Space and Time coverage maps in MOCPy

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What is a ST-MOC ?:

Source catalogs and image surveys all have a footprint on the sky. Taking into account a **new dimension** such as the **observational time** will allow to represent the time evolution of a spatial footprint.

Originally initiated by the **IVOA organization**, Space-Time coverage map (ST-MOC) is a **new efficient and consistent data structure** for storing observational positions along with their temporal information.

Please refer to http://www.ivoa.net/documents/stmoc/ for more information.

Some Useful Links:

- GitHub : https://github.com/cds-astro/mocpy
- Documentation : https://cds-astro.github.io/mocpy/

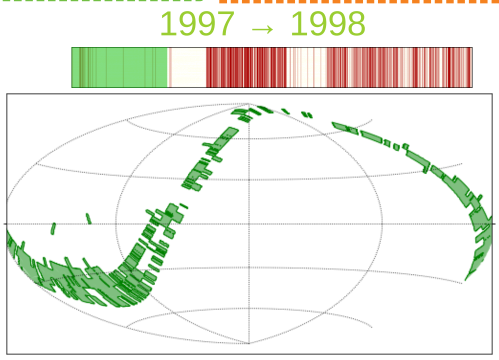
- Notebooks : https://mybinder.org/v2/gh/cds-astro/mocpy/master

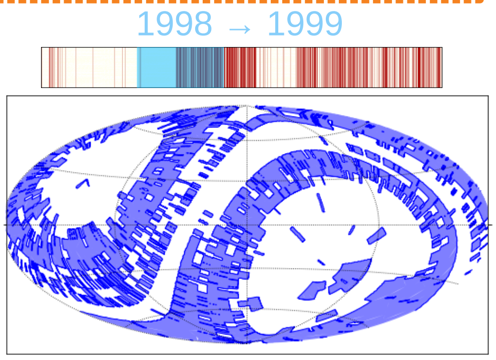
- PyPI : https://pypi.org/project/MOCPy/

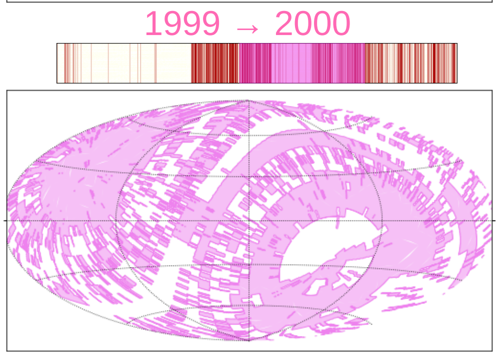
pip install mocpy

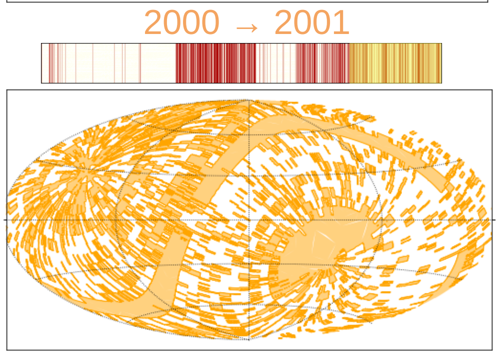
New MOCPy Features:

- **Create** from a list of Astropy times and skycoords.
- **Query** by a time range to retrieve the spatial regions being observed within it.
- Perform **logical operations** (e.g. intersection of the XMM and Chandra ST coverages to find simultaneous observations).
- **Filter** an Astropy table containing position and time columns.
- **Save** to a **FITS** file.









Available ST-MOCs:

About **160** ST-MOCs generated for **VizieR** thanks to MOCPy and available as **FITS files** through : http://alasky.u-strasbg.fr/footprints/STMOC/
Open them with **MOCPy** or **Aladin Desktop** !

Implementation notes:

- Core functions have been fully rewritten in **Rust**. Rust is a **compiled programming language** comparable to C++ that is **safe**, **concurrent** and **performant**.

- Python code is now interfaced with Rust thanks to **PyO3**, a performant Python/Rust binder. **Numpy** has a wrapper in Rust too.

- The library is **multi-platform**. Binary wheels are generated for 32/64 bits Linux, MacOS and Windows architectures !

Performance:

- Rust exploits the full potential of your machine thanks to the **rayon** crate simplifying writing concurrent code.

- **2MASS** image survey has **4.8M** (position, time) tuples. On a i5-4690 CPU @ 3.50GHz (i.e. 4 physical cores), generating its ST-MOC takes 5.17s CPU time for a **user time of 1.83s (~4x speedup)** !