

Space Sciences 2023 Vision Project of Turkiye: Eastern Anatolia Observatory (DAG) and Space Sciences Ecosystem

Cahit YEŞİLYAPRAK¹ 

¹Atatürk University, Science Faculty, Department of Astronomy and Space Sciences, 25050, Erzurum, Turkiye
Atatürk University, Astrophysics Research and Application Center, 25050, Erzurum, Turkiye

ORCID: C.Y. 0000-0003-1894-7190

ABSTRACT

Eastern Anatolia Observatory (DAG) is an international observatory with Turkiye's largest diameter (4 m) telescope which can observe both the visible and infrared regions. DAG, as the largest fundamental science investment in the history of the Turkish Republic, is one of Turkiye's 2023 Vision Projects. DAG brings innovations to both the field of space sciences and the optical and space technologies. Besides, DAG will create the knowledge and equipment that will also serve the technology. In this context, it creates both human resources and an infrastructural environment for the innovative technologies it needs, and thus becomes the trigger for an ecosystem environment that offers different opportunities for space sciences.

Keywords: Eastern Anatolia Observatory, DAG, Infrared Observatory, Space Sciences, Ecosystem, 2023 Vision Project

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Corresponding author: Cahit YEŞİLYAPRAK / cahity@atauni.edu.tr

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1. Eastern Anatolia Observatory (DAG)

Eastern Anatolia Observatory (DAG) is an international observatory that is being established in Erzurum within Atatürk University Astrophysics Research and Application Center (ATASAM) with the financial support of the Presidency of the Republic of Türkiye Strategy and Budget Directorate and Atatürk University. With a telescope that has a diameter of 4 m, DAG is the biggest and the first IR observatory of Türkiye, constructed on the summit of Konaklı mountain (Figure 1 and 2). DAG, as the largest fundamental science investment in the history of the Turkish Republic, is one of Türkiye's 2023 Vision Projects. DAG brings innovations to both the field of space sciences (such as infrared observations, high resolution, observation of faint celestial objects with a large-scale telescope), and optical and space technologies (such as active and adaptive optics, infrared imaging system).



Figure 1. The concept design of Eastern Anatolia Observatory (DAG)

The mission of DAG is to make competitive observations at the international level, to offer opportunities to innovative technologies and to support the development of current science. In particular, a vision for DAG has been drawn that can provide opportunities for competitive and new technological focal plane instruments, which are preferred in terms of their global location and the optical technologies they contain.



Figure 2. Eastern Anatolia Observatory (DAG) and DAG site in Erzurum – Konaklı (3170 m altitude)

The DAG site is an observatory site on Konaklı, in the Karakaya Hills, located about 35 km away from Erzurum city center, at an altitude of 3170 m. DAG has a 4 m diameter telescope, which will fill a large global observational gap thanks to its location in the Northern Hemisphere. The atmospheric conditions of DAG are especially suitable for IR observations. The DAG site has many clear nights, low humidity, temperature, wind speed and atmospheric inversion layer, and a consistent snow season and wind direction.

In this scope for DAG, with the support of the Turkish Government, a comprehensive project was developed with three stages between 2012 and 2022. First, the Eastern Anatolia Observatory (DAG) Project; second, the Focal Plane Instruments (FPI) Project and third, the Mirror Coating System (MCS) Project. An other aim of the FPI project is to establish an optical laboratory (OPAL: Optomechatronics Research Laboratory) to be equipped with maintenance, repair and test instruments that will also ensure R&D. DAG is expected to be operational at the end of 2022.

ATASAM is not only a center in which studies solely on space sciences at the international level will be implemented. It is also developing as an R&D center where technological information gathered as a result of these studies and the constructed research infrastructures will serve space sciences and technologies.

2. Space Sciences and DAG

The relationship between DAG and space sciences is not just about astronomical observations. Thanks to DAG and other infrastructures (OPAL, MCS) being established within ATASAM, interdisciplinary studies in the fields of astrophysics, astrophotonics, astrometeo, astro-optics, astroinformatics and remote sensing will be possible.

The aims of DAG and OPAL Research and Development (R&D) service infrastructures are:

- 1) Establishing DAG and OPAL R&D infrastructures;
- 2) Providing observation and infrastructure usage services;
- 3) Establishing national and international collaborations;
- 4) Engaging in R&D activities;
- 5) Carrying out training and awareness activities.

3. Türkiye's 2023 Vision at Space Sciences

The reflections of the visionary studies in space sciences and other related subjects with the synergy coming from Türkiye's 2023 Vision are summarized in items below.

- Türkiye's 2023 Vision: to create Türkiye's largest basic science investment;
- Space Sciences: to establish Türkiye's largest and first infrared telescope;
- Optics Technologies and Sciences: to establish the largest mirror coating system in Türkiye and Europe;
- Science Strategy: to fill the great observational gap on Earth
- Science Diplomacy: to increase international scientific and technological cooperation in the field;

- Scientific Prestige and Pioneering: to carry out competitive and quality research,
- Scientific Diversity and Awareness: to carry out interdisciplinary studies;
- Scientific and Technological Competition: to develop new technologies;
- Scientific Competence and Sustainability: to create competent human resources and develop domestic technological products.

4. Space Sciences Ecosystem (Industrial Society to Information Society)

The objectives and activities of both DAG and OPAL research infrastructures established within ATASAM were taken into consideration while designing and creating the “Space Sciences Ecosystem”, the Turkish National Space Program, the 11th Development Plan for Turkiye, the Research Infrastructures Law No. 6550 in Turkiye, the mission and vision. In this context, the process of creating the ecosystem for space sciences in Turkiye can be identified and summarized in order of development and process management as follows:

The stages of Space Sciences Ecosystem in Turkiye:

- 1) Public/Government Support (Turkish Republic Strategy and Budget Presidency, Universities, Public Organisations);
- 2) Astronomical observation (space sciences) with DAG and research and product development (space and optical technologies) with OPAL;
- 3) Establishing strategic and large basic science investment;
- 4) Structuring a university research and application center (ATASAM);
- 5) Creating an advanced research center/infrastructure with Research Infrastructures Law No. 6550 (commercial legal entity).

5. Requirements for Space Sciences Ecosystem in Turkiye

Some requirements for the space science ecosystem in Turkiye and its dimensional analysis are summarized in Table 1.

Table 1. Some requirements for the space sciences ecosystem in Turkiye

Stages / Dimensions	Requirements / Criteria
Strategic Program - Objectives	Observation Service, R&D, Product, Infrastructure
Transparency - Openness Policy	Commercial Legal Entity, Financing, Information, Purpose
Internal/External Stakeholders - Users	Public, Private Sector, University, Individual
Service - R&D Product	Observation, Data, Infrastructure, Product, Device
Technology - Innovation	Technology Transfer, Innovative Products
Internationalization - Cooperation	Observation, R&D, Education, Device, Technology
Horizontal - Vertical Technologies	Being an Interdisciplinary Study Infrastructure
Competition - Sustainability	Technology, Service, Finance, Human Resource, R&D
Coordination - Governance Policy	Stakeholder, Demands, Dynamic Structure
Systemic - Project Working Policy	Update, Project Based Works
Human Resources - Team Policy	Competent Multidisciplinary Human Resource, Being a Team
Intellectual Property - Patent Policy	Observation, R&D, Product, Method
Open Data - License Policy	Astronomical / Atmospheric Data Service and Sharing
Social Contribution - Publication Policy	In / Out of Service Activity, Publication / Thesis

References

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