Bringing the CHANDRA/CIAO workshop to underrepresented communities and under-resourced institutes in the USA

A. Fruscione, J. McDowell, D. Burke, T. Connor, K. Glotfelty, H.M. Guenther*, W. Joye, V. Kashyap, N.P. Lee, R. Montez Jr., A. Siemiginowska, M. Sobolewska

* Massachusetts Institute of Technology

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Abstract

After over 20 years of successful Chandra/CIAO workshops at the CfA, at the AAS, and abroad in India, Egypt and Italy, it is time to expand our reach "closer to home" toward the underserved parts of the United States. Building on our own experiences and following the recent recommendations from the Astro2020 Decadal Survey, we are proposing to bring the workshop to underrepresented communities and under-resourced institutes in the USA. Our team at the CfA has the unique expertise, experience and skills needed for this project. Funding support, institutional recognition and endorsement by the CfA are crucial to the success of this initiative.

Introduction

CIAO (Chandra Interactive Analysis of Observations) is the software package developed by the Chandra X-Ray Center (CXC) for analyzing data from the Chandra X-ray Observatory. It was released for the first time in 1999, after Chandra's launch, and it is currently used by professional (X-ray and non-) and amateur astronomers all over the world. It is often praised for its extensive and helpful documentation that makes X-ray astronomy easily accessible even to first-time users.

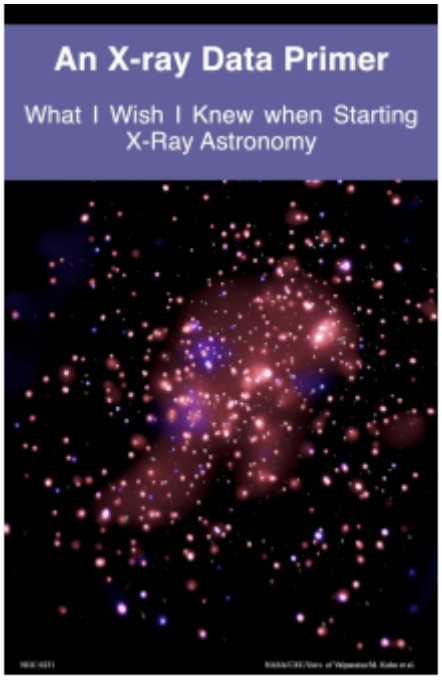
However at the beginning of the Chandra mission, the software interfaces were more complicated and unfamiliar, the documentation was in its infancy, the only -CIAO experts were at the CXC, and X-ray astronomy expertise in general was less widespread in the community. Therefore in order to transmit the knowledge to the wider community we decided to experiment with the concept of a "workshop" to teach an introduction about Chandra and X-ray astronomy–but

The first 2001 Chandra/CIAO workshops in Phillips

especially CIAO–to a large number of users. The workshop model was conceived as a mix of talks and hand-on sessions, where students could work with real Chandra data and could try to analyze them under the watchful eye of CIAO "experts." In many cases this was the first time students were able to work with real X-ray data. In 2001 we organized the first of many such workshops. The formula was a great success and has been reproduced by many other missions (for example by XMM and Spitzer whose organizers were among our first "students").

We soon realized that the value of these workshops went beyond helping students learn to use CIAO; they also learn the concepts and methods that underlie high-energy astronomy. The workshops have done more than make it easy for people to use Chandra data, they have made it easy for students and first-time users to perform research in **high-energy astronomy**.

An additional bonus for us–the CIAO team–has always been the fact that we learn from workshop participants almost as much as they learn from us, and our documentation has therefore expanded and adapted to the needs of those who use the CIAO software.



The 20 page guide, intended for users new to X-ray astronomy, is the result of our interactions during workshops, conferences and the CXC Helpdesk (N.P. Lee & J. McDowell)

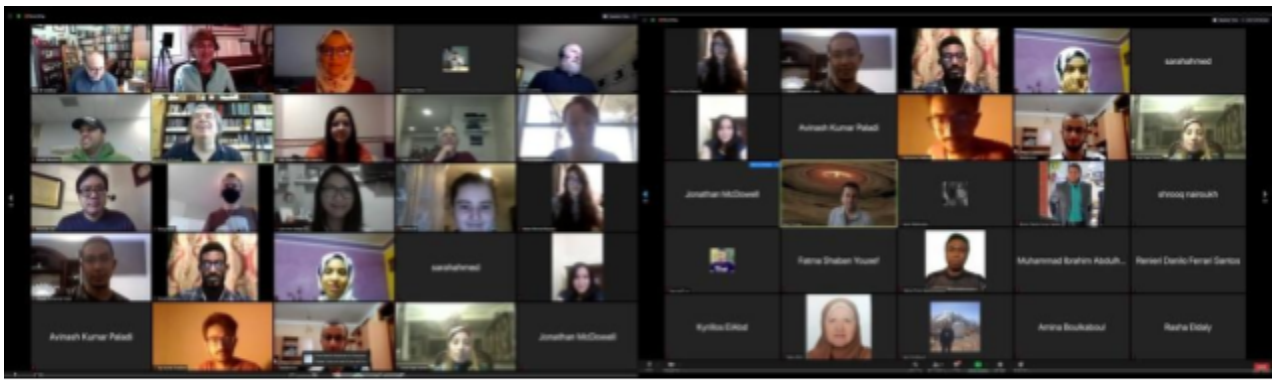
Workshops at the CfA, India, Egypt

The original workshops were all in Cambridge at the CfA with an average of ~30 students per workshop coming from the largest astronomical institutions, mostly based in the USA and Europe. As the years went by we decided to offer our expertise off-site to institutions who would like to host a CIAO workshop but lacked local expertise to organize it. In this context in 2017 we were asked by Dr. Lal from the National Centre for Radio Astrophysics of the Tata Institute for Fundamental Research (NCRA-TIFR) to organize a Chandra/CIAO workshop in Pune, India. A group of CXC CIAO people traveled to India to teach to a cohort of 40 students coming from all over the country (Fruscione et al. 2018). The same students would have never been able to participate in a workshop at the CfA for logistic and practical reasons (funding/administrative resources/visa etc.).

Participants of the Chandra/CIAO workshop in Pune, India, 2017

The experience was amazing, and we realized immediately how narrow our view of the world is

from the perspective of the CfA. For example, we learned first hand the impact of limited resources and infrastructure (such as large internet bandwidth, latest and greatest laptops, uniform operating systems, etc.)–that we often take for granted–on using our software and documentation.
Similarly, in 2020 we were asked by Dr. Raid Suleiman from CfA to organize a CIAO workshop in the context of the Fifth ArAS School for Astrophysics in Egypt (held remotely) with students coming from 13 Arab countries plus places like Madagascar, Namibia and Ethiopia. Again, the workshop was very well received by the students and we had a similar experience where we were confronted with users who often have limited capabilities both in terms of hardware and support, and in terms of scientific guidance. In many cases they had to be more creative than we ever envisioned and independently invented original solutions to their issues with hardware and software!



The remote Chandra/CIAO workshop at the Fifth ArAS School for Astrophysics in 2020

As an example of the type of positive feedback we received, here is one of the responses from the post-workshop survey for the workshop held in India:

> **Did the participants get enough help/support during hands-on sessions?**
> *Yes! In fact much more than what they asked for. It did not matter if the question was stupid or sensible, the CIAO people answered everything that was asked, they were not in a hurry and answered with patience.*

These experiences abroad, in regions of the world typically out of reach from the Euro- and US-centric institutions, have definitely broadened our horizon and taught us that we need to push our support toward institutions and users who may not have the infrastructure, the support, and the expertise needed to benefit from the “free and open” data and the “free and open” software.

Expanding our Reach

In 2020 one of the members of the Chandra Users Committee (CUC) was so impressed with our reach beyond the typical institutions that he suggested that it would be very important to expand the scope of our workshop activities “closer to home”, in particular toward the underserved parts of the United States. **This is the goal of this white paper.**

Our experience at large astronomy and physics meetings (for example the recent American Physical Society April meeting) is telling us over and over again that there are communities of students eager to learn if and when given the opportunity. While connecting with Community Colleges, or organizations like SACNAS (Society for Advancement of Chicanos/Hispanics & Native Americans in Science) or NSBP (National Society of Black Physicists) we plan to explore the possibility of bringing our workshop to underrepresented communities or under resourced institutes in the United States. We plan to reach out to Tribal Colleges and Universities (TCUs), Historically Black Colleges and Universities (HBCUs) or other minority serving institutions to organize free workshops integrated and adapted to the needs and the educational level and goals of the students. This would leave these institutions with an improved ability to take advantage of exciting and cutting-edge scientific educational opportunities inherent in the Chandra public data.

We also plan to reach out to the AAS Committee on the Status of Minorities in Astronomy for advice on how best to expand our reach in a meaningful and enriching but respectful way.

The Astro2020 Decadal Survey (Appendix N - Report of the Panel on State of the Profession and Societal Impact) states

"*In the past two decades, the field has undergone massive shifts in the structure and size of research teams, the places where research is carried out, and the skill sets for which students are trained. Large collaborations and survey-scale missions are increasingly prominent, with an explosion of data and a workforce that is more digitally connected and more geographically distributed than ever before. The "grand challenges" of the next 10 years will require advanced, innovative methodological and computational approaches to solve. It is imperative that the current and coming generations of astronomers are trained in computational methods.* ***Despite the broad access to massive data sets via public facilities and surveys, the most powerful computers, and the knowledge and training to use them, is not openly accessible. Institutions where most astronomers and students from underrepresented groups reside have the least access and thus least opportunity to engage in this new mode of astronomical training and discovery***."

Expanding the reach of our workshop and teaching how to exploit the enormous amount of public data in the Chandra archive–and other connected archives–would be one answer to this common goal.

A program aimed at community college students (Henry Ford Community College in Dearborn, Michigan) was started by an avid Chandra user (Dr. Kristen Dage) and has been successful at driving broader engagement with students using Chandra data and CIAO analysis tools. It represents a potential avenue for a collaboration. The program also attracted funding opportunities for students from the Henry Ford Dean of Science.

Why this white paper and what are we asking?

The call for white papers asked to *"Identify the key education and outreach programs that we as an organization are uniquely positioned to provide, based on our range of science programs, skills and expertise*."

Members of the CIAO team and others within the CXC at the CfA are uniquely positioned to provide the needed expertise and skills to teach basic and advanced concepts of X-ray astronomy

to a wider, targeted audience. Topics we would cover include how to access and use high level science data products (like spectra and images) from public archives and how to use the Chandra observatory, the CIAO data analysis software, the archive and the Chandra Source Catalog.

Organizing workshops and especially identifying the best strategies and the best institutions or groups for collaborations requires a substantial investment of time and resources. In order to achieve our goals we need:

- **Funding support**: administrative support at all stages of the organization and support for travel expenses is required for the workshop organizers and presenters (about 6 people for a week once or twice per year). Our experience shows that in person support is much more valuable and crucial especially in the hands-on session and especially for first-time users.
- **Institutional recognition of effort**: contributing to an important and novel education and outreach effort should be regarded as an important and meaningful part of our job.
- **Endorsement from the CfA**: it would make this initiative recognizable beyond the boundary of the CXC. An institutional endorsement would help propose, for instance, for NSF or NASA EPO programs, and undoubtedly make it more palatable for donors to support travel to the hinterlands.

References

Astro2020 Decadal Survey, National Academies of Sciences, Engineering, and Medicine 2021. Pathways to Discovery in Astronomy and Astrophysics for the 2020s. Washington, DC: The National Academies Press. https://doi.org/10.17226/26141

Chandra/CIAO workshop main website: https://cxc.harvard.edu/ciao/workshop/index.html

Fruscione et al. 2018, Chandra News https://cxc.harvard.edu/newsletters/news_25/ciao.pdf

Acknowledgements

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