Mini-panel exercise: proposal excerpt (authors redacted)

NASA ADAP-style proposal. Review as a panelist: 1 (excellent) – 5 (poor) on scientific merit, relevance to ADAP, and feasibility. Primary: 2-sentence summary + one strength + one weakness. Secondary: add what the primary missed.

Executive Summary

Science Objectives and Impact. The primary science goal of this proposal is to provide a multiwavelength baseline for understanding the nature of obscured accreting supermassive black holes in high spatial resolution observations. This work will address how and when active galactic nuclei are triggered, and the role they play in regulating the structure and dynamics of gas in their immediate vicinity. Combining high-quality space-based data with adaptive optics-assisted ground-based archival observations from the Keck Telescopes, we will synthesize a set of the highest angular resolutions of observations afforded by current technology across the electromagnetic spectrum. The anticipated results will set a benchmark for the nuclear structure and dynamics surrounding central black holes in nearby merging galaxies — critical for understanding the growth and impact of active nuclei on the host galaxy at small physical scales.

Relevance to NASA ADAP. Our proposed study takes advantage of the wealth of high resolution data in the various NASA-supported archives from a myriad of multiwavelength facilities, in particular those of Chandra, HST, and Keck, to leverage the utility and legacy of past X-ray observations of infrared galaxies. We propose to deliver calibrated images for the KOA, spatially-resolved SEDs, an automated archival query tool, and a visualization system that endeavor to maximize the scientific value of archival science. In line with the foremost mission of ADAP, the scientific and technical deliverables from this work will facilitate further studies utilizing the NASA archives, are aligned with NASA's mission to understand the origin of the universe, and will pave the way for interpreting imminent Early Release Science observations with the next NASA flagship James Webb Space Telescope.

Approach

We propose the novel use of an expansive set of the highest angular-resolution optical to submillimeter images currently afforded by state-of-the-art observing facilities in generating resolved, sub-kiloparsec clump-by-clump SEDs. Through combination with X-ray observations, we will address key questions on the growth of accreting SMBH and its interaction with the circumnuclear interstellar medium (ISM) as follows:

- Monitoring AGN Growth: When and how do AGN get triggered?
- Tracing AGN feedback: How do embedded SMBHs drive the structure and dynamics of gas in the circumnuclear regions?

Sample

The GOALS survey provides a complete sample of local (U)LIRGs that span various stages of the merging sequence, perfect for a detailed investigation of how SMBHs grow via mergers. For this study, we employ a selection based on availability of high-resolution data (< 0.5″/px) across the electromagnetic spectrum, taken with Chandra, HST, Keck, and ALMA. We note that while ALMA data analysis does not qualify for ADAP funding, it constitutes a secondary emphasis for the proposed work. The inclusion of this data set will significantly enhance the usefulness of the deliverables and scientific results for the wider extragalactic community while leveraging the utility and legacy of the NASA-supported data sets that are ADAP-compliant.

Telescope	Energy range	Detector plate scale	# of sources
Chandra	0.2−10 keV	0.5″/px (ACIS)	120
HST	435 nm, 814 nm	0.05″/px (ACS)	88
Keck	1−2.5 μm	0.035−0.1″/spaxel (OSIRIS); 0.01−0.04″/px (NIRC2)	52
ALMA	100−900 GHz	0.03−0.5″/beam	53
Subset of sources with all four data sets available:			22

Timeline

Year 1. The archive query and the interactive visualization tools will be developed, writtened up, and shared. All the Keck data from the archive that were not taken as part of our KOALA campaign will be processed uniformly as were done in our previous publications. The multiwavelength data set will be assembled for resolution-matched SED maps after PSF deconvolution and aperture matching.

Year 2. Manuscript on resolved SEDs will be submitted. Analysis of Keck IFU and ALMA data cubes will involve generating line emission and kinematic maps, overlaid with optical and X-ray emission. Relevant gas properties will be computed while morphological and kinematic comparisons across the wavelengths will be quantitatively assessed. Any serendipitous discoveries on the most interesting object(s) regarding obscured AGN or multi-phase outflows will be reported immediately.

Year 3. High-z simulations of gas kinematics based on a representative set of local sources will be made available to the community. Analysis of the merger nuclei for the entire sample will be completed and submitted for publication.

Deliverables

Our results will provide the community with the following:

- An archival query extension to the KOA and an interactive data visualization tool to broaden data-driven archival or survey science exploration;
- X-ray to submillimeter calibrated images and spatially-resolved (≤ 0.5″) SEDs of the inner kiloparsec regions of galaxy mergers that demonstrate the AGN-starburst interplay within bins of host properties;
- Bolometric luminosity and broadband spectral properties for clumps and double nuclei (with < 1 kpc separation) that might otherwise be unresolved by NuSTAR/Swift;
- Simulated high-z integral-field data cubes for 30-meter class telescopes that will help constrain the distance and projected separation at which robust signature of dual SMBHs can still be distinguished.