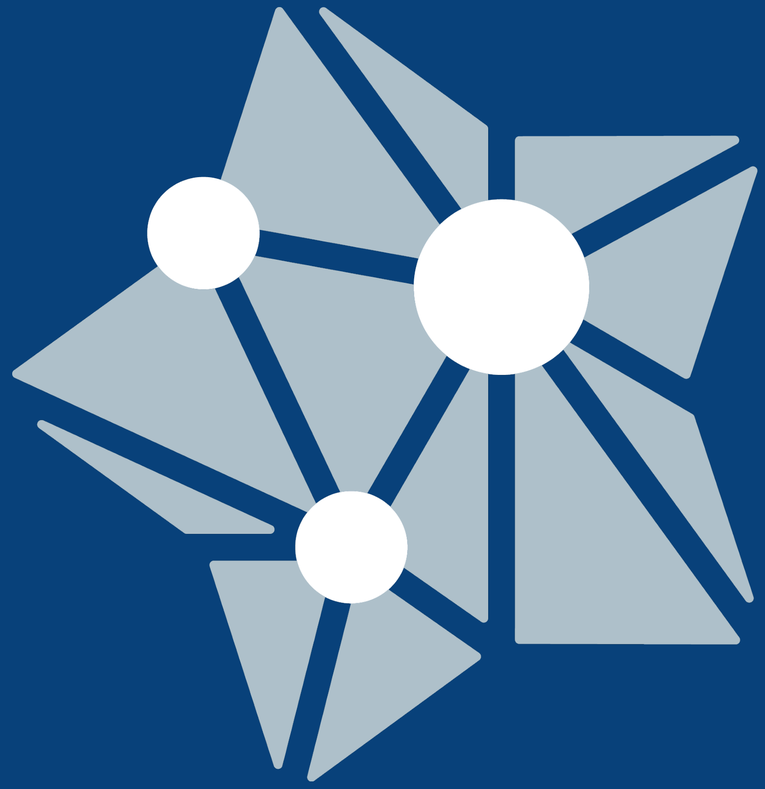


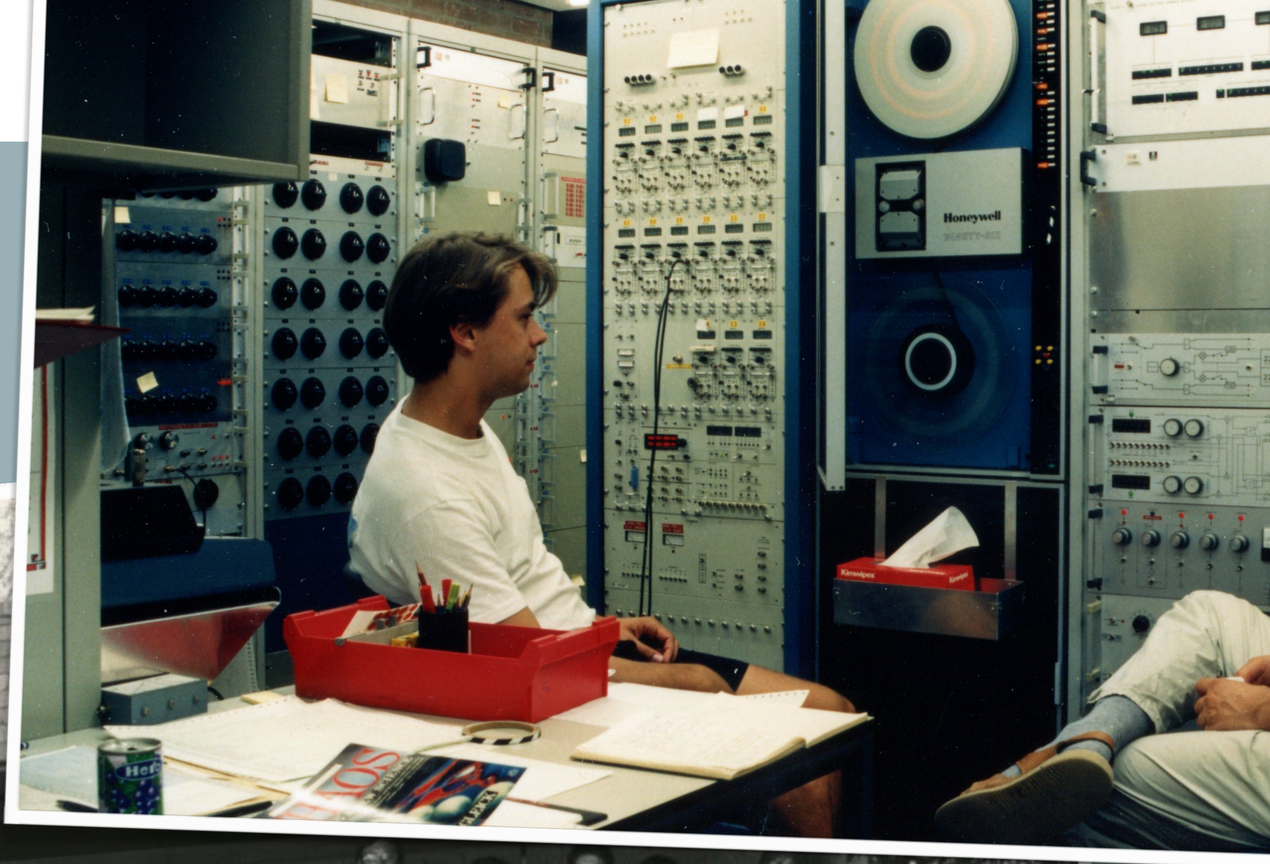
JIVE

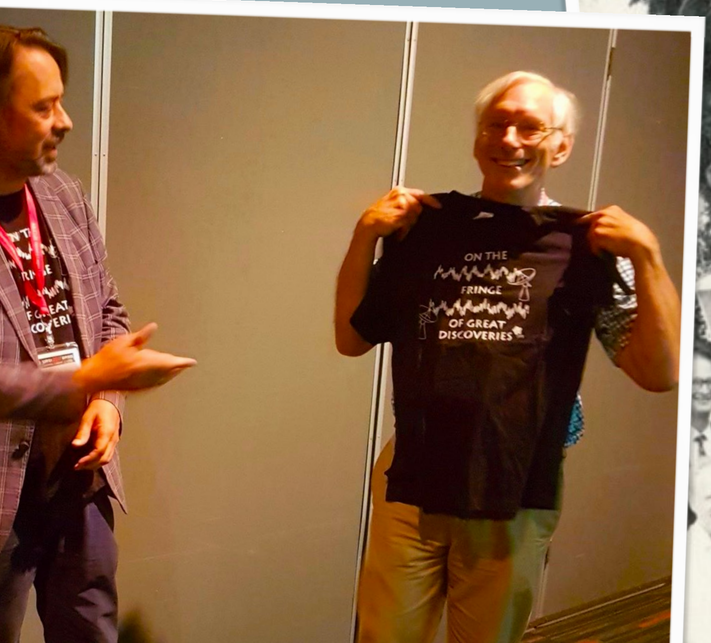
The evolution of EVN & JIVE

Huib van Langevelde

50 years of VLBI

- I entered the field around 1987
  - To change tapes in Westerbork
- So not a complete history from me
  - But talk on ‘soft’ aspects of JIVE+EVN





50 years of VLBI

- Co-evolution of EVN & JIVE
  - When two or more species reciprocally affect each other's evolution

- EVN: European VLBI Network
  - Consortium of (European) Telescopes operators
  - Often national facilities, some universities
- JIVE: Joint Institute for VLBI ERIC
  - Country members, supported by radio-astronomy institutes and research councils
    - NWO (NL), ASTRON (NL), STFC (UK), INAF (IT), ICN-IG (ES), OSO (SE), VIRAC (LV), MPG (DE) CAS (CN), CNRS (FR), NRF (ZA)
  - JIV-ERIC established 20 Dec 2014
    - European Research Infrastructure Consortium
    - Truly European legal entity

EUROPEAN vlbi NETWORK

JIVE
Joint Institute for VLBI ERIC

The history of VLBI, EVN, 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

First EVN consortium board

Dedication of Mk4 correlator

Inauguration of JIV-ERIC

List by Richard Schilizzi

EVN

JIVE

- A consortium
  - Operating telescopes
  - Contributing observing time
- Consortium Board
  - Sets strategy
  - Agrees to allocate resources
- PC allocates
  - Observing time
  - Data rights
- Distributed expertise
  - Receivers, backends
  - Science users
  - Links to other facilities

- An institute
  - Running correlators
  - Delivering data products
- Director overseen by Council
  - Agree on strategy
  - Annual budget
- Support teams
  - Hands-on user support
  - Data quality aspects
- Centralised development
  - Correlator modes
  - Data processing tools
  - Project definitions

Together: one Research Infrastructure

The succes of EVN+JIVE

- Assume we agree it is a success?
  - Stable role, career path of a quite a few astronomers
  - steady stream of publications
  - solid contributor technology development
  - steady funding
- Technology upgrade path
- Very broad range of science applications
- Governance and funding opportunities
  - Duality: Nuisance? Fitting? Key to success?
- Great, dedicated, diverse people

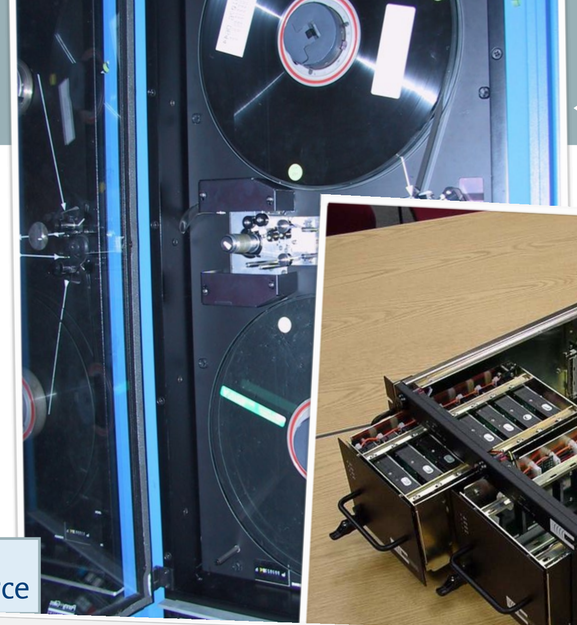
The people

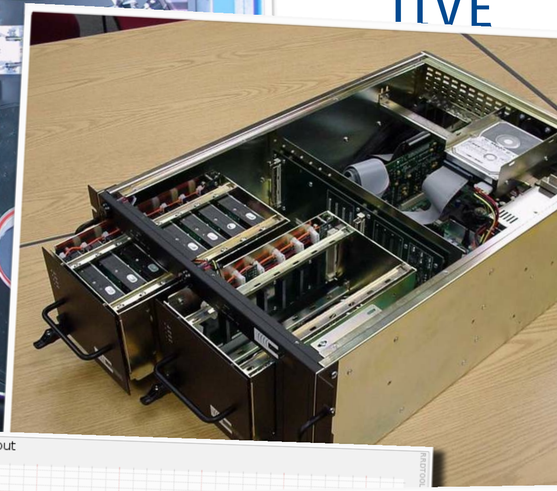
- Distributed community
  - With very specific expertise in many places
  - Good mix engineering and scientific community
- Across many countries and cultures
  - Has a stabilising effect
  - Is politically correct, with the EC at least
- ‘Myth’ of VLBI/EVN is very strong

Technology I

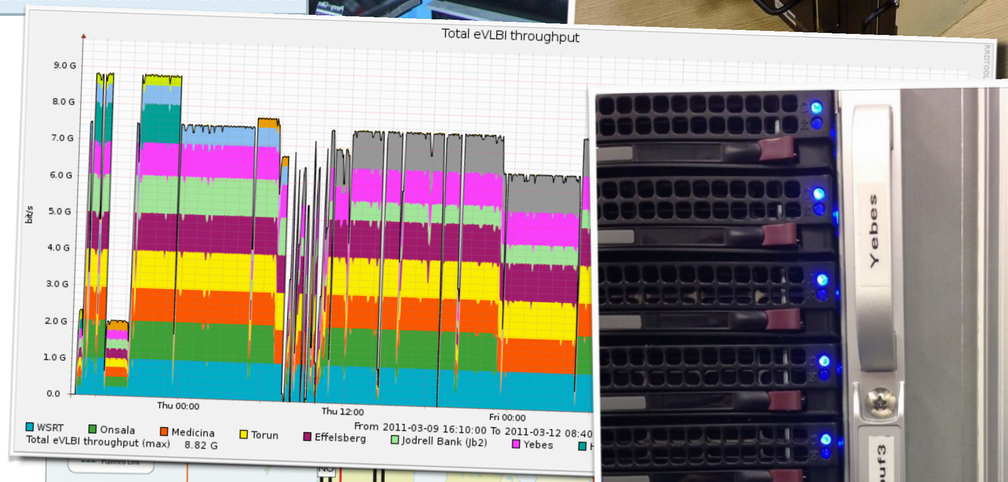
- Increasing use of of-the-shelve components, revolutionising science capabilities

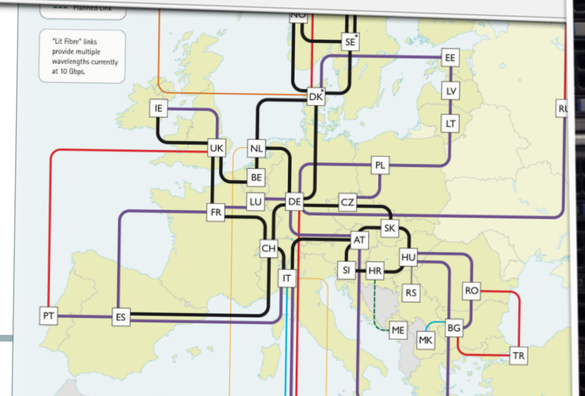
- Data sampling and recording
  - Transition of tape to disk recording dramatic:
    - Much cheaper recorders
    - Cheaper media
    - More reliable recording
    - Random access at playback
    - Digital tricks more manageable
    - Allowing broadcast of (part of data)
  - Digitisers for large bands
    - 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

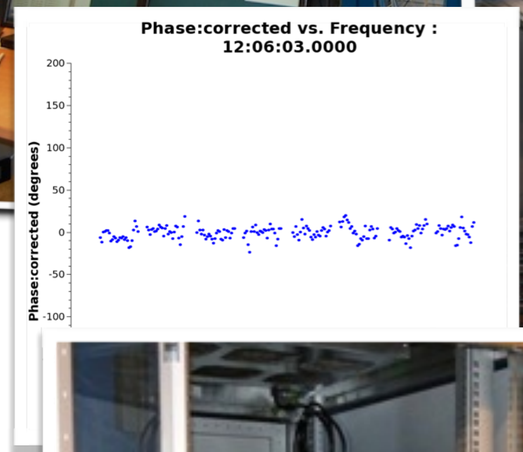


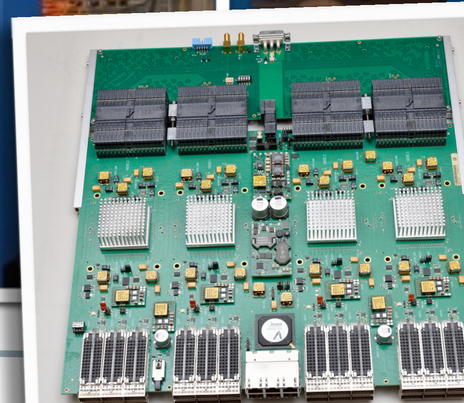


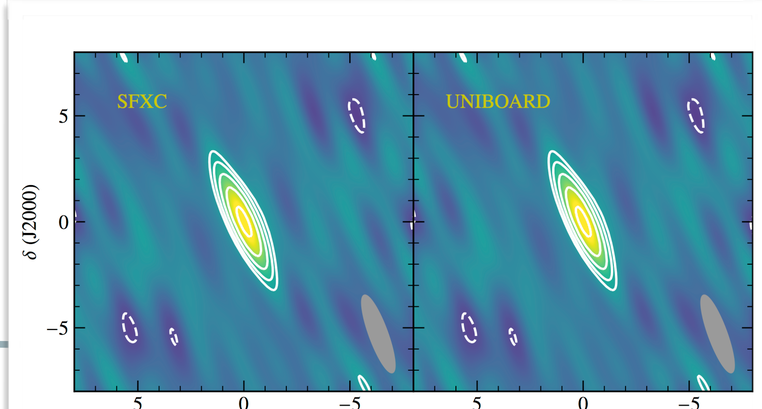
Technology II

- 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

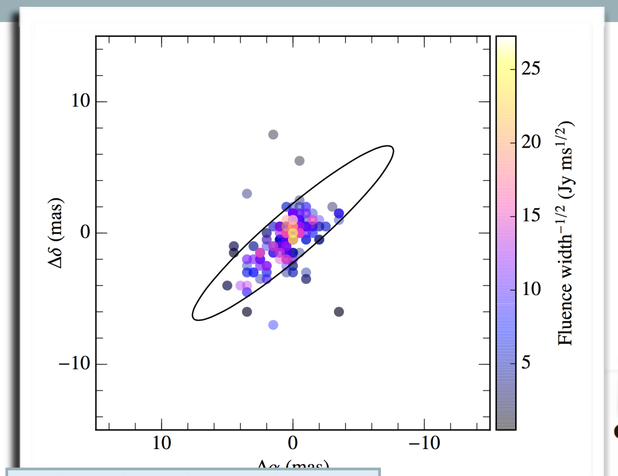




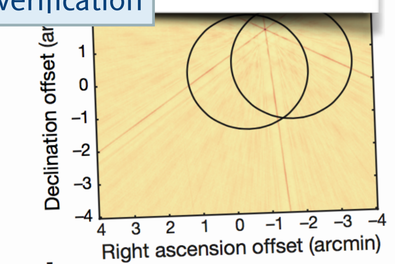


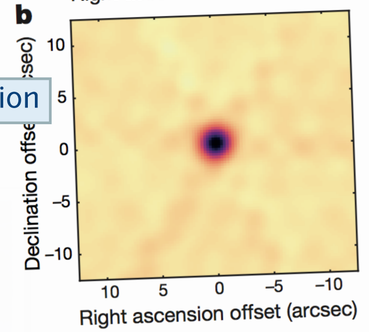
Applied to Fast Radio Burst

- 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

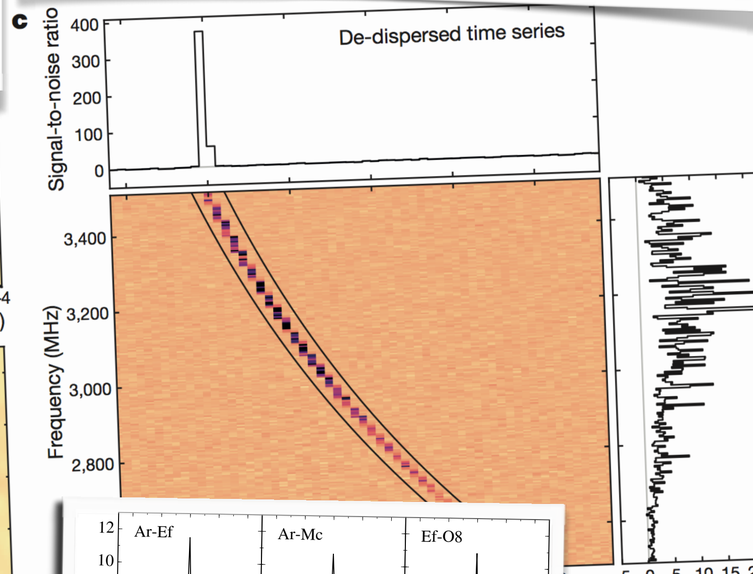


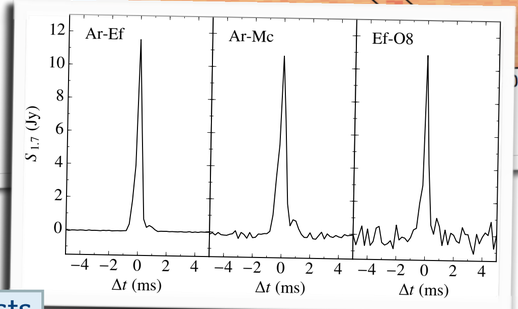
Pulsar data for verification



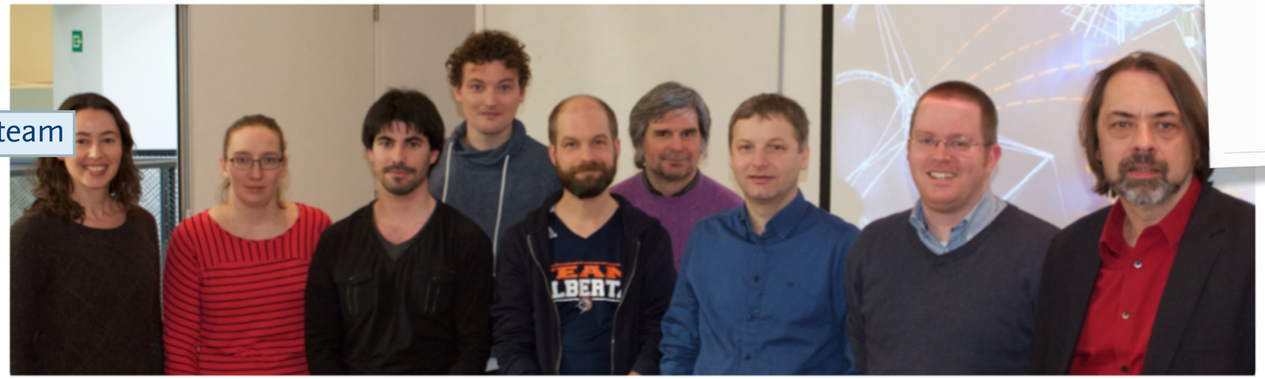


VLA localisation



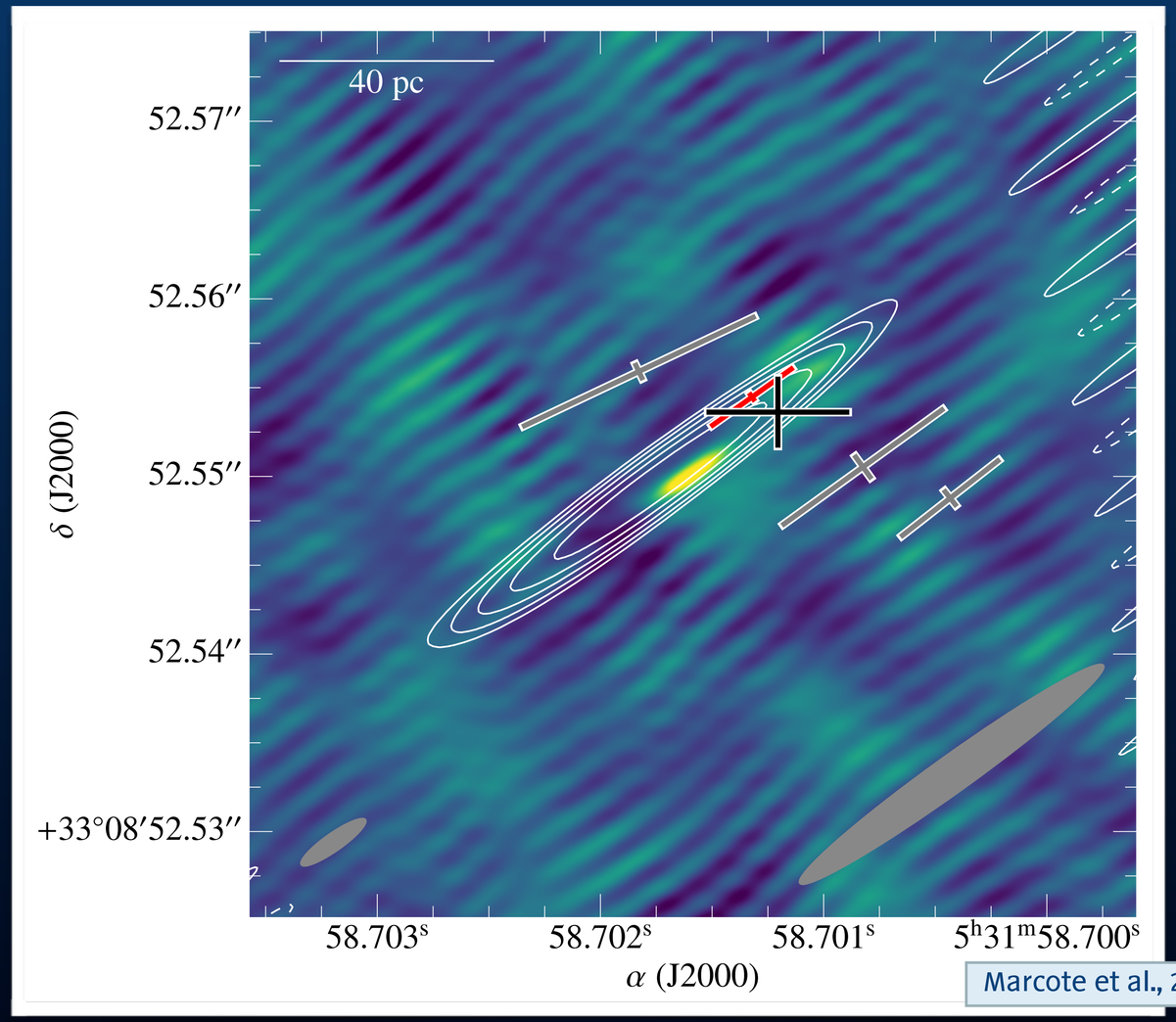


EVN bursts



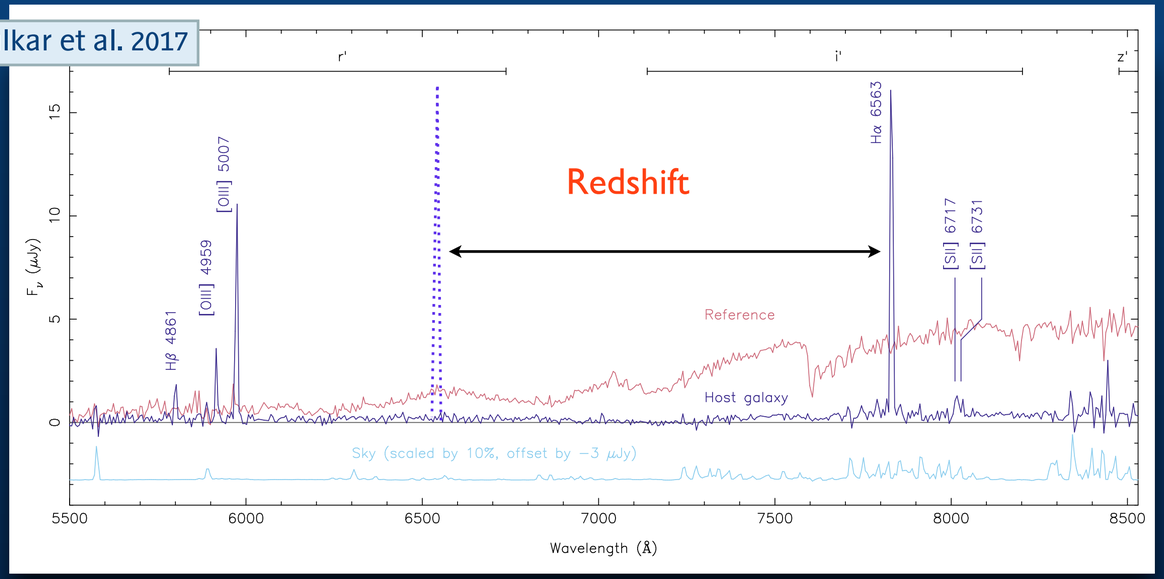
Local Dwingeloo team

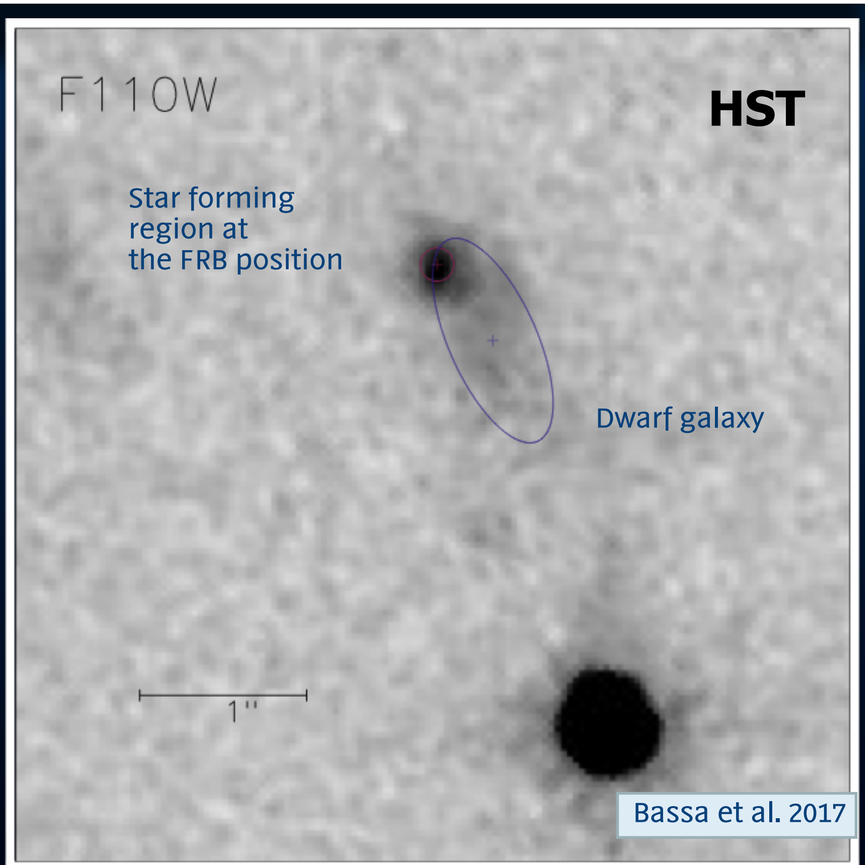
- Association with mas scale accuracy
- Host is a dwarf galaxy at z = 0.19
- Radio source associated with star-forming region
- Offset from centre



Marcote et al., 2017

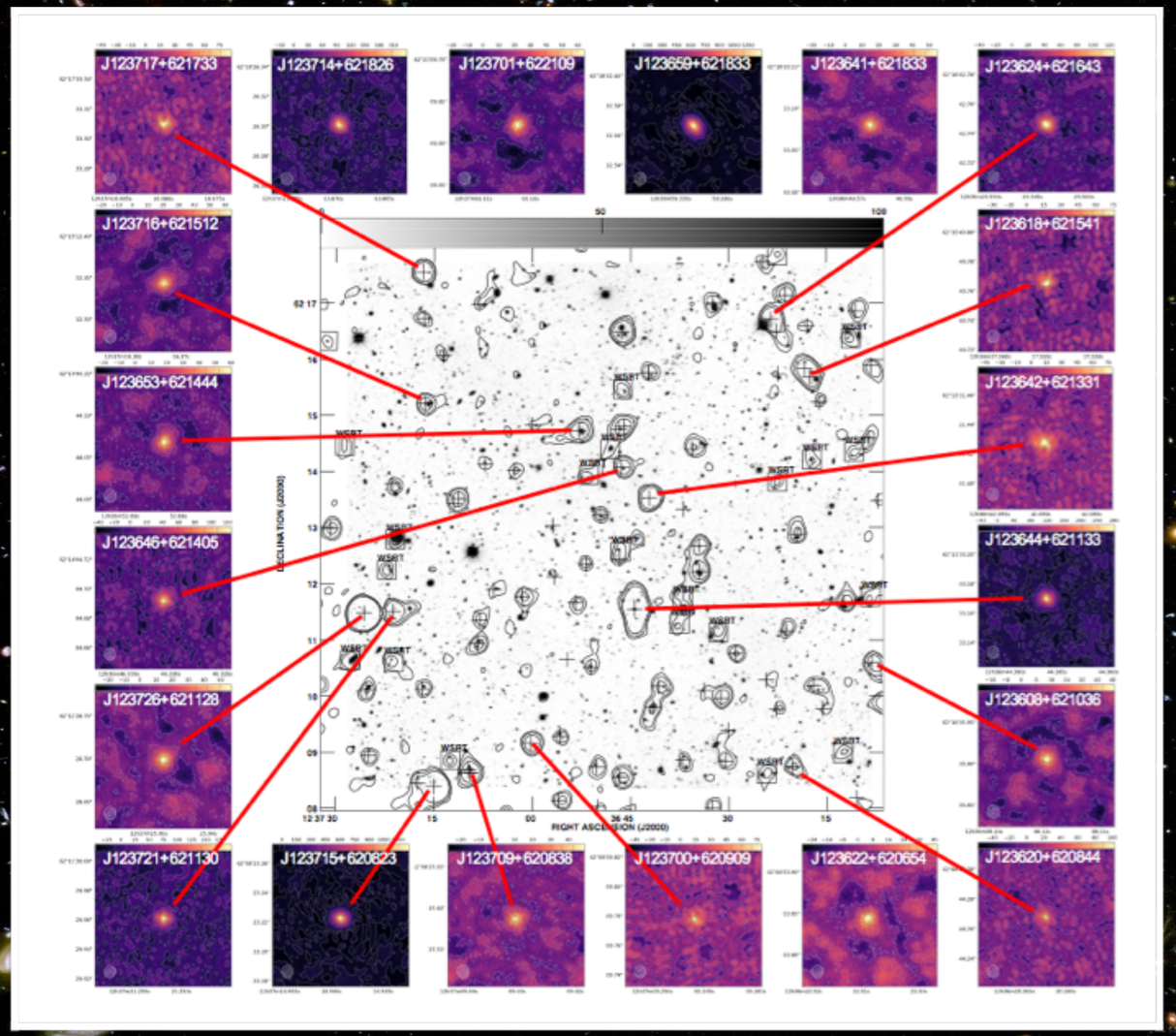
Tendulkar et al. 2017

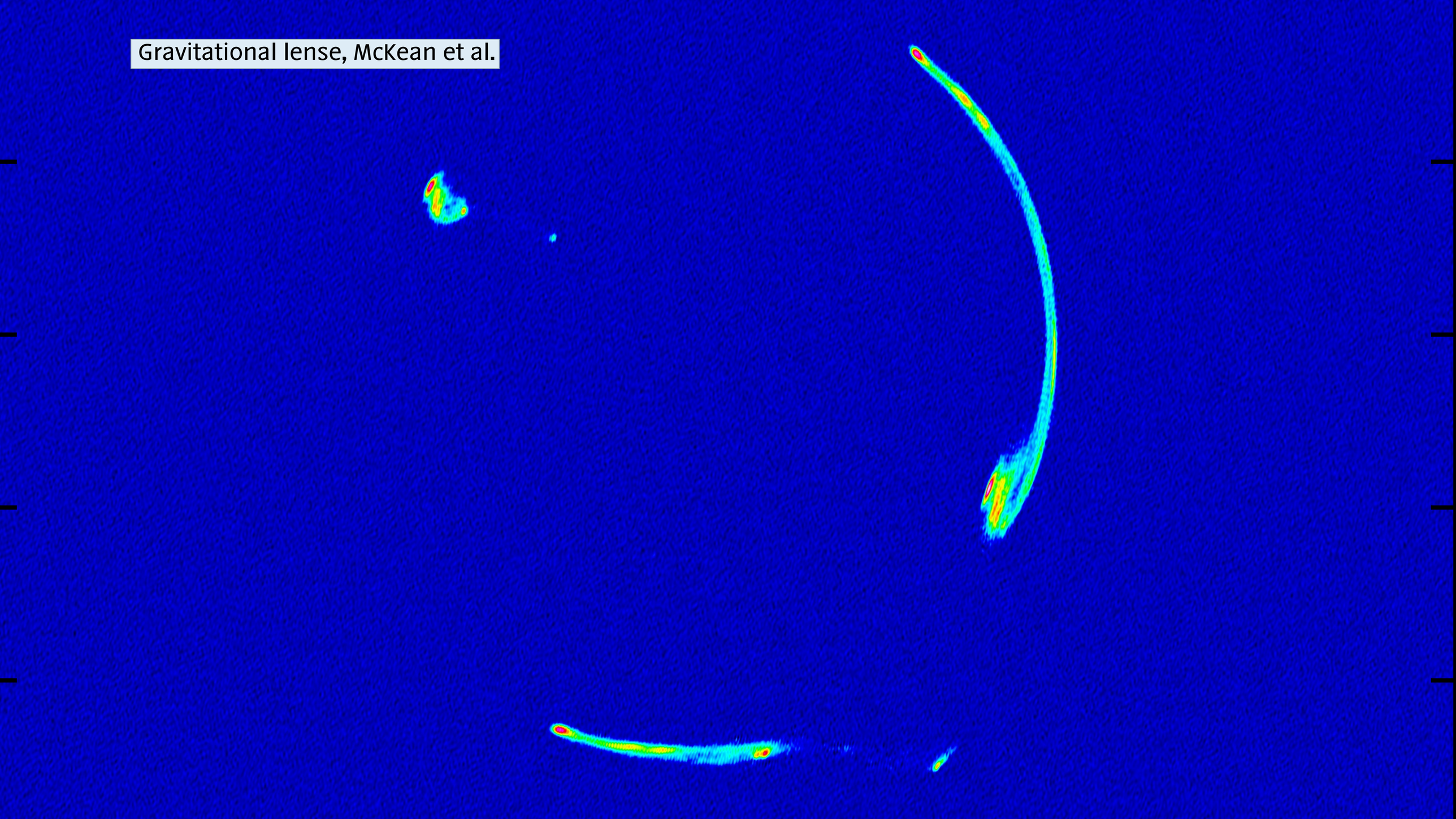


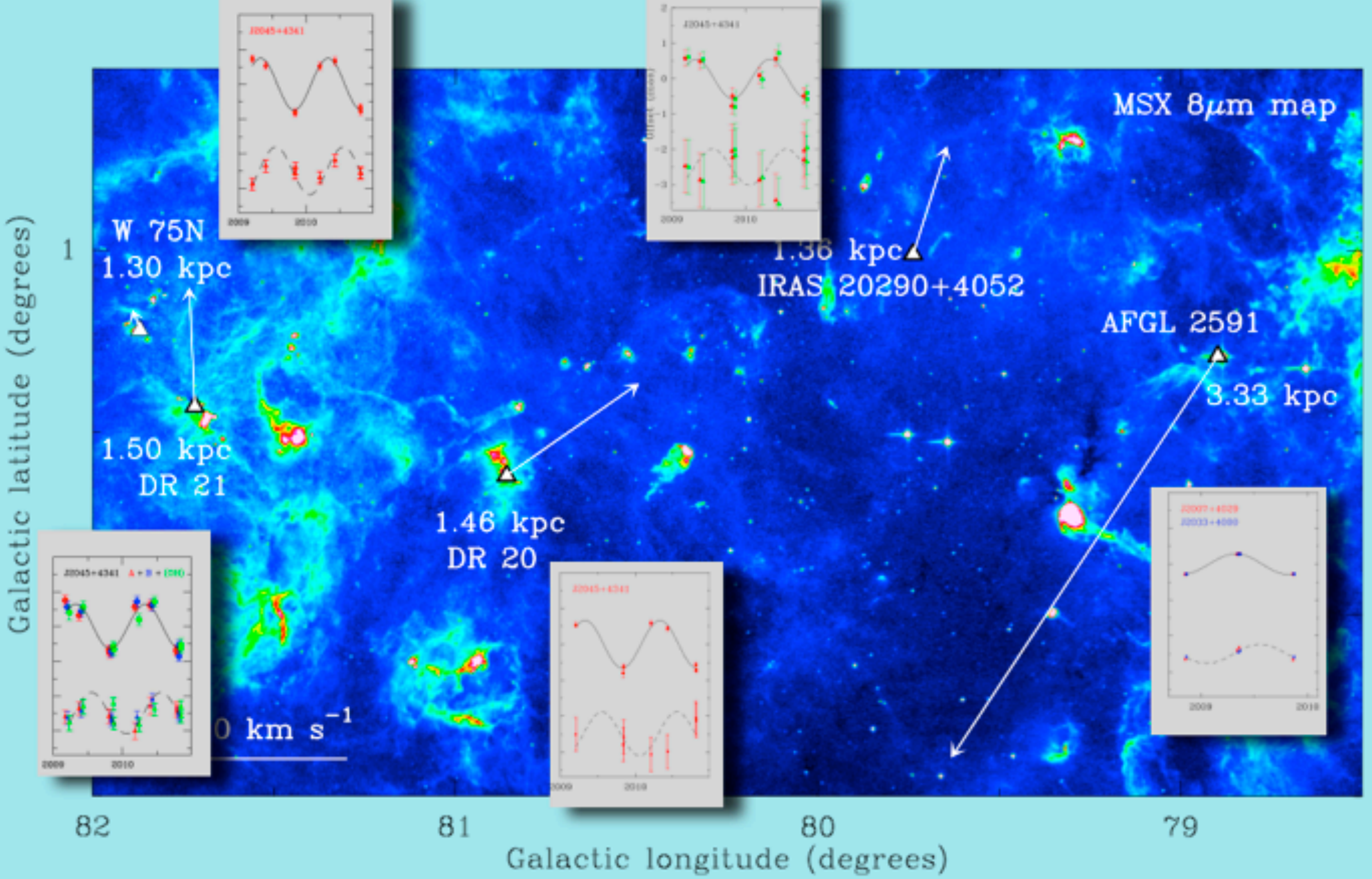


Bassa et al. 2017

Hubble Deep Field observations




Gravitational lense, McKean et al.

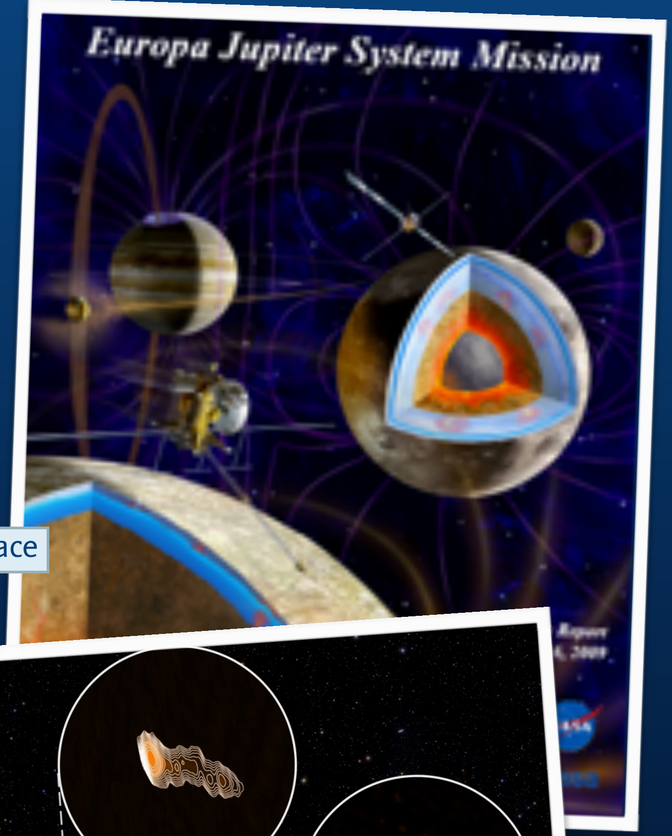


Astrometry: maser distances in the CygX region, Rygl et al. 2012

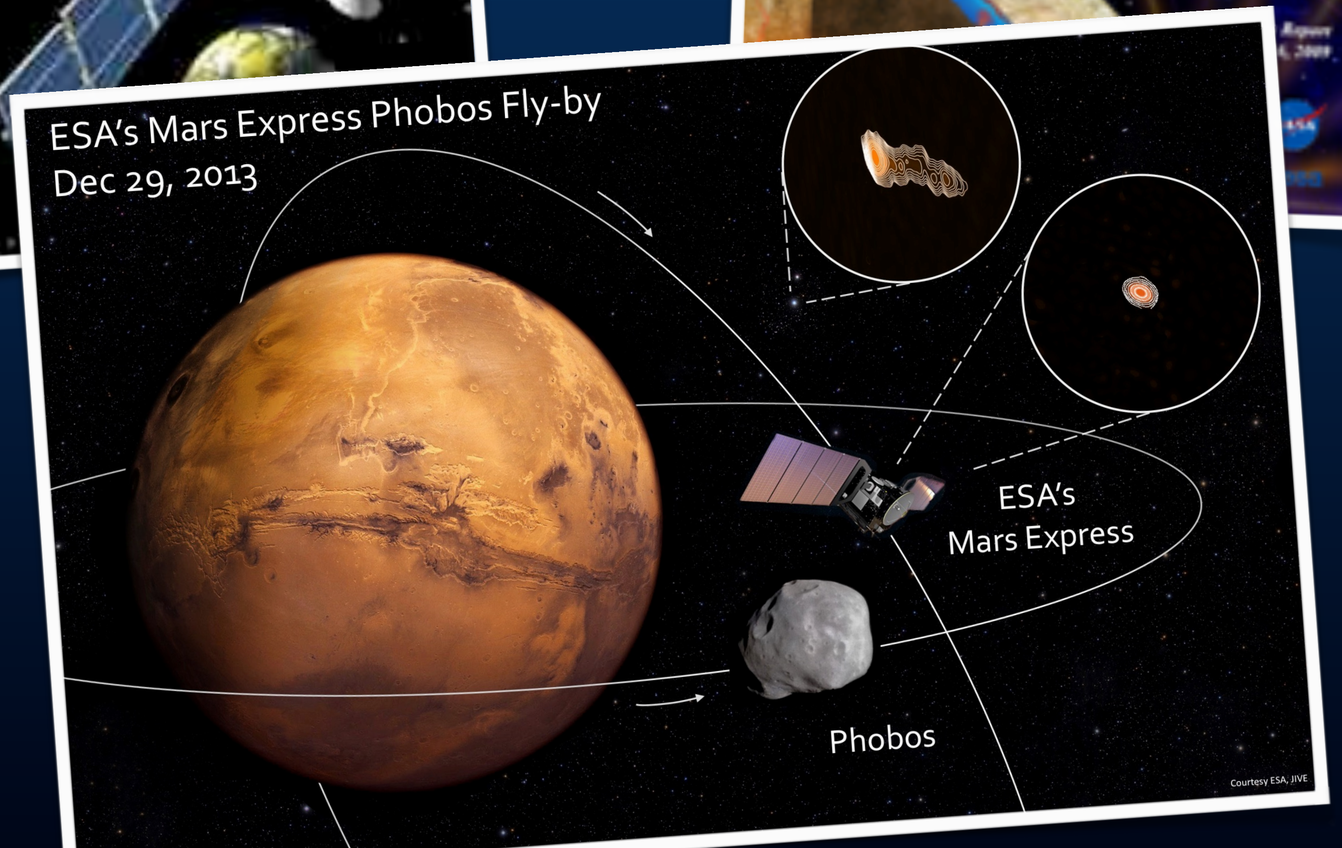
VLBI for Space applications…

RadioAstron

JUICE-Laplace



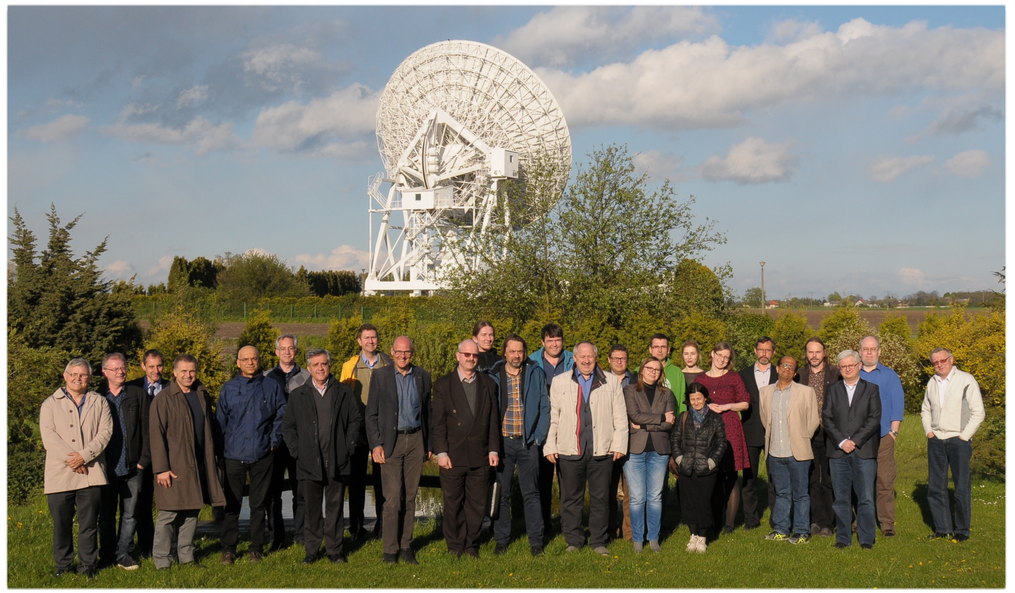
Huygens



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 attracting 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
    - 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

- E.R.I.C.
  - 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, the gory 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

- Operations: most crucial
  - Is the RadioNet 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 EHT
  - ASTERICS support development of data handling
  - RadioNet::RINGS to develop fringe fitting
  - Jumping JIVE: Sched, Geodesy capabilities, telescope support
  - BRAND-EVN future digital receiver
  - SKA-NL contributes to SADT and VLBI@SKA

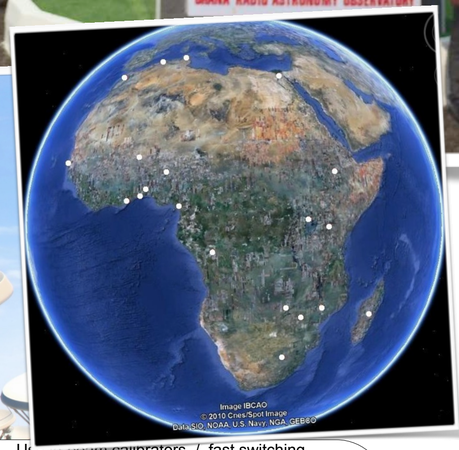
- Policy development and outreach
  - Some elements in RadioNet
  - Very strongly supported by JUMPING JIVE
    - Advertise JIVE as an attractive partner
    - Prepare for Global VLBI

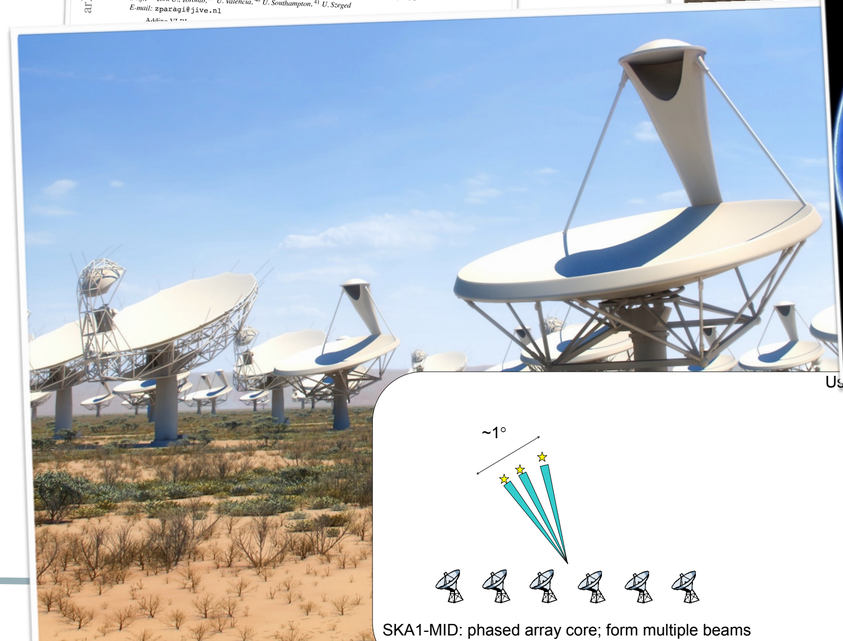
Governance: appropriate and future proof?

- Consortium + Institute structure has served us well
  - Easy to enter collaboration
  - Stable central operations
  - Maintained distributed expertise and user community
  - Funding commitments not very visible
  - Frustrating for most efficient operations and R&D
- ERIC transition
  - Labels EVN+JIVE an excellent European RI
  - Can be used for more centralisation
  - More visible to policy makers
  - Can engage with international partners
- Future: Global VLBI in the SKA era
  - ERIC good vehicle for entering global collaborations
  - Will be looking for operational engagement with SKA and other partners

Ready for the future

- Much more VLBI to support
  - Can support correlation with SKA1_Mid or African VLBI Network
    - Correlation, but that is no longer the key operation
  - (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
- Start thinking about formal Global Network arrangement!
- Other roles for JIVE?
  - Smaller countries may be looking for SKA link
  - EC may want to give access to SKA





Use in-beam calibrators / fast switching







JIVE


NWO


ASTRON


NAOC


Science & Technology
Facilities Council


cnrs


VENTSPILS AUGSTSKOLA


Max-Planck-Institut
für Radioastronomie


ONSALA RYMDOBSERVATORIUM
CHALMERS
TEKNISKA HÖGSKOLA


NRF


INAF