Temporal exploration in Aladin

Time series and T-MOC

Interop meeting – 28 May to 1 June 2017

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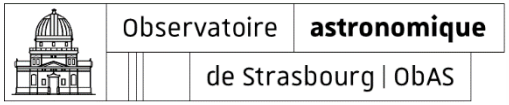
and others contributors



The Aladin time exercice

- What we would like:
  - Resource discovery by time constraints
  - Time plots (time series)
  - Time coverages (collections of time ranges)
  - …
- Aladin provides good responses for Space.
  Why not reuse the same recipe for Time ?

Time exercice level 1…

- How to know the time system of our data
  (format, scale, observer, offset).
  Notably in VOTable:
  - TIMESYS ?
  - GROUP, VODML serialization ?
- For easy interoperability, which reference time system can be used ?

… in Aladin proto

- Presently, no time meta information in VOTable => Aladin prototype uses heuristics

VOTable format
.Table J/AcA/58/163/catalog
  -assuming Time column 15 (proba=90.0%) timesys unknown (assuming TDB/Barycentric)
  -assuming RADEC in degrees column 1 for RA and 2 for DEC
    [RA=0 (proba=100.0%) DE=1 (proba=100.0%) PMRA=-1 (proba=0.0%) PMDEC=-1 (proba=0.0%) X=-1 (proba=0.0%) Y=-1 (proba=0.0%)]
  -Coordinate system references found:
    ID="J2000" => eq_FK5 Eq=J2000
    => RA/DEC coordinate conversion not required: ref="J2000" => FK5(J2000.0) to ICRS
  -found CSV DATA (field sep=Tab record sep=\n)
  -Found 3 lines CVS header with dash separator
  -assuming Time format:JD timeOffset: 2450000.0

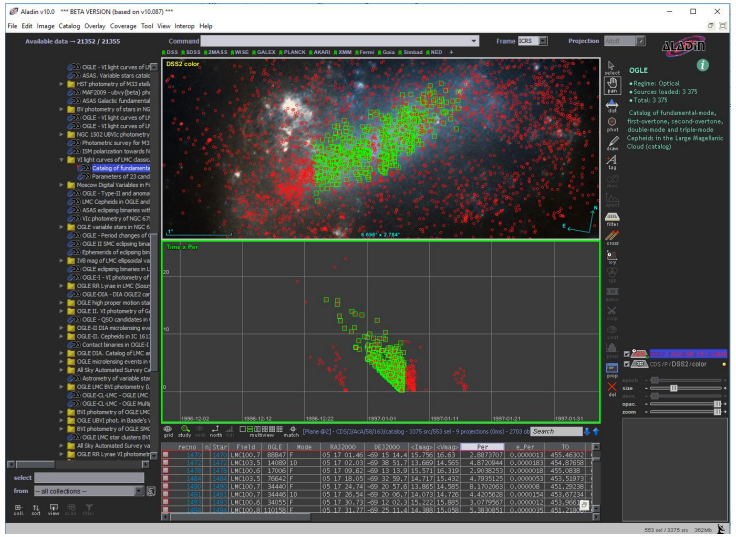
CDS/J/AcA/58/163/catalog

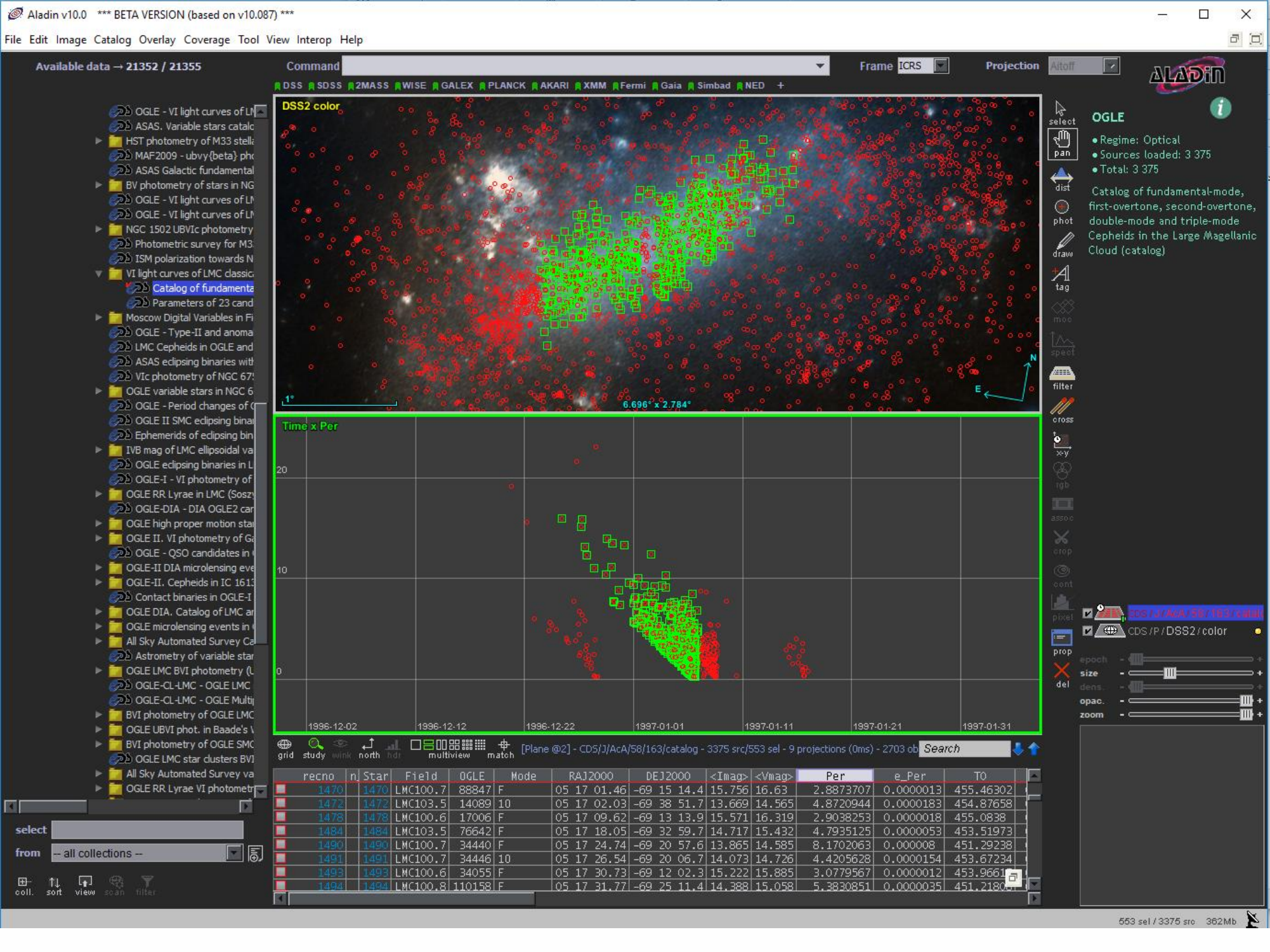
	Visible	Coo	Name	Description	Unit	Datatype	UCD
1	☐	RA	_RAJ2000	Right ascension (FK5, Equinox=J2000.0) (co…	deg	double	pos.eq.ra;meta.main
2	☐	DE	_DEJ2000	Declination (FK5, Equinox=J2000.0) (compu…	deg	double	pos.eq.dec;meta.m…
3	☑		recno	Record number assigned by the VizieR team.…		int	meta.record
4	☑		n_Star	Simbad column added by the CDS		char	meta.note
5	☑		Star	Cepheid ID (OGLE-LMC-CEP-NNNN)		char	meta.id;meta.main
6	☑		Field	OGLE-III field (LMCNNN.N)		char	meta.id;obs.field
7	☑		OGLE	OGLE-III database number		int	meta.id
8	☑		Mode	Mode of pulsation		char	meta.code;src.var
9	☑		RAJ2000	Right ascension, equinox J2000.0	"h:m:s"	char	pos.eq.ra
10	☑		DEJ2000	Declination, equinox J2000.0	"d:m:s"	char	pos.eq.dec
11	☑		<Imag>	? Intensity mean I-band magnitude	mag	float	phot.mag;em.opt.I
12	☑		<Vmag>	? Intensity mean V-band magnitude	mag	float	phot.mag;em.opt.V
13	☑		Per	Period (longest period for double and triple …	d	double	time.period
14	☑		e_Per	Uncertainty of the period	d	double	stat.error
15	☑	JD	T0	? Time of maximum brightness (HJD-2450000)	d	double	time.epoch
16	☑		Iamp	? I-band amplitude (maximum-minimum)	mag	float	src.var.amplitude
17	☑		R21	? Fourier coefficient R_21_		float	stat.fit.param
18	☑		phi21	? Fourier coefficient {phi}_21_	rad	float	stat.fit.param
19	☑		R31	? Fourier coefficient R_31_		float	stat.fit.param
20	☑		phi31	? Fourier coefficient {phi}_31_	rad	float	stat.fit.param
21	☑		LC	Plot the light curve		char	meta.ref.url
22	☑		PerM	? Shortest (double mode) or Medium (triple …	d	double	time.period

- Reference time system: JD(TDB,Barycentric)

The result…

- Detection of catalogs containing temporal measurements (epochs)
- New kind of panel
  => Time view panel
- Ability to draw any time series in these times views
  (TIME column vs another column)
- Ability to cross select objects





recno	n	Star	Field	OGLE	Mode	RAJ2000	DEJ2000	<Imag>	<Vmag>	Per	e_Per	T0
1470		1470	LMC100.7	88847	F	05 17 01.46	-69 15 14.4	15.756	16.63	2.8873707	0.0000013	455.46302
1472		1472	LMC103.5	14089	10	05 17 02.03	-69 38 51.7	13.669	14.565	4.8720944	0.0000183	454.87658
1478		1478	LMC100.6	17006	F	05 17 09.62	-69 13 13.9	15.571	16.319	2.9038253	0.0000018	455.0838
1484		1484	LMC103.5	76642	F	05 17 18.05	-69 32 59.7	14.717	15.432	4.7935125	0.0000053	453.51973
1490		1490	LMC100.7	34440	F	05 17 24.74	-69 20 57.6	13.865	14.585	8.1702063	0.000008	451.29238
1491		1491	LMC100.7	34446	10	05 17 26.54	-69 20 06.7	14.073	14.726	4.4205628	0.0000154	453.67234
1493		1493	LMC100.6	34055	F	05 17 30.73	-69 12 02.3	15.222	15.885	3.0779567	0.0000012	453.9661
1494		1494	LMC100.8	110158	F	05 17 31.77	-69 25 11.4	14.388	15.058	5.3830851	0.0000035	451.2180

Time exercice level 2…

- Can we have a computer dedicated system for manipulating time
  - Fast, interoperable, multi-resolutions, packageable…
- We did MOC for the space (S-MOC), why not reuse MOC for Time (T-MOC)

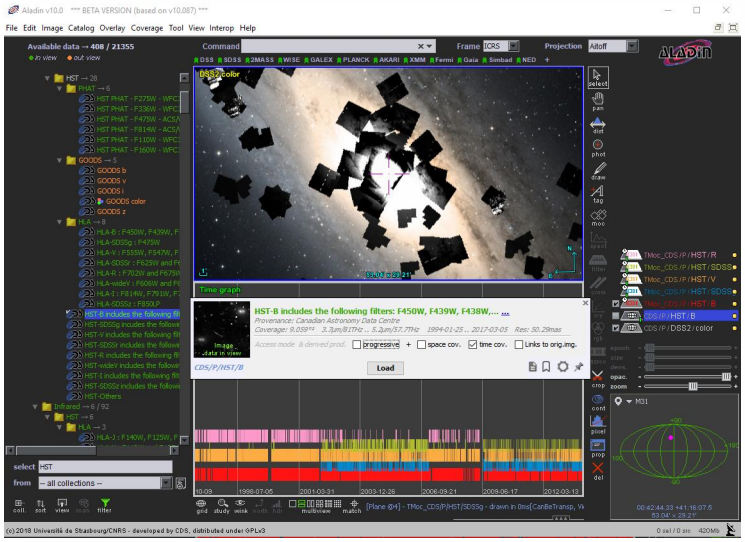
In Aladin proto…

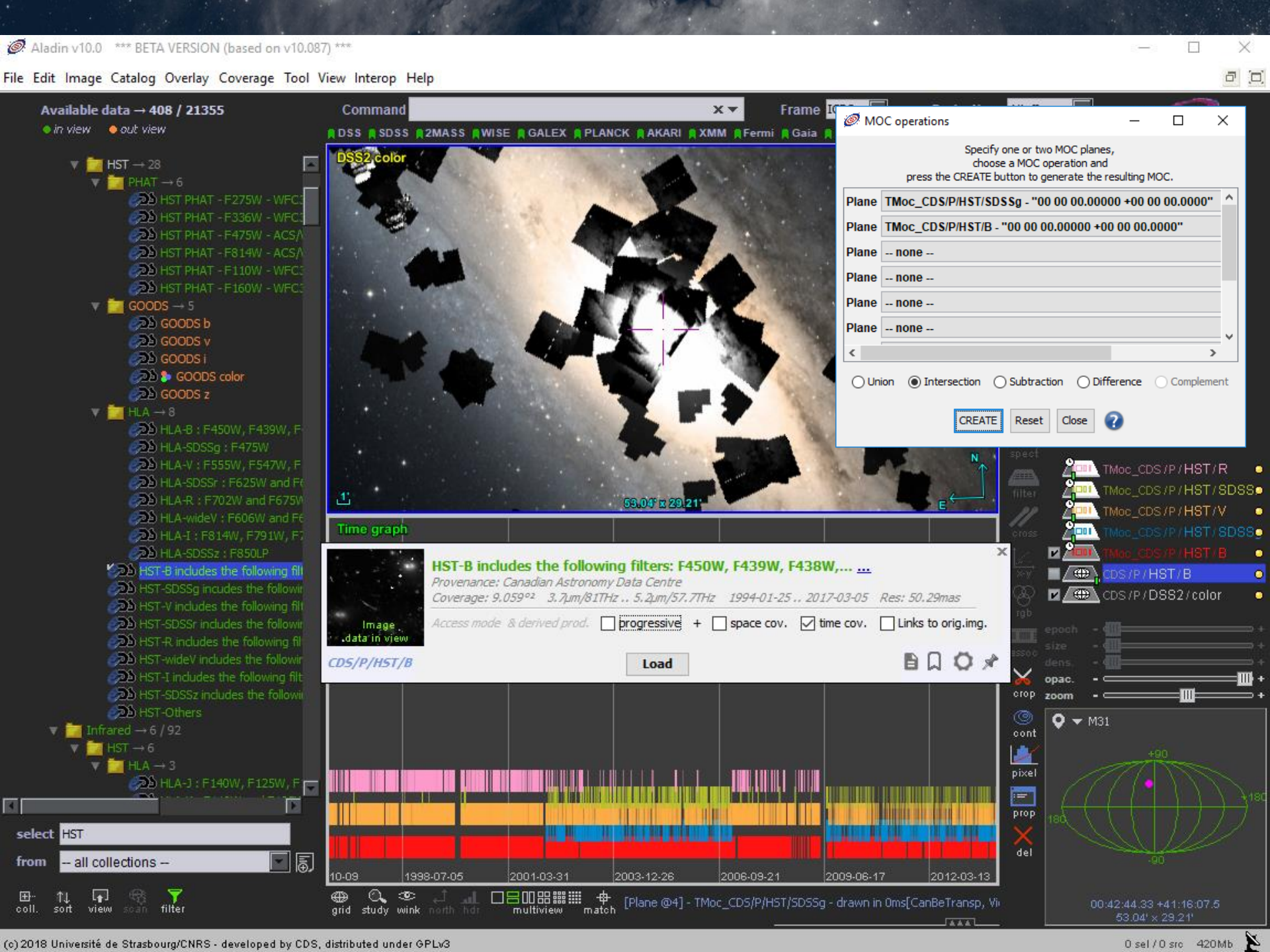
- WE reuse MOC lib as is (50 additional java code lines for time extension)
- Proposal: TMOC conventions:
  - JD(TDB,Barycentric,no offset)
  - Order 29 -> 1 µs TMOC resolution
  - Allow to describe 9133 years from JD=0

See Thomas Boch talk – Python Time MOC

The results…

- We can manipulate Time coverages:
  - Generation
  - Manipulation (intersection, union, …)
  - Drawing (easy zoom in thanks to the hierarchy nature of the MOC)
  - Packaging (as a MOC = FITS binary table)
  - …




Aladin v10.0 *** BETA VERSION (based on v10.087) ***
File Edit Image Catalog Overlay Coverage Tool View Interop Help
Available data → 408 / 21355
in view
out view
Command
Frame
DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia
DSS2 color
HST → 28
PHAT → 6
HST PHAT - F275W - WFC
HST PHAT - F336W - WFC
HST PHAT - F475W - ACS/
HST PHAT - F814W - ACS/
HST PHAT - F110W - WFC
HST PHAT - F160W - WFC
GOODS → 5
GOODS b
GOODS v
GOODS i
GOODS color
GOODS z
HLA → 8
HLA-B : F450W, F439W, F
HLA-SDSSg : F475W
HLA-V : F555W, F547W, F
HLA-SDSSr : F625W and F
HLA-R : F702W and F675W
HLA-wideV : F606W and F
HLA-I : F814W, F791W, F
HLA-SDSSz : F850LP
HST-B includes the following fil
HST-SDSSg incudes the followi
HST-V includes the following filt
HST-SDSSr includes the followi
HST-R includes the following fil
HST-wideV includes the followi
HST-I includes the following filt
HST-SDSSz includes the followi
HST-Others
Infrared → 6 / 92
HST → 6
HLA → 3
HLA-J : F140W, F125W, F
select HST
from -- all collections --
coll. sort view scan filter
MOC operations
Specify one or two MOC planes,
choose a MOC operation and
press the CREATE button to generate the resulting MOC.
Plane TMoc_CDS/P/HST/SDSSg - "00 00 00.00000 +00 00 00.0000"
Plane TMoc_CDS/P/HST/B - "00 00 00.00000 +00 00 00.0000"
Plane -- none --
Plane -- none --
Plane -- none --
Plane -- none --
Union Intersection Subtraction Difference Complement
CREATE Reset Close
53.04' x 29.21'
Time graph
HST-B includes the following filters: F450W, F439W, F438W,... ...
Provenance: Canadian Astronomy Data Centre
Coverage: 9.059°² 3.7µm/81THz .. 5.2µm/57.7THz 1994-01-25 .. 2017-03-05 Res: 50.29mas
Access mode & derived prod. progressive + space cov. time cov. Links to orig.img.
Image data in view
CDS/P/HST/B
Load
10-09 1998-07-05 2001-03-31 2003-12-26 2006-09-21 2009-06-17 2012-03-13
TMoc_CDS/P/HST/R
TMoc_CDS/P/HST/SDSS
TMoc_CDS/P/HST/V
TMoc_CDS/P/HST/SDSS
TMoc_CDS/P/HST/B
CDS/P/HST/B
CDS/P/DSS2/color
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00:42:44.33 +41:16:07.5
53.04' x 29.21'
grid study wink north hdr multiview match
[Plane @4] - TMoc_CDS/P/HST/SDSSg - drawn in 0ms[CanBeTransp, Vi
(c) 2018 Université de Strasbourg/CNRS - developed by CDS, distributed under GPLv3
0 sel / 0 src 420Mb

The live demo…

Please do not load the net for
the next 5 minutes...thanks

Load a Cepheid catalog
Draw time vs period
See the spatial / time correlation
Compare with another Cepheid catalog
Load a list of observations (SIAv2)
Draw time vs exposure
Compare with another providers
Generate T-MOC for both
Do the intersection

Next level => MocServer

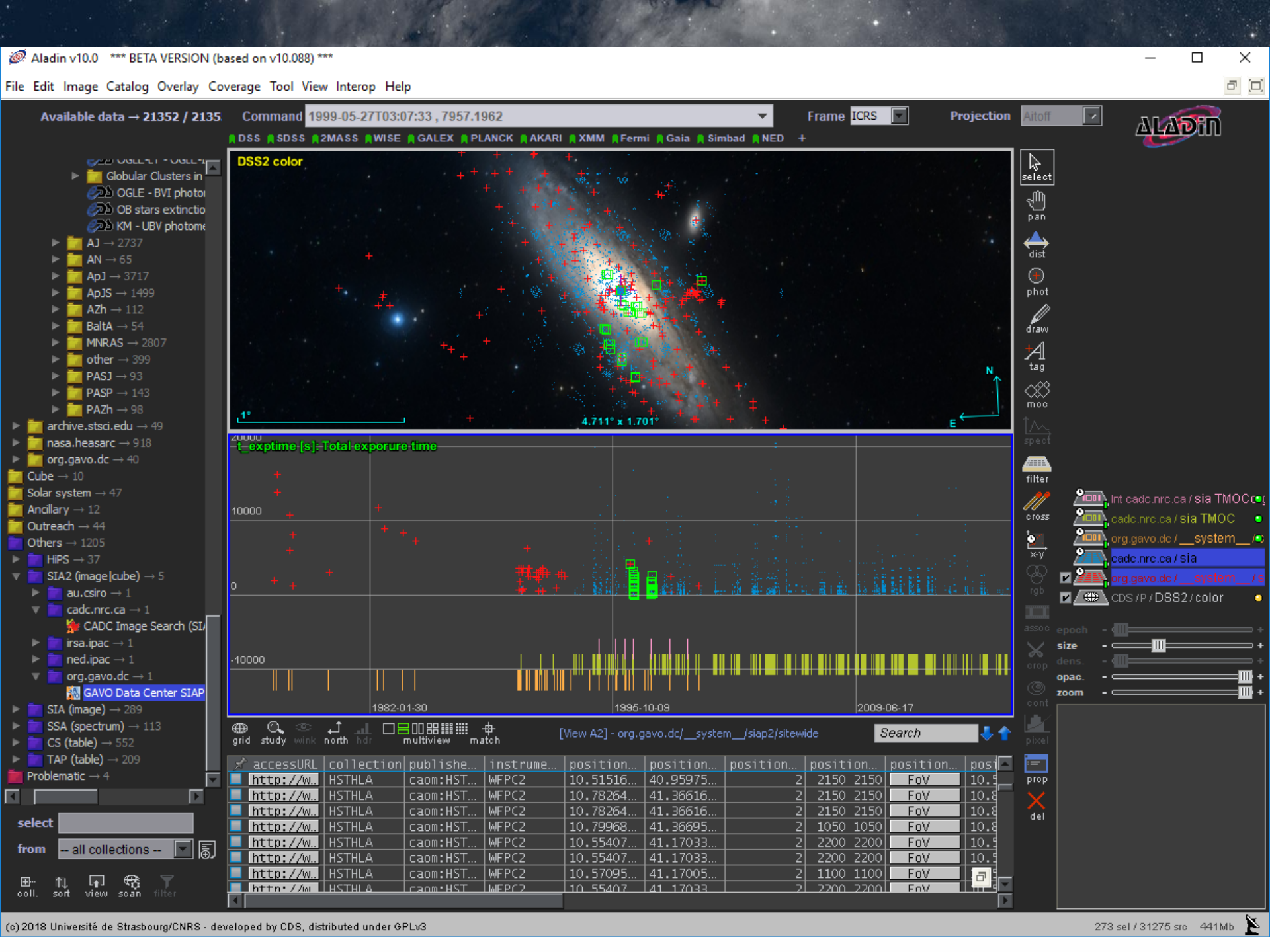
- We will build T-MOC for all VO collections. We will start with HiPS and VizieR catalogs
- Ingest them in the MocServer
  = 20 000 (ID,properties,S-MOC,T-MOC)
- Use them to filter dynamically the Aladin discovery tree (in green the collections having at least one observation in a given time range

Future levels ?

- Query by T-MOC
  - use TMOC as a query parameter
- Space&Time MOC : merge together both dimensions in a unique MOC in order to have simultaneously space and time coverage
  - constraint 1: coded in 64 bits => requires to degrade space and time resolution (approximatively 14 arcmin and 1 day)
  - constraint 2: maybe too big in practice (combinatory explosion)

Do it yourself…

- Proto available for tests, explorations, …
  http://aladin.u-strasbg.fr/java/AladinBeta.jar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File Edit Image Catalog Overlay Coverage Tool View Interop Help
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Frame ICRS
Projection Aitoff
DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad NED +
DSS2 color
4.711° x 1.701°
t_exptime [s]: Total exporure time
10000
0
-10000
1982-01-30
1995-10-09
2009-06-17
Globular Clusters in
OGLE - BVI photo
OB stars extinctio
KM - UBV photome
AJ → 2737
AN → 65
ApJ → 3717
ApJS → 1499
AZh → 112
BaltA → 54
MNRAS → 2807
other → 399
PASJ → 93
PASP → 143
PAZh → 98
archive.stsci.edu → 49
nasa.heasarc → 918
org.gavo.dc → 40
Cube → 10
Solar system → 47
Ancillary → 12
Outreach → 44
Others → 1205
HiPS → 37
SIA2 (image|cube) → 5
au.csiro → 1
cadc.nrc.ca → 1
CADC Image Search (SI
irsa.ipac → 1
ned.ipac → 1
org.gavo.dc → 1
GAVO Data Center SIAP
SIA (image) → 289
SSA (spectrum) → 113
CS (table) → 552
TAP (table) → 209
Problematic → 4
select
from -- all collections --
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select pan dist phot draw tag moc spect filter cross x-y rgb assoc crop cont pixel prop del
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cadc.nrc.ca / sia TMOC
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Search
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http://w... HSTHLA caom:HST... WFPC2 10.51516... 40.95975... 2 2150 2150 FoV 10.5
http://w... HSTHLA caom:HST... WFPC2 10.78264... 41.36616... 2 2150 2150 FoV 10.8
http://w... HSTHLA caom:HST... WFPC2 10.78264... 41.36616... 2 2150 2150 FoV 10.8
http://w... HSTHLA caom:HST... WFPC2 10.79968... 41.36695... 2 1050 1050 FoV 10.8
http://w... HSTHLA caom:HST... WFPC2 10.55407... 41.17033... 2 2200 2200 FoV 10.5
http://w... HSTHLA caom:HST... WFPC2 10.55407... 41.17033... 2 2200 2200 FoV 10.5
http://w... HSTHLA caom:HST... WFPC2 10.57095... 41.17005... 2 1100 1100 FoV 10.5
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273 sel / 31275 src 441Mb