MANCHESTER 1824
The University of Manchester

e-MERLIN data set

Javier Moldon

This presentation/publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet].

Native format

- The native output from the e-MERLIN correlator is FITS-IDI
  http://www.aips.nrao.edu/FITS-IDI.html
- A single file containing all information, data and tables.
- Traditionally processed using AIPS, working with UVFITS format
- Currently, we import FITS-IDI to MEASUREMENT SET to work in CASA
- In the future, native format will be MS directly

```
[1]: from astropy.io import fits

[2]: with fits.open('./LE1006_C_005_20180526_01.fits') as hdul:
...:     hdul.info()
...:
ename: ./LE1006_C_005_20180526_01.fits
   Name          Type       Cards   Dimensions   Format
 PRIMARY       GroupsHDU       11   ()       0 Groups  0 Parameters
 ARRAY_GEOMETRY  BinTableHDU     52   6R x 7C   [8A, 3D, 3E, 1J, 1J, 3E, 1E]
 SOURCE        BinTableHDU     78   5R x 23C   [1J, 16A, 1J, 4A, 1J, 4E, 4E, 4E, 4E, 4E, 4E, 1D, 1D, 8A
D, 1D, 4D, 8A, 8A, 4D, 1D, 1D, 1E]
 FREQUENCY     BinTableHDU     33   1R x 6C   [J, 4D, 4E, 4E, 4J, 4J]
 ANTENNA       BinTableHDU     52   6R x 13C   [1D, 1E, 8A, 1J, 1J, 1J, 1J, 1A, 1E, 2E, 1A, 1E, 2E]
 UV_DATA       BinTableHDU     85   2037R x 11C   [1D, 1D, 1D, 1D, 1D, 1J, 1J, 1J, 1E, 16E, 16384E]
 UV_DATA       BinTableHDU     85   2037R x 11C   [1D, 1D, 1D, 1D, 1D, 1J, 1J, 1J, 1E, 16E, 16384E]
 UV_DATA       BinTableHDU     85   2037R x 11C   [1D, 1D, 1D, 1D, 1D, 1J, 1J, 1J, 1E, 16E, 16384E]
 UV_DATA       BinTableHDU     85   2037R x 11C   [1D, 1D, 1D, 1D, 1D, 1J, 1J, 1J, 1E, 16E, 16384E]
 UV_DATA       BinTableHDU     85   2037R x 11C   [1D, 1D, 1D, 1D, 1D, 1J, 1J, 1J, 1E, 16E, 16384E]
```

Where is the raw data stored?

- e-MERLIN internal archive
- Only accessible from inside JBO
- Catalog of all projects, sources and configurations observed
- Scriptable. Can export data in batch mode.

But...

- Catalogue and archive not browsable from outside
- Working on a full data archive so data will be accessible (not ready yet).

Data Finder

	Start	End	OJD ID	Status	Experiment	Target	Group	Frequency	Note	File Size	L
_008_20180318	18 Mar 2018 11:59:02	18 Mar 2018 13:20:56	ePI_C_008_20180318	Ready	LE1004	J0543+2326	g2_cycle	CBand-Low		24.098 GiB	3
_008_20180318	18 Mar 2018 12:10:02	18 Mar 2018 13:31:56	ePI_C_008_20180318	Ready	LE1004	J0542+2330	g2_cycle	CBand-Low		24.098 GiB	3
_008_20180318	18 Mar 2018 13:56:33	18 Mar 2018 14:26:29	ePI_C_008_20180318	Ready	LE1004	0319+415 (3C84)		CBand-Low		24.098 GiB	3
12_C_006_20180318	18 Mar 2018 15:02:28	18 Mar 2018 15:41:57	CY6212_C_006_20180318	Ready	CY6212	0319+415 (3C84)		C-Band_5GHz		38.268 GiB	5
12_C_006_20180318	18 Mar 2018 15:42:03	18 Mar 2018 19:36:56	CY6212_C_006_20180318	Ready	CY6212	0112+3522 (CY6212ref)	cycle	C-Band_5GHz		38.268 GiB	5
12_C_006_20180318	18 Mar 2018 15:44:33	18 Mar 2018 19:41:56	CY6212_C_006_20180318	Ready	CY6212	0109+3543 (CY6212targ)	cycle	C-Band_5GHz		38.268 GiB	5
12_C_006_20180318	18 Mar 2018 19:42:03	18 Mar 2018 20:11:56	CY6212_C_006_20180318	Ready	CY6212	1331+305 (3C286)		C-Band_5GHz		38.268 GiB	5
12_C_006_20180318	18 Mar 2018 20:12:02	18 Mar 2018 20:34:59	CY6212_C_006_20180318	Ready	CY6212	1407+284 (OQ208)		C-Band_5GHz		38.268 GiB	5
13_C_012_20180318	18 Mar 2018 20:45:12	18 Mar 2018 21:44:56	CY6213_C_012_20180318	Ready	CY6213	0319+415 (3C84)		C-Band_5GHz		58.312 GiB	7
13_C_012_20180318	18 Mar 2018 21:45:02	19 Mar 2018 04:43:57	CY6213_C_012_20180318	Ready	CY6213	1331+305 (3C286)		C-Band_5GHz		58.312 GiB	7
13_C_012_20180318	18 Mar 2018 22:15:03	19 Mar 2018 05:11:59	CY6213_C_012_20180318	Ready	CY6213	1407+284 (OQ208)		C-Band_5GHz		58.312 GiB	7
13_C_012_20180318	18 Mar 2018 22:44:02	19 Mar 2018 04:08:26	CY6213_C_012_20180318	Ready	CY6213	1311-2329 (CY6004ref)	cycle	C-Band_5GHz		58.312 GiB	7
13_C_012_20180318	18 Mar 2018 22:46:02	19 Mar 2018 04:11:26	CY6213_C_012_20180318	Ready	CY6213	1309-2322 (CY6004targ)	cycle	C-Band_5GHz		58.312 GiB	7
13_C_012_20180318	18 Mar 2018 23:11:32	19 Mar 2018 04:13:56	CY6213_C_012_20180318	Ready	CY6213	1259-2310 (CY6004targ2)	cycle	C-Band_5GHz		58.312 GiB	7
08_C_009_20180319	19 Mar 2018 05:15:11	19 Mar 2018 05:44:58	DD5008_C_009_20180319	Ready	DD5008	1407+284 (OQ208)		C-Band_5GHz		10.365 GiB	1
08_C_009_20180319	19 Mar 2018 05:45:03	19 Mar 2018 06:14:56	DD5008_C_009_20180319	Ready	DD5008	1331+305 (3C286)		C-Band_5GHz		10.365 GiB	1
08_C_009_20180319	19 Mar 2018 06:15:02	19 Mar 2018 06:44:59	DD5008_C_009_20180319	Ready	DD5008	1415+1320 (CY4215ref)		C-Band_5GHz		10.365 GiB	1
ve 0319+415	19 Mar 2018 09:13:57	19 Mar 2018 17:21:52	Observe 0319+415	Ready		0319+415 (3C84)		C-Band_5GHz		56.353 GiB	3
13_C_013_20180319	19 Mar 2018 20:40:12	19 Mar 2018 21:39:58	CY6213_C_013_20180319	Ready	CY6213	0319+415 (3C84)		C-Band_5GHz		58.292 GiB	7
13_C_013_20180319	19 Mar 2018 21:40:03	20 Mar 2018 04:38:56	CY6213_C_013_20180319	Ready	CY6213	1331+305 (3C286)		C-Band_5GHz		58.292 GiB	7
13_C_013_20180319	19 Mar 2018 22:10:02	20 Mar 2018 05:06:59	CY6213_C_013_20180319	Ready	CY6213	1407+284 (OQ208)		C-Band_5GHz		58.292 GiB	7
13_C_013_20180319	19 Mar 2018 22:39:03	20 Mar 2018 04:03:27	CY6213_C_013_20180319	Ready	CY6213	1311-2329 (CY6004ref)	cycle	C-Band_5GHz		58.292 GiB	7
13_C_013_20180319	19 Mar 2018 22:41:03	20 Mar 2018 04:06:27	CY6213_C_013_20180319	Ready	CY6213	1309-2322 (CY6004targ)	cycle	C-Band_5GHz		58.292 GiB	7
13_C_013_20180319	19 Mar 2018 23:06:33	20 Mar 2018 04:08:56	CY6213_C_013_20180319	Ready	CY6213	1259-2310 (CY6004targ2)	cycle	C-Band_5GHz		58.292 GiB	7

Filters

Type: Sub-array job data | ID name | number | Start time: 18 03 2018 | End time: 20 03 2018

Data status: Any | OJD ID name | number | Experiment ID | number

Source name | type: Any | Group ID | number

Frequency ID | Receiver ID | Note

Find Yesterday's Entries | Find Entries | Find Today's Entries

Data Manager Entry

Delete | Edit | New | Export Data | Quick Export

Data Location

Location

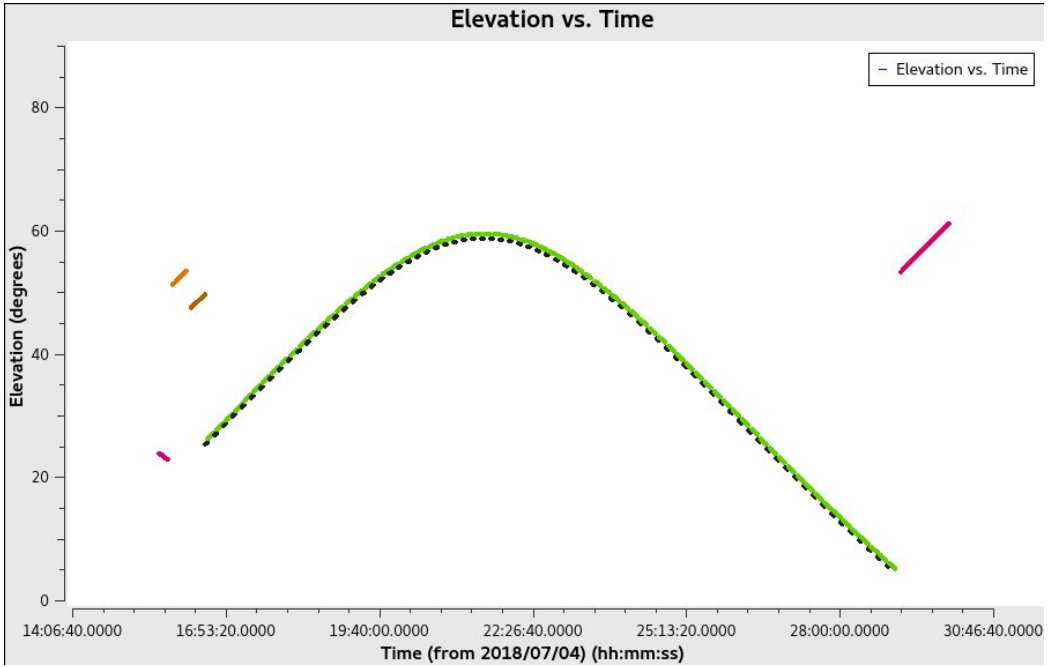
Help

Typical data set: sources

- Sources observed: science target, phase calibrator, standard calibrators
- Observations in phase-reference mode
  - Target/phase reference calibrator cycles
  - Usually 2-3 minutes on phasecal and 6-10 minutes on target
- Standard calibrators:
  - 3C286 (1331+305): Flux scale calibrator/pol angle calibrator
  - OQ208 (1407+284): Bandpass calibrator
  - 3C84 (0319+415): bandpass/ leakage calibrator, check in general (very bright)

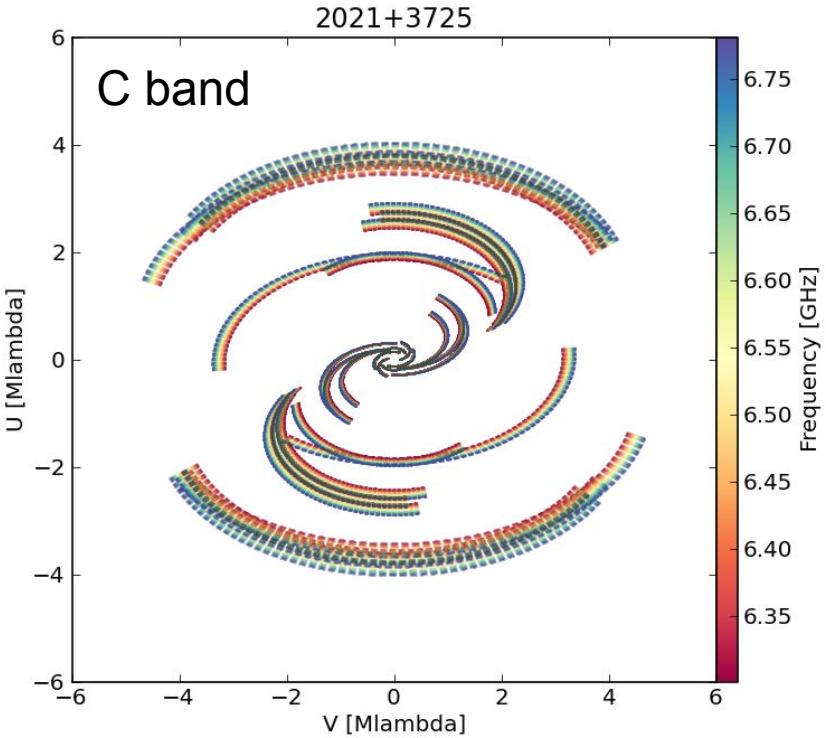
Typical data set: schedule

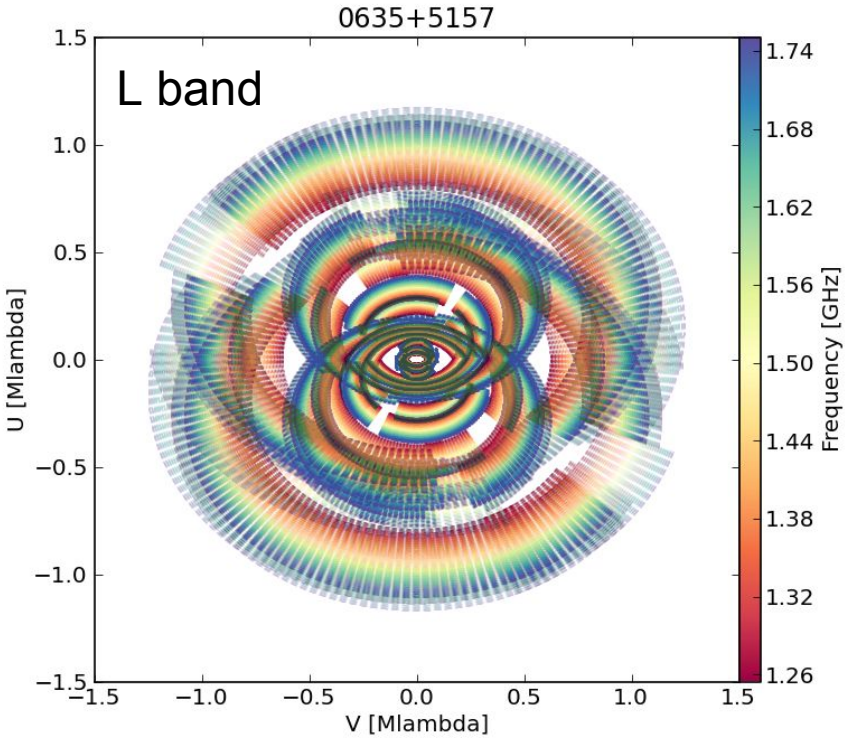
- Usually 100+ scans on target and phasecal
- 1 or 2 long scans on each standard calibrator



Typical data set: uv-coverage

- Long observations for image fidelity





Listobs - header and scan information

```
> listobs(vis='msfilename', listfile='myproject.listobs.txt')
```

```
================================================================================
           MeasurementSet Name:  /mirror2/scratch/jmoldon/emerlin/L0631/L0631.ms      MS Version 2
================================================================================
   Observer: Gravitational Lensing     Project: Gravitat
Observation: e-MERLIN
Data records: 20055392       Total elapsed time = 89866 seconds
   Observed from   05-Feb-2015/19:02:13.5   to   06-Feb-2015/19:59:59.5 (UTC)

   ObservationID = 0         ArrayID = 0
  Date        Timerange (UTC)          Scan  FldId FieldName             nRows     SpwIds   Average Interval(s)    ScanIntent
  05-Feb-2015/19:02:13.5 - 19:05:01.5     1      2 0631+5311              37632  [0,1,2,3,4,5,6,7]  [1, 1, 1, 1, 1, 1, 1, 1]
              19:05:04.5 - 19:12:00.5     2      1 0635+5157              93632  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              19:12:04.5 - 19:15:00.5     3      2 0631+5311              39872  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              19:15:03.5 - 19:22:00.5     4      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              19:22:03.5 - 19:25:00.5     5      2 0631+5311              40096  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              19:25:03.5 - 19:32:00.5     6      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              19:32:03.5 - 19:35:00.5     7      2 0631+5311              40096  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              19:35:03.5 - 19:42:00.5     8      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              19:42:03.5 - 19:45:00.5     9      2 0631+5311              40096  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              19:45:03.5 - 19:52:00.5    10      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              19:52:03.5 - 19:55:00.5    11      2 0631+5311              40096  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              19:55:03.5 - 20:02:00.5    12      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
              20:02:03.5 - 20:05:00.5    13      2 0631+5311              40096  [0,1,2,3,4,5,6,7]  [0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989, 0.989]
              20:05:03.5 - 20:12:00.5    14      1 0635+5157              93856  [0,1,2,3,4,5,6,7]  [0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995, 0.995]
```

listobs - source information

- Source id number
- Source name
- Field phase center (source position)
- Number of rows (visibilities)

```
Fields: 5
  ID   Code Name                RA               Decl           Epoch        nRows
  0    ACAL 1331+305            13:31:08.287300 +30.30.32.95900 J2000       806176
  1         0635+5157           06:35:12.310000 +51.57.01.80000 J2000     12099136
  2         0631+5311           06:31:34.685968 +53.11.27.75692 J2000      5161184
  3         1407+284            14:07:00.394410 +28.27.14.68990 J2000       806400
  4         0319+415            03:19:48.160110 +41.30.42.10330 J2000      1182496
```

listobs - frequency information

- Number of spw
  - There can be continuum + spectral line data
- Observed frequency
- Number of channels
- Channel width and total bandwidth

Spectral Windows: (8 unique spectral windows and 1 unique polarization setups)

SpwID	Name	#Chans	Frame	Ch0(MHz)	ChanWid(kHz)	TotBW(kHz)	CtrFreq(MHz)	Corrs			
0	none	512	TOPO	1254.462	125.000	64000.0	1286.3995	RR	RL	LR	LL
1	none	512	TOPO	1318.462	125.000	64000.0	1350.3995	RR	RL	LR	LL
2	none	512	TOPO	1382.462	125.000	64000.0	1414.3995	RR	RL	LR	LL
3	none	512	TOPO	1446.462	125.000	64000.0	1478.3995	RR	RL	LR	LL
4	none	512	TOPO	1510.462	125.000	64000.0	1542.3995	RR	RL	LR	LL
5	none	512	TOPO	1574.462	125.000	64000.0	1606.3995	RR	RL	LR	LL
6	none	512	TOPO	1638.462	125.000	64000.0	1670.3995	RR	RL	LR	LL
7	none	512	TOPO	1702.462	125.000	64000.0	1734.3995	RR	RL	LR	LL

listobs - antenna information

- List of antennas
- Antenna names

Antennas: 7:

ID	Name	Station	Diam.	Long.	Lat.	Offset from array center (m)			ITRF Geocentric coordinates (m)		
						East	North	Elevation	x	y	z
0	Lo	e-MERLIN:0176.0	m	-002.18.25.8	+53.03.07.9	19400.8559	21183.6803	6369.1778	3822252.643000	-153995.683000	5086051.443000
1	Mk2	e-MERLIN:0224.0	m	-002.18.08.9	+53.02.58.7	19713.9103	20897.1596	6334.4681	3822473.365000	-153692.318000	5085851.303000
2	Kn	e-MERLIN:0525.0	m	-002.59.44.9	+52.36.18.4	-26733.5549	-28428.6831	6480.6814	3859711.503000	-201995.077000	5056134.251000
3	De	e-MERLIN:0625.0	m	-002.08.35.0	+51.54.50.9	30394.6148	-105100.8391	6688.6339	3923069.171000	-146804.368000	5009320.528000
4	Pi	e-MERLIN:0725.0	m	-002.26.38.3	+53.06.16.2	10235.7831	26985.6080	6271.3637	3817176.561000	-162921.179000	5089462.057000
5	Da	e-MERLIN:0825.0	m	-002.32.03.3	+52.58.18.5	4186.5058	12262.8833	6330.1699	3828714.513000	-169458.995000	5080647.749000
6	Cm	e-MERLIN:0932.0	m	+000.02.19.5	+51.58.50.2	176561.6720	-97724.9405	6660.8614	3919982.752000	2651.982000	5013849.826000

casabrowser