan

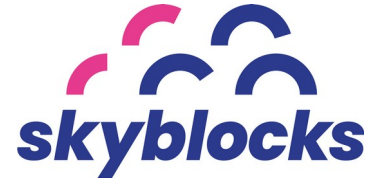
- Closely related to the EuroHPC LEVENTE project including Quantum Computing & Quantum simulations



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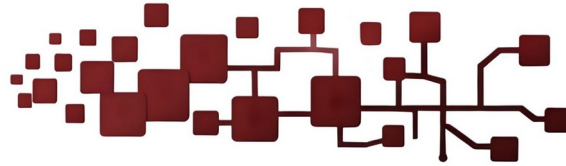
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ET DE PHYSIQUE DES PARTICULES



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ELKH | Eötvös Loránd  
Research Network



l'Observatoire  
de Paris

KRONOS  
GROUP  
CONNECTING SOFTWARE TO SILICON

SZÉCHENYI 2020



UNIVERSITY OF  
OXFORD



QNEXUS



Cerntech

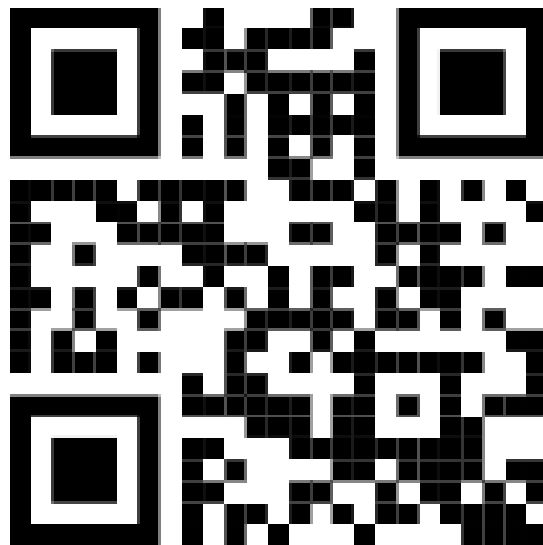




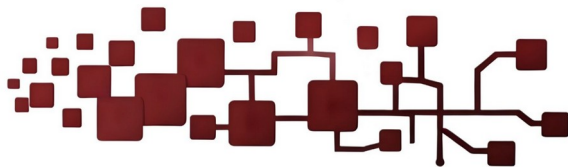
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