Single Dish Matters

Large Millimeter Telescope
(50m, Mexico, at 5km)

IVOA RadioIG
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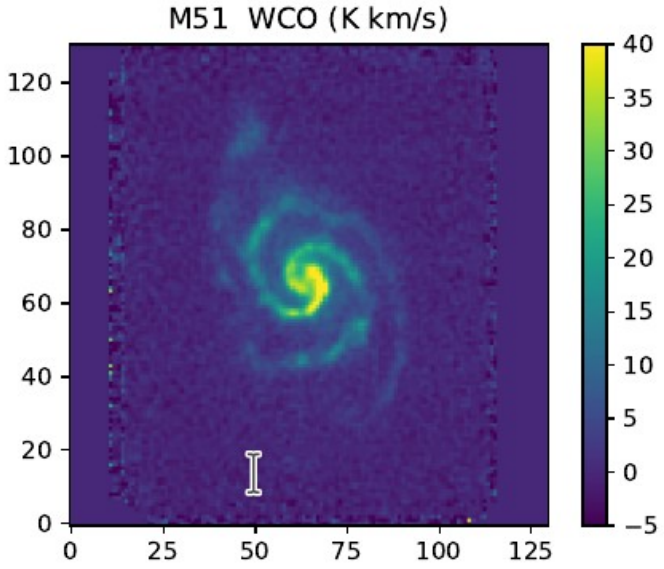

M51 – moment-0 map
last pre-pandemic data

SD data formats

spectral axis will be in GHz/MHz/...

- **Raw data**
  - Should we even bother? They can be big, very instrument specific, and sometimes even have odd units.
  - Usually a set of related spectra, sometimes in Freq space, sometimes in Lag space
  - Sometimes require other observatory data not stored in online databases for calibration
- **Spectra** (likely calibrated)
  - SDFITS (1995 draft standard) – but many dialects now exist (e.g. Parkes, FAST, Arecibo)
  - MBFITS (2007) (IRAM, APEX, INAF) - raw only?
  - CLASS (GILDAS, 30m)
    - FITS export (no good import?)
      - “single” – this is a primary HDU fits file with NAXIS1=nchan and NAXIS2=NAXIS3=NAXIS4=1
      - “index” – thjis is an SDFITS dialect, called MATRIX instead of ‘SINGLE DISH’.
  - ASCII tables: ECSV ?
- **Maps/Cubes**
  - These are standard FITS, so no special needs for SD
  - Gridders can take spectra and create a map/cube
  - Combine single dish and interferometric data
- **Pulsar Timing**
  - PSRFITS

See also: https://www.asterics2020.eu/dokuwiki/doku.php?id=open:wp4:wp4techforum5:radiointhevo

(some) Current SD data producers

- **FAST** 500m
- **Arecibo** 300m
- **GBT** 110m
- **Effelsberg** 100m
- **Lovell** (Jodrell Bank) 64m
- **Parkes/Murriyang** 64m
- **SRT** (Sardinia) 64m
  - Also: **Medicina** and **Noto** from INAF
- **LMT** (Mexico) 50m: spectra, cubes, continuum maps → SRDP + archive
- **Nobeyama** 45m
- **IRAM** 30m
- **ALMA** TP 12m
- **APEX** 12m
- Various EVN/VLBI telescopes?

- SD archives
  - NRAO (GBT, ALMA)
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(some) Current SD software

- (GBT) gbtidl → SDFITS (“standard”)
- (Arecibo) AO IDL → CIMAFITS
- (IRAM 30m) GILDAS/CLASS → SPECTRUM (“single” vs. “index” [=sdfits])
- (ALMA) CASA “sd” toolkit
- (Effelsberg) nod3
- (LMT) lmtoy → SDFITS (“standard”, Nddata-like)
- (Parkes) ?? → HDF5 with an SDFITS inspired header

- Astropy: specutils, specreduce, specviz, pyspeckit
- “OLD”: comb, specx, DISH (AIPS++), UniPOPS
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VO use cases

- Find data by RA,DEC,FREQ,LINE
- Extract single spectra, spectral data cubes or (cont) maps
  - Should SDFITS play a role?

Action Items

- Solidify the 1995 SDFITS draft standard [wishful thinking]
  - Document common practices (“SDFITS dialects”)
- Survey other SD formats?
  - Compare IFU formats to SDFITS
    - EURO3D (abandoned)
    - ?
- SDFITS loader in astropy::SpecUtils (partially done)
- Which VO services will the LMT archive provide?
- ObsCore representation
  - Data units can be “weird”: **Jy/beam** or **K** (but: T_a^*, T_{mb}, ….)