Proposal Technical Justification

- Suppose you have a good science case
  - Is your observation technically feasible?
  - What instrument is best?
  - What is the optimum instrumental setup (resolution etc.)?
  - How long do you need to observe/What noise level?
- All observatories will require this information in a proposal
  - Technical Justification section (typically 1 page)
  - Often requires the use of a specific tool (e.g. to calculate noise level/observing time)
- Plenty of help available
  - Start with Observatory web pages (examples later)
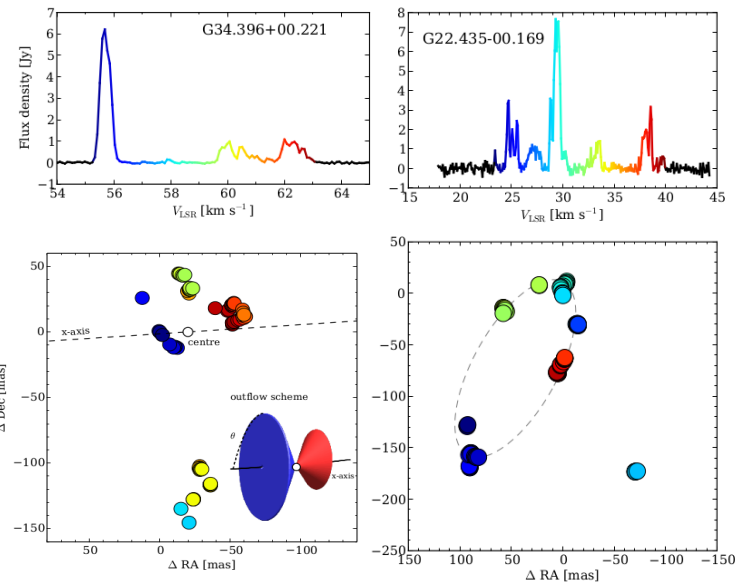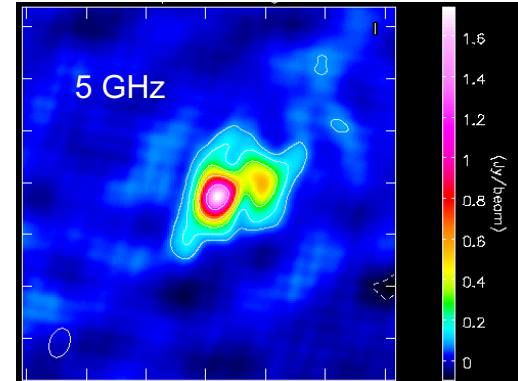
Things to think about (1)

- What wavelength?
  - Spectral lines + redshift/velocity → wavelength (λ)
    - Choice of line (e.g. CO transition) or is there only one possibility (HI)?
  - Continuum emission is trickier:
    - do you need spectral information?
    - trade-offs between sensitivity and flux density?
- What spatial resolution?
  - Resolution (λ/D_{max}) + wavelength (λ) → maximum baseline D_{max}
- What spectral resolution and range?
  - Number and width of spectral channels
- Field of View
  - Maximum scale of structure (λ/D_{min}) → minimum baseline D_{min}
  - Primary beam (λ/d) → dish or station size d
  - Do you need a mosaic of pointings to cover your field?
- How many targets?
- Where is my target (North or South?)
- What arrays can do what I want?

Things to think about (2)

- Sensitivity
  - Key parameter is surface brightness
  - Is your target resolved, or is it a point source?
  - If resolved:
    - Total flux density S (Jy), solid angle on the sky Ω (arcsec^2), beam area B (arcsec^2)
    - Work out S(B/Ω) (Jy/beam)
  - Start from earlier observations or theory
  - Bandwidth Δv is important (rms noise $\propto \Delta v^{-1/2}$)
  - Use a sensitivity calculator to work out how long an observation you need (links later)
- Is your observation feasible?
- If not:
  - Is the resolution too high?
  - Do you have too many targets?
  - Could you pick a better frequency?
  - Is there a better array?

Example projects

- Extra-galactic double source 3C345
  - Core+jet? Gravitational lens? Double?
    - Observe at different frequency or resolution
      - Spectral index
      - Resolve more detail
- 6.7 GHz methanol maser in star-forming region
  - Does single-dish spectrum
  - come from a disc?
  - An outflow?
  - Spectral line VLBI at 6.7 GHz
  - Or methanol transitions at other frequencies

5 GHz

Bartkeiwicz et al 2016

Some example links

- ALMA
  - Introduction https://almascience.eso.org/documents-and-tools/cycle-8-documents#section-0
  - Sensitivity Calculator https://almascience.eso.org/proposing/sensitivity-calculator
  - Archive https://almascience.eso.org/asax/ or http://jvo.nao.ac.jp/portal/alma/archive.do
  - Simulator http://almaost.jb.man.ac.uk/
- EVN
  - Introduction https://www.evlbi.org/using-evn
  - Observation Planner https://planobs.jive.eu/
  - Archive http://archive.jive.nl/scripts/avo/fitsfinder.php
- Jansky VLA
  - Introduction https://science.nrao.edu/facilities/vla/docs/manuals/propvla
  - Sensitivity Calculator https://obs.vla.nrao.edu/ect/
  - Archive https://science.nrao.edu/facilities/vla/archive/index
- VLBA
  - Introduction https://science.nrao.edu/facilities/vlba/introduction-to-vlba
  - Archive as VLA
- MeerKAT
  - Call for proposals https://aas.org/posts/news/2020/07/meerkat-radio-telescope-call-observing-proposals
  - Archive https://skaafrica.atlassian.net/servicedesk/customer/portal/1/topic/bc9d6ad2-8321-4e13-a97a-d19d6d019a1c/article/302546945 (needs account)

More things to think about (1)

- Calibration
  - What's the right calibration strategy?
    - If you are lucky, the Observatory will do most of this for you – but it is always good to understand why – and sometimes they leave it to you
    - Which calibrators and how often to observe them?
    - Can you self-calibrate?
  - Overheads
    - Have you included a reasonable overhead for calibration, slew time?
- Imaging
  - How complex a field?
  - Long track or snapshot?
  - Do you need to combine arrays or configurations?
  - Some arrays have simulation tools to help you
    - Import a model (from theory or earlier observations)
    - Predict the image for realistic noise and calibration errors

More things to think about (2)

- Special considerations
  - Polarization? Can you calibrate?
  - Do you need a special observing mode?
  - Do you have time constraints (simultaneous observations at another waveband)
  - Targets of opportunity?
  - Do you need additional calibration (e.g. for precise astrometry)?
- Proposal pressure
  - Some arrays are in high demand; others less so
  - Some parts of the sky are more popular than others
  - Some projects can only be scheduled in really good weather (e.g. night time, low water vapour column, stable ionosphere) – is yours very demanding?
  - Check these on telescope web site

More things to think about (3)

- Has someone done it before?
  - Literature
  - Look in telescope archives
  - Reanalyse old data
    - Better reduction with modern tools?
    - Good enough? if so, do not re-apply.
- If not good enough
  - May help you to give a better justification
    - Better estimate of required resolution and sensitivity
    - Model for imaging simulations
  - May be able to combine with new data