

Science with the *Hubble* and *James Webb* Space Telescopes. V

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Traditionally, every few years, ESA organizes a high visibility scientific conference in Europe with the goal to give the *Hubble* user community an opportunity to gather, share their latest scientific results and discuss topics of common interest. This is part of the long-standing collaboration between NASA and ESA on the *Hubble* mission, now extended to the partnership on the *James Webb Space Telescope*, together with the Canadian Space Agency.

We have already held four of these conferences during the lifetime of the *Hubble* mission, in locations such as Sardinia, Rome, or Venice. They all have the trademark title “Science with the *Hubble Space Telescope*,” but every time we enjoy challenging the astronomical community to brainstorm together on a different, specific topic. We have discussed the future of space astronomy: What should *Hubble*'s successor be? We have asked ourselves: What are the key questions in astrophysics that *Hubble* has left unsolved? How should we use *Hubble* in the outer years to consolidate, or complete, its already remarkable scientific legacy?

This time, the Scientific Organizing Committee (see Table 1) pondered the fact that *Hubble* is still going very strong, and in high demand, and the *James Webb Space Telescope* will launch in 2019. It is likely that the two missions will be operating together for a few years. We felt it was necessary to engage the community in thinking about how best to exploit the very real possibility that the two missions will be in operation simultaneously. Being able to use the two observatories in a coordinated fashion will offer a scientific return much greater than the sum of the parts, with *Hubble* providing unique ultraviolet capabilities and superb optical imaging, and *Webb* exploring the very complementary near and mid-IR domain, with unprecedented sensitivity, resolution, and multi-object spectroscopic capabilities.

We met in Venice on March 20–24, 2017, graciously hosted by the Istituto Veneto di Scienze, Lettere ed Arti, in their beautiful location of Palazzo Franchetti, on the banks of the Grand Canal (Figure 1).

We asked all speakers to address the *Hubble–Webb* synergy in their talks, and they all did, offering very concrete ideas, and comprehensive strategies. All contributors offered their insight on what they plan to do with *Webb* in a very quantitative way. And as the Institute gets ready to evaluate the proposals submitted for the Early Release Science call for *Webb*, the feeling is strong that the *Webb* mission is truly a reality, and soon taking off.

The conference spanned a broad variety of scientific topics, from our close neighbors in the solar system to the furthest galaxies. The scientific program and the talks can be found here ([Conference Page](#)).

In four exciting days, we learned that *Webb*'s Near-Infrared Camera (NIRCam) and Near-Infrared Spectrograph (NIRSpec) will be perfectly suitable to study Jupiter Aurorae (Grodent), and that the combination of *Hubble* and *Webb* will make it possible to understand the full chemistry of clouds in the atmospheres of extrasolar planets (Sing). Astronomers are eager to demonstrate what *Webb*

will be able to do with transit spectroscopy of exoplanets (Bean), and are confident that *Webb* will constrain the properties of transiting asteroids around white dwarfs (Xu).

In the realm of resolved stellar populations, a *Hubble* stronghold, astronomers look forward to using *Webb* to complement the superb high-resolution photometric studies done with *Hubble* in recent years to follow the assembly of star-forming regions in different environments and address how local and global conditions affect star formation (Sabbi). For example, for the first time, *Webb*'s NIRCам will allow observations of the assembly and dynamical evolution of embedded class 1 and 2 young stellar objects (YSOs; Sabbi).

Moving to the more distant Universe, astronomers are excited by the new capabilities of slitless spectroscopy that *Webb* will offer to further the understanding of galaxy evolution, and building on the current *Hubble* surveys such as 3D-*HST* and GLASS (Brammer). It is clear that *Webb* spectroscopy will have many important roles in the study of galaxy stellar-mass assembly at high redshift (Kaputi), and that any *Webb* survey will need ancillary *Hubble* data for galaxies at $z < 6$ (Kaputi).

Two panels were organized to solicit additional thoughts and conversation: the first, moderated by Jason Kalirai, attacked the topic, “Defining Success for *Webb*” and the second, moderated by Meg Urry, gave an opportunity to the panel members to give their personal opinion on what “The Future of Space Astronomy” will be.

The conference also offered the opportunity to organize a public lecture on the *James Webb Space Telescope* by Nobel Laureate John Mather, Senior *JWST* Project Scientist at NASA GSFC. A very interested public crowded the conference hall, demonstrating that there is always big appetite in the public worldwide to learn more of the newest and exciting space astronomy endeavors.

To allow a break from an otherwise fully packed conference, astronomers were treated to a conference banquet in stunning Palazzo Zen, one of the oldest palaces in Venice, which is adorned by large mural mirrors. The lively scientific conversation continued, accompanied by great food in a very “venetian” setting.

On the last day, we organized a dedicated workshop to help astronomers translate their ideas into real observations with *Webb*, and despite the fact that it was a sunny Friday in Venice, most conference attendees remained inside to listen to a comprehensive suite of technical talks on the expected instrument performances and on the tools that will be available to reduce and analyze the data.

Daniel Lennon offered the summary talk, and an interesting visual rendition of the concepts heard during the five days (Figure 2). He concluded, quoting a question that Meg Urry had posed to her panel: Why do astronomers do what they do? We do it to inspire, educate, inform — and when we wandered through the rooms of the art and science exhibit, [Our Place in Space article 2017](#), and [Our Place in Space article 2016](#) on display at Palazzo Franchetti during the conference, the answer is clear in the awe in the eyes of the visitors. We do what we do to bring the Universe to all!

Table 1: Scientific Organizing Committee

Antonella Nota – Co-Chair	European Space Agency/STScI
Pierre Ferruit – Co-Chair	European Space Agency
Neta Bahcall	Princeton University
Martin Barstow	University of Leicester
Francesco Bertola	Università di Padova
Roger Davies	University of Oxford
René Doyon	Université de Montréal
Annette Ferguson	Institute for Astronomy, University of Edinburgh
Garth Illingworth	UCO/Lick Observatory
I. Neill Reid	STScI
Marco Sirianni	European Space Agency
Massimo Stiavelli	STScI
Monica Tosi	INAF – Osservatorio Astronomico di Bologna
Jennifer Wiseman	NASA GSFC
Gillian Wright	UK Astronomy Technology Centre
Simone Zaggia – LOC Chair	INAF – Osservatorio Astronomico di Padova