Open Universe

Open Service Obligations

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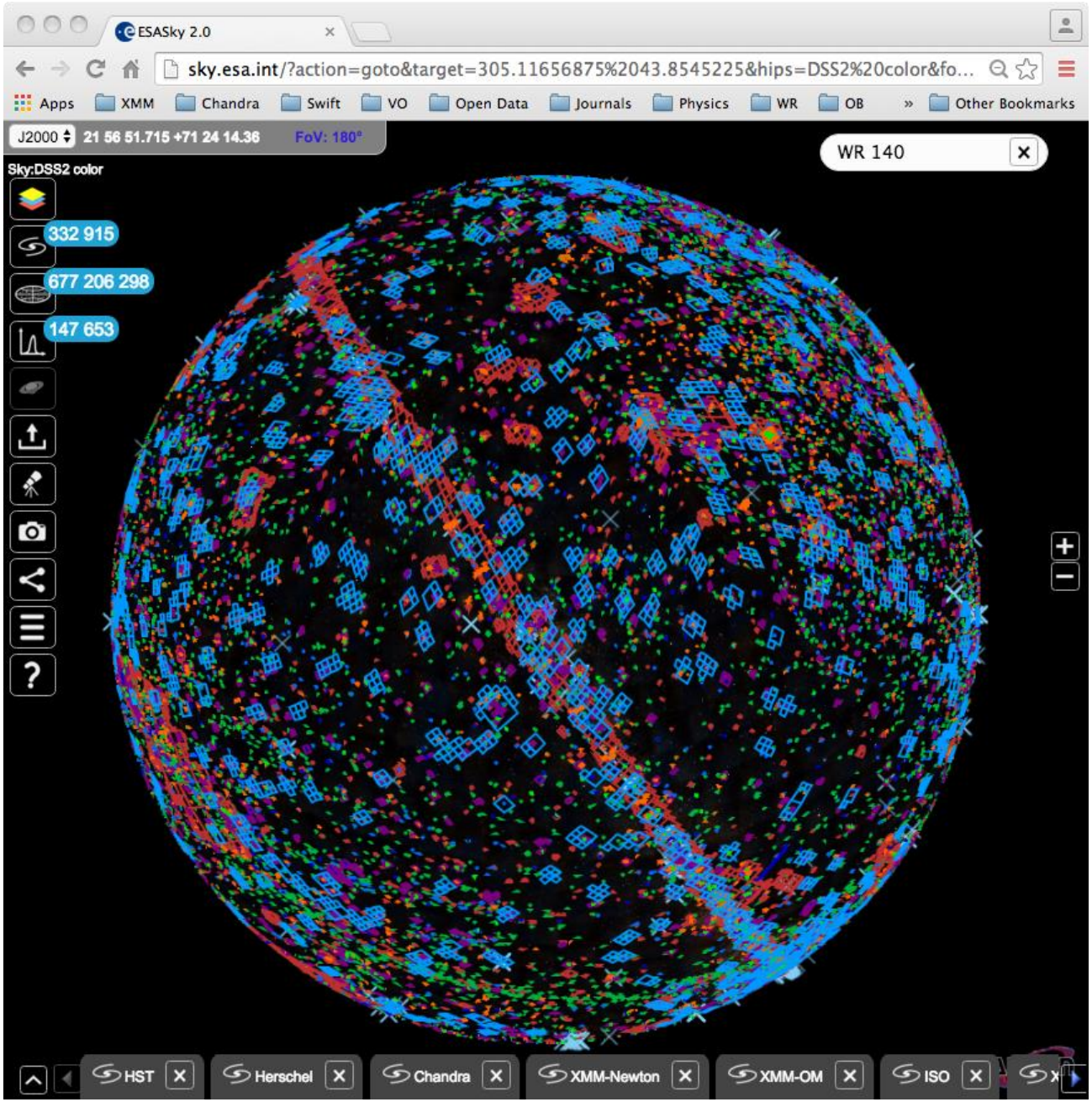
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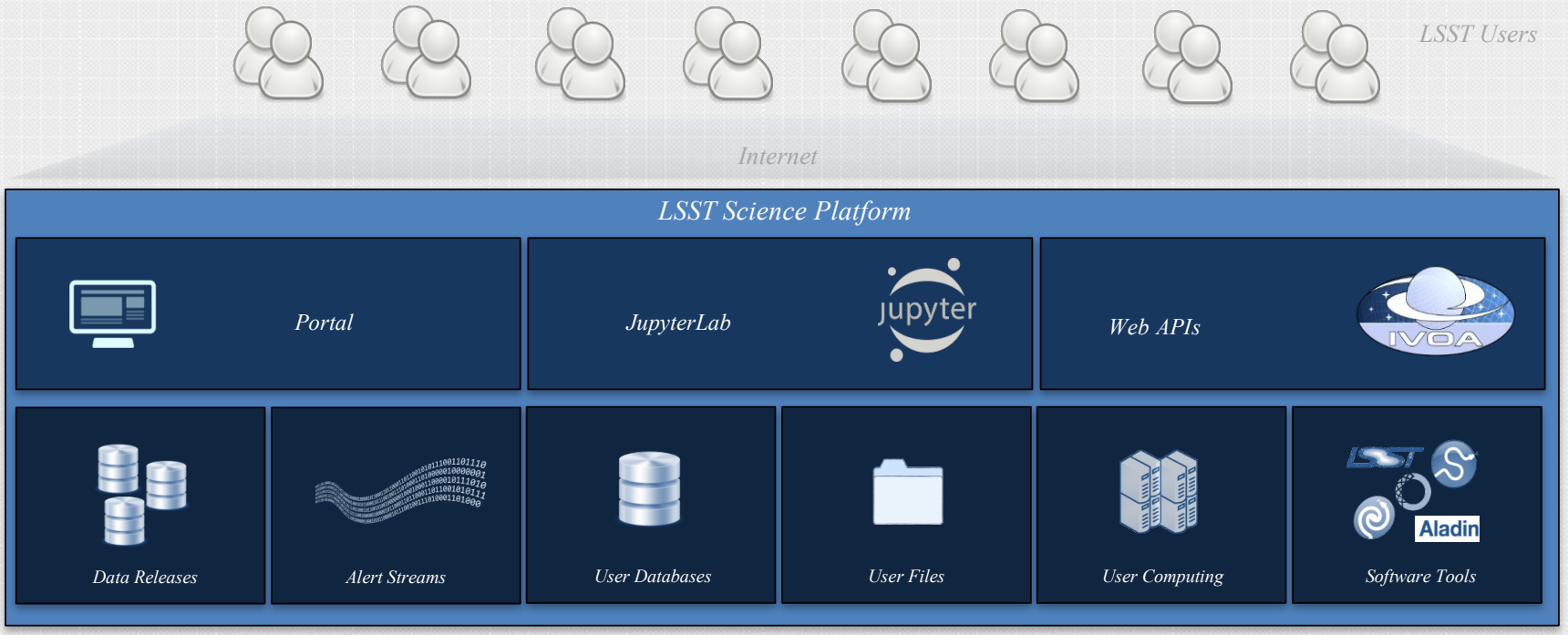
ISO

The LSST Science Platform: Accessing LSST Data and Enabling LSST Science



The **LSST Science Platform** is a set of integrated web applications and services deployed at the LSST Data Access Centers (DACs) through which the scientific community will access, visualize, subset and perform next-to-the-data analysis of the data.

The *Einstein* View of the Wolf-Rayet Stars (1987)

TABLE 2

Einstein IPC X-Ray Observations of Wolf-Rayet Stars

WR	Name	IPC field	Date	t_{obs} (100s)	λ	h_-	h_n	h_+	L_X (0.2–4.keV) (10^{32}ergs s^{-1})
						counts per 100s			
5	HD17638	5041	1979.47	61	0.		0.	0.1	0. ± 4.
6	HD50896	2281	1979.79	31	176.1	4.5	5.1	5.6	9.0 ± 0.9
		7872	1980.22	101	334.8	3.2	3.5	3.8	6.2 ± 0.5
		2282	1981.30	42	54.9	1.4	1.7	2.1	3.0 ± 0.6
11	γ Vel	2284	1979.84	32	137.7	5.1	6.0	6.8	1.1 ± 0.2
12	MR13	736	1980.43	20	0.		0.	0.5	0. ± 29.
16	HD86161	5077	1979.97	31	5.5	0.1	0.4	0.8	11. ± 7.
17	HD88500	10058	1981.07	55	0.		0.	0.1	0. ± 8.
18	HD89358	3012	1979.96	22	0.		0.	0.4	0. ± 5.
21	HD90657	3342	1979.53	19	1.7	0.	0.5	1.4	5.8 ± 9.6
22	HD92740	3139	1979.53	22	12.7	0.7	1.3	2.0	9.0 ± 3.
		4222	1979.53	49	14.5	0.6	1.1	1.5	8.1 ± 4.
		776	1978.98	118	3.1	0.1	0.3	0.6	2.7 ± 2.
24	HD93131	3141	1979.53	17	3.9	0.2	0.9	1.8	8.1 ± 3.7
		4223	1979.53	41	10.5	0.6	1.1	1.8	
25	HD93162	3141	1979.53	17	129.9	12.	14.	15.	137. ± 9.
		4222	1979.53	49	257.0	11.	12.	14.	
		4223	1979.53	41	193.4	12.	13.	15.	
28	MS2	1167	1978.98	14	0.		0.	0.5	0. ± 35.
30	HD94305	10059	1981.07	37	0.9	0.	0.2	0.5	15. ± 29.
38	MS8	2161	1979.53	113	1.2	0.	0.2	0.5	1.7 ± 2.7
40	HD96548	2285	1979.53	21	0.		0.	0.3	0.7 ± 3.4
		3009	1979.53	9	0.	0.	0.	0.4	
		7873	1980.64	61	0.2	0.	0.0	0.2	
46	HD104994	5042	1980.11	56	11.0	0.2	0.4	0.7	35. ± 18.
47	HDE311884	7256	1980.65	21	3.3	0.1	0.6	1.1	19. ± 15.
48	θ Mus	5956	1980.65	36	103.0	3.0	3.5	4.0	20. ± 3.
54	MR48	7257	1980.65	17	0.8	0.	0.3	0.8	27. ± 50.
57	HD119078	5044	1980.07	65	0.		0.	0.1	0. ± 9.
67	MR55	775	1979.68	23	0.5	0.	0.6	1.3	8. ± 10.
		7925	1980.62	59	0.9	0.	0.2	0.6	
78	HD151932	3140	1979.16	21	5.3	0.1	0.5	0.8	2.6 ± 1.7
79	HD152270	5075	1980.25	18	2.1	0.0	0.9	1.9	4.4 ± 4.4
97	HDE320102	2552	1979.73	21	26.3	1.4	2.0	2.6	34. ± 10.
98	HDE318016	2552	1979.73	21	0.		0.	0.4	0. ± 4.
101	DA3	2550	1979.73	21	0.		0.	0.3	
102	LS54368	5045	1980.25	48	2.1	0.0	0.2	0.5	13. ± 13.
104	MR80	2170	1979.24	17	0.7	0.	0.4	1.3	3.8 ± 8.2
105	AS268	4671	1979.69	17	3.7	0.1	0.8	1.5	8.2 ± 6.6
111	HD165763	5959	1981.23	43	1.0	0.	0.2	0.5	0.4 ± 0.8
113	CV Ser	5960	1981.20	79	4.6	0.0	0.2	0.5	2.0 ± 1.5
122	NaSt1	3490	1979.23	34	0.7	0.	0.2	0.6	35. ± 70.
124	M1–67	7417	1981.27	34	0.1	0.	0.1	0.3	2. ± 12.
125	MR93	8680	1981.27	57	39.1	0.9	1.3	1.6	14. ± 4.
134	HD191765	5046	1979.90	99	23.5	0.5	0.7	1.0	4.6 ± 1.6
		3137	1979.90	9	3.3	0.1	0.6	1.1	
135	HD192103	5046	1979.90	99	0.3	0.	0.1	0.2	0.3 ± 1.1
		3137	1979.90	9	0.		0.	0.6	
136	HD192163	827	1979.27	111	2.0	0.	0.1	0.3	0.6 ± 0.6
137	HD192641	5963	1980.33	45	5.0	0.1	0.4	0.7	1.6 ± 1.1
138	HD193077	3495	1979.27	53	23.6	0.6	1.0	1.4	4.6 ± 1.6
139	V444 Cygni	7875	1980.27	109	116.4	1.2	1.5	1.7	7.7 ± 1.3
144	MR110	Σ_5	1978.96	183	0.		0.	0.1	0. ± 1.7
145	AS422	3378	1978.96	54	10.3	0.5	0.9	1.4	8.4 ± 3.2
		3389	1978.96	54	3.8	0.1	0.6	1.0	
		3381	1978.96	30	1.8	0.	0.4	1.0	
		3388	1978.96	24	0.9	0.	0.3	0.9	
		3387	1978.96	25	1.1	0.	0.4	1.1	
146	MR112	3384	1978.96	51	6.3	0.2	0.6	1.1	9.4 ± 5.9
147	AS431	5995	1979.92	52	127.0	2.6	3.0	3.4	47. ± 6.
148	HD197406	7874	1980.39	99	0.		0.	0.2	0. ± 14.
152	HD211654	4558	1979.95	14	2.4	0.0	0.4	0.8	9.1 ± 8.9
154	HD213049	10061	1981.07	43	0.3	0.	0.1	0.3	1.1 ± 4.0
155	CQ Cep	1319	1980.53	19	6.7	0.3	0.7	1.1	14. ± 9.
for comparison from EXOSAT (Pollock 1987)									
140	HD193793		1984.45						400. ± 40.

A single page of results that took 3 years to assemble 30 years ago could now take 3 clicks.

Deconstruction exercise

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Open Service Obligations for Astronomy and Space Science

Findable

- Client infrastructure
  - Persistent settings
  - Sample of one or more objects
    - Name resolution || VizieR
  - Embedded core services
    - Simbad || NED || ADS || NIST || ATOMDB
  - Dialogue
- Disclosed complete metadata infrastructure
  - Instrument aggregated stack
    - Raw data || Footprints || Calibration
  - Science-ready aggregated pipeline stack
    - Images || Sources || Spectra || Time-series || Polarisation
    - *In-situ* measurements
  - Web-ready aggregated pipeline stack
    - Aggregates
      - HiPS maps || SED builder || Histories
      - Catalogues
    - Mobile services
    - Citizen science
- Methods
  - Selection
    - No errors of the first kind
    - No errors of the second kind
  - Auxiliary
    - Remedial analysis || null management

Accessible

- Complementary interoperable dynamic presentation methods
  - Persistent client configuration
  - Visualisation
    - Select || Explore || Zoom || Pan || Blink || Recontext || Animate || Stack
  - Tabular
    - Sort || Select || Eliminate
  - Graphic design
- Consolidated download management || cutout

Interoperable

- IVOA standards
- Cross-calibration
- API set
- Innovation || Open source || Educational || Commercial

Reusable & Reproducible

- Stateful || Client history
- Instrument stack || Science-ready stack || Web-ready stack

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Notions underlying Open Service Obligations

- Maximise
  - Scientific return
  - Calibration responsibility
  - Algorithmic quality
  - Statistical rigour
  - Provenance
  - Aesthetic & intuitive appeal
  - IVOA use
- Minimise
  - Duplication
  - Platform dependencies
  - Inoperability
  - Clutter
  - Privilege
- Equalise
  - Big data and small data
  - Rights