At a Glance

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Executive Summary

Prof. DSc. Alexander Yarovoy
PROJECT COORDINATOR

"PHARA will be designed and built in such a way that it will provide resolution in space at an unprecedented level."

The year 2024 was the first full calendar year of PHARA, which we spent on detailed sub-system design of PHARA, building the organisation and consortium, and shaping the PHARA community. The radar hardware manufacturing has been contracted from Robin Radar System as the result of a European tender, and our first PostDoc in the project is hired by TU/e. The consortium has been formed, NDA and collaboration agreements signed, and the governing bodies are installed and operational: We installed a management team for day-to-day decisions, a governing board for strategic decisions and we have an International Advisory Board to review our plans and results and advise on strategy. We put in place the necessary infrastructure to facilitate collaboration, communication and reporting, which includes the launch of our website and linked-in account. We also started to form the PHARA universe, shaping our user community and growing our network of interested researchers. Our first PHARA summit that was held in May brought together a variety of interested researchers, stakeholders and future users and has helped us to sharpen our focus on how PHARA will be used, both for industry and for science. The further we proceed with the project, the more enthusiastic we become on the PHARA project and its importance for our users.

Highlights

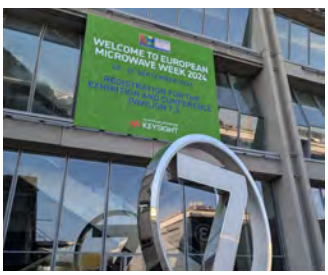
The PHARA website was launched on January 10, 2024, and the PHARA Linked-In account a few weeks later. The website (https://phara.tudelft.nl/) contains information on the project, the team, the technology and the potential applications and will regularly share the PHARA news. The contact page can be used to get in touch with the PHARA team.

Website Launch

First PHARA summit

On May 30, 2024, the first PHARA summit united team members, advisors, and the user community to shape the future of Europe's first 3D phased-array weather radar. Led by Professor Alexander Yarovoy and supported by a diverse team, PHARA aims to revolutionize weather monitoring, contribute to improved flood forecasting and urban water management, optimize wind park management, protect crops, and enhance shipping safety. The summit fostered collaboration and set the stage for a decade of innovation in radar and meteorological research.

PHARA System Concepts and System Requirements Specification have been delivered. The initial PHARA design has been adjusted with respect to the user requirements, which have been derived by the consortium. Preliminary Design Review has been completed.



EUMW 2024

PHARA consortium members from TNO, Robin Radar, TU/e, and TUD showcased their research at the 27th European Microwave Week (EuMW 2024) in Paris.

Key sessions, including EuMC35 on radar antenna advancements, and Europe's largest RF trade show, made EuMW 2024 a vital platform for collaboration and innovation in radar and microwave technologies.

Introduction

With PHARA we bring together a team of experts to create a first-of-its-kind research infrastructure for atmospheric and weather sciences: a fast-scanning phased-array radar in Ku-band with polarization diversity. PHARA will enable to track continuously cloud volumes and measure microphysical processes directly with a minimum of assumptions.

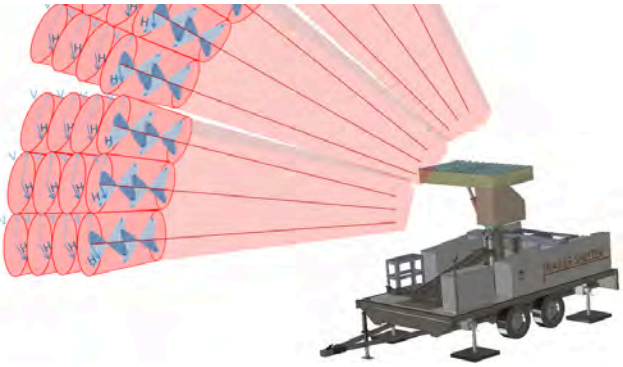
The Radar PHARA provides the ability to track a specific sky volume with unprecedented resolution. By using Ku-band this radar will bridge the gap in observation between traditional precipitation radars and cloud profilers and provide data highly demanded both for cloud physics and precipitation analysis. It will enable further research with routine measurement and simulation of atmospheric dynamics and physics at turbulence-resolving resolution. Moreover, PHARA will be installed on a transportable platform (chassis), which will allow taking measurements at various locations

The Team To create PHARA, we bring together an outstanding multidisciplinary consortium with expertise both in remote sensing technology and in atmospheric science & water management. This expertise is delivered to the consortium by the world's foremost research groups on radar meteorology and remote sensing (TU Delft, KNMI), phased-array antennas (ASTRON, TU Eindhoven), and atmospheric physics (RU Groningen), in close cooperation with knowledge institutes, such as the NWO institute Astron, research labs (TNO & KNMI), and Robin Radar Systems.

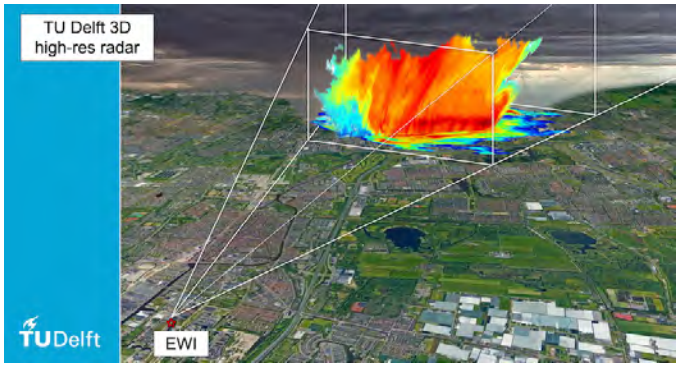
The Purpose Supplementing the radar facilities of the Ruisdael Observatory, the new radar will be the first of its kind with major impact on not just atmospheric sciences, but also on weather forecasting, extreme weather warnings, electromagnetic wave-based sensing, hydrology and water management. We will also initiate activities to exploit the radar for multiple different functions, such as airport surveillance for wind shear and air traffic control, wind turbines and road traffic management, monitoring birds and sea-life, serving many research communities at the same time.

Science & Engineering

Beyond combining two concepts PHARA combines the technology of phased array radars and radar systems with polarization diversity. Polarization diversity is extremely important for weather radars to reveal information about the shape, orientation, and phase of clouds and other hydrometeors, whereas phased array radars can provide simultaneous measurements of the atmosphere in multiple directions. PHARA goes beyond combining these two concepts to provide multiple-beam observation of the atmosphere with a ten times higher update rate, while keeping both range and Doppler resolution. This allows accurate monitoring of the dynamics of rapidly evolving cloud and precipitation systems. By using Ku-band PHARA will bridge the gap in observation between traditional precipitation radars and cloud profilers and provide data highly demanded both for cloud physics and precipitation analysis.



TU Delft Phara radar



TU Delft 3D high-res radar

Solving the cloud mystery PHARA is expected to provide atmospheric sciences with the much-needed measurement capabilities needed to overcome the scientific challenges faced in pursuit of our understanding of clouds and precipitation. Solving the mystery of what exactly happens with particles in the clouds, how they develop themselves and grow into rain drops, requires advanced infrastructure as these processes are very detailed and on microphysical scales, and happen very fast, especially in severe weather conditions. PHARA can provide fast scanning rates, a 3D picture of the rain, and information on how the rain develops on different heights. These abilities will supplement the radar facilities of Ruisdael Observatory, and enormously impact fundamental atmospheric sciences and the more applied fields, such as weather forecasting, wave-based sensing, hydrology, water management and communication technologies. The technology will reveal how severe weather events evolve in time, and how the changing atmosphere is affecting our climate and consequently our living environment.

PHARA innovations

Polarimetric waveform agility

Integration of multi frequency radars

Multi beam management

Ku-band waveforms

Agile beamforming and scanning for 3D imaging

Multiple mode operation (cloud mode, precipitation mode)

Applications

Smart Cities Radars are crucial for metropolitan areas to manage frequent, intense rainfall and to gather high-resolution precipitation data for climate-smart city planning and water management.

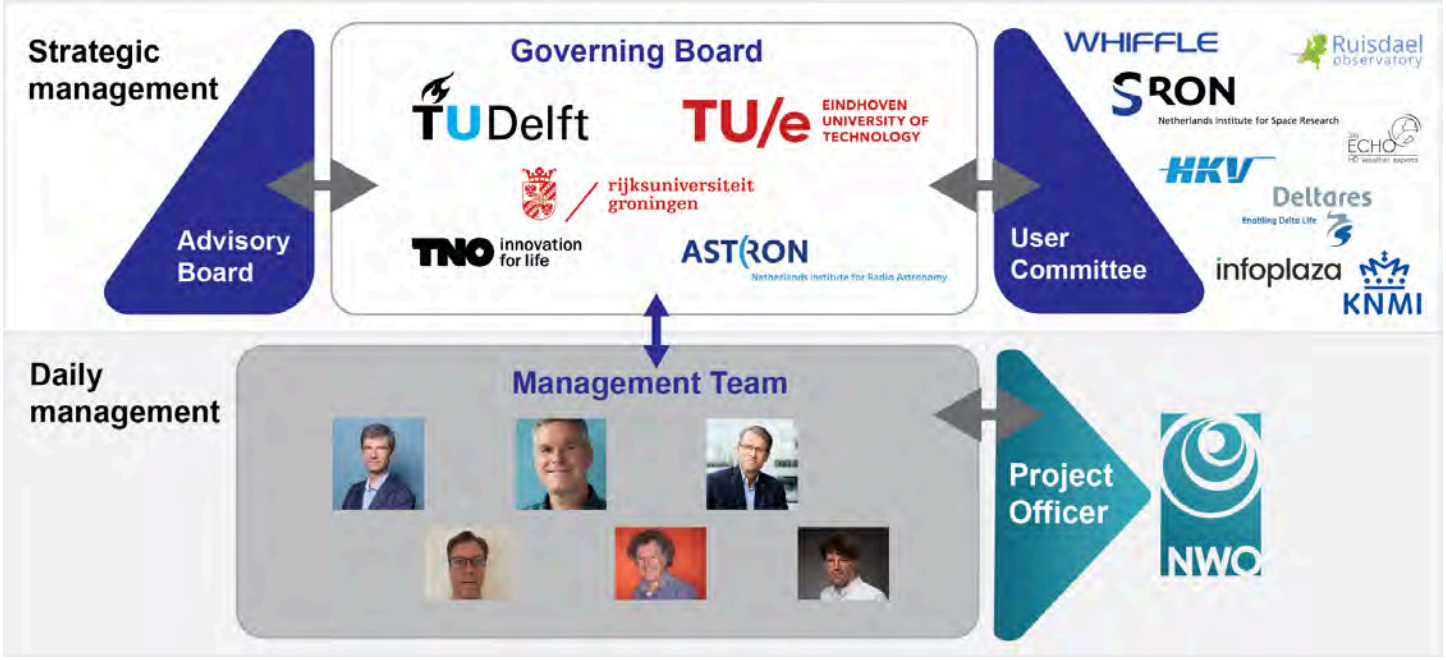
Sustainable Energy Energy providers can benefit from PHARA by accurately measuring 3D wind behavior near wind farms and detecting the presence of birds, bats, and insects in the vicinity.

Ecology & Environment The PHARA facility can be used to estimate and track migratory movements of insects and birds. It can also monitor sea life.

Organisation & Team

Governance We implemented a two-layered governance structure. The Governing Board is composed of representatives of all project partners and is responsible for the strategy and quality of the consortium, and approves changes to the strategy and composition of the consortium proposed by the Management Team. The Management Team is the core body for managing the strategy and program execution on a daily base. The Management Team meets monthly, is chaired by the Project Coordinator (Alexander Yarovoy - TUD), consists of the Vice-coordinator (Remko Uilenhoet - TUD), Director Manufacturing (Ir. Rob van der Meer – RRS), Director Design (Dr. W. van Rossum – TNO) and Director Deployment (Prof. Dr. Ir. B. Smolders -TU/e), User representative and Valorisation (Herman Russchenberg - TUD) and is supported by a project manager.

We established a non-disclosure agreement, which was signed by all participating parties, including our advisory board members, and a binding consortium agreement that arranges responsibilities of the participating institutions, the management structure as outlined below, financial procedures, intellectual property rights and liability. The agreement has been signed by all participating partners.



International advisory board We invited a strong international advisory board to ensure critical evaluation of our strategy and results. The advisory board is composed of:

- Prof. Dr. Ir. P. Knott Executive Director, Fraunhofer, Institute for High Frequency Physics and Radar Techniques, Germany
- Prof. Dr. D. Moisseev Director of radar laboratory at the INAR – Institute for Atmospheric and Earth System Research, University of Helsinki, Finland.
- Prof. Dr. V. Chandrasekar Fellow American Meteorological Society, Colorado State University, USA articipating members.

New PHARA members We welcomed new PHARA members from within the participating organisations:

- TU/e (Phased array antennas, polarization): Dr. Ir. Gabriele Federico
- Astron (Project management, meteorology): Dr. Ágnes Mika
- Robin Radar Systems (Project management): Yorick Koumans
- TNO (Project management, Electrical engineering): Filip Zlatanović

Outreach

Website Launch The PHARA website was launched on January 10, 2024. The website contains information on the project, the team, the technology and the potential applications and will regularly share the PHARA news. The contact page can be used to get in touch with the PHARA team.

Conference visits PHARA members visited and presented at a several (inter)national conferences:

- The 12th European conference on RADar in meteorology and hydrology (ERAD 2024, Rome, September 9-13) was visited by PHARA team members Christine Unal, Marc Schleiss, and Remko Uijlenhoet, and user representatives (Hidde Leijnse and Aart Overeem from KNMI).
- Marc Schleiss presented his search for rare rainfall patterns at the Ruisdael Science Day 2024 (Utrecht, September 30, 2024).
- The 27th European Microwave Week (EuMW 2024, Paris, September 22-27), gathering experts from industry and academia, featured featured three conferences: the 54th European Microwave Conference (EuMC), the 19th European Microwave Integrated Circuits Conference (EuMIC), and the 21st European Radar Conference (EuRAD). PHARA consortium members from TNO, Robin Radar, TU/e, and TUD attended the EUMW and presented their research.

PHARA Flyer We developed a PHARA flyer, introducing the project and highlighting PHARA's innovations and potential applications. It was distributed to our consortium members for spreading at scientific conferences and other events to raise awareness for the PHARA project and invite researchers to join our research could and work with us on projects to further exploit PHARA. The flyer can be downloaded here.

Meetings

User Community Meeting On January 10, 2024 our first user committee meeting was held. The consortium introduced PHARA to the user community, and and discussed with potential users how they see this new radar and what intended uses they envisage for the future.

Phara Summit The first PHARA summit, held at May 30, 2024, brought together all PHARA members, advisors and the user community to shape the future and work together on building the PHARA universe: a research cloud supported by PHARA as research instrument. The summit fostered collaboration and set the stage for a decade of innovation in radar and meteorological research.

Ruisdael Observatory

Looking Ahead

We expect an exciting year coming up in which we will start testing PHARA modules, design algorithms for PHARA raw data processing and initiate software development for the PHARA digital backend. We look forward to further interactions and discussions with our stakeholders and user community and further shaping and grow the PHARA universe to exploit this innovative radar to its full potential.

Contact Us

For further information, please reach out to us at:
contact - PHased Array Radar for Atmospheric research

LinkedIn: Linkedin.com/company/phararadar/

Website: www.phara.tudelft.nl