



Dr. Paul Hertz
Director, Astrophysics Division
SMD, NASA Headquarters
300 E. St. SW, Washington, DC 20546

January 24 2020

Re: Making Roman/WFIRST¹ a Great Observatory: Building Astronomy community support

Dear Paul:

As I indicated in my earlier letter to you (attached here) I am following up with some suggestions that could help build Roman/WFIRST into a Great Observatory, and so build support for Roman/WFIRST in the broad astronomy community, while still retaining a clear link to the Decadal Survey. I have been thinking about what might help to further the objective of developing the support for Roman/WFIRST, and removing the community perception that this will be a very expensive PI-like mission with a narrow science focus that is dominated by a few teams who will get all the funding and essentially all the scientific glory.

I recognize that you are also thinking about how to change the perception of Roman/WFIRST, given the goals that you outlined on your slide on Roman/WFIRST at the recent AAS NASA Town Hall. This was valuable, and I do appreciate your comments. The effort to broaden support for Roman/WFIRST is clearly an ongoing process to which I would like to add my thoughts and recommendations.

What concerns me a great deal is that the lack of interest in Roman/WFIRST (and the sense of Roman/WFIRST is “not for me”) is quite ingrained. Roman/WFIRST is not seen as a Great Observatory in the sense of being an accessible resource for the community for carrying out contemporary (circa 2025) survey science. The recent AAS meeting was an opportunity to get some further feedback from community members and from those who have been responding to questions from community members. I was struck by the sense that the younger people were resigned to a situation that Roman/WFIRST was not for them. There are many aspects of how Roman/WFIRST is viewed, but it is clearly seen as a mission for just a small fraction of the community’s broad range of interests. Dark energy and the limited exoplanet science that comes from microlensing are acknowledged as important, but represent a tiny fraction of the broad research endeavor in astronomy. The claim that Roman/WFIRST has GO opportunities is dismissed by many, given how little emphasis is placed on the GO aspect. This feeling has been exacerbated by having “science insiders” in the form of the Science Investigation Teams (SITs) that has reached the point where their dominance of the science messaging indicates that Roman/WFIRST is basically just for dark energy and limited exoplanet science for a small fraction of the community.

Transitioning Roman/WFIRST to a Great Observatory: In these circumstances it would really help to send a clear, strong message that NASA plans to transition Roman/WFIRST to being a Great Observatory for all astronomers, and not just for some select groups. There are two simple principles that I think would dramatically change the perception of Roman/WFIRST. These are (1)

¹ Occurrences of “WFIRST” have been replaced by “Roman/WFIRST” for alignment with the mid-2020 name change to Nancy Grace Roman Space Telescope, widely abbreviated to “Roman” by NASA, while retaining consistency with the original document’s use of WFIRST.

state clearly that Roman/WFIRST is to be a mission that will be driven by *contemporary* 2025-2030 science goals, and (2) that this will be achieved by ensuring that *ALL* the observing time on Roman/WFIRST will be selected through a fully open and competitive peer review Time Assignment Committee (TAC) process. In addition, the science advisory structure will clearly need to undergo a major change so as to show the commitment to a broad science focus and to remove the perception that the benefits of Roman/WFIRST will be restricted to a narrowly defined group.

These approaches can be structured so that the science carried out on Roman/WFIRST is both contemporary and "state-of-the-art", while being consistent with the old 2010 Decadal Survey goals. The mechanism for this aspect is to designate Key Projects on Dark Energy and Exoplanets for the TAC process (more on this below), just as we did for the Hubble Key Projects.

In broadening the science opportunities we can be true to the broad goals on the Decadal Survey, while making Roman/WFIRST (1) responsive to contemporary science, (2) accommodating of the major scientific advances that will surely occur from years of observing up to 2025 with LSST, Euclid, DESI, Hubble, ALMA, and particularly JWST, and (3) opening up opportunities for the large number of younger astronomers who have joined the profession since the 2010 Decadal Survey and who will be the scientific leaders in the 2025-2030 timeframe.

Roman/WFIRST has particular value for realizing the potential of the increasingly diverse community of younger scientists by opening up scientific opportunities across the full field of astronomical research at a time when they are beginning to assume leadership roles in the science community. But this opportunity will only come to fruition if Roman/WFIRST changes from the narrowly-focused science mission of today.

It is useful to keep in mind that community science interests are broad. Using Hubble as an example, over the last few years an estimate of the publication fraction on dark energy has been about 3% and for *all* exoplanet research is around 10%. Microlensing would contribute only fractionally to all exoplanet interests, and so Roman/WFIRST in its focus on dark energy and microlensing is of direct interest to just a tiny fraction of the science community. This is not wise for an ~\$4B (LCC) Observatory-Class NASA mission.

It is useful also to remember that when WFIRST acquired its AFTA mirror and grew in size, capability and cost, it was also implicitly transformed into a facility that was significantly beyond what the Decadal Survey intended. Both Fiona's AFTA NAS committee (*Evaluation of the Implementation of WFIRST/AFTA in the Context of New Worlds, New Horizons in Astronomy and Astrophysics 2014*) and the Mid-Decadal NAS committee (*New Worlds, New Horizons: A Midterm Assessment 2016*) were not happy about this transformation and the attendant growth in cost. But the 1.5-m Roman/WFIRST of the 2010 Decadal is now history. Concerns regarding the cost will remain, but can be lessened if the science value returned to the community expands beyond the narrow goals from 2010. This can be done by making it clear to the community that the full breadth of scientific opportunities expected of a Great Observatory will be available on Roman/WFIRST on all science topics, while also accommodating the Decadal goals.

Such a characterization would be valuable to bring astronomers "on-board" more broadly, including members of key committees, and enhance the community support for Roman/WFIRST. We need to change the skepticism that permeated the AFTA NAS study and the Mid-Decade NAS study. Such a change to broaden the scientific opportunities from Roman/WFIRST is scientifically rational, but, most importantly, will also enhance the political support for Roman/WFIRST – both aspects of which are key to realizing such a costly mission. As we know, Roman/WFIRST is by no means out of the woods, even though we have been fortunate that Congress has supported Roman/WFIRST after the zeroing out of the budget by the Administration. Hopefully developing Roman/WFIRST to

being a broader Great Observatory consistent with its ~\$4B LCC cost, while enabling the science goals of the old 2010 Decadal Survey, will help on both counts.

If we don't succeed in enhancing the interest in Roman/WFIRST we run the risk that the 2020 Decadal Survey will offer very weak support for Roman/WFIRST. If there is a sense from the 2020 Decadal of just "well it should be done because it was highly ranked in 2010", we are on track to having Roman/WFIRST become SOFIA 2.0 with little support and interest, except for the participation from a small segment of the community.

Bringing Realism to Science Requirements: There is another aspect that is also challenging for the mission. When Roman/WFIRST grew from a 1.5-m telescope in the Decadal to a far more powerful 2.4-m telescope with AFTA, the demands of the science teams (SITs and FSWG) grew as well (understandably). The Decadal-defined surveys that dominate the time, and which also drive the system requirements (somewhat excessively), are more than what was envisaged for a 1.5-m. The Decadal did not specifically define the scope of the programs – those detailed requirements came from the SITs and the FSWG and they were developed in a way that was essentially unconstrained, as the 134 pages of the Science Requirements (Level 2) document exemplify.

There are good intentions behind this science requirements effort, but they constitute demands on the program that are problematic. It appears that very little pressure has been applied to limit the WFI science program requirements, and to ensure that what was planned for the surveys was realizable and implementable by the mission within the cost bounds that Roman/WFIRST has faced. Stepping back and thinking about Roman/WFIRST as a broadly-based Observatory will help rationalize the requirements. *Every desired capability of the current survey science programs may not be realized. But it is better to have an executable mission than no mission if the cost cap is broken.*

Large/Treasury Key Projects in Dark Energy and Exoplanets: The 2010 Decadal Goals could be accommodated by designating Large/Treasury Key Projects in Dark Energy and Exoplanets in the first, and subsequent TACs. The opportunity to enable multi-year programs should be clearly stated, with the option to do so being chosen by the proposing team from the community, and accepted at the discretion of the TAC. The TAC then decides on the amount of time. It is important to allow the TAC the discretion to do this. Just as with JWST, there may well be some concern about allocating vast swaths of time in the first year before the Observatory performance is known. The same concerns led the JWST JSTAC to recommend² that large multi-year programs **not** be implemented before the on-orbit performance of the Observatory was known. In my view the same prudence regarding allocating large amounts of time pre-launch, particularly on multi-year programs, should be applied in the case of Roman/WFIRST.

Roman/WFIRST as an Observatory for Contemporary Science in the 2025-2030+ Timeframe:

At the risk of being proven wrong, I am willing to speculate that the most exciting science for the majority of the astronomy community by the mid-late 2020 Decade will **NOT** be dark energy and exoplanet science from microlensing. They will no doubt be seen as important, but the scientific landscape will surely be different in many aspects in the 2025-26 timeframe after 3+ years of JWST observations, after DESI, after several years of Euclid, and after 4 years of LSST, as well as

² <http://stsci.edu/jwst/about/history/jwst-advisory-committee-jstac>

From the JSTAC May 28 2016 letter regarding the Cycle 1 GO TAC proposal process:

"(C) JSTAC similarly recommends that large multi-cycle programs should not be part of the baseline for Cycle 1, though well-justified smaller programs that require multi-cycle observations (transient, transit or proper motion programs) were considered by the JSTAC to be appropriate (possibly with additional review in Cycle 2 to ensure viability once the performance characteristics of JWST are better known)."

another 7 years of Hubble, ALMA and other major ground telescopes, plus of course advances in computational and modeling capability. Science evolves and scientific frontiers evolve as well. There will *surely* be remarkable discoveries about which the science community will be clamoring to get Roman/WFIRST datasets that are *not* included in the planned surveys.

The nature of the science programs to optimally use Roman/WFIRST's unique wide-field capabilities will differ from Hubble, but in no way does this lessen the importance of selecting programs that are scientifically contemporary in 2025-2030, in the context of major new projects like JWST and LSST and also after 15 years of scientific developments since 2010.

Peer review through a Roman/WFIRST TAC process will enable the broad community to establish the science program for Roman/WFIRST. This crucially enables the inclusion of the younger, more diverse, generation who are growing to become the scientific leaders in 2025-2035. With the exception of the Key Projects mentioned above the constraints on the science to be proposed should be minimal. Clearly, as noted, there should be emphasis on the use of Roman/WFIRST's unique wide-field capabilities. The contemporary science opportunities should be developed so as to be consistent with Roman/WFIRST's wide-field capability, and so the nature of the programs will differ from those accepted for missions like Hubble or JWST, but the principle of open, competitive access is central. Given this it is likely that most of the accepted proposals for a broadly-based Roman/WFIRST will be larger projects in the many areas of late 2020s contemporary high-priority science.

Roman/WFIRST should be more than an Archival facility for the broad community: I have heard arguments that Roman/WFIRST should be considered to be like LSST, and be viewed as a community resource that essentially just supplies archival data to the community. I do not think this is appropriate or relevant. Of course, the archive will be scientifically useful, and a valuable resource. However, I suspect that few community members think that an ~\$4B space telescope that is intrinsically capable of carrying out cutting-edge science across so many fields should just be an archival facility. Such an expensive Observatory really must provide research opportunities outside the relatively narrow interests of microlensing for exoplanets and dark energy. Even with the dramatic growth in interest in exoplanets, microlensing studies of exoplanets and dark energy studies constitute a quite small fraction (a few percent) of the community's interest, as noted above. This "narrow science" aspect, in particular, has been noted in the feedback from younger community members as both a concern and a reason for lack of their interest in Roman/WFIRST.

The need to restructure the Roman/WFIRST Science Advisory Groups: I fully expect that there will be pushback from the FSWG and SITs on the changes outlined here. It is understandable. The FSWG and the SITs have spent a lot of time on helping to define the science and performance requirements for the mission. They have invested a lot into this mission. The effort they have made is appreciated, but any pushback should be considered in the context of their focus on the current narrow science program. From the community perspective the current science teams are seen as narrowly-focused groups who are positioned to dominate the rewards, both the financial rewards and those from scientific recognition and prizes. Is this PI-like status really appropriate for a ~\$4B LCC NASA program? *No, it is not, in my view, and the feedback that I am getting is that this concern about the narrow science advisory structure is widely shared.*

Now that the mission is about to transition to its Implementation phase after KDP-C in February, it really is time for the FSWG and SITs to be disbanded at the start of Implementation, and a new science advisory team formed – something like an Implementation Science Working Group (ISWG) – as per the announcement in 2015 re the formation of the FSWG/SIT advisory structure.

Data processing capability and the SOC role: A key element of a Great Observatory is developing the data handling, processing and archival capabilities that are focused on the needs of

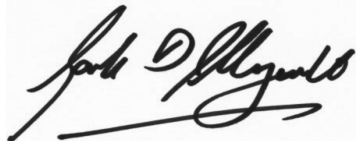
a broad community. The current Great Observatory missions, Hubble, Chandra, Spitzer and JWST, have been committed to end-to-end science operations and data processing support of the breadth and depth needed by the astronomy community. Much of the data processing effort that the SITs have been doing should transition to the Science Operations Center (SOC) in the case of a Great Observatory class mission, be it at GSFC or STScI. By building on the well-honed approach for the current Great Observatories, the data processing deliverables can then be managed per NASA procedures. Such procedures are focused on the SOC developing the software deliverables so as to ensure that the analysis tools and packages have the needed functionality, and are fully tested, documented and supported for the long-term. In this demonstrated approach, per Hubble, Chandra and what is being done for JWST, community members, such as those in the SIT teams who have been contributing algorithmic knowledge, can continue to contribute their expertise and algorithmic experience. The SOC then provides long-term continuity and support while meeting NASA standards regarding deliverables and functionality over the life of the mission.

CGI: I have not discussed the science role of the CGI coronagraph here since it is my understanding that all those concerned (SMD, HQ Roman/WFIRST Program, GSFC Roman/WFIRST Project and the JPL CGI team) are committed to the role of CGI being a Technology Demonstration. I fully recognize the importance of CGI for retiring uncertainty and risk such that future Strategic Missions could be enabled with powerful exoplanet characterization capabilities. In addition, the recommendations of the recent review groups such as the CGI Tiger Team, the WSAT and the WFIRST Action Team will enhance the likelihood that CGI will not drive the schedule and so will not drive the cost of Roman/WFIRST beyond the Congressionally-imposed cost cap. The discussion of the priority given to enabling CGI observations early in the mission life will also help ensure that this important demonstration of coronagraphy in space is realized in a timely and cost-effective way.

As I indicated in my previous letter, I am very happy to do what I can to help support this mission, but I really think that we are in for a rough time getting broad astronomy community support unless the way this is portrayed to the community changes to Roman/WFIRST being a mission of GO opportunities for the best science in the mid-2020s post-JWST launch. With such changes the likelihood of broad community interest and support will surely grow.

I am very happy to discuss this further. I think that for enabling our future strategic missions, as well as for justifying the cost of Roman/WFIRST, this mission has to succeed and be seen as one of our ensemble of Great Observatories that have opened up new scientific frontiers!

Sincerely



Garth Illingworth

*Distinguished Professor Emeritus, Department of Astronomy and Astrophysics, UCSC
Astronomer, University of California Observatories/Lick Observatory
+1 831 459 2843 gdi@ucolick.org <http://www.ucolick.org/~gdi/> <http://www.firstgalaxies.org/>*

Attached -- November 17, 2019 letter: *Roman/WFIRST: Community support*

cc:	Jeanne Davis	Astrophysics Division, SMD, NASA HQ
	Jacqueline Townsend	Astrophysics Division, SMD, NASA HQ
	Dominic Benford	Astrophysics Division, SMD, NASA HQ