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Astronomy in Georgia 2026

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Abstract

Astronomical research in Georgia combines a long tradition of observation with theoretical and computational studies in astrophysics. This review surveys recent developments at the Evgeni Kharadze Georgian National Astrophysical Observatory within the framework of its 2024–2028 research programme. In 2025, the commissioning of a 1.5-m robotic telescope at Abastumani expanded Georgia's ground based observing capabilities. Selected results illustrate the breadth of the Observatory's recent research. The review also describes how university programmes, practical observing courses, teacher training, and public outreach extend access to the Observatory's expertise and facilities.

Keywords: *astronomy in Georgia, Abastumani, astronomical archives, astronomy education.*

1 Introduction

Professional astronomical research in Georgia took institutional form in 1932, when Evgeni Kharadze founded the Abastumani Astrophysical Observatory. Its early strengths included stellar spectral classification and polarimetric studies of the Moon and planets. Over time, the Observatory's research extended to the Sun, galaxies, and theoretical astrophysics. The photographic archive assembled over these decades documents both the objects observed and the evolution of observing practice (Chargeishvili, 2024).

The transition from photographic plates to electronic detectors coincided with a period of institutional and financial change. Renewing the observing facilities took several stages, culminating in the installation of the 1.5-m telescope in 2024 and its commissioning in 2025. The new telescope adds robotic observing capability at a site where smaller instruments continue to support long-term photometry, polarimetry, and solar observations (Tevzadze & Chanishvili, 2025). Digitization extends the time baseline available for research. The plates, films, and logbooks document observations made with a range of instruments over several decades. Recovering when and how an exposure was made allows historical measurements to be compared with modern data. Such comparisons are especially valuable for processes that unfold over many years, including changes in stellar variability and solar activity.

The Observatory's role today also extends beyond the observations made on Mount Kanobili. Its researchers contribute to large surveys, coordinate follow-up observations, and develop theoretical models for interpreting astronomical data. The 2024–2028 programme brings these activities together to strengthen research in Georgia and deepen participation in international collaborations. This article reviews the programme and facilities as they stand in 2026, surveys research results published in 2025, and describes how university teaching, practical observing, and public astronomy draw on the Observatory's resources.

2 The Observatory and its research programme

The Observatory operates at two sites. Mount Kanobili, above Abastumani, houses the observing facilities and historical collections. The Tbilisi office supports research, administration, and academic coordination. The scientific departments link the work at both sites through a common research programme.

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2.1 Scientific departments

The Department of Galaxies and Stars studies stellar variability, transients, active galactic nuclei, and galaxy evolution. The Department of the Sun and Solar System covers the Sun, space weather, and Solar System bodies. The Department of Theoretical Astrophysics and Cosmology studies astrophysical flows, plasmas, compact objects, and the evolution of the Universe.

Today, the Observatory has 58 scientific staff, including research assistants and laboratory personnel. Instrument support, digitization, education, and outreach serve and complement all three departments.

2.2 The 2024–2028 research programme

The five-year research programme for 2024–2028 builds on the Observatory's 2019–2023 programme.Its subprogrammes are carried out through distinct projects organised by the Observatory's researchers. The corresponding 15 projects are listed below:

1. Variable stars and other transients.
2. High energy studies of active galactic nuclei.
3. Optical searches for gravitational wave counterparts within the GRANDMA observing network.
4. Monitoring of selected active galaxies.
5. Physical properties of galaxies at different evolutionary stages.
6. Growth of large scale structure from the galaxy three-point correlation function.
7. Photometric and spectroscopic searches for periodic signals and transits in stars of different spectral classes.
8. Observations of potentially hazardous near-Earth asteroids from Abastumani.
9. Magnetoseismology of the solar atmosphere and interior, and space weather.
10. Observations and modelling of solar and space weather processes.
11. Physical processes in the solar chromosphere.
12. Magnetospheric heating and pair production driven by magnetocentrifugal effects in pulsars and other compact objects.
13. Tests of non-standard cosmological models using gravitational waves, primordial magnetic fields, dark energy, and neutrino physics.
14. Formation of turbulence and coherent structures in astrophysical planar and disc shear flows.
15. Dynamics of planar and disc shear flows with non-ideal magnetohydrodynamic effects.

3 Observing facilities and historical data

Abastumani's observing facilities span several generations of instruments. The robotic telescope adds imaging and spectroscopic capability, while established instruments continue to support programmes in photometry, polarimetry, and solar physics. The plates and films obtained with earlier instruments provide a historical baseline for these studies.

3.1 Telescope renewal and observing capability

The 1.5-m ASA AZ1500 is an $f/6$ robotic Ritchey–Chrétien telescope (see Fig. 1). It replaces the former 1.25-m AZT-11. The telescope was installed in 2024 and commissioning was completed in 2025. It is already involved in different research as well as for student observing projects in both 2025 and 2026.

The supporting instruments include Andor iKon-XL 230 BV imaging CCD and a Shelyak Whoppshel echelle spectrograph covering 400–750 nm.

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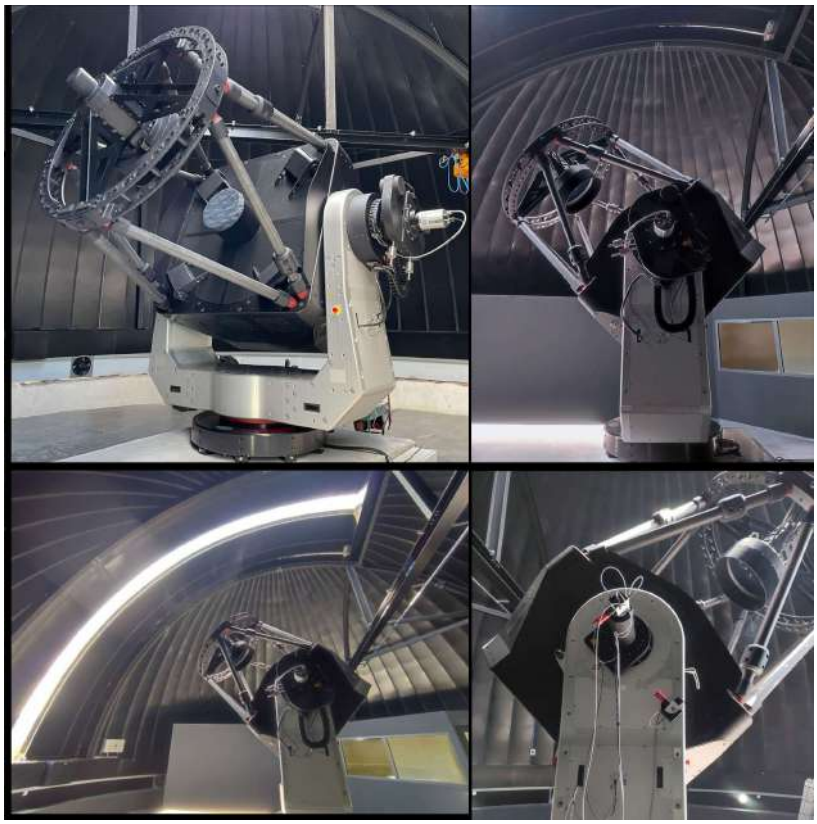

Figure 1: Four views of the 1.5-m ASA AZ1500 robotic Ritchey–Chrétien telescope in its dome on Mount Kanobili, Abastumani. The telescope was commissioned in 2025 for imaging and echelle spectroscopy.

Table 1 summarizes selected operating instruments and their uses. The AS-32, a Maksutov telescope with a 70-cm meniscus, links the Observatory's plate-era surveys to small-body and stellar work (Ayvazyan et al., 2025, Chargeishvili, 2024, Kiladze & Chanturiya, 1994). The automated Schmidt–Cassegrain with a 36-cm corrector was installed in 2018 for photometry and polarimetry. The historic 40-cm Zeiss refractor is used for public observing. Instrumentation work also includes a polarization-holographic Stokes imaging polarimeter (Kurkhuli et al., 2025).

Table 1: Selected instruments at Abastumani.

Instrument	Principal use	Status
1.5-m ASA AZ1500	Robotic imaging, echelle spectroscopy capability	In operation (research and education)
AS-32 (70-cm Maksutov meniscus)	Wide-field optical observations, small-body work, and transient follow-up	In operation (research)
48-cm AZT-14	Stellar photometry, including variable stars	In operation (research)
40-cm double astrograph	Wide-field optical observations	In operation (research)
53-cm solar coronagraph	Spectroscopy of the solar outer atmosphere	In operation (research)
Schmidt–Cassegrain (36-cm corrector)	Photometry and polarimetry	In operation (research)
40-cm Zeiss refractor	Public observing and museum demonstrations	In operation (outreach)

3.2 Photographic plates, films, and logbooks

An earlier inventory put the Abastumani collection at approximately 70,000 plates and films. The largest holdings listed there came from the 44-cm Schmidt camera, which produced about 25,000 plates before 1985, and the 70-cm meniscus telescope, which contributed about 20,500. The collection also includes approximately 6,500 images from the historic 40-cm telescope and 3,000 negatives from the double astrograph. By

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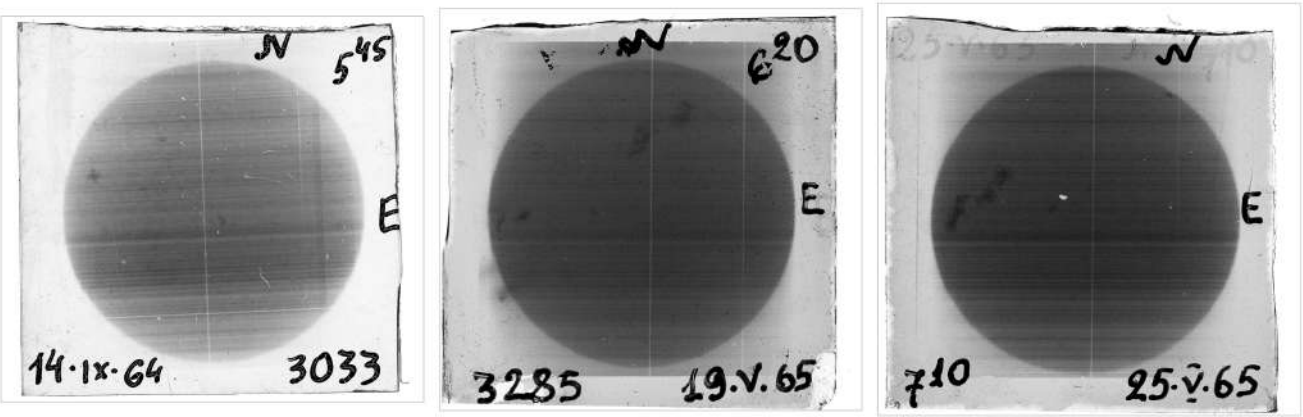
the time of that inventory, the Observatory had digitized the stellar telescope logbooks and scanned about 1,600 spectroheliograph tapes and more than 16,000 Schmidt camera films.

The Observatory's 2025 Zenodo release makes one part of its photographic plate and film collections publicly accessible. It contains a digitized subset of the 1957–1986 Ca II K spectroheliographic series. Figure 2 shows three of the released glass plate scans, with the original handwritten dates and markings visible. The FITS images are grouped by year or date range, and an accompanying spreadsheet lists filenames and observation dates in 1,584 entries. The FITS headers record exposure and calibration information where available. The dataset is available under a Creative Commons Attribution 4.0 license.



(a) SpHel_21 · 14 Sep 1964 (b) SpHel_41 · 19 May 1965 (c) SpHel_47 · 25 May 1965

Figure 2: Three digitized glass plates from the Abastumani solar spectroheliograph in Ca II K (393.3 nm), labelled by FITS filename and observation date. The plates are shown here for illustration and constitute only a representative sample of the extensive dataset published on Zenodo by Georgian National Astrophysical Observatory (2025).

The index helps researchers assess the temporal coverage of the series and select observations before downloading the images. Where available, exposure and calibration metadata help establish whether images taken at different epochs can be compared on a common basis. Linking further scans to their original observing logs and instrument records would make a larger part of the archive usable for quantitative studies. A separate example of the scientific value of historical observations is the Abastumani Hα filament record for 1957–1993. Its long baseline has already been used to investigate cyclic variations in solar differential rotation (Mdzinarishvili et al., 2025).

4 Research highlights

Research in astronomy and astrophysics at the Observatory ranges from studies of individual sources to analyses of entire populations. Time series observations of stars, active galaxies, and the Sun help distinguish processes that unfold on different timescales. Surveys reveal how astrophysical structures vary across environments, while theoretical studies help explain the processes that shape them.

For variable stars, a long photometric record can reveal whether changes seen today repeat a pattern from earlier cycles. The study of the recurrent nova T CrB uses this approach to compare its recent evolution with behaviour before earlier eruptions (Merc et al., 2025). Other work uses photometry to characterize variable stars, investigate differential rotation along the main sequence, and identify unusual eclipsing systems among hot B stars (Kvernadze et al., 2025b, Shevchenko et al., 2025, Tabatadze & Kukhianidze, 2025).

Eclipses and transits can reveal companions through periodic dimming, while microlensing detects a companion's gravitational effect on the light of a background star. In the event AT2021uey, outside the Galactic bulge, the light curve is consistent with a Jupiter-like planet beyond the snow line of a roughly half-solar-mass M dwarf at about 1 kpc. Abastumani contributed follow-up photometry (Ban et al., 2025). Other studies examine candidate transits in late-B stars and use Gaia astrometry to distinguish physical open clusters from chance groupings on the sky (Kapanadze et al., 2025a, Kvernadze et al., 2025a).

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The variability of active galactic nuclei can look different from one waveband to another. Nearly two decades of optical photometry of the blazar 3C 454.3 show that the source generally became redder as it brightened, with the colour trend flattening at high brightness. The authors interpret this behaviour in terms of a growing contribution from the jet (Dogra et al., 2025). Related monitoring studies examine 3C 371, Ton 599, 1ES 1218+304, Mrk 421, and two TeV blazars of uncertain redshift (Kapanadze, 2025, Kapanadze et al., 2025b,c, Otero-Santos et al., 2025, Vince et al., 2025). Studies of the jets address one-sided structures, relativistic variability, and possible gravitational lensing in TXS 0506+056 (Berezhiani et al., 2025, Britzen et al., 2025, Kobaidze et al., 2025).

For short-lived events, an alert can trigger coordinated follow-up. Examples include an X-ray flash detected by the Einstein Probe and searches for optical counterparts to neutron star–black hole mergers (Jiang et al., 2025, Vidadi et al., 2025). For the gravitational-wave candidate S230518h, optical upper limits placed model-dependent bounds of $0.03\,M_{\odot}$ on each of the dynamical and wind ejecta components (Pillas et al., 2025).

The timing and polarization of pulsar radio emission give different clues to the physics of the emitting plasma. The studies examine periodic modulation of pulse amplitude and the polarization of individual pulses, alongside models of how coherent radio emission is generated (Basu et al., 2025a,b, Mitra et al., 2025a,b). Work on black hole magnetospheres asks related questions about how the surrounding plasma is supplied, accelerated, and heated (Dvali et al., 2025, Kurtskhalia et al., 2025, Nikuradze & Osmanov, 2025, Osmanov, 2025d,e). A 2026 study examines Schwinger pair creation in the magnetosphere of Sgr A* (Osmanov, 2026).

Solar observations span very different spatial and temporal scales. G-band images from the Daniel K. Inouye Solar Telescope at about 0.03 arcsec resolution revealed photospheric striations approximately 20–50 km wide. Radiation MHD simulations reproduced comparable structures and linked their contrast to variations in magnetic flux concentrations and in the height from which the observed light emerges (Kuridze et al., 2025a,b,c). On decadal timescales, the Abastumani Hα filament record spans 1957–1993 and has been used to examine cyclic changes in differential rotation (Mdzinarishvili et al., 2025). Studies of Balmer lines, flare spectra, and quiet Sun bright points use different diagnostics to characterize the atmosphere, while theoretical work considers the production of high energy particles (Criscuoli et al., 2025, De Wilde et al., 2025, Humphries et al., 2025, Osmanov et al., 2025).

Research on spicules, prominences, filament magnetic fields, and tachocline waves connects these observations with the dynamics of the chromosphere and interior (Jarolim et al., 2025, Sikharulidze et al., 2025, Zaqarashvili et al., 2025). Longer timescales are central to studies of cycle variability, solar dynamo timing, and possible links between solar activity and influenza pandemics (Oghrapishvili et al., 2025, Stefani et al., 2025a,b, Tsabadze et al., 2025). In geospace, work ranges from explaining the formation of sporadic E layers to evaluating forecasts of geomagnetic storms and coronal mass ejection arrival times (Didebulidze et al., 2025a,b, Kuznetsova et al., 2025a,b, Mays et al., 2025).

Repeated observations of small bodies can constrain their shape and rotation or reveal a change after a disturbance. One study reconstructs the shape, rotation, and density of the contact binary asteroid (153201) 2000 WO107, while another examines changes to Dimorphos after the DART impact (Inasaridze et al., 2025, Krugly et al., 2025). These studies complement work on the opposition effect and photometric and polarimetric monitoring of asteroids (Ayvazyan et al., 2025, Kruhlyi et al., 2025, Slyusarev et al., 2025). Exploratory studies address panspermia, potential transfer of life to Europa, and technosignatures (Osmanov, 2025a,b,c).

Analytical and numerical models let researchers vary properties of flows and fields that are difficult to isolate in observations. Simulations of Taylor–Couette flow found nonlinear dynamo action at magnetic Prandtl numbers at or below unity. They identified a weak regime dominated by large-scale magnetic modes and a stronger turbulent regime dominated by small scales (Mishra et al., 2025). Studies of planar shear and discs investigate the formation of coherent structures and the amplification of waves, while other work examines pressure anisotropy in dilute plasmas (Burdiladze & Chagelishvili, 2025, Kavtaradze & Chanishvili, 2025, Tevzadze, 2025). On cosmological scales, related studies address how primordial magnetic fields can be generated and how their spectra evolve (Abramson et al., 2025, Gurgenidze et al., 2025).

Large surveys connect the properties of individual galaxies to the distribution of matter on cosmological

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scales. DESI data releases, tracer samples, and large-scale structure catalogues provide the basis for these measurements (Adame et al., 2025d, DESI Collaboration, 2025, Ross et al., 2025). Baryon acoustic oscillations supply a characteristic distance scale that can be measured with galaxies, quasars, and the Lyman-α forest. The 2025 work includes validation of these measurements and comparisons between tracers (Adame et al., 2025a,c, Andrade et al., 2025, Valcin et al., 2025). Full shape analyses use the broader clustering pattern, while cross-correlations with gravitational lensing help relate galaxy positions to the underlying matter distribution (Adame et al., 2025e,f, Gsponer et al., 2025, Maus et al., 2025, Morawetz et al., 2025, Novell-Masot et al., 2025, Shao et al., 2025, Zhang et al., 2025).

ODIN takes a complementary approach by studying how the luminosity function of Lyman-α emitters changes across epochs and environments (Nagaraj et al., 2025). One analysis combined DESI DR2 distance measurements with Type Ia supernovae and a cosmic microwave background distance prior. It found moderate support for evolving dark energy, with the strength of the preference depending on the datasets and reconstruction used (Gu et al., 2025). Other cosmological analyses investigate neutrino physics, the matter–radiation equality scale, the baryon fraction, and the Hubble constant (Abdul Karim et al., 2025, Adame et al., 2025b, Avsajanishvili, 2025, Bahr-Kalus et al., 2025, Crespi et al., 2025, Elbers et al., 2025, Krolewski et al., 2025, Lodha et al., 2025). Gravitational-wave and pulsar-timing data provide a separate route to testing massive gravity (Choi & Kahniashvili, 2025b,a, Kenjale & Kahniashvili, 2025).

5 Education and public astronomy

Higher education institutions (HEI) introduce students to astronomy through their physics and mathematics curricula. Practical placements at Abastumani complement this instruction by giving students experience in planning observations, acquiring data, and analysing the results. The Observatory also supports teacher training and engages the wider public through observing programmes.

5.1 University programmes and research training

At Ivane Javakhishvili Tbilisi State University (TSU), the Physics BSc includes electives in introductory astronomy and the evolution of the Universe. The Fundamental Physics Master's programme offers Astrophysics and Plasma Physics specializations, and the Physics PhD includes an Astrophysics module. In 2026, the university installed a 175-mm APM LZOS 175/1400 refractor and a digital planetarium. The facility supports practical training in astronomy, astrophysics, and physics, as well as public outreach.

At Ilia State University (ISU), the Bachelor's programme in Physics offers coursework in astronomy and astrophysics. The Master's programme in Physics and Astronomy awards an MSc in Physics and offers concentrations in Astronomy and Astrophysics, Theoretical Astrophysics, Cosmology and Gravitation, and Atmospheric and Ionospheric Physics. The curriculum includes a 30-ECTS Master's thesis and identifies the Observatory as a partner (Ilia State University, 2026a). The doctoral programme in Physics and Astronomy awards a PhD in Physics and includes research areas in astronomy, astrophysics, and solar physics (Ilia State University, 2026b).

Alongside the physics-based pathways at TSU and ISU, Samtskhe–Javakheti State University offers a dedicated programme leading to the degree of Master of Astronomy. The two-year programme of 120 ECTS credits combines coursework in celestial mechanics, stellar dynamics, and extragalactic astronomy with training in observational methods and data analysis. Students complete a practical placement at Abastumani Observatory and a 30 ECTS master's thesis.

The Observatory complements university study with practical research training. Its 2026 Practical Astronomy Course on Mount Kanobili brought together students from Tbilisi State University, Ilia State University, Samtskhe–Javakheti State University, and the Agricultural University of Georgia. Participants planned observations, reduced and interpreted data, and worked on mentored projects. Fourteen students earned completion certificates. Projects were presented at the Abastumani Practical Astronomy Workshop on 15 August 2026, and the student presentations are openly archived.

5.2 Teacher education and public astronomy

The Observatory hosted the Network for Astronomy School Education course NASE-540 at its Tbilisi office on September 2026. Teachers from public and private schools in Tbilisi and other regions took part, and those who completed the training received NASE certificates. At Abastumani, guided tours and observations through the historic refractor give visitors a direct encounter with astronomical instruments. School visits, the museum, and the annual astronomical calendar provide other ways to engage with astronomy. The Observatory's Amateur Astronomers' Studio in Tbilisi offers introductory classes and practical sessions with small telescopes.

6 Conclusions and outlook

The Observatory's research output in 2025 included 55 journal articles, 19 conference contributions, and 21 preprints. Publications appeared in leading international journals, including *Nature Astronomy* and *Physical Review Letters*.

In June 2026, the Board of Directors of *Astronomy & Astrophysics* granted Georgia observer country status for 2026-2030 (Georgian National Astrophysical Observatory, 2026). Under this arrangement, papers whose first author lists a Georgian higher education or research institution as their primary affiliation qualify for a full waiver of the journal's standard page charges. The waiver is expected to broaden publication opportunities for research teams in Georgia and support the further development of astronomy in the country.

Student projects with the ASA15 already connect the telescope upgrade with research training. Documentation of its observing modes would help university teams plan further observations. The solar archive release offers a model for making other parts of the historical collection accessible, with each image linked to the information needed to assess its scientific use.

The growing interest in astronomy and astrophysics among bachelor's, master's, and doctoral students is reflected in their joint research with experienced scientists at the Observatory. Its renewed observing facilities and digitized collections support projects across a wide range of topics, while established international partnerships connect this work with research groups abroad. These collaborations help prepare a new generation of scientists to lead independent research and contribute to the long term development of astronomy and astrophysics in Georgia.

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