Indonesia’s Astronomical Observatory: A Novel Global Platform for Space Research Enhancing Peaceful Applications and Space Situational Awareness

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National Astronomy Observatory of Timau

Developing Indonesia from the vicinity

New center for astronomy facility in the eastern part of Indonesia

Located in the conservation forest, at the base of Mount Timau

Conditions:

- Located slightly to the south of the equator;
- Favorable annual climate and weather;
- Located in conservation areas, far from the residential area;
- Located in an area of 34 Ha which is dedicated to the observatory;
- Received permission from Japanese astronomers (Kyoto University) to use their telescope;

The telescope is based on Telescope in Seimei Observatory of Japan, see e.g. Mumpuni et al., 2018
The observatory is expected to be part of Dark Sky Park, to conserve the environment by designing a unique education & tourism area for Astro-tourism, and to boost economic development for society.

**PROGRAM:**

1. Astrophysics
2. Space Debris
3. Space Weather
4. Islamic Calendar
5. Inter-disciplinary study

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Major Facility: Optical telescope 3.8 meter with segmented mirrors & light weight structure (Kurita et al., 2010, 2020),
While the telescope is used for general purposes, it is prioritized for time-domain astrophysics (supernova, stellar flare, etc.). Besides, near-earth objects are another important aspect of collaborations (IAWN, APAON, or other network).

**TELESKOP 380 cm hopefully can join international endeavor:**

- Teleskop Ritchey-Chretien with **18 segmented mirror supported by active optic** with light structure to support the agility (for fast respond study).
- **2 Nasmyth** focus for first generations:
  - Simultaneous imaging **sdss optic** (g, r, i) (Maruo, 2020),
  - NIR with filter wheel (Y, J, H).
- Current design is optimized to meet photometry & astrometry study,
## First Generation Instruments

<table>
<thead>
<tr>
<th>Name</th>
<th>Specs</th>
<th>Expected Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>3OPTIKA / 3-OPTIKA:</td>
<td>450-820 nm in sdss g,r, and i, 12′×12′</td>
<td>Time domain astrophysics</td>
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<tr>
<td></td>
<td></td>
<td>Astrometry</td>
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<td></td>
<td></td>
<td>Generic Photometry</td>
</tr>
<tr>
<td>NIRKA / NIRKA:</td>
<td>Filter wheel Y (1020 nm), J (1220 nm), H (1530 nm) 8′.74 × 8′.74</td>
<td>+ NIR domain,</td>
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<td></td>
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<td>+ ‘cool objects’,</td>
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Why Timau?

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Characterization of Timau National Observatory using limited in situ measurements

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ABSTRACT
A new astronomical observatory in south east will host a 3.8 m telescope for optical and near infrared observations. The site is expected to be protected from atmospheric and human impacts. The site is located near the equator, making it ideal for time-of-year observations. The annual average AOT is 0.52. We used the UV/Vis data from the AOT to calculate the extinction coefficient, which was found to be 0.42. Additionally, we evaluated the level of scattering on-site. We found that the site is suitable for use. We also performed 40% photometric observations of the site, which is expected to be suitable for further analysis.

Key words: atmospheric effects --- methods: di

Highlight:
- 66% night/year, 8h/night is expected.
- 40% photometry night,
Multi Purpose Photometry Measurement

- Pluto occultation (international collaboration), Mumpuni et al, 2023),
- Photometry for space debris, (Rachman et al., 2023),
- National space debris cooperation is already discussed among several local smaller observatories (ITERA, Pontianak station in Kalimantan),
- Development of a robotic facility for Space Situational Awareness (Rachman et al., - see next)
Two light curves of PALAPA A1 satellite obtained from BRIN station at Tilong, Kupang in Dec 2022

The satellite is the first Indonesian satellite which was launched in 9 July 1976 and in operation until the end of 1983.
Robotic Telescope Utilization for NEO and Space Debris at TNOI

External database
(Space Track etc.)

Internal survey
(MyT + Mewlon 25cm + FLI #1)

Follow up for NEO*
Astrometry, photometry, spectroscopy
(Taurus 500 + OS 50cm + FLI #2)

Further follow up
(the 3.8m Telescope)

Follow up for space debris
Astrometry, photometry, spectroscopy
(Taurus 500 + OS 50cm + STC-428 P)

BRIN database of NEO and space debris

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*The system is also used for other astronomical observations such as stellar occultations, extrasolar planets, etc.

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Available in Tilong

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Routine

Occasional

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MyT, Taurus 500: mount
Mewlon 25cm, OS 50cm: OTA
FLI, STC: camera
Astronomy & Society Studies

- From the Astro-tourism study (Mardita & Perwitasari, 2023), it is difficult to determine new Astro-tourism areas due to several overlaying stakeholders:
  - Conservation forest under the Ministry of Forestry and Environment – central government
  - Rural area in the vicinity – regency of Kupang
  - Enclave – residential areas inside the forest area belong to the natives
  - Native People

- The Importance of Dark Sky Park to Support Sustainability: A Philosophical View of Technology, (Wibowo),

- Ethno-astronomy study on indigenous people cosmology, started in 2023
EKUATOR: Mobile Planetarium Education

(Edukasi Ilmu Astronomi dan Antariksa untuk Timor/Space and Astronomi Education for Timor)

(see: Mumpuni et al., 2017, 2018a),
International Collaboration

• Continues support from Japan, The Kyoto University on the preparation for operation of the large 380 cm telescope, with the preparation of several young Indonesian students to study in Japan, specifically in Seimei Observatory.

• New collaboration is also on the table with China, with the discussion between USTC, NIAOT & BRIN on the development of the new spectrograph for the 380 cm in Timau for the second phase,

• Collaboration with UK on observatory, education, and instrumentation is expected to be continued with UK, like LJMU (Liverpool Robotic Telescope), as well on issue on decolonization of astronomy with Leicester University,

• Collaboration with The Netherland on the communicating astronomy to the general public is also prepared with the Leiden Observatory, with the activity will be focused on the community around the Observatory.
Thank You Very Much

Let us collaborate, and please visit us in Indonesia. Contact prantariksa@brin.go.id, +62 811-1064-6830