Research Proposal: Advancing Astronomical Research in Japan Tokyo

# Research Proposal: Pioneering Extragalactic Astronomy at the Tokyo Cosmic Observatory

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## I. Introduction and Context

The field of modern astronomy stands at a pivotal moment where technological advancements converge with fundamental scientific questions about the universe's origin and structure. As an astronomer deeply committed to pushing the boundaries of cosmic knowledge, this Research Proposal outlines a groundbreaking initiative for Japan Tokyo—a hub of astronomical innovation poised to lead global astrophysical research. With Tokyo's unique geographical advantages, cutting-edge infrastructure like the Subaru Telescope at Mauna Kea (via Japan's strategic partnership), and a legacy of pioneering discoveries such as those from the Hubble Deep Field collaborations, our proposed project leverages Tokyo's position as an international astronomical epicenter. This initiative directly addresses critical gaps in extragalactic astronomy while strengthening Japan's role in global space science.

## II. Research Objectives

This 5-year Research Proposal targets three interconnected objectives:

1. **High-Redshift Galaxy Evolution Mapping:** Utilize Tokyo's next-generation adaptive optics systems to catalog star-forming galaxies at redshifts >7, capturing the epoch of reionization (13 billion years ago).
2. **Dark Matter Distribution Analysis:** Deploy machine learning algorithms on Japan's KAGRA gravitational wave detector data to map dark matter filaments through weak lensing effects.
3. **International Collaborative Platform Development:** Establish Tokyo as the central node for the Asia-Pacific Astronomy Network (APAN), enabling real-time data sharing among 12 observatories across Japan, China, and Australia.

## III. Methodology: Integrating Tokyo's Unique Assets

The methodology strategically harnesses Japan Tokyo's unparalleled resources:

* **Telescopic Infrastructure:** Full utilization of the 8.2m Subaru Telescope (operated from Tokyo headquarters) and the planned 15m Next-Generation Optical Telescope at Mount Ikeno, just outside Tokyo. This gives our astronomer team unprecedented access to wide-field imaging capabilities.
* **Computational Excellence:** Leveraging the K computer at RIKEN's Advanced Institute for Computational Science—Japan's most powerful supercomputer—ensuring rapid processing of petabytes of observational data generated during Tokyo-based surveys.
* **Cultural and Collaborative Synergy:** Implementing a "Tokyo Astronomer Exchange Program" with institutions like the National Astronomical Observatory of Japan (NAOJ) and the University of Tokyo, fostering cross-pollination between Japanese and international research groups.

## IV. Significance: Why This Research Matters to Japan Tokyo

This Research Proposal transcends academic inquiry—it is a strategic investment in Japan's scientific sovereignty and global leadership. For the astronomer, it offers a unique opportunity to lead multi-institutional projects at the vanguard of discovery. For Japan Tokyo specifically:

* **Economic Impact:** The project will generate 37 high-skilled jobs in Tokyo's science sector and attract international grants exceeding $15M USD over five years, directly supporting Japan's "Society 5.0" innovation agenda.
* **Cultural Legacy:** Honoring Japan's astronomical heritage—from ancient star charts at Horyu-ji Temple to the KAGRA gravitational wave observatory—by positioning Tokyo as the birthplace of next-generation cosmological models.
* **Diplomatic Value:** Strengthening scientific ties with ASEAN nations through collaborative data-sharing protocols, enhancing Japan's soft power in East Asia while addressing shared challenges like space debris monitoring.

## V. Timeline and Milestones

Phase 1 (Year 1): Secure telescope time at Subaru; establish APAN data framework. \*Deliverable: First Tokyo-compiled galaxy catalog of z>6 objects.\*
Phase 2 (Year 2-3): Deploy machine learning models on K computer; initiate international workshops in Tokyo. \*Deliverable: Dark matter map of Virgo Cluster with 95% accuracy.\*
Phase 3 (Year 4-5): Publish flagship findings in Nature Astronomy; launch Tokyo Astronomer Training Program for ASEAN scholars. \*Deliverable: Policy paper on "Tokyo's Role in Global Space Governance" presented at UNOOSA.

## VI. Resource Requirements

The proposed budget of $12.4M USD (funded 60% by MEXT, 30% industry partners like Canon Optical Instruments, 10% from international consortia) will cover:

* Telescope time allocation ($4.1M)
* K computer processing credits ($2.8M)
* Astronomer team (3 senior scientists, 5 postdocs, 10 graduate students) salaries ($4.7M)
* International workshop logistics in Tokyo ($0.8M)

## VII. Expected Outcomes and Impact

Beyond advancing cosmological theory, this Research Proposal will produce transformative outcomes for Japan Tokyo:

1. **Scientific Breakthroughs:** Precise measurement of the universe's expansion rate (H0) to within 1% error—a problem unresolved since Hubble's initial measurements.
2. **Tokyo as a Research Magnet:** Attract top global talent (e.g., former ESA astronomers) to Tokyo, reversing the "brain drain" trend observed in Japanese academia.
3. **Educational Catalyst:** Develop Japan's first undergraduate astrophysics curriculum co-designed with Tokyo universities, directly training future astronomers for national observatories.

## VIII. Conclusion: The Astronomer's Vision for Tokyo

To the global community of astronomers, this Research Proposal represents a call to join Japan in reclaiming its place among the world's scientific vanguard. For Tokyo—a city where ancient temples coexist with quantum labs—it offers a unique opportunity to anchor space science within Japan's cultural fabric while driving technological innovation. As an astronomer working at the intersection of cutting-edge technology and cosmic inquiry, I envision Tokyo not merely as a location but as a living laboratory for humanity's oldest question: "Where do we come from?" This project will ensure that Japan Tokyo becomes synonymous with answers to that question—through rigorous data, international collaboration, and visionary leadership. The time is now to build the foundation for the next century of astronomical discovery on Japanese soil, where every observation made in Tokyo contributes to our collective understanding of existence.

## IX. Acknowledgements

This proposal has been developed with extensive consultation from NAOJ leadership, RIKEN computational scientists, and the Japan Society for the Promotion of Science. We express profound gratitude to Dr. Toshio Suzuki (Director of Tokyo Cosmic Observatory) for his unwavering support in establishing this initiative.

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