

Explore the hidden Universe

ASTROCENT

**Particle Astrophysics
Science and Technology Centre**

Leszek Roszkowski

Particle astrophysics*?

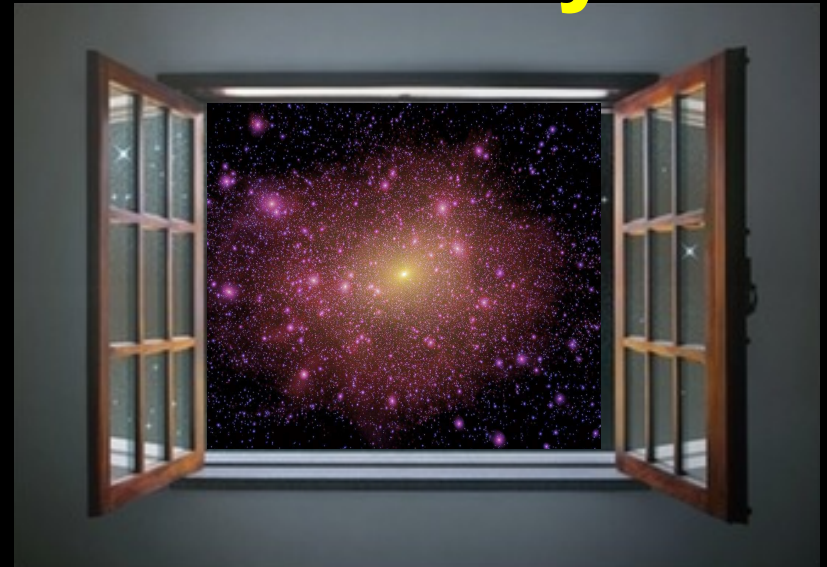
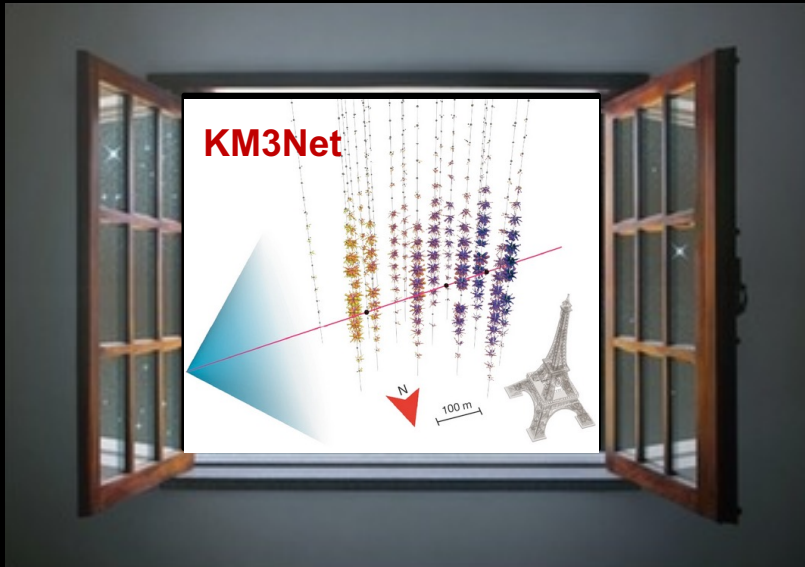
Hidden Universe?

* aka astroparticle physics (APP)

Windows on the Universe



→ multimessenger astronomy



Particle astrophysics: science and technology

Signals arriving from the hidden
(or invisible, or dark) Universe...

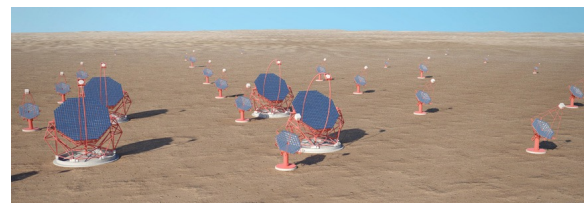
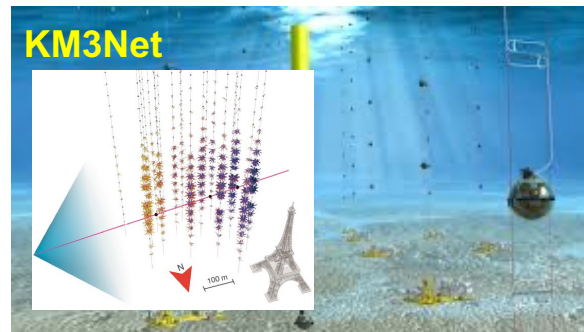
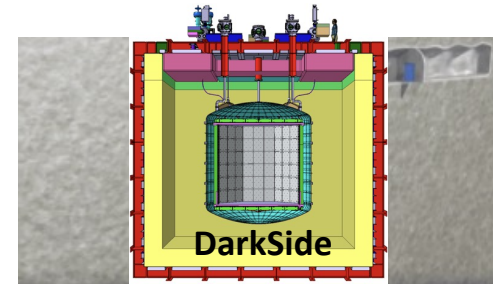
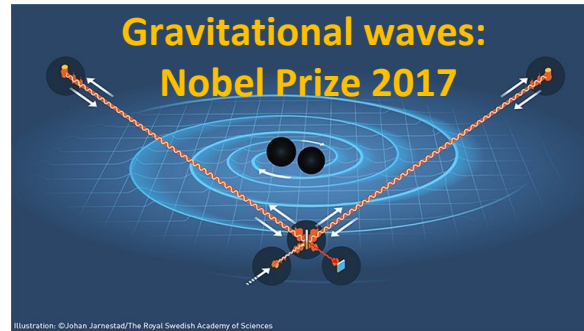
...are (expected to be) extremely faint

- ☐ Dark matter
- ☐ Gravitational waves
- ☐ Neutrinos
- ☐ ...

Fruitful cooperation of:

- fascinating, frontline science, and
- innovative, cutting-edge technologies

- enormous, complex challenges
- require international cooperation



Phase I: create CoE AstroCeNT

Particle Astrophysics Science and Technology Centre

- **International Research Agenda:** new centre of excellence
- **Funding:** 38 MPLN (8.3 M Euro, ERDF) for 5 years (**1 July 2018 – 30 June 2023**)
- **Autonomous department of CAMK PAN**

31 December '23

Main objectives:

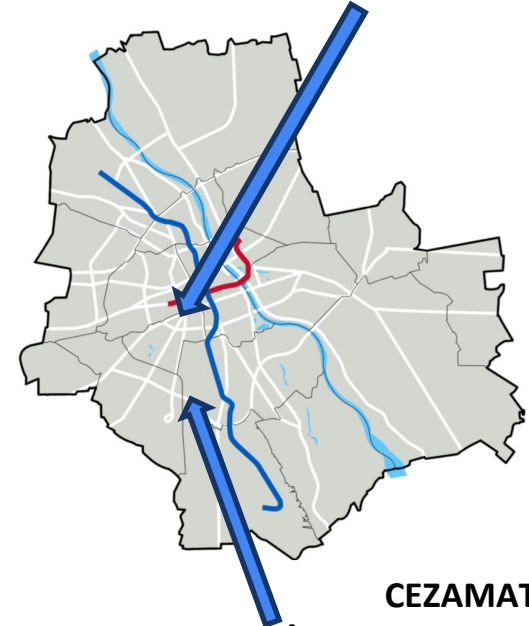
- **Studies of the invisible Universe** (neutrinos, dark matter, gravitational waves, theory and experiment...)  **Big science**
- **Ultra-sensitive instruments to detect extremely faint signals** (seismic sensors, modules of silicon photomultipliers (SiPMs), ...)
- **Big data collection and processing**  **Innovative technologies**
- **Applications to hi-tech industry and medicine (e.g., PET)**
- ...

Main outcomes:

- * ~150 publications, 2 patents (+1 pending),
- * some 60 researchers from 19 countries and 6 continents, ...
- * Astrocent became internationally recognised CoE,
- * member of seven large international experiments

ASTROCENT

- **Interdisciplinary**
(physics, engineering, programming,...)
- **electronics lab and clean room,**
equipment 3.5 M PLN (0.8 M Euro)
- **Member of 7 international experimental collaborations**
 - neutrinos: KM3Net, Hyper-Kamiokande
 - gravitational waves: AdVirgo, Einstein Telescope
 - dark matter: DarkSide, DEAP-3600, ARGO
- **2 patents, 1 pending approval, more in preparation**
- **collaboration with research and industrial partners**
- **strong support from Int'l Scientific Committee**
- **strong support from two Nobel prize winners:**
A. B. McDonald and B. Barish
- ...



Public
talks
22 Feb.
2023

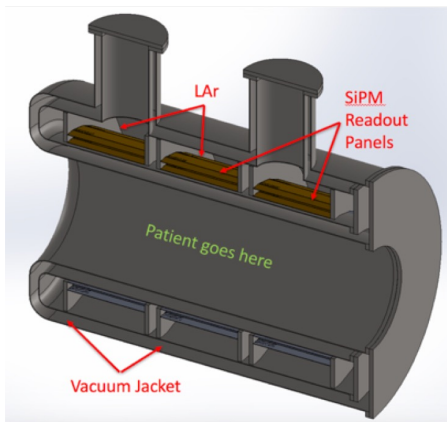


Astrocent: science and technology...

➤ sensors for environment:

- infrasound microphones
- autonomous seismic sensor
(M. Suchenek)

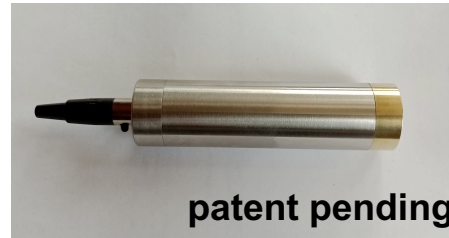
➤ liquid argon PET scanner



(M. Wada)

➤ wavelength shifters

(M. Kuźniak)



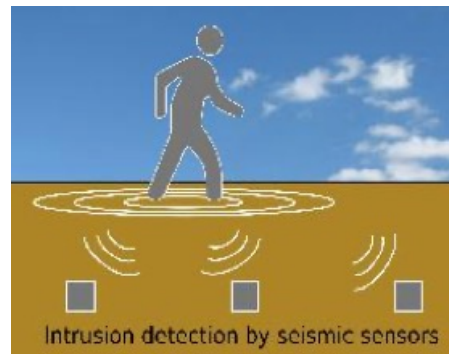
- ~20x cheaper than market products
- IP protected
- noise monitoring: wind farms, acoustic, ...



utility model

- early warning system, diagnostics, ...
- safety, ...

- ~10x cheaper than market products
- oil/gas exploration
- monitoring of large structures
- security, ...



Phase II: transform ASTROCENT *into a new interdisciplinary institute*

❖ **Prime objective of Teaming for Excellence project Astrocent Plus**

1 January 2025 – 31 December 2030, 15 MEuro (EC) + 15 MEuro (compl. fund.: Ministry + IRA/FNP)

~100 researchers (expt, theory) + ~25 support staff

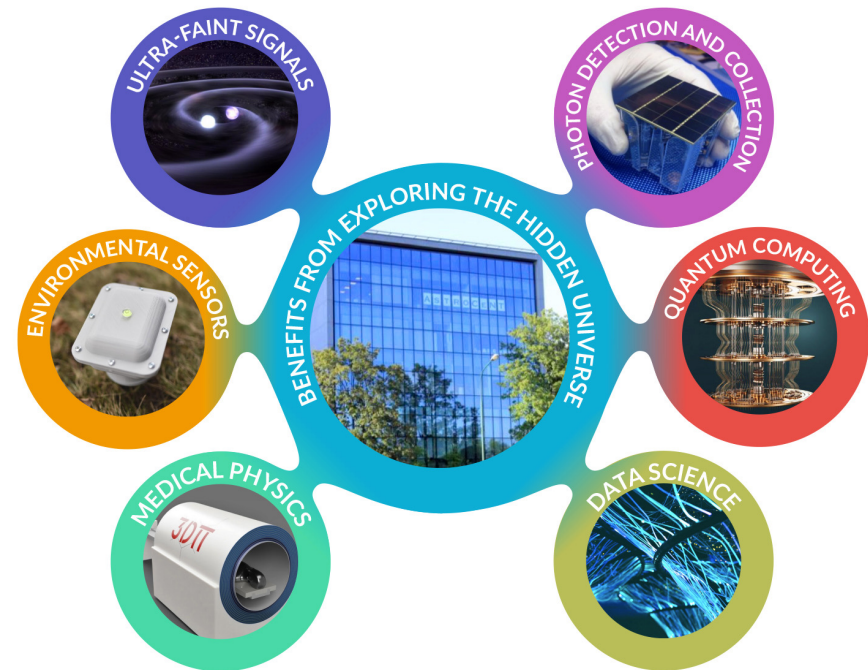
<u>Consortium Members:</u>	Country
Nicolaus Copernicus Astronomical Centre Polish Academy of Sciences (NCAC) – initial coordinator	Poland
Łukasiewicz Center (LC)	Poland
Centre National De La Recherche Scientifique (CNRS)	France
Universite Paris Cite (UPC) -- <i>Affiliated Partner</i>	France
Gran Sasso Science Institute (GSSI)	Italy
Deutsches Elektronen-Synchrotron Desy (DESY)	Germany
Arthur B. McDonald Canadian Astroparticle Physics Research Institute (MI) -- <i>Associated Partner</i>	Canada

Why new astroparticle physics centre in in Poland



Main research goals of Astrocent Plus:

- combine future-oriented fundamental research programme in astroparticle physics with widely-applicable innovative technologies
- focus on developing technologies beneficial for both frontline research and for addressing global challenges:
 - healthcare,
 - climate change,
 - sustainable energy sources
 - ...



Inspiration:
Stavros Katsanevas,
Chair of ISC (2018-22)

Welcome to Astrocent!