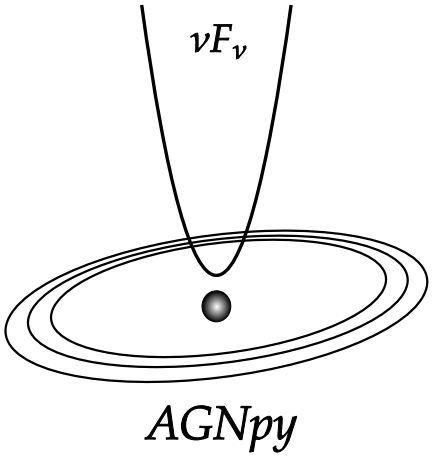

astropy-powered
astropy.org

NUMERICAL MODELLING OF ACTIVE GALACTIC NUCLEI SPECTRA IN PYTHON

Workshop on Open-Source Software Lifecycles

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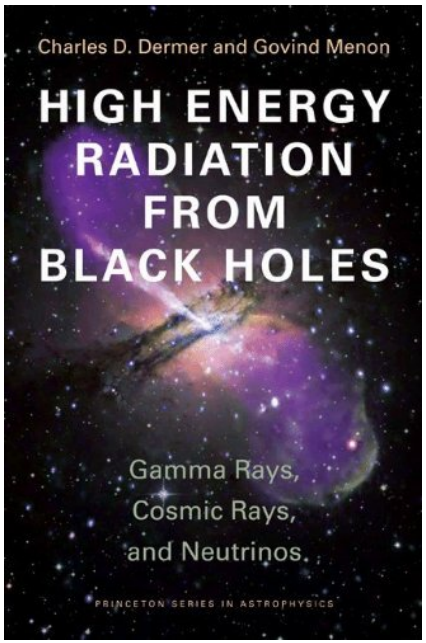
> my idea was to create a tool for AGN modelling that lived in the numpy + astropy ecosystem, increasingly dominant in astronomy;
> agnpy is an astropy affiliated package.

> **concept**

> numerical computation of the photon spectra produced by **leptonic** radiative processes in jetted AGN;

> notations and formula borrowed from



> **implementation**

> available on GitHub;

> numerics delegated to numpy, quantity casted as astropy units;

> documentation built with sphinx, hosted on readthedocs;

> pytest suite + CI via GitHub actions.

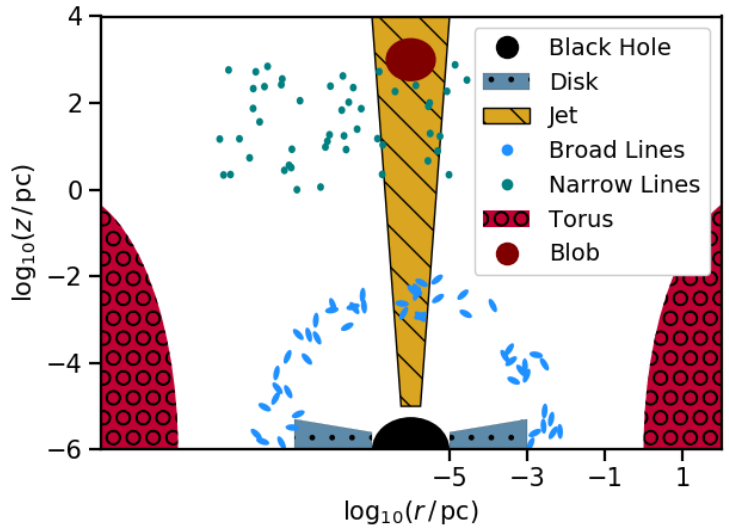
How do we build a code for modelling?

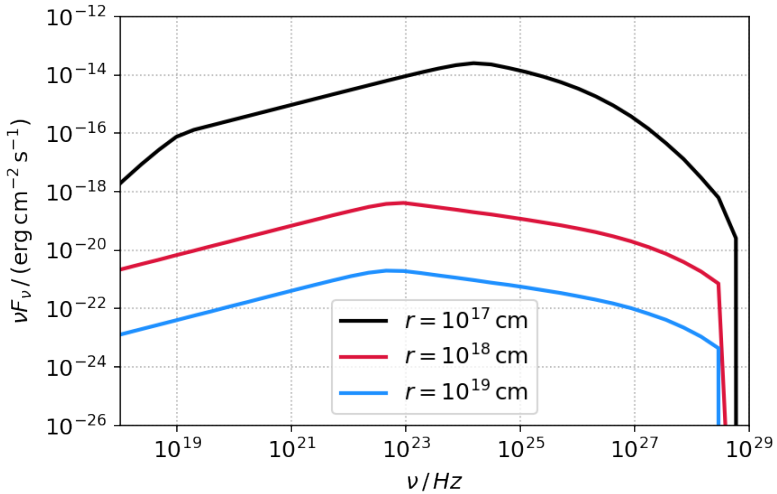
- Each AGN element has its own submodule / class:
  - → `agnpy.emission_regions.blob` plasmoid containing the accelerated electrons;
  - → targets for external compton:
  - → `agnpy.targets.SSDisk`;
  - → `agnpy.targets.SphericalShellBLR`;
  - → `agnpy.targets.RingDustTorus`.

- Each physical process has its own submodule / class:
  - → `agnpy.synchrotron.Synchrotron`;
  - → `agnpy.compton.SynchrotronSelfCompton`;
  - → `agnpy.compton.ExternalCompton`;
  - → `agnpy.absorption.Absorption` (γ-γ).

- emission regions and targets can be plugged inside processes to compute spectral energy distributions (SED).

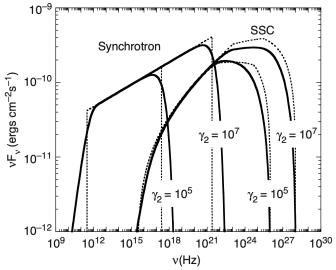
```
ec = ExternalCompton(blob, disk, r=1e17*u.cm)
nu = np.logspace(15, 30) * u.Hz
ec.sed_flux(nu)
```

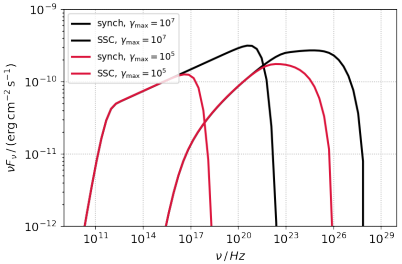


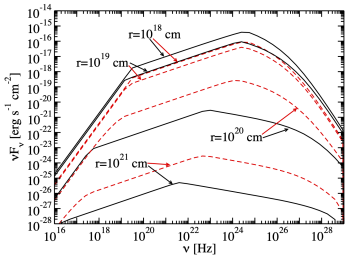


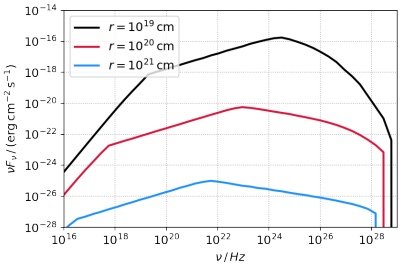
How do we test a code for modelling?

> tutorial notebooks reproduces results from literature:

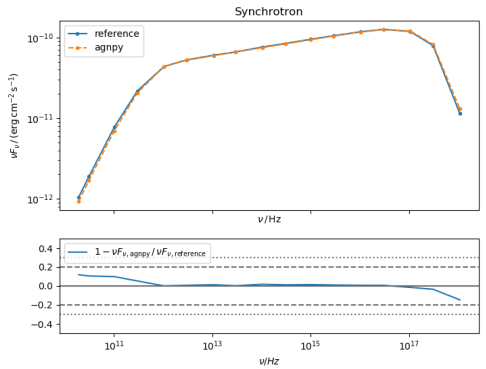


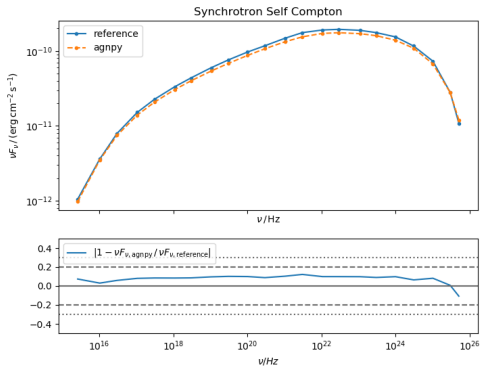


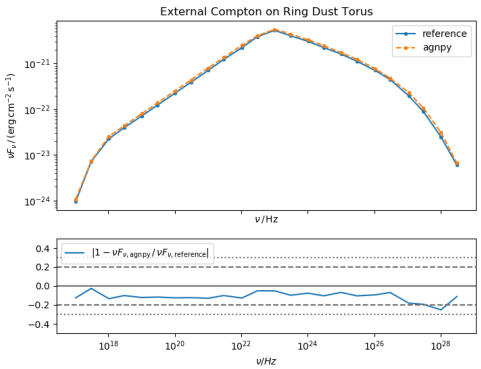




> tests suite checks deviation from SED sampled from literature is within a given factor:







Prospects

- check the code and advertise it, it's in a phase in which feedback is critical;
- interface it with other packages like gammapy, especially for **fitting multi-wavelength SEDs**;
- hope to provide an important missing piece in AGN studies and in the growing community of python-based astronomical software.