

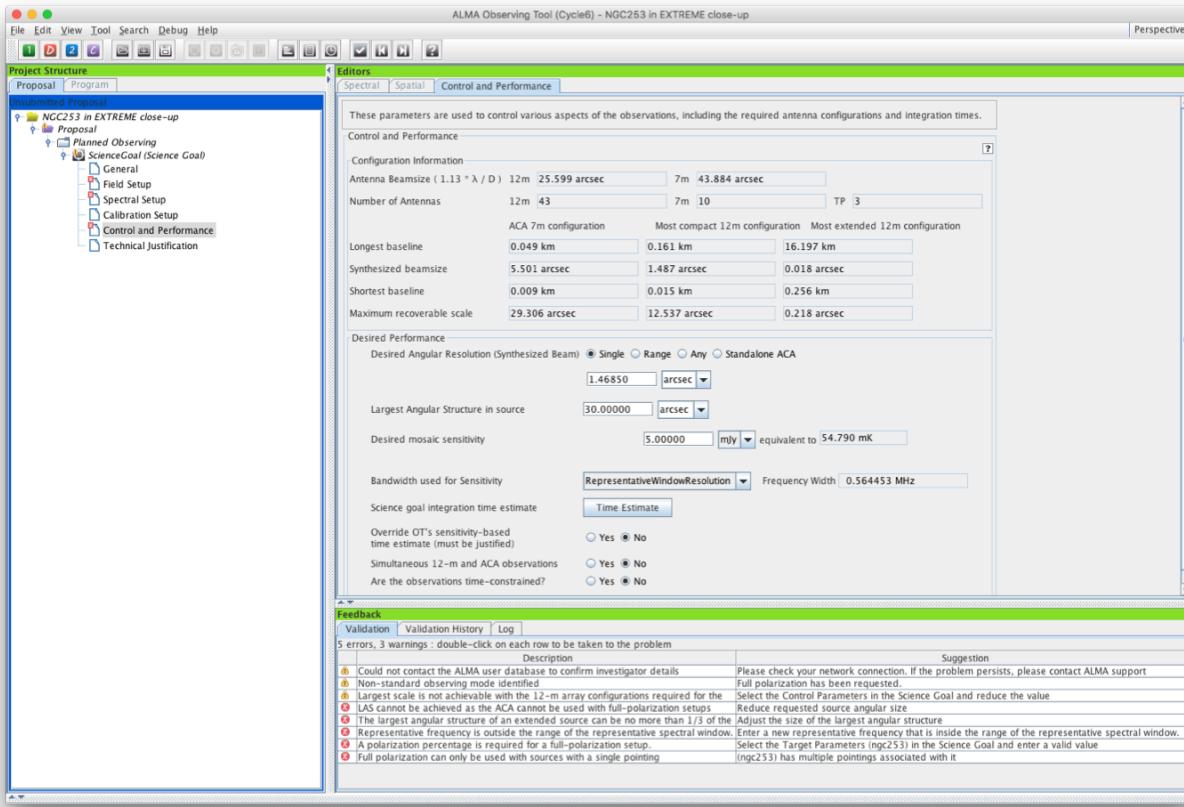
# ALMA Observing Strategies

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# The ALMA Observing Tool



Java-based Desktop application which translates scientific requirements into Scheduling Blocks which are run at the telescope

# Scheduling of Total Power

- Done automatically by ALMA Observing Tool
  - User does not explicitly request TP observations
- Configuration selection based on **LAS** and **MRS**
  - LAS: Largest Angular Scale (of structure to be imaged)
  - MRS: Max. Recoverable Scale (of configuration)
- MRS equivalent to angular size seen by “L05”
  - L05 = 5<sup>th</sup> percentile baseline (L00 = shortest baseline)

TP is scheduled if MRS of 7-m Array < requested LAS

# Configuration Information

OT displays MRS on “Control & Performance” panel

Control and Performance			
Configuration Information			
Antenna Beamsize ( $1.13 * \lambda / D$ )	12m 43	7m 10	TP 3
	ACA 7m configuration	Most compact 12m configuration	Most extended 12m configuration
Longest baseline	0.049 km	0.161 km	2.517 km
Synthesized beamsize	5.496 arcsec	1.486 arcsec	0.134 arcsec
Shortest baseline	0.009 km	0.015 km	0.015 km
Maximum recoverable scale	29.281 arcsec	12.526 arcsec	1.805 arcsec

MRS is a function of frequency and source declination

# TP Restrictions

- Continuum observing not commissioned\*
  - Except for solar observing
- Band 9 and 10 still not possible\*
  - Sideband separation difficult
- Full polarization
- Spectral scans
- OT won't allow with C43-10 (largest 12-m config)
- Must be part of interferometric project

\*High priority to offer as part  
of Cycle 7 or 8

# Field Setup

- User defines area to observe using either
  - Individual (interferometric) pointings
  - Rectangular areas
- One mosaic per source
  - All pointings must overlap
  - One rectangle
- Total power map area
  - Smallest rectangle that encompasses all pointings
  - Or the user-defined rectangle
  - In both cases, rectangle is expanded by 7-m beamsize

# Spatial Visualiser

- Shows pointings/mapping area on an image
  - Various servers to download from (DSS, 2MASS, IRAS, etc.)
  - Or upload own FITS file
- Pointings/mapping area can be drawn on image
  - Red circles: interferometric pointings
  - Green rectangle: user-defined rectangle
  - Blue rectangle: OT-calculated TP mapping area

# Rectangle

Spatial Image

Source

Source Name: 30\_Dor

Choose a Solar System Object?  Name of object: Unspecified

Source Coordinates:

- System: ICRS
- RA: 05:38:42.3960
- Dec: -69:06:03.360
- Parallax: 0.00000 mas
- PM RA: -2.70000 mas/yr
- PM DEC: 8.00000 mas/yr

Source Radial Velocity: 274.000 km/s hel z 0.000914384 Doppler Type: RELATIVISTIC

Target Type:  Individual Pointing(s)  1 Rectangular Field

Expected Source Properties

- Peak Continuum Flux Density per Synthesized Beam: 0.10000 Jy
- Continuum Linear Polarization: 0.0 per cent
- Continuum Circular Polarization: 0.0 per cent
- Peak Line Flux Density per Synthesized Beam: 10.00000 mJy
- Line Width: 1.30000 km/s
- Line Linear Polarization: 0.0 per cent
- Line Circular Polarization: 0.0 per cent

Rectangle

Coords Type:  Relative  Absolute

Field Center Coordinates:

- Offset(Longitude): 0.00000 arcsec
- Offset(Latitude): 0.00000 arcsec

p length: 100.00000 arcsec

q length: 100.00000 arcsec

Position Angle: 0.00000 deg

Spacing: 0.51093 fraction of antenna beamsize

#Pointings: 12m Array 67 7m Array 27

Add Source Load from File... Export to File... Clone Source Delete Source Delete All Sources

Nyquist sampling important when mapping large (TP) sources

# Single pointing

Spatial Image

30\_Dor

Source

Source Name: 30\_Dor

Choose a Solar System Object?  Name of object: Unspecified

Source Coordinates:

System: ICRS	Sexagesimal display? <input checked="" type="checkbox"/>	Parallax: 0.00000 mas
RA: 05:38:42.3960	PM RA: -2.70000 mas/yr	
Dec: -69:06:03.360	PM DEC: 8.00000 mas/yr	

Source Radial Velocity: 274.000 km/s hel z 0.000914384 Doppler Type: RELATIVISTIC

Target Type:  Individual Pointing(s)  1 Rectangular Field

Expected Source Properties:

Peak Continuum Flux Density per Synthesized Beam: 0.10000 Jy
Continuum Linear Polarization: 0.0 per cent
Continuum Circular Polarization: 0.0 per cent
Peak Line Flux Density per Synthesized Beam: 10.00000 mJy
Line Width: 1.30000 km/s
Line Linear Polarization: 0.0 per cent
Line Circular Polarization: 0.0 per cent

Field Center Coordinates:

Coord Type:  Relative  Absolute

Offset Unit: arcsec

#Pointings: 1

RA [arcsec]: 0.00000	Dec [arcsec]: 0.00000
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FOV Parameters

Representative Frequency (Sky): 230.327 GHz

Antenna Diameter:  12m  7m

Antenna Beamsize (HPBW): 43.339 arcsec

Show Antenna Beamsize:

Image Query

Image Server: Digitized Sky at ESO

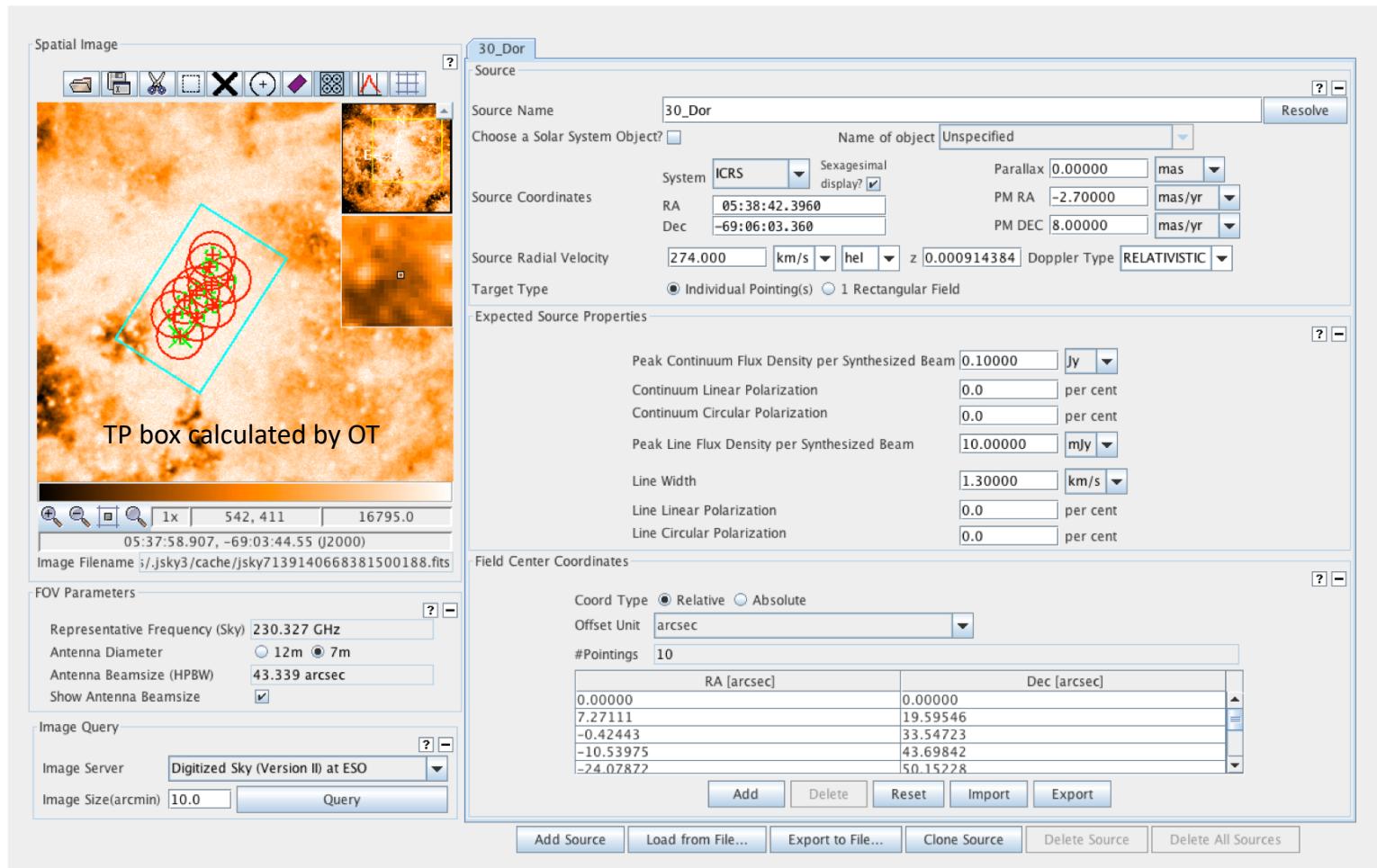
Image Size(arcmin): 10.0

Query

Add Delete Reset Import Export

Add Source Load from File... Export to File... Clone Source Delete Source Delete All Sources

# Multiple pointings



# Galactic coordinates

OT will now rotate rectangles to account for different coordinate systems

Spatial Image

Sgr A\*

Source

Source Name: Sgr A\*

Choose a Solar System Object:

Name of object: Unspecified

System: galactic

Parallax: 0.0 mas

Lon (deg): 359.99992751 mas/yr

Lat (deg): 0.00002114 mas/yr

PM RA: 0.00000 mas/yr

PM DEC: 0.00000 mas/yr

Source Radial Velocity: 0.000 km/s  hel  z 0.000000000 Doppler Type: RELATIVISTIC

Target Type:  Individual Pointing(s)  1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Synthesized Beam: 1000.00000 mJy

Continuum Linear Polarization: 1.0 per cent

Continuum Circular Polarization: 0.0 per cent

Peak Line Flux Density per Synthesized Beam: 1000.00000 mJy

Line Width: 1.00000 km/s

Line Linear Polarization: 1.0 per cent

Line Circular Polarization: 0.0 per cent

All servers deliver images in J2000 coordinates

FOV Parameters

Representative Frequency (Sky): 210.000 GHz

Antenna Diameter:  12m  7m

Antenna Beamsizes (HPBW): 27.728 arcsec

Show Antenna Beamsizes:

Image Query

Image Server: Digitized Sky at ESO

Image Size(arcmin): 10.0

Rectangles

Coords Type:  Relative  Absolute

Field Center Coordinates

Offset(Longitude): -0.00000 arcsec

Offset(Latitude): 0.00000 arcsec

p length: 100.00000 arcsec

q length: 140.00000 arcsec

Position Angle: 0.00000 deg

Spacing: 0.51093 fraction of antenna beamsize

#Pointings: 12m Array: 85  7m Array: 27

Add Source  Load from File...  Export to File...  Clone Source  Delete Source  Delete All Sources

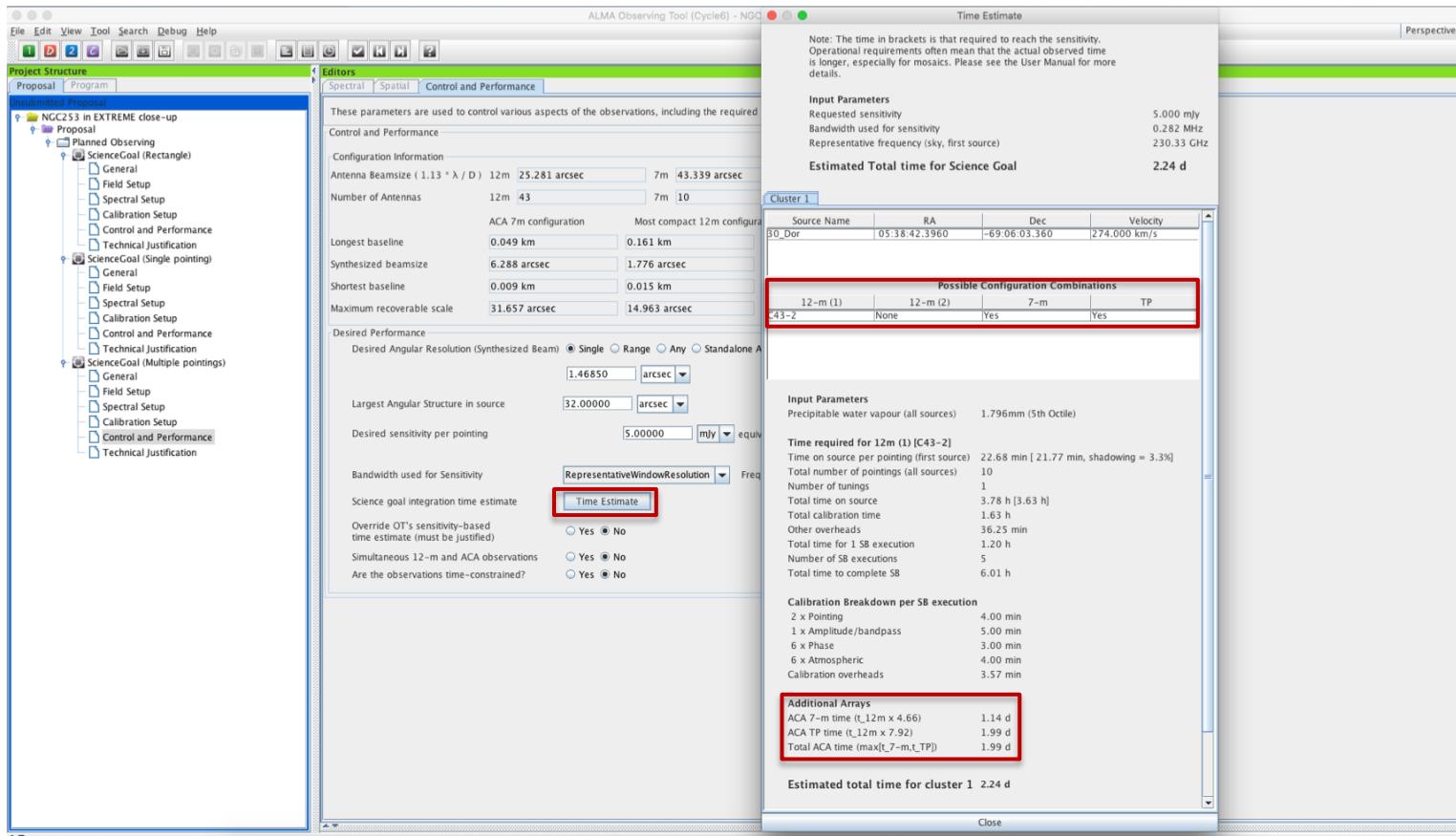
# Observing time

- ALMA time based on that required for largest interferometric array
  - User enters sensitivity, not time
  - ALMA Sensitivity Calculator derives required time
- Time for other configurations based on simulations
  - Time multipliers derived for all possible combinations
  - E.g. C43-4 : C43-1 : 7-m : TP = 1 : 0.4 : 5 : 8.5

TP time is always 1.7 times that of 7-m Array

# Time Estimate Dialogue

Shows time for 12-m, 7-m and TP plus the configurations that will be used



# Rastering (spectral line)

Also known as “On-The-Fly” mapping (OTF)

Multiple 1-D scans along one axis of rectangle

Use OFF position to correct for gain variations (must be free of line emission)

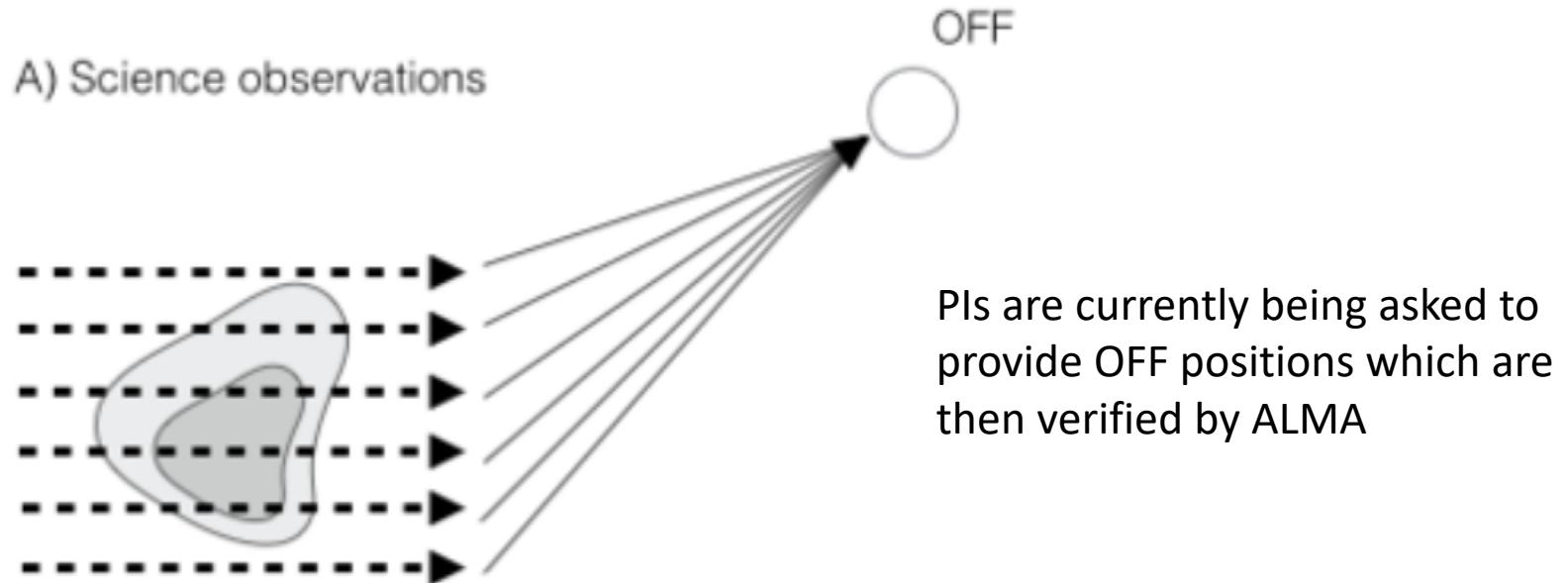


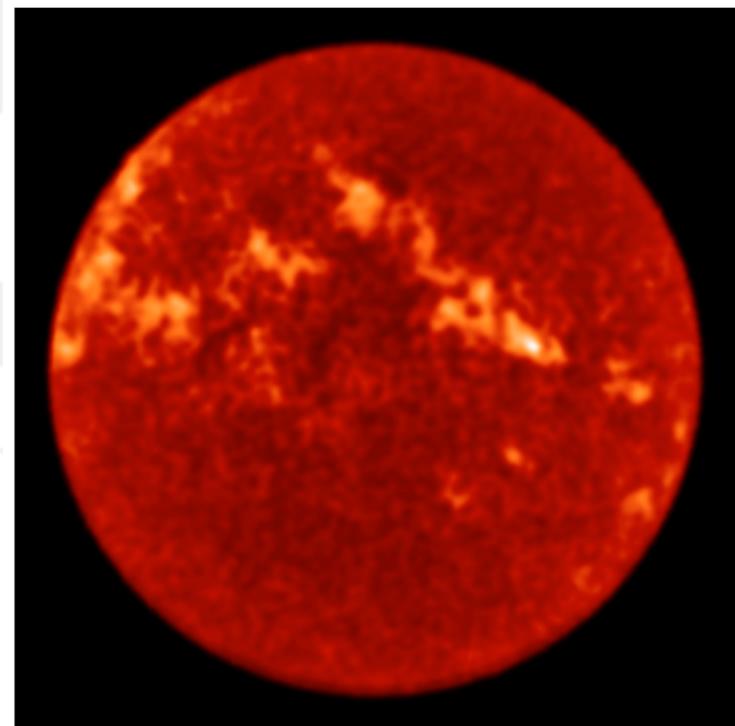
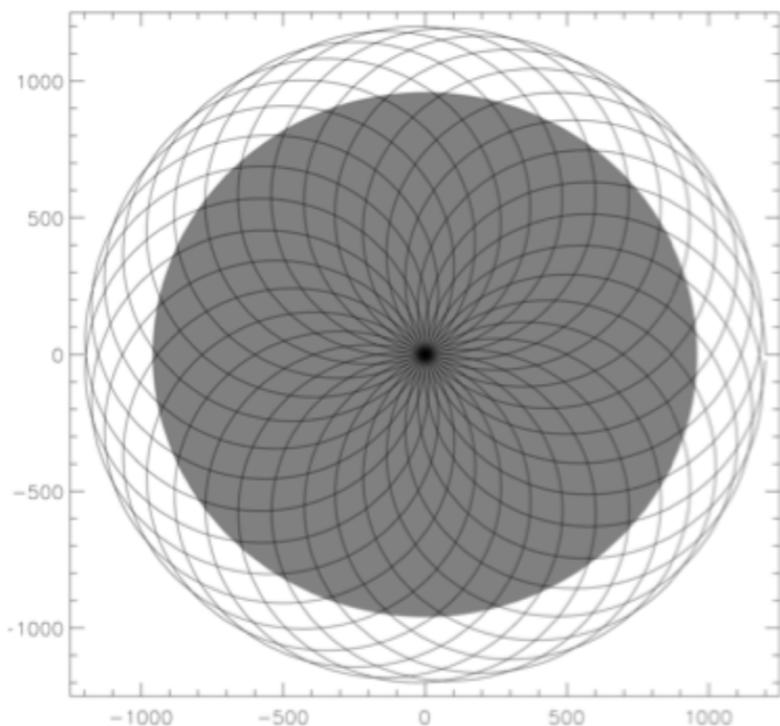
Image taken from CASA Cookbook

# Fast Scanning (continuum)

Currently only commissioned for solar observing

Uses “double-circle” pattern to scan solar disk in  $\gtrsim 7$  mins

Opacity changes calculable due to multiple passes through centre



Images taken from ALMA Technical Handbook

# Simultaneous observing

- Simultaneous 12-m + 7-m observing new in Cycle 5
- 7-m time set equal to that of 12-m
- Requested by the planetary community
  - Time not driven by sensitivity
  - Want to monitor source variability in multiple arrays
  - Arrays not meant to be combined
- Available for first time in Cycle 6 with TP

# Summary

- TP maps needed when imaging large sources
  - OT schedules TP automatically based on source LAS
- All (non-solar) TP done using rectangular raster maps
  - OT will derive a rectangle from individual pointings
  - Spectral line only
- PI currently asked to provide OFF positions
- Total power capabilities will expand in future cycles
  - Bands 9 and 10
  - Continuum for non-solar