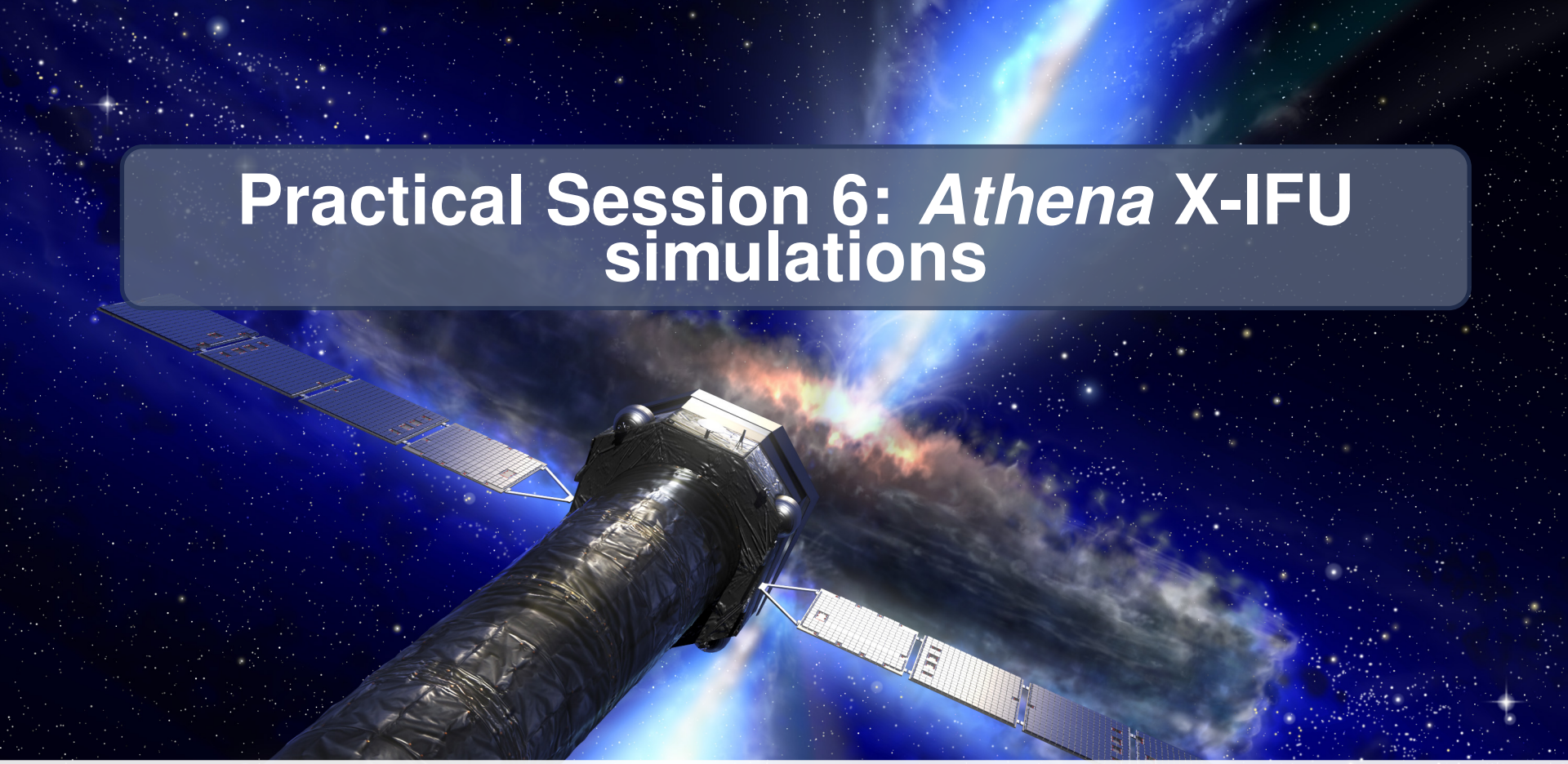
Practical Session 6: *Athena* X-IFU simulations



The SIXTE Team

Online Sixte Workshop — March 2022

ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

WFI ATHENA

IFU ATHENA X-ray Integral Field Unit

Session 6

We will now do three exercises:

- X-IFU simulation of Cas A
- Simulation of a Galaxy Cluster
- (Optional) Impact of bright sources on the X-IFU

Solutions for all these tasks can be found in the subfolders of

`~/workspace/Storage/sixte/sixte_volume/sixtedata/tutorial/solution_scripts/practical_6`

Tutorial: Extended Source Simulations (continued)

We begin by comparing observations from the X-IFU and WFI in the case of Cas A.

- simulate a 100 s observation of Cas A (using the SIMPUT generated yesterday) for the X-IFU using `xifupipeline`.
- construct an image from the event file using `imgev`. How does it compare to the WFI?
- create spectra for both observations via `makespec`. For this, use the same extraction region in RA and Dec in both (keyword: `EventFilter`) and compare them.

A `xifupipeline` command is shown in the Simulator Manual, Sect. 10.7.2

Tutorial: Simulating Galaxy Clusters

The main difficulty of simulating a galaxy cluster observation lies in the building of a suitable SIMPUT file containing all the information probed by a high-resolution integrated field unit like the X-IFU.

- get the input files for the galaxy cluster A2146: the file containing all data to simulate A2146
  - `~/workspace/Storage/sixte/sixte_volume/sixtedata/tutorial/inputs/X-IFU_clusters_tutorial` on the SciServer
  - `X-IFU_clusters_tutorial.tgz` on the SIXTE webpages
- construct a point source XSPEC model file with an absorbed `apec` model (`phoabs * apec`)
- create a SIMPUT file of A2146 with `simputmultispec`, using the given temperature and abundance map such that the source spectrum changes over the source

detailed commands in the Simulator Manual, Sect. 10.7.1

Tutorial: Simulating Galaxy Clusters

The main difficulty of simulating a galaxy cluster observation lies in the building of a suitable SIMPUT file containing all the information probed by a high-resolution integrated field unit like the X-IFU.

- look at the simput with `fstruct` and/or `fv` and try to understand what `simputmultispec` does
- simulate the source with `xifupipeline`
- extract spectra from different source regions and compare them

For region extraction: Either use the `EventFilter` keyword as before, or create an image with `imgev`, define extraction regions with, e.g., `ds9` and give those regions to the `EventFilter` keyword.
In the latter case, you also need to run `radec2xy` on your `xifupipeline` eventfile – also see the solutions.

detailed commands in the Simulator Manual, Sect. 10.7.2

Tutorial: High Count-Rate Observations (Optional)

We will now examine the effect of high count-rates on the energy resolution of the X-IFU, and how it can be mitigated.

- Prepare the model: Build a 1 mCrab model file (c.f. simulator manual section 10.2.2), adding a sharp gaussian emission line at 6.4 keV (XSPEC model `gauss, sigma=0.001 keV, norm=0.1`)
- Build a simput file using this model, setting its flux to the equivalent of 1 Crab (`srcFlux=2.137e-8`)
- Run a 10 s simulation using `xifupipeline`, with the `doCrosstalk` option set to `all`, and extract the spectrum using `makespec`. Plot the emission line! Does it look like a Gaussian?
- Run the same simulation, now using the defocused option (change `XMLFile` to `.../xifu_baseline_35mm.xml`). Extract the spectrum again, and compare the shape of the emission line with the previous simulation.
- Compare the counts distribution on the detector between simulations.