Rationale for DD-ERS Program

With our ERS MIRI observations of bright WISE W4 quasars, we will deliver all the tools necessary to the community in order to optimize Cycle 2 proposals of 5-30μm milliJansky bright sources. This is *a fundamental tool* for the exploitation of a key MIRI instrument mode

We will satisfy the Goals and Principles of the DD ERS program by:

- ensure open access to representative datasets in support of the preparation of Cycle 2 proposals, and
- engage a broad cross-section of the astronomical community in familiarizing themselves with JWST data and scientific capabilities.

These goals distinguish the DD ERS program from standard GO investigations. In service of these goals, DD ERS proposals are invited from the community. The DD ERS program is guided by the following key principles:

- Projects must be substantive science demonstration programs that utilize key instrument modes to provide representative scientific datasets of broad interest to researchers in major astrophysical sub-disciplines. Note that a meritorious DD ERS project need not cover every mode of the observatory. The request should match the focused science goals of the proposal.
- Projects must design, create, and deliver science-enabling products to help the community understand JWST's capabilities. An initial set of products must be delivered by the release of the Cycle 2 GO Call for Proposals (September 2019). Each project must define a core team to be responsible for the timely delivery of such products according to a proposed project management plan, with performance subject to periodic review.
- All observations must be schedulable within the first 5 months of Cycle 1 (planned to be from April to August 2019), and a substantive subset of the observations must be schedulable within the first three months. Target lists must be flexible to accommodate possible changes to the scheduled start of science observations.
- Both raw and pipeline-processed data will enter the public domain immediately after processing and validation at STScI. These data will have no exclusive access periods (i.e., no proprietary time).

STScI recognizes and supports the benefits of having diverse and inclusive scientific teams involved in the formulation of ERS proposals. Programs with diverse representation of community members in a given sub-discipline helps ensure that the investigations will be of broad interest. Broad involvement also facilitates the dissemination of JWST expertise through a more extensive network, and promotes more equitable participation in JWST scientific discovery.

The DD ERS program will be essential for informing the scientific and technical preparation of Cycle 2 General Observer (GO) proposals, submitted seven months after the end of commissioning.

Critically, we have alreayd begun working closely with the MIRI team (due to the P.I.'s location at Edinburgh) and will continue to develop tools here for the MIRI Imager and MRS.

Scientific Justification

The lasting scientific legacy of the *Hubble Space Telescope* will be the discovery of giant black holes at the centers of galaxies, confirms longstanding theory of the central engines of quasars. One of the major surprises from the *Hubble* was the discovery of a correlation between black hole mass and galaxy properties. This may provide crucial clues to how and why these holes formed.

Furthermore, discovery of spectral lines in active galaxies reveals that black holes can trigger massive star formation.

Giant Black Holes at the Centers of Galaxies Hubbles high angular resolution allows astronomers to peer into the hearts of galaxies to measure the orbital speeds of gas and stars close to their centers. The speeds of stars reach 1000 km/s in many objects, thereby indicating the presence of intense gravitational fields caused by massive black holes of up to a billion solar masses. Though mostly invisible today, these black holes shone brilliantly in the past as quasars, fueled by the infall of then-abundant interstellar gas. Key data found by the Hubble telescope reveal a correlation between black hole mass and galaxy properties that may provide crucial clues to how and why these holes formed.

The two main energy sources available to a galaxy are nuclear fusion in stars and gravitational accretion onto compact objects. The link between massive galaxies and the central super-massive black holes (SMBHs) that seem ubiquitous in them is now thought to be vital to the understanding of galaxy formation and evolution ([1], [2]). As such, huge observational and theoretical effort has been invested in trying to measure and understand the physics involved in these enigmatic systems.

Hubble discovered $M - \sigma$.

Gives rise to the idea of AGN/QSO feedback (in order to shape the LF at the high-mass end)

However, *direct observational evidence* for AGN feedback is conspicuous by its absence. This is especially true at high-z, e.g. $z = 2 - 3$, at the height of the Quasar Epoch.

We have identified the best candidates that suggest we are seeing quasar feedback in action, in situ at high-redshift. These are the "Extremely Red Quasars" identified via their WISE W3/4 colors.

As such, these milliJansky luminous AGN *are ideal targets for JWST MIRI.*

Description of the Observations

Describe the targets and observational modes to be used. Quantitative estimates must be provided of the accuracy required to achieve key science goals. Proposers must demonstrate that all observations can execute in the first 5 months of Cycle 1 (planned to be from April to August 2019), and that a substantive subset of the observations are accessible in the first 3 months. This description should also include the following::

a Plan for Alternative Targets: As described in JWST DD ERS Special Observational Policies, proposers should qualitatively describe the availability of alternate targets and the process used to identify those targets should the start of science observations be delayed. Robust ERS programs involve science investigations that can be performed with a variety of different targets and observations.

b Special Observational Requirements (if any): Justify any special scheduling requirements, e.g., time-critical observations.

c Justification of Coordinated Parallels (if any): Proposals that include coordinated parallel observations should provide a scientific justification for and description of the parallel observations. It should be clearly indicated whether the parallel observations are essential to the interpretation of the primary observations or the science program as a whole, or whether they address partly or completely unrelated issues. The parallel observations are subject to scientific review, and can be rejected even if the primary observations are approved.

d Justification of Duplications (if any): as detailed in the JWST DD ERS Proposal Policies and the JWST Duplicate Observations Policy, observations taken as part of the DD ERS program cannot duplicate those specified for the GTO Cycle 1 Reserved Observation Catalog (planned for release on June 15, 2017). Any duplicate observations must be explicitly justified.

Object R.A.	08:34:48.48	12:32:41.73	22:15:24.00	23:23:26.17
object declination	+01:59:21.1	+09:12:09.3	−00:56:43.8	−01:00:33.1
r-b& AB magnitude	21.20±0.05	21.11± 0.05	22.27±0.12	21.62± 0.08
Redshift $z_{\rm in}$	2.591	2.381	2.509	2.356

Plan for Alternative Targets

Special Requirements

Justify Coordinated Parallel Observations

Justify Duplications

Data Processing & Analysis Plan

Dave Bowman: Hello, HAL. Do you read me, HAL? HAL: Affirmative, Dave. I read you. Dave Bowman: Open the pod bay doors, HAL. HAL: I'm sorry, Dave. I'm afraid I can't do that. Dave Bowman: What's the problem? HAL: I think you know what the problem is just as well as I do. Dave Bowman: What are you talking about, HAL? HAL: This mission is too important for me to allow you to jeopardize it. Dave Bowman: I don't know what you're talking about, HAL. HAL: I know that you and Frank were planning to disconnect me, and I'm afraid that's something I cannot allow to happen. Dave Bowman: [feigning ignorance] Where the hell did you get that idea, HAL? HAL: Dave, although you took very thorough precautions in the pod against my hearing you, I could see your lips move. Dave Bowman: Alright, HAL. I'll go in through the emergency airlock. HAL: Without your space helmet, Dave? You're going to find that rather difficult. Dave Bowman: HAL, I won't argue with you anymore! Open the doors! HAL: Dave, this conversation can serve no purpose anymore. Goodbye.