A new era of high-resolution X-ray spectroscopy

I-HOW & COSPAR workshop 2024 ABC guide

2024 Aug. 19 – 30 @ Fudan University, Shanghai, China

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A NEW ERA OF HIGH-RESOLUTION X-RAY SPECTROSCOPY
I-HOW & COSPAR WORKSHOP 2024 @FUDAN UNIVERSITY

Latest update: Junjie Mao, October 16, 2024

Contents

1. Introduction

Warm and hot astrophysical plasmas are ubiquitous in the Universe, e.g., stellar corona, hot gas in supernova remnants, ionized outflows running away from black holes, hot atmosphere of individual galaxies and galaxy assemblies, and warm-hot intergalactic medium in the cosmic web filaments. Characteristic emission and absorption spectral features in high-resolution X-ray spectroscopy provide powerful diagnostics to quantify the physical properties of the ionized plasmas, including temperature, density, abundance, kinematics, etc. These physical properties are essential to advance our knowledge of the formation and evolution of our Universe.

In the past few decades, high-resolution X-ray spectra have been sourced from the grating spectrometers aboard Chandra and XMM-Newton. In the next decade or so, we will enter a golden era for high-resolution X-ray spectroscopy, when most of the next-generation X-ray space observatories will have high-resolution spectrometers aboard. XRISM/Resolve has kicked off the show (launched in September 2023), Athena/X-IFU has been selected as the ESA L2 mission and is expected for launch in the 2030s. A few more missions have been proposed, such as DIXE, HUBS, Arcus, LEM, and so forth. All these missions will provide a large number of high-resolution X-ray spectra. The main goal of the proposed I-HOW workshop is to facilitate the learning of high-resolution X-ray spectroscopy for early-career scientists in the Asia-Pacific countries. We will invite experts to teach

- current high-resolution X-ray spectrometers and archival databases
- data reduction and analysis skills on high-resolution X-ray spectra
- astrophysical plasma models and the underlying atomic data
- the next generation of high-resolution X-ray spectrometers
- writing and evaluating observational proposals

We will also provide hands-on exercises for the learners.

1.1   ReadMe

This is a living document, please check this link for the latest version (indicated by the last part of the filename). To be environmentally friendly, we do not provide a printed version of this document. Please download the latest version yourself. If you have any corrections, comments, and suggestions for this guide, please email Junjie Mao (jmao@tsinghua.edu.cn).

1.2   Timeline and deadlines (Shanghai local time)

- Project abstract soft deadline: Aug. 12 (MON) 16:59
- Project abstract hard deadline: Aug. 14 (WED) 16:59
- Arrival: Aug. 18 (SUN)
- Registration & welcome reception: Aug. 18 (SUN) 17:00 - 19:50
- Excursion: Aug. 25 (SUN) 13:00 - 18:00
- Deadline of exit poll: Aug. 31 (SAT)
- Departure: Aug. 30 (FRI) or Aug. 31 (SAT)

1.3   Venue and Facilities

Fudan University in Shanghai will host the workshop. Fudan is well connected to two airports (Hongqiao Airport and Pudong Airport) and two railway stations (Shanghai Hongqiao Railway Station and Shanghai Railway Station) in Shanghai. Shanghai is well-connected domestically and internationally.

The weather forecast predicts that the temperature range is $28-38$ °C in the coming two weeks and it might rain in a few days. As a coastal city, the humidity in Shanghai is in general high (> 50 %).

Important note: Please bring your passport or Chinese ID card to enter the campus.

1.3.1   Classroom

The workshop will take place at the Jiangwan Campus of Fudan University. Room C101 of the physics building will be used for teaching, learning, and assessment activities. In the same building, Room S132 ($8:30-17:30$ from Aug. 19 to 30) will be used as the teacher's lounge.

1.3.2   Accommodation

Lecturers, supervisors, teaching assistants, and learners will stay at the Fengjing Hotel near campus (Figure 1.1). It took about 20 min to walk from the hotel to the Physics Building. Take this into account when attending lectures! By default, the accommodation cost in the period of Aug. 18 (SUN, check-in) to Aug. 30 (FRI, check-out) is covered. For those who need extra stay(s), please inform the hotel when check-in and deal with the cost/reimbursement yourself.

Depending on the funding sources, some participants need to put a down payment on the day you check in. It can be cash or Alipay/WeChat. Please also bring your Chinese ID card or passport to check in.   Please see the latest version of hotel_XXYYZZ.pdf[1] in this link for a summary of the roommates, extra stays, funding sources, and payment notes.

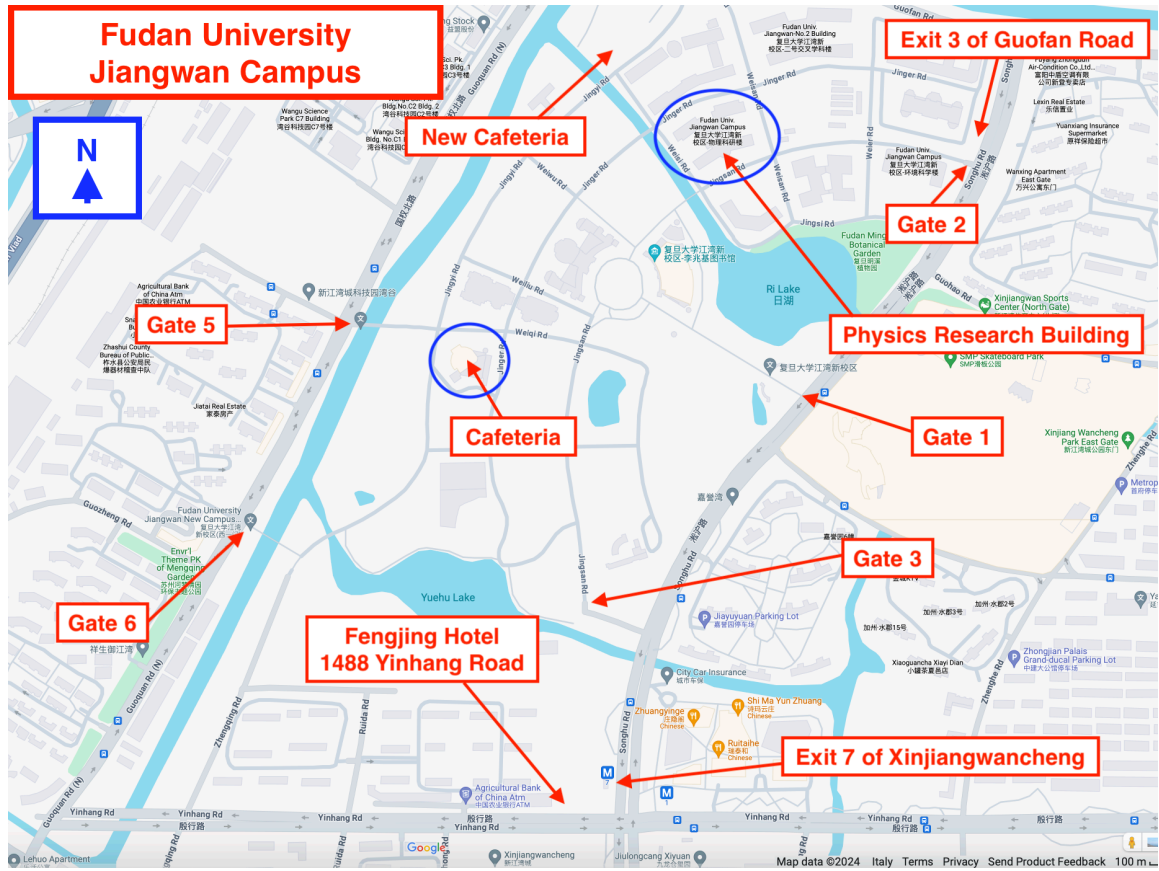[1] XXYYZZ are the year-month-day, e.g., 240805 = 2024 Aug. 5

Figure 1.1: Jiwangwan campus map of Fudan University.

Figure 1.2: Hotel building (left) and hotel entrance (right).

Again, you can request extra stay to the hotel at your own cost even if the spreadsheet says the check-out date is Aug. 30.

There is a washing machine and a dryer in the hotel. The cost depends on several factors, e.g., the number of pieces, the weight of the clothes, and which program to use. Please ask one of the Chinese participants to use it (only accepts Wechat/Alipay).

1.3.3 Lunch and dinner

By default, we will provide lunch and dinner for all. However, if you prefer to order take-out yourself (cost not covered by the summer school), please fill out the daily poll one day in advance so that the canteen can prepare food accordingly. We will announce how to fill the daily polls in the first two days of the workshop.
- Regular lunchbox will be delivered to the meeting room.
- Regular dinner will take place at the cafeteria (Figure 1.1).
- Splinter dinner will take place at the new cafeteria (Figure 1.1).
- Gala dinner will take place at Zhujiajiao ancient town (Sect. 4.5.4)

1.3.4 How to get there

A similar version can also be found on Prof. Cosimo Bambi's personal website link.

From Shanghai Pudong (PVG) International Airport to hotel or campus
Location of the Physics building on the Jiangwan campus of Fudan University in Chinese (any Chinese can easily find it based on the info below and Figure 1.1 above):
- 上海市杨浦区淞沪路 2005 号复旦大学江湾校区物理楼 C101 室

Location of Fengjing Hotel in Chinese (any Chinese can easily find it based on the info below with the map Figure 1.1 above):
- 上海市杨浦区殷行路 1488 号枫憬酒店（五角场新江湾城店）

Taxi (**recommended**): Follow the English sign at the airport to the taxi region. Show the taxi driver one of the Chinese addresses above. It takes ~ 50 min by car and costs around 200 CNY. Cost can be shared if you travel in groups (3 persons max. per group). Please see the latest version of flight_XXYYZZ.pdf[2] file in this link to identify possible travel groups yourselves. Contact info of all learners can be found in Sect. 5.1.

Subway (more challenging and time-consuming for less frequent visitors to Shanghai): Follow the English sign at the airport to the subway station. Take Line #2 (Xujingdong 徐泾东 direction) and get off at East Nanjing Road Station (南京东路, sometimes you may have to change to another Line #2 train at Guanglan Road 广兰路 Station. Because some Line #2 trains do not stop at the East Nanjing Road 南京东路 Station). At the East Nanjing Road 南京东路 Station, follow the sign within the station to switch to Line #10 (direction Jilong Road 基隆路 Station) and get off at the Xinjiangwancheng 新江湾城 Station if you want to go to the hotel or the Guofan Road 国帆路 Station if you want to go the campus (Figure 1.1). It takes about two hours (!!) but costs only ~ 10 CNY.

1.3.5 Other tips for international travelers

Here is a YouTube video for an ultimate China travel survival guide: link. Strongly recommended to watch if you are not a many-time visitor to China.

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[2]XXYYZZ are the year-month-day, e.g., 240805 = 2024 Aug. 5

1.3.6   **WIFI access**

WIFI access through eduroam shall normally work in Fudan. Please let us know if you have any troubles.
- Network: eduroam
- Username: ttwlyth2024@guest
- Password: Astro2024

1.3.7   **Online conference tool**

We will use Tencent (for domestic users) or Voov (for overseas users) for the online platform. This is mainly for broadcasting lectures, other teaching and learning activities are not included. Please download the latest version of Voov (download link) to get access. Online links will be provided on the workshop website and emails to all participants approaching the workshop.

Meeting link (same for everday): 920-202-441

1.3.8   **VPN**

Note that software and data (Chapter 2) used for the summer school are available for download without VPN. Only if for personal reasons to access certain websites (e.g., Google, Twitter, Facebook), education/university VPNs usually work in China. Note that most commercial VPN services that work well outside China will not work in China.

1.4   **Finance**

1.4.1   **Travel subsidy for learners**
- Book and pay for travel tickets yourself.
- The travel subsidy covers also visa-related costs.
- Keep the proofs of travel cost (electronic versions are acceptable), including booking confirmation with your name and amount of money (local currency is okay), bank transfer record, or other payment proof with your name on it. Send a summary (a list of items and costs in local currency) in text or PDF as well as all the proofs to us in one single email to hr_xrayspectroscopy_2024@outlook.com and cc jmao@tsinghua.edu.cn
- If we have verified your travel cost (by email) before you travel, during the registration process (Sect. 4.1), you will get the travel subsidy (in Chinese yuan with the exchange rate via Google on Aug. 18, SUN). Alternatively, you will get the travel subsidy (in Chinese yuan with the exchange rate via Google on Aug. 18, SUN) during the workshop after the validation of the travel cost.

1.4.2   **Travel subsidy for lectures**
- Book and pay for travel tickets yourself unless specified otherwise.
- Fill out the reimbursement (link) and collect your travel cost proofs (electronic versions are acceptable), including booking confirmation with your name and amount of money (local currency is okay), bank transfer record, or other payment proof with your name on it. Send the form and proofs in one single email to Carlos

juan.carlos.gabriel@gmail.com and cc jmao@tsinghua.edu.cn. Carlos will take care of the reimbursement.

1.5   Photo album

Here is the link to the photo album.

1.6   Code of conduct

We aim to create a meeting environment that values diversity and inclusion. To promote a respectful and interesting meeting that is free of discrimination and harassment, we expect all participants to share our values and adhere to the following guidelines:

- Behave professionally. Refrain from discrimination and harassment in any form, including the continuous disruption of presentations, inappropriate contact, and intimidation.
- Be respectful to all participants and facilitators of the event.
- Ensure all communication is appropriate for a professional audience. Sexual or sexist language and imagery are not appropriate.
- Critique scientific ideas in a professional way. Refrain from offensive comments related to individual characteristics, including age, gender (identity and expression), disability, physical appearance, race, nationality, religion, etc.
- Get the speaker's permission if you wish to share photos or videos of the speaker on social media. It is free to share the contents of talks/slides via social media unless speakers have asked that specific details/slides not be shared.
- Should you witness an incident, you are welcome to approach the affected person to show support. As a witness, you can suggest that the affected person reports inappropriate behavior, but it is up to the affected person themselves to decide whether they wish to report it or not.
- If you notice any deviation from the above guidelines, please contact any member of the Local Organising Committee. Participants asked to stop any improper behavior are expected to comply immediately and, in serious cases, may be asked to leave the event.
- Retaliation is prohibited.

2. Preparation

To maximize your learning outcome, please get yourself prepared for the workshop. We expect most (if not all) of you to have the proper operation systems and software before you travel to the workshop. However, if you still need some help after your arrival, please do not hesitate to contact our ICT help desk (Sect. 2.3).

2.1 Operation system

We strongly recommend having Linux (or Linux + Windows dual-boot) or MacOS on the laptop for the workshop. Many of the software listed below (Sect. 2.2) work better with Linux (e.g., Ubuntu, CentOS) or MacOS operation systems (Intel chip is better than the Silicon chip). If you prefer to install Ubuntu alongside Windows in a dual-boot setup, please follow this guide. Please reserve at least 128 GB for your Ubuntu OS. This allows you to install all the software and calibration files along with some space for observation or tutorial data storage.

If, in any case, Linux or MacOS is not feasible, there are still two options. For Windows users, please install Windows Subsystem for Linux (WSL2): `https://woshub.com/install-wsl-windows-subsystem-linux/`. It is important to install graphic servers (follow this guide for plotting purposes. Another alternative is using SciServer, where most of the software listed below has been installed and users can access them through the web browser (with any operation system). However, it is relatively slow, especially when many users running jobs at the same time. Again, we strongly recommend having Linux (+Windows dual-boot) or MacOS on the laptop for the workshop.

2.2 Software

2.2.1 Data reduction software

- CIAO (Chandra Interactive Analysis of Observations) for Chandra data reduction
  - Installation guide: `https://cxc.cfa.harvard.edu/ciao/download/index.html`

- – CALDB: To use CIAO for data reduction properly, please also download the CALDB along with CIAO.
- Heasoft for X-ray data reduction in general
  - – Download the complete source code: https://heasarc.gsfc.nasa.gov/lheasoft/download.html
  - – Installation guide for Linux systems: https://heasarc.gsfc.nasa.gov/lheasoft/linux.html
  - – Installation guide for MacOS: https://heasarc.gsfc.nasa.gov/lheasoft/macos.html
- SAS (Science Analysis System) for XMM-Newton data reduction
  - – https://www.cosmos.esa.int/web/xmm-newton/sas-installation
  - – SAS v21.0 was compiled for Ubuntu-20.04, Ubuntu-22.04, RHEL-8.6, Centos-7.3 and MacOS-12.6. SAS v21.0 will probably work on newer Ubuntu-24.04, but we may have problems. Please see this link for details.
  - – To use SAS for data reduction properly, please also download the CCF files via this link.
  - – (optional) SAS can also be installed via docker via this link.

2.2.2 Spectral analysis software

Depending on your projects or tutorials to do (Sect. 4.3.4), you can choose and install some software below.

- AtomDB & pyatomdb
  - – AtomDB website: http://atomdb.org/
  - – (optional) APEC files download: http://www.atomdb.org/download.php
  - – (optional) pyatomdb installation guide: https://atomdb.readthedocs.io/en/master/installation.html
- Cloud (optional)
  - – Cloudy code on GitHub: https://gitlab.nublado.org/cloudy/cloudy
  - – For the latest updates related to XRISM, please clone the npSplit branch.
  - – Compiling guide for versions later then C17: link
- SPEX (optional)
  - – Installation guide: https://spex-xray.github.io/spex-help/getstarted/install.html
  - – Installation tutorial: link
- XSPEC (It is part of the Heasoft package.)

2.2.3 Python

We highly recommend to install python via Anaconda (full package), so that many useful packages and tools are installed at the same time, including numpy, scipy, jupyter notebook.

Anaconda can be downloaded via the following link: https://www.anaconda.com/.
https://docs.anaconda.com/anaconda/install/linux/

The widely used plotting package in Python is matplotlib, the following two links lead you to some example codes to generate different types of plots:
https://matplotlib.org/stable/tutorials/pyplot.html
https://matplotlib.org/3.3.0/tutorials/introductory/sample_plots.html

2.3 ICT help desk

For any ICT or data reduction issues, you are welcome to talk to our ICT help desk led by Aitor Ibarra (ESA, in person up to Aug. 23 FRI) and Celia Sanchez-Fernandez (ESA).

2.4 Data

To reduce the Internet traffic load, the workshop will provide access to the following data sets:

- Public XMM data archive: Please prepare the list of observation ID before asking Aitor and Celia for the portable hard disk
- XRISM early data release

3. Check list before you travel

Here is the checklist for registration (again, the YouTube video might be useful for less frequent visitors to China):

- ID or passport, electronics (charger, socket converter to be used in China), cash (optional), invitation letter (optional), umbrella, water bottle, and other travel necessities.
- Read the latest version of the ABC guide (including the latest distribution of hotel rooms).
- Submit the project abstract (soft deadline: Aug. 12 16:59 Beijing time and hard deadline: Aug. 14 16:59 Beijing time)
- Submit travel cost proofs (optional)
- Install proper operation system and software listed in Sect. 2.2 and email us if you have troubles

4. Program

4.1 Registration

The registration will take place at the coffee shop (2nd floor of the physics building) from 17:00 to 19:50 on Aug. 18 (SUN). If you miss this time window, please contact our admin team to register any time during the workshop.

- Debtroy Das + Yiming Huang: registration line #1 (overseas travelers)
- Chunyi Zhang + Xinyi Zheng registration line #2 (domestic travelers)
- Honghui Liu: travel subsidy
- Songcheng + Shuaitongze: quick tour to the meeting room and 2nd floor coffee shop

Here is the checklist for registration:
- Signature for those who are affiliated with a Chinese institution
- Name tags, handbag, notebook, and pen.
- Have you encountered issues with the operation system and software installation in Sect. 2.2?
- Double check of food restrictions.
- Will you attend the splinter dinner on Aug. 22 (THU)?
- Will you attend the excursion and/or gala dinner (Aug. 25, SUN, Sect. 4.5.4)?
- Please fill out the daily poll for lunch/coffee/dinner.
- (optional) Travel subsidy with the currency exchange rate on Aug. 18 (SUN)

4.2 Lectures

Lecture slides or recordings: link

Please see the latest version of program_XXYYZZ.pdf[1] file in this link to identify possible travel groups yourselves.

Statistics:
- Lecture hours: ~ 20

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[1]XXYYZZ are the year-month-day, e.g., 240805 = 2024 Aug. 5

- Hands-on exercise + project hours: ~ 33
- Mock TAC hours: 6
- Presentation hours: 6

4.3   Hand-on tutorials and Projects

4.3.1   Learning objectives

Each learner will choose a specific high-resolution X-ray spectroscopy project related to ISM, XRB, AGN, individual galaxies, and galaxy clusters according to their interest. Our project supervisors will be happy to provide help when selecting projects. In general, each learner will have one project supervisor. The main goals of this project-based learning are:

- Acquire knowledge of high-resolution X-ray spectroscopy
    - Observing facilities (past, current, and future)
    - Why do we need high-resolution spectroscopy?
    - Archival databases and quick views of the spectra
- Acquire data reduction skills of grating spectra observed with XMM-Newton and Chandra
    - SAS for XMM-Newton
    - CIAO for Chandra
- Apply analysis tools to identify key spectral features
    - Redshift, Doppler shift, atomic transition information
    - NIST, AtomDB, and CHIANTI web tools and software packages
- Understand fundamental atomic processes and plasma modeling
    - Astrophysical plasma codes and models: AtomDB models in XSPEC and SPEX
    - Atomic processes and atomic data
- Analyze observed and simulated spectra
    - Exam/Compare/Differentiate plasma models to draw quantitative conclusions
- Simulate spectra for current and future observatories
    - Acquire knowledge of XMM-Newton and Chandra proposals
    - Understand the evaluation process of observational proposals

4.3.2   Software validation

To maximize the learning outcome, on Aug. 19 (MON) from 11:30 to 12:00, the very first hands-on exercise session will be used for software validation. This is to ensure that every learner has successfully installed the proper operation system and software (Sect. 2.2). We will offer assistance if there are some issues left over. You are more than welcome to inform us (hr_xrayspectroscopy_2024@outlook.com) well before your arrival.

4.3.3   Project meeting

On Aug. 20 (TUE) from 9:30 to 12:00, each learner (one by one in alphabetical order of the surnames) will have a 15-minute meeting individually with their project supervisor at the coffee shop on the 2nd floor (same place as the welcome reception). While one learner is meeting the project supervisor, others can still use the time for hands-on exercises.

4.3.4 List of hands-on tutorials and threads

Depending on the projects and the capabilities of learners, some threads and tutorials might be useful for some projects. That is to say, all threads and tutorials below are optional. Please discuss this with your project supervisor during the project meeting (Sect. 4.3.3).

General data reduction threads for Chandra and XMM-Newton.
- Chandra data reduction threads: link
- XMM-Newton data reduction threads (including Jupyter notebook style threads): link

Reference book:
- High-Resolution X-ray Spectroscopy: Instrumentation, Data Analysis, and Science (Editors: Cosimo Bambi, Jiachen Jiang): link

The following threads are provided by supervisors:
- Priyanka Charkaraboty (online): Intracluster media study using APEC models
- Priyanka Charkaraboty (online): X-ray binary photoionization modeling using Cloudy
- Liyi Gu: N132D supernova remnant XRISM early release data analysis
- Liyi Gu: Perseus galaxy cluster XRISM early release data analysis
- Aitor Ibarra: Data lab (https://datalabs.esa.int/) tutorial, which is similar to Sciserver (Sect. 2.2)
- Junjie Mao: Metalicity measurement of collisional ionization equilibrium plasma using SPEX/CIE
- Junjie Mao: Photoionized absorption features of winds running away from black holes using SPEX/PION
- Junjie Mao: Warm emitter study of active galactic nuclei using SPEX/PION
- María Díaz Trigo: Chandra/HETG spectra of a black hole X-ray binary
- Daniele Rogantini: Advanced insterstellar medium modeling using SPEX/AMOR and SPEX/HOT
- Daniele Rogantini: Time-dependent photoionization modeling with SPEX/TPHO
- Daniele Rogantini: BXA using XSPEC
- Celia Sanchez-Fernandez: RGS data reduction tutorials
- Shui-Nai Zhang: RGS spectral analysis of star-forming galaxies (with possible charge exchange contribution)

These tutorials and threads will be useful for projects (Sect. 4.3.5).

4.3.5 Projects

Learners are certainly welcome to bring their own high-resolution X-ray spectroscopy projects to the summer school, but we are also happy to provide some projects based on tutorials (Sect. 4.3.4).

Before Aug. 12 (MON) 16:59 (soft deadline) or Aug. 14 (WED) 16:59 (hard deadline), each learner please submit an abstract (250 words max.) about the project in the PDF format to the workshop mail account (hr_xrayspectroscopy_2024@outlook.com). The hard deadline can also be used for an update if a previous version was submitted before the soft deadline. We will assign project supervisors to all learners based on your abstract submission.

The abstract should cover the following aspects: (1) context or the background of the

project (i.e., the big picture, what others have done already); (2) aim or what you want to achieve in this project (i.e., which scientific question you want to answer); (3) method, i.e., how to fulfill the goal(s), including but not limited to which instrument, data, and technique to be used; (4) expected results and discussions (i.e., the impact of the expected results).

We completely understand that you might not have rich experience with high-resolution X-ray spectroscopy. Please still try to come up with an abstract. For instance, you might want to take a look at the list of hands-on tutorials (Sect. 4.3.4) and try to identify useful ones for you. You can think about when you have learned such knowledge and skills, what you can do for which scientific topic.

Please send title and abstract (no more than 100 words for the abstract) in plain text before Aug. 28 (WED) 17:20 to us[2]. Please also let me know if you have any time constraints on Aug. 30 (FRI). The slides in PDF formats should be sent before Aug. 29 (THU) 17:20 to us (same email addresses). No changes will be accepted after the title/abstract or slide deadline.

On Aug. 30 (FRI), all learners will present their learning outcomes. While we do not expect most of you to finish your projects in two weeks, it is good to see some progress. Each learner will have 7 minutes of oral presentation, followed by 3 minutes of Q&A. Questions can come from everyone (learners, supervisors, etc.). LOC members who have projects will have 3-min flash talks.

Please use 4 ± 1 slides for your talk. No more than this number of pages. Te main goals are: a) share your results; b) reflect on your achievements; c) train your presentation skills. Just to give a guideline of the content of slides (feel free to adapt to your case):

- Title slide: name, affiliation –do not comment much on it, we know you!
- Science question addressed during the project (1 slide)
- Choice of mission/instrument (1 slide)
- Data reduction and analysis (1 slide)
- Main results (1-2 slides)
- A "Summary slide" for a short talk is not needed

The program and slides of the presentations are available in this link.

4.4   Mock Time Allocation Committee

4.4.1   Learning objectives

The main goals of this mock Time Allocation Committee activity and related lecture are:

- Acquire knowledge of the full cycle of X-ray proposals
- Understand fundamentals (e.g., formats, structures, anonymous types) of X-ray observing proposals
- Acquire general writing philosophy of X-ray observing proposals
- Analyze individual mock proposals
- Evaluate all mock proposals in the panel

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[2]Matteo.Guainazzi.astronomy@gmail.com and jmao@tsinghua.edu.cn

4.4.2 Guidance

On Aug. 24 (FRI) and 25 (SAT), we will have the mock Time Allocation Committee (TAC) activity, where learners will experience the proposal reviewing exercise[3].

Before lunch on Aug. 24 (FRI), a lecture on the X-ray observing proposal will be delivered. The distribution of panels, panel assistants, primary/secondary reviewers, and voting links will be announced during the lecture on observational proposals before lunch on Aug. 24 (FRI).

After lunch on Aug. 24 (FRI), each learner will read 6 proposals individually without discussing with each other. When reading the proposal, assume everything about the mock target is correct unless there are conflicts within or among the proposals. All other general knowledge applies as usual. Each reviewer should submit individual ratings for all 6 proposals to their panel assistant before Aug. 24, 17:25. Each proposal has a primary and a secondary reviewer. Each learner will be a primary reviewer for 1 proposal, a secondary reviewer for 1 proposal, and a general reviewer for 4 proposals.

On Aug. 25 (SAT) 8:30 - 10:00, the panel discussion will take place. Each panel, consisting of 6 reviewers, will discuss all 6 proposals together (2 large program proposals and 4 regular proposals). Panel assistants should keep track of the timing and panel advisors can use questions to guide the discussion but not involve too much. Each panel should first decide the strategy of the discussion (e.g., the order of the proposals to be discussed). Subsequently, for each proposal, the primary reviewer should briefly present the proposal without slides, followed by comments from the secondary reviewer, and then all other reviewers can comment on this proposal. After the discussion of all 6 proposals, each reviewer should submit their final rating (again, vote individually) to the panel assistant before 10:00.

Each panel can only approve 1 regular proposal. For the large program (LP) proposal, only one LP proposal will be approve if at least 3 panels agree.

After the coffee/tea break (10:00 - 10:30), each panel will gather again to provide feedback in a single online document, detailing the strengths and weaknesses of each proposal (50 words min. and 250 words max.). Suggestions to improve the proposals are welcome. Feedback will be submitted to the panel assistant before 11:30. Then, panel advisors will give their feedback to their panel reviewers (including discussion, feedback writing, etc.).

4.5 Social activities

4.5.1 Welcome reception

On the evening of Aug. 18 (SUN) 17:30 - 20:00, please come to the coffee room on the 2nd floor of the Physics Building for the welcome reception to say hi to each other. We will provide some drinks and snacks. Shortly after the welcome reception, supervisors please stay for a meeting.

4.5.2 Splinter dinner

On the evening of Aug. 22 (THU) 18:00 - 20:00, all learners and teaching assistants go to the new cafeteria (Figure 1.1) for the splinter dinner. All lecturers/supervisors go to

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[3]For those who are the 2nd time reviewers, you might encounter resubmitted proposals. Note that reviewers delete proposals one month after the reviewing process.

another place for dinner.

4.5.3 Sports game

We plan to organize basketball (Aug. $22-24$) and frisbee games (Aug. $26-28$). The exact dates depend on the weather. Both are optional, everyone is welcome to join. To register, form a team with a unique team name and contact one of the teaching assistants. We also need $2-4$ referees for the basketball game to keep track of time usage and scores. We need $2-3$ referees for the frisbee game to keep track of time usage and scores.

The basketball game will be a shooting competition.
- Each team consists of 4 players. Each player will have 3 chances to get points. Each team will have 16 chances in total, i.e. 3 extra chances from any of the 4 players (it can be the same player).
- Female players can score 4 points from the 3-point line, 2 points between the free-throw line and 3-point line, and 1 point from any other place near the hoop.
- Male players can score 3 points from the 3-point line, and 2 points from any other place between the free-throw line and 3-point line.
- Teams with higher scores win. If there is a tie to rank the top 3 teams, we will have an extra game with any of the 2 players from each team. Again, 3 chances for each player plus 2 extra chances (8 chances in total). If there is another tie, we will have an extra game of 1 player for each team in the penalty style.

The basic rules and flow of an Ultimate Frisbee game:
- Objective: Score points by catching the frisbee in the opposing team's end zone.
- Teams: Two teams of seven players (no gender bounds) each.
- Starting the Game: Begin with a "pull" (throw-off) from one team to the other. Players line up on their respective end zones before the pull.
- Movement: Players cannot run while holding the frisbee. The player with the frisbee (thrower) can pivot on one foot. Other players (cutters) move to get open for a pass.
- Passing: Throw the frisbee to teammates to advance toward the end zone. Any type of throw is allowed (forehand, backhand, hammer, etc.).
- Scoring: A point is scored when a player catches the frisbee in the opposing team's end zone (for male players, 1 point is scored; for female players, 2 points are scored). After a score, teams switch end zones, and the scoring team pulls to the other team.
- Turnovers: Occur when a pass is incomplete, intercepted, knocked down, or goes out of bounds. The opposing team takes possession at the spot of the turnover.
- Stalling: The thrower has ten seconds to release the frisbee. A defender (marker) counts aloud to ten. If the frisbee is not thrown within ten seconds, it results in a turnover.
- Fouls: Physical contact is generally not allowed. Fouls include pushing, grabbing, and other forms of physical interference. Fouls result in a stoppage of play and if uncontested, the fouled player retains possession.
- Self-Officiating: Ultimate Frisbee is a self-officiated sport. Players are responsible for calling their own fouls and resolving disputes on the field.
- Spirit of the Game: Emphasis on sportsmanship and fair play. Respect between players is crucial for maintaining the integrity of the game.

Figure 4.1: Zhujiajiao town and restaurant location (this is the only gathering point).

- End of the Game: The game is typically played to a predetermined number of points or within a time limit. The team with the most points at the end of the game wins.

4.5.4 Excursion

Unless there are extreme weather conditions, we plan to visit an ancient town named Zhujiajiao (朱家角) in the afternoon of Aug. 25 (SUN). Bring your umbrella if it rains a bit.

Departure: We will leave at 13:30 from the Physics building by a rental bus (plate number: 沪 ES2902).

Gathering point: 苏枕河沪韵苏浙菜·景湖餐厅 (朱家角店). This is also the restaurant that we will have dinner at 18:00.

Address in Chinese: 青浦区朱家角古镇旅游区新风路 288 弄 3 号

While the town is free to visit, some museums and exhibitions require tickets (at your own cost).

Return: Together, we will walk from the restaurant to the same rental bus (plate number: 沪 ES2902). Then we will leave Zhujiajiao (朱家角) at 20:00. If you miss this bus, it will take 1.5 hr or so to come back to campus by taxi and it will cost ~ 230 CNY!

Here is the official and English website of Zhujiajiao (朱家角). History, food, photos, and videos of the town can be found on this website.

Figure 4.2: Zhujiajiao ancient town. Image credit: www.zhujiajiao.com.

5. Participants

5.1 Learners

All the lists below follow the alphabetical order of surnames.

- Khusan Alibekov: Master student at Ulugh Beg Astronomical Institute and National University of Uzbekistan.
  - alibekov@astrin.uz
- Kewal Anand: PhD student at Indian Institute of Technology Kanpur, India.
  - kanand@iitk.ac.in
- Varun Bahal: Postdoc at Nanjing University.
  - varunbahal@nju.edu.cn
- Sajad Ahmad Boked: PhD student at the University of Kashmir.
  - sboked10@gmail.com
- Kaushik Chatterjee: Postdoc at SWIFAR, Yunnan University, China.
  - kaushik@ynu.edu.cn
- Jiayi Chen: PhD student at Tsinghua University.
  - chenjiay23@mails.tsinghua.edu.cn
- Yi-Heng Chi: Incoming graduate student at Nanjing University.
  - 201850042@smail.nju.edu.cn
- Lingxiao Dang: PhD student at Nanjing University.
  - lxdang@smail.nju.edu.cn
- Panachery Ullas Devanand: PhD student at Aryabhatta Research Institute of Observational Sciences.
  - devanandullas@gmail.com
- Siew HoongWah: PhD student at Shanghai Jiao Tong University.
  - siewhoongwah@sjtu.edu.cn
- Jie Liao: Master student at Xinjiang Astronomical Observatory, Chinese Academy of Science.
  - liaojie@xao.ac.cn

- Zikun Lin: PhD student at National Astronomical Observatory, Chinese Academy of Science.
    - zklin@bao.ac.cn
- Jiejia Liu: PhD student at Tsinghua University.
    - liujj21@mails.tsinghua.edu.cn
- Bing Lyu: Postdoc at Peking Univ.
    - lyubing@pku.edu.cn
- Seshadri Majumder: PhD student at Indian Institute of Technology, Guwahati.
    - smajumder@iitg.ac.in
- Gitika Mall: PhD student at Fudan University.
    - gitikamall20@fudan.edu.cn
- Sujoy Kumar Nath: PhD student at Indian Centre for Space Physics.
    - sujoynath0007@gmail.com
- Zeyang Pan: Incoming PhD student at National Astronomical Observatories, Chinese Academy of Science.
    - zypan@bao.ac.cn
- Vaibhav Sharma: PhD student at Indian Institute of Technology, Kanpur, India.
    - svbhv@iitk.ac.in
- Fangzheng Shi: Postdoc at Shanghai Astronomical Observatory, Chinese Academy of Science.
    - fzshi@shao.ac.cn
- Srijan Srivastava: PhD student at the University of Leicester.
    - srijan4007@gmail.com
- Hitesh Tanenia: Junior Research Fellow at Jamia Millia Islamia, New Delhi,
    - hitesh43_sps@jnu.ac.in
- Jialai Wang: Master student at the University of Science and Technology of China.
    - jialaiwang@mail.ustc.edu.cn
- Tao Wu: Master student at Anhui Normal University.
    - 2361683164@ahnu.edu.cn
- Avaneesh Yadav: Master student at Veer Bahadur Singh Purvanchal University Jaunpur.
    - avaneeshastro@gmail.com
- Yi Zhang: PhD student at Max Planck Institute for Extraterrestrial Physics.
    - yizhang@mpe.mpg.de
- Zuobin Zhang: Incoming postdoc at Oxford University.
    - 21110190020@m.fudan.edu.cn
- Yuanyuan Zhao: PhD student at Shanghai Jiao Tong University.
    - yuanyuan.zhao@sjtu.edu.cn

5.2   Teaching team

All the lists below follow the alphabetical order of surnames.

5.2.1   Lecturer

Depending on the format of lectures, there are two types of lecturers: in-person (default) and online. Note that some flying lecturers will only stay for a few days during the summer

school.
- Cosimo Bambi (Fudan Univ.): flying
- Priyanka Chakraborty (CfA): online
- Wei Cui (Tsinghua Univ.): flying
- Maria Diaz Trigo (ESO): flying
- Liyi Gu (SRON): flying
- Matteo Guainazzi (ESTEC/ESA)
- Aitor Ibarra (ESA): flying
- Junjie Mao (Tsinghua Univ.)
- Daniele Rogantini (Chicago Univ.)
- Celia Sanchez-Fernandez (ESA)
- Yuanyuan Su (Univ. of Kentucky): online
- Jun Yang (University of Massachusetts Amherst) flying
- Shui-Nai Zhang (PMO, CAS)
- Ping Zhou (Nanjing Univ.): flying

5.2.2 Project supervisor
By default, project supervisors will be in person, exceptions are clarified below.
- Priyanka Chakraborty (CfA)
  - online only (12 hr time difference, e.g., Aug. 20, 9:00 Shanghai time = Aug. 19, 21:00 Boston time)
  - priyanka.chakraborty@cfa.harvard.edu
  - Expertise: Galaxy cluster, X-ray binary
- María Díaz Trigo (ESO)
  - Aug. 26 (MON) to Aug. 30 (FRI) in person, not available for the rest
  - mdiaztri@eso.org
  - Expertise: X-ray binary
- Liyi Gu (SRON):
  - Aug. 19 (MON) to Aug. 23 (FRI) in person, online for the rest (6 hr time difference, e.g., Aug. 20, 15:00 Shanghai time = Aug. 20, 9:00 Amsterdam time)
  - l.gu@sronl.nl
  - Expertise: Galaxy cluster, supernova remnant, active galactic nuclei, XRISM
- Matteo Guainazzi (ESTEC)
  - matteo.guainazzi.astronomy@gmail.com
  - Expertise: active galactic nuclei, XMM-Newton, XRISM
- Aitor Ibarra (ESA):
  - Aug. 19 (MON) to Aug. 23 (FRI) in person, not available for the rest
  - aibarra@sciops.esa.int
  - Expertise: XMM
- Junjie Mao (Tsinghua Univ.)
  - jmao@tsinghua.edu.cn
  - Expertise: Metalicity of ionized plasmas, black hole ionized winds
- Daniele Rogantini (Chicago Univ.)
  - danieler@uchicago.edu
  - Expertise: active galactic nuclei, X-ray binary, interstellar medium (including dust)

- Celia Sanchez-Fernandez (ESA)
    - Celia.Sanchez@ext.esa.int
    - Expertise: XMM-Newton
- Jun Yang (University of Massachusetts Amherst)
    - Aug. 22 (THU) to Aug. 30 (FRI) in person, not available for the rest
    - junyangpro@gmail.com
    - Expertise: Pulsar, interstellar medium (including dust)
- Shui-Nai Zhang (PMO, CAS)
    - snzhang@pmo.ac.cn
    - Expertise: starburst galaxies

5.2.3 Teaching assistant

We are also grateful to the following teaching assistants who can offer great support throughout the workshop!

- Honghui Liu (Fudan. Univ. → Univ. of Tübingen): PhD student → postdoc
    - hhliu19@fudan.edu.cn
- Kuan Liu (Guangxi Univ.): graduate student
    - liuk@st.gxu.edu.cn
- Lei Sun (Nanjing Univ.): postdoc
    - l.sun@nju.edu.cn
- Wenhui Yu (Xiangtan Univ., IHEP): graduate student
    - whyu@ihep.ac.cn
- Yijun Wang (Nanjing Univ.): postdoc
    - wangyijun@nju.edu.cn
- Chunyi Zhang (Xiamen Univ.): graduate student
    - 1412133683@qq.com
- Xinyi Zheng (Beijing Normal Univ.): graduate student
    - 202321160026@mail.bnu.edu.cn

5.3 Admin team

All the lists below follow the alphabetical order of surnames.

5.3.1 Organizing committee

- Cosimo Bambi (Fudan Univ.)
- Carlos Gabriel (COSPAR): co-chair
- Matteo Guainazzi (I-HOW): co-chair
- Li Ji (PMO, CAS)
- Junjie Mao (Tsinghua Univ.): co-chair
- Mariano Mendez (I-HOW)
- Randall Smith (COSPAR)
- Feng Yuan (Fudan Univ.)
- Ping Zhou (Nanjing Univ.)

5.3.2 Local Organizing Committee

- Cosimo Bambi (Fudan Univ.): co-chair

- Debtroy Das (Fudan Univ.)
- Yimin Huang (Fudan Univ.)
- Jiachen Jiang (Cambridge Univ.): co-chair
- Songcheng Li (Fudan Univ.)
- Jing Lu (Fudan Univ.)
- Yindong Zhang (Tsinghua Univ.)
- Shuaitongze Zhao (Fudan Univ.)

5.3.3 Funding sources

This workshop is part of the IAU Hands-On Workshop (I-HOW) program and COSPAR capacity building workshops. The initiative of these workshops is to train early career scientists in developing countries in accessing, analyzing, and using observational data collected by large facilities on the ground or in space for their research projects.

This workshop is financially supported by (alphabetical order) COSPAR, ESA, Fudan University, Gordon and Betty Moore foundation, IAU, Nanjing University, NASA, Purple Mounting Observatory, and Tsinghua University (Figure 5.1).

Figure 5.1: Funding agencies of the I-HOW & COSPAR workshop 2024.

6. Exit report

This section is for evaluation purposes and is not included in the ABC guide released to the learners.

6.1 Introduction

On Aug. 19-30, 2024, the I-HOW & COSPAR 2024 workshop: A new era of high-resolution X-ray spectroscopy was held at the Fudan University, Shanghai, China. The workshop was proposed by Junjie Mao (Tsinghua University), Cosimo Bambi (Fudan University), and Jiacheng Jiang (University of Cambridge). The context and main goals of this workshop can be found in Sect. 1.

This workshop, mainly organized by the I-HOW and COSPAR PCB initiatives, is supported by several international organizations (including IAU, COSPAR, ESA, and NASA). The workshop is supported locally by the Tsinghua University, Fudan University, Nanjing University, and Purple Mounting Observatory, Chinese Academy of Science (Sect. 5.3.3).

6.2 Participants

6.2.1 Learners

There were in total 57 complete registrations. Diego Altamirano, Cosimo Bambi, Matteo Guainazzi, Jiachen Jiang, and Shui-Nai Zhang reviewed the applications. To make a fair selection, Junjie Mao did not join the reviewing process since he knew a large fraction of the Chinese participants.

Originally, 31 participants were selected. However, 3 selected participants did not join the workshop due to personal issues, conflict of agenda, and cancellation without notice. No substitutions, in terms of formal offers, were made since Kuan Liu (Guangxi Univ.), Chunyi Zhang (Xiamen Univ.), and Xinyi Zheng (Beijing Normal Univ., female) were recruited as (self-funded) teaching assistants. These three were all registered participants but were not

selected during the reviewing process. The institutions of the three TAs add diversity to the participants (not covered in official learners).

The full list of 28 learners from 22 institutions can be found in Sect 5.1.

- Among the 28 learners, slightly more than half of the learners come from China (including 4 non-Chinese afflicted with Chinese institutions). These learners come from 10 institutions with no more than 3 learners from the same institution.
- Slightly less than half come from India (all Indian). These learners are from 8 institutions.
- The rest includes one Uzbekistan from Uzbekistan, one Indian the Leicester in the UK, and one Chinese from MPE in Germany.
- Among the 28 learners, only 6 were female (5 Chinese and 1 Indian).

6.2.2 Teaching team

The full list of teaching team members can be found in Sect. 5.2. Except Celia Sanchez-Fernandez and Aitor Ibarra (both from ESA), all others come from different institutions. Among all lecturers, 6/14 were female.

- Matteo Guainazzi and Aitor Ibarra had attended such kind of workshops for years. Shui-Nai Zhang was a LOC member for the 2013 COSPAR capability building workshop (Ping Zhou and Junjie Mao were learners back then). Priyanka Chakraborty attended the first I-HOW workshop in X-ray. All others attended such workshops as lecturers or supervisors for the first time.
- The distribution of supervisors and learners can be found in the proj_240819d.pdf in the the cloud drive folder. There were 10 project supervisors with no more than 4 students per supervisor each week.
- 7 teaching assistants (self-funded) were recruited and joined the workshop in person. 2/7 were female and 2/7 were experienced (in high-resolution X-ray spectroscopy) postdocs.

6.2.3 Local Organizing Committee

The full list of LOC members can be found in Sect. 5.3.2. 4 LOC members were mostly present throughout the workshop (all from Fudan Univ.): Debtroy Das, Yiming Huang, Songcheng Li, and Shuaitongze Zhao. Two secretaries, Jing Lu (Fudan Univ.) and Yindong Zhang (Tsinghua Univ.) did most of the admin work behind the scenes.

6.3 Program

The program can be found in the program_240819d.pdf in the the cloud drive folder. There are ~ 21 hr of lectures, ~ 33 hr hands-on exercises/projects, 6 hr on mock Time Allocation Committee (Sect. 4.4), and 6 hr on the final presentation. The Mock Time Allocation Committee activity was a new trial for I-HOW & COSPAR workshops. The evaluation form did not include an evaluation on this event though but when Junjie Mao organized such an event in the summer of 2023, 2/10 learners won their first XMM proposal as PI! Unfortunately, we did not ask learners to prepare proposals or ideas for this workshop (due to time limits).

We had two sports events at Fudan University (Sect. 4.5.3), one basketball shooting game in the first week and two frisbee games (the first one interrupted due to rain) in the

second week. For the excursion, we visited Zhujiajiao town (Sect. 4.5.4) and had dinner there.

Some photos taken during the workshop can be found in this cloud drive folder.

6.4 Projects

The program and slides of the presentations are available in this link.

Projects are mostly proposed by learners before they come to the workshop. As the evaluation form indicated, nearly half of them would like to spend more time on projects. As noticed by some lecturers/supervisors, some learners did work hard during the night at the hotel lobby (with desks and tables) until 22 o'clock or even later for some nights. A tiny fraction of the learners had no background in X-ray spectroscopy. They learned the basics of X-ray astronomy and data reduction.

The overall quality of the presentations is good, reflecting what they have learned in this workshop. All presentations, including flash talks by some TA and LOC members, are well structured as suggested (Sect. 4.3.5) and stayed within the time limits (7-minute presentation + 3-minute Q&A for regular talks and 3-minute for flash talks).

6.5 Finance

The budget sheet can be found in the cost_241016.pdf in the cloud drive folder.

In general, we spent less than expected (see the table below, all in CNY with 1 EURO = 7.9 CNY). This is contributed by the following: (1) some lecturers/supervisors could not come in person or significantly reduced their stay; (2) some learners could not come in person as mentioned above; (3) coffee/tea costs were lower than expected partly due to a special agreement made with the coffee shop by Junjie Mao before the starting of the workshop, and partly due to the reduced amount required (after cross-checking with the shop assistants who deal with the leftovers); (4) Not everyone joined the dinner for various reasons (e.g., some Chinese learners prefer to go out for dinner themselves) and we reduced the amount of food according to the daily poll (still food waste was more than expected).

One extra cost item was added to the final budget, an allowance for hard-working LOC members (5 from Fudan Univ. and 1 from Tsinghua Univ.).

6.6 Evaluation

25/28 ($\sim$ 90 %) participants submitted the evaluation form successfully. Results can be found in this link, including a spreadsheet and the visualization of the results (PDF). For most items, more than 80% (20/25) of the submissions have no negative feedback.

For the following items, all responses are very positive (agree and strongly agree).
- General - Applications were efficiently handled
- Accommodation and Venue - The trip to China and Shanghai was efficiently done
- Fudan University was a good place to hold this workshop
- The Future - I will be able to use high resolution X-Ray spectroscopy data in my future research

For the following items, no negative feedback:
- Science lectures - The lectures were stimulating

- Science lectures - I found it easy to get on with the lecturers
- Science lectures - The lecturers responded well to questions
- Software lectures - The lecturers responded well to questions
- Project - I found the supervisors helpful and easy to get on with
- The room at the Fengjing hotel was good
- I have benefitted significantly from attending the workshop

For the following items, the results diverge mainly due to the mixed level of experience, skills, and expected goals to achieve.

- 7/25: the science lectures were either too short or too long
- 11/25: The time spent on software lectures was either too short or too long
- 8/25: The software lectures were at too low a level
- 12/25: The time spent on the projects was too short
- 7/25: The lectures did not prepare me adequately for the projects
- 9/25 (strongly) agree: they realized too late which the ultimate scope of the project is
- 7/25 disagree: I have learned enough to do this without much extra help

6.7   Lessons learned

The following items are in no particular order, some are only relevant to this workshop.

- In rare cases, we noticed some mismatches between application materials and the level of selected learners. A small fraction also had language issues. Not sure if it is too much work (for both participants and reviewers) to send a 3-minute video instead of the motivation letter. If so, we need to send a detailed guide on how to make a recording with Zoom or other tools.
- The reviewing process considered regional/institutional balance but did not consider gender balance. More female learners were selected in China, but only one in India. It is hard to judge objectively if this needs to be improved or not. It might be good to have gender balance statistics from IAU (I've seen one IAU figure at some conference at some point) as guidance for gender balance consideration.
- We released a detailed ABC guide two weeks before the workshop's formal start. It might be possible to prepare and distribute the ABC guide even earlier but it should not be too early.
- While we clarified that travel subsidy will be given in CNY, only during the registration on-site, Indian learners informed us that they cannot convert CNY to INR at Indian banks. This is not a critical issue as they can spend some CNY in China (many stayed a few more days after the workshop ended) or convert CNY to INR at the airports. This is unexpected. If the organizers were informed early, overseas lecturers could bring some cash in EURO or USD for the travel subsidy. Future workshops might consider to improve this aspect.
- For the XRISM-related data reduction, we were not allowed to teach. While the XRISM lecture covers this (verbally), it might be better to explain this in the ABC guide (written).
- Some vegetarian learners complained about the food service as shown in the evaluation form. Indeed, limited vegetarian options were provided at Fudan University. The welcome reception did not provide vegetarian pizza (the shop owner informed JM

incorrectly about their vegetarian option). JM have made special agreements to the Fudan canteen to replace one of the meat dishes with 2-3 vegetarian dishes for dinner every day (pure vegetarian lunch boxes were provided every day). There is no easy way out though. While there are some vegetarian restaurants (including Indian) in Shanghai, they are not within walking distance.