EASTERN ANATOLIA OBSERVATORY (DAG): RECENT DEVELOPMENTS AND A PROSPECTIVE OBSERVING SITE FOR ROBOTIC TELESCOPES

C. Yesilyaprak\textsuperscript{1,2}, S. K. Yerli\textsuperscript{3}, and O. Keskin\textsuperscript{4}

ABSTRACT

This document (Eastern Anatolia Observatory (DAG) is the new observatory of Turkey with the optical and near-infrared largest telescope (4 m class) and its robust observing site infrastructure. This national project consists of three phases with DAG (Telescope, Enclosure, Buildings and Infrastructures), FPI (Focal Plane Instruments and Adaptive Optics) and MCP (Mirror Coating Plant) and is supported by the Ministry of Development of Turkey. The tenders of telescope and enclosure have been made and almost all the infrastructure (roads, geological and atmospherical surveys, electricity, fiber optics, cable car, water, generator, etc.) of DAG site (Erzurum/Turkey, a 3.170 m altitude) have been completed. This poster is about the recent developments of DAG and about the future possible collaborations for various robotic telescopes which can be set up in DAG site.

Key Words: site testing — telescopes

1. INTRODUCTION

DAG (Eastern Anatolia Observatory in Turkish) Project is about construction of the newest and largest observatory of Turkey with its robust observatory site. The project which is supported by the Ministry of Development of Turkey and awarded to Atatürk University, consists of three main phases: DAG, FPI (Focal Plane Instruments and Adaptive Optics) and MCP (Mirror Coating Plant).

2. PROJECT

The specifications of DAG Project are given in Table 1.

\begin{table}[h]
\centering
\begin{tabular}{|l|}
\hline
\textbf{Name} & \textbf{Eastern Anatolia Observatory (DAG)} \\
\hline
\textbf{Institute} & Atatürk University (ATAUNI) \\
\hline
\textbf{Financial Resources} & Ministry of Development (DPT), Atatürk University (ATAUNI) \\
\hline
\textbf{Project Executive Unit} & ATAUNI - ATASAM \\
\hline
\textbf{Project Timeline} & 2012 - 2019 \\
\hline
\textbf{Final Budget} & ~28M Euro (2015) \\
\hline
\textbf{Feature of Project} & Turkey’s Largest and First IR Telescope \\
\hline
\textbf{End of Project} & First Light in 2019 \\
\hline
\textbf{Phases} & Eastern Anatolia Observatory (DAG), Focal Plane Instruments (DAG-FPI, 2016 - 2019), Mirror Coating System (DAG-MCS, 2020 - 2022) \\
\hline
\end{tabular}
\caption{Project Specifications}
\end{table}
Project Support Units - Team
Dept. of Astronomy and Astrophysics (ASA), ATASAM - 50 cm Telescope (ATA50), International and National Advisory Board, Project Technical Team

Project Managers
Dr. Lorenzo Zago (HEIG-VD, Switzerland), Dr. Onur Keskin (FMV İsk Unıv., Turkey)

Current Status of Project
Establishment of a Research Center (ATASAM), Erection of ATA50 Telescope in ATAUNI Campus, Establishment of a Department (ASA), Land Allocation for DAG Site, Land Master Planning, Technical Specifications, Telescope Tender, Telescope Preliminary Design Review, Enclosure Tender, Mirrors Order, Observatory Building Design, Focal Plane Instruments Project Submission, infrastructure (almost ready, 80%)

3. SITE

The geographic place of the DAG site is given in Table 2.

<table>
<thead>
<tr>
<th>Region</th>
<th>Erzurum - Eastern Anatolia - Turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Karakaya Tepeleri - Konaklı - Erzurum</td>
</tr>
<tr>
<td>Terrain</td>
<td>High altitude plato, 5 km long mountain range</td>
</tr>
<tr>
<td>Altitude</td>
<td>3170 m (the 3rd highest observing site)</td>
</tr>
<tr>
<td>Geographic Coords</td>
<td>39° 47′ N 41° 14′ E</td>
</tr>
<tr>
<td>Distance from City</td>
<td>~35km/35′ (by road)</td>
</tr>
<tr>
<td>Position</td>
<td>Filling the longitude, gap in northern hemisphere</td>
</tr>
<tr>
<td>Acreage</td>
<td>2500 decares, suitable land for various telescopes</td>
</tr>
<tr>
<td>Weather Conditions</td>
<td>Many clear nights (&gt; 250 d, Clear), Low humidity (up to 2-10%, Dry), Certain prevailing wind direction (N-E, Stable), Low wind speeds (Calm), Low temperature values (up to -350°C for winter, Cold), Low atmospheric inversion layer (~2600m, Ideal), Iced thin snow cover (~100 cm, Dust-free), Snow season (November - April, Consistent)</td>
</tr>
</tbody>
</table>

4. INFRASTRUCTURE

The infrastructure specifications of DAG project are given in Table 3.

<table>
<thead>
<tr>
<th>Buildings</th>
<th>ATASAM Building in ATAUNI Campus, (1000 m2, Tech.-Obs.-Guest Rooms, Labs., Fiber, 60KW UPS), Service Prefab Building -1 in DAG Site, (100 m2, Temporary, Tech.-Obs. Rooms, Fiber, 30KW UPS), Service Prefab Building -2 in DAG Site, (40 m2, Temporary, Tech. Rooms, Fiber), Atmospheric Systems + DIMM Tower in DAG Site, (7 m height , Fiber, 10 KW UPS, Atm.-Ast. Systems), Energy + Snow Vehicles Garage near DAG Site (2015), (300 m2, Garage, 20 Tons Gasoline Tank, Generators, Transformers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning Safety</td>
<td>3 Rods in DAG Site, (Active, R &lt; 1Ω, Permanent)</td>
</tr>
<tr>
<td>Internet</td>
<td>48 Cores - 100 Gbits Transmission Fiber Line, (Underground, 26 km line ATASAM to DAG Summit, Active), 24 Mbits RadioLink (RL) System, (Redundant, RL from ATASAM to DAG Summit, Active)</td>
</tr>
<tr>
<td>Transport</td>
<td>12 km Asphalt Road, (Erzurum Airport to ATAUNI Campus, Open in Winter), 25 km Asphalt Road, (ATAUNI Campus to Konaklı Ski Center, Open in Winter), 7 km Stabilizing Road, (Konaklı Ski Center to DAG Summit, Close in Winter)</td>
</tr>
<tr>
<td>Cable Car/Lift</td>
<td>2 Cable Cars, (Konaklı Ski Center to 2 different DAG Summits, Active)</td>
</tr>
</tbody>
</table>
Electricity 3 Phases Medium Voltage Lines in DAG Site, (Underground, 3.6 km line, Redundant line, Active), Power: 30 KW + 10 KW UPS in DAG Site, (Now, 3 Phases, Temporary), 10 KW Mobile UPS in DAG Site, (Now, 3 Phases, Temporary), 2 x 250 KW UPS in DAG Site, (3 Phases, Redundant, Permanent), 110 KW Generator near DAG Site,(3 Phases, Temporary), 2 x 400 KW Generators near DAG Site, (3 Phases, Redundant, Permanent), 2 x 630 KW Transformers near DAG Site (2015), (3 Phases, Redundant, Permanent)

Vehicles 1 Pickup (4x4, 2500cc), 1 ATV (4x4, 800cc), 1 Snow Track (500cc), 1 Snow Cabin Track (5000cc) + 1 Pickup (4x4)

Water 2 Natural Water Supplies, (Distance from Summit: 1 and 1.5 km, Altitude: 3000 - 2800 m), Artificial Lake in Konaklı Ski Center, (Pumped up to DAG summit, Altitude: 2200 m), Water Tank in DAG Site, (Filtered, 30 Tons, Underground, Heat System, Altitude: 3000 m)

5. TELESCOPE

The specifications of DAG Telescope is given in Table 4.

<table>
<thead>
<tr>
<th>TABLE 4. Telescope Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
</tr>
<tr>
<td>FoV</td>
</tr>
<tr>
<td>Optical</td>
</tr>
<tr>
<td>Mounting</td>
</tr>
<tr>
<td>Mirror Type</td>
</tr>
<tr>
<td>Pointing - Tracking Accuracy</td>
</tr>
</tbody>
</table>

Optical Performance  
Ritchey - Chrétien (RC), Active Optics (aO), Adaptive Optics (AO), Derotator + Field Corrector, Diffraction Limited with aO + AO, Long Focal Length (56 m) + Large Field of View (30′), (Higher performance than other 4 m class telescope)

Focal Platforms  
2 Nasmyth, (N1: Adaptive Optics, N2: Seeing Limited), Instrument Capacity 6 Instruments (VIS: 3 + NIR: 3)

AO Types  
Narrow Field + Ground Layer AO (3″ - 5″)

AO Design  
Dr. L. Jolissaint + Dr. O. Keskin, Manufacturers, AMOS (Advanced Mechanical and Optical Systems, Main Manuf., Belgium), EIE, (European Industrial Engineering, Sub-Manuf., Italy)

6. CONCLUSIONS

The DAG project welcomes all kinds of scientific and technical collaborations. The DAG site with its robust and powerful infrastructure on the Anatolian peak is ready to accommodate different size of telescope and various instrumentations.

Acknowledgments. This study is supported by DAG Project (Project ID: 2011K120230), Atatürk Universiy and ATASAM. Authors are grateful to DAG Project, Atatürk University and ATASAM for continuous and valuable supports.