PROCEEDINGS OF SCIENCE

# The $27^{th}$ European Cosmic Ray Symposium – General remarks

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The $27^{th}$ European Cosmic Ray Symposium (ECRS) has been held in Nijmegen, the Netherlands from 25 to 29 July 2022. Some general remarks about the symposium are given in this contribution.

*27th European Cosmic Ray Symposium - ECRS*
*25-29 July 2022*
*Nijmegen, the Netherlands*

*Speaker





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## 1. Introduction

The 27$^{th}$ European Cosmic Ray Symposium (ECRS) has been held in Nijmegen, the Netherlands from 25 to 29 July 2022. The symposium was hosted by the Radboud University in Nijmegen. Nijmegen is the largest city in the Dutch province of Gelderland and tenth largest of the Netherlands as a whole, located on the Waal river close to the German border [1]. Nijmegen is the oldest city in the Netherlands, the second to be recognized as such in Roman times, and in 2005 celebrated 2 000 years of existence. Nijmegen became a free imperial city in 1230 and in 1402 a Hanseatic city. The city is well known for the International Four Days Marches Nijmegen event. Its population in 2022 was 179 000.

Radboud University [2] (Dutch: Radboud Universiteit, formerly Katholieke Universiteit Nijmegen) is a public research university located in Nijmegen. The university bears the name of Saint Radboud, a 9th century Dutch bishop who was known for his intellect and support of the underprivileged. Established in 1923, Radboud University has consistently been included in the top 150 of universities in the world by four major university ranking tables. Among its alumni Radboud University counts 12 Spinoza Prize laureates and 1 Nobel Prize laureate, Sir Konstantin Novoselov, the discoverer of graphene. Other notable alumni include former Prime Minister of the Netherlands Dries van Agt and First Vice-President of the European Commission Frans Timmermans.


**Figure 1:** Code of arms of Radboud University.

About 25 000 students are studying at Radboud University, accompanied by about 3 340 FTE academic staff and 350 FTE professors. The university is organized in seven faculties: Faculty of Arts, Faculty of Law, Radboud University Medical Centre, Nijmegen School of Management, Faculty of Philosophy, Theology and Religious Studies, Faculty of Social Sciences, and the Faculty of Science. The latter hosts among others the Institute for Mathematics, Astrophysics and Particle Physics (IMAPP). Research on Astroparticle Physics is conducted in two of its departments: the Department of High Energy Physics and the Department of Astrophysics.

## 2. Local connections

Since its beginnings the research about the properties and origin of cosmic rays is connected to Dutch scientists. A pioneer of cosmic ray investigations was Theodor Wulf. He taught physics at the Jesuit University in Valkenburg, the Netherlands from 1904 to 1914 and 1918 to 1935. In the early twentieth century the electrometer was the standard instrument to study radioactivity and the related conductivity of air [3]. It was known that radioactivity ionizes air (or gases in general) and an electrometer in the vicinity of a radioactive source will be discharged. One of the best electrometer builders of this time was Wulf. In 1909 he publishes on "A new Electrometer for static charges" [4]. A schematic view of his apparatus is given in Fig. 2. Heart of the device is a pair of quartz fibers. They are attached at the bottom to a further, bend quartz fiber, which acts as a spring. By adjusting the tension on this spring, the sensitivity of the electrometer can be adjusted. The

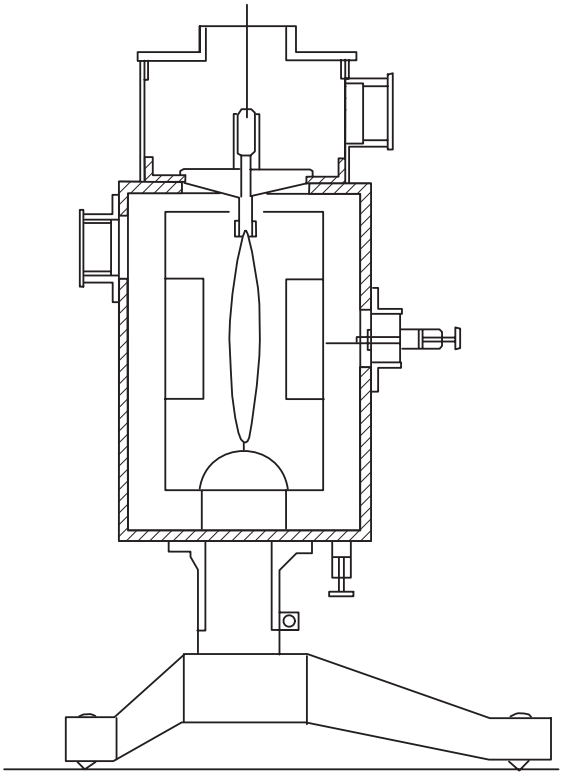

**Figure 2:** Electrometer after Th. Wulf [4].

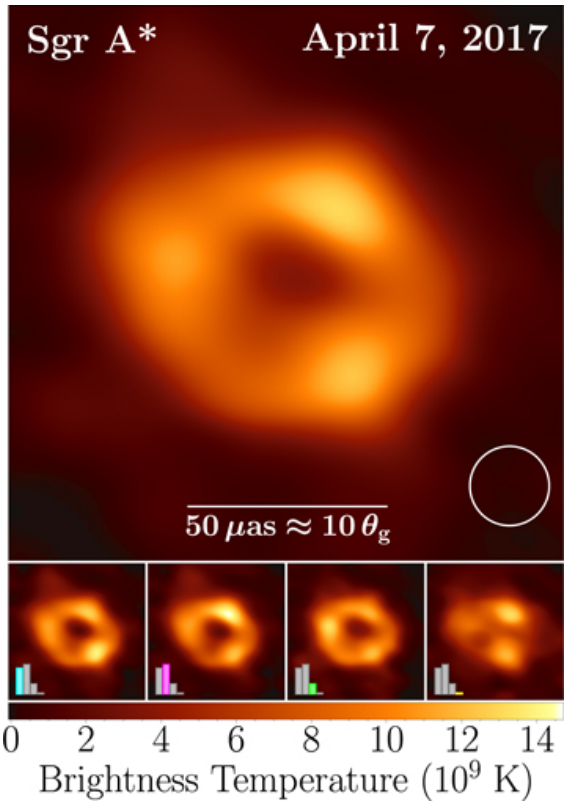


**Figure 3:** Representative EHT image of Sgr A* from observations on 2017 April 7.



distance of the two fibers is measured through a microscope, which is attached at the circumference of the device. Main application was a survey to find the origin of the radioactivity in the air.

Another pioneer is J. Clay who worked in the 1930s in Amsterdam. In 1934 and 1935 he published articles on "Results from the Dutch cosmic ray expedition 1933" [5]. During a journey from Holland to Java (Indonesia) the intensity of cosmic rays/atmospheric radiation has been recorded and it has been found that the intensity changes as a function of geomagnetic latitude. This was a clear hint that cosmic rays are charged particles (and not gamma rays, as suggested earlier).

In present days Dutch scientists are involved in a broad spectrum of activities in the field of Astroparticle Physics. A good overview is given in the "Strategic plan for astroparticle physics in the Netherlands 2014 – 2024" which has been published by the Committee for Astroparticle Physics in the Netherlands – CAN [6]. Research is centered around the questions: What is the origin of the highest energy particles in the Universe? What is the nature of spacetime? What is the nature of Dark Matter? What is the origin of the large-scale structure of the Universe? What is the structure of the physics beyond the Standard Model? Dutch scientists have strong roles in Theoretical research, Measurement of cosmic rays – Pierre Auger Observatory, Neutrino astronomy – KM3NeT, Gamma ray astronomy – CTA, Detection of gravitational waves – Virgo, Einstein Telescope, and Direct detection of dark matter – XENON.

One of the recent highlights of research activities at Radboud University was the first image of a black hole in the Galaxy M87 and in our own Milky Way. In [7] the first Event Horizon Telescope

(EHT) observations of Sagittarius A* (Sgr A*) have been presented, the Galactic center source associated with a supermassive black hole. The EHT data resolve a compact emission region with intrahour variability, see Fig. 3. A comparison with the EHT results for the supermassive black hole M87* shows consistency with the predictions of general relativity spanning over three orders of magnitude in central mass.

## 3. Special circumstances

The organization of the 27$^{th}$ European Cosmic Ray Symposium has been accompanied by very special circumstances. Originally, the symposium has been planned for the year 2020. However, the outbreak of the world wide corona pandemic has set this plans on halt. Eventually, the International Advisory Committee has decided to conduct the symposium in July 2022.

A few months before the planned start of the symposium the world has been shocked by the Russian invasion of Ukraine. This is of particular importance for the ECRS, since the ECRS series has been established in the Cold War in order to build bridges between the East and the West.

The organizers of the 27$^{th}$ European Cosmic Ray Symposium clearly commit to the

**IUPAP Statement on the events occurring in Ukraine**

*We are consternated by the news regarding the Russian military offensive in Ukraine and the terrible consequences that this has on the lives of our colleagues in Ukraine. We extend our deepest sympathy and solidarity to them and to all the Ukrainian people at this difficult time. We praise the large number of Russian colleagues who have expressed their sympathy for their Ukrainian colleagues and demanded peace for their countries.*

*In our 100th anniversary this year, we note the critically important historical role that IUPAP has always strived to play in bringing physicists together across political divides even during our most difficult years in the past. IUPAP continues to embrace and promote scientific collaboration across the world as a driver for peace.*

Given all those circumstances, the organizers were pleased to have welcomed around 100 participants personally in Nijmegen and having another about 70 participants joining remotely via video conferencing.

## 4. Sponsors

We are grateful to our sponsors who helped to make the 27$^{th}$ European Cosmic Ray Symposium a success. Without their generous contributions the symposium would not have been possible. In particular, we acknowledge contributions from
NWO – The Dutch research council,
Nikhef – The Dutch Institute for Subatomic Physics,
NOVA - The Netherlands Research School for Astronomy,
Hamamatsu Photonics,
Springer/European Physical Journal C, and
Radboud University.


**Figure 4:** Sponsors of the 27$^{th}$ European Cosmic Ray Symposium.

## 5. Committees

For the organization of the 27$^{th}$ European Cosmic Ray Symposium the following bodies have been crucial.

**The International Advisory Committee – IAC:**

Sabrina Casanova,
Andrea Chiavassa,
Silvia Dalla,
Mateja Dumbovic,
Erwin Flückiger,
Phillipe Gorodetsky,
Bernd Heber,
Pavel Klimov,
Kumiko Kotera,
Leonid Aleksandrovich Kuzmichev,
Olga Malandraki,
Piergiergio Picozza,
Mario Pimenta,
Jacek Szabelsky,
Ilya Usoskin,
Veronique Van Elewyck,
Vladimir Zirakashvilli, and
Jörg R. Hörandel (chair).

**The International Scientific Program Committee – ISPC:**

Silvia Dalla, SH – Solar and heliospheric cosmic rays, SEPs and GCR propagation,
Olga Malandraki, GEO – Cosmic rays at Earth and planets,
Monica Laurenza, SW – Space weather,
Manuela Vecchi, CRD – Direct measurements of cosmic rays,
Antonella Castellina, CRI – Indirect measurements of cosmic rays,
Elena Orlando, THEO – Acceleration, propagation, origin of cosmic rays,
Michael Unger, EAS - Air shower physics and hadronic interactions,
Markus Ahlers, NU – Neutrinos,
Sabrina Casanova, GA – Gamma rays,
Elisa Resconi, MM – Multi-messenger astroparticle physics,
Francesca Caore, DM – Dark matter,
Anna Nelles, INSTR – Future measurements, instrumentation and methods, and
Jörg R. Hörandel (chair).

**Local Organizing Committee:**

Merijn Augustus,
Astrid Linssen,
Monique van Ballegooijen,
Gertie Verbeek,
Sandra Wessels,
Patrick Decowski,
Katie Mulrey,
Dorothea Samtleben,
Harm Schoorlemmer,
Manuela Vecchi,
Washington Carvalho Jr.,
Tomáš Fodran,
Ugo Giaccari,
Mohamed Ismaiel,
Krishna Nivedita Gopinath,
Abha Khakurdikar,
Bjarni Pont, and
Jörg R. Hörandel (chair).

We are grateful to all colleagues who helped to make the 27$^{th}$ European Cosmic Ray Symposium a success.

## 6. Pervious symposia

The ECRS series has been initiated in 1968 by Arnold Wolfendale (University of Durham, United Kingdom) and Wlodzimierz (Alexander) Zawadski (Head of the Cosmic-Ray Group in Łódź, Poland). At the height of the Cold War (1947 – 1991), when exchanges were often extremely difficult, they decided to promote links between scientists from Eastern and Western Europe through a series of symposia. Alan Watson, who attended the first ECRS in Łódź shares his memories about the first symposium in a paper in these proceedings [8].

The following list gives an overview on all previous symposia of this series:

| | | |
|---|---|---|
| 1st ECRS | 1968 | Bern, Switzerland & Lodz, Poland |
| 2nd ECRS | 1970 | Amsterdam, the Netherlands & Leeds, United Kingdom |
| 3rd ECRS | 1972 | Göttingen, Germany & Paris, France |
| 4th ECRS | 1974 | Frascati, Italy & Lodz, Poland |
| 5th ECRS | 1976 | Leeds, United Kingdom |
| 6th ECRS | 1978 | Kiel, Germany |
| 7th ECRS | 1980 | Leningrad, Sovjet Union |
| 8th ECRS | 1982 | Rome, Italy |
| 9th ECRS | 1984 | Kosice, Czechoslovakia |
| 10th ECRS | 1986 | Bordeaux, France |
| 11th ECRS | 1988 | Balaton, Hungary |
| 12th ECRS | 1990 | Nottingham, United Kingdom |
| 13th ECRS | 1992 | CERN, Geneva, Switzerland |
| 14th ECRS | 1994 | Balatonfüred, Hungary |
| 15th ECRS | 1996 | Perpignan, France |
| 16th ECRS | 1998 | Alcala de Henares, Spain |
| 17th ECRS | 2000 | Lodz, Poland |
| 18th ECRS | 2002 | Moscow, Russia |
| 19th ECRS | 2004 | Florecne, Italy |
| 20th ECRS | 2006 | Lisbon, Portugal |

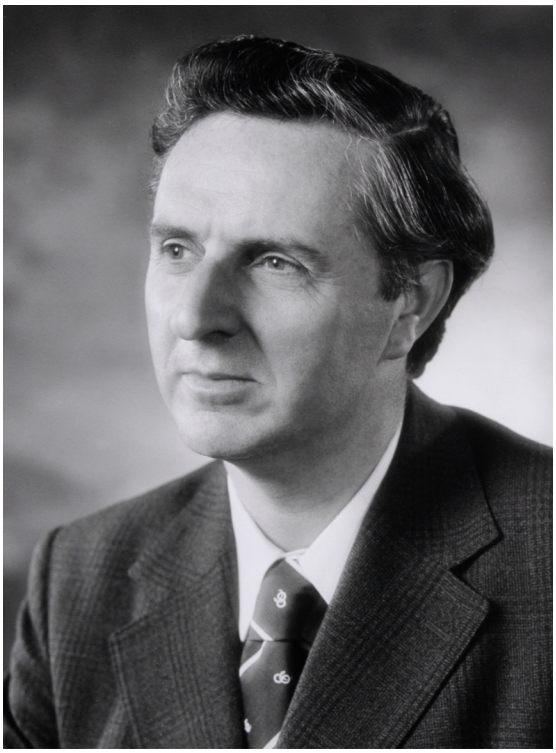

**Figure 5:** Sir Arnold Whittaker Wolfendale, 25 June 1927 – 21 December 2020.

**Figure 6:** Mikhail Igorevich Panasyuk, 14 August 1945 – 3 November 2020.



| | | |
|---|---|---|
| 21st ECRS | 2008 | Kosice, Slovakia |
| 22nd ECRS | 2010 | Turku, Finland |
| 23rd ECRS | 2012 | Moscow, Russia |
| 24th ECRS | 2014 | Kiel, Germany |
| 25th ECRS | 2016 | Torino, Italy |
| 26th ECRS | 2018 | Barnaul, Russia |

The scientific community mourns with deep sadness the loss of several distinguished colleagues. In particular, we mourn the loss of Arnold Wolfendale, one of the founding fathers of the ECRS series. For over 50 years Arnold Wolfendale was an international leader in the fields of cosmic rays and gamma-ray astronomy, making many seminal contributions [9]. Arnold Wolfendale was the soul of the ECRS series and he was a brilliant communicator.

In November 2020 the ECRS community had to mourn another loss, Mikhail Igorevich Panasyuk. His dead hit us unexpected, loosing the chair of the International Advisory Committee of the ECRS. He was a specialist in the field of experimental studies of cosmic rays and solar-terrestrial physics.

Furthermore we mourn the loss of our colleagues Maria Giller, Lev Dorman, Eugene Parker, Thomas K. Gaisser, Benedetto D'Ettore Piazzoli, Evgenia Eroshenko, Eduard Vashenyuk, and Michael Alania.

**Figure 7:** Participants of the 27$^{th}$ European Cosmic Ray Symposium. First row, 6th from the right is the main organizer Jörg R. Hörandel. To his left, Alan Watson who attended the 1st ECRS in Lodz. To his right, Erwin Flückiger who attended the 1st ECRS in Bern.

## 7. Scope

The 27$^{th}$ European Cosmic Ray Symposium covers a broad range of activities in the field of Astroparticle Physics. Topics include:
Solar and Heliospheric Cosmic Rays (22),
Space Weather (3),
Cosmic Rays at Earth and Planets (5),
Direct Measurements of Cosmic Rays (10),
Air shower physics and Hadronic interactions (12),
Indirect Measurements of Cosmic Rays (15),
Neutrinos (7),
Gamma Rays (15),
Dark Matter (6),
Theory (17), and
Future measurements, instrumentation and methods (18).
The numbers in brackets indicate the numbers of contributions presented at the symposium as talks or posters.

The program was complemented by eight invited review talks and 17 invited highlight talks, giving a good overview on the activities in the sub fields. The symposium started with a welcome address by the major of Nijmegen, Hubert Bruls. We were also pleased to receive a video message from the dean of the Faculty of Science at Radboud University, Prof. Dr. Sijbrand de Jong. We thank all participants for their participation, contributions, and participating in the discussions.

## 8. Poster award

A poster award committee, consisting of Markus Ahlers, Mateja Dumbovic, and Carmelo Evoli has reviewed all posters. The ECRS poster award 2022 has been awarded to Jean-Marco Alameddine for the poster with the title "High-energy lepton and photon propagation with the simulation framework PROPOSAL". We congratulate the winner to a 500 EUR award.




## References

[1] https://en.wikipedia.org/wiki/Nijmegen.

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[3] J. R. Hörandel, AIP Conf. Proc. **1516** (2013) no.1, 52-60 doi:10.1063/1.4792540 [arXiv:1212.0706 [physics.hist-ph]].

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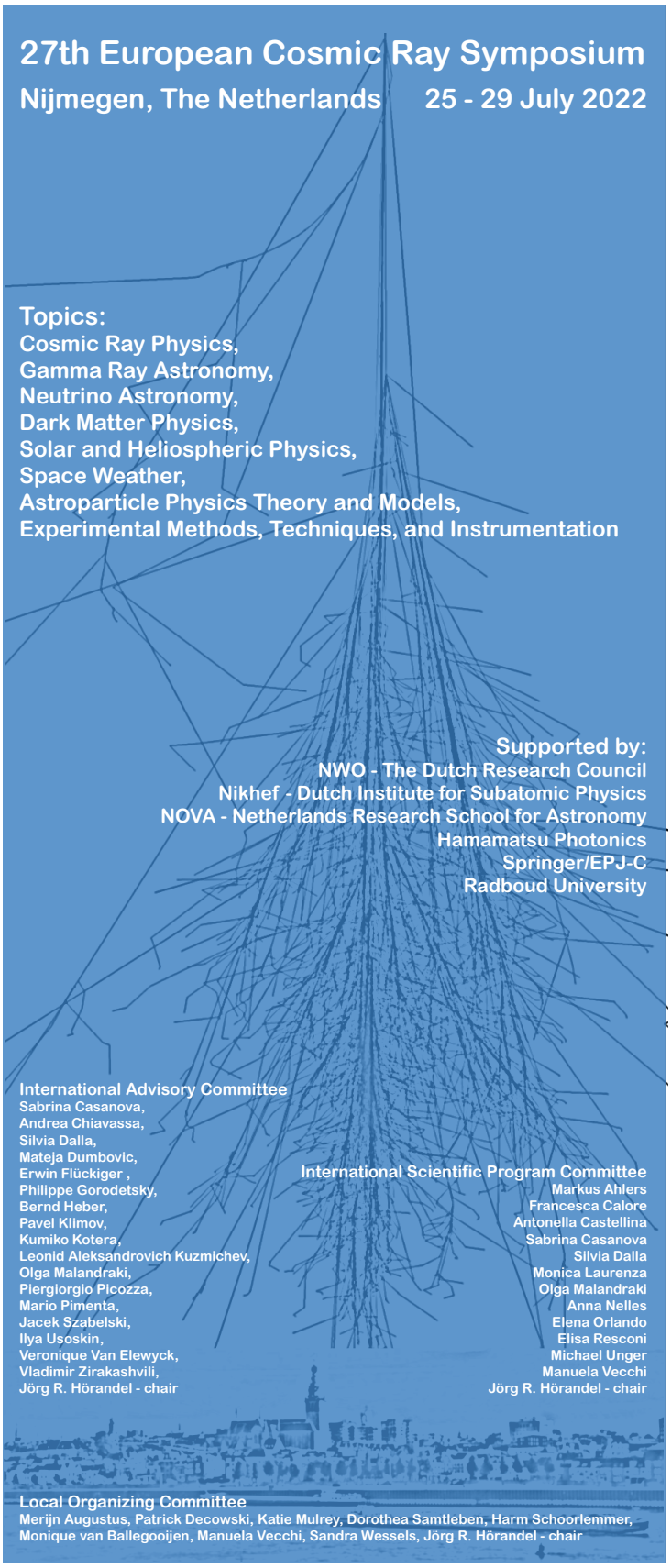
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Nijmegen, The Netherlands 25 - 29 July 2022
Topics:
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Gamma Ray Astronomy,
Neutrino Astronomy,
Dark Matter Physics,
Solar and Heliospheric Physics,
Space Weather,
Astroparticle Physics Theory and Models,
Experimental Methods, Techniques, and Instrumentation
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