ESO mmVLBI with ALMA Discussion Session

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Heino Falcke & Robert Laing

- Ultimate Goal:
  - Build a radio super-camera at frequencies >35 GHz with unprecedented resolution (20μas@λ0.8mm) and sensitivity, facilitating a wide range of science for a broad user base, doing sustainable turn-key operations.
- VLBI needs to be accepted by the broader community using the array elements
  - need to convince ESO/ALMA board
  - there needs to be a rigorous, competitive time allocation process
- mmVLBI is and was technically challenging – need good case, enthusiasm, and patience!
  - Event Horizon Project can carry the initial science case and determine initial commissioning focus (but cannot be the only goal to consider)
- VLBI needs many helping hands
  - Needs a strong global community, a good and sustainable science case, an accepted technical roadmap, agreed and fair partnership between observatories and science groups ⇒ solid and stable consortium
- Europe has a strong heritage for this
  - Pioneering work on Sgr A*, shadow idea, pioneering mmVLBI efforts, GMVA, EVN, ALMA(ESO) ⇒ build strong European involvement
- VLBI is by definition global ⇒ collaborate globally!

- What are the big science questions? Need one-liners!
- Black Holes
  - Event horizon of Sgr A* (and M87)
  - Jet formation and accretion physics in M87 (and Sgr A*?)
  - High-emission region in jets – do jets start dark (Poynting jets)?
- Pulsars
- Stars:
  - Masers in evolved stellar envelopes – get the most excited masers
  - Continuum emission from stars?
  - Starforming regions?
- Extragalactic masers:
  - Cosmological constant and BH masses
- Absorption
  - AGN Torus
- What are we missing?
  - Protoplanetary disks, Faraday rotation to get accretion rate,…

- Some input may be needed before the ALMA board meeting in November!
- Things to do in short term:
  - Set up European coordination group to organize community, communicate with ESO and international partners (use SOC+ to start)
  - Write a European white paper to identify science interests and available resources in Europe
    - Needs editorial board, possibly publish as paper?
    - Define workshop participants as initial SWG (unless you resist)

- Eventually develop a coordinated view within EU on
  - long-term development of (sub-)mm VLBI
  - engagement with global consortium
  - direction of technical effort in support of global effor
  - time allocation
- Consortium structure:
  - From white paper derive structure for a mmVLBI consortium, science working group, technical working group
  - Open for small and large groups/commitments
  - Joint data and publication policy (e.g., jointly publish commissioning results, free access to data)
  - Define different Key-Science Projects (Event Horizon Project is one) which will drive initial development and push science further after commissioning phase
  - Transition to open time experiment (plus large programs)

Technical Roadmap

- Phasing and commissioning ALMA
- Equipping and operating existing mm-Telescopes
  - LMT, CARMA, IRAM, Apex, …
- "New" Telescopes
  - LLAMA, Sardinia, GLT, Yebes 40m + IGN network, SEST?, Peru?, .
- Software and data analysis
- VLBI operations …

- Funding:
  - Use national and in-kind resources
  - ALMA development program
  - ERC Synergy grant
    - Technical upgrades of (sub)mm-telescope and joint agreements for operations
    - “Friends of VLBI”-fellowships at different locations throughout Europe: do science and keep relation between consortium and particular telescope
    - Theory program (connect to GR community)
    - Central coordination and development
- Other ideas?
  - …..