

Report of COPAG Science Analysis Group # 7
Cosmic Origins Science Enabled by Operations Overlap
of the Hubble Space Telescope and the James Webb Space Telescope

Submitted by James Green on behalf of the members of SAG #7
November 7, 2014

Charter:

The Science Analysis Group # 7 was charged with polling the community and receiving input on the following questions:

1. Are there precursor observations that HST should do prior to JWST launch that might not otherwise be done through the regular time allocation process?
2. Are there compelling science cases for simultaneous HST-JWST observations?
3. Are there compelling science cases for HST follow-up of JWST observations or discoveries?
4. Are there expected discoveries by other facilities in the 2020 timeframe (such as Euclid or LSST) that would require follow-up by both HST and JWST?

In practice, question 1 was expanded to include precursor observations for EUCLID and/or JWST and not just follow up observations.

Execution:

Prof. James Green of the University of Colorado was selected to lead SAG 7. Members were recruited through community emails and at the January AAS meeting. The final list of interested parties is included as an appendix. An open session was held at the June AAS meeting, as well as a community telecon in July 3, 2014. In addition, Prof. Green sought input on the material whenever the opportunity presented itself.

Conclusions:

1: The rationale for maintaining HST operations in the future is very strong, *regardless of any scientific efforts coordinated with or for other missions*, including JWST, LSST and/or Euclid. The limited number of large programs identified by this analysis group should not be taken as an indication that the scientific value of continued HST operations is in any way lessened.

2: While significant enthusiasm existed for maintaining an overlap period for HST/JWST amongst all scientists polled, only two precursor surveys were identified that match the criteria described in the charter. Many examples of particular targets that would benefit from JWST and HST observations were suggested; however, the size and scope of these observations could be accommodated by the current time allocation process and be awarded HST observing time at the discretion of the HST Time Allocation Committee (TAC). No change to the current process is required to enable these observations.

The two identified surveys are a WFC3 UV imaging survey and the EUCLID multi-color precursor survey of galaxy color-shape relationships. Both of these surveys require HST's unique capabilities and a large allocation of observing time, and would probably not be able to be implemented through the normal TAC process. They are described in more detail below.

3: No compelling cases for simultaneous HST/JWST observations were submitted. This does not preclude the possibility that such cases exist, only that none were brought to the attention of this SAG.

4: In terms of follow up observations, high quality optical and UV observations of newly discovered objects were always viewed as beneficial. Astronomers have come to expect panchromatic data as the norm. Unfortunately, specifics are difficult to define as the nature of the newly discovered objects is, by definition, unknown. While HST imaging is almost always superior to ground-based imaging, in

many cases ground based optical data would suffice. Medium-high resolution UV spectroscopy and imaging is the unique purview of HST, and there will be no alternative source for many years after HST is decommissioned. However, no large scale UV spectroscopic or imaging surveys have been identified that are required as *follow-up* JWST/LSST/EUCLID observations. (In principle, the pre-cursor surveys could be executed as follow-up surveys if the operational lifetime of HST could accommodate them; however, they are suggested as pre-cursor surveys to maximize the likelihood of their successful execution.)

The science case for JWST was developed as a stand-alone program, as is the case for all space missions. Since an HST/WST operational overlap has never been certain, none of the JWST science cases *require* HST follow-up, although they would undoubtedly benefit from it.

5: It is the finding of this analysis group that with the possible exception of the WFC3 UV and pre-EUCLID surveys described below, no other special programs for precursor surveys have been identified, and no alteration of the HST time allocation process is required.

WFC3 UV survey

In order to track star formation histories across cosmic time requires measuring galaxies at a wide range of redshifts, and rest frame UV measurement are required to quantify the star formation rates. At low redshifts, this requires high resolution imaging observations in the ultraviolet. HST has unique capabilities in this wavelength that will not be replicated for many years after HST end-of-life. The proposed survey would take deep UV images with WFC3 of the CANDLES field. JWST will also observe this field to provide the panchromatic information necessary to understand the star formation history.

This program is sufficiently large (many hundreds of orbits) that it would require a special time allocation outside of the normal TAC process should it be viewed as scientifically compelling.

A powerpoint presentation conveying the relevant points is available at:

http://casa.colorado.edu/~jgreen/COPAG_SAG7/aas14hstuv_jwst.pdf

The EUCLID precursor survey

The weak lensing survey for EUCLID involves observing millions of galaxies, and measuring their ellipticities to determine if there are shear patterns in the fields indicative of weak lensing of the galaxies by foreground matter. This requires measuring the mean ellipticity of ensembles of galaxies to a very high precision. It is likely that the dominant systematic error in this observation is the color-shape relationship for galaxies. Because EUCLID will be performing its weak lensing survey in a broad visible filter, it will not be able to self-calibrate this color-shape relationship. The proposal would be to perform a multi-band survey with HST to calibrate the color-shape relationship at the relevant redshifts for the EUCLID survey. This would then allow ground based color-measurements of the EUCLID fields to be used to correct for this systematic.

The following reference describes the issue in greater detail:

<http://arxiv.org/abs/1211.5025>

6: It is the finding of this committee that these survey concepts be peer-reviewed to determine if the allocation of orbits is justified, and if approved, the resulting surveys should immediately enter the public archive (no proprietary period). The peer review process could be the standard HST Time allocation process, if the call for proposals allows large proposals for HST observations to support JWST/LSST/Euclid science. The committee does not recommend any specific number of orbits be awarded for such programs.

Appendix: SAG Members / Contributors

Martin Barstow
Guido De Marchi
James Green (SAG lead)
Stephen Holt
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Steve Kahn
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Susan Neff
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