MOC

ASTERICS Workshop June 2016 - Heidelberg

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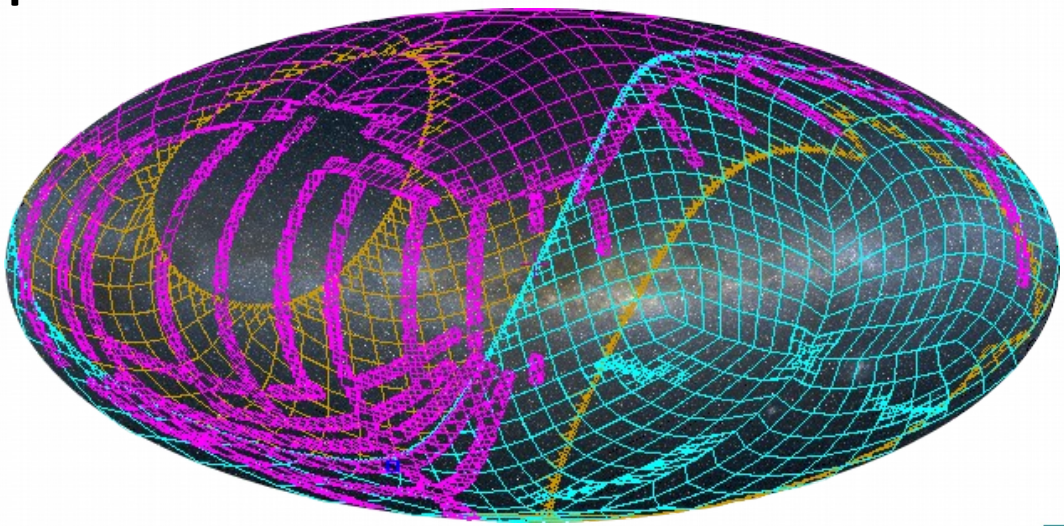
What's the plan ?

1)What is a MOC ?

2)How to create it ? Use it ?

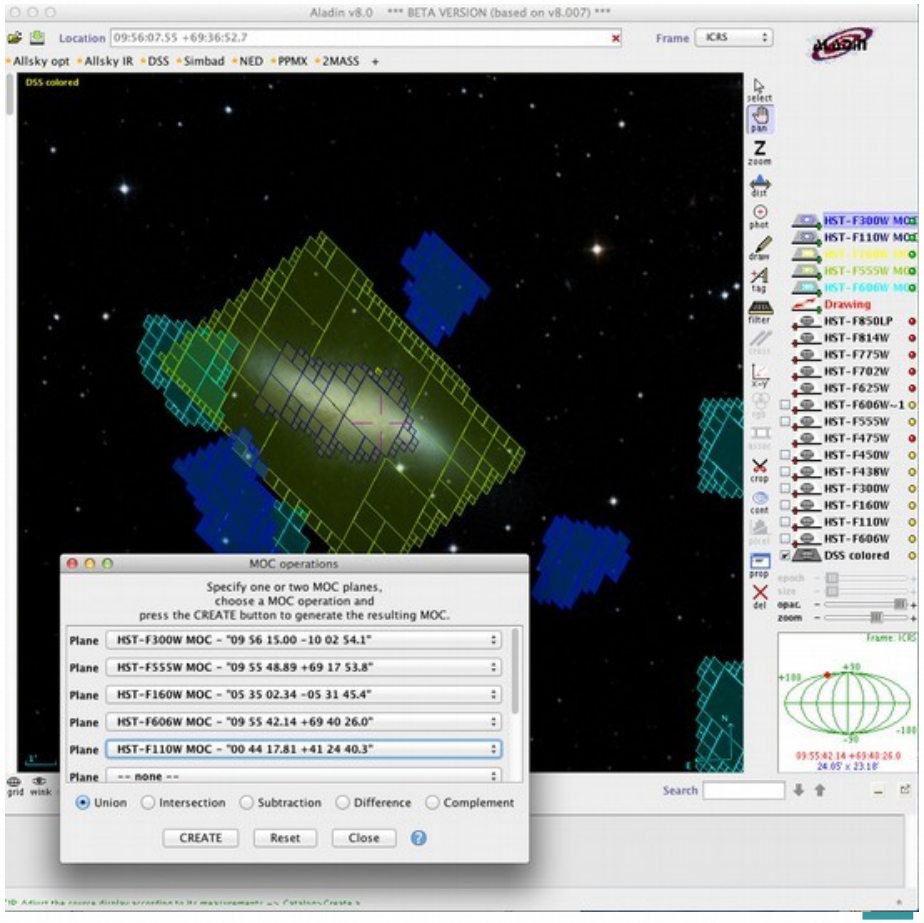
3)The MOC server



MOC – What is it ?

MOC = a generic tool for manipulating sky regions

- Intersection
- Union
- Storing
- Filtering
- Querying



MOC – What is it ?

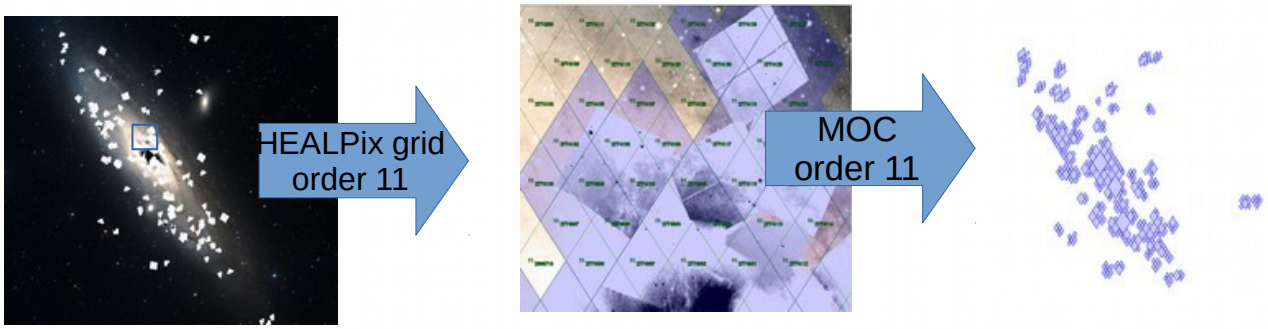
MultiOrder Coverage map

"*Combine sky regions in few milliseconds*"

- A simple and efficient method to specify any kind of sky regions
- Based on HEALPix tessellation
- Existing libraries: Java, C, python
- Used in VO tools (Aladin, TOPcat, …)
- IVOA Standard since 2013

The MOC idea

- "Just" the list of HEALPix cell numbers covering a region

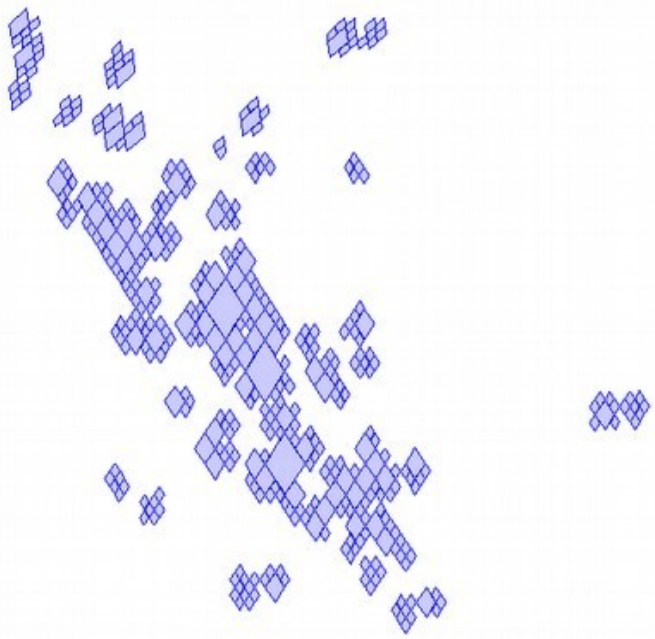


- 4 adjacent cells are replaced by the parent, recursively => intrinsic compression
- Store as a FITS table (or JSON)


```
{"9":[167870,173376,173380],
"10":[671433,671465,671467,671469,671475,671478,671626,671627,671642,671649,671659,671663,671669,671674,671675,
671676,671690,671715,671719,671725,671726,671730,671731,671734,671735,671736,682657,682721,682725,693076,
693251,693267,693269,693270,693279,693302,693313,693314,693315,693320,693322,693323,693328,693332,693339,
693342,693371,693508,693509,693510,693513,693516,693517,693524,693526,693528,693529,693531,693578,693581,
693591,693614,693732,704512,704513,704519],
"11":[2685615,2685626,2685627,2685673,2685675,2685676,2685678,2685679,2685689,2685691,2685692,2685694,2685713,2685714,2685715,
2685716,2685718,2685719,2685720,2685721,2685723,2685724,2685725,2685740,2685741,2685744,2685746,2685851,2685854,2685855,
2685859,2685872,2685873,2685874,2685880,2685894,2685895,2685897,2685898,2685899,2685906,2685909,2685911,2685936,2685945,
```

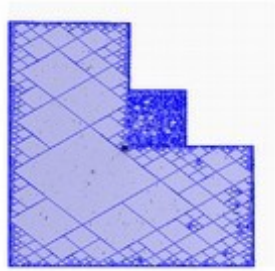
MOC accuracy

- Depends of the MOC **order**
  = the smallest HEALPix cell level used in the MOC



Order **11**
=>1.718 arcsec

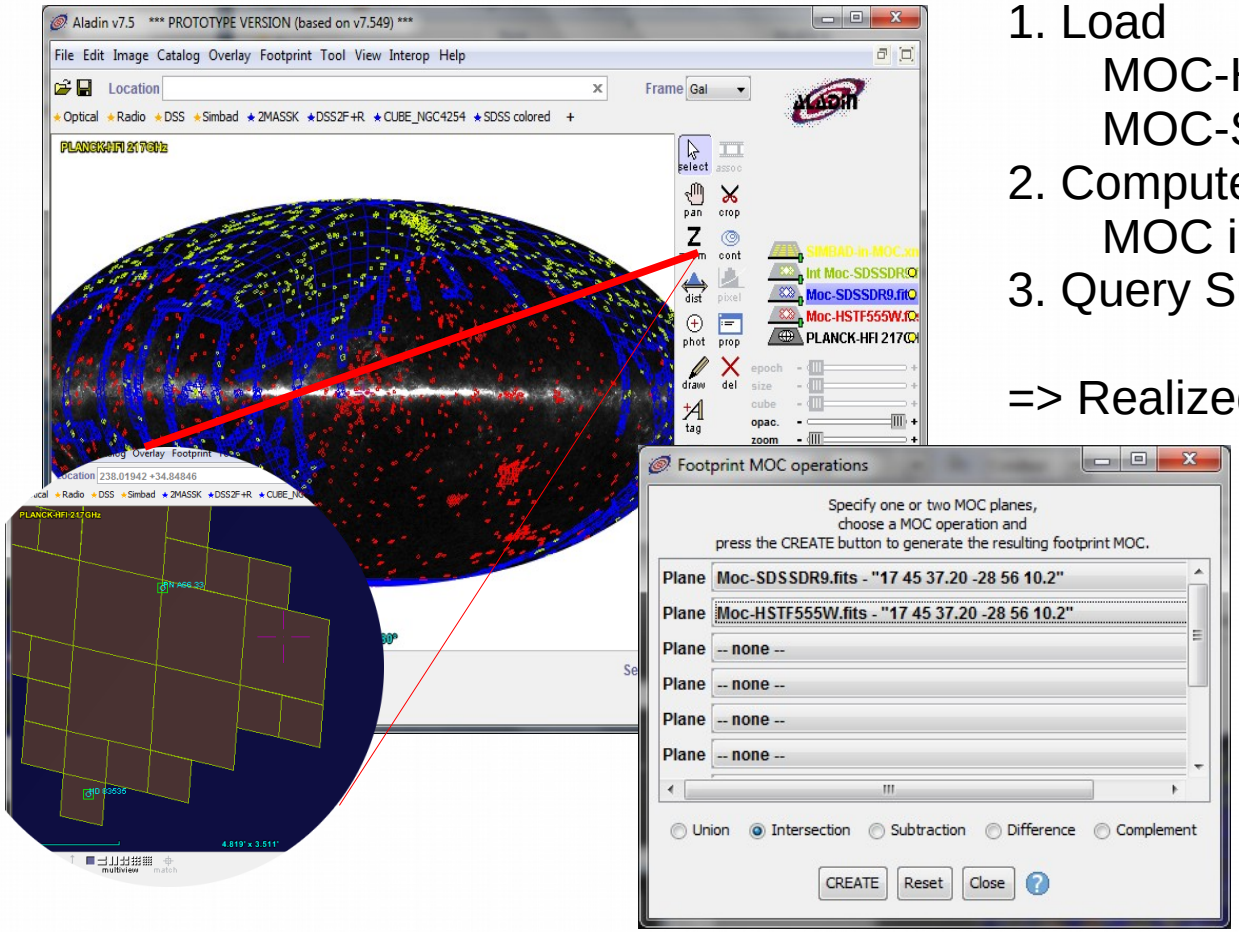
Order **20**
=>201.3mas



Order **29**
=>391 µas

MOC – Use case

"*Get all Simbad objects for which there are both HST and SDSS observations ?*"

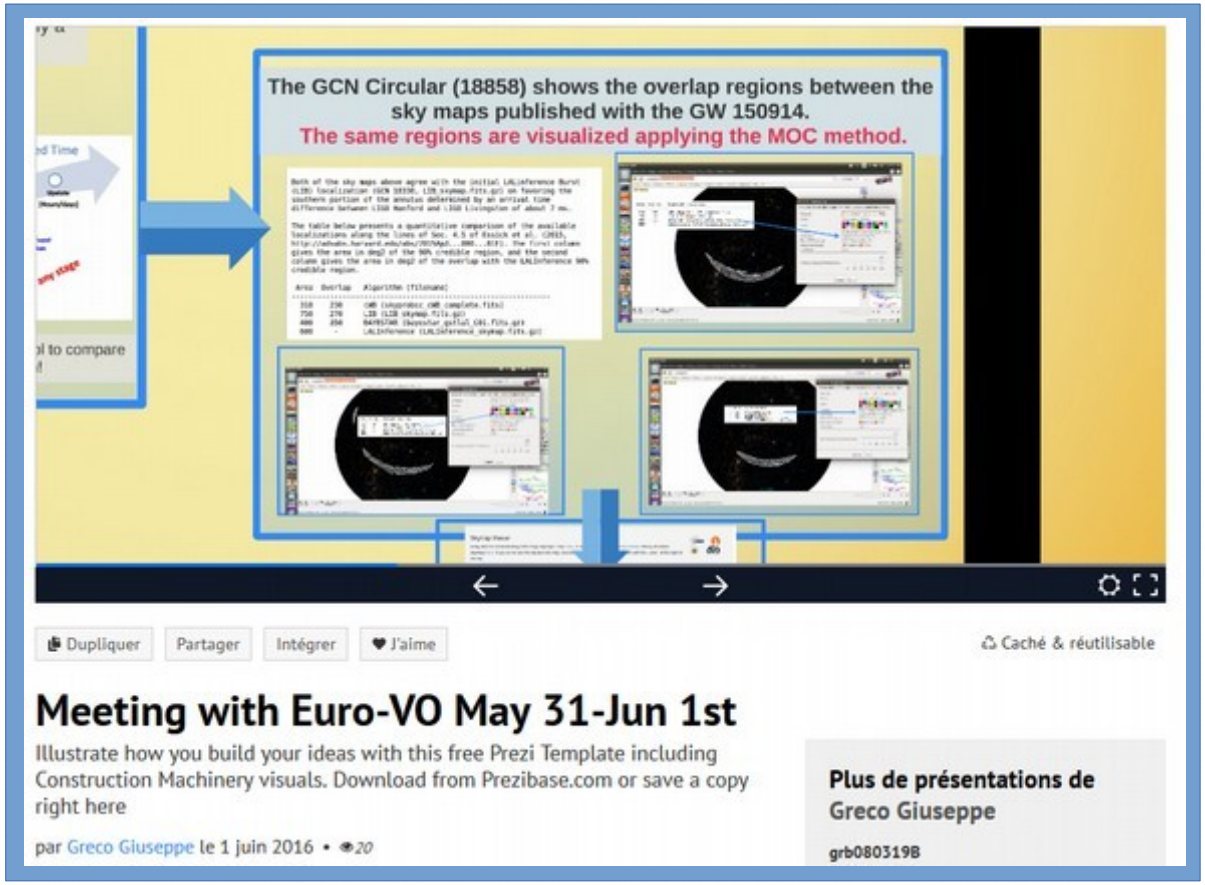


1. Load
   - MOC-HST
   - MOC-SDSS
2. Compute
   - MOC intersection
3. Query Simbad by MOC

=> Realized in 5s

MOC – Use case

"*MOC for describing the gravitational wavelength origin region*"



The 4 MOC principles (in an ideal world)

- Simplicity: Just a table of numbers – no spherical computations in MOC lib.
- Efficiency: extremelly fast, quite compact
- Versatility: Can be used for a rough description, or an accuracy description...
- Compatibility: Healpix based

The MOC server

"What & where in a few milliseconds"

- **Idea**: store several MOCs in a unique server
- In order to answer to these kind of questions:
  - *Which data collections are localized in this sky region ?*
  - *What is their coverage ?*

The MOC server: in details

- A Tomcat servlet at CDS (just 3 000 java line code)
- Containing thousands of MOCs in RAM
- Queryable by region (circle, polygon or MOC) via HTTP GET or POST
- Provides the ID list of the data set found in the region...
- ...Or the union - resp. the intersection – of the datasets MOCs (format : FITS or JSON)

The MOC server: metadata extension

- **Idea**: extend the MocServer contents with some properties associated to each data set (title, description, keywords, etc)
- MOC server becomes **a extremely fast and powerful meta-data server**, spatially indexed.

The MOC server: examples

http://alasky.unistra.fr/MocServer/query

5 ms
IDs of all data sets in 5 deg around M31:
=> ...? RA=10.68 & DEC=41.273 & SR=5

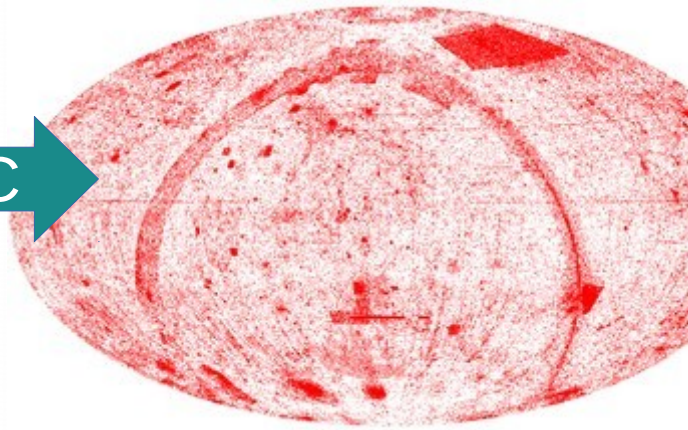
21 ms
IDs of HST collections overlapping SDSS obs:
=> ...? ivorn=*HST* & url=http://urlMocSDSS

492 ms
731 tables
MOC union of all A&AS tables:
=> ... ? ivorn=CDS/J/A+AS/* & get=moc

44 ms
46 cats
MOC union of all Seyfert data sets
=> ...? obs_astronomy_kw=Seyfert* & get=moc

IDs

MOC

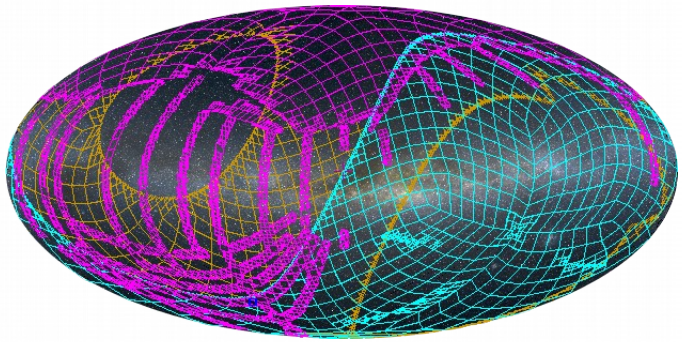


The MOC server: for whom ?

- The **MocServer is dedicated to any remote clients**.
- Its speed allows to implement dynamic interfaces.
- It contains all Vizier tables MOCs, Simbad MOC, and HiPS MOCs (16 279 data set MOCs)
- It is already **in use by Aladin** Lite and Aladin Desktop for continuously displaying the data set list concerned by the current user view.
- A stress test has demonstrated that it fully supports several millions queries per day.

MOC hands-on

MOC! You said MOC?! (15mn)



Thanks !
Questions ?