



ALMA and the UK Regional Centre Node

Tom Muxlow – October 31st 2012

ALMA

Aperture synthesis array optimised for wavelengths of 1cm – 0.3mm (30 – 950 GHz)

High, dry site: Chajnantor Plateau, Chile (5000m)
54 x 12m + 12 x 7m antennas
Baselines from ~15m to 16km
Dynamically reconfigurable

Resolution: $\approx 0.2(\lambda/\text{mm})/(\text{max baseline}/\text{km})$
5 mas for 0.3mm/16km

Sensitive: Wide-band (8GHz) receivers, full polarization

Flexible: Correlator \rightarrow wide range of spectral resolutions

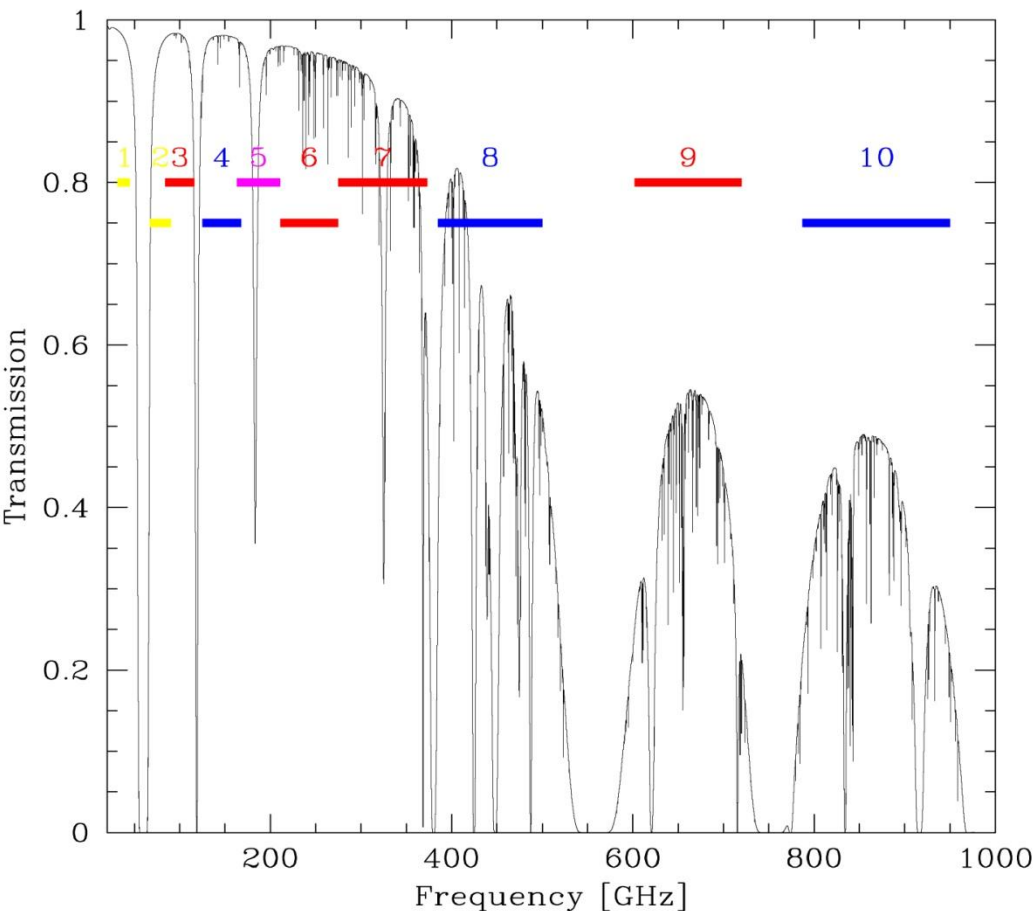
Current situation (Early October)...

46 antennas delivered to commissioning team – 42 currently at 5000m

52 Front-End Assemblies in Chile – All front ends have Bands 3, 6, 7 and 9
– first Band 4, 5, 8, 10 cartridges on some antennas

Full sets of water-vapour radiometers, calibration devices, etc.

Atmospheric transmission at Chajnantor, pwv = 0.5 mm



ALMA Timeline:

Cycle 0 until end 2012

~70% high-priority proposals observed

Cycle 1 deadline July 12 2012

1133 proposals

Allocations - November 2012

Cycle 1 start Jan 1 2013 (32 antennas)

Construction complete ~end 2013



The ALMA Site – OSF and AOS

Remote observing is the standard mode for users of ALMA

OSF

The ALMA **O**perations **S**upport **F**acilities

- base camp for routine operation
- height 2900m



AOS

The **A**rray **O**perations **S**ite

- 2nd highest building in the world
- human operations minimized
- height 5100m



Interacting with ALMA

ALMA operations at the AOS are controlled from the Joint ALMA Office (JAO) in Santiago

Users submit proposals

After approval, project is reduced to scheduling blocks – awaiting weather/configuration

After observations are made, data are forwarded to the JAO.

QA & first-stage data processing performed at JAO before transmission back to the PI



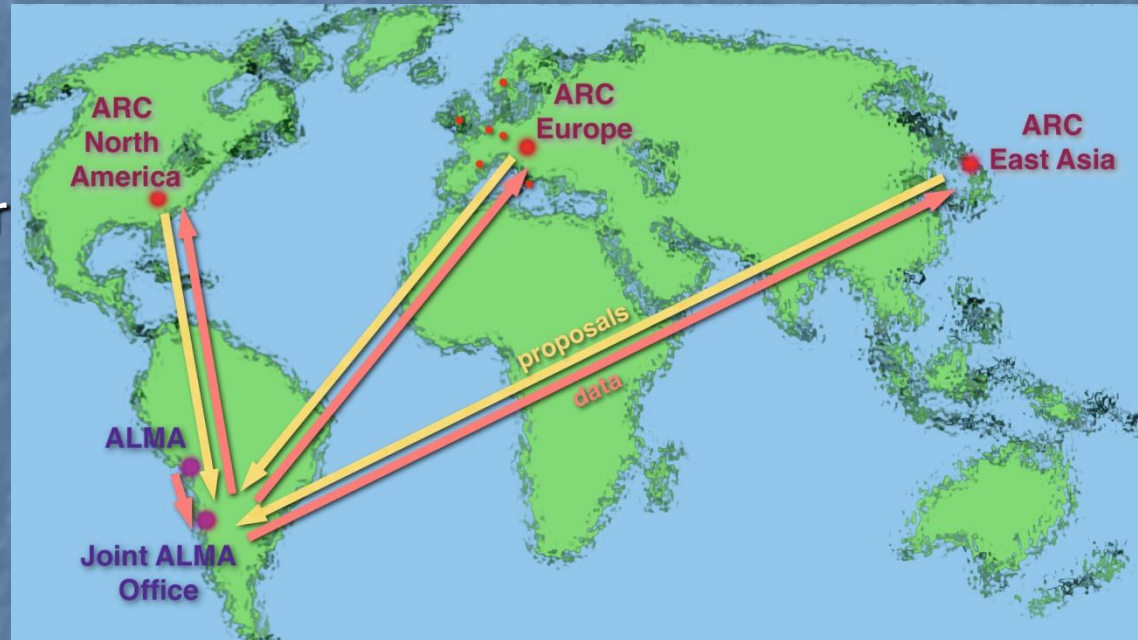
Interacting with ALMA

Via your local **ALMA Regional Centre (ARC)**.

Local proposal preparation before transmission to JAO

Data will flow back to the user from the JAO via local **ARC**

There are 3 ARCs:
North American
European
East Asian



How the European User Interacts with ALMA

Central European ARC at Garching
providing core user support:

Mirror of the ALMA archive
Provision of software tools
Conduit for proposal submission
Delivery of data from JAO

7 European ARC nodes
– face-to-face support:

UK	Manchester
Germany	Bonn
Italy	Bologna
Nordic	Onsala
France/Spain	IRAM
Netherlands	Leiden
Czech Republic	Ondřejov



ALMA will study the Universe...

The design of ALMA is driven by three key science goals:

The ability to detect spectral line emission from CO or [CII] in a normal galaxy like the Milky Way at a redshift of $z=3$, in less than 24 hours

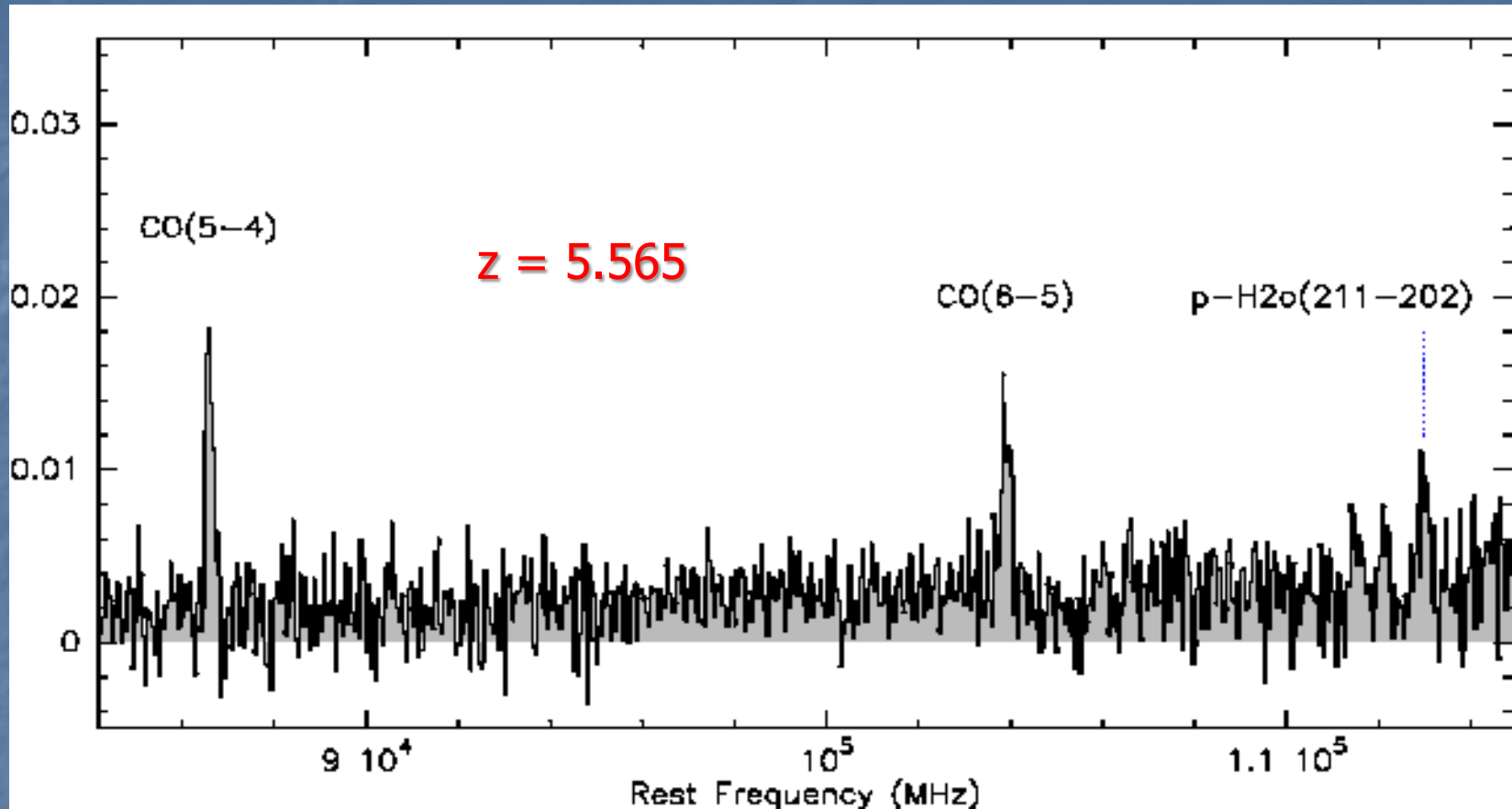
Bands allow CO transitions to be imaged to $Z\sim 10$

The ability to image the gas kinematics in proto-stars and in proto-planetary disks around young Sun-like stars in the nearest molecular clouds (150 pc),

The ability to provide precise high dynamic range images at an angular resolution of 0.1 arcsec.

Some recent CSV/Cycle 0 results...

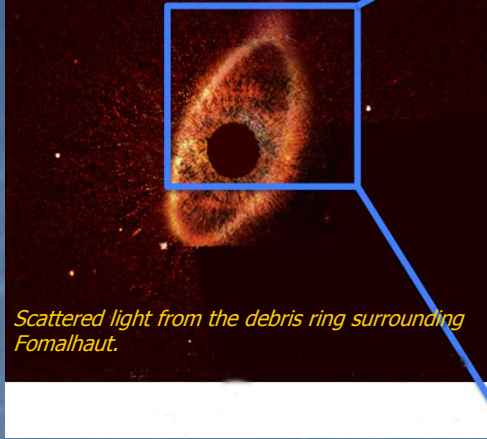
ALMA as a redshift machine



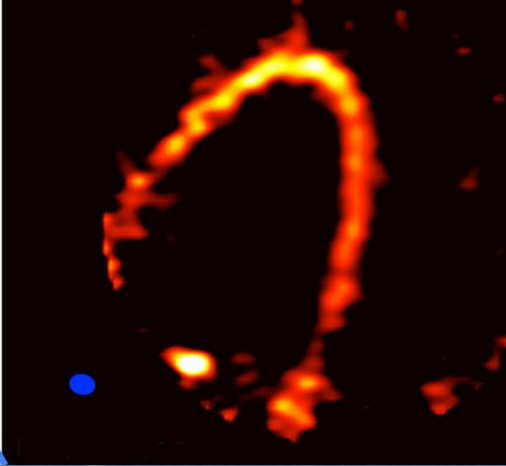
Lensed sub-millimetre galaxy found by the South Pole Telescope Survey
5 frequency settings in Band 3 → 2 CO transitions detected

Axel Weiss, Carlos de Breuck, SPT SMG Team

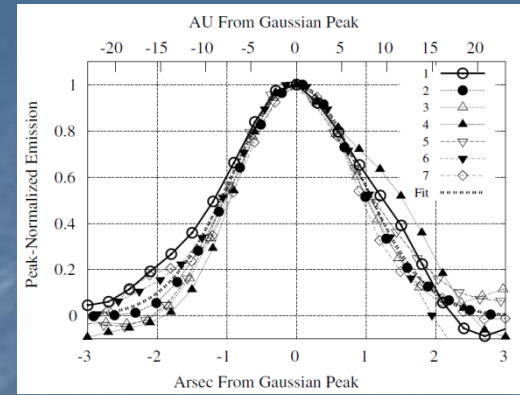
HST coronagraphic image
(Paul Kalas/NASA/ESA)



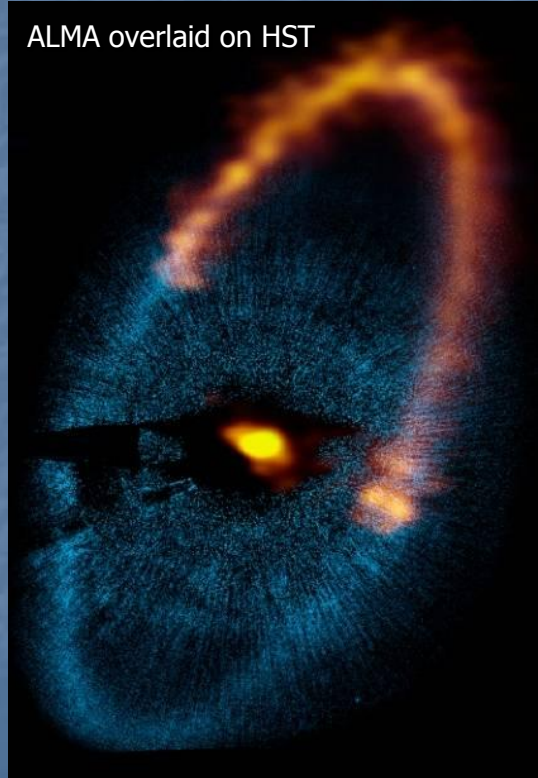
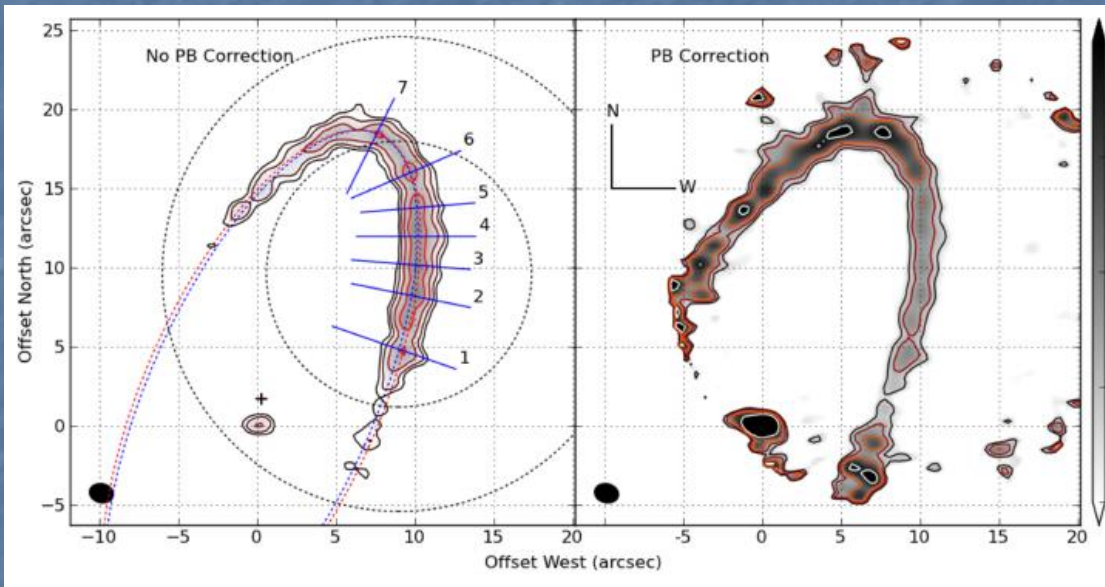
ALMA – Band 7 continuum



Fomalhaut Debris Disk



Fits to
disk
slices

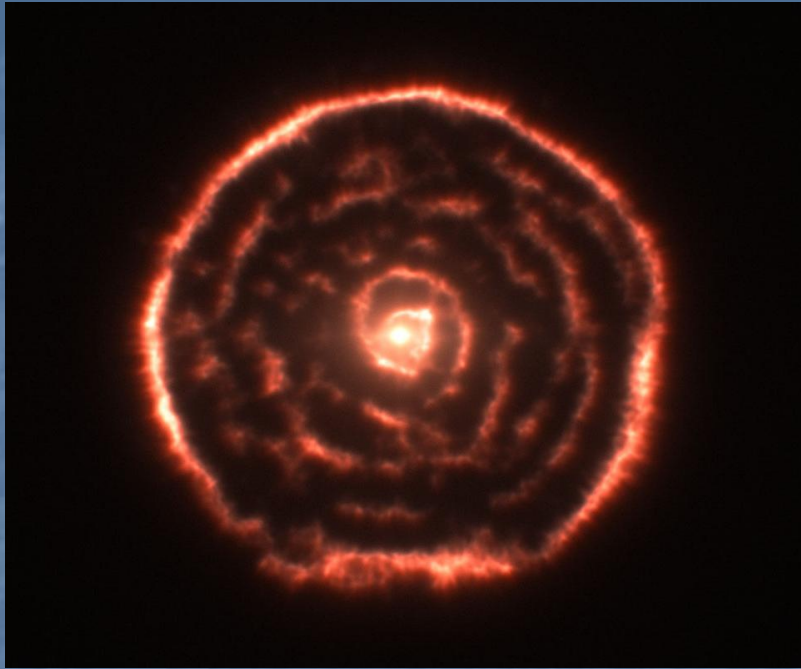
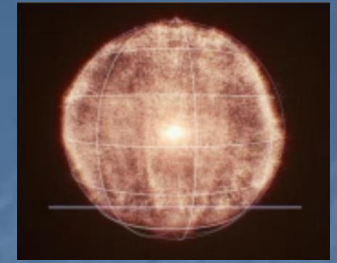


ALMA overlaid on HST

Boley et al 2012, ApJL, 750, L21:

Sharp ring profile in mm-sized grains + disk ellipticity
→ indirect evidence for two shepherding planets

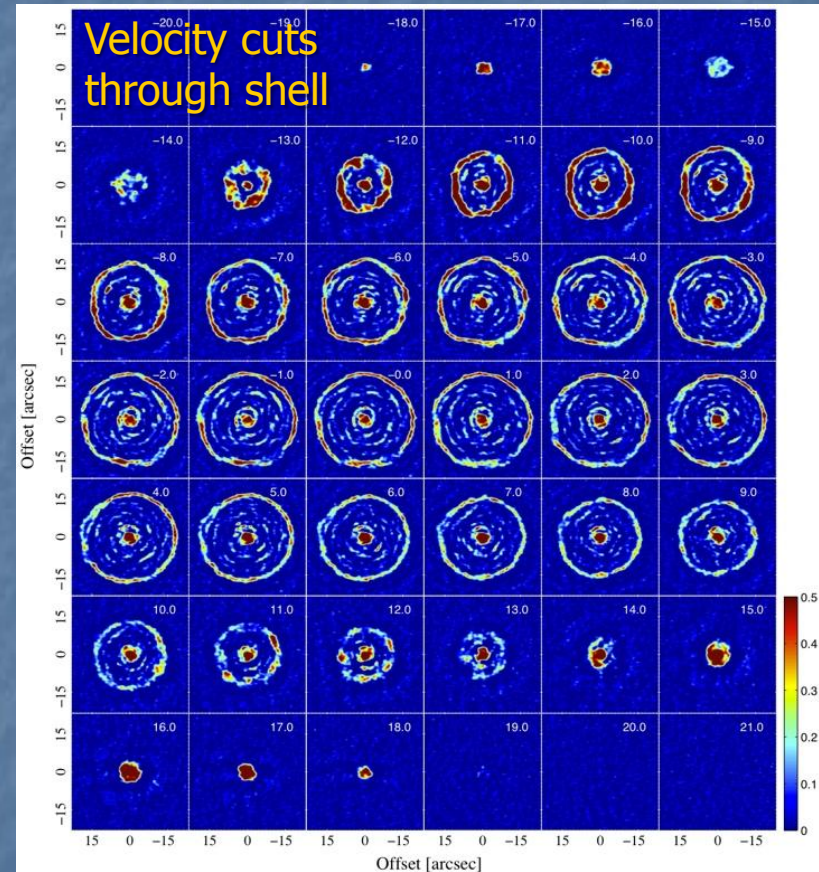
CO 3-2 in Red Giant Carbon Star R Sculptoris



Detached CO shell ejected by thermal pulses over last ~ 2000 years

Spiral structure from the presence of a companion star

CO3-2 line, Band 7 345 GHz



Maercker et al. 2012, Nature 29 232



Gary Fuller:
Galactic star-formation
and stellar evolution



Tom Muxlow:
High redshift
star-formation

UK ALMA Regional Centre (ARC)

Face-to-face support from
proposal preparation
through to final imaging....

+ workshops & outreach

+coordinates other ALMA
UK activity

Adam Avison:
Massive star-formation,
methanol masers

Rob Beswick:
AGN & star-formation
in nearby galaxies

Jaime Pineda:
Dense cores & low-
mass star-formation

Anita Richards:
Evolved stars and
maser physics

George Bendo:
Role of dust in
galaxies



ALMA Developments

Bands 1 & 2 (overlap with JVLA) – UK ARC Node personnel involved in a bid to develop Band 2

Phasing of ALMA to produce the equivalent of an 84m single dish

- provides sensitivity for a Global mm VLBI array
- 10,000km baselines → $\sim 25\mu\text{s}$ resolution “Event Horizon Telescope”
- image region of the event horizon in Sgr A* and M87...

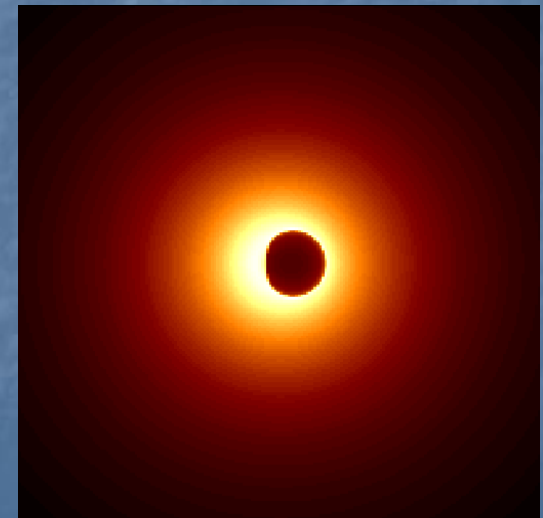
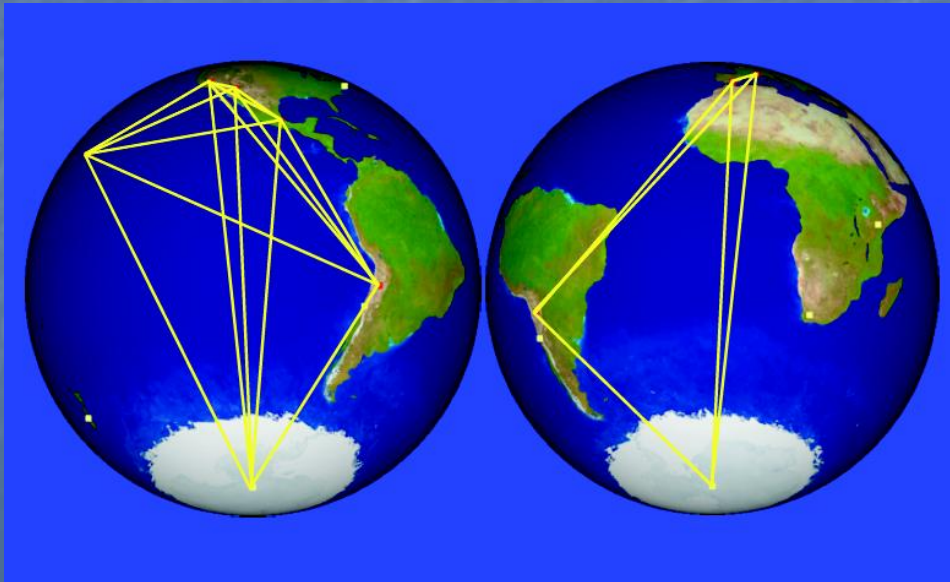


Image of shadow of EH

UK ALMA Regional Centre (ARC)

...here to help **you** & UK astronomers in their
ALMA research – just come and see us...



