JIVE

From VLBI to JIVE to ERIC

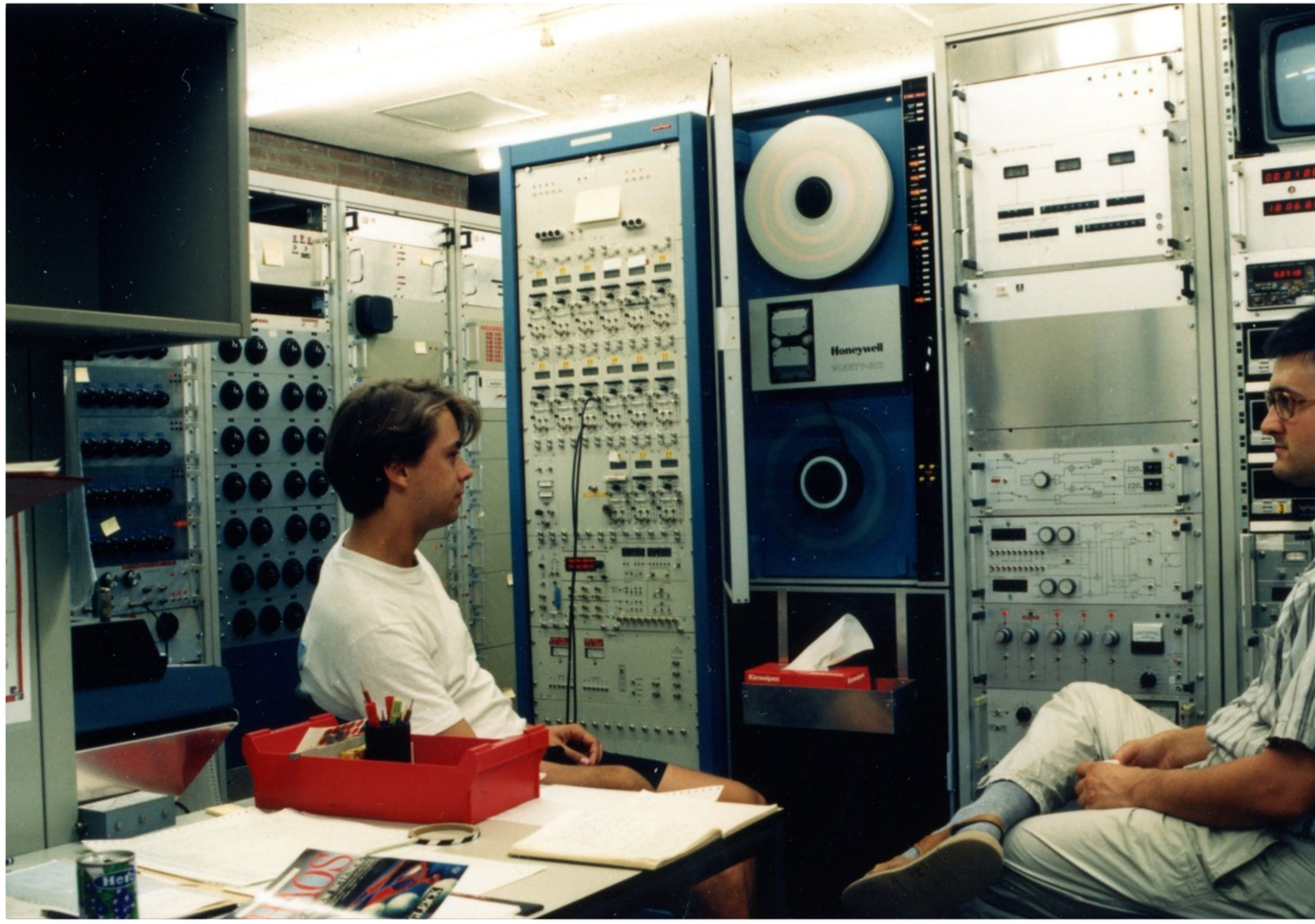
Huib van Langevelde

1987A&AS...71...250

tion by spurious sources. This contamination is especially severe when strong sources are present in the field.

(3) Six sources are found which are either variable on time scales of a year, or steadily decrease in flux with time. Two of these variable sources are associated with blue radio galaxies, which frequently seem to have this property. It indicates that the radio emission originates from a small non-thermal nucleus.

dancy techniques. Peter Katgert looked over our shoulder from time to time and with his expertise contributed to solving some of the problems with the reduction and analysis.



Acknowledgements.

We would like to thank Ger de Bruyn and [illegible] for their help and valuable advice concernin[illegible]

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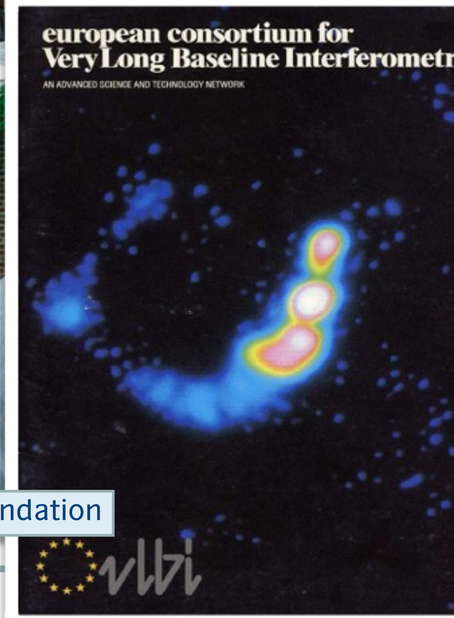
The history of JIVE

- 1967 first VLBI observations, in the US
- 1968 first US-Europe (Sweden) observations
- 1975 first discussions of European VLBI
- 1976 US VLBI Network formed
- 1976 first intra-European VLBI observations
- 1980 European VLBI Network formed
- 1993 Joint Institute for VLBI in Europe (JIVE)
- 1993 US VLB Array opened
- 1997 Japanese space VLBI telescope launched
- 1998 JIVE Data Processor opened, in Dwingeloo
- 2011 Russian space VLBI telescope launched
- 2015 JIVE becomes a European legal entity

List by Richard Schilizzi

First EVN consortium board



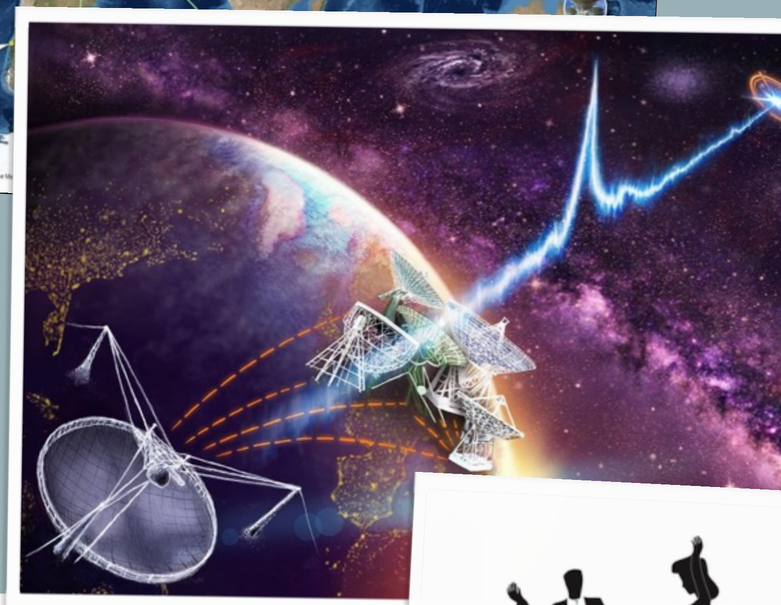
Launch of JIVE foundation

The succes of JIVE

- Is the success of the EVN?

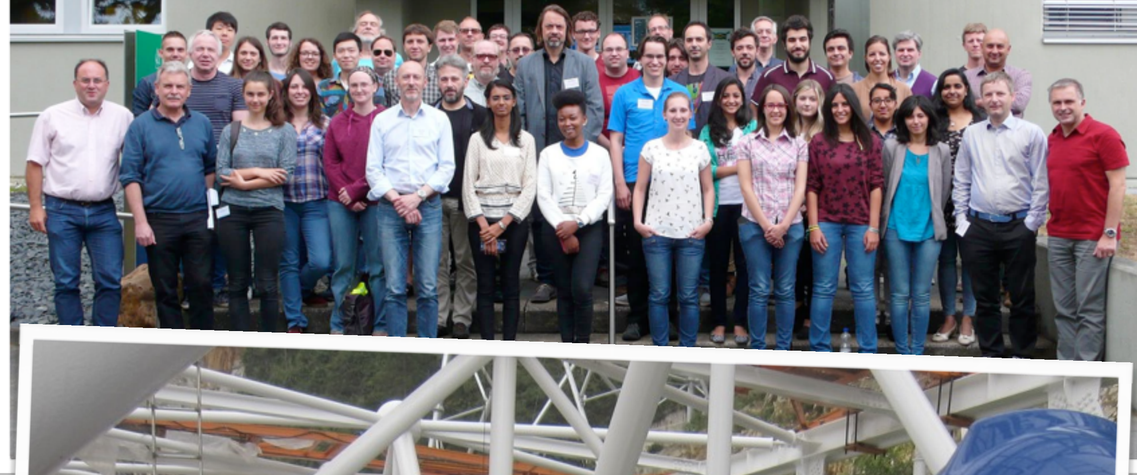
- Assume we agree it is a success?
  - Stable role, career path of a quite a few astronomers, steady stream of publications, technology development, steady funding

- Technology upgrade path
- Very broad range of science applications
- Governance and funding opportunities
  - And illustrate with FRB's, JUMPING-JIVE
- Great, dedicated, diverse people



The people

- Distributed community
  - With very specific expertise in many places
  - Good mix engineering and scientific community
- Across many countries and cultures
  - Has a stabilising effect
    - Many sources of funding
  - Is politically correct
    - With the EC at least
- Source of inspiration

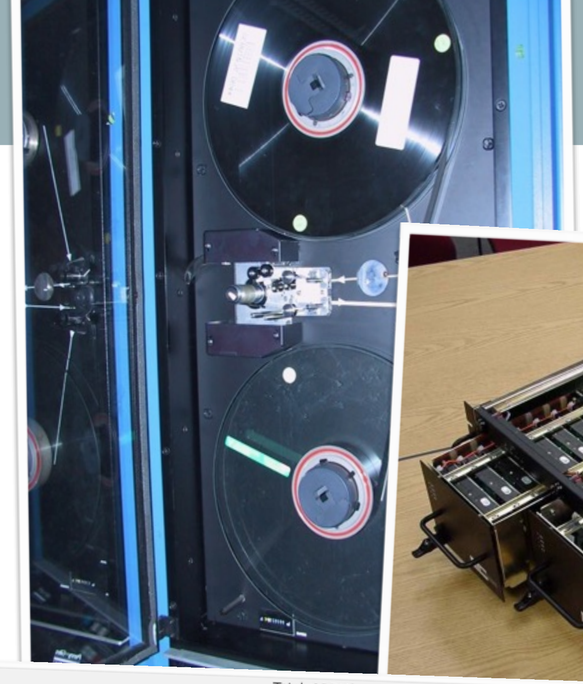


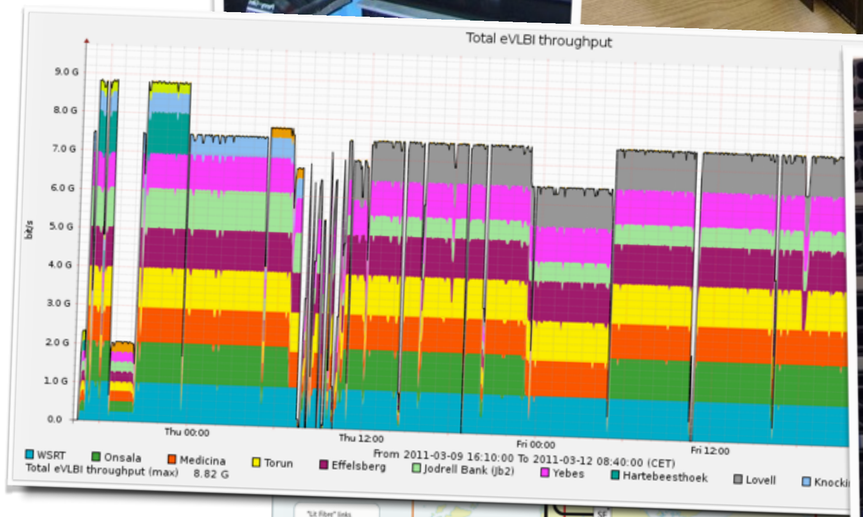
Technology I

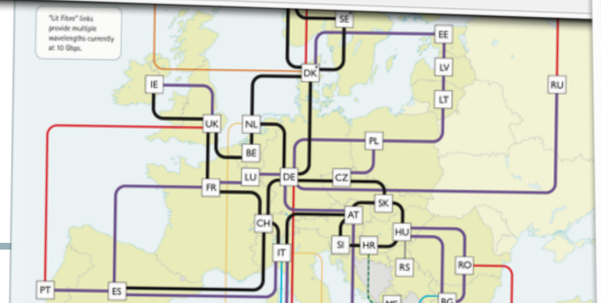
- Increasing use of of-the-shelve components, revolutionising science capabilities

- Data sampling and recording
  - Transition of tape to disk recording dramatic:
    - Much cheaper recorders
    - Cheaper media
    - More reliable recording
    - Random access at playback
    - Digital tricks more manageable
    - Allowing broadcast of (part of data)
  - Digitisers for large bands
    - Bandwidth increasing (gradually)
    - Digital receivers are being introduced
- Data transport, aka e-VLBI
  - Fast response science
  - The thrill of observing with VLBI
  - Most impact: closing the feedback loop
  - Now, flexbuffs: best of both worlds

Allowing much more use with same human resource



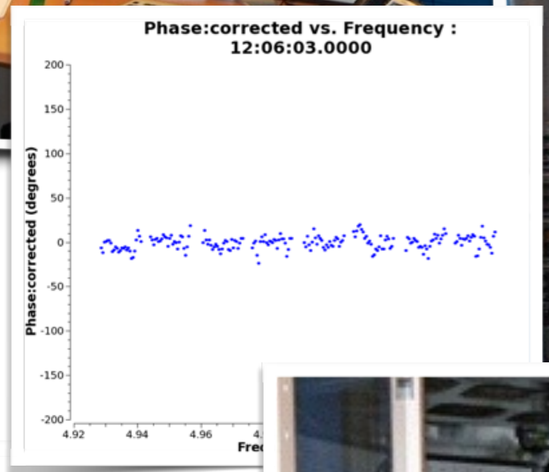


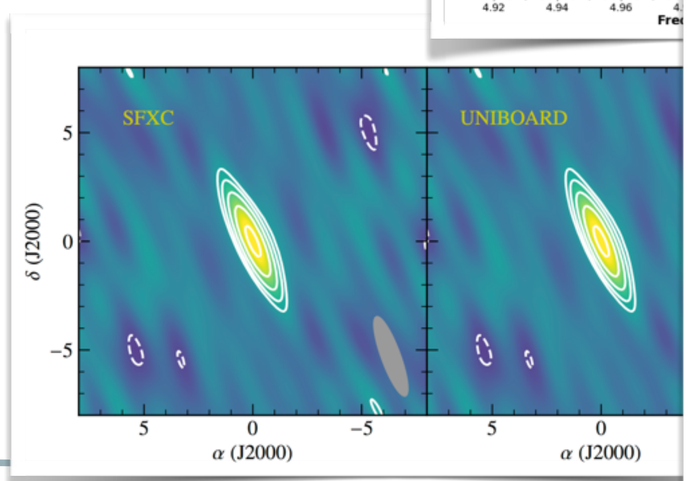


Technology II

- Software methods
  - Phase referencing with accurate models and calibration techniques
  - Finer sampling of the output data
    - Large FoV, pulsar applications
  - Data pipelines with ParselTongue
    - Improving the user experience
  - Currently orking on VLBI casa data path

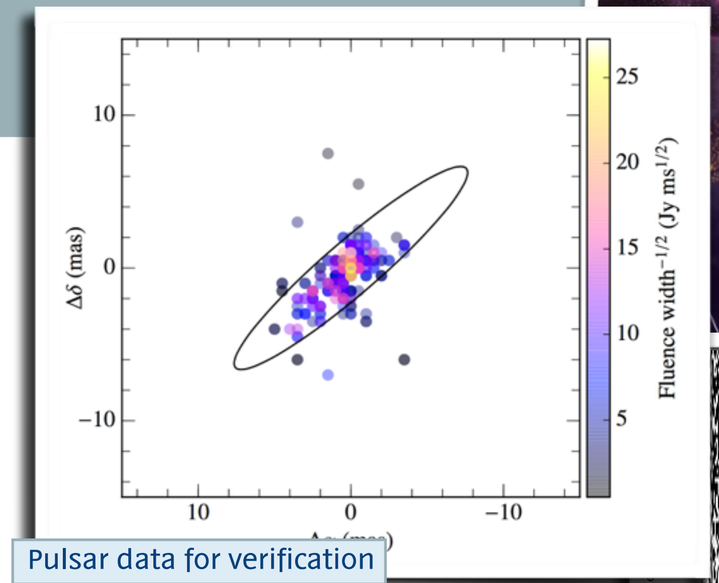
- Correlators
  - From extremely hard engineering
    - Custom chips
    - Completely synchronous data path
  - Increasing flexibility
  - Balanced against power consumption
    - Software correlator
      - Space, pulsars, large field, transients
    - FPGA based correlator
      - Large number telescopes applications



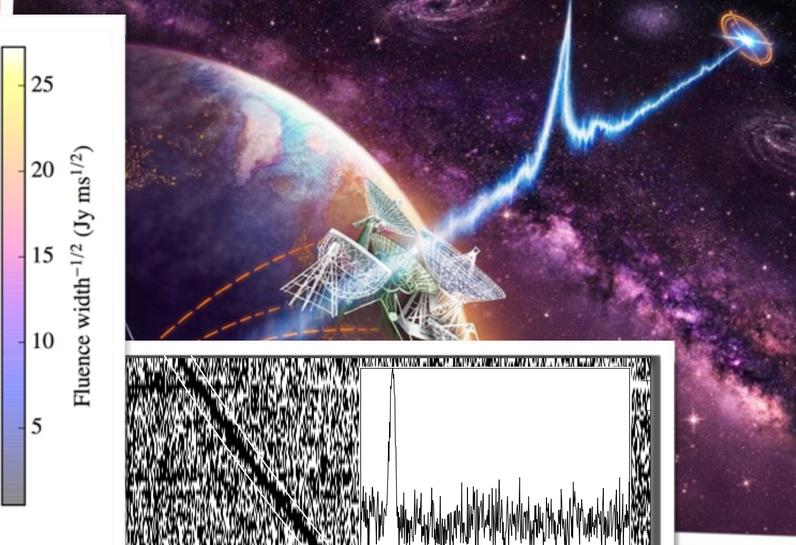


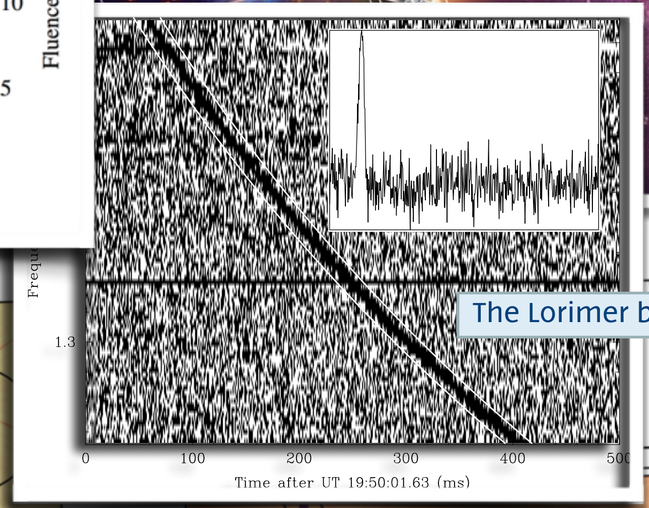
Applied to Fast Radio Burst

- SFXC correlator can do:
  - Deal with e-VLBI and buffered data
  - Coherent de-dispersion
  - Arbitrary small pulse gating
  - Phase rotate to anywhere in primary beam
  - Trigger on auto-correlation signals
  - Produce time series for pencil beam
    - Applying calibration factors
- Proved of great value
  - Global collaboration hunting FRB's
    - Including Arecibo, VLA
- Repeating FRB121102
  - And really lucky with few EVN campaigns

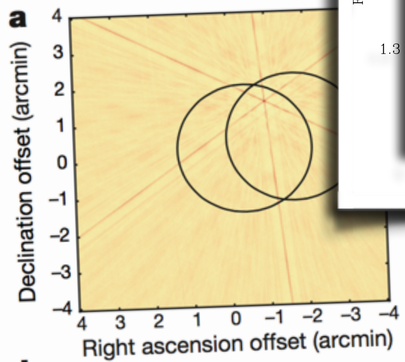


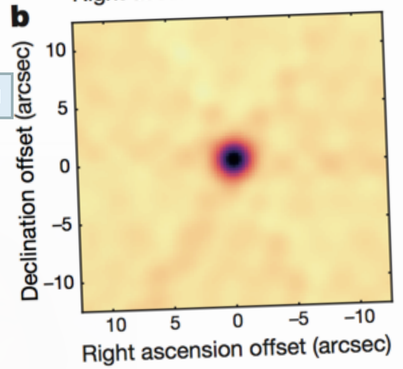
Pulsar data for verification



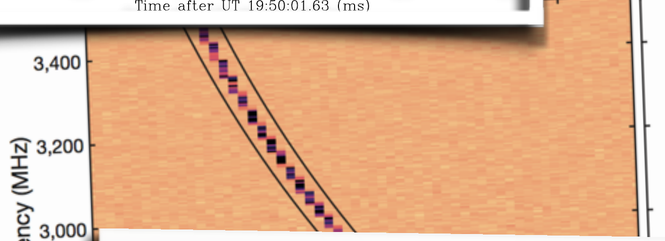


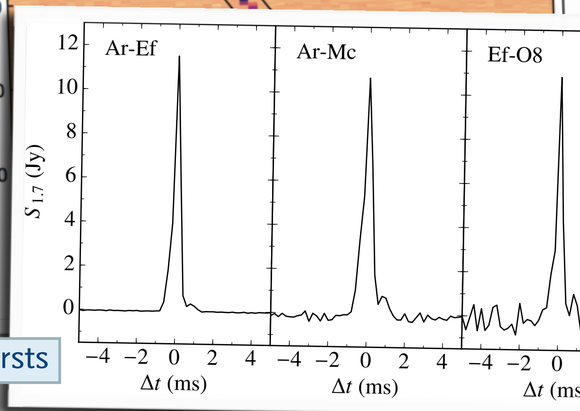
The Lorimer burst





VLA localisation



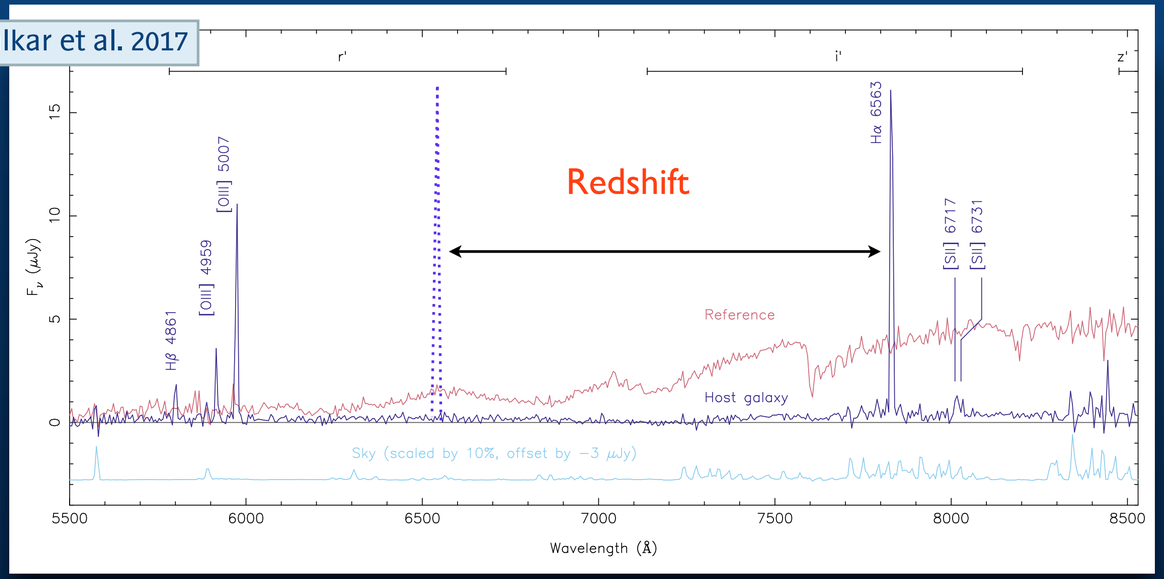


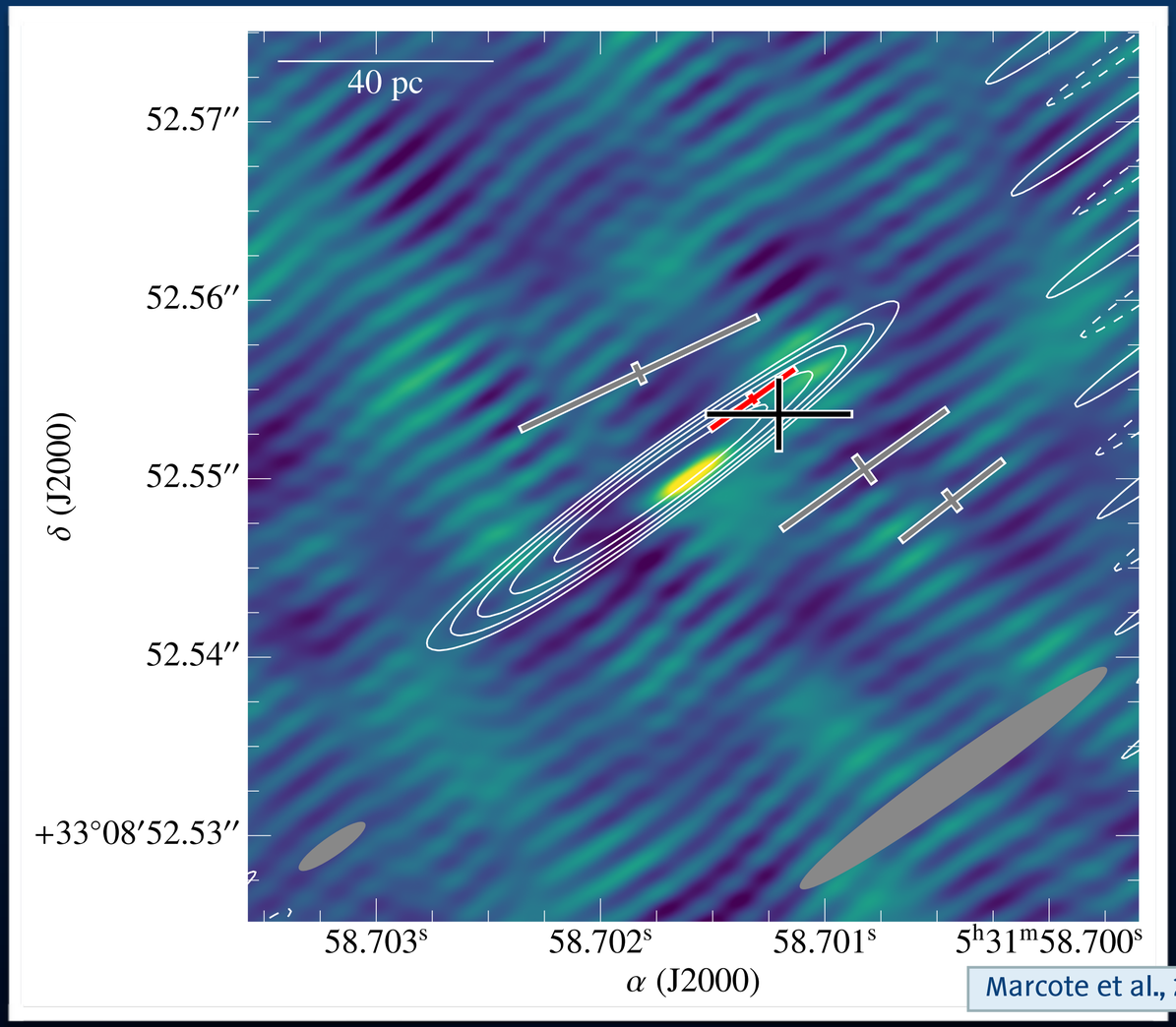
EVN bursts

Local Dwingeloo team

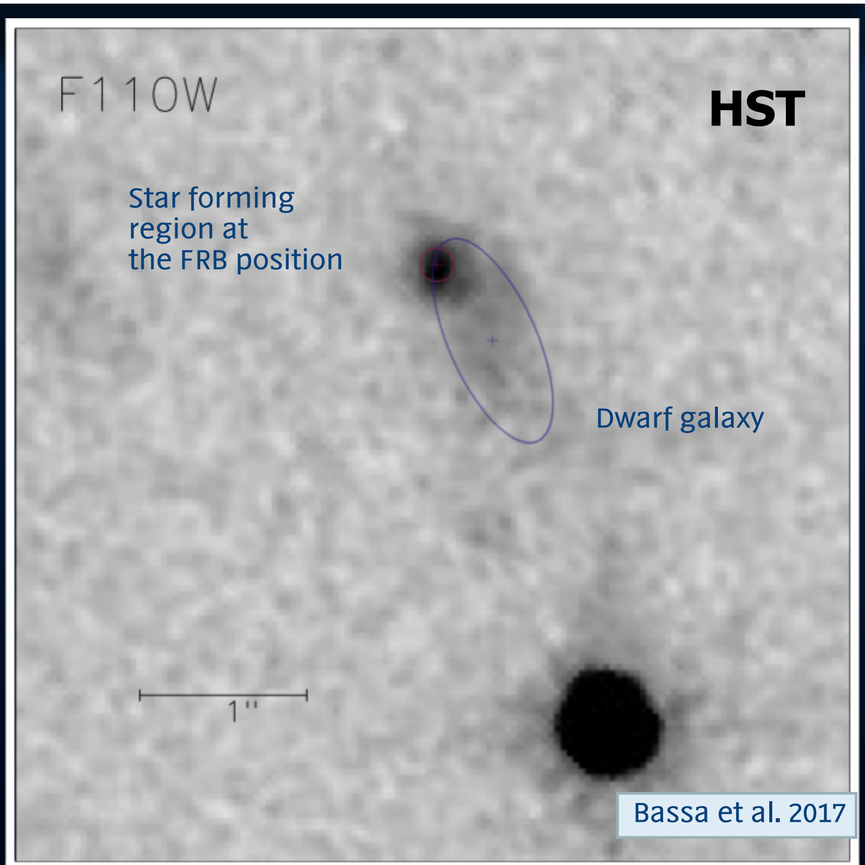
- Association with mas scale accuracy
- Host is a dwarf galaxy at z = 0.19
- Radio source associated with star-forming region
- Offset from centre

Tendulkar et al. 2017

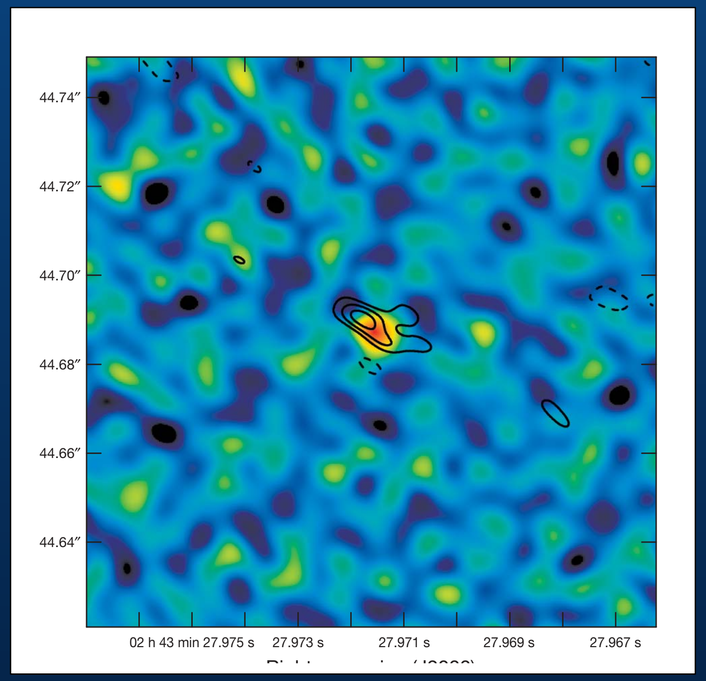




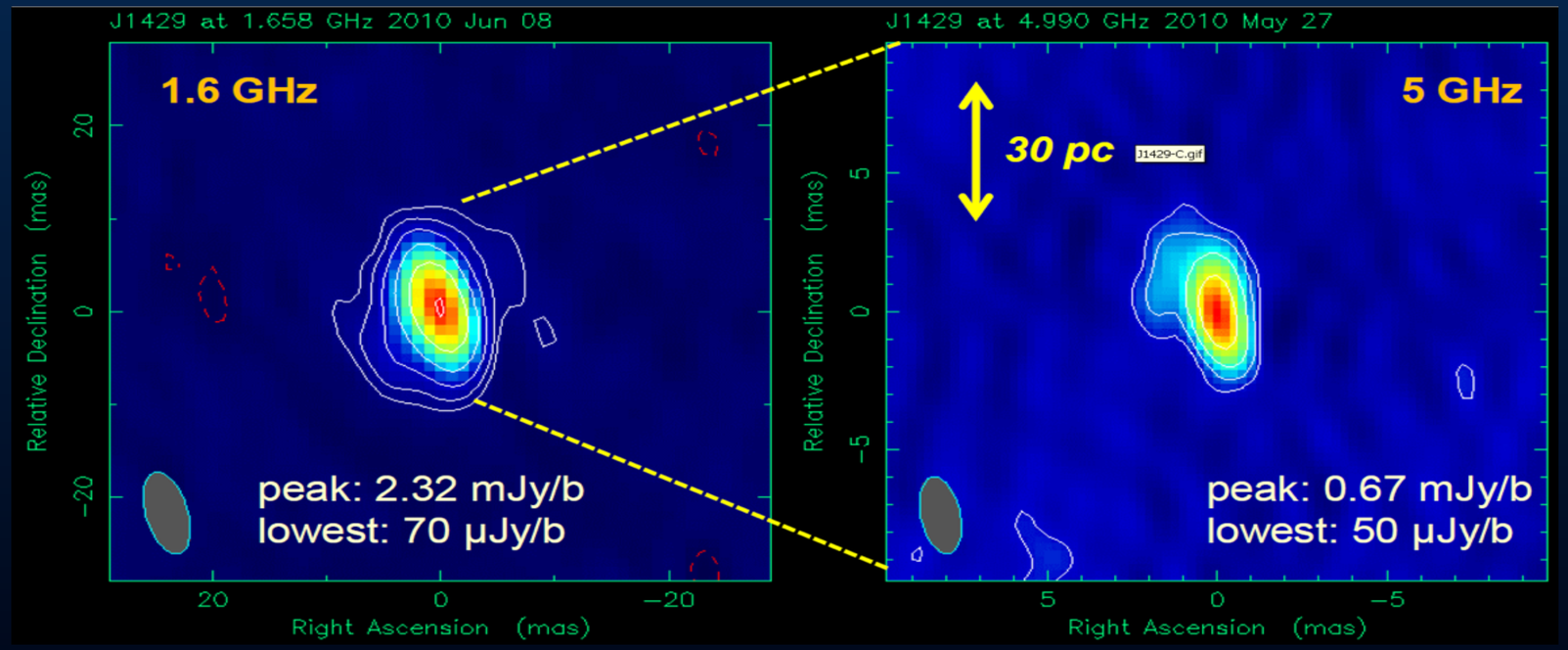
Marcote et al., 2017



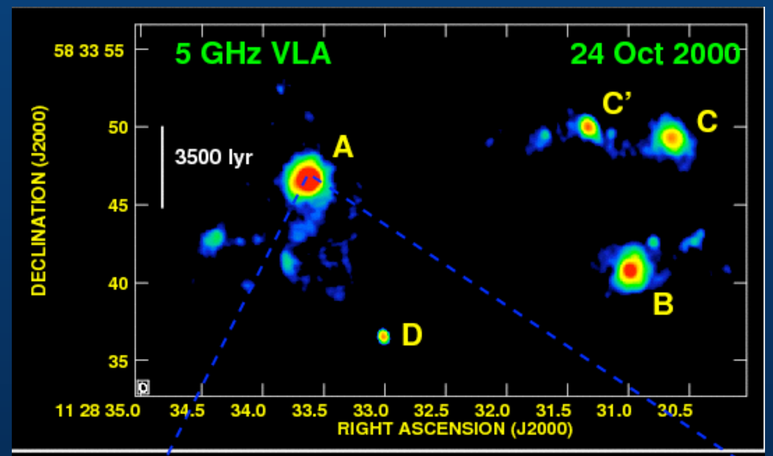
Bassa et al. 2017

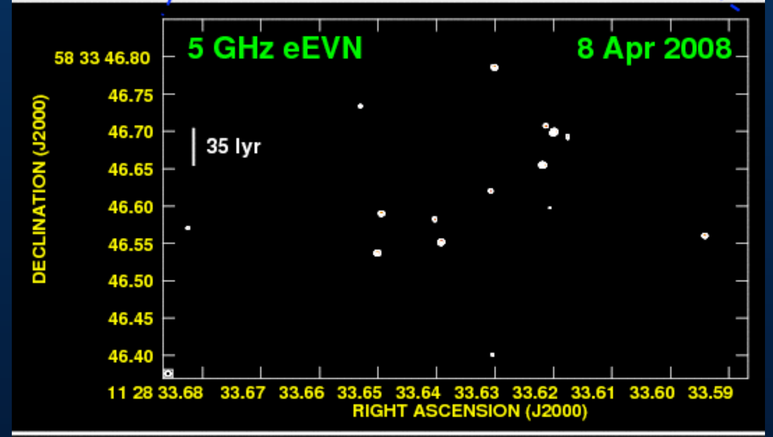


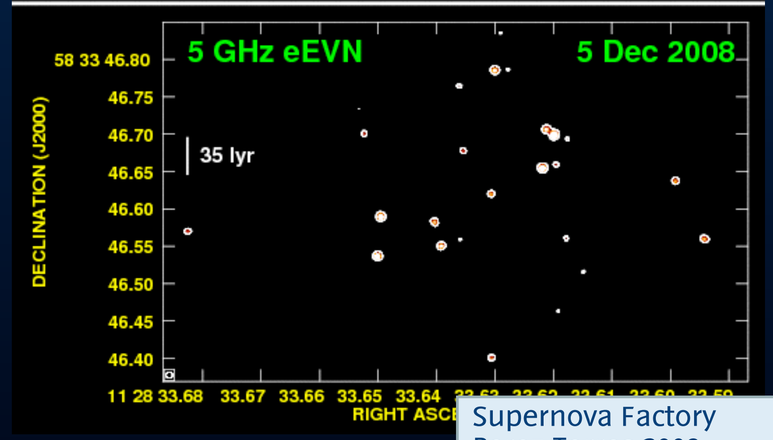
Relativistic expansion in GRB?
Paragi, 2010



Z=6.2 quasar EVN
Frey et al

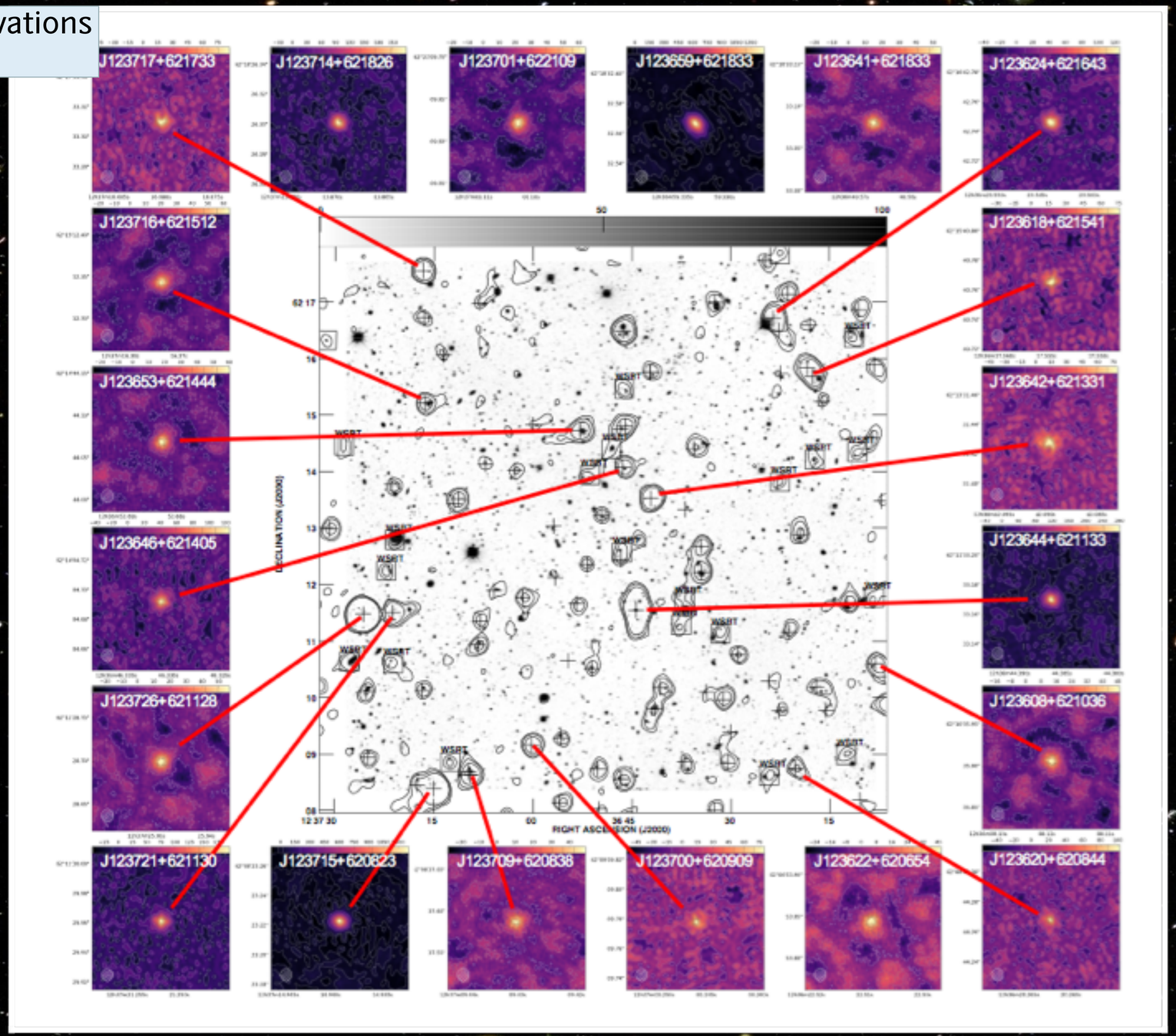


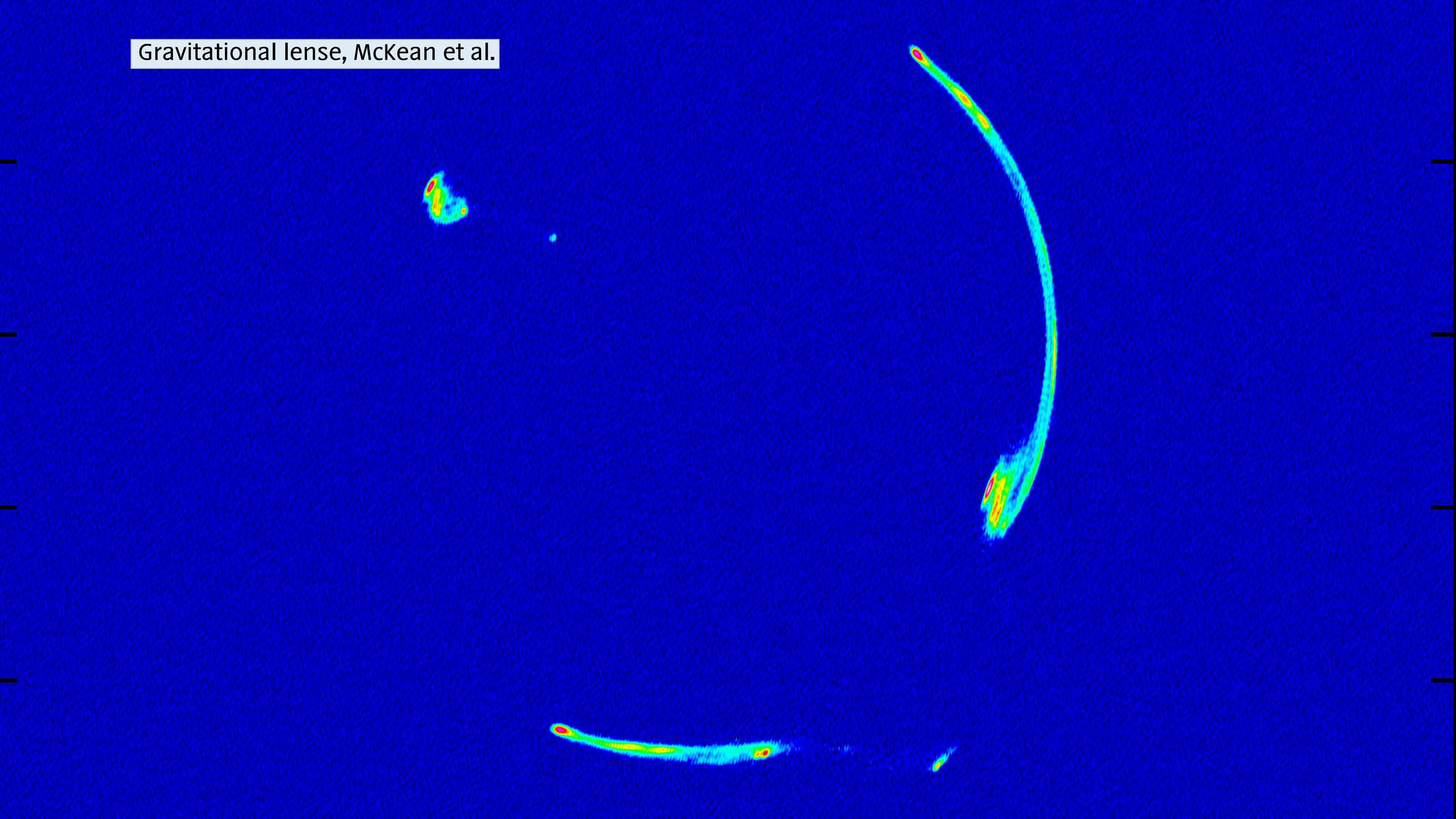


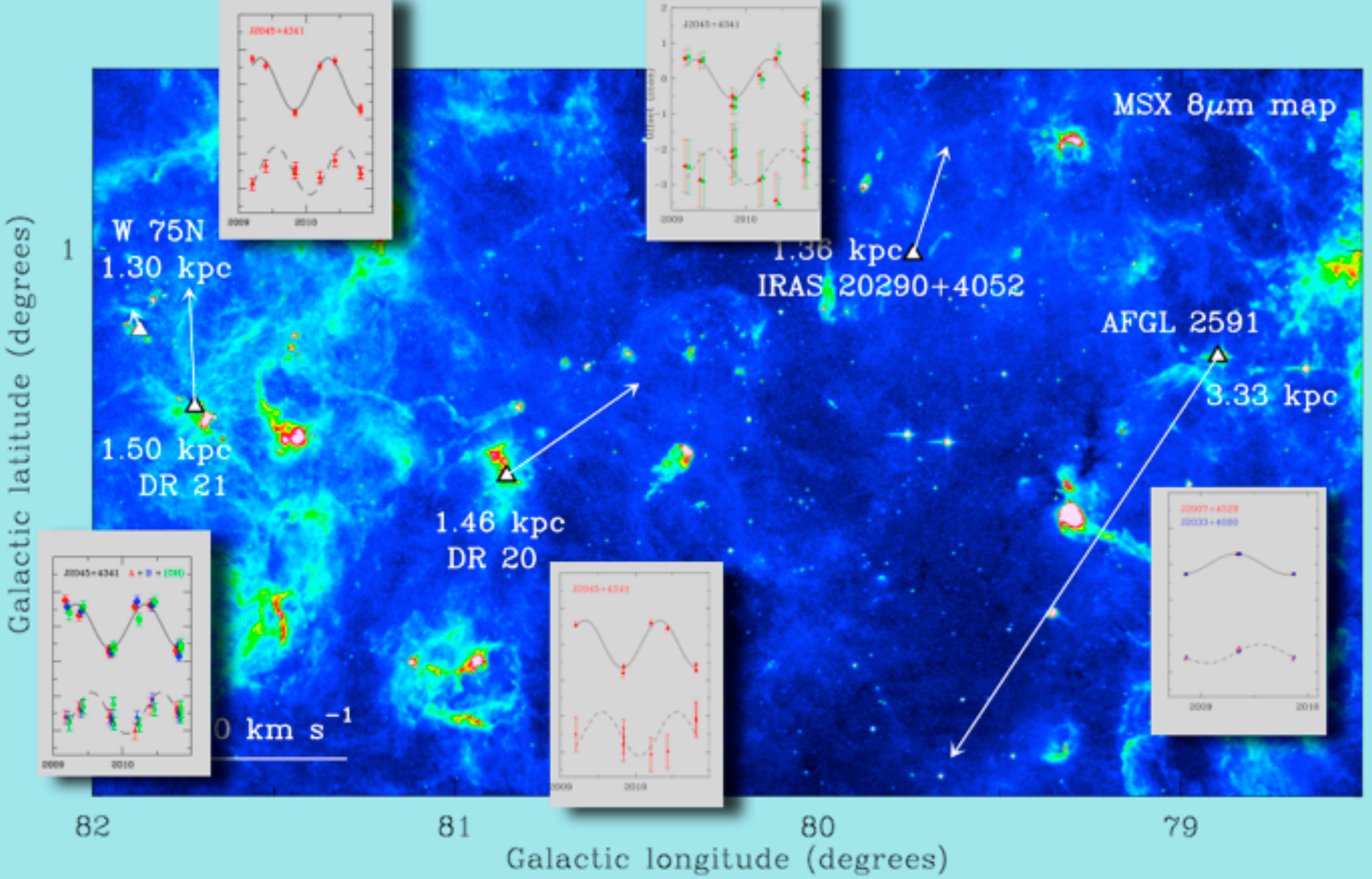


Supernova Factory
Perez-Torres 2009

Hubble Deep Field observations
Radcliffe et al., 2016




Gravitational lense, McKean et al.

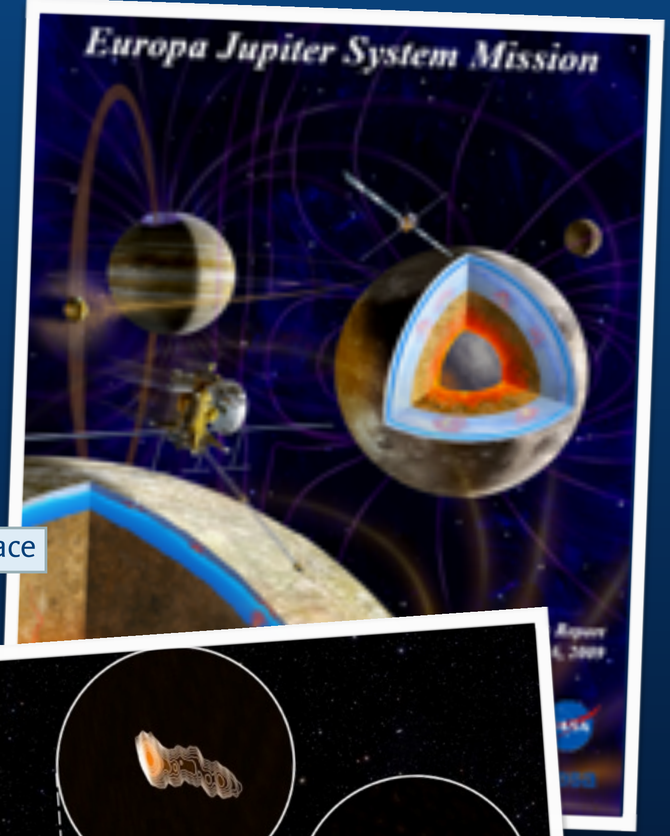


Astrometry: maser distances in the CygX region, Rygl et al. 2012

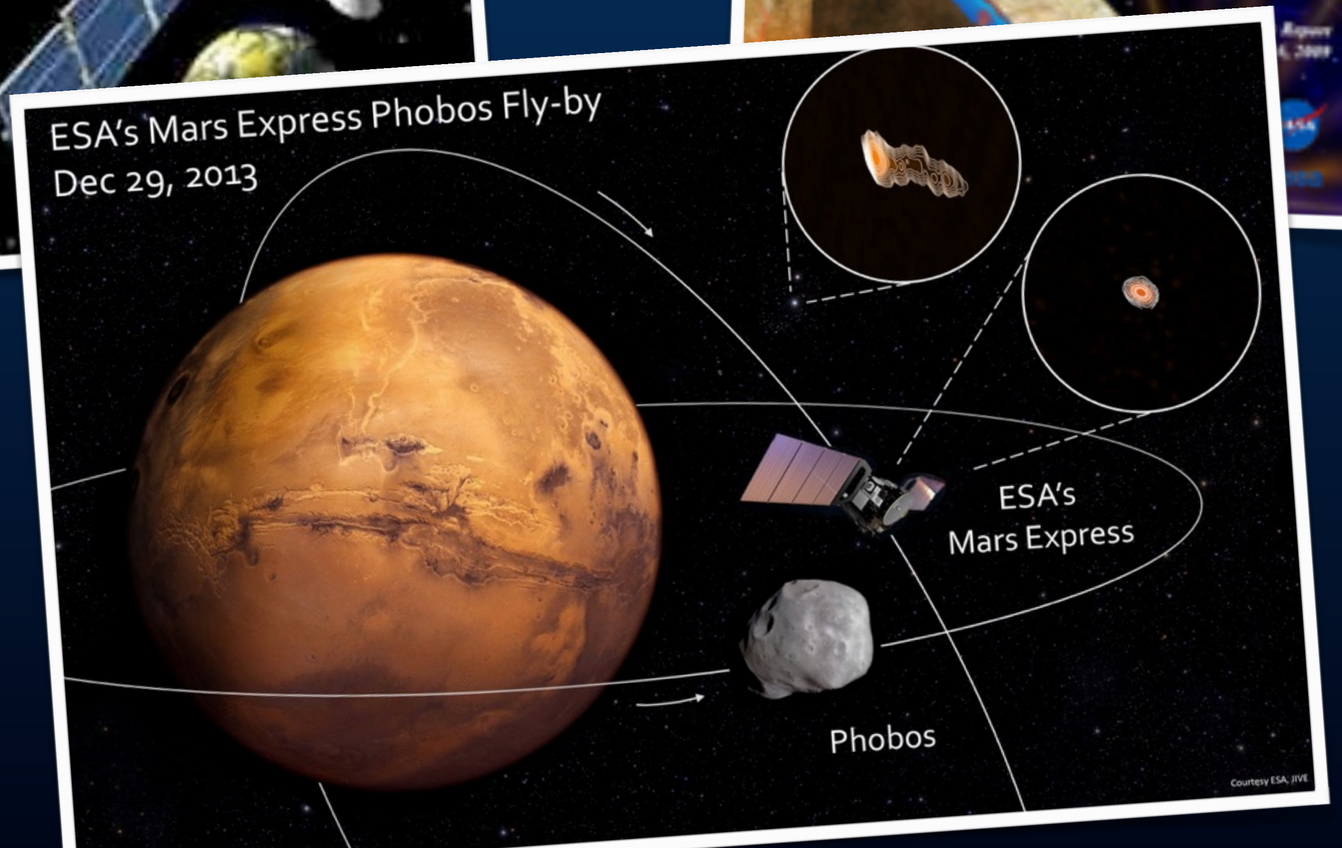
VLBI for Space applications…

RadioAstron

JUICE-Laplace



Huygens



Governance EVN & JIVE

- EVN continues to be a loose consortium
  - Different observatories operate on different speeds
    - Can be frustrating, indecisive, conservative
  - But also low threshold, easy for airing members
    - Nurtures many different participants
  - Existence of JIVE allows EVN to survive like this

- JIVE: the foundation
  - Was established 1993
  - Ceased to exist 2016
    - Year overlap
    - Was really very easy
    - After we transferred all accounts
  - Foundation served well initially
    - Easy to establish, room for range of missions
  - But had some problems
    - Personal responsibility, maybe liability
      - Does not work well with international board
    - VAT issue with NWO personnel
    - Anchored at many different levels in various countries

JIVE ERIC, going Brussels

- ERIC
  - Commitment by countries to facilitate a R.I.
    - Research Infrastructures with European significance
    - In some places mandate with ministries or parliament
  - Blessed by EC
    - But paid by Members

- Follow local personnel law
- VAT exemptions may be possible
  - For goods owned by the ERIC to do its mission
- Favourable position EC programmes
  - Invitations to preparation meetings
  - ERIC directly eligible
  - Some programmes aimed at European RIs/ESFRI
- Good opportunity
  - To polish up the corporate identity
    - Yes, the logo :-)
  - And table the (national) commitments
    - In a landscape that is SKA dominated

- Status
  - NL, FR, SE, UK, ES from the start, 2014
  - LV joined 2016
  - INAF IT, DST SA contributing
    - And looking for membership
  - CAS CN, MPI DE contributing
    - Not likely to join

ERIC, important details

- Structure to allow associated institutes
  - With voting rights on operational matters
  - If they contribute to operational budget
- Relation with EVN
  - Only together we are a Research Infrastructure
- Funding principles
  - Base fee
  - And percentage of local operations cost
    - Pay to get your data correlated
    - Fraction into common infrastructure
- Relation with NWO
  - Needs to employ staff
    - Continuity is important
  - Equal working conditions in ASTRON building
- Ability to do Research & Development
  - Need excellent scientists on staff
  - Who push and advertise the instrument
  - No explicit R&D budget
    - But ample expertise to keep everything going

- Special clauses in the ERIC Statutes
- As well as the Rules of Procedure
- MoA's with the associated institutes

- Non standard solution for programme committee and data-rights: adhere to EVN MOU
- New EVN - JIVE agreement on some of these issues
- And representation in the Council

Complicated for a number of countries
- Have multiple telescopes
- Participate in multiple networks
- No EVN operations or maintenance funds (yet)

- MOU with NWO arranges personnel status, even during transition
- JIVE maintains reserves to cover personnel risks
- Director has employer status
- Working with ASTRON MT on homogeneous local practices

- Most staff has science time
- Local scenery attractive for some scientists
- Well positioned to apply for relevant R&D projects
- Less so for personal grants

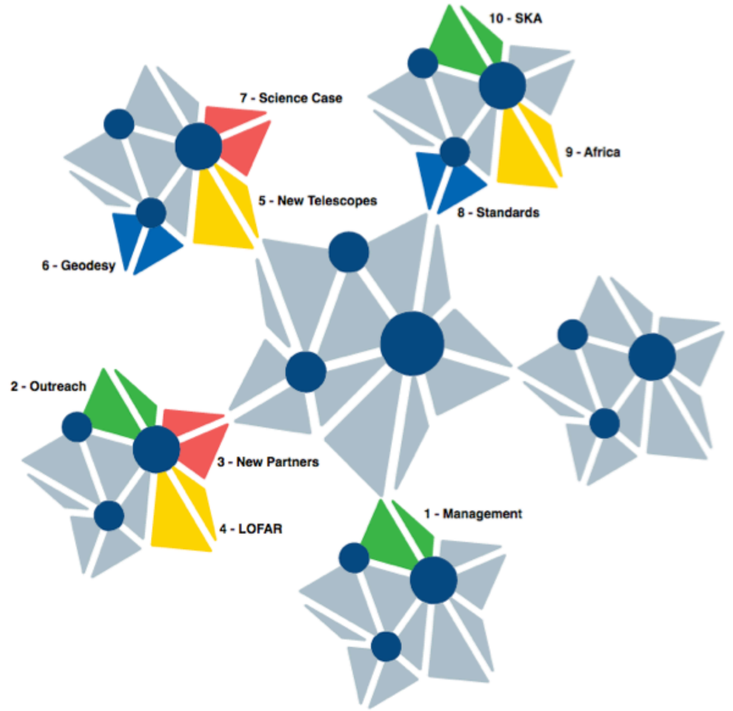
ERIC at work…

- For a start, it came with a 5 year commitment
  - From most partners
- VAT saving is substantial
- Partnerships
  - Latvia was very determined to join
  - South Africa could become a Member
    - Important to the EC
  - Italy back on track to join ERIC?
- Join forces with other ERICs/RIs
  - Discussion on financial, managerial issues
  - Looking for a common review principles
  - Open science etc..
- Attractive partner for EC projects
  - seen as a European radio astronomy entity?

Projects

- The all important funding stream
  - Is the EVN transnational access program!
    - Based on making available fraction of EVN observing
    - Which is an enormous joint investments
  - Makes the EVN accessible by adaptive support
    - Preferred over making the perfect black box

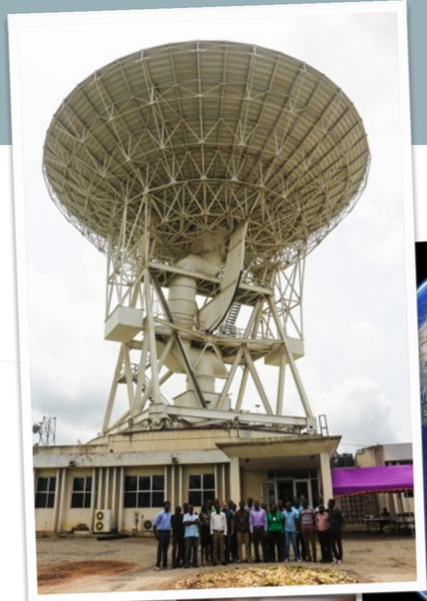
- R&D efforts are supported
  - BlackHoleCam support user software and recording for Event Horizon Telescope
  - ASTERICS support development of data handling and (N)EXPReS like development
  - RadioNet::RINGS to develop fringe fitting
  - Jumping JIVE: Sched, Geodesy capabilities, telescope support
  - BRAND-EVN important for EVN future
  - SKA-NL contributes to SADT and VLBI@SKA
- Policy development and outreach
  - Some elements in RadioNet
  - Very strongly supported by JUMPING JIVE
    - Advertise JIVE as an attractive partner
    - Prepare for Global VLBI

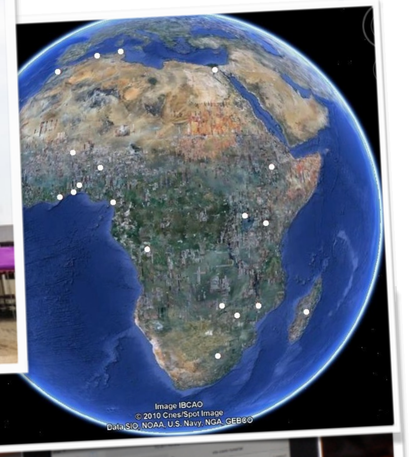


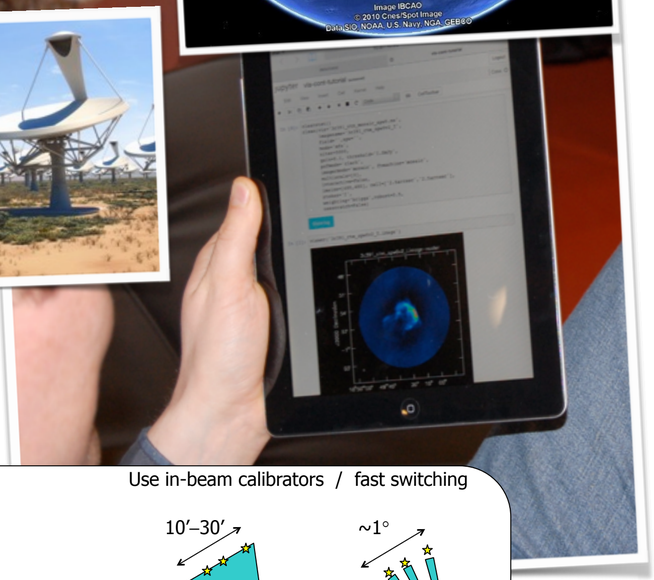
Future

- Much more VLBI to support
  - Can support correlation with SKA1_Mid or African VLBI Network
    - But correlation? Any one can do that these days
  - (Adaptive) User Services and
  - Data curation will be key
    - Quality control & calibration
  - Especially for future, SKA users
    - Support Global VLBI array that is on-call
      - For transients
      - And commensal observation
      - Or time-critical space applications

- Other roles for JIVE?

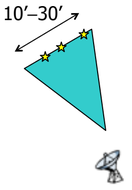


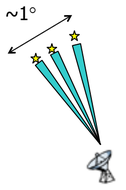




Use in-beam calibrators / fast switching

SKA1-MID: phased array core; form multiple beams





Matching resources: 30–100m telescopes






JIVE

NWO

ASTRON

NAOC

Science & Technology Facilities Council

cnrs

VENTSPILS AUGSTSKOLA

Max-Planck-Institut für Radioastronomie

ONSALA RYMDOBSERVATORIUM CHALMERS TEKNISKA HÖGSKOLA

NRF

INAF