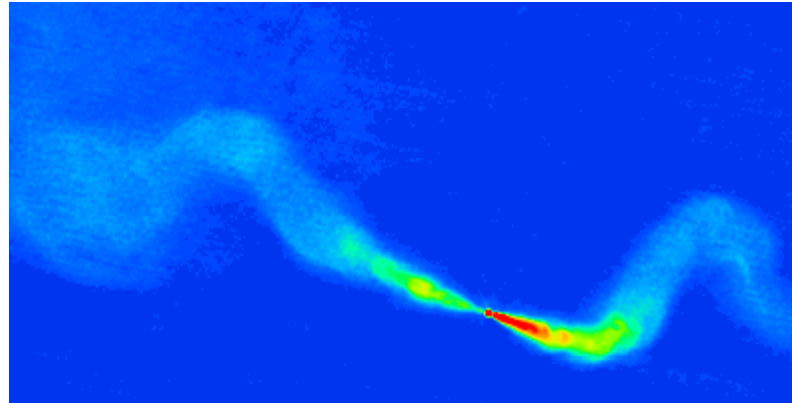


AGN and Compact Objects

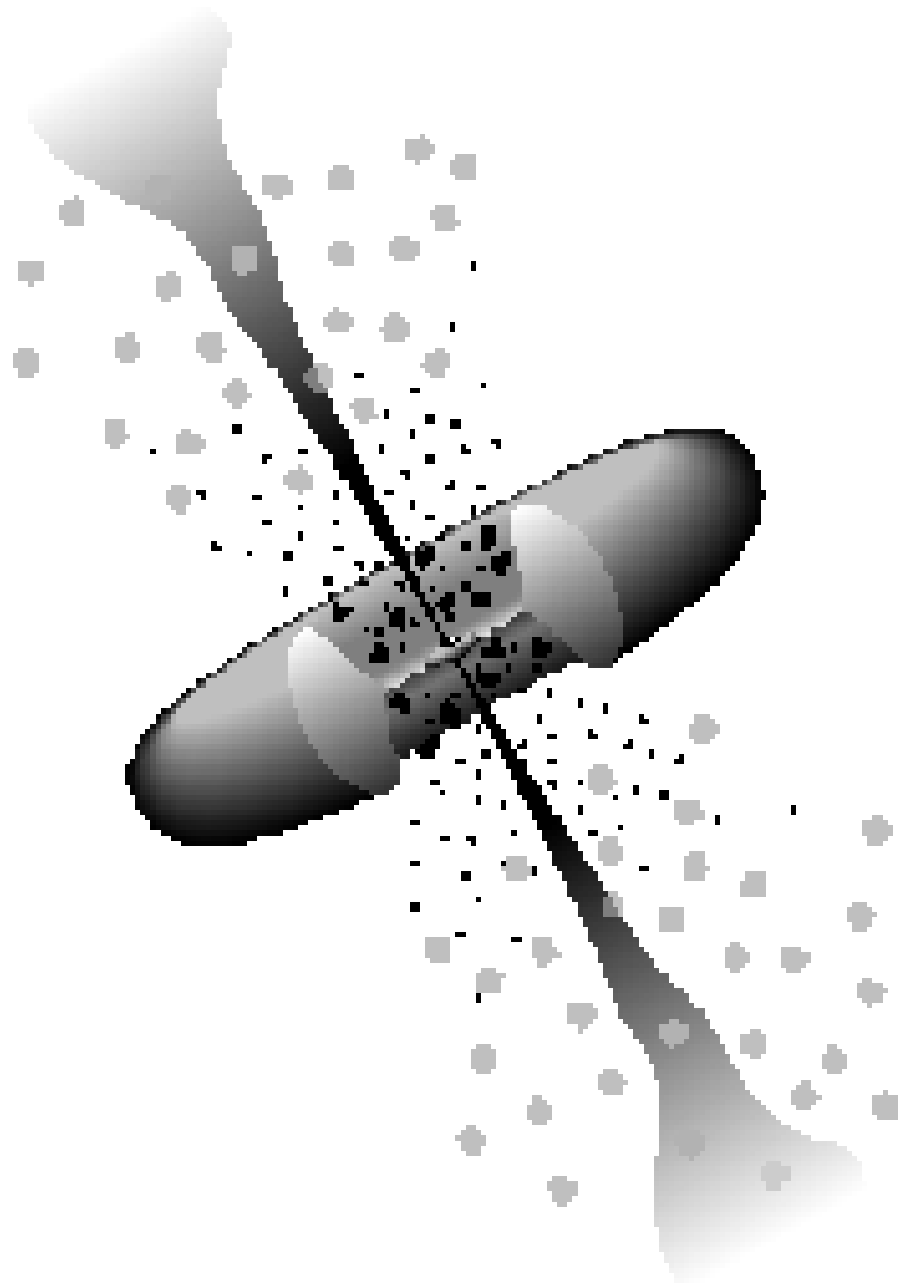
Summary of Working Group



Overview

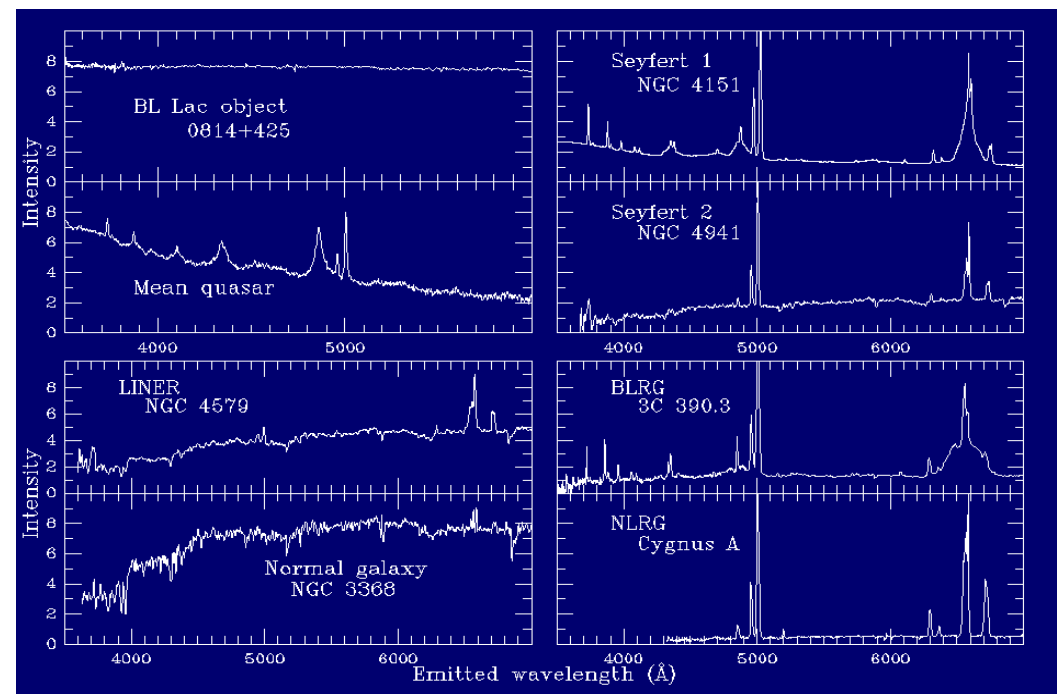
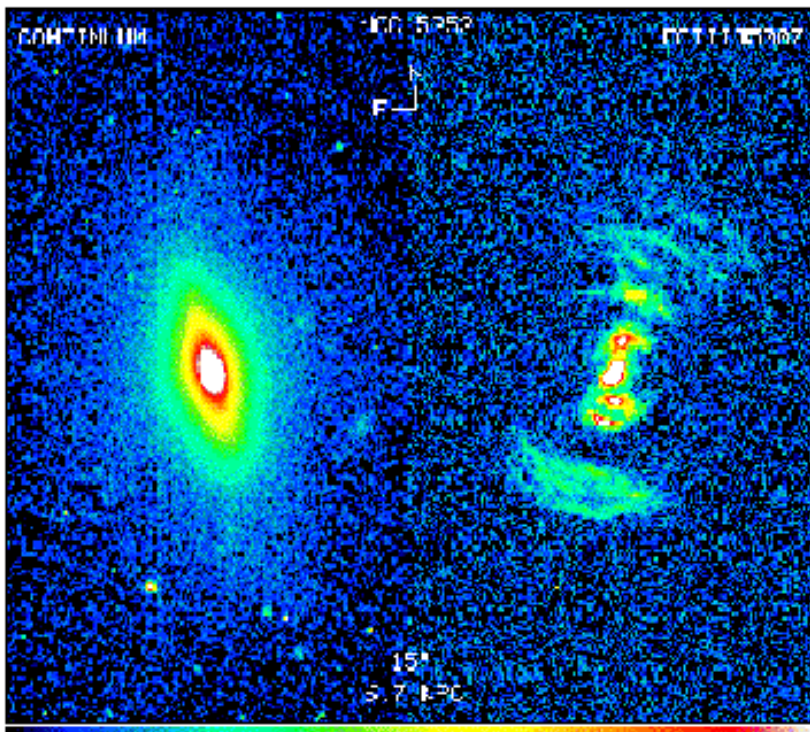
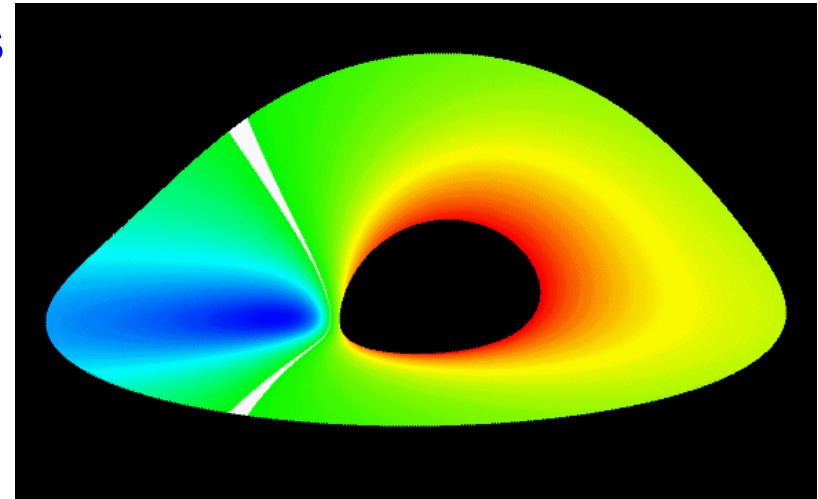
- **Probe strong-field gravity near the black hole event horizon**
- **Resolve the formation and collimation of jets**
- **Imaging, kinematics and dynamics of:**
 - **broad-line region**
 - **obscuring torus**
- **Understand the relation between accretion and jet formation**
- **Magnetic fields**
- **Environmental impact**
 - **Feedback in cooling cores**
 - **AGN and starbursts**
- **SMBH and galaxy formation**
 - **Census of AGN**
 - **BH and galaxy evolution**

Cartoon radio-loud AGN



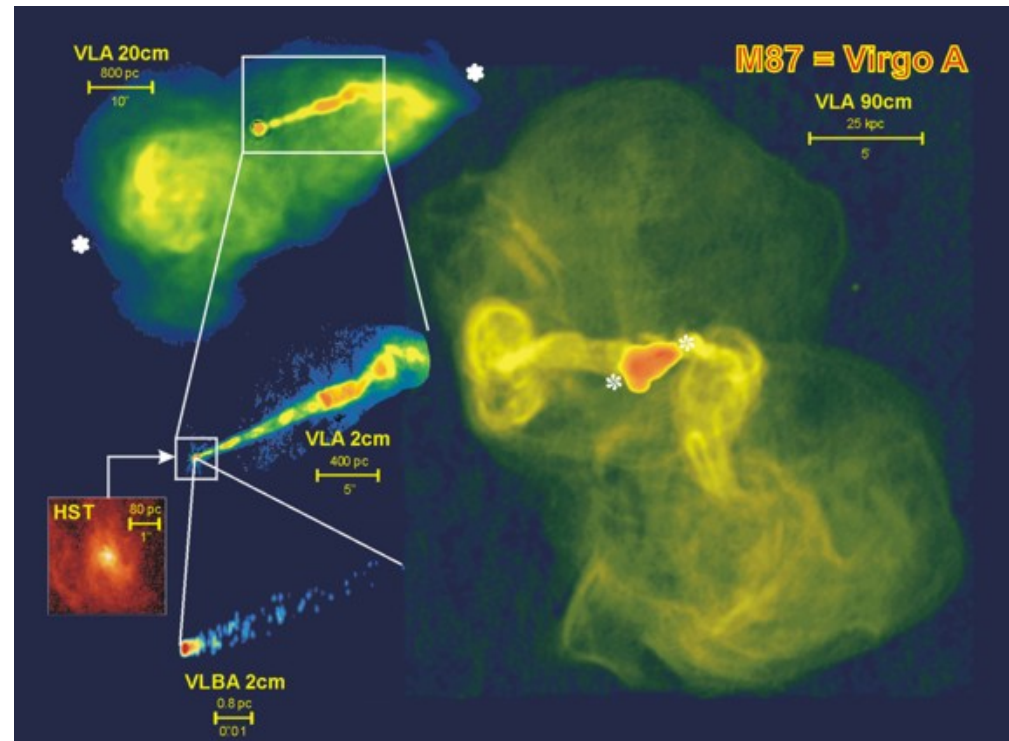
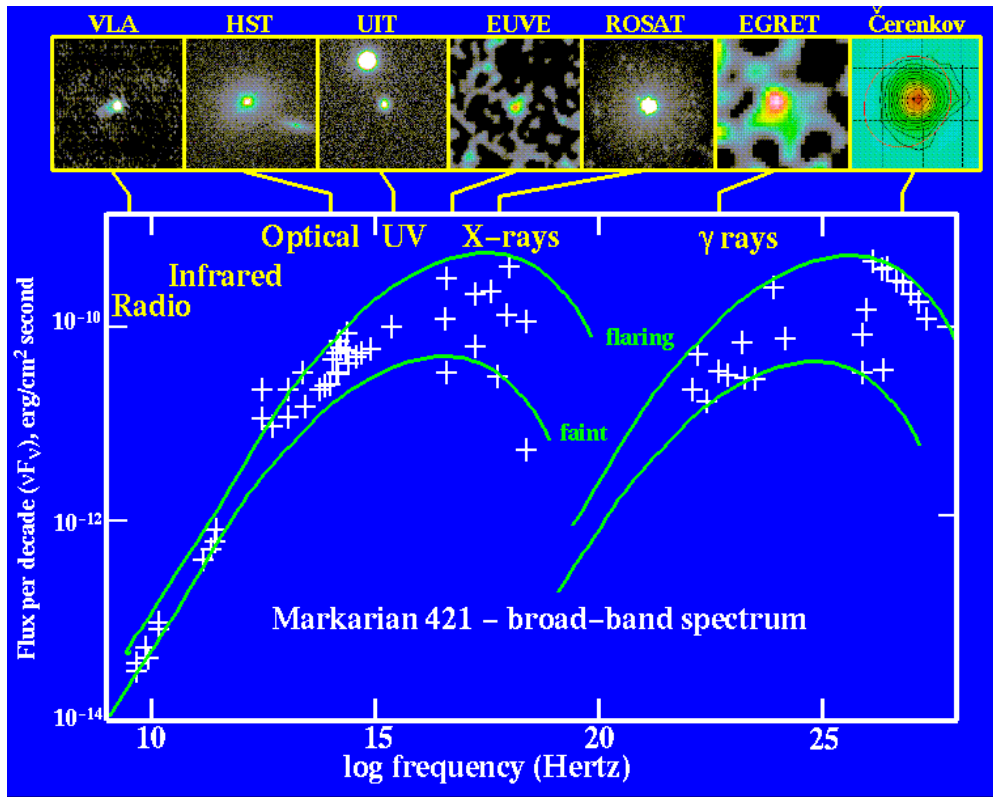
Physical processes - accretion

- Thermal emission from accretion discs
- Corona, Comptonization
- Atomic lines from BLR, NLR
- Dust emission from torus, scattering
- Molecular lines, masers



Physical processes - jets

- Jets (AGN, microquasars); Pulsars and PWN
 - Bulk relativistic flow
 - Non-thermal, ultrarelativistic particles, B, Poynting flux
 - Wide energy range – hence radio to γ rays
 - Synchrotron, inverse Compton, coherent radiation



Strong-field gravity

- Imaging
 - sub-mm VLBI (ALMA+)
 - X-ray interferometry (MAXIM)
- Pulsar-BH binaries - SKA
 - BH mass, spin and quadrupole
 - Naked singularities and the no-hair theorem
- X-ray line profiles
- AGN BH mass measurements
 - Masers
 - Gas
 - Stars

Jet formation and propagation

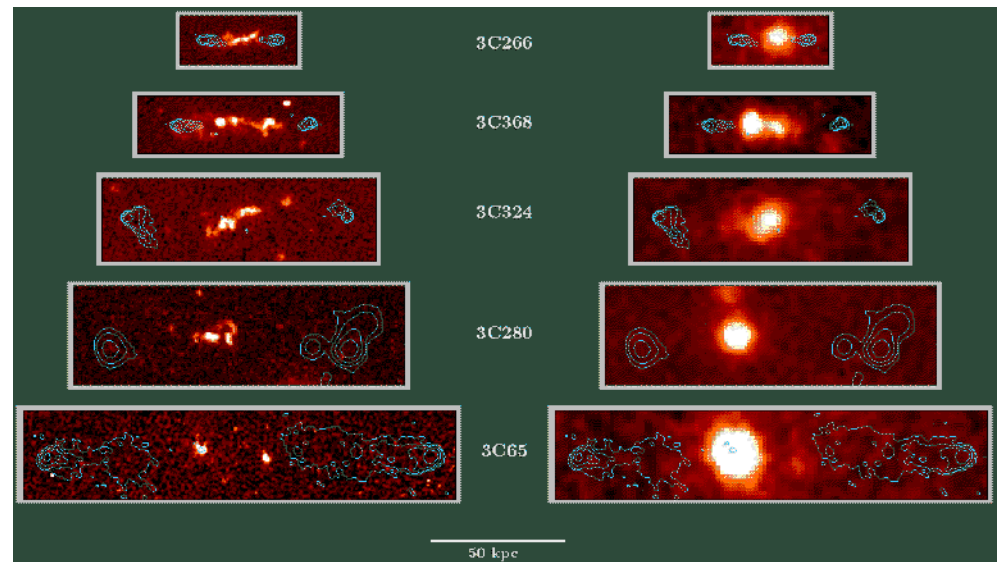
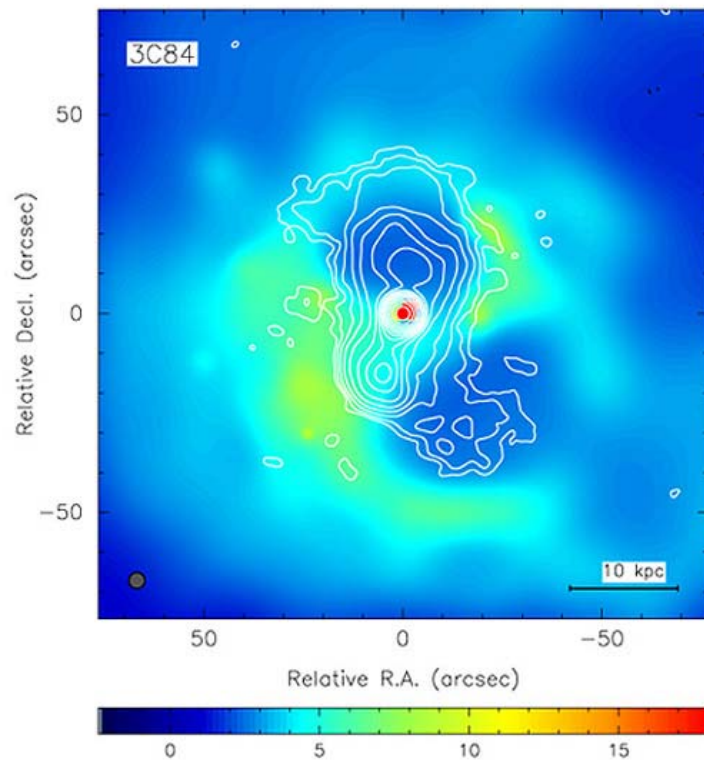
- Image nearest radio galaxies (M87, Cen A) - $R < 10 R_g$
- Magnetic collimation
 - linear and circular polarization
 - Faraday rotation
 - Need theory!
- Physical conditions in jets: diagnostics are subtle:
 - deep, high-resolution observations; high dynamic range
 - Compare synchrotron and iC → high resolution radio to X-ray (or even γ -rays)
 - Linear and circular polarization
 - Understand the environment (IGM)

Imaging the broad-line region and torus

- BLR
 - Size scale ~ 1 pc
 - Current picture from models + reverberation mapping/tomography
 - Optical/near-IR interferometry: requires long baselines (100m – 1 km) and large collecting area (e.g. ELSA)
 - Strong lines \rightarrow kinematics and dynamics
- Torus
 - Mid-IR interferometry (new results from VLTI; need imaging spectroscopy)
 - Molecular lines in cooler gas
 - Ionized component?

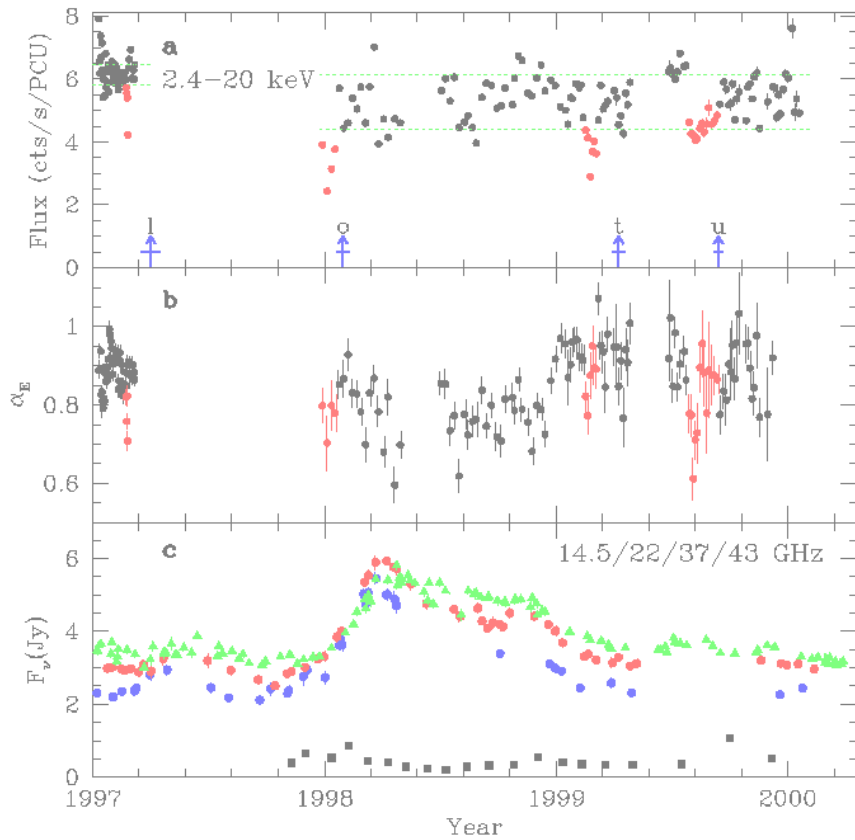
Feedback

- AGN and cooling cores in clusters
- Effects of AGN on galaxy evolution
- AGN and star formation/starbursts

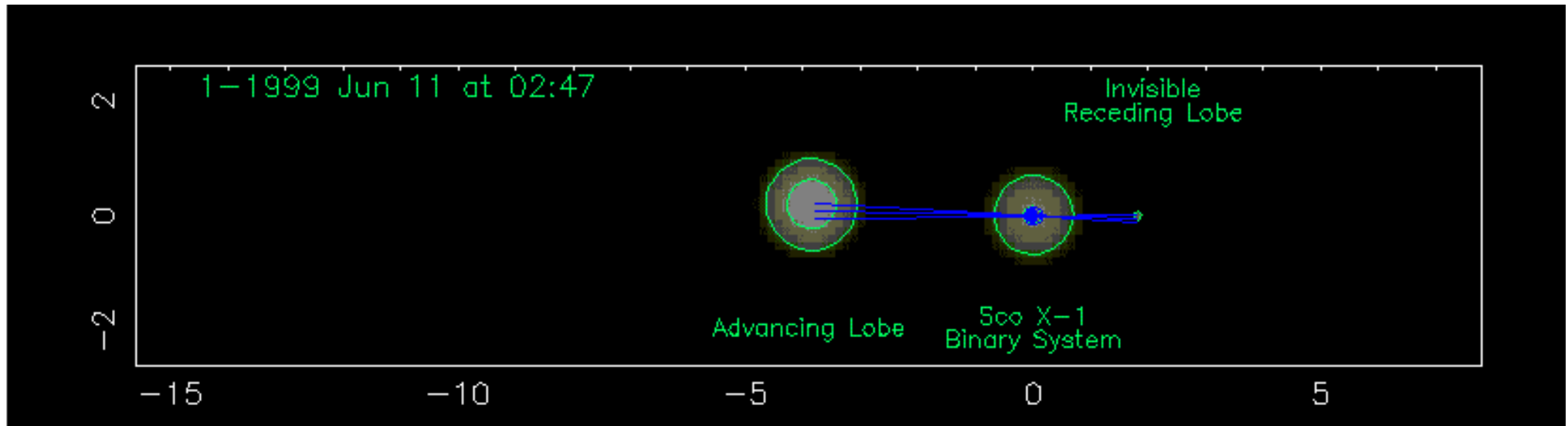


What is the connection between accretion and jet formation?

- Connections between accretion (as measured by X-ray continuum and Fe lines) and jet ejections in both microquasars and AGN.
- Why? Change in accretion mode?
- Simultaneous high-resolution imaging (proper motions ...) at multiple wavelengths; X-ray, BLR spectroscopy.



Sco X-1



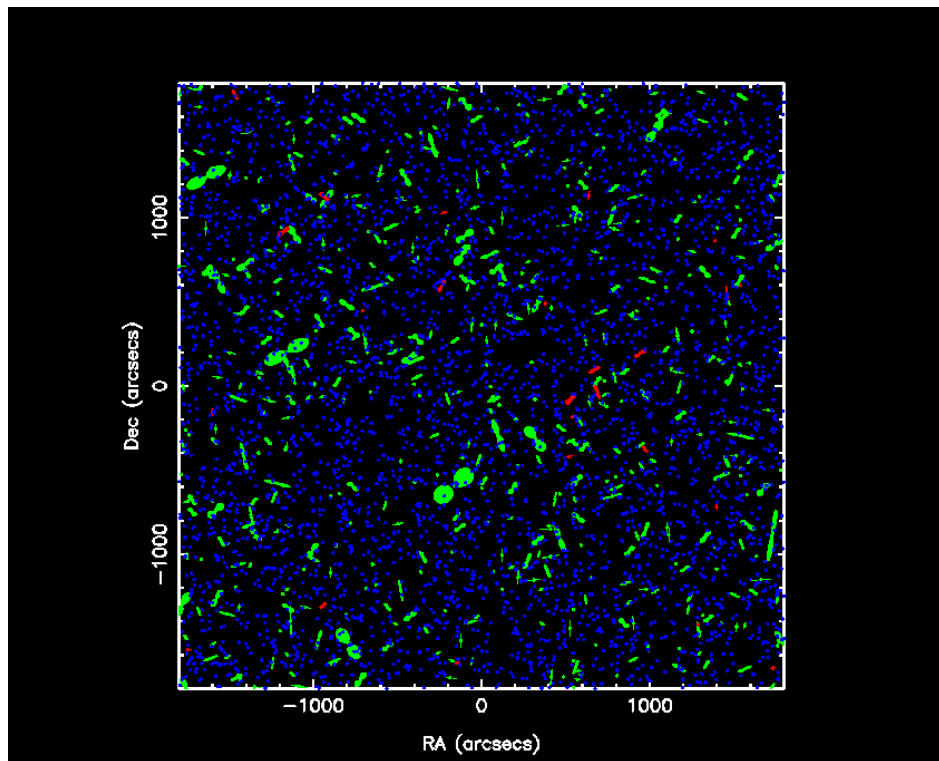
Magnetic fields

- Important in accretion as well as jet formation
- How do AGN amplify B and transport it through the IGM.
- Are primordial fields related to the first BH?
- X-ray and gamma-ray polarimetry needed, not just radio and optical

AGN as probes and foregrounds

Foreground contaminants for primordial CMB and SZ

Probes of intervening material



The first BH and galaxy evolution

- How do SMBH form?
- Why is there a connection between BH mass and bulge luminosity?
- How is this relevant to galaxy evolution?
- Can we see AGN or naked BH at very early epochs, before galaxies form (e.g. via lensing)?
- BH mergers and galaxy evolution
- How do individual AGN evolve?
- How can we isolate very distant objects in surveys of the nJy sky?
Are some very faint sources intrinsically distant?
- Need multi-band surveys to recognise and measure redshifts for all classes of AGN.

What's missing?

- Resolution at all wavelengths
 - Sub-arcsec X-ray imaging and spectroscopy
 - Sub-mm VLBI
 - Km baseline optical/IR interferometry
- Dynamic range
- Polarization – linear and circular – all wavelengths
- Connections to neutrino, UHECR astronomy
- Theory