IXPE Users Committee Report

IUC Meeting date: 17 September 2024

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I. IXPE Timeline

2021 December	IXPE Launch
2022 January	Start of 2-year Prime Mission
2023 October	GO Cycle 1 Deadline
2024 February	Start of Cycle 1
May	1st IUC Meeting
August	GO Cycle 2 Deadline
September	2nd IUC Meeting
2025 February	Start of Cycle 2
~ April	3rd IUC Meeting
September	Current end of IXPE operations, pending Senior Review

II. Overview

The IXPE mission: A joint collaboration between NASA and the Italian Space Agency, IXPE is an explorer-class mission (Prime Mission cost of < $200M) currently operating in a low-Earth orbit. It uses a three-telescope design with a gas pixel detector to measure linear polarization of incoming X-rays over the energy range of 2-8 keV, reaching a sensitivity 2 orders of magnitude deeper than predecessor OSO-8, which was operational in the 1970s. IXPE was launched in December 2021 and began its 2-year prime mission phase the following January. In February 2024 the mission entered its first extended mission phase as a 100% guest observer (GO) facility. IXPE operations are funded through FY25 (30 September 2025) and will undergo a senior review in early 2025, where the team intends to request a 3-year mission extension through FY28.

The first IXPE Users Committee Meeting was held in May of 2024 and the report is accessible online from the IXPE project website at MSFC.[1] That report includes a brief summary of the major discoveries and science outcomes from the Prime Mission phase of IXPE, as well as a discussion of the results of the cycle 1 GO Call.

This Report: The IXPE Users Committee (IUC) was formed in January 2024 and currently consists of the members listed on the title page of this report.[2] The IUC charter is available at the IXPE webpage hosted at MSFC. In preparation for this report, the IUC collected information and presentations from the IXPE team and conducted a community survey prior to the formal semi-annual IUC meeting on 17 September 2024, which was held in a hybrid format. Information about the meeting, survey, and modes of sending both anonymous and non-anonymous feedback to the IUC were advertised to the community via the HEAD listserv and other venues (including the IXPO Symposium) several weeks prior to the meeting. A contact form is also available at the IXPE UC page

[1] https://ixpe.msfc.nasa.gov/for_scientists/iuc_docs/

[2] Alan Marscher (BU) served on the first committee through September 2024 and was replaced by Herman Marshall (MIT) at the 2nd IUC Meeting. The committee thanks Alan for his time and service.

linked in the above footnote. This report reflects the information and feedback gathered before and during the September 2024 meeting.

III. The IXPE Guest Observer Program & GO Science Return

Publications: In the first IUC report, we noted the very impressive publication output of the IXPE team during the prime mission phase, and the nearly 200 total peer-reviewed papers which had been published or submitted related to IXPE.[3] In only the 4 months from May to September 2024 an additional 50 papers have appeared, with a pace that is clearly accelerating, reflecting the growing IXPE science community. At present there is no public formal tracking system to identify publications associated with specific GO proposals, but the IXPE team does compile publications using the HEASARC Bibliography service.[4] If feasible, requesting authors to include the specific ObsID codes in their acknowledgement statements would enable tracking publications by program.

GO Program: The second cycle of the IXPE General Observer program was announced via the NASA Research Opportunities in Space and Earth Science (ROSES) 2024 solicitation. The call opened in February 2024, without the optional notices of intent used in Cycle 1, and with phase 1 (science) proposals due 29 August 2024. The shift of the regular cycle deadline from October to August was sought by the mission team to give more time to conduct the review before cycle 2 start; the next GO deadline is anticipated to be in September, pending approval of the most recent mission extension request.

One hundred and forty-one (141) proposals were submitted, a slight increase from the 135 proposals received for cycle 1. A total of 11 Ms was available, and while at the time of the 2nd IUC meeting further data was not available (due to confidentiality constraints prior to the review), this suggests a similarly high oversubscription rate to cycle 1 (which was 6.9 – notably higher than flagship missions like Hubble and Chandra.[5,6]), and the committee accordingly feels strongly that several more years of IXPE operations will be scientifically productive.

Cycle 2 offered coordinated joint observing time with NICER, NuSTAR, and Swift (expanding from NICER only in cycle 1), allowing accurate X-ray spectra to be determined simultaneously with IXPE polarization measurements. The possibility of offering ground-based optical polarimetry for cycle 3 is being discussed, while (two-way) joint programs with the National Radio Astronomy Observatory (NRAO) were recently established. Such joint programs facilitate the multi-wavelength synergies by requiring a single proposal to request observations by multiple telescopes.

[3] NASA/ADS Service search using both IXPE and full name in title or abstract field
[4] https://heasarc.gsfc.nasa.gov/docs/heasarc/biblio/pubs/ixpe.html
[5] https://www.stsci.edu/contents/annual-reports/2022/by-the-numbers
[6] https://cxc.harvard.edu/newsletters/news_28/article4.html

Further details of results of the Cycle 2 proposal call (including scientific balance, approved large programs, demographic and other statistics) will be summarized in the next IUC Report in mid-2025.

IV. Community Feedback and Committee Findings

In preparing this report, the IUC requested mission updates from the IXPE team and surveyed the community.[7] We also held an in-person feedback session in September 2024 at the International X-ray POlarimetry (IXPO) Symposium which resulted in useful feedback.[8] For the online survey that same month, we slightly updated that which was originally sent out prior to the first IUC meeting in May 2024. The earlier version of the survey had 26 respondents, while the expanded survey in August-September (with a few additional questions/clarifications) added 18 for a total of 44 respondents. The goal of the survey and feedback session was to gather feedback from the science community on a number of matters, including the GO program and proposal submission process, proprietary time for GO programs, IXPE software and analysis tools, as well as training workshops.

GO Program

The responses and comments showed broad satisfaction with the GO proposal submission and program selection processes. Importantly, nearly 40% of respondents had no experience with IXPE, but were interested in using it in the future, showing that the pool of IXPE users will likely continue to grow. Approximately 60% of respondents declared that IXPE Data were “essential” for their research.

Repeating comments given in the first report, the committee finds the $3M in funding for cycle 1 and 2 programs a necessary amount given the more time-consuming and challenging nature of opening a new field and developing analysis methods for a new observing mode. The experience of the committee is that these challenges dissipate slowly (over a few years) rather than rapidly, and that continued high levels of funding are critical to maintaining scientific output and to grow the community of users.

Proprietary Periods

A major topic at the feedback session was the default lack of proprietary time for GO Programs. While proposers can request a 6-month proprietary time with justification, there was broad feedback from the community which was generally critical of the lack of a universal proprietary time. The committee findings and concerns raised in the first

[7] At this time we have not received any messages from the community through the online contact form, which can be found on the MSFC IXPE Website.
[8] IXPO Website: https://sti.usra.edu/ixpo/

report from May 2024 are thus strengthened, and in lieu of simply re-iterating those concerns in different words we quote here that section of the report:

> *As previously noted, the lack of a proprietary period, especially for a brand-new observing capability, leads to a high pressure to publish very rapidly, for fear of being 'scooped'. The side effect of this pressure is that complex and deeper analyses, requiring unavoidably more time, are often postponed to subsequent papers which may not always appear due to the arrival of new/additional data which competes for the finite time of researchers. The final effect is likely the publication of more papers, but with average lower quality, which is particularly upsetting for the novelty of the data provided by IXPE. The committee feels this pressure to publish will be even higher for new IXPE users, who will need to invest not only the work to prepare a successful proposal, but also to learn how to analyze IXPE data. The IXPE GO program does allow for early career researchers and programs which are part of student theses to request proprietary periods, but the move away from default proprietary periods (previously the standard practice in astronomy) to the requirement of an exception statement may discourage those that would benefit from the proprietary time from requesting it, as evidenced by the several cycle 1 IXPE programs which involve a PhD thesis but which did not request the exception. The committee notes that PIs/teams from under-resourced institutions, such as those with high teaching loads during the academic year, would also likely benefit from proprietary time; we believe further study is urgently needed to understand the potential impacts of this policy on new and early-career IXPE users in particular.*

The committee repeats its concerns expressed in the first IUC report about the importance of having an adequate level of funding for the IXPE operations team to allow them to complete important (and currently deferred) instrument support work, including the reprocessing of IXPE data with new and better calibrations and updated analysis tools and modes. This work will require a higher level of FTE support for the team than currently appropriated.

Analysis Tools and Software

Two sets of software exist for IXPE analysis: ftools based software provided through HEASARC, and ixpeobssim, provided through github. In addition, basic predictions can be made involving IXPE through the web-based WebPIMMS tool hosted by HEASARC. We note that IXPEOBSSIM is not officially supported by the instrument team, but is used extensively by both team members and the community and training and community guides related to the package have been contributed by IXPE team members.

In our survey, users expressed general satisfaction with all the tools, with a slightly higher percentage of users reporting issues with IXPEOBSSIM (about 25% of users attempting the software, though this corresponds to only 5 respondents). Moreover,

some users reported the need for additional documentation on how to determine the feasibility of a specific observation or to recalculate the livetime, especially in view of the unique characteristics of IXPE. The May report contained a number of findings related to the available analysis tools and software, and expressed some concerns about the need for more and better training materials. These needs have clearly been heard by the IXPE team with active development and regular updates to e.g. the IXPE “quick start guide” as well as more extensive tutorials. We note again the importance of supporting users that utilize the ftools-based as well as those using ixpeobssim-based tools.

Community Training and Outreach

The IXPE team has made a significant effort to engage and grow the science community, particularly through small community workshops. Most recently the team organized a joint NICER/IXPE Workshop in a hybrid format with the in-person location of Washington, D.C. from Jul. 29-Aug. 1, 2024. Over 300 total applications were made to join the free workshop, with actual attendance of about 50 in-person and 100 online participants. These are excellent numbers considering the small size of the high-energy community in general and existing strong interest in IXPE (as evidenced by the very high over-subscription of available time in the GO cycles so far). Even more impressive is that 90% of attendees were either not familiar with IXPE at all (60%) or only moderately familiar (25%). Similarly ~60% of attendees were either students or postdocs, showing the importance of these training events in supporting the development of the next generation of high-energy astronomers. The workshop focused on data analysis and proposal preparation and 100% of respondents to the post-workshop survey rated it either excellent (71%) or good (29%). One point of constructive feedback from in-person attendees was to allow more time for a general poster session. The analysis tutorials from the workshop are now available at the IXPE science website, an enduring and useful resource for the community.

The committee strongly approves of hybrid-format workshops and the creation of “portable” training materials that are posted online for continued use. Both aspects continue to be highly preferred by potential and existing IXPE users in our user community survey.