Astrométrie & photométrie des images EROS-2

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LAB

Astrométrie -1ère version linéaire (T. Lasserre, E. Lesquoy)

- Version de 2009
- Projection tangentielle
- La matrice CDx_y donne la correspondance x/y <—> RA/DEC
- Pas de distorsion prise en compte (importante dans les angles des mosaïques !)
- Orientation standard (x = 2048 - y ; y = 2048 - x)

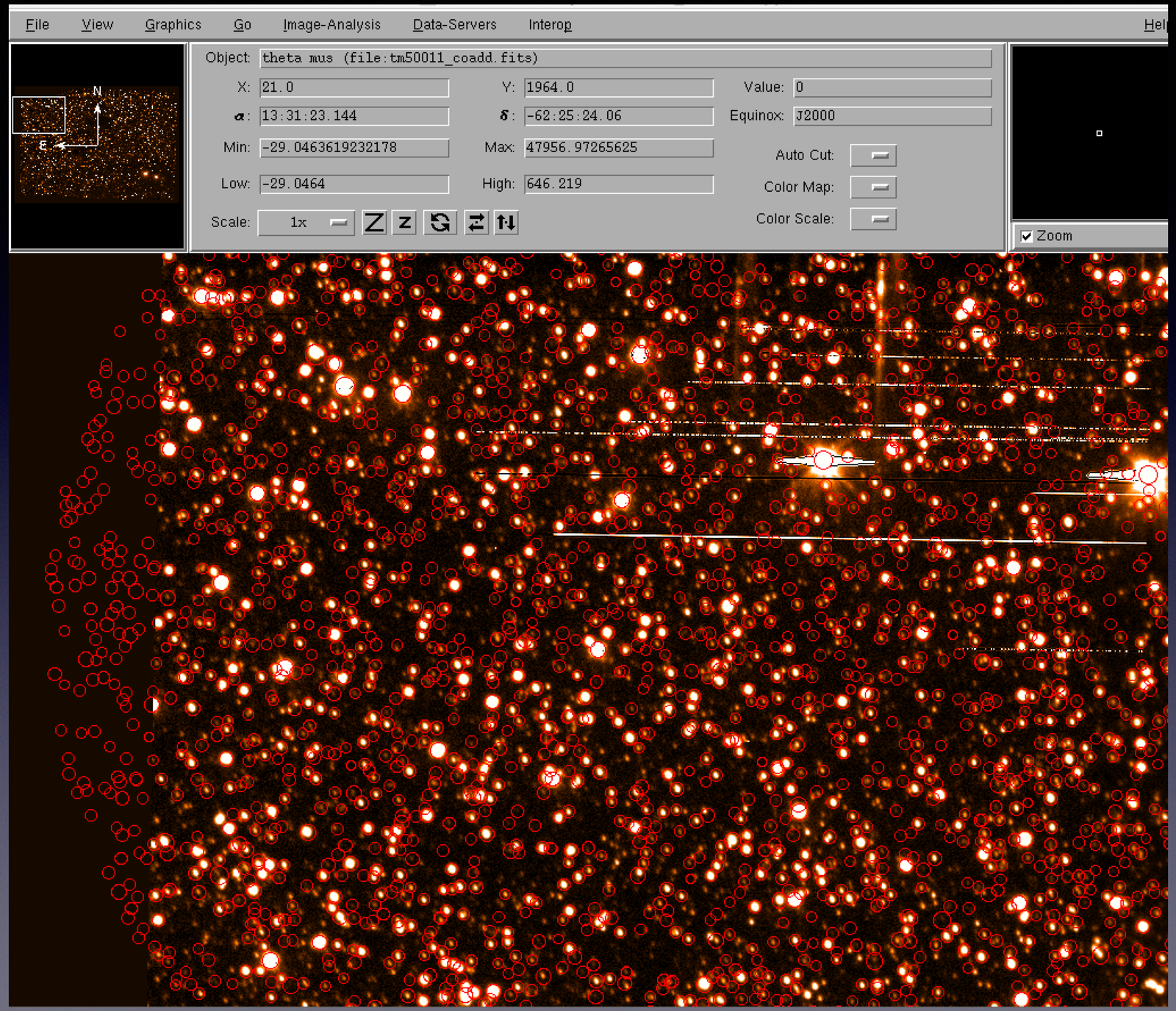
```
HISTORY    Astrometric solution by SCAMP version 1.6.2 (2009-10-26)
COMMENT    (c) Emmanuel BERTIN <bertin@iap.fr>
COMMENT
CUNIT1  = 'deg     '           / Axis unit
CUNIT2  = 'deg     '           / Axis unit
FGROUPNO=                    1 / SCAMP field group label
ASTIRMS1=      2.375721424E-05 / Astrom. dispersion RMS (intern., high S/N)
ASTIRMS2=      2.013836072E-05 / Astrom. dispersion RMS (intern., high S/N)
ASTRRMS1=      6.136915125E-05 / Astrom. dispersion RMS (ref., high S/N)
ASTRRMS2=      7.242469911E-05 / Astrom. dispersion RMS (ref., high S/N)
ASTINST =                    1 / SCAMP astrometric instrument label
FLXSCALE=      0.000000000E+00 / SCAMP relative flux scale
MAGZEROP=               0.0000 / SCAMP zero-point
PHOTIRMS=               0.1293 / mag dispersion RMS (internal, high S/N)
PHOTINST=                    1 / SCAMP photometric instrument label
PHOTLINK= '                  F'   / True if linked to a photometric field
HISTORY    Astrometric solution by SCAMP version 1.6.2 (2009-10-26)
COMMENT    (c) Emmanuel BERTIN <bertin@iap.fr>
COMMENT
CTYPE1  = 'RA---TAN'           / WCS projection type for this axis
CTYPE2  = 'DEC--TAN'           / WCS projection type for this axis
CRVAL1  =      2.808622116E+02 / World coordinate on this axis
CRVAL2  =     -7.673968685E+00 / World coordinate on this axis
CRPIX1  =     -1.251477458E+03 / Reference pixel on this axis
CRPIX2  =     -4.253562212E+03 / Reference pixel on this axis
CD1_1   =     -1.169603257E-04 / Linear projection matrix
CD1_2   =     -1.589076646E-06 / Linear projection matrix
CD2_1   =     -2.076202776E-06 / Linear projection matrix
CD2_2   =      1.163466501E-04 / Linear projection matrix
END
```

Astrométrie - Version actuelle

- Version de 2017 sur cet exemple
- Projection tangentielle avec distorsion (TPV)
- Coefficients PVx_y de distorsion
- Traitement systématique et complet par mosaïque et par champ
- Combinaison SExtractor/PSFex/SCAMP (E. Bertin), MaxiMask (M. Paillassa, doctorant LAB)
- Catalogue de référence : 2MASS, puis Gaia DR2

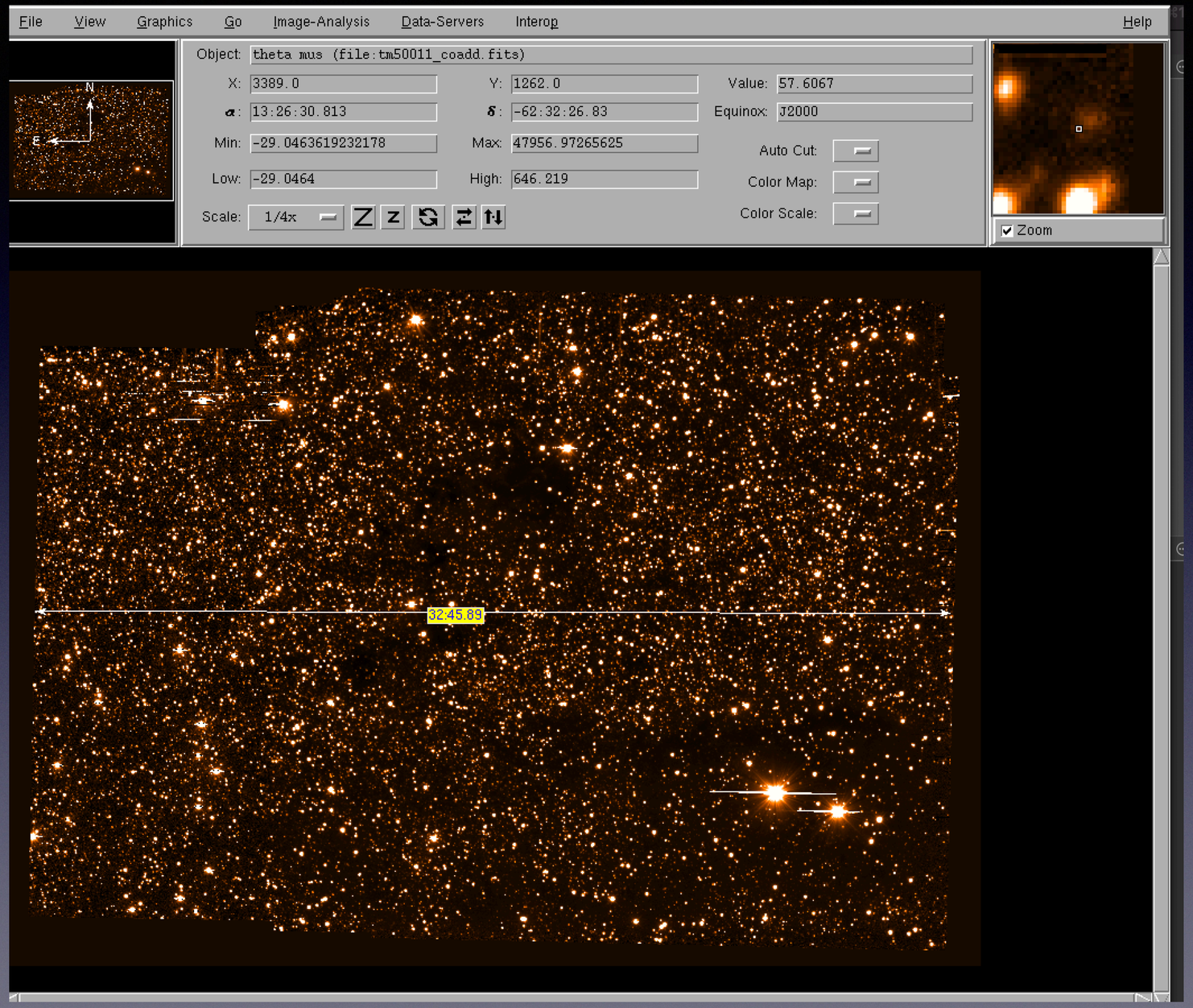
```
CTYPE1  = 'RA---TPV'
CTYPE2  = 'DEC--TPV'
HISTORY   Astrometric solution by SCAMP version 2.0.4 (2017-03-31)
COMMENT   (c) 2010-2013 IAP/CNRS/UPMC
COMMENT
CRVAL1  =   2.805685982075E+02 / World coordinate on this axis
CRVAL2  =  -7.870339119640E+00 / World coordinate on this axis
CRPIX1  =  -2.417000000000E+01 / Reference pixel on this axis
CRPIX2  =  -2.124940000000E+03 / Reference pixel on this axis
CD1_1   =  -1.672216944800E-04 / Linear projection matrix
CD1_2   =  -1.650516146059E-06 / Linear projection matrix
CD2_1   =  -2.093873566675E-06 / Linear projection matrix
CD2_2   =   1.666975155699E-04 / Linear projection matrix
PV1_0   =  -7.290628707824E-03 / Projection distortion parameter
PV1_1   =   9.540402523822E-01 / Projection distortion parameter
PV1_2   =   4.097110933043E-02 / Projection distortion parameter
PV1_4   =  -1.383015211928E-01 / Projection distortion parameter
PV1_5   =   9.918998531642E-02 / Projection distortion parameter
PV1_6   =  -8.656368272410E-02 / Projection distortion parameter
PV1_7   =  -3.552204162376E-03 / Projection distortion parameter
PV1_8   =   3.146261103742E-01 / Projection distortion parameter
PV1_9   =   8.281152946349E-03 / Projection distortion parameter
PV1_10  =   6.686440939031E-02 / Projection distortion parameter
PV2_0   =  -5.542334291248E-02 / Projection distortion parameter
PV2_1   =   1.300804026419E+00 / Projection distortion parameter
PV2_2   =  -1.276722020197E-01 / Projection distortion parameter
PV2_4   =  -5.449416824329E-01 / Projection distortion parameter
PV2_5   =   3.696010872747E-01 / Projection distortion parameter
PV2_6   =  -2.315984485289E-01 / Projection distortion parameter
PV2_7   =   3.267735031679E-01 / Projection distortion parameter
PV2_8   =  -2.840601185015E-01 / Projection distortion parameter
PV2_9   =   2.855358346910E-01 / Projection distortion parameter
PV2_10  =  -1.619108438483E-01 / Projection distortion parameter
```

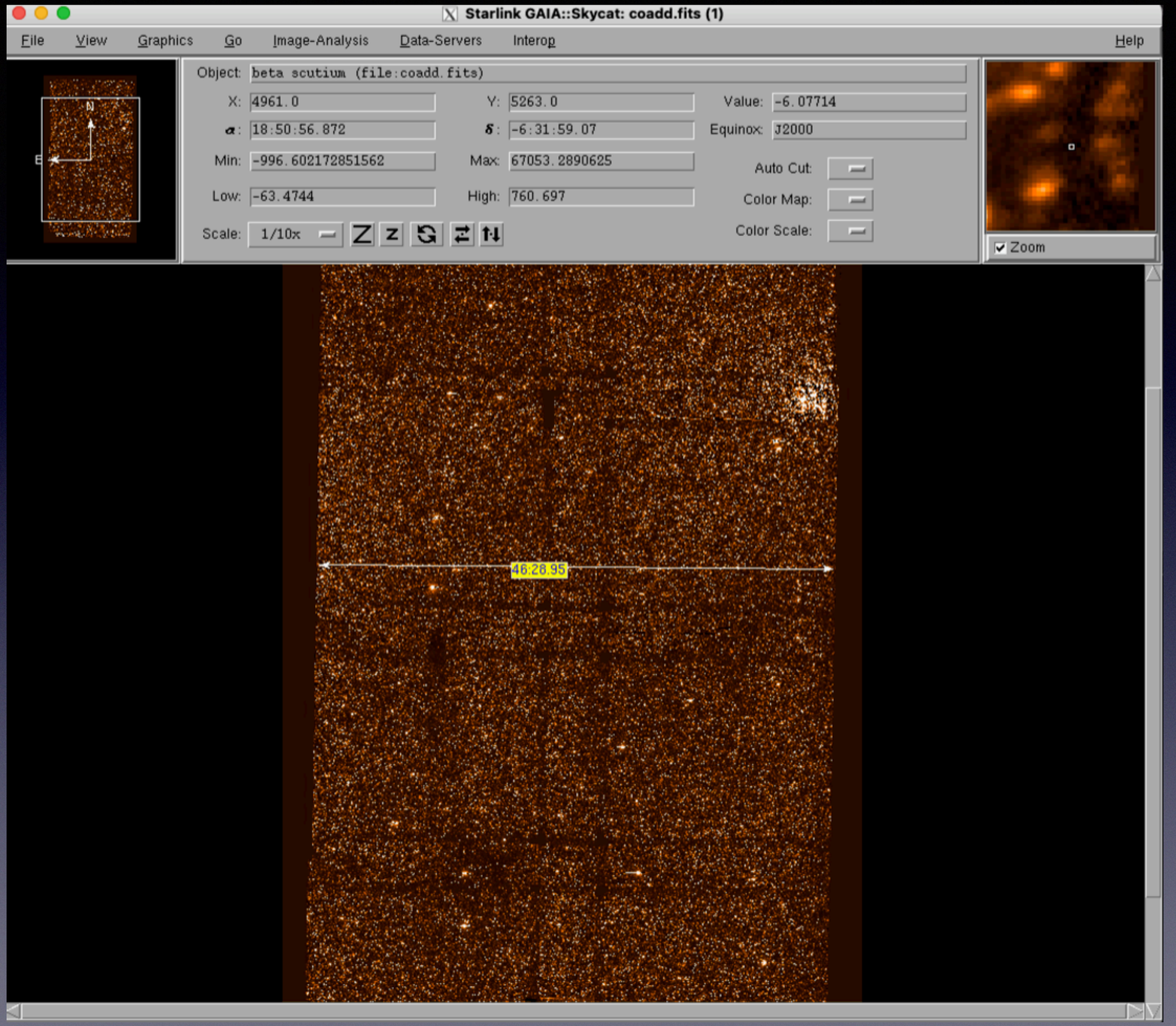
Coin de mosaïque, champ tm500, catalogue 2MASS superposé

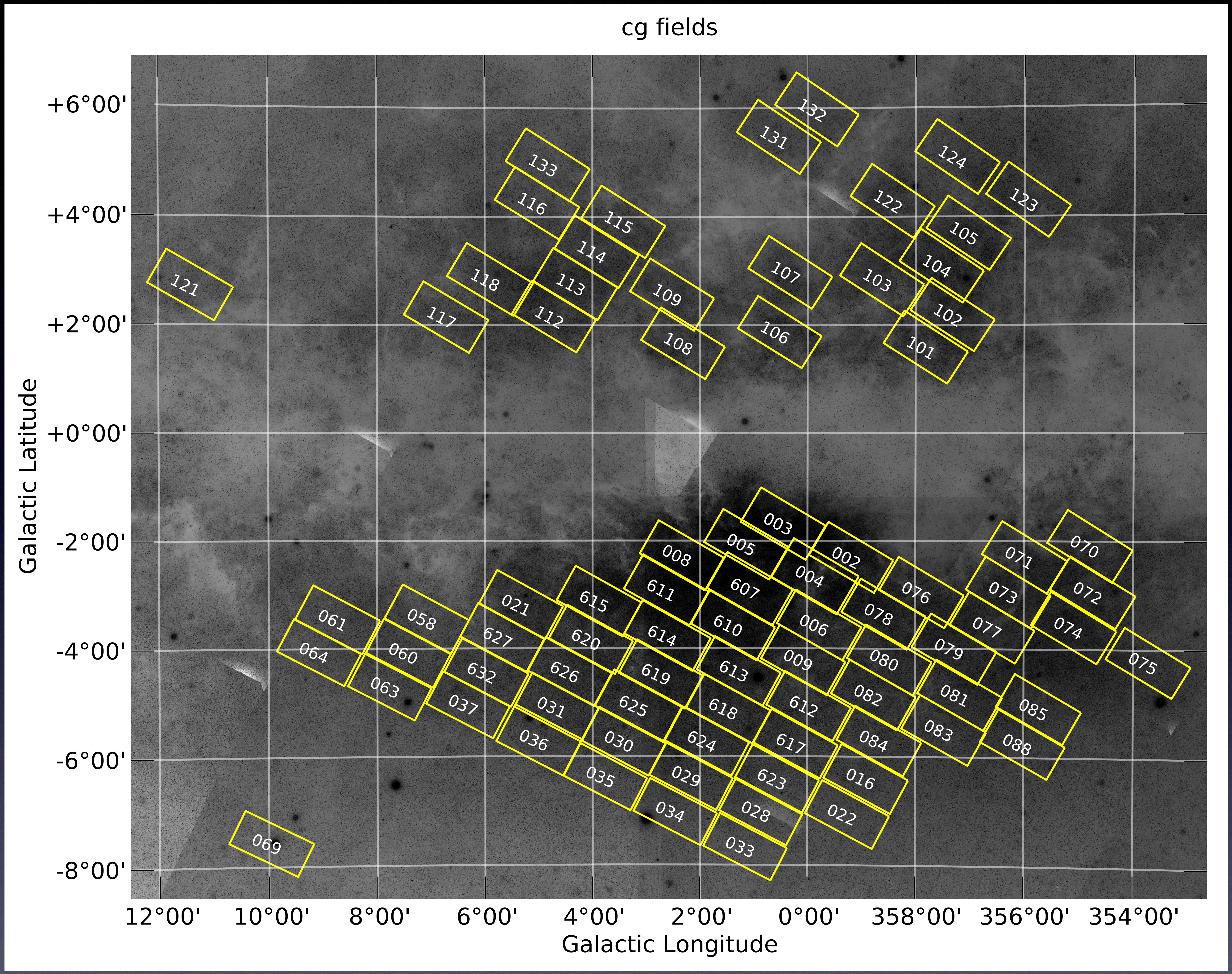


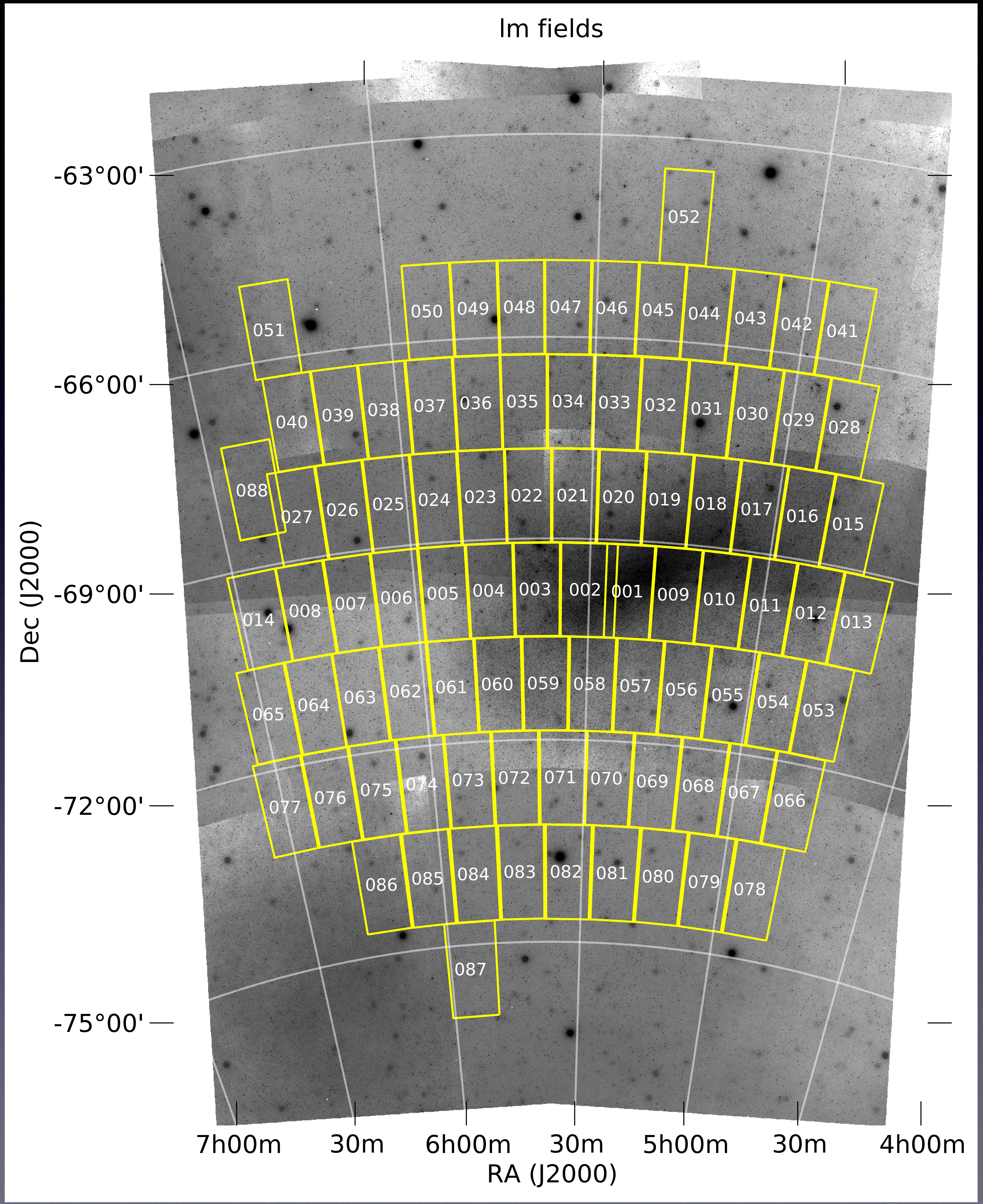
Pointage du MARLY !

Très important décalage durant le temps du projet : jusqu'à > 10 arcmin (~1/2 CCD)
Des objets de « bord » passent d'un champ à un autre —> les identifier par RA/DEC (ou Healpix) quel que soit le champ observé

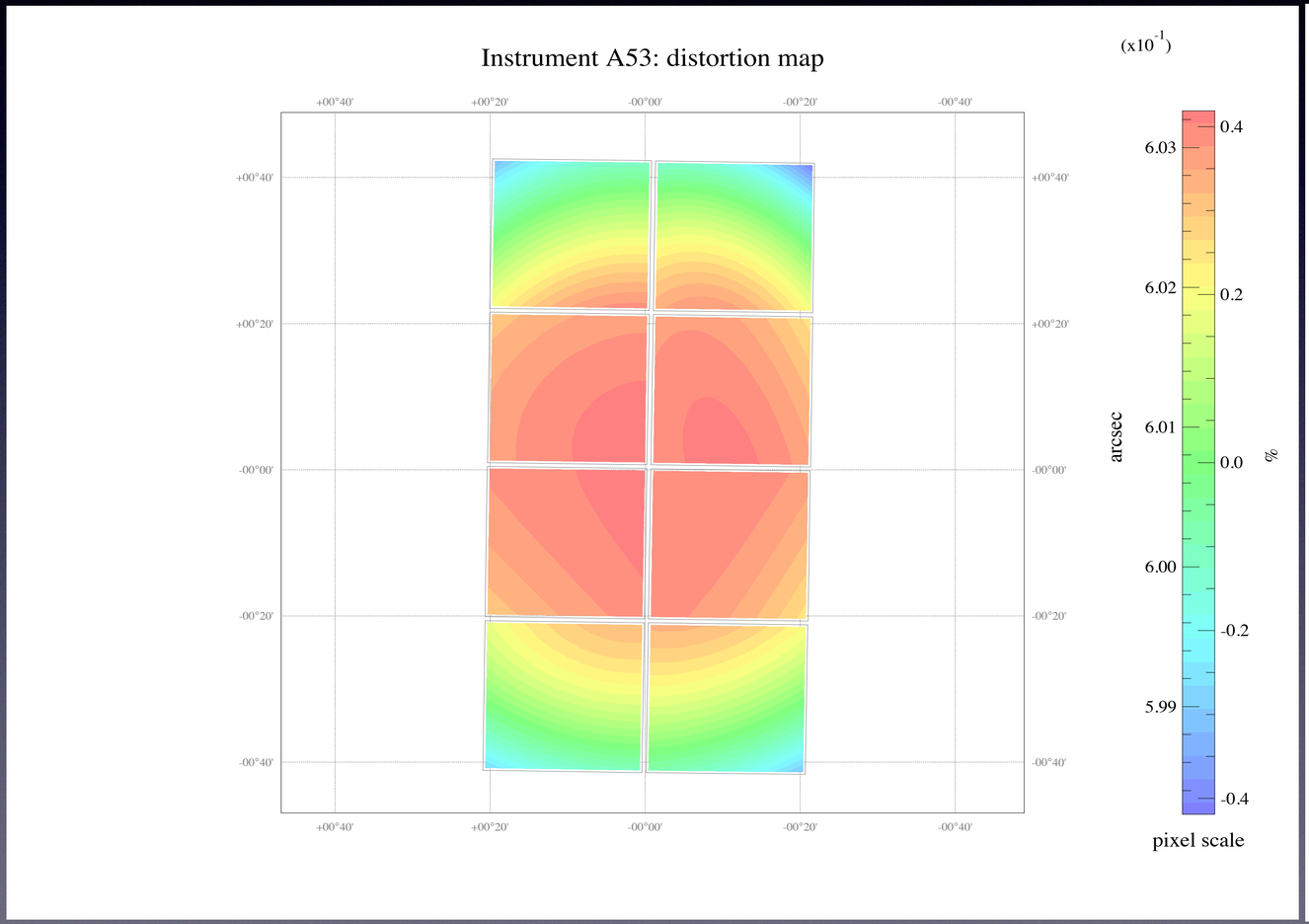


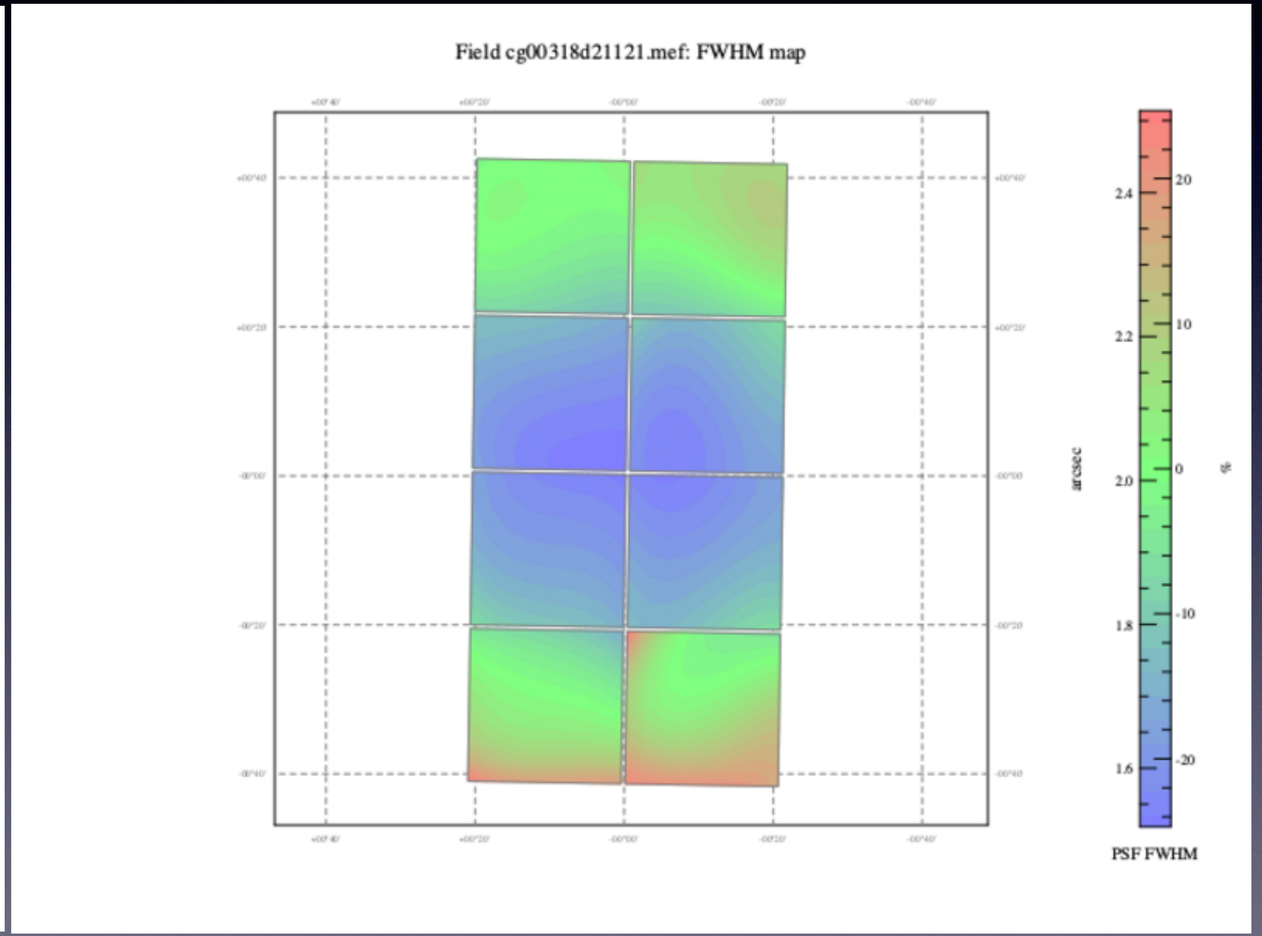

Starlink GAIA::Skycat: coadd.fits (1)
File
View
Graphics
Go
Image-Analysis
Data-Servers
Interop
Help
Object: beta scutium (file:coadd.fits)
X: 4961.0
Y: 5263.0
Value: -6.07714
α: 18:50:56.872
δ: -6:31:59.07
Equinox: J2000
Min: -996.602172851562
Max: 67053.2890625
Low: -63.4744
High: 760.697
Auto Cut:
Color Map:
Color Scale:
Scale: 1/10x
Zoom
46:28.95


cg fields
+6°00'
+4°00'
+2°00'
+0°00'
-2°00'
-4°00'
-6°00'
-8°00'
Galactic Latitude
12°00'
10°00'
8°00'
6°00'
4°00'
2°00'
0°00'
358°00'
356°00'
354°00'
Galactic Longitude


lm fields
-63°00'
-66°00'
-69°00'
-72°00'
-75°00'
Dec (J2000)
7h00m
30m
6h00m
30m
5h00m
30m
4h00m
RA (J2000)

Traitement AstrOmatic (E. Bertin) : ici cg003
Par mosaïque et champ complet, plus de 1/4 CCD





MaxiMask, Maxime Paillassa (thésard LAB)
https://github.com/mpaillassa/MaxiMask
Machine learning, travaille en GPU

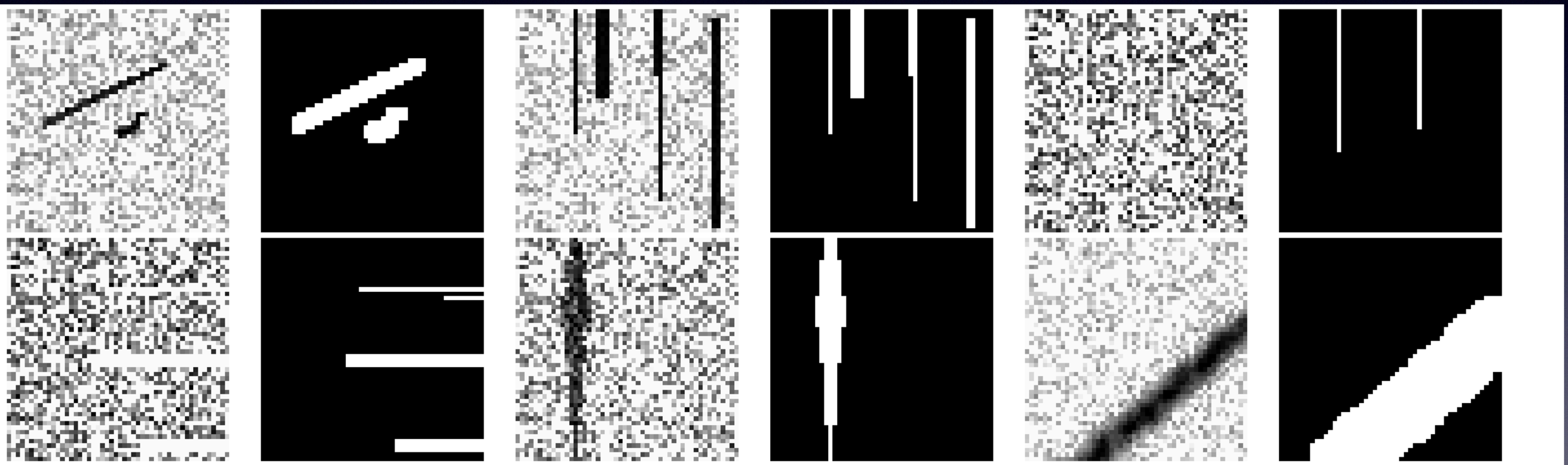
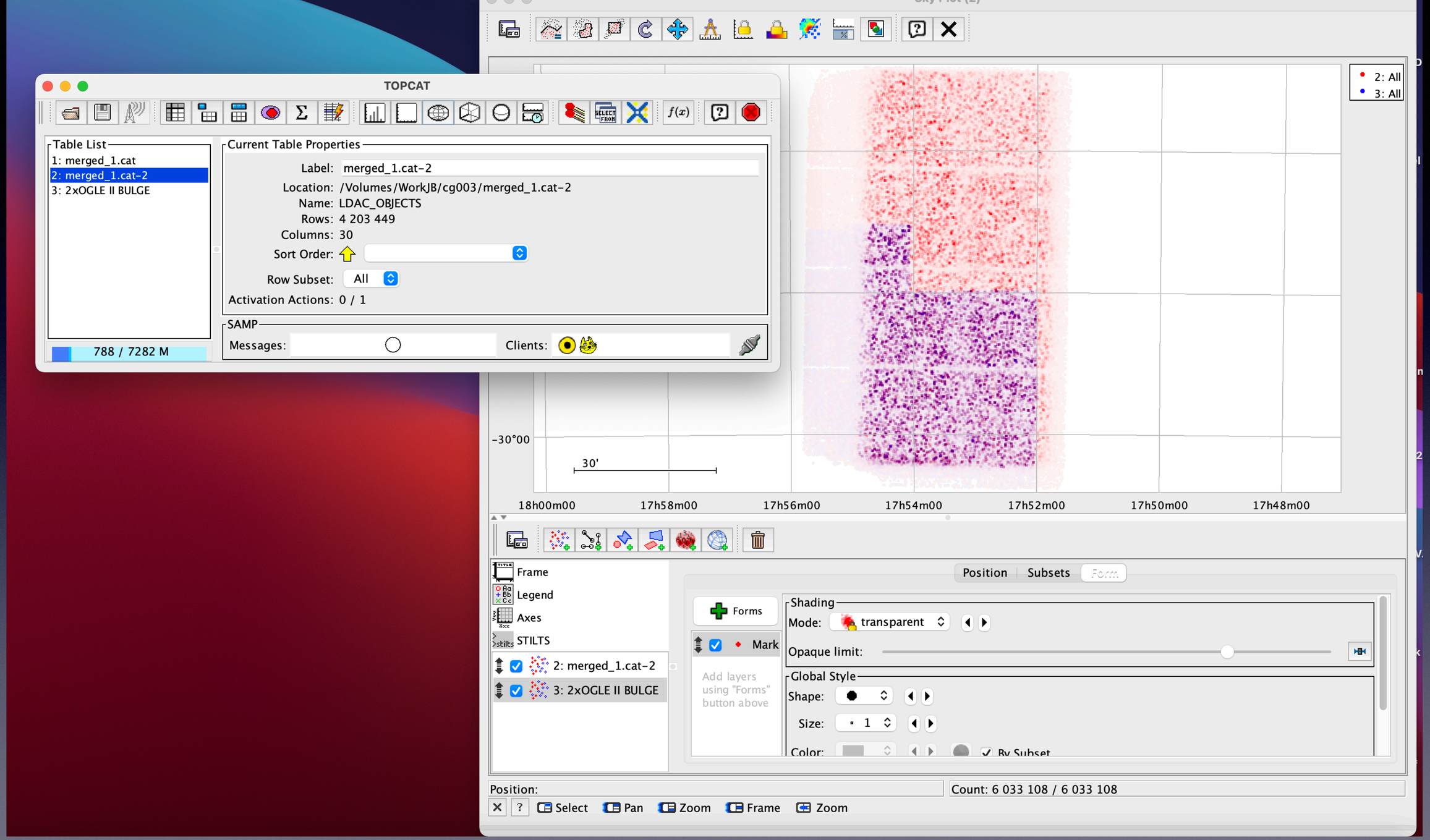


Fig. 1. Examples of contaminants and their ground truth. Top row: cosmic ray hits, hot columns, bad columns. Bottom row: bad lines, persistence, satellite trails.


TOPCAT
Table List
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2: merged_1.cat-2
3: 2xOGLE II BULGE
788 / 7282 M
Current Table Properties
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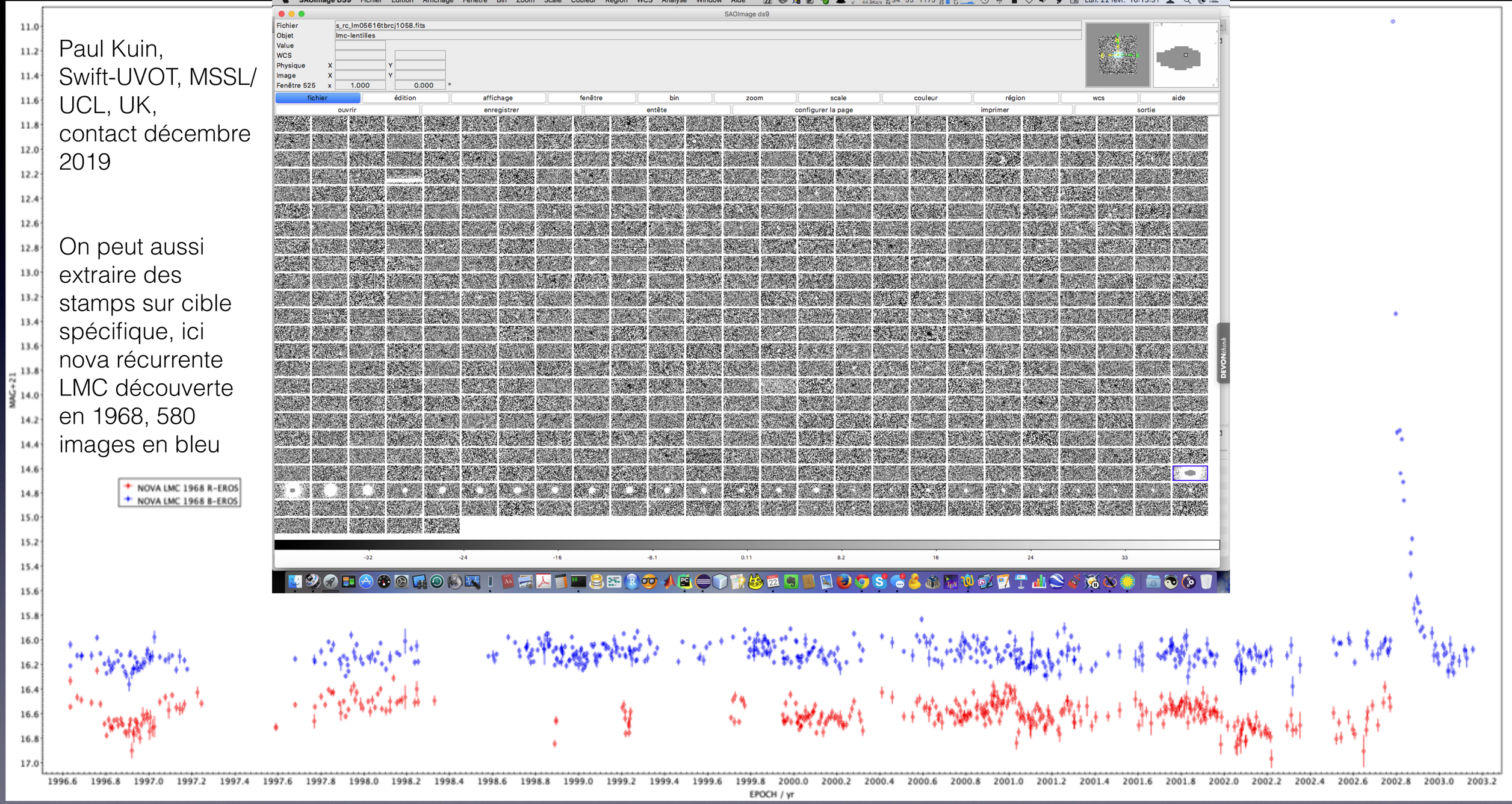
Location: /Volumes/WorkJB/cg003/merged_1.cat-2
Name: LDAC_OBJECTS
Rows: 4 203 449
Columns: 30
Sort Order:
Row Subset: All
Activation Actions: 0 / 1
SAMP
Messages:
Clients:
2: All
3: All
-30°00
30'
18h00m00
17h58m00
17h56m00
17h54m00
17h52m00
17h50m00
17h48m00
Frame
Legend
Axes
STILTS
2: merged_1.cat-2
3: 2xOGLE II BULGE
Position
Subsets
Form
Forms
Mark
Add layers using "Forms" button above
Shading
Mode: transparent
Opaque limit:
Global Style
Shape:
Size: 1
Color:
By Subset
Position:
Count: 6 033 108 / 6 033 108
Select
Pan
Zoom
Frame
Zoom

Paul Kuin, Swift-UVOT, MSSL/ UCL, UK, contact décembre 2019

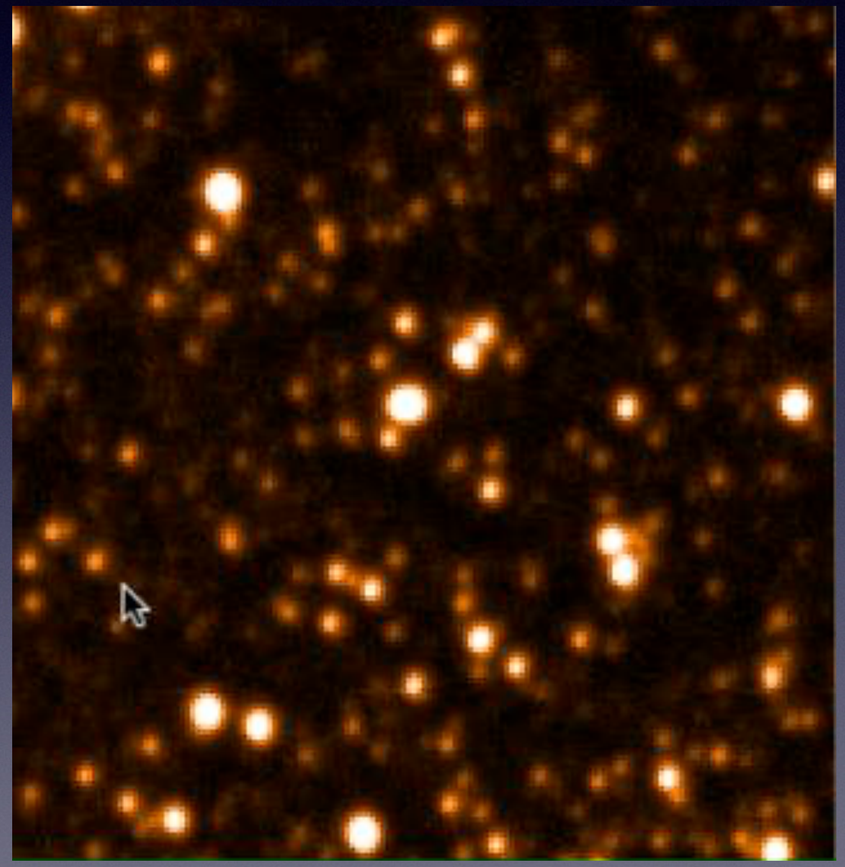
On peut aussi extraire des stamps sur cible spécifique, ici nova récurrente LMC découverte en 1968, 580 images en bleu



Corps du Système solaire !

Quelque part vers les Bras spiraux…

Clignotement entre deux observations EROS-2



—> IMCCE —> NAROO !