

# Modeling Instrument Field of View : DM proposal



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# Project status

- Data model developed by CDS + Laurent Michel
- Serialization in VOTable using MIVOT specification (currently in RFC)
- Internship project goals already presented in April
- Implementation in AladinDesktop and AladinLite prototypes done by the student since then



# Motivation : replace Instrument FoV facility in Aladin → HST

Aladin v11.0

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 27808  
in view out view

Command  Frame ICRS Projection Aitoff

DSS PanSTARRS SDSS ZMASS GALEX Gaia Simbad NED +

DSS2 color

Server selector

Others File FoV... Tools...

Image servers: SkyView, Aladin Hips2fits, Sloan, DSS..., Archives...

Catalog servers: SIMBAD, TAP, Gaia, SkyBot, NED, hyperLEDA, VO

Instrument fields of view ?  
Specify a position, select one instrument and press the SUB...

Target (ICRS, name) 05 41 11.64166 -02 15 02.4480

Angle (in degrees) 0.0

Instrument	Tele...	Description	Author
CFH12K	CFHT	Large field camera	CFH
ESPADONS	CFHT	Echelle Spectropolarimetric device	CFH
MEGACAM	CFHT	Wide field imaging camera	CFH
MEGAPRIME	CFHT	Wide field imaging camera + guiders	CFH
MegaCam	CFHT	Mosaic camera with 40 2kx4.5k CC...	CFHT
WIRCAM	CFHT	Wide field IR camera	CFH
HST	HST	All Hubble Space Telescope FoVs	STScI/T...
WFCINT	INT	Isaac Newton Telescope Wide Fie...	Luis Co...
SOFI	NTT	ESO NTT single CCD camera	ESO-CDS

Create your o... Load it...

Reset Clear SUBMIT Close ?

select from -- all collections --

exp. sort view scan filter

grid study wink north hdr multiview match

15' 1.298' x 52.2'

ALADIN

Last news  
Aladin manual has been released (dedicated to version 11, in english and french) Ok

epoch size dens. opac. zoom

05 41 11.64166  
-02 15 02.4480

0 sel / 0 src 698Mb



# Motivation: replace Instrument FoV facility in Aladin → MEGACAM

Aladin v11.0

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Command [DSS] [PanSTARRS] [SDSS] [ZMASS] [GALEX] [Gaia] [Simbad] [NED] +

Frame [ICRS] Projection [Aitoff]

Available data → 27808  
● in view ● out view

- Collections → 27808
- Image → 503
- Data base → 4
- Catalog → 25997
- Cube → 27
- Ancillary → 74
- Outreach → 50
- Others → 1153

DSS2 color

Server selector

Others File FoV... Tools...

Instrument fields of view ?  
Specify a position, select one instrument and press the SUB...

Target (ICRS, name) 05 41 12.60240 -02 15 16.8480

Angle (in degrees) 0.0

Instrument	Tele...	Description	Author
CFH12K	CFHT	Large field camera	CFH
ESPADONS	CFHT	Echelle Spectropolarimetric device	CFH
<b>MEGACAM</b>	<b>CFHT</b>	<b>Wide field imaging camera</b>	<b>CFH</b>
MEGAPRIME	CFHT	Wide field imaging camera + guiders	CFH
MegaCam	CFHT	Mosaic camera with 40 2kx4.5k CC...	CFHT
WIRCAM	CFHT	Wide field IR camera	CFH
HST	HST	All Hubble Space Telescope FoVs	STScI/T...
WFCINT	INT	Isaac Newton Telescope Wide Fiel...	Luis Co...
SOFI	NTT	ESO NTT single CCD camera	ESO-CDS
SuperCam	GEMINI	The Subaru Prime Focus Camera /	ESO/C...

Create your o... Load it...

Reset Clear SUBMIT Close ?

2.257' x 1.513'

epoch + size dens. opac. zoom

05 41 12.60240 -02 15 16.8480

MEGACAM CDS/P/DSS2

242 sel / 0 src 458Mb

# Motivation : replace Instrument FoV facility in Aladin → Editor

## Instrument Footprint Editor

Footprint name:



New



Save



Test in Aladin



Copy shape



New rect



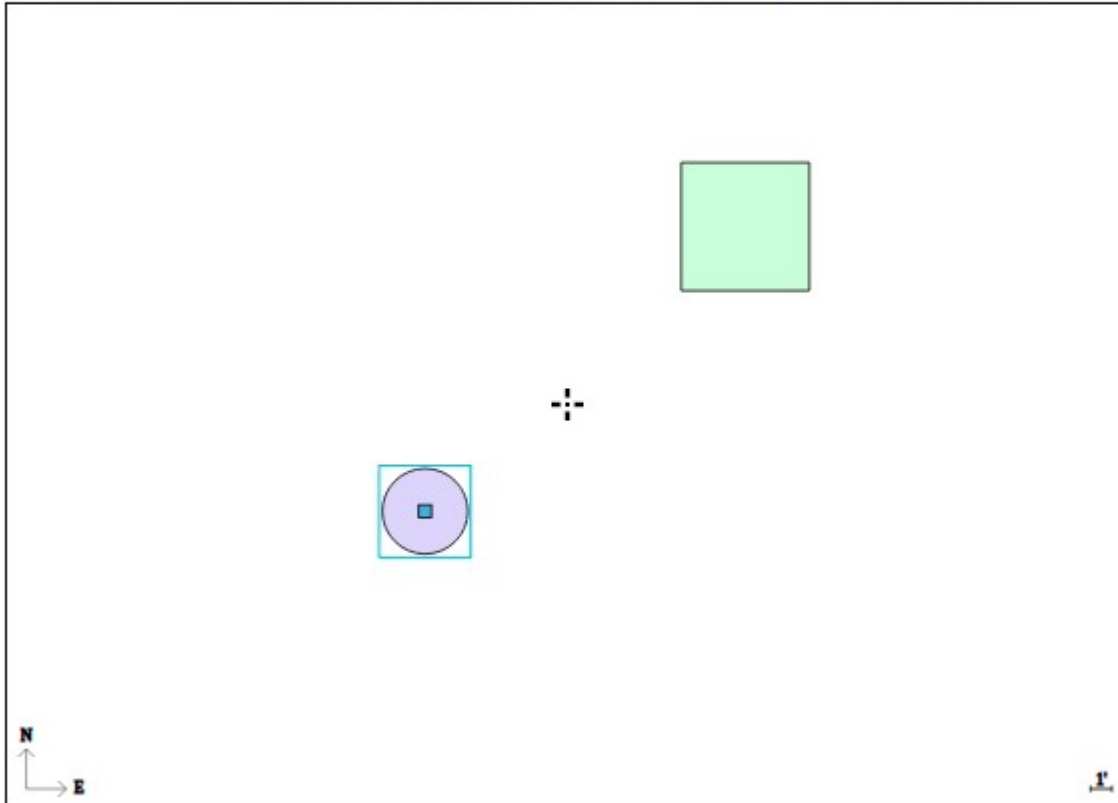
New circle



Zoom out



Zoom in



Properties  
Circle

Center.X	<input type="text" value="-400"/>	arcsec
Center.Y	<input type="text" value="-300"/>	arcsec
Radius	<input type="text" value="120"/>	arcsec





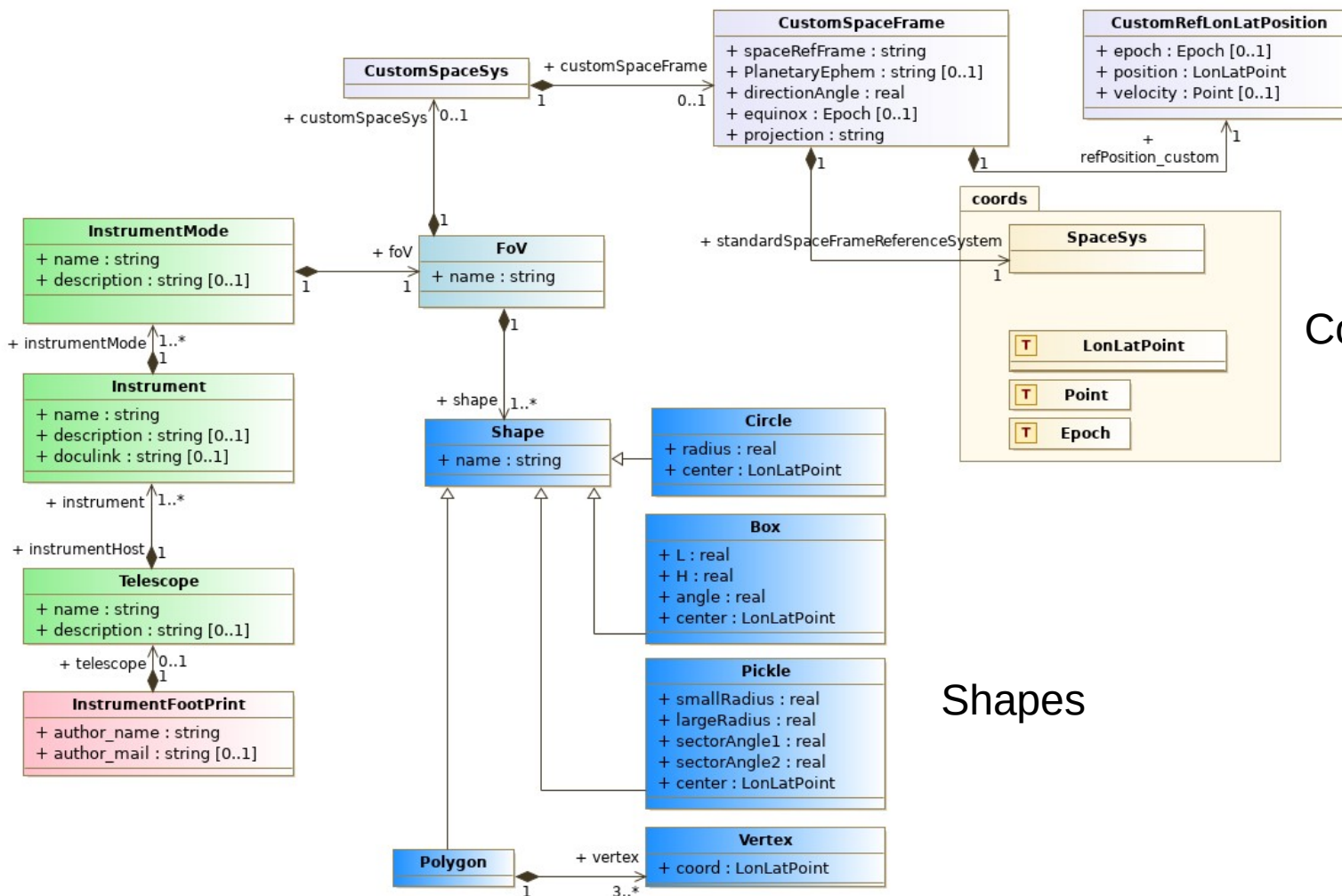
# Why a new project ?

- Old system was used by several projects (HST, CFHT, .... ) but not by several clients.
- Old « standardisation » was simply
  - VOTable,
  - STC1 utypes, GROUPS, and Fov structure (obsoleted)
  - not an IVOA recommendation (only a Note)
- Restart the project in a more interoperable way by
  - deriving a new FoV data Model from Coords,
  - using the upcoming MIVOT mapping syntax to describe model elements
- Explore usage outside AladinDesktop



# The FOV datamodel (vo-dml consistent)

## CustomSpaceSys



Coords datamodel

Shapes

CONTEXT



# The FOV datamodel

- Extending coords model :
  - Coordinates classes
  - coordinates systems classes
- Define CustomSpaceSys on the tangent plane :
  - projection instrument specific
  - variable central positions and orientation
- Define shapes (instrument specific) in this custom CoordSpaceSys





# The Serialisation : Mapping using MIVOT

- MIVOT is a Proposed recommendation in RFC
  - Xml schema available
  - Validation software in python
  - Parsing code in python
- Provides :
  - Mapping of *instances* of data models (Coords, Meas, PhotDM, Mango) on top of VOTables
  - Full serialization of *instances* of datamodels



# The Serialisation / Mapping using MIVOT

Telescope  
Instrument  
Mode

Shapes

```
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.4" xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.3 http://www.ivoa.net/xml/VOTable/v1.3">
  <RESOURCE xmlns="" type="results">
    <RESOURCE type="meta">
      <VODML xmlns:dm-mapping="http://www.ivoa.net/xml/merged-syntax">
        <REPORT status="OK">hand-made mapping: ad hoc model so far</REPORT>
        <MODEL name="instfov" url="https://www.ivoa.net/xml/instfov.xml"/>
        <MODEL name="coords" url="https://www.ivoa.net/xml/Coords-v1.xsd"/>
      </VODML>
      <GLOBALS>
        <INSTANCE dmid="footprint" dmtpe="instfov:InstrumentalFootPrint">
          <ATTRIBUTE dmrole="instfov:InstrumentalFootPrint.author_name" dmtpe="ivoa:string" value="Laurent MICHEL"/>
          <ATTRIBUTE dmrole="instfov:InstrumentalFootPrint.author_email" dmtpe="ivoa:string" value="laurent.michel@astro.unistra.fr"/>
          <INSTANCE dmrole="instfov:InstrumentalFootPrint.telescope" dmtpe="instfov:Telescope">
            <ATTRIBUTE dmrole="instfov:Telescope.name" dmtpe="ivoa:string" value="MockedTelescope"/>
            <ATTRIBUTE dmrole="instfov:Telescope.description" dmtpe="ivoa:string" value="mocked telescope"/>
          </INSTANCE>
          <COLLECTION dmrole="instfov:Telescope.instrument">
            <INSTANCE dmtpe="instfov:Instrument">
              <ATTRIBUTE dmrole="instfov:Instrument.name" dmtpe="ivoa:string" value="MockCamera"/>
              <ATTRIBUTE dmrole="instfov:Instrument.description" dmtpe="ivoa:string" value="mocked camera"/>
              <COLLECTION dmrole="instfov:Instrument.instrumentMode">
                <INSTANCE dmtpe="instfov:InstrumentMode">
                  <ATTRIBUTE dmrole="instfov:InstrumentMode.name" dmtpe="ivoa:string" value="AllFrames"/>
                  <ATTRIBUTE dmrole="instfov:InstrumentMode.description" dmtpe="ivoa:string" value="full frames together"/>
                  <INSTANCE dmid="_fov" dmrole="instfov:InstrumentMode.fov" dmtpe="instfov:Fov">
                    <COLLECTION dmrole="instfov:Fov.shape">
                      <INSTANCE dmtpe="instfov:Polygon">
                        <COLLECTION dmrole="instfov:Polygon.vertex">
                          <INSTANCE dmtpe="coords:LonLatPoint">
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0.04156275976724854"/>
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="0.0187580621064599"/>
                            <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
                          </INSTANCE>
                          <INSTANCE dmtpe="coords:LonLatPoint">
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0.04156275976724854"/>
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="-0.017449787534225568"/>
                            <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
                          </INSTANCE>
                          <INSTANCE dmtpe="coords:LonLatPoint">
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0.021889720144084225"/>
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="-0.032651556467337785"/>
                            <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
                          </INSTANCE>
                          <INSTANCE dmtpe="coords:LonLatPoint">
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0.022166805209199225"/>
                            <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="0.034789018435923705"/>
                            <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
                          </INSTANCE>
                        </COLLECTION>
                      </INSTANCE>
                    </COLLECTION>
                  </INSTANCE>
                </COLLECTION>
              </INSTANCE>
            </COLLECTION>
          </INSTANCE>
          <INSTANCE dmtpe="instfov:Pickle">
            <ATTRIBUTE dmrole="instfov:Pickle.smallRadius" dmtpe="ivoa:real" value="0.009722222222222222"/>
            <ATTRIBUTE dmrole="instfov:Pickle.largeRadius" dmtpe="ivoa:real" value="0.018055555555555554"/>
            <ATTRIBUTE dmrole="instfov:Pickle.sectorAngle1" dmtpe="ivoa:real" value="0"/>
            <ATTRIBUTE dmrole="instfov:Pickle.sectorAngle2" dmtpe="ivoa:real" value="180"/>
            <INSTANCE dmrole="instfov:Circle.center" dmtpe="coords:LonLatPoint">
              <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0"/>
              <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="0"/>
              <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
            </INSTANCE>
          </INSTANCE>
          <INSTANCE dmtpe="instfov:Pickle">
            <ATTRIBUTE dmrole="instfov:Pickle.smallRadius" dmtpe="ivoa:real" value="0.009722222222222222"/>
            <ATTRIBUTE dmrole="instfov:Pickle.largeRadius" dmtpe="ivoa:real" value="0.018055555555555554"/>
            <ATTRIBUTE dmrole="instfov:Pickle.sectorAngle1" dmtpe="ivoa:real" value="0"/>
            <ATTRIBUTE dmrole="instfov:Pickle.sectorAngle2" dmtpe="ivoa:real" value="90"/>
            <INSTANCE dmrole="instfov:Circle.center" dmtpe="coords:LonLatPoint">
              <ATTRIBUTE dmrole="coords:LonLatPoint.lon" dmtpe="ivoa:real" value="0"/>
              <ATTRIBUTE dmrole="coords:LonLatPoint.lat" dmtpe="ivoa:real" value="0"/>
              <REFERENCE dmrole="coords:LonLatPoint.coordSys" dmref="_custcoordsys"/>
            </INSTANCE>
          </INSTANCE>
        </COLLECTION>
      </INSTANCE>
    </COLLECTION>
  </RESOURCE>
</VOTABLE>
```







# AladinDesktop : Collection of new version of previous footprints

Aladin v11.0

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 30469  
 in view out view

Command  Frame ICRS Projection Aitoff

DSS PanSTARRS SDSS 2MASS GALEX Gaia Simbad NED +

DSS2 color

Collections → 30469  
 Image → 522  
 Data base → 4  
 Catalog → 28549

Server selector

Others File FoV... Tools...

Image servers  
 SkyView  
 Aladin Hips2fits  
 Sloan  
 DSS...  
 Archives...

Catalog servers  
 VMAD  
 SELECT TAP  
 SkyBot  
 NED  
 HyperLED4  
 VO

Instrument fields of view ?  
 Specify a position,  
 select one instrument and press the SUB...

Target (ICRS, name)

Angle (in degrees)

Instrument	Telesco... /	Description	Author
NEW_COS.LNPSA	HST	COS.LNPSA Instrument	STScI/T. Do...
NEW_FGS	HST	FGS Instruments	STScI/T. Do...
NEW_HST	HST	ALL Hubble Space Telescope FoVs	STScI/T. Do...
NEW_NIC	HST	NIC Instrument	STScI/T. Do...
NEW_NUV.25M...	HST	NUV.25MAMA Instrument	STScI/T. Do...
NEW_SBC	HST	SBC Instrument	STScI/T. Do...
NEW_WFC	HST	WFC Instruments	STScI/T. Do...
NEW_WFCINT	INT	Isaac Newton Telescope Wide Field Camera	Luis Corral
NEW_SOFI	NTT	ESO NTT single CCD camera	ESO-CDS

Create your o... Load it...

Reset Clear SUBMIT Close ?

select   
 from all collections --

exp. sort view scan filter  
 grid study wink north hdr multiview match

15' 1.15 x 43.78'

epoch - size - dens. - opac. - zoom -

202 sel / 0 src 459Mb

Welcome to Aladin,  
 your professional sky atlas.

- Discover all astronomical data available over the net!
- Compare them with your own data.
- Prepare your observation missions.

To start, type any object name, such as M1, and press ENTER...

Or easier, clic in the main frame and enjoy the sky...



# AladinDesktop : Collection of new version of previous footprints

The screenshot displays the Aladin v11.0 desktop application. The main window shows a star field with a large green footprint overlay. The interface includes a menu bar (File, Edit, Image, Catalog, Overlay, Coverage, Tool, View, Interop, Help), a toolbar, and a sidebar with a tree view of data collections. The main display area shows a star field with a green footprint overlay. The footprint is a large, irregular polygon. A red crosshair is visible in the center of the footprint. The text 'DSS2 color' is displayed in the top left of the main display area. The bottom status bar shows coordinates and zoom information: '15' and '1.15 x 43.78'. The right sidebar contains a 'Welcome to Aladin' message and a list of tools and filters.

Aladin v11.0

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 30469  
● in view ● out view

Command [x]

Frame ICRS Projection Aitoff

ALADIN

select  
pan  
dist  
phot  
draw  
tag  
moc  
spect  
filter  
cross  
xxy  
rgb  
assoc  
crop  
cont  
pixel  
prop  
del

Welcome to Aladin,  
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To start, type any object name, such as M1, and press ENTER...

Or easier, clic in the main frame and enjoy the sky...

DSS2 color

15' 1.15 x 43.78

select  
from --all collections--

exp. sort view scan filter  
grid study wink north bar multiview match

epoch -  
size -  
dens. -  
opac. -  
zoom -

15 160:08:22.7 4816 +60  
1150 x 43.78

180 -90

202.sdl / 0 scr - 788Mb



# AladinDesktop : Collection of new version of previous footprints

The screenshot displays the Aladin v11.0 software interface. The main window shows a star field with several instrument footprints overlaid. The 'Server selector' dialog box is open, showing the 'Instrument fields of view' section. The dialog includes a 'Target (ICRS, name)' field with the value '20 34 54.14816+60 08 22.6540' and an 'Angle (in degrees)' field with the value '30'. Below these fields is a table listing various instruments and their details.

Instrument	Teles... /	Description	Author
NEW_Suprim...	SUBARU	The Subaru Prime Focus Camera (Supri...	CDS/S. D...
NEW_Schulm...	Schulma...	Schulman 32-inch Telescope	Adam BL...
NEW_HSC	Subaru	Hyper-SuprimeCam	Herve B...
NEW_VIRcam	VISTA	Wide Field IR camera	Laurent ...
NEW_FOR51	VLT	ESO FOcal Reducer/low dispersion Spe...	ESO-CDS
NEW_FOR52	VLT	ESO FOcal Reducer/low dispersion Spe...	ESO-CDS
NEW_ISAAC	VLT	ESO infrared imager and spectrograph	ESO-CDS
NEW_VIMOS	VLT	ESO VIMOS mosaic camera	ESO
NEW_DECam	Victor M...	Dark Energy Camera with imaging (blue...	Luis Cicu...

The interface also shows a menu bar (File, Edit, Image, Catalog, Overlay, Coverage, Tool, View, Interop, Help), a toolbar, and a sidebar with various tool icons. The main window title is 'Aladin v11.0'.



# AladinDesktop : Collection of new version of previous footprints

Aladin v11.0

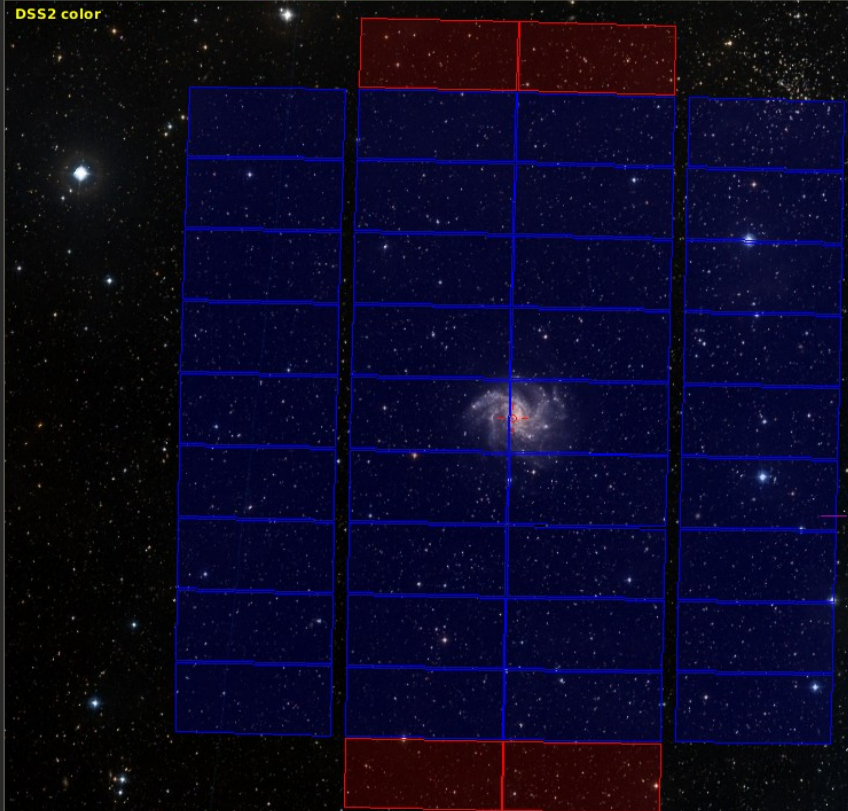
File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 30469

● in view ● out view

Command  Frame ICRS Projection Aitoff

DSS PanSTARRS SDSS 2MASS GALEX Gaia Simbad NED +



select  from all collections --

2.384 x 1.513

grid study wink north hot multiview match

### Server selector

Others

● Instrument fields of view ?

Specify a position, select one instrument and press the SUB...

Target (ICRS, name)

Angle (in degrees)

Instrument	Tel... /	Description	Author
CFH12K	CFHT	Large field camera	CFH
ESPADONS	CFHT	Echelle Spectropolarimet...	CFH
MEGACAM	CFHT	Wide field imaging camera	CFH
MEGAPRIME	CFHT	Wide field imaging camera...	CFH
<b>NEW_MegaCam</b>	<b>CFHT</b>	<b>Mosaic camera with 40 2k...</b>	<b>CFHT</b>
WIRCAM	CFHT	Wide field IR camera	CFH
NEW_CCD.50CCD	HST	CCD.50CCD Instruments	STScI/T...
NEW_COS.LNPSA	HST	COS.LNPSA Instrument	STScI/T...
NEW_FGS	HST	FGS Instruments	STScI/T...
NEW_LIT	HST	ALL-LEIS Instruments	STScI/T...

?

cont pixel prop X del

**NEW MegaCam**

CDS/P/DSS2/col

epoch -

size -

dens. -

opac. -

zoom -

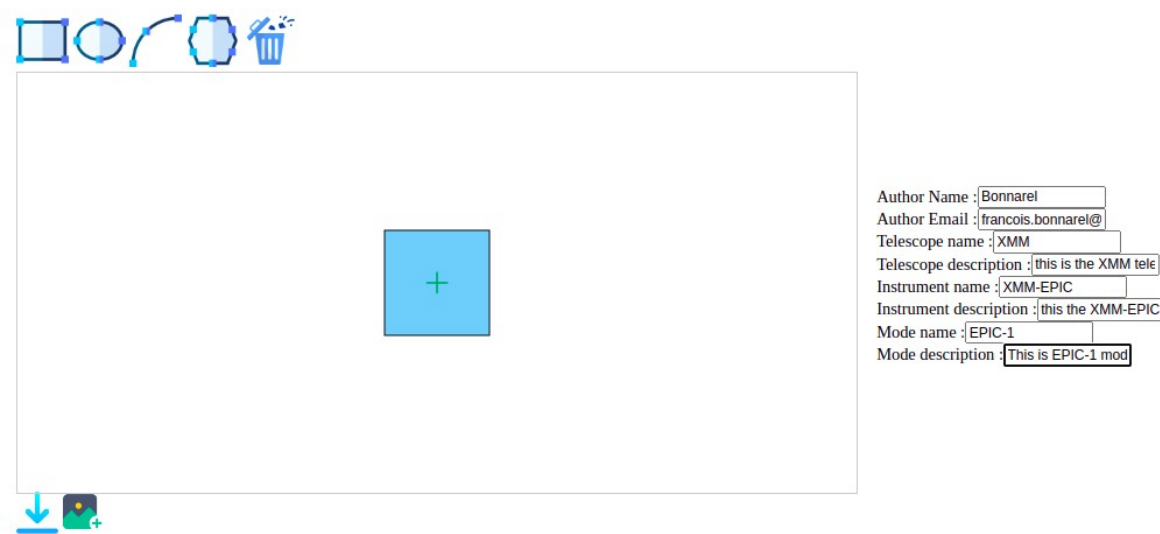
68 +60:01:52.8

30 20 31 30 6779 +60

# JavaScript Editor interface

- Draw instrument footprints description with the editor and save it in MIVOT format

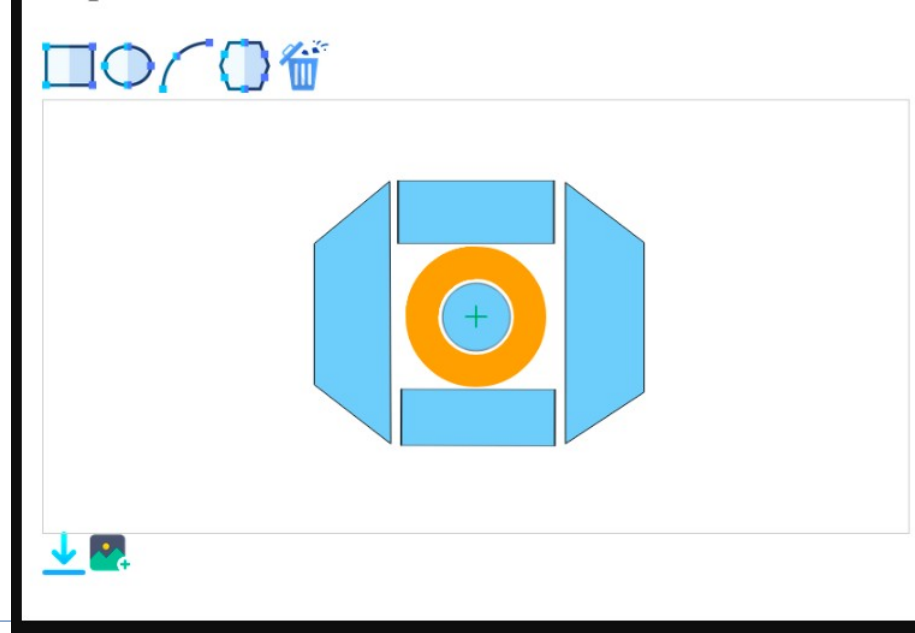
Footprint editor



The screenshot shows the 'Footprint editor' interface. At the top left, there is a toolbar with five icons: a square, a circle, a curved line, a square with a cross, and a trash can. Below the toolbar is a large white canvas containing a single blue square with a green plus sign in the center. To the right of the canvas is a form with the following fields: Author Name (Bonnaire), Author Email (francois.bonnaire@), Telescope name (XMM), Telescope description (this is the XMM tele), Instrument name (XMM-EPIC), Instrument description (this the XMM-EPIC), Mode name (EPIC-1), and Mode description (This is EPIC-1 mod). At the bottom left of the canvas, there are two small icons: a download arrow and a camera icon.

- Can also be done on top of an image of the sky with a given instrument

Footprint editor



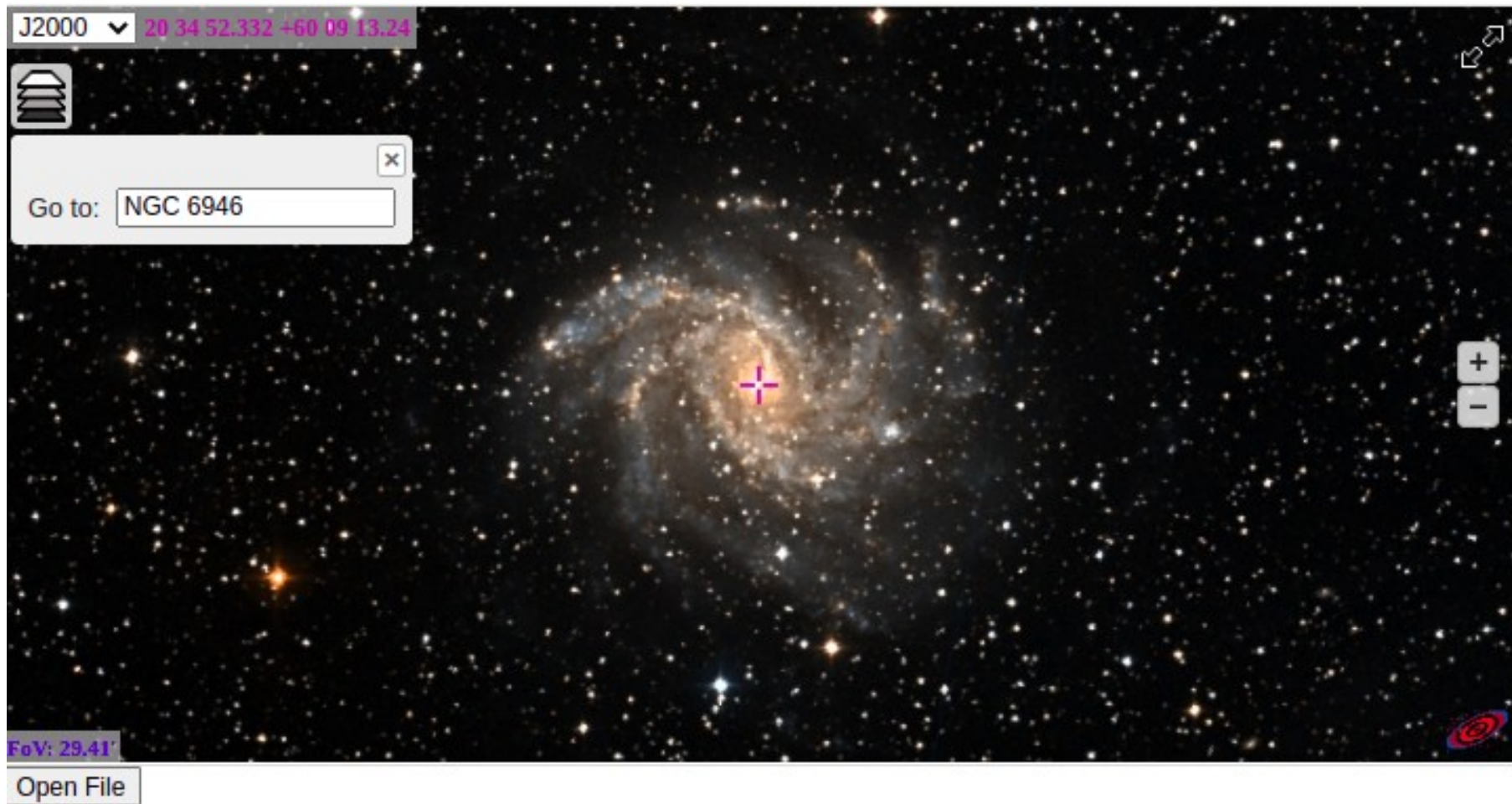
The screenshot shows the 'Footprint editor' interface with a sky image. The toolbar and form are identical to the previous screenshot. The canvas now displays a complex footprint shape overlaid on a dark blue sky image with stars. The footprint consists of a central orange circle with a green plus sign, surrounded by a blue ring, and four blue rectangular segments extending outwards. At the bottom left of the canvas, there are two small icons: a download arrow and a camera icon.





# Loading footprints in AladinLite

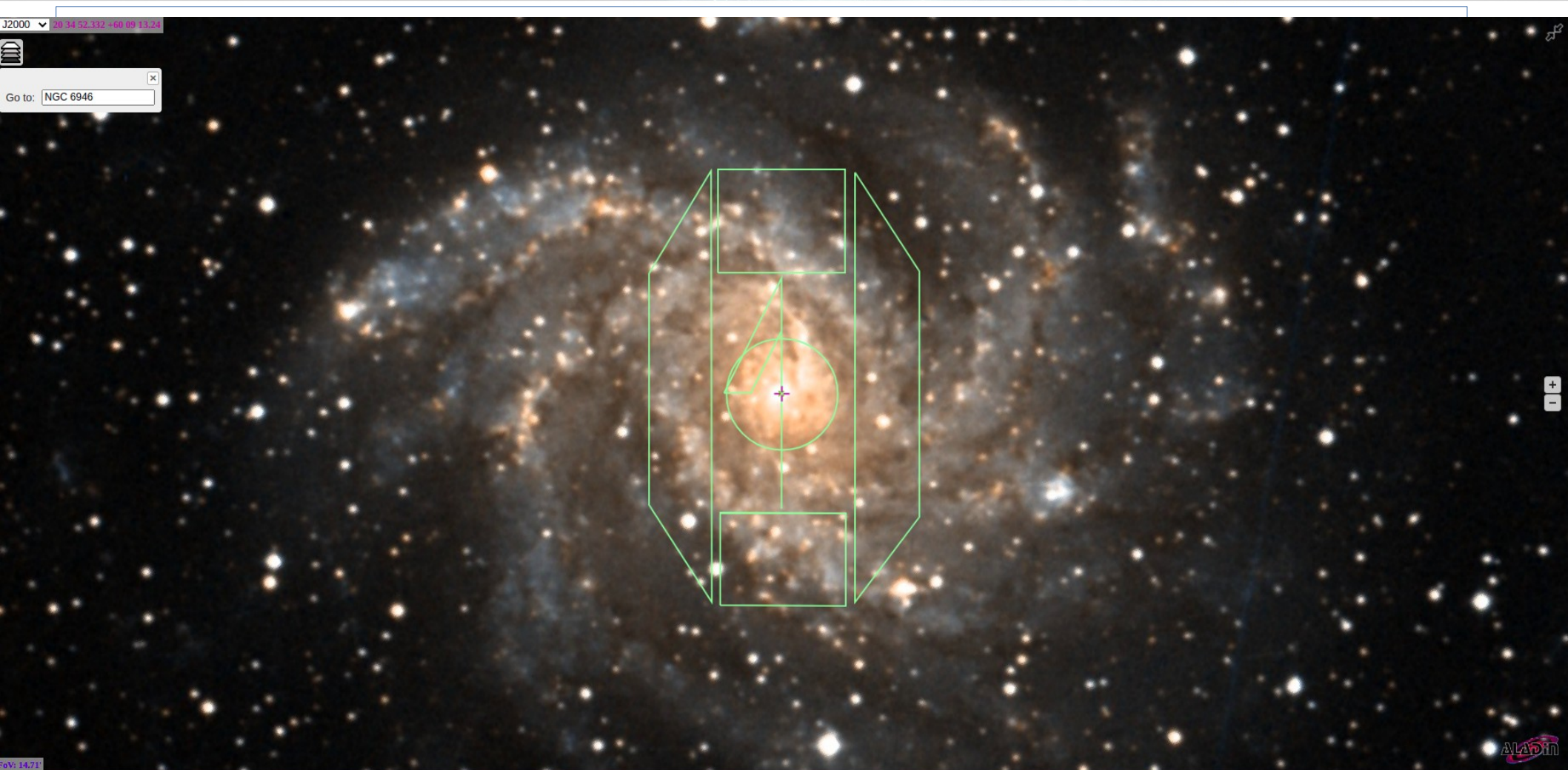
→ interoperability with another tool





# Loading footprints in AladinLite

→ interoperability with another tool



# Future work

- Extend the usage of the format to new instruments (X-ray : XMM, Chandra)
- Use the standard to display sources detected during an observation on top of the FoV display
- Write a Working draft for an IVOA « instrument footprint datamodel »
- Manage the « rendering » of the footprint display in the serialization.  
----> add a rendering class as an extension of the data model

