

Introduction to the basic concepts and terminology of radio interferometry



EUROPEAN ARC
ALMA Regional Centre || Germany



Universität zu
Köln

ALMA community days

German ARC node – April 2017



Outline

Part 1: by L. Moser

- Introduction to aperture synthesis
- Interferometers: spatial filters

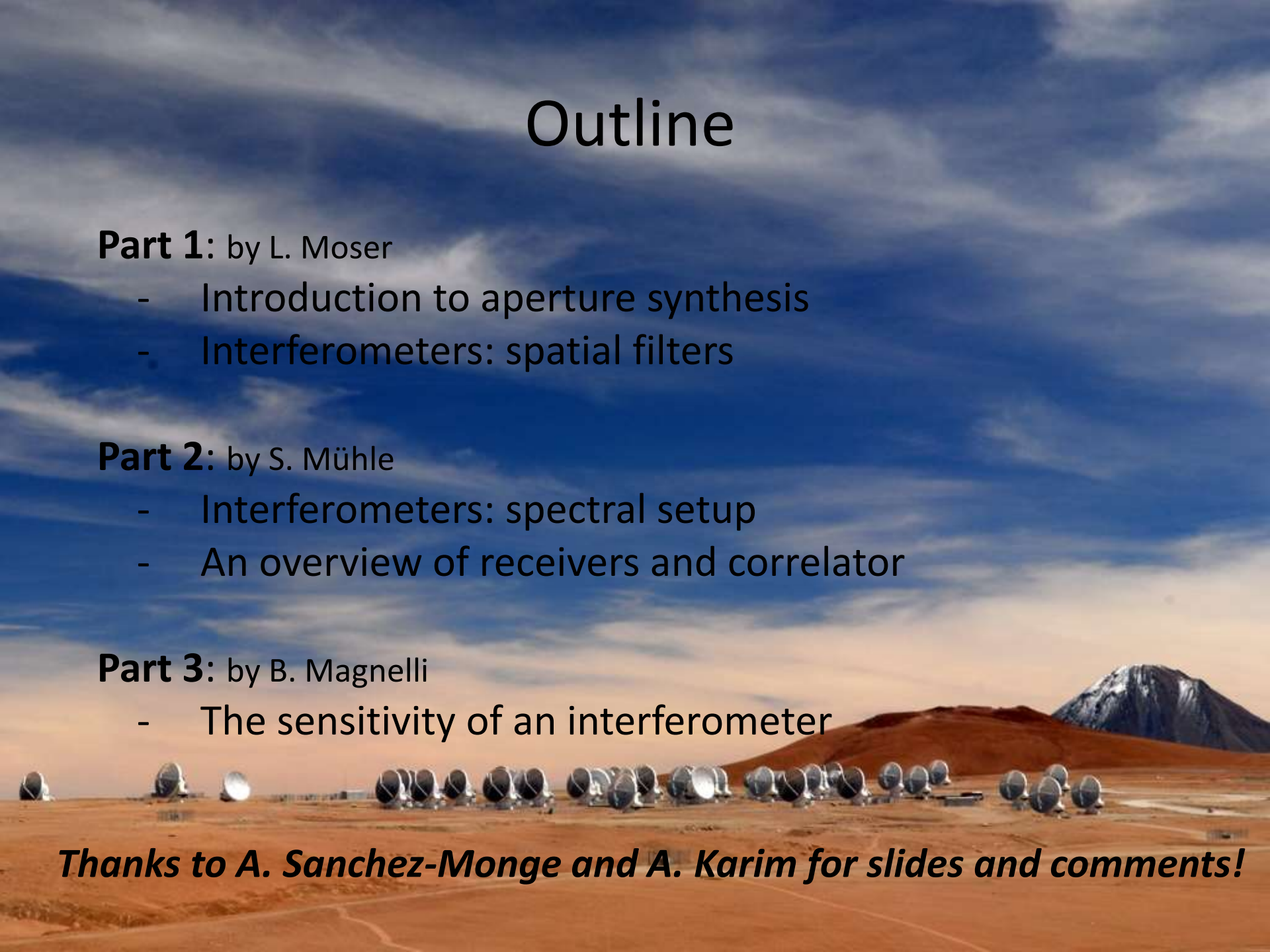
Part 2: by S. Mühle

- Interferometers: spectral setup
- An overview of receivers and correlator

Part 3: by B. Magnelli

- The sensitivity of an interferometer

Thanks to A. Sanchez-Monge and A. Karim for slides and comments!



Part 1: aperture synthesis, spatial filters



German ARC: ALMA community days (March 2017)

Atacama Large Millimeter/submillimeter Array



Image credit: Mélisse Bonfand

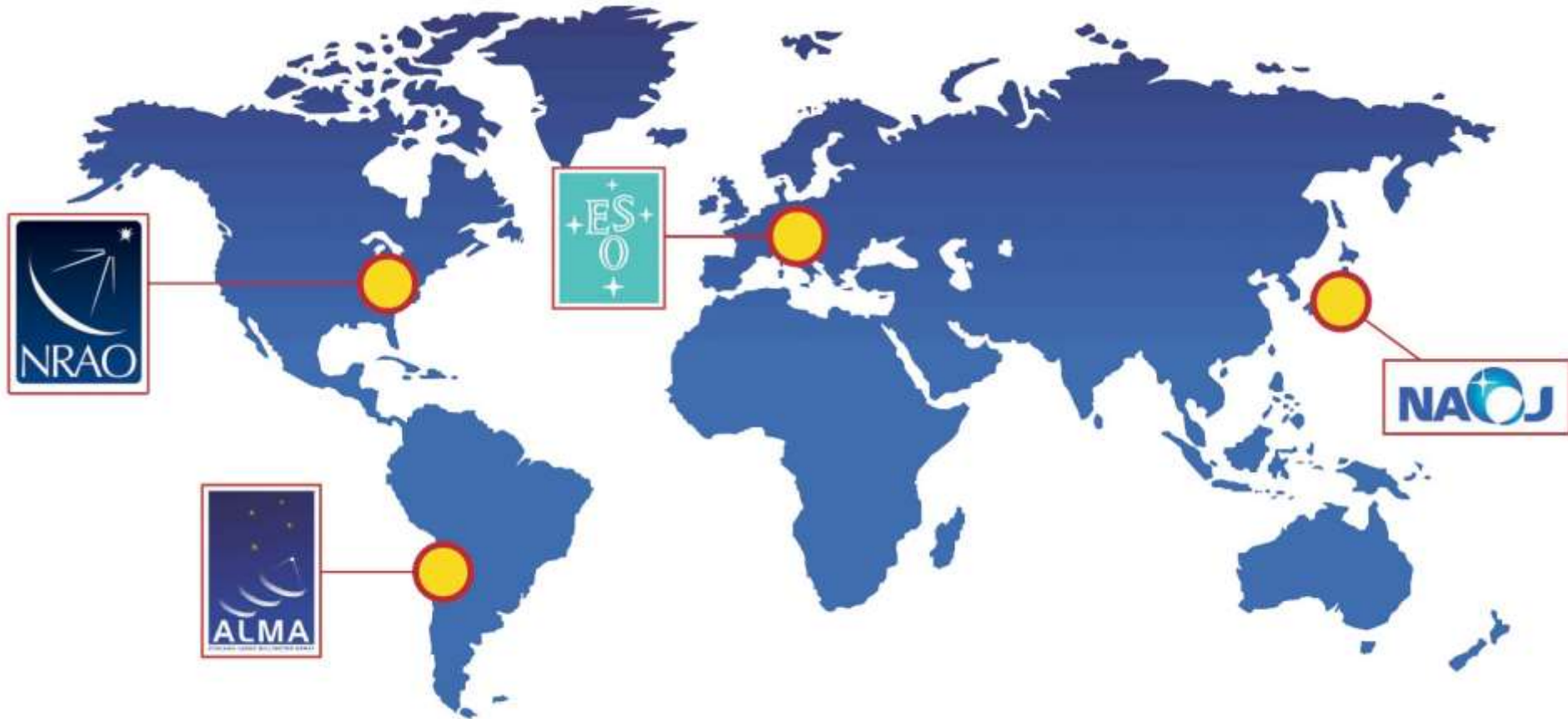
Where is ALMA?

Atacama desert (Chile)

- ... on the Chajnantor Plateau
- at 5000 m height
- ... control center
- at 2900 m height



What is ALMA?



International collaboration:

3 ARC (ALMA Regional Centers) + JAO (Joint ALMA Observatory)

What is ALMA?

ALMA in Cycle 5 is ...



What is ALMA?

ALMA in Cycle 5 is ...

43x

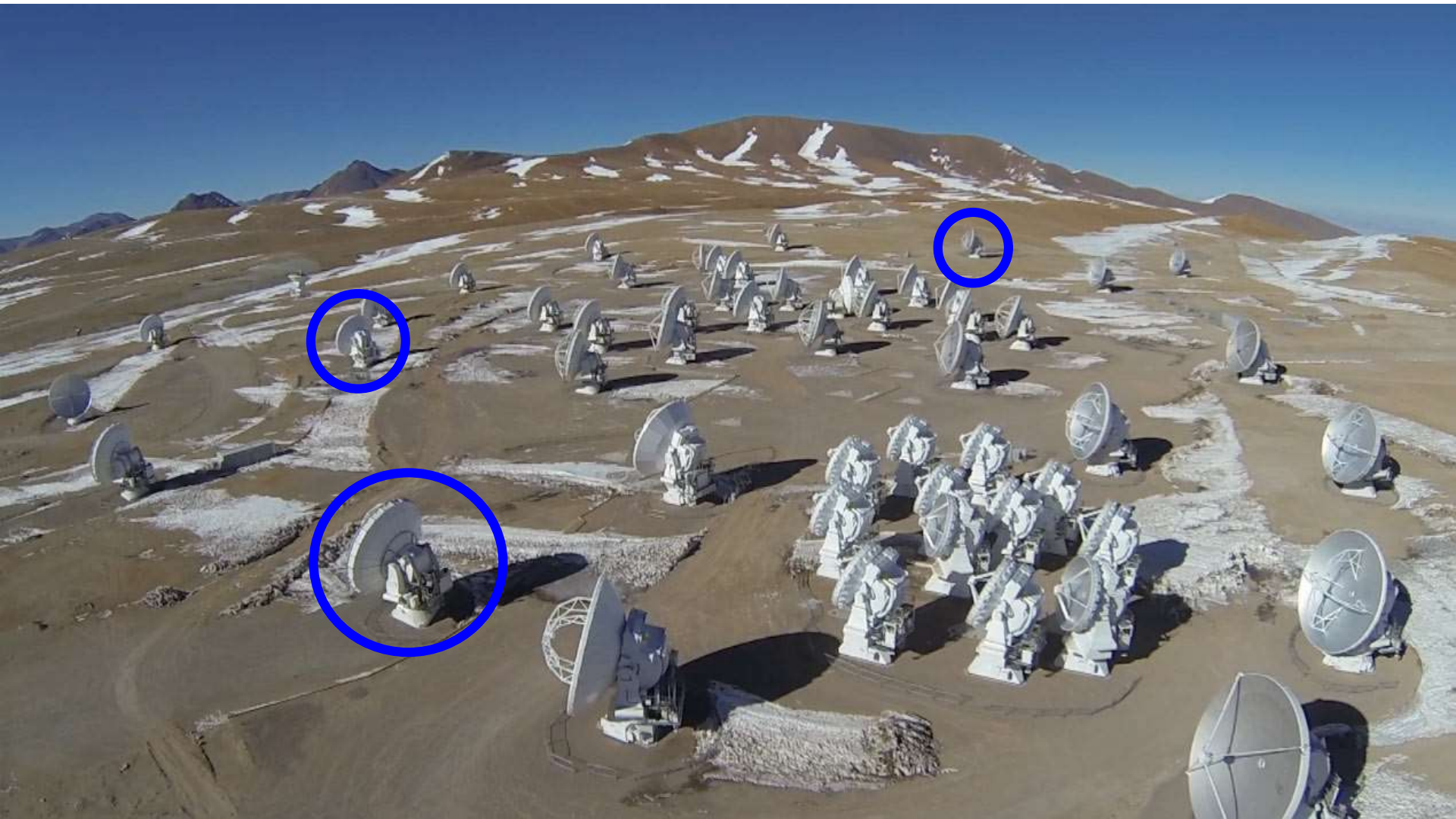
12m antennas

10x

7m antennas (ACA)

3x

12m antennas (TP)



What is ALMA?

ALMA in Cycle 5 is ...

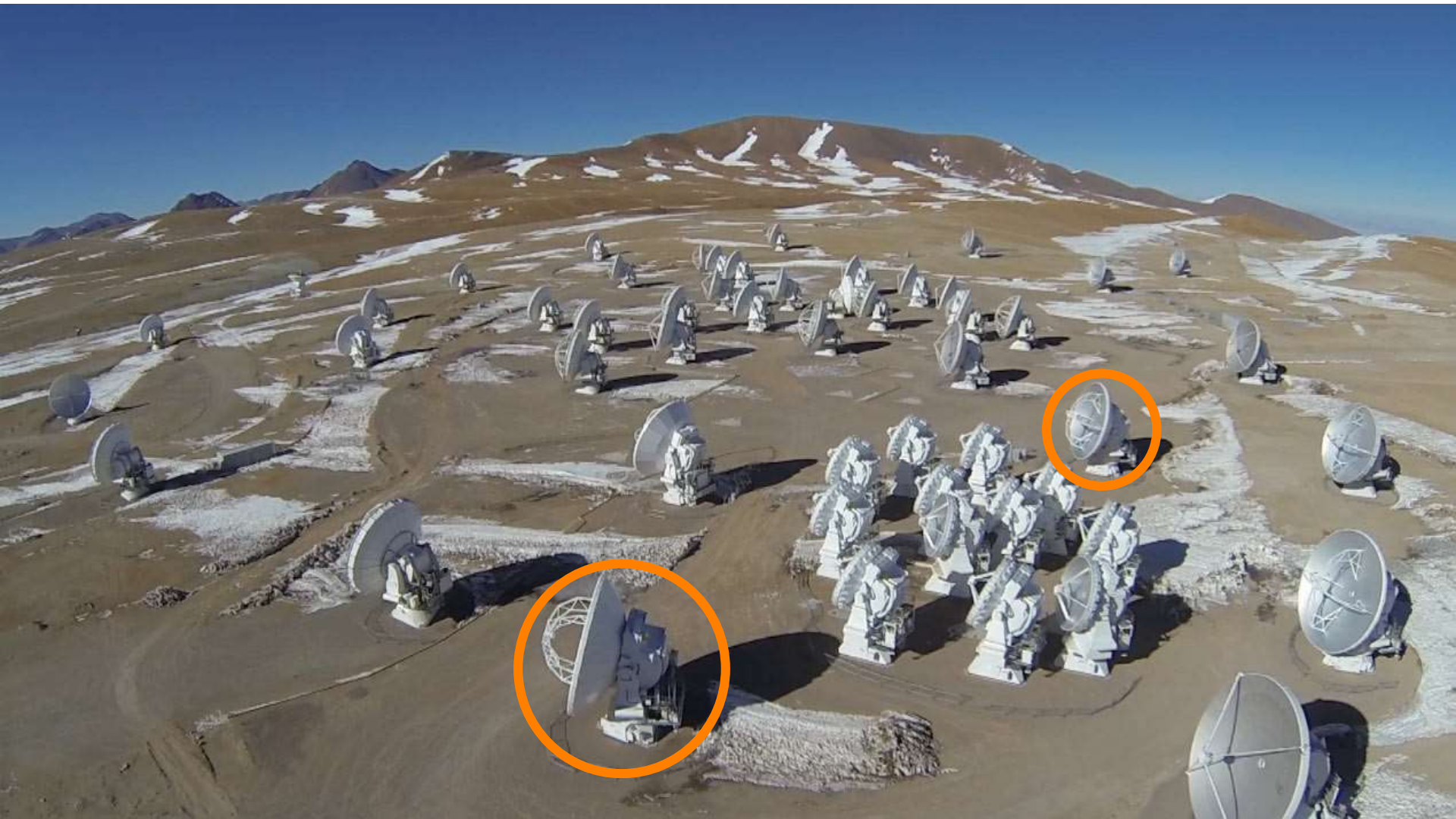
43x	12m antennas
10x	7m antennas (ACA)
3x	12m antennas (TP)



What is ALMA?

ALMA in Cycle 5 is ...

43x 12m antennas
10x 7m antennas (ACA)
3x 12m antennas (TP)



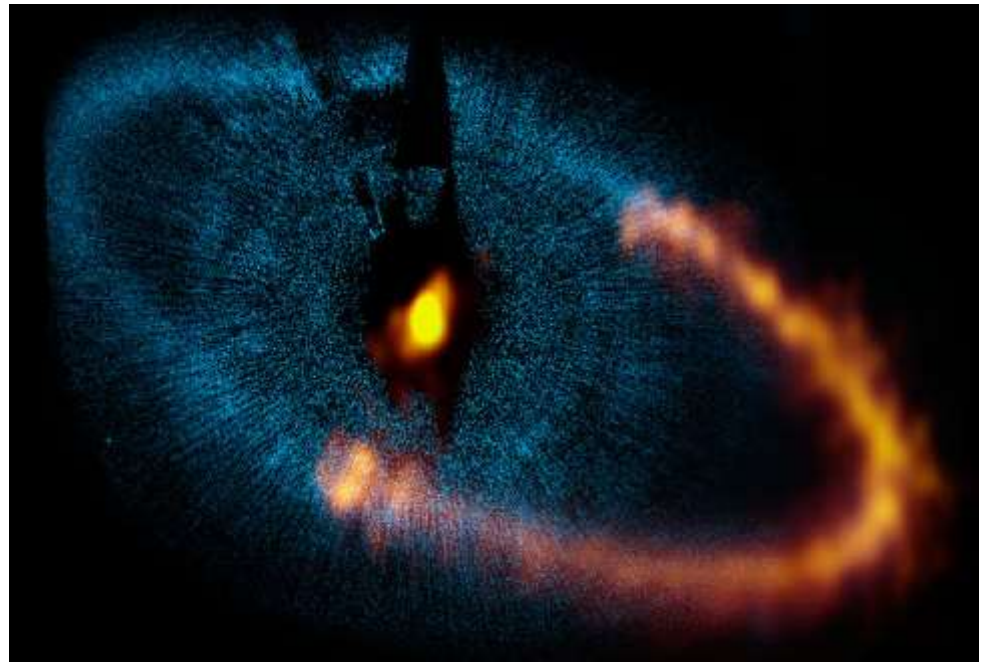
What can ALMA do?

HL Tau



protoplanetary disks

Formalhaut



debris disks

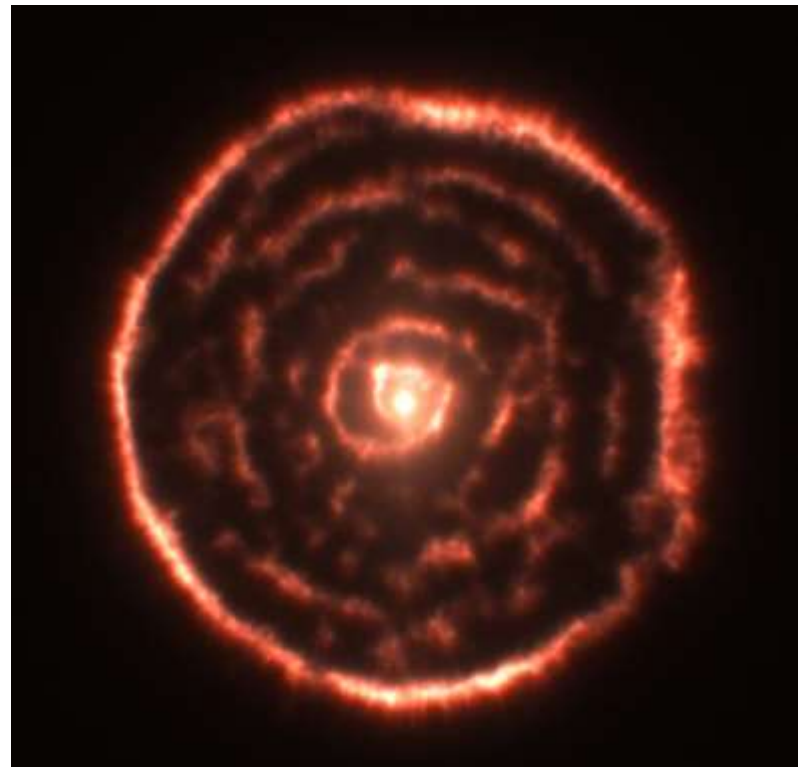
What can ALMA do?

Herbig-Haro 46/47



molecular outflows and jets

R Sculptoris



red giants and old stars

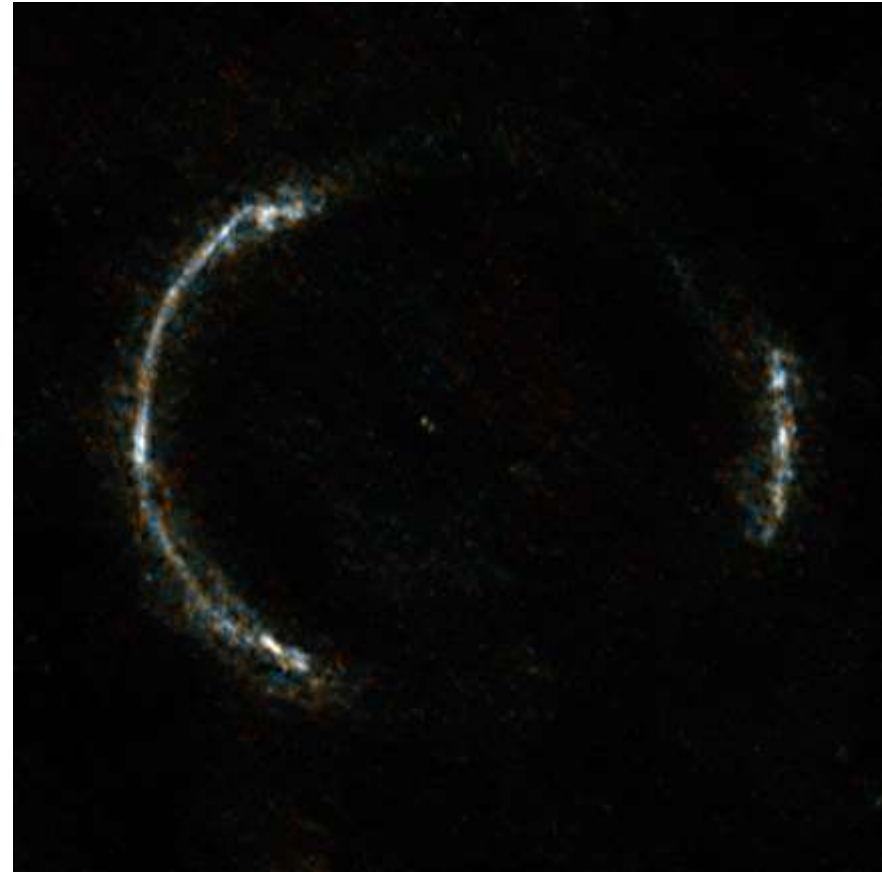
What can ALMA do?

Antennae galaxies

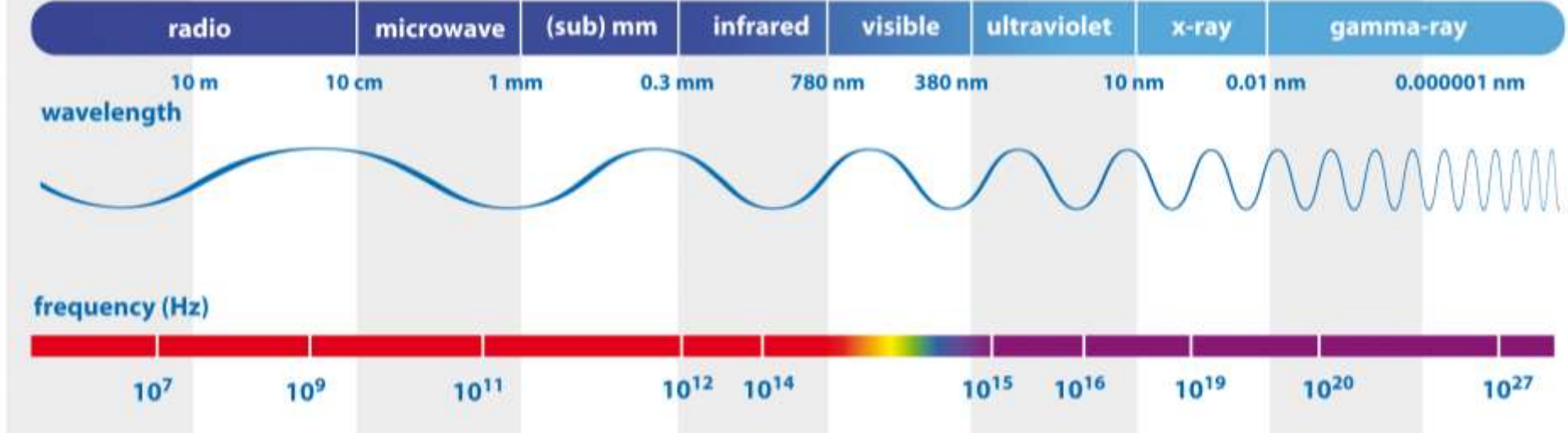


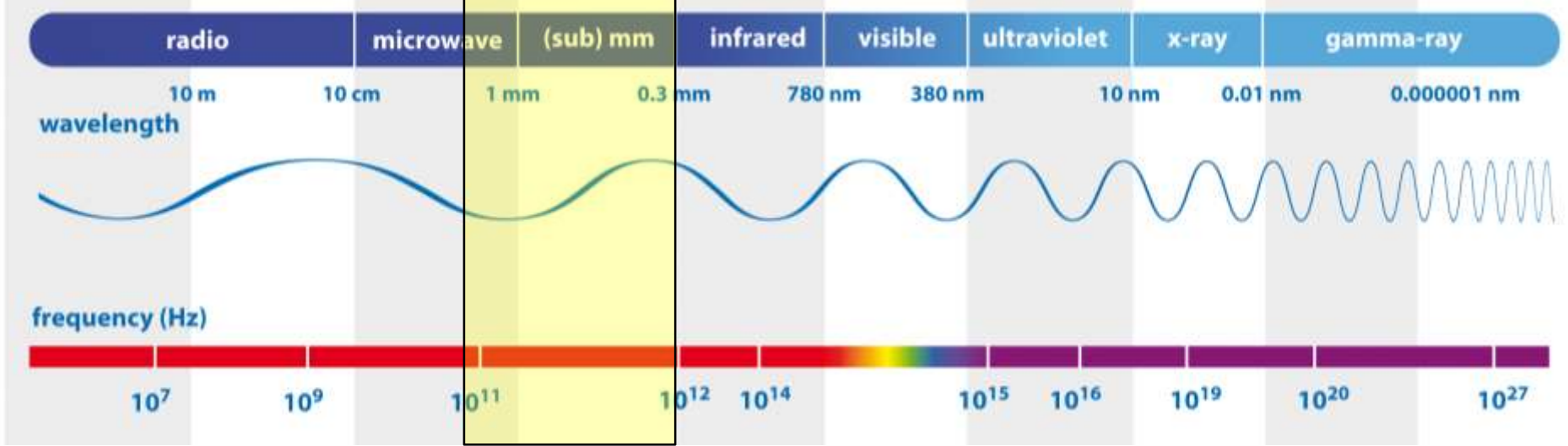
galaxy mergers

SPT.81



lensed galaxies





ALMA observable range
“Cold Universe”

Why is ALMA on the Chajnantor plateau?

... at this altitude (5000 m) the water vapor in atmosphere is low

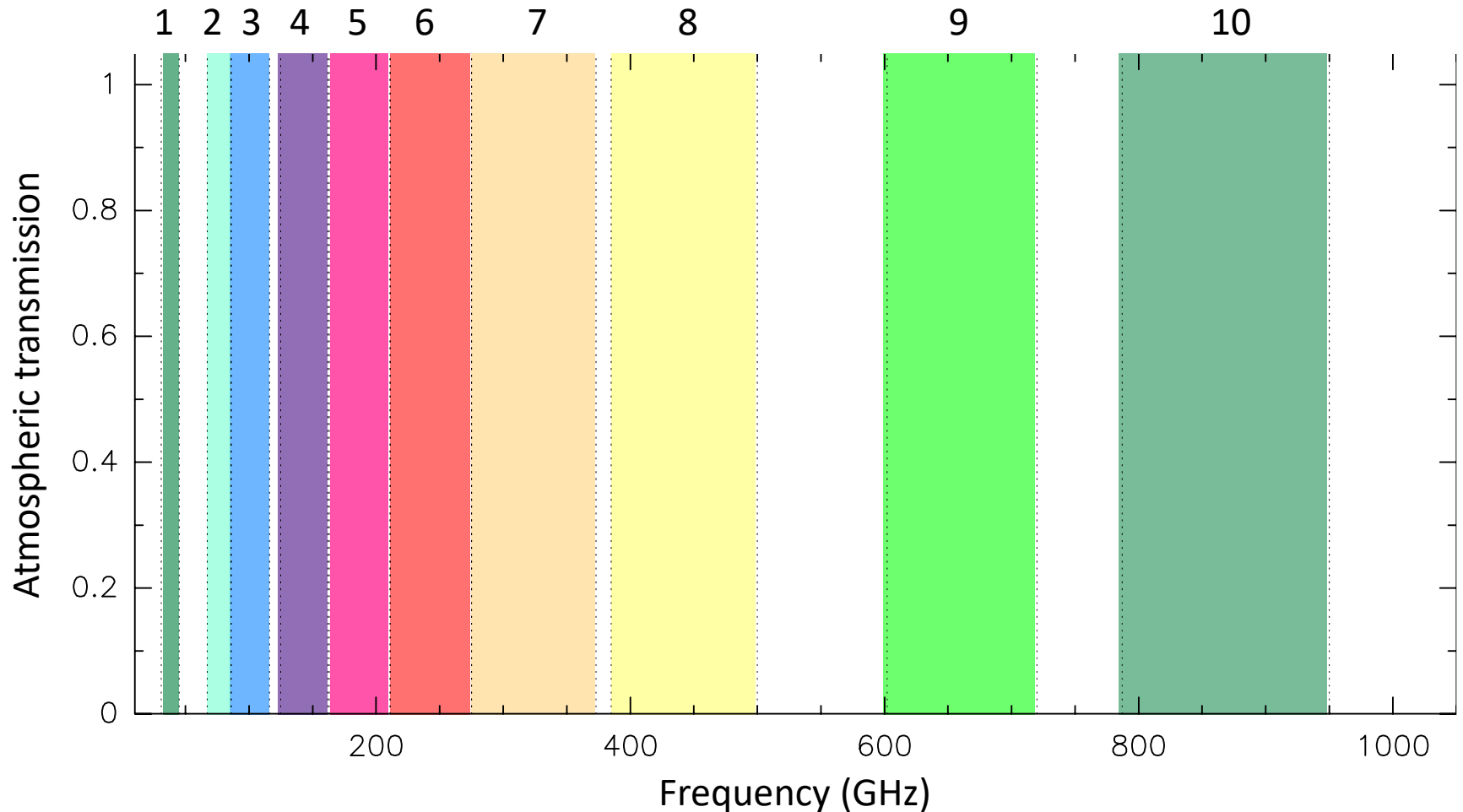
1 feet = 0.3 meters



Why is ALMA on the Chajnantor plateau?

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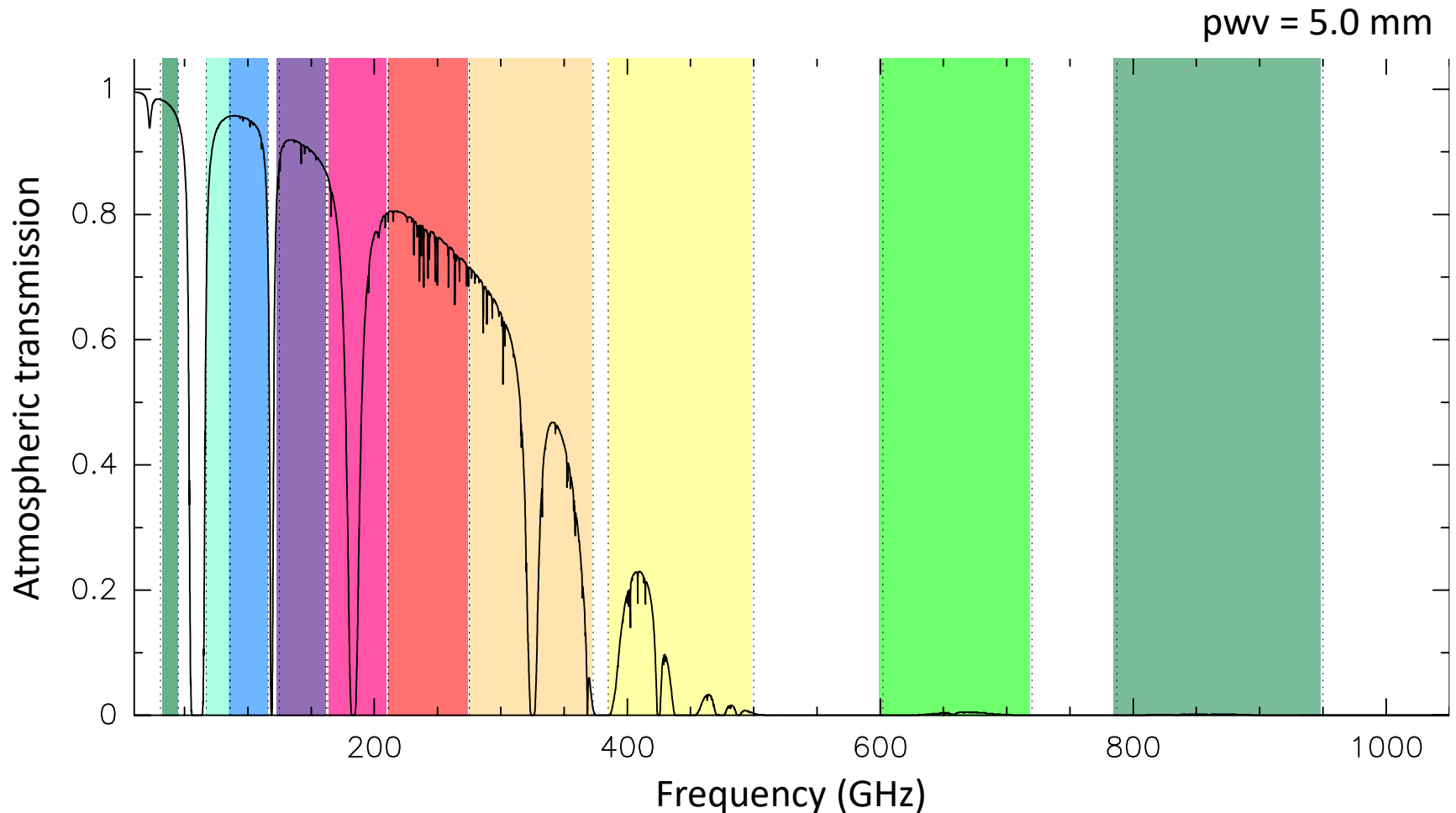
ALMA frequency bands



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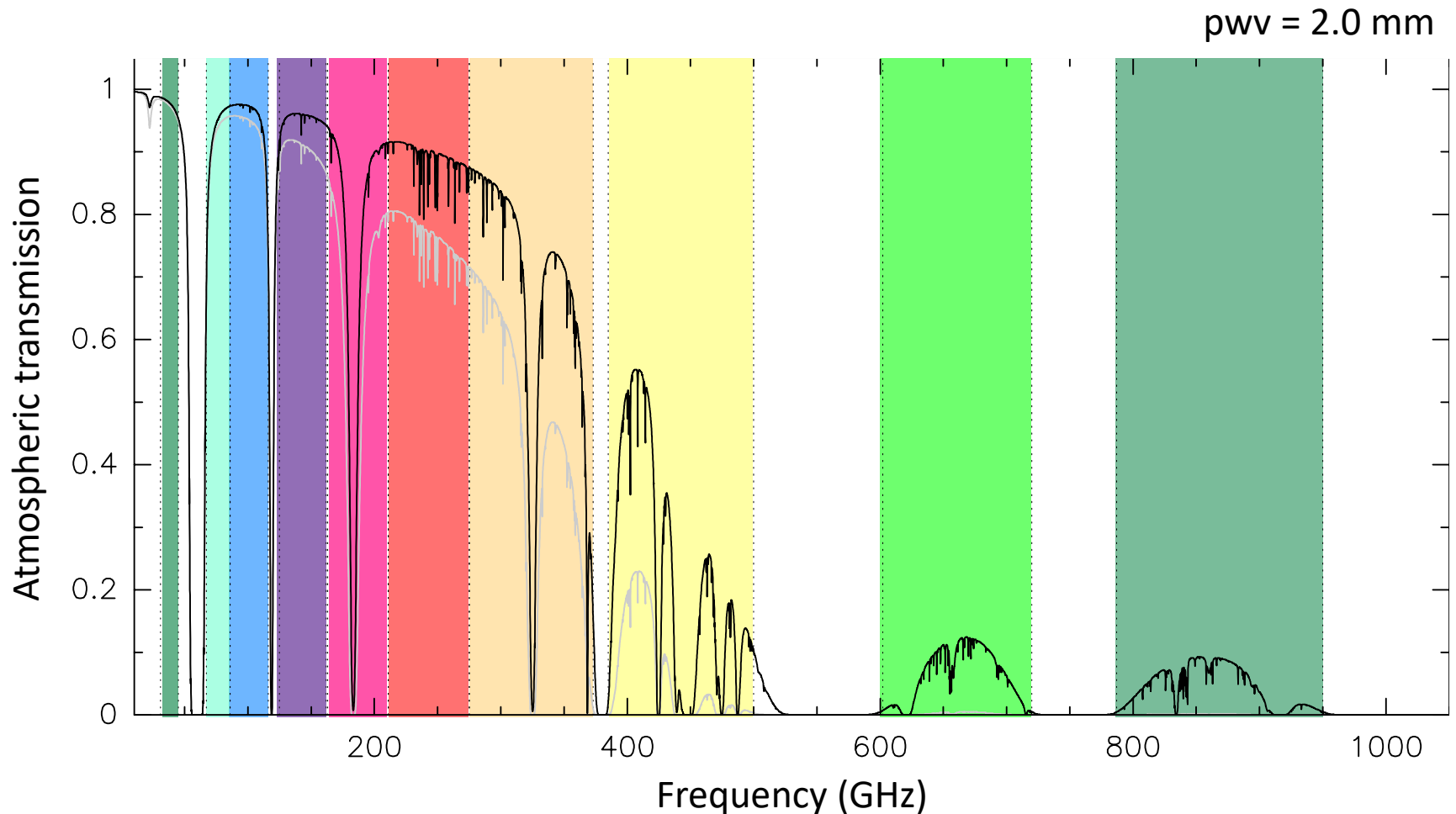
ALMA frequency bands



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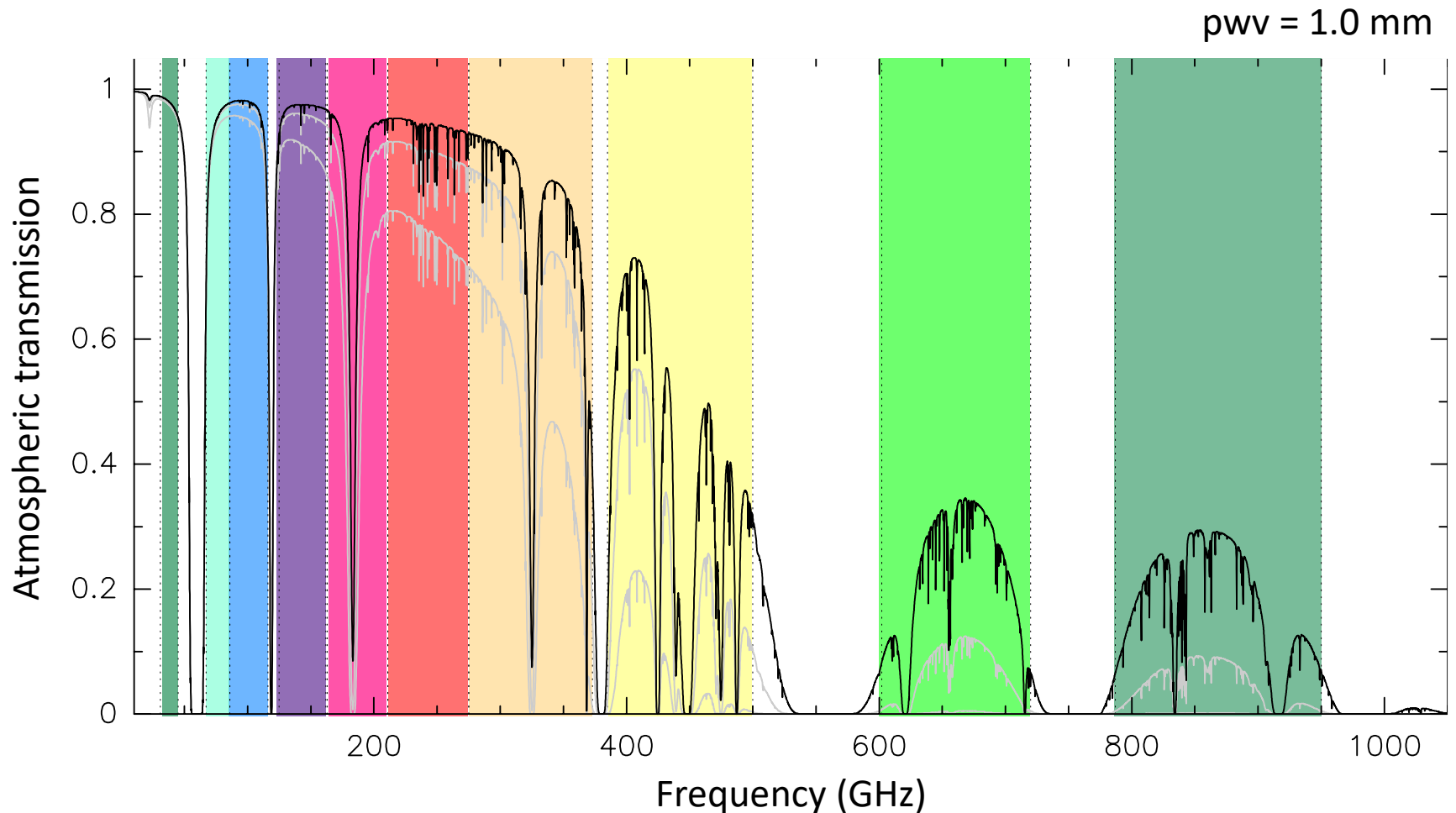
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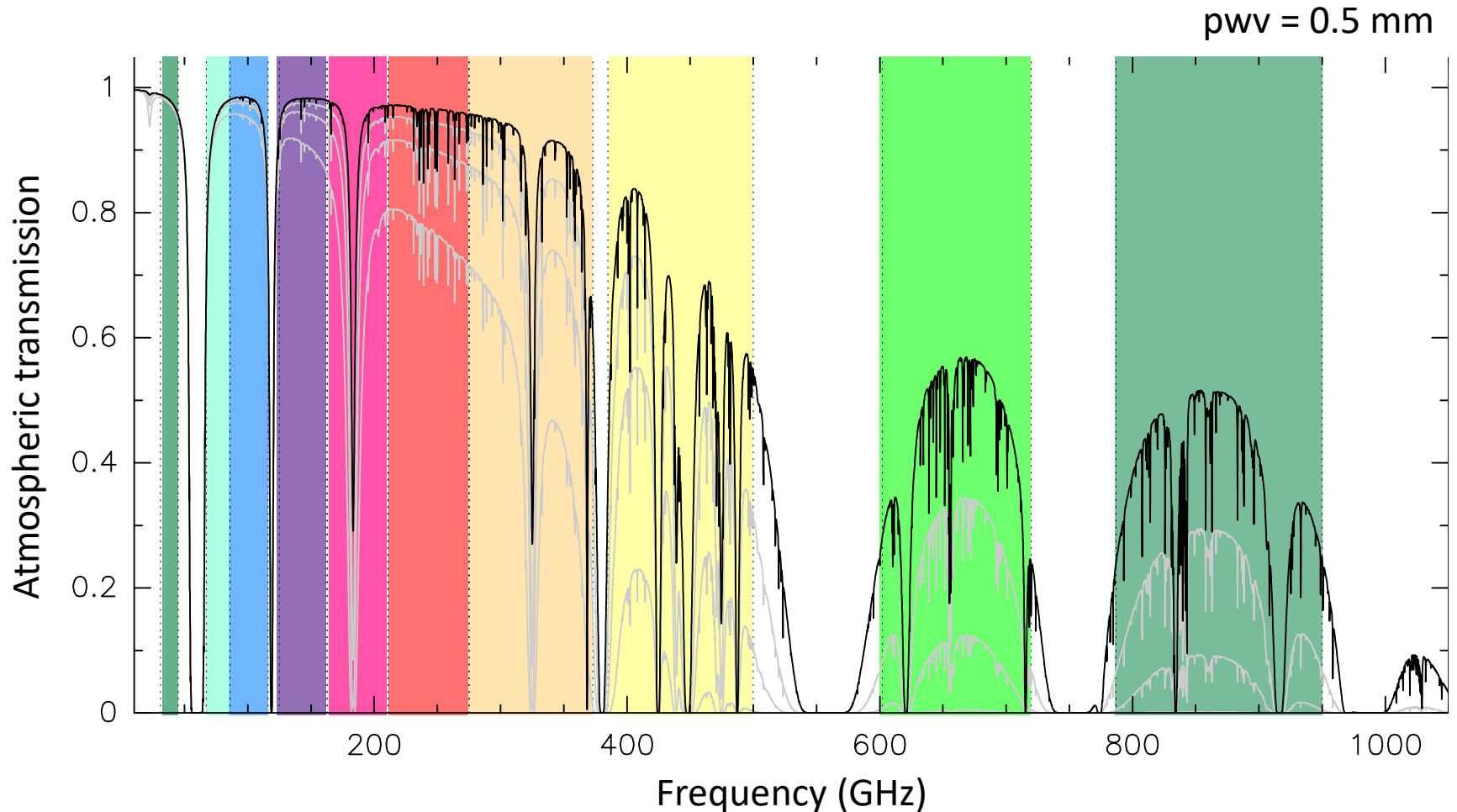
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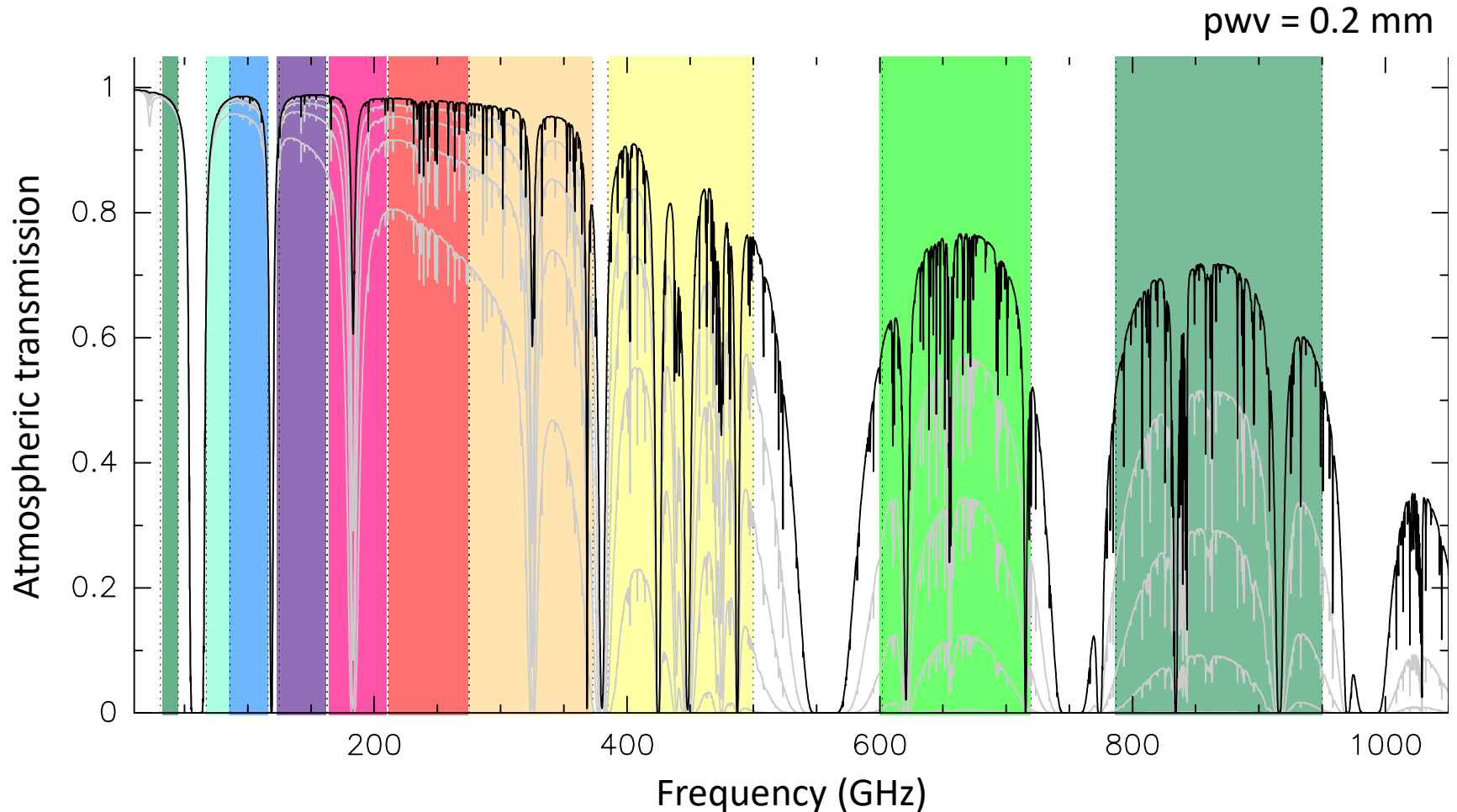
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ALMA frequency bands



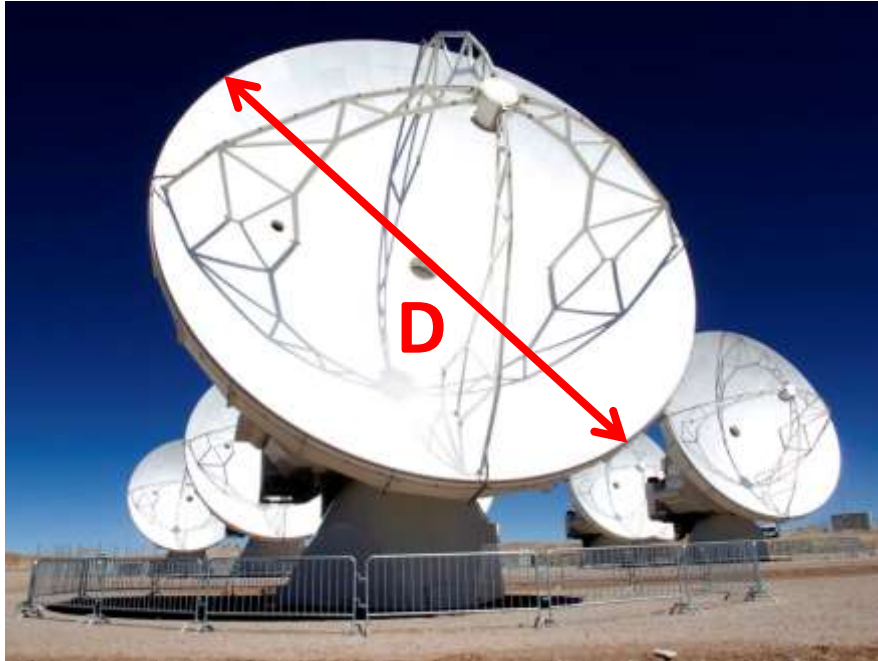
Why so many antennas? ... instead of one



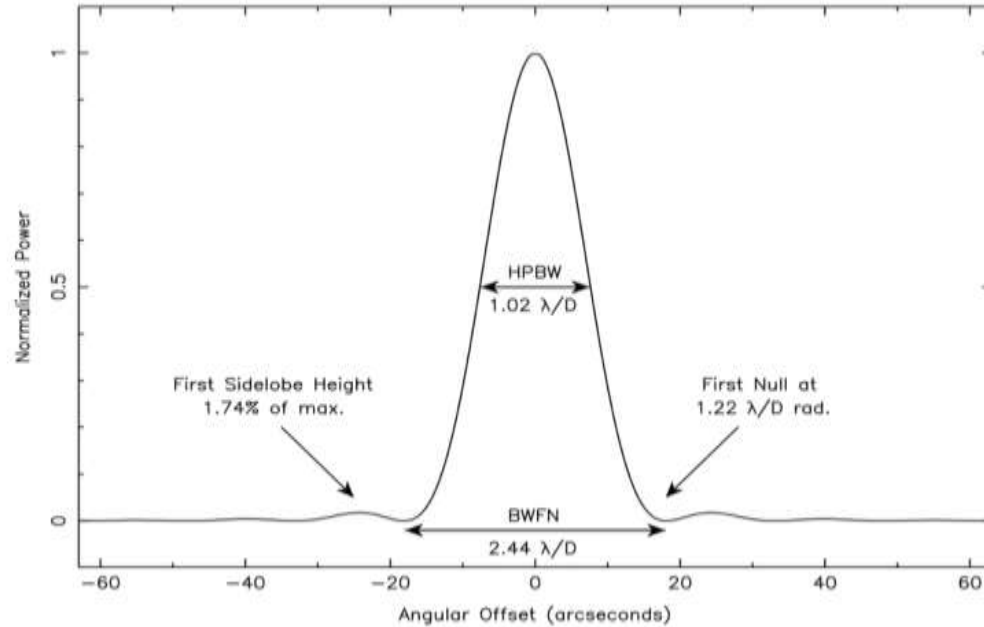
Image credit: Mélisse Bonfand

Single-dish response

Single-dish with diameter D

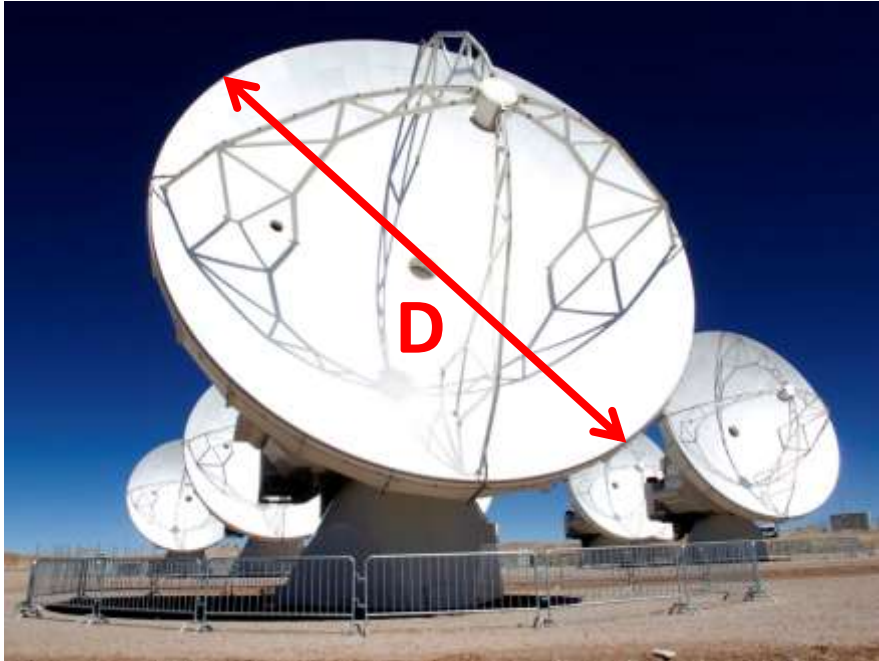


(1D) antenna power response

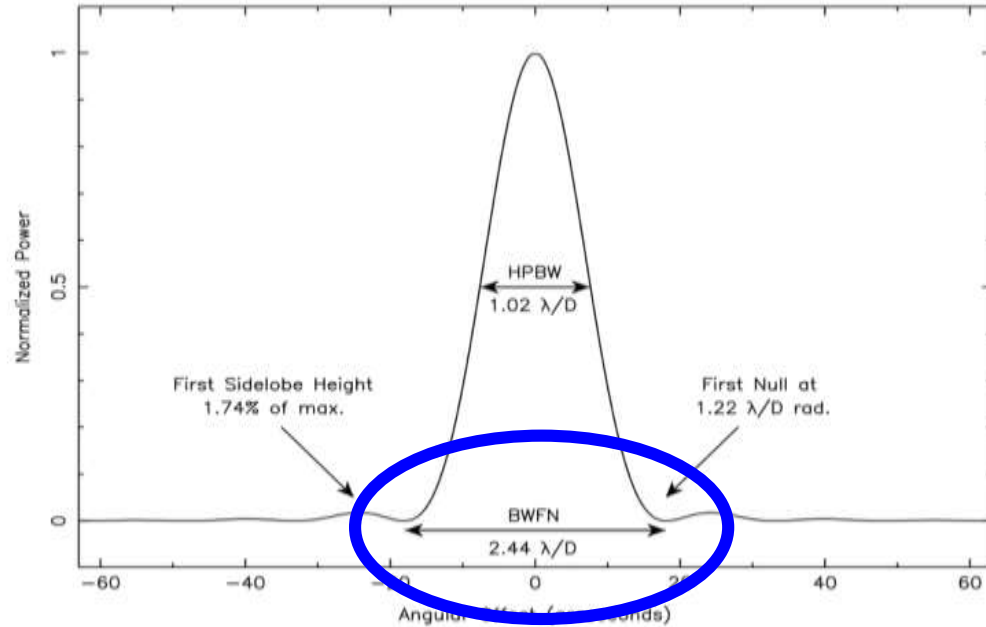


Single-dish response

Single-dish with diameter D



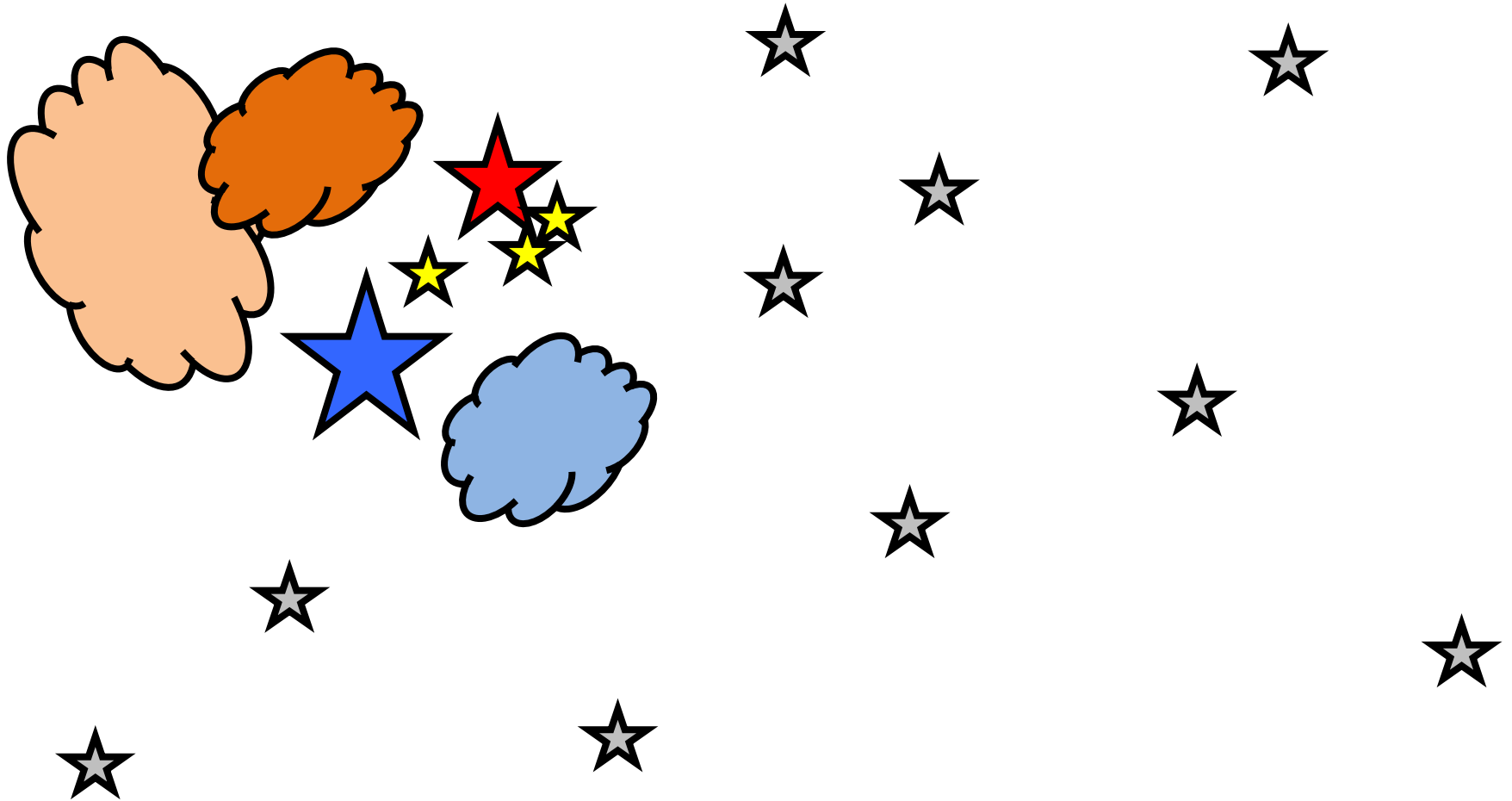
(1D) antenna power response



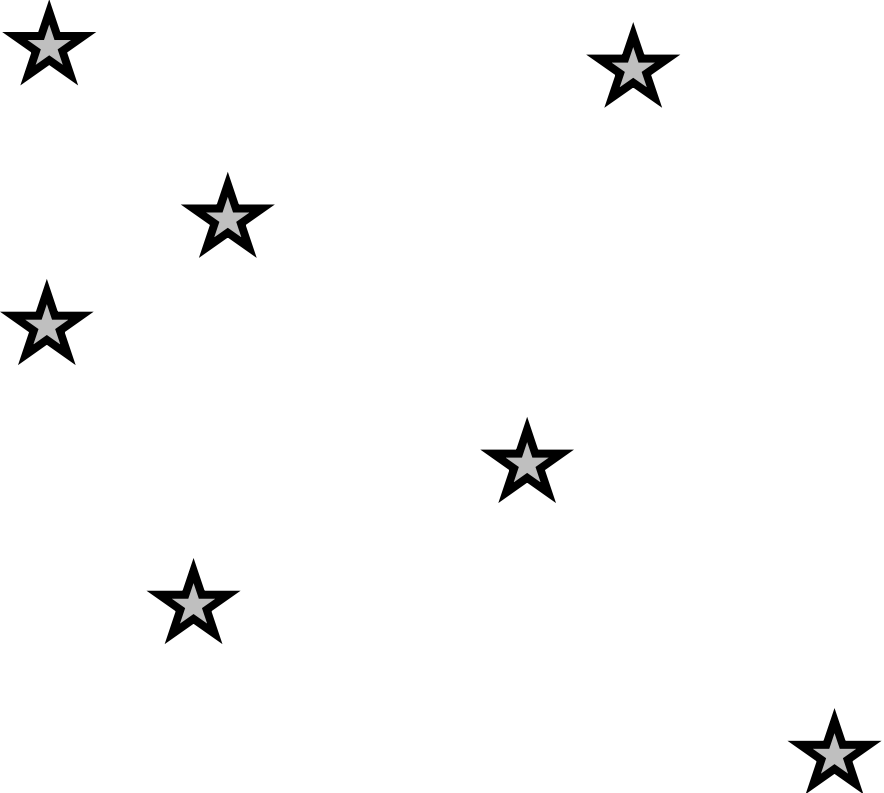
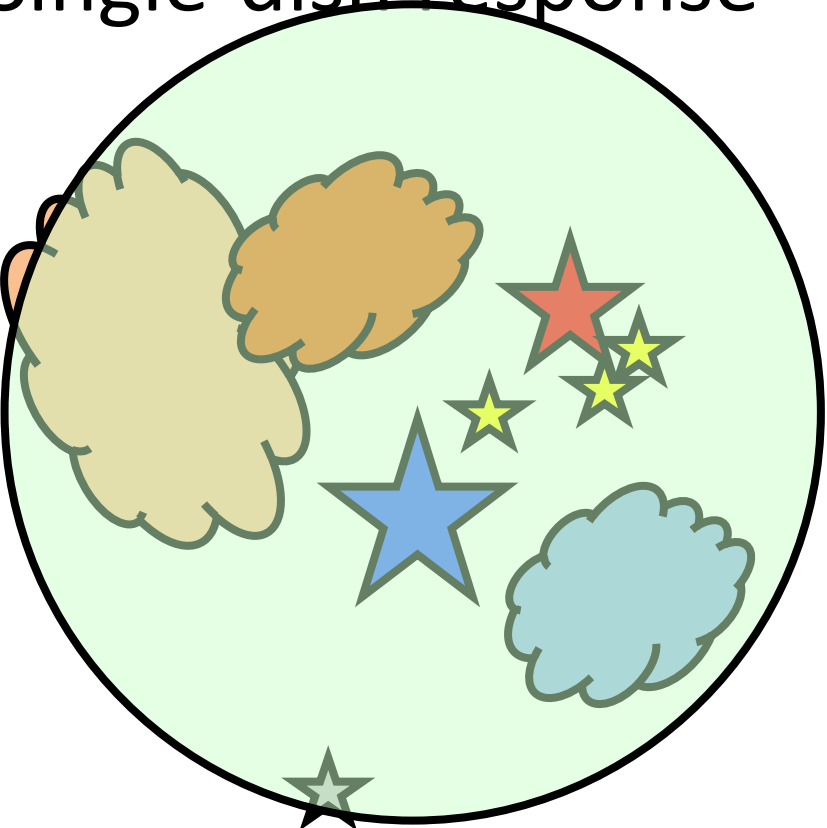
$$PB = 1.22 \frac{\lambda}{D}$$

PRIMARY BEAM

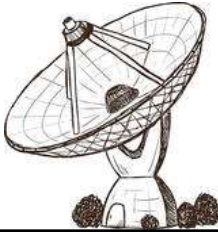
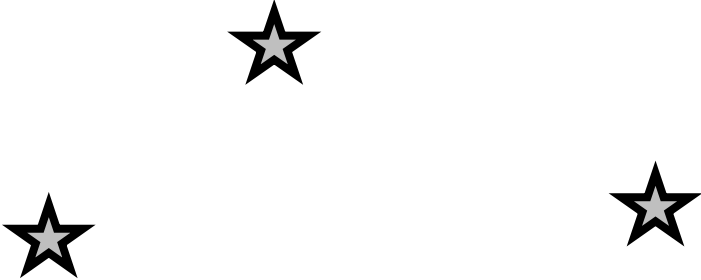
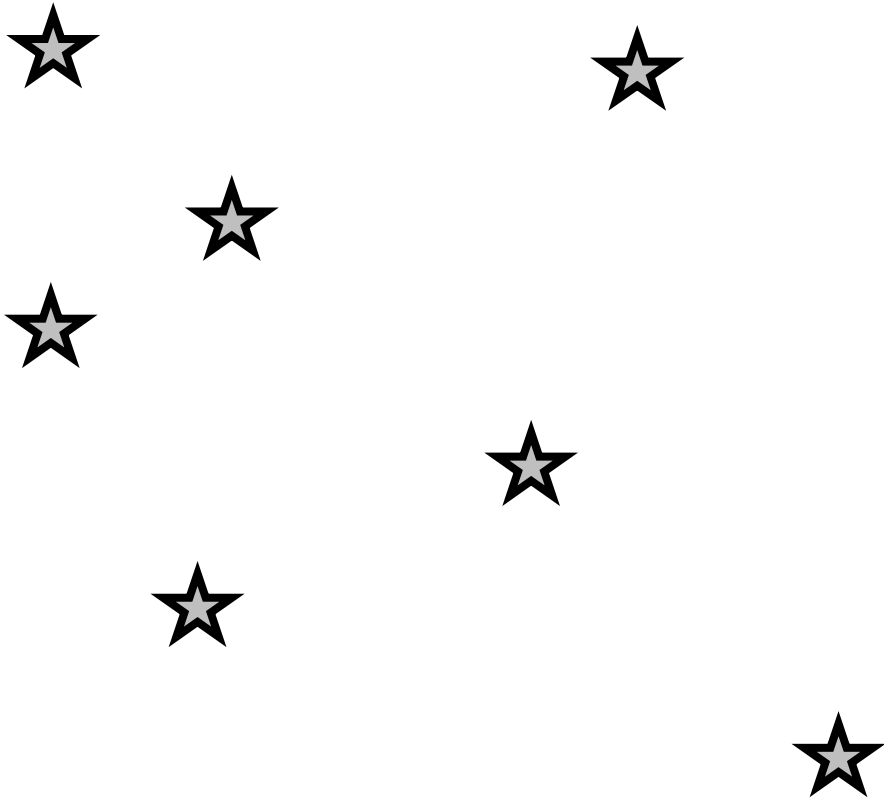
Single-dish response



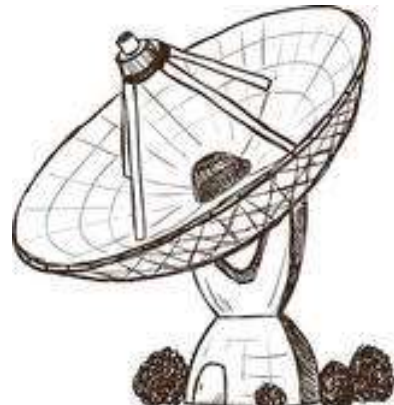
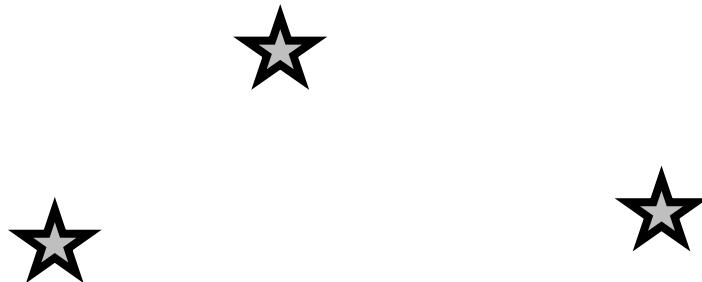
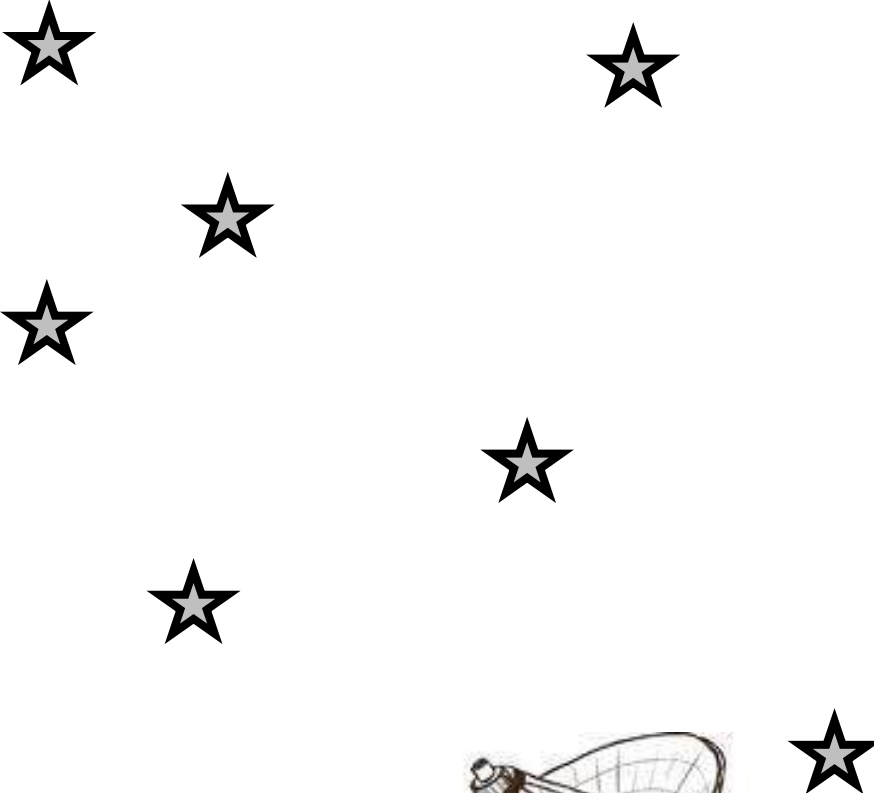
Single-dish response



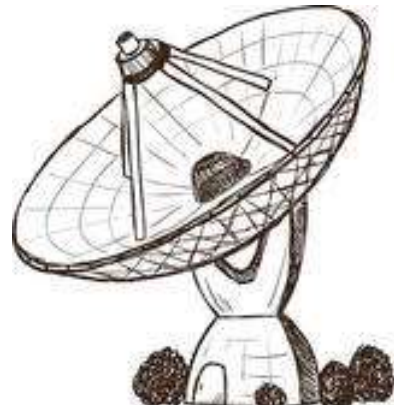
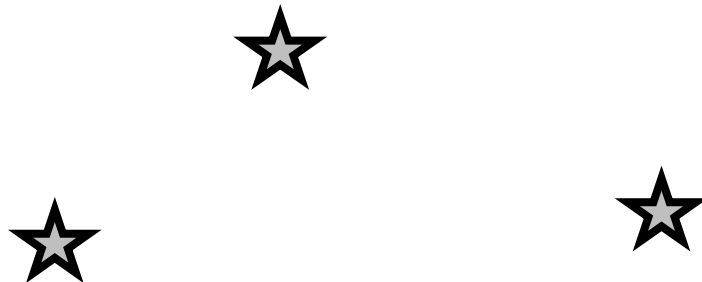
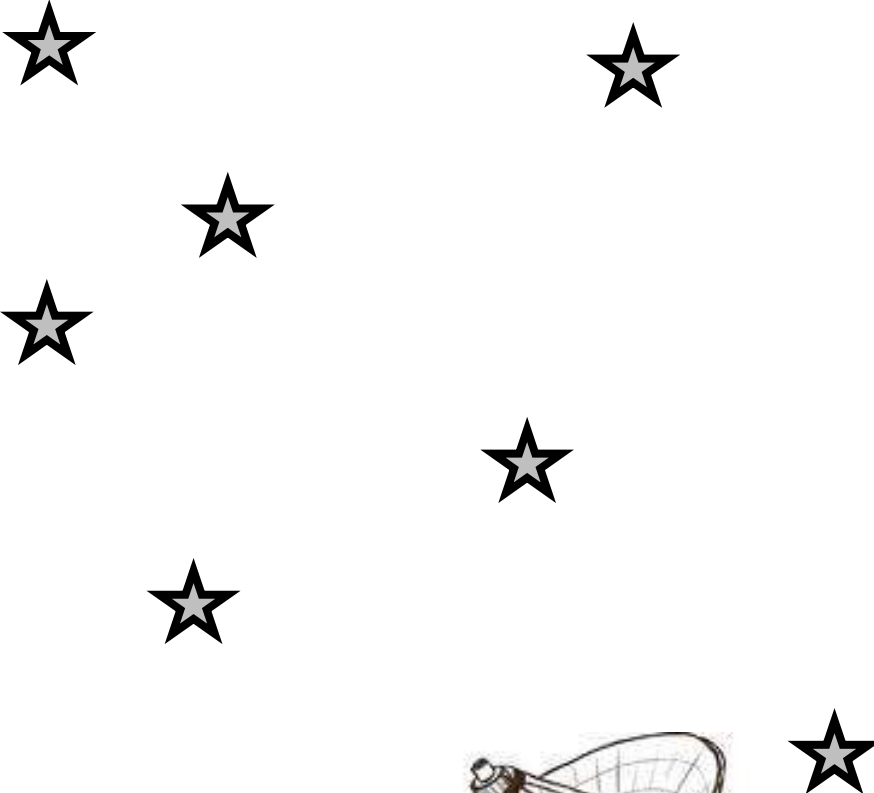
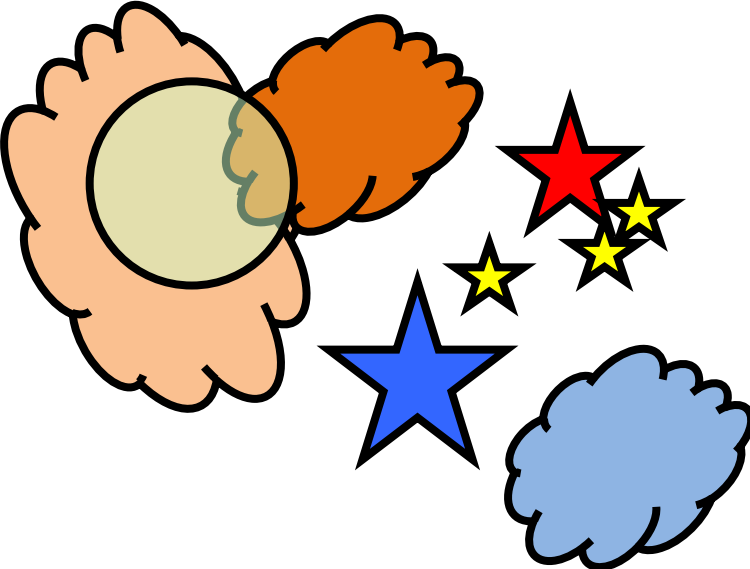
Single-dish response



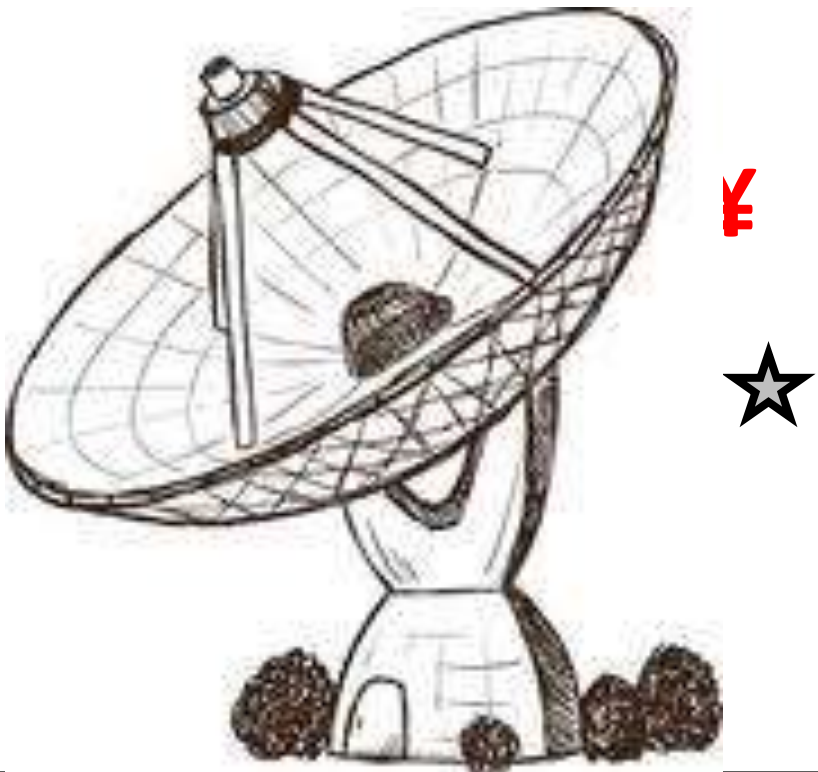
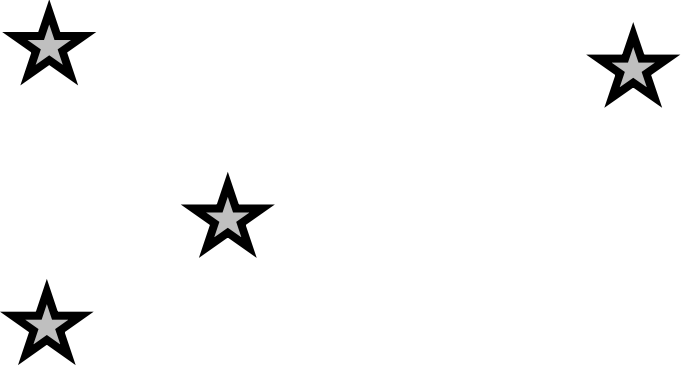
Single-dish response



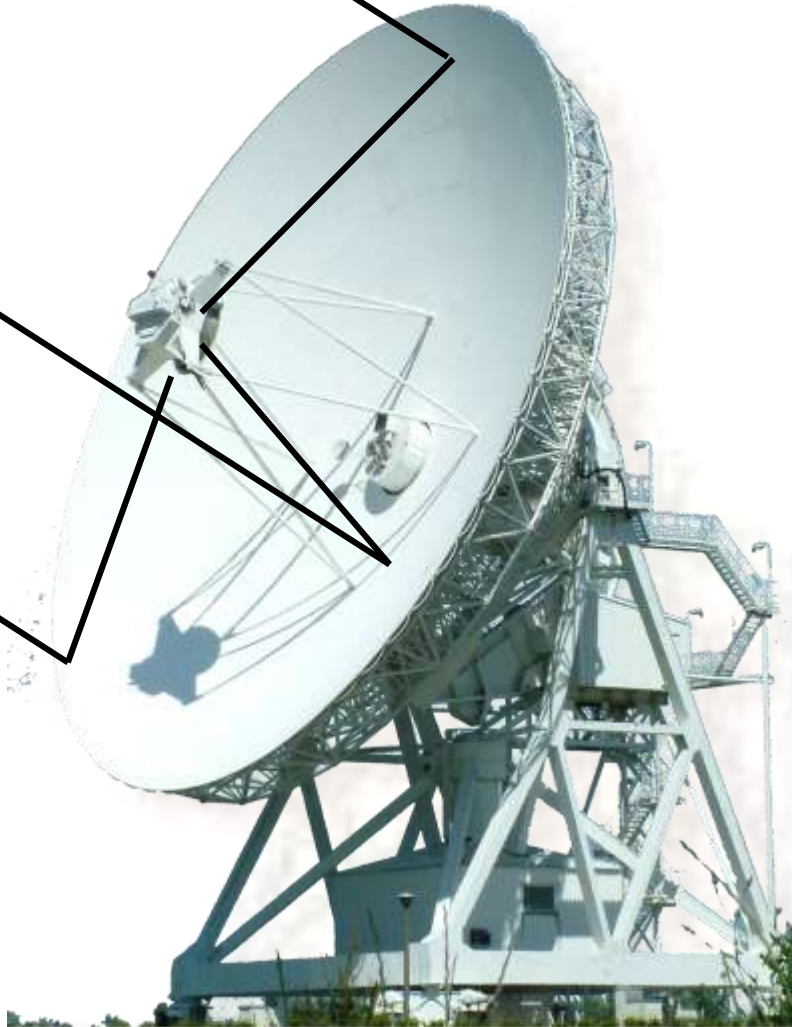
Single-dish response



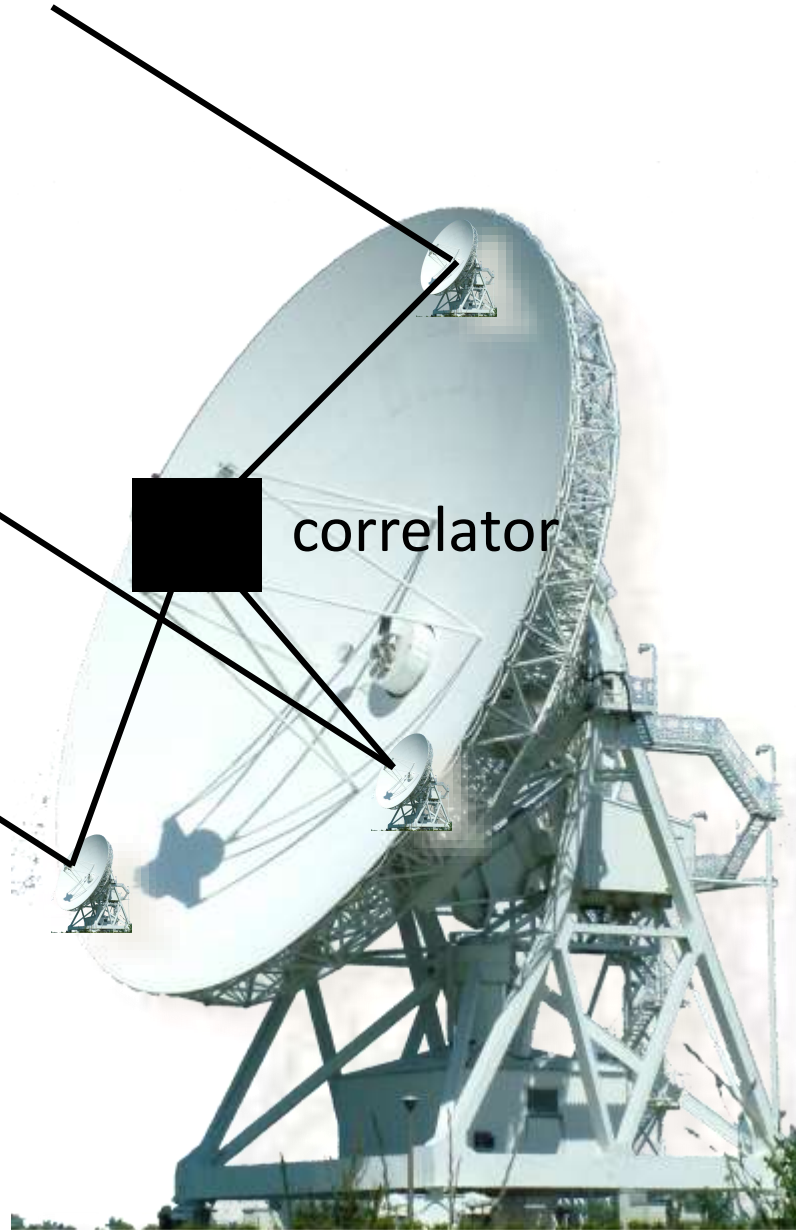
Single-dish response



Interferometer – multiple dishes



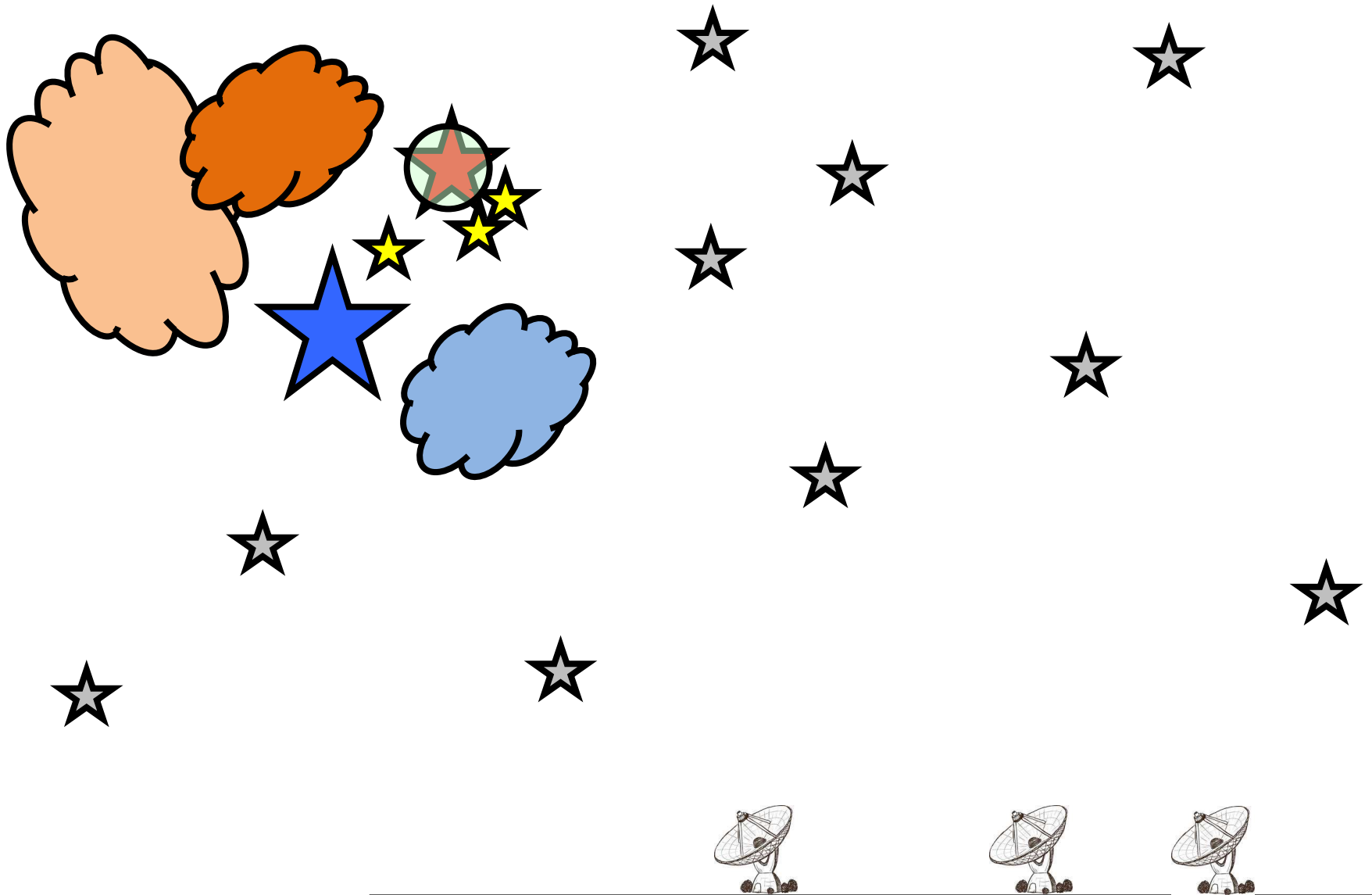
Interferometer – multiple dishes



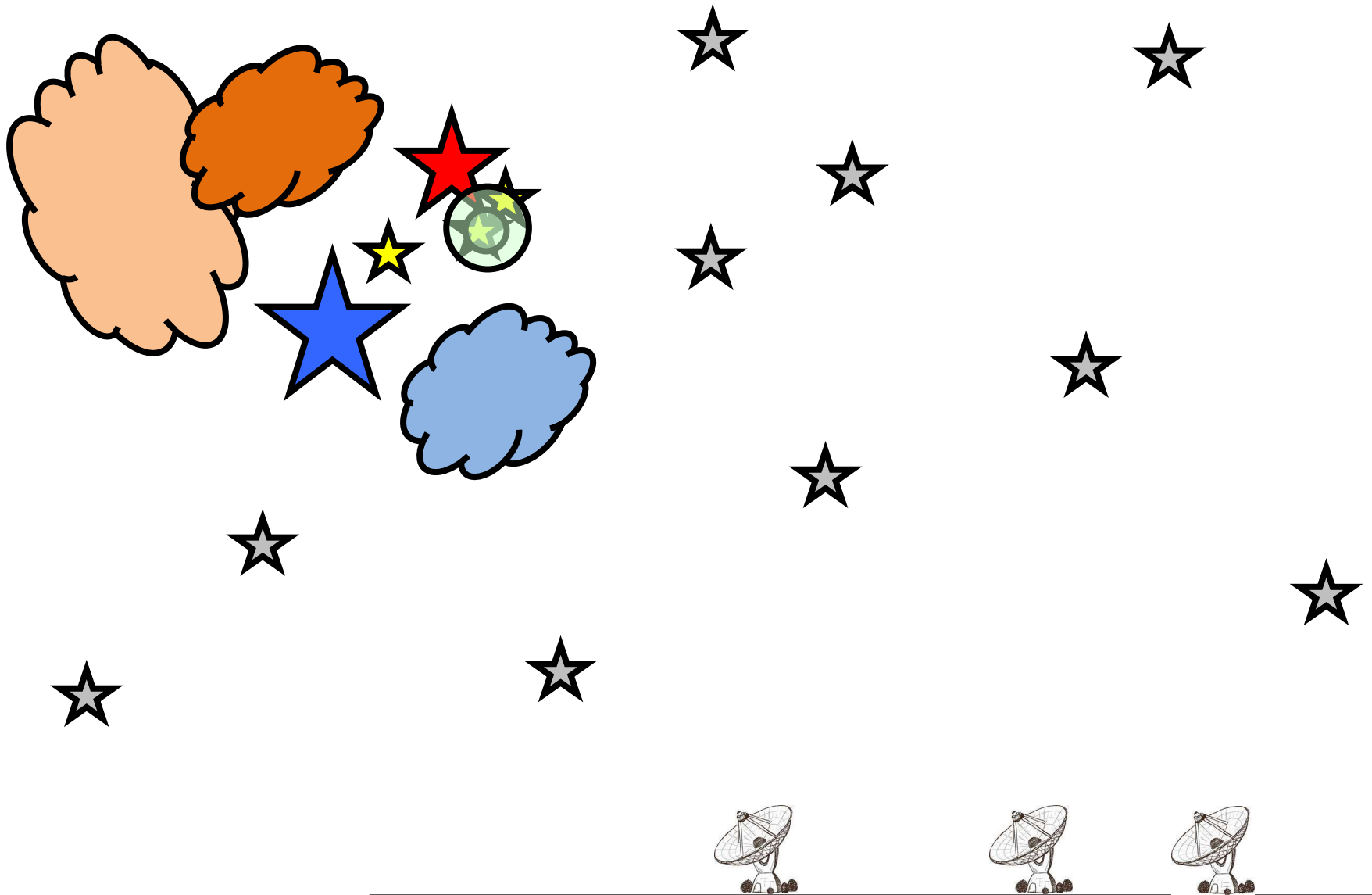
Interferometer – multiple dishes



Interferometer – multiple dishes

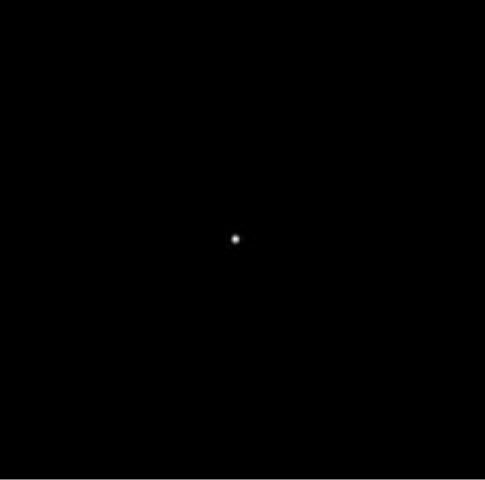


Interferometer – multiple dishes



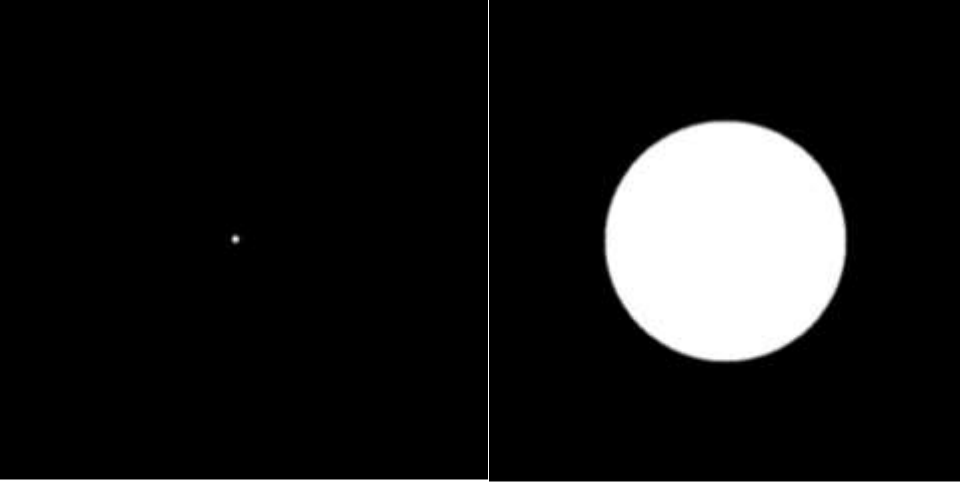
Interferometer – multiple dishes

Small Single-Dish



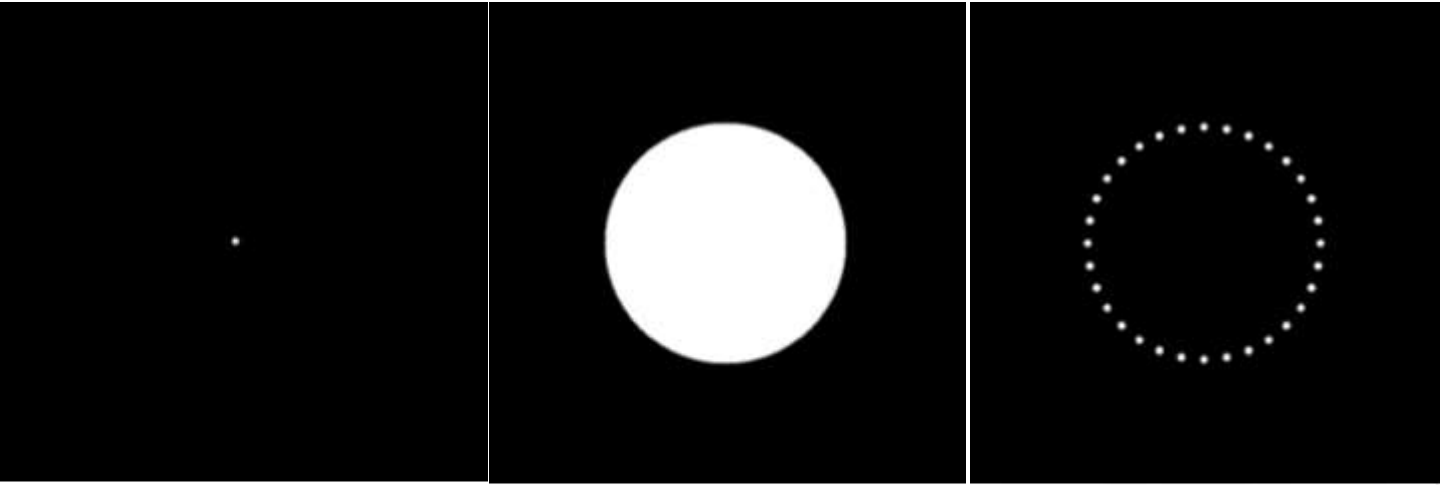
Interferometer – multiple dishes

Large Single-Dish



Interferometer – multiple dishes

“Circular” dishes

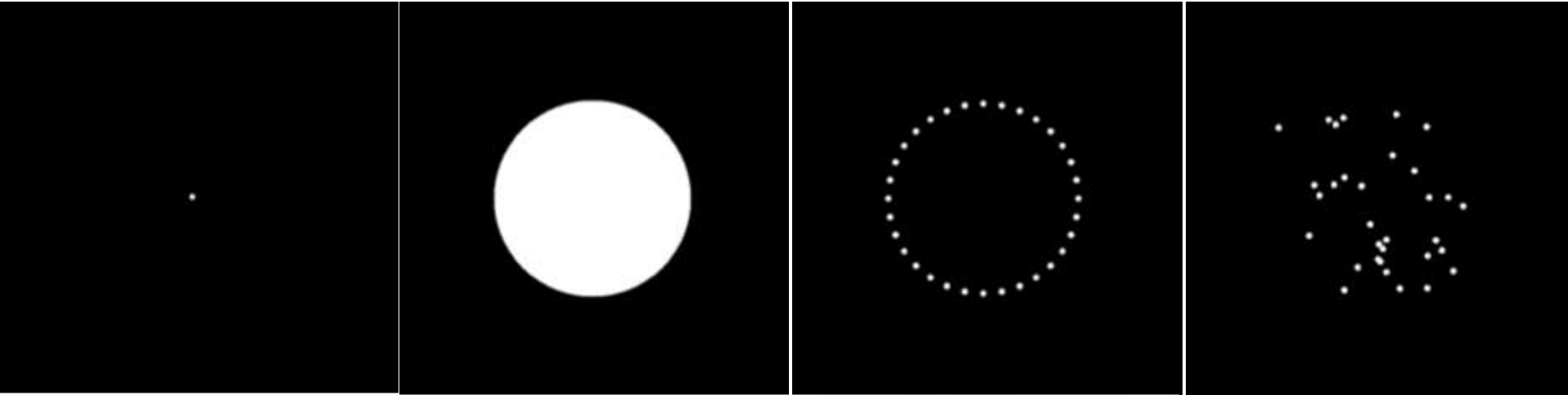


A B C D
A B C D E F G
A B C D E F G H I J K
A B C D E F G H I J K L M N O P Q R
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z



Interferometer – multiple dishes

“Random” dishes



A B C D
A B C D E F G
A B C D E F G H I J K
A B C D E F G H I J K L M N O P Q R
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z



Interferometry – visibilities

... a bit of equations (Fourier Transform)

$$V(u, v) = \iint I(l, m) e^{2\pi i(ul+vm)} dl dm$$

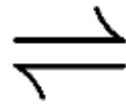
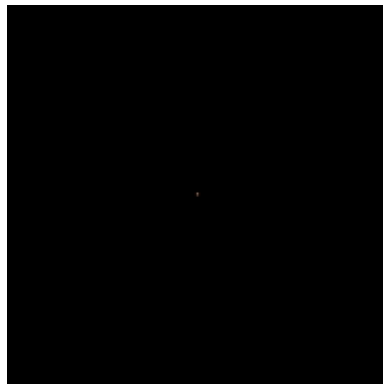
Interferometry – visibilities

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$I(l, m)$

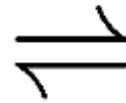
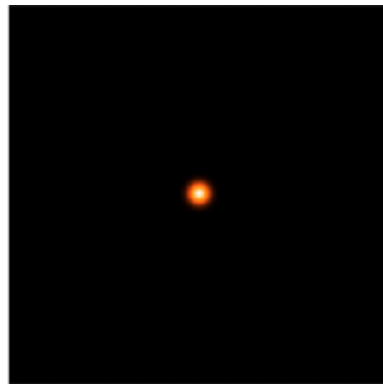
δ Function



$V(u, v)$

Constant

Gaussian



Gaussian

Interferometry – visibilities

... a bit of equations (Fourier Transform)

$$V(u, v) = \iint I(l, m) e^{2\pi i(ul+vm)} dl dm$$

$I(l, m)$

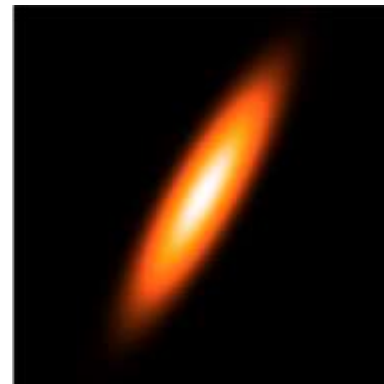
elliptical
Gaussian



\Downarrow

$V(u, v)$

elliptical
Gaussian

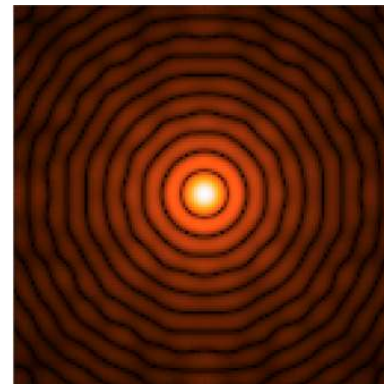


Disk

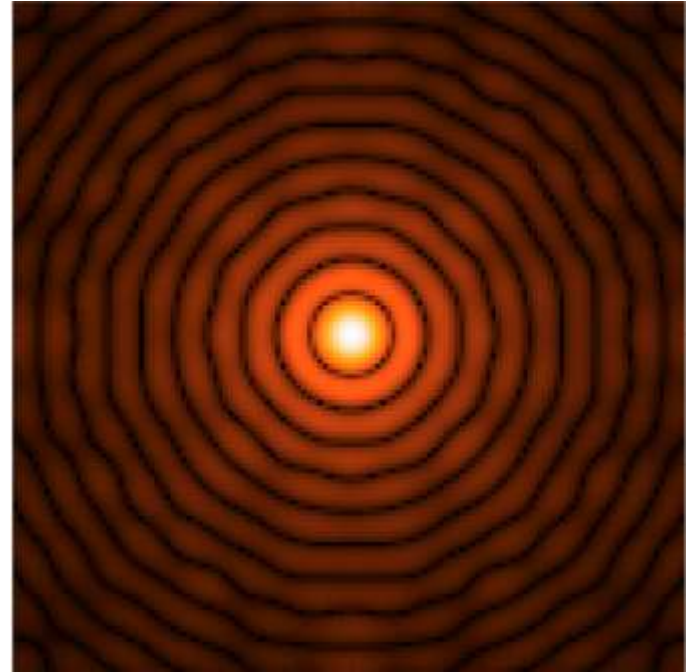
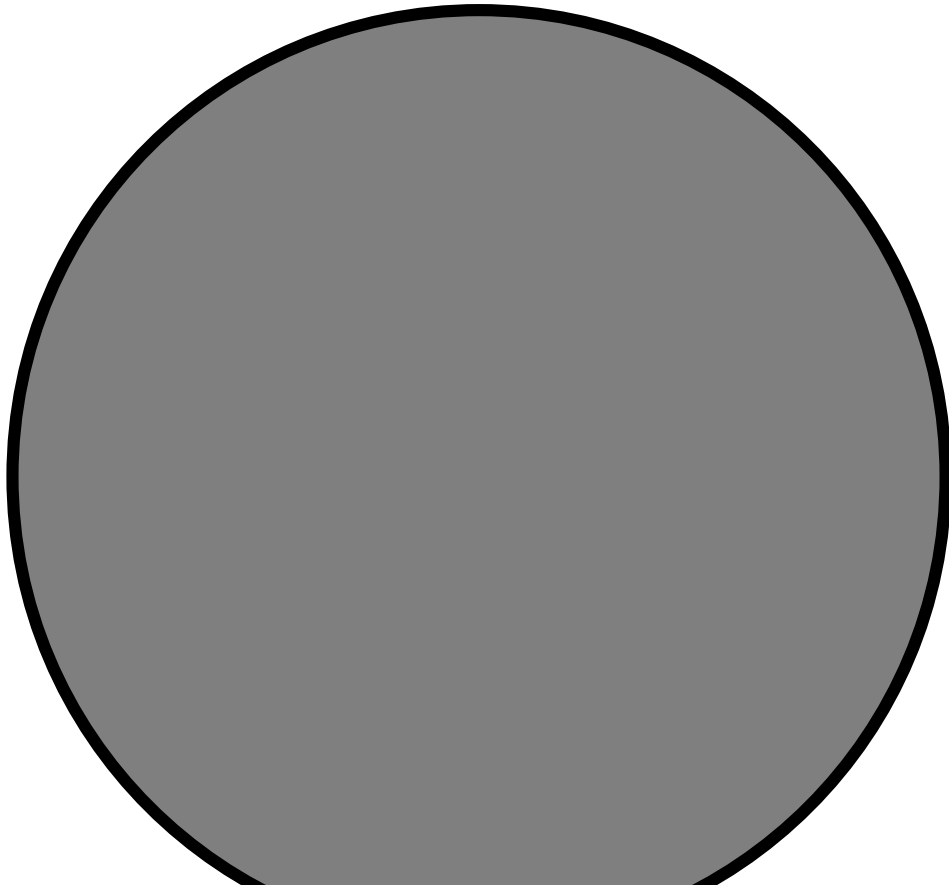


\Downarrow

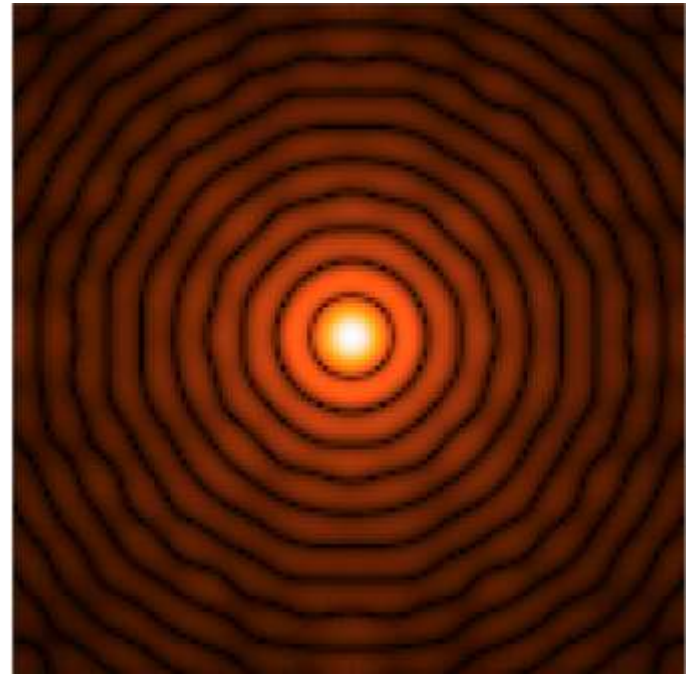
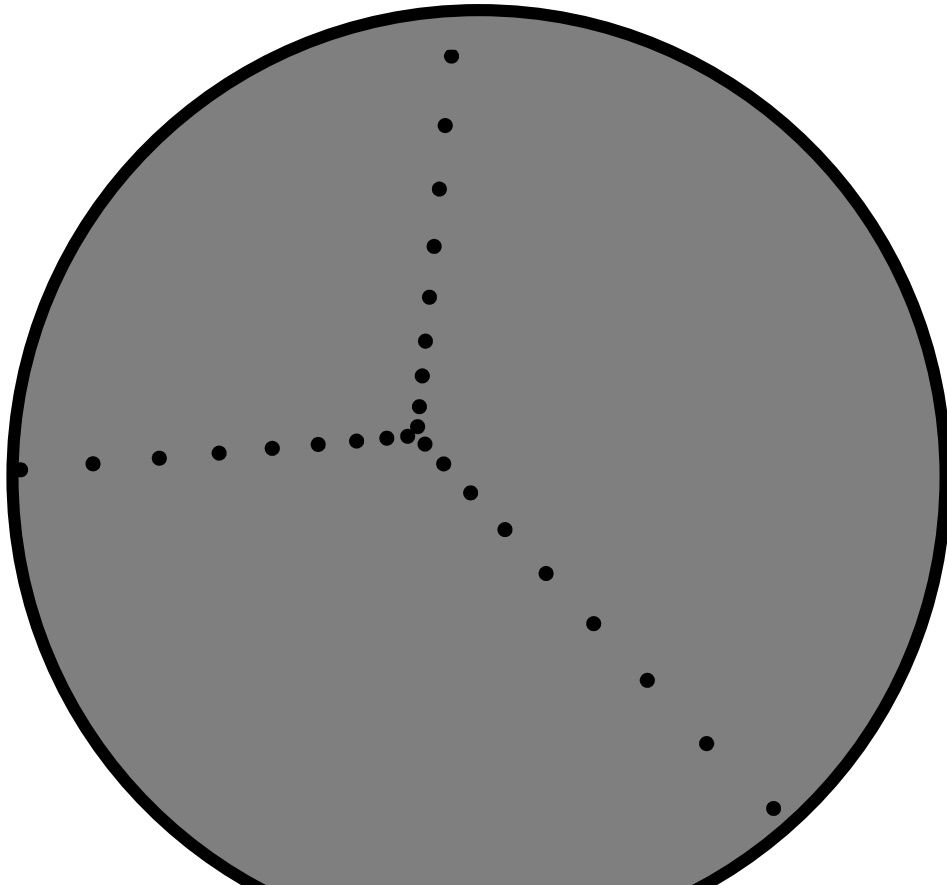
Bessel



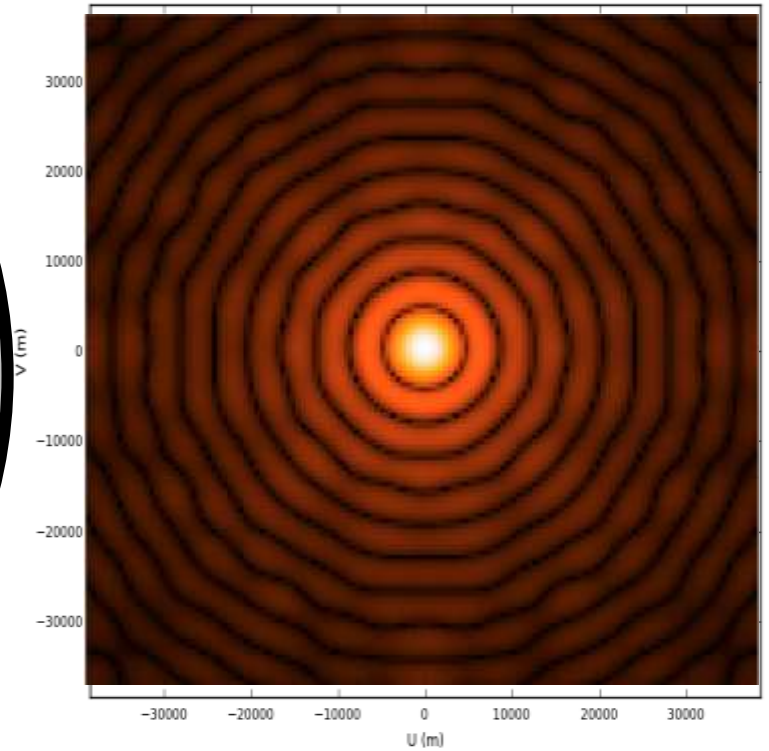
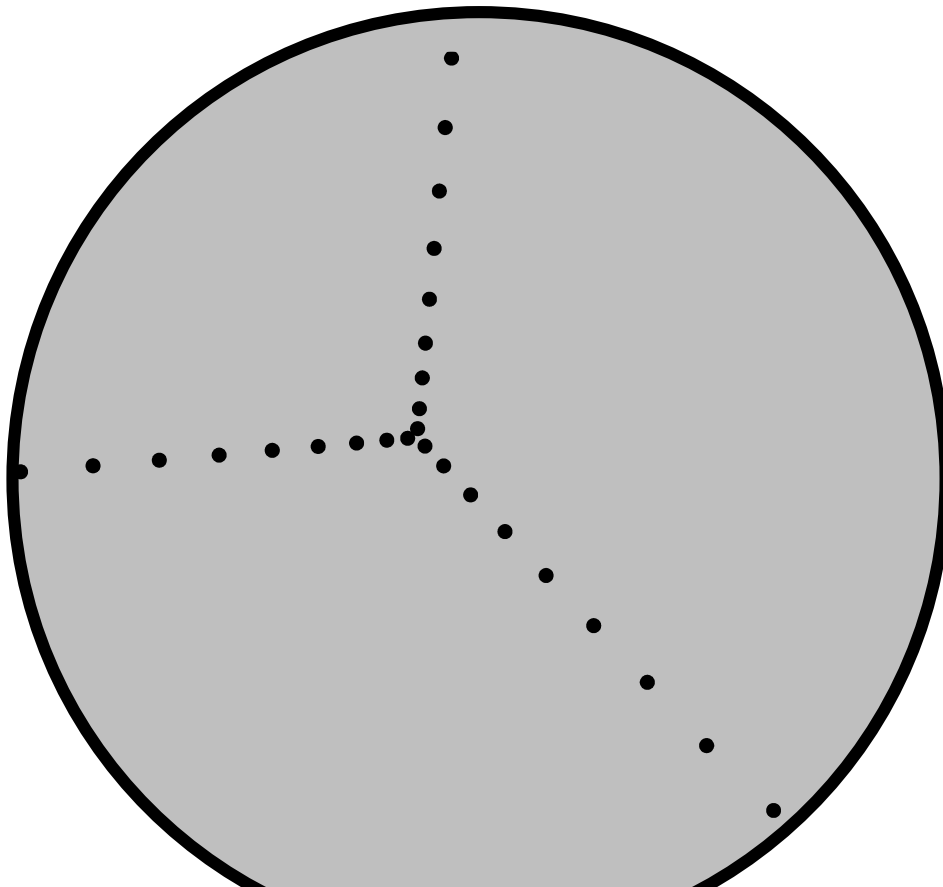
Interferometry – spatial filters



Interferometry – spatial filters



Interferometry – spatial filters

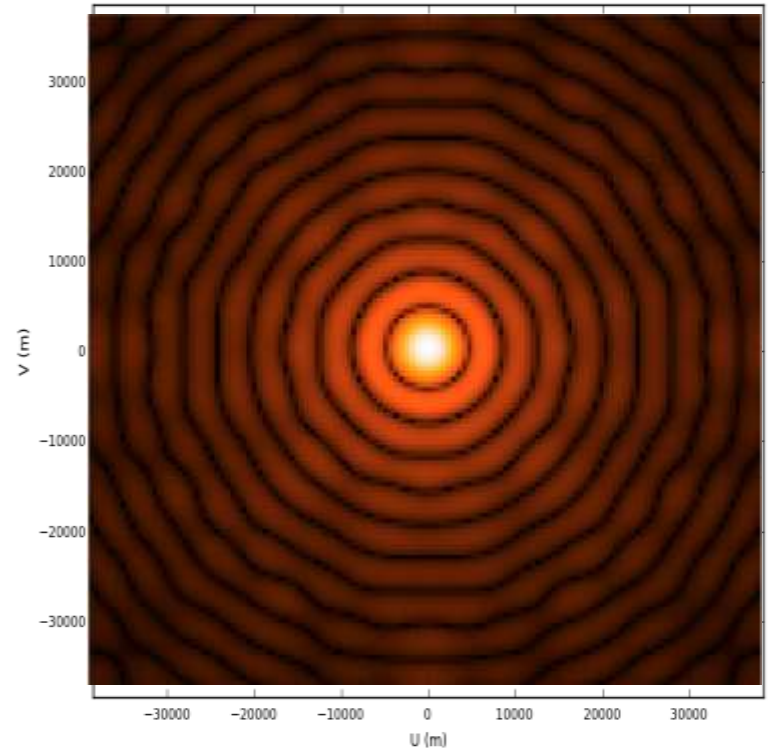
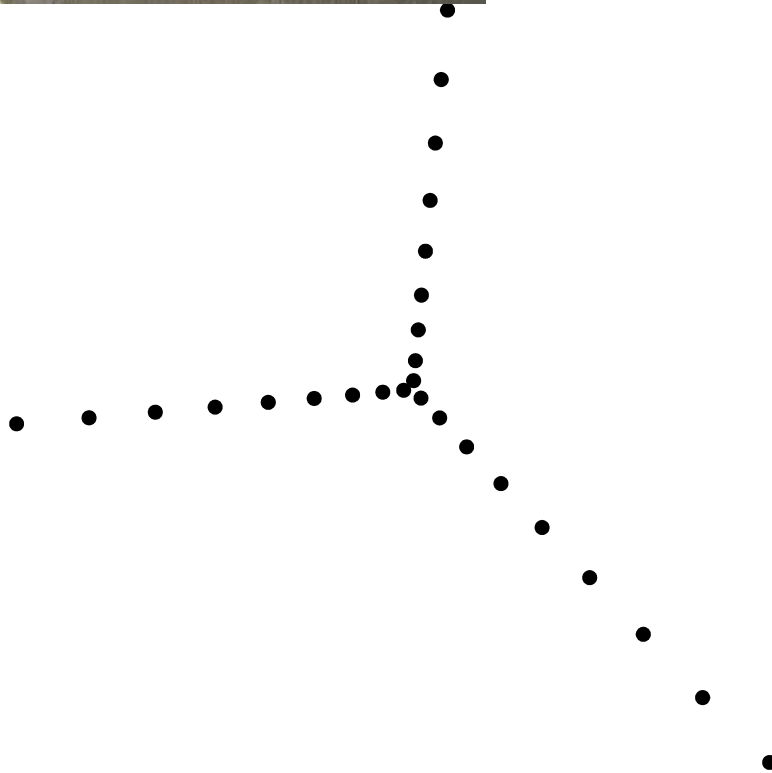


Example: VLA



Very Large Array (VLA)

- 27 antennas of 25 meters (diameter)
- observing from cm to mm wavelengths
- in New Mexico (USA)

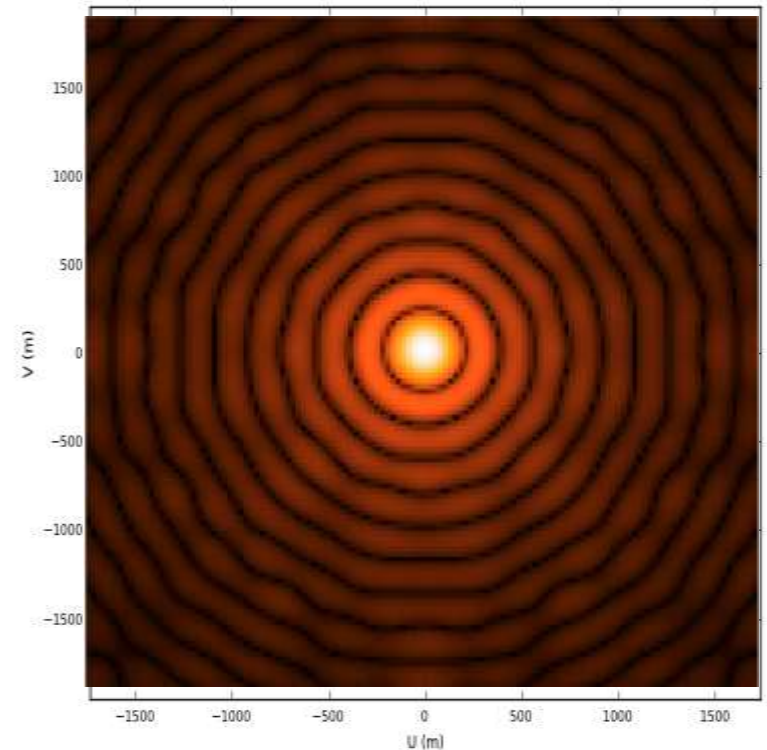
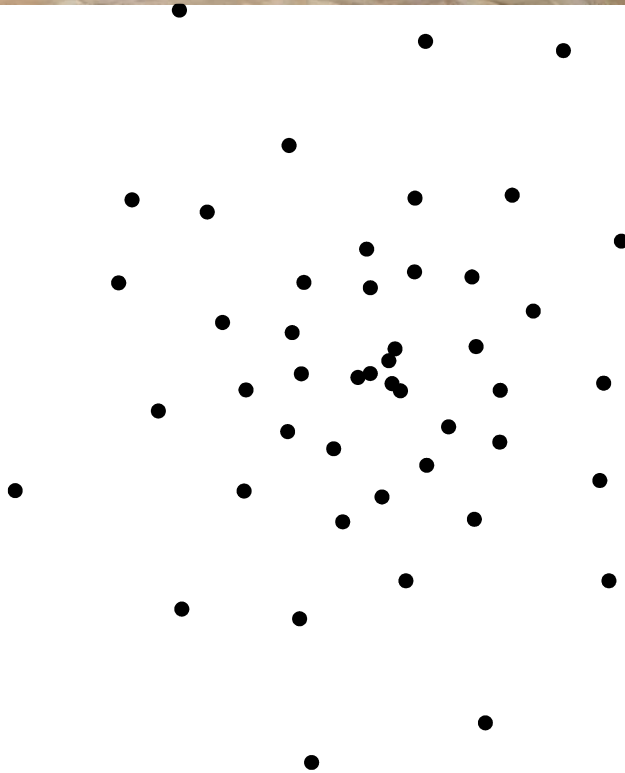


Example: ALMA

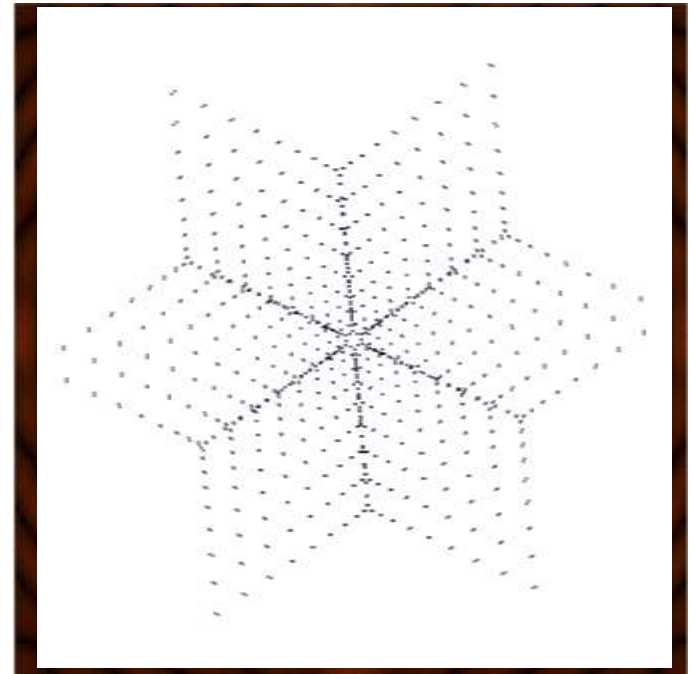
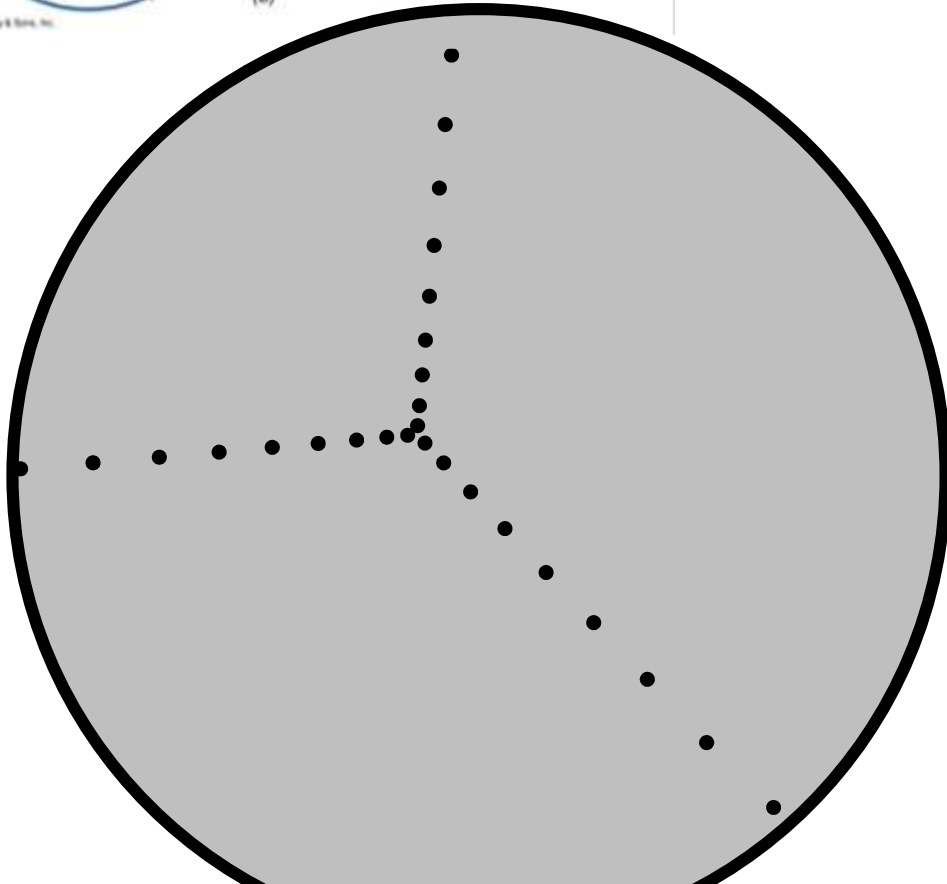
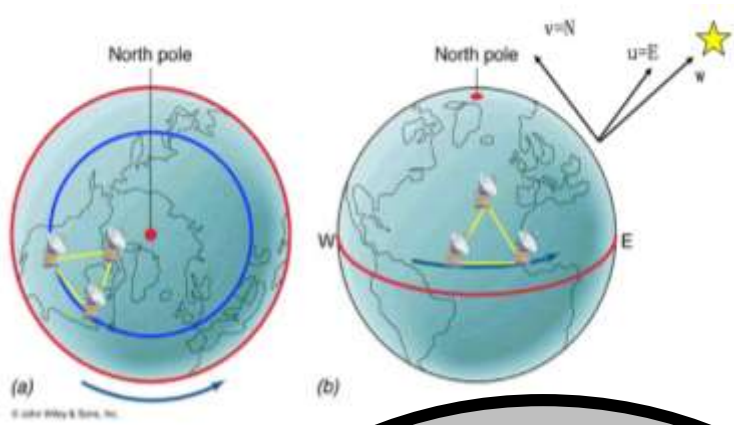


Atacama Large mm/submm Array (ALMA)

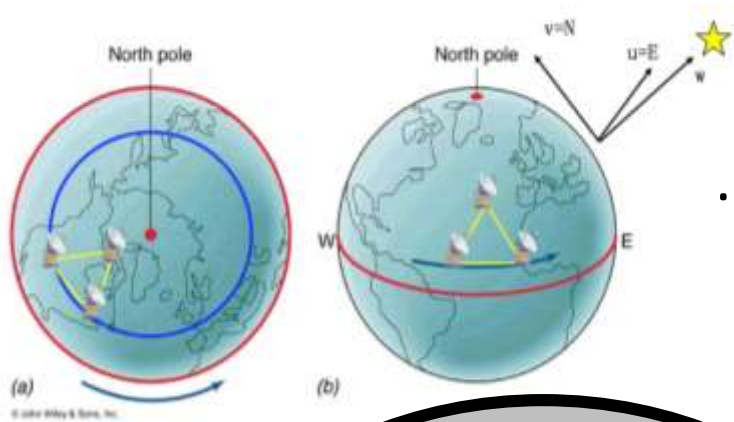
- 50 antennas of 12/7 meters
- observing from mm to submm
- in Llano Chajnantor (Chile)



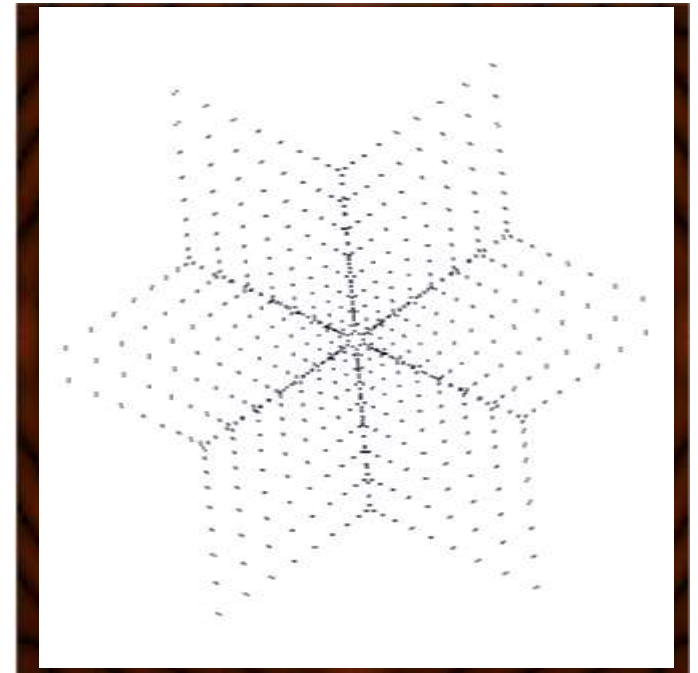
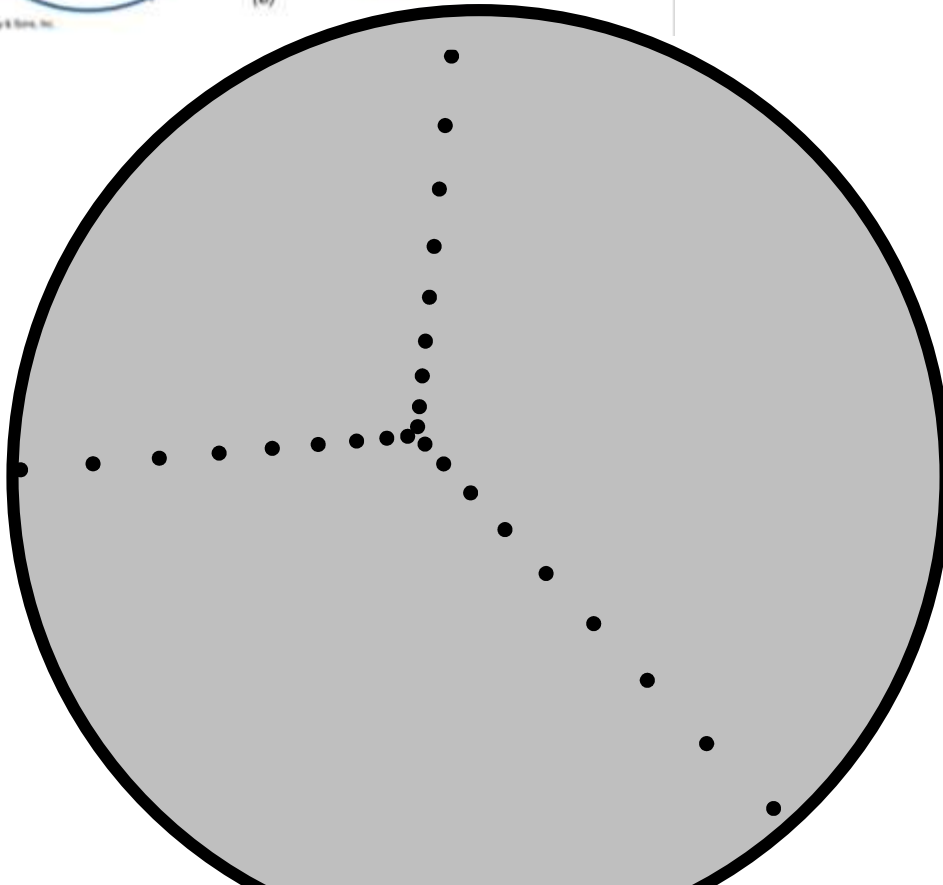
Interferometry – snapshots vs Earth rotation



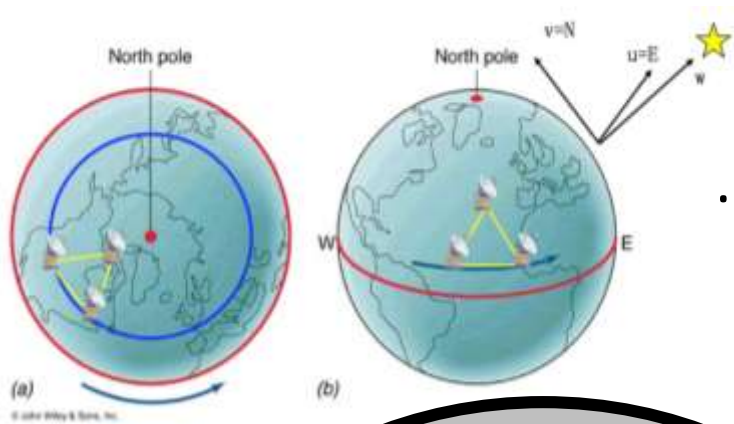
Interferometry – snapshots vs Earth rotation



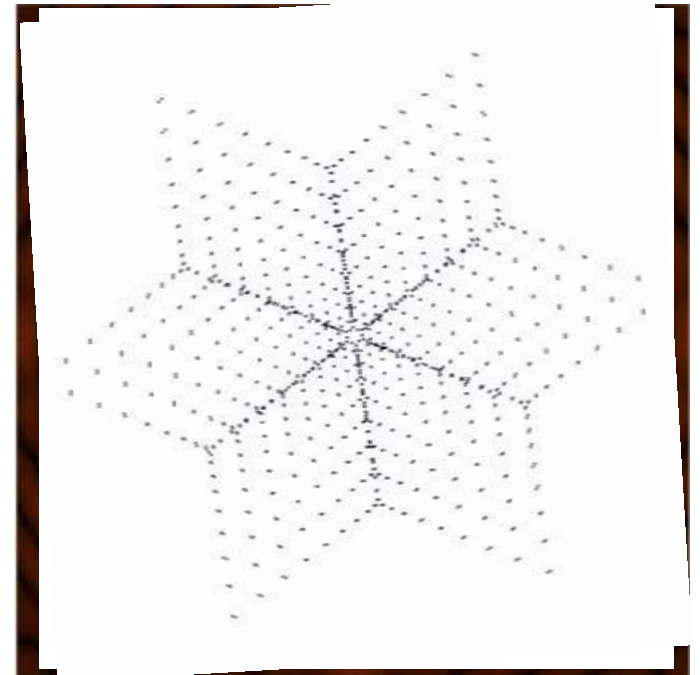
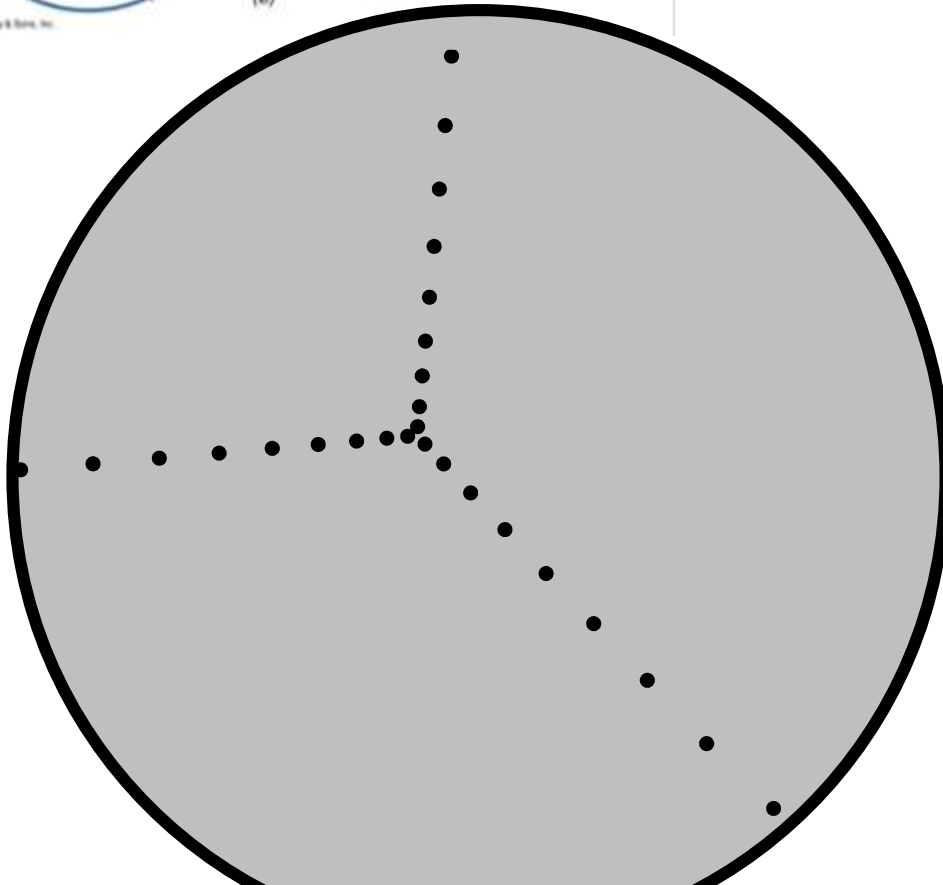
... we can just wait for the Earth to rotate



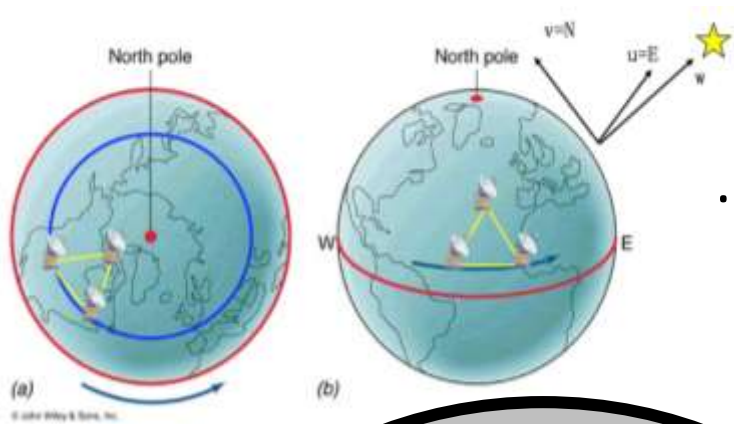
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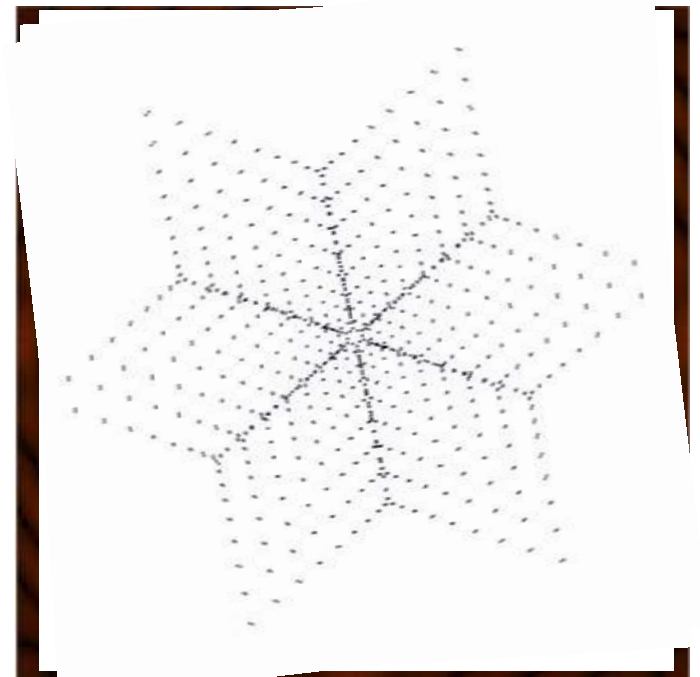
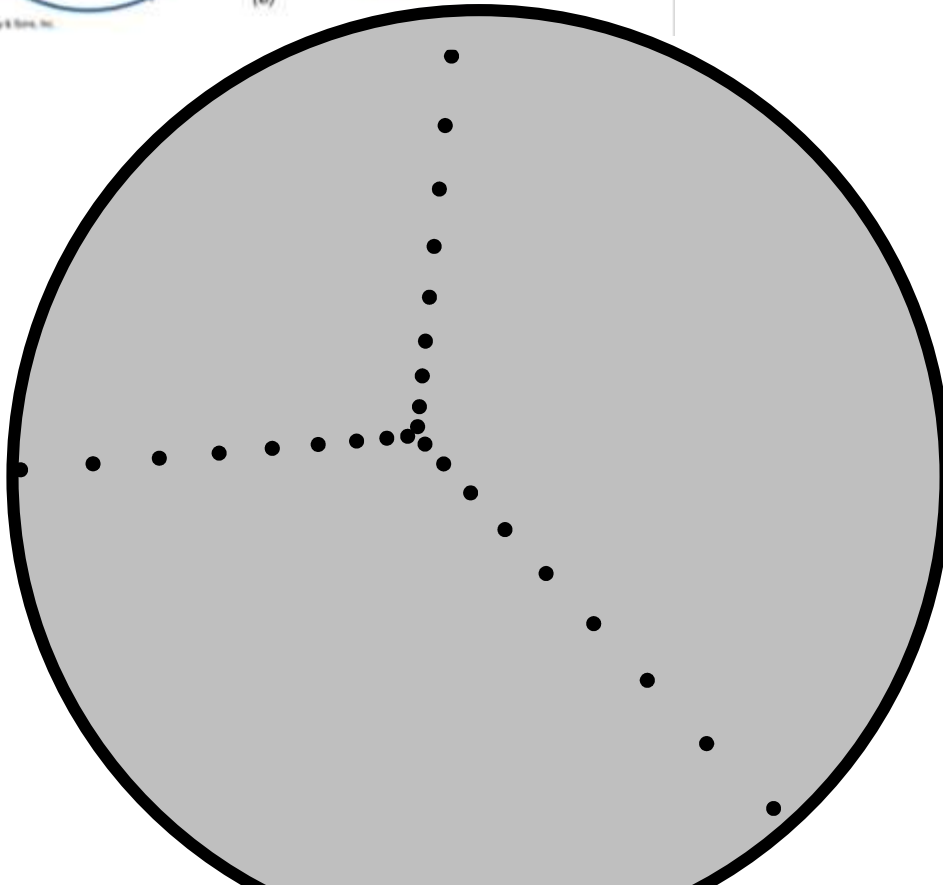
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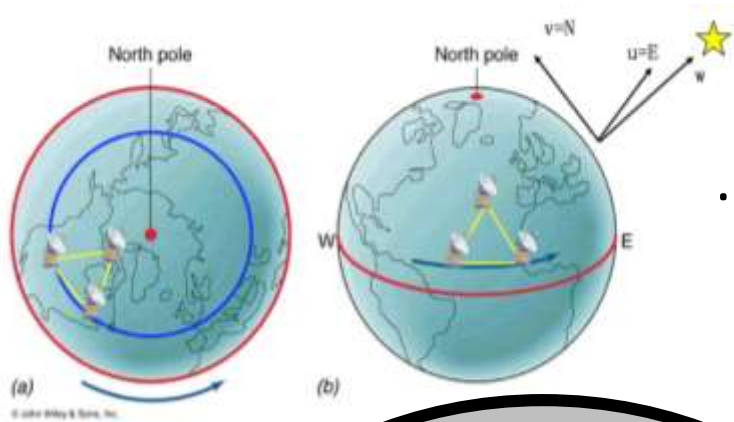
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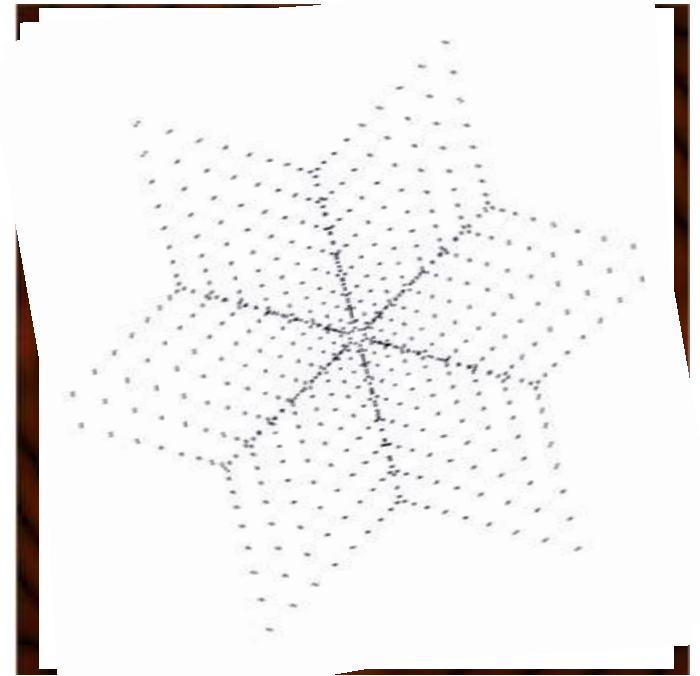
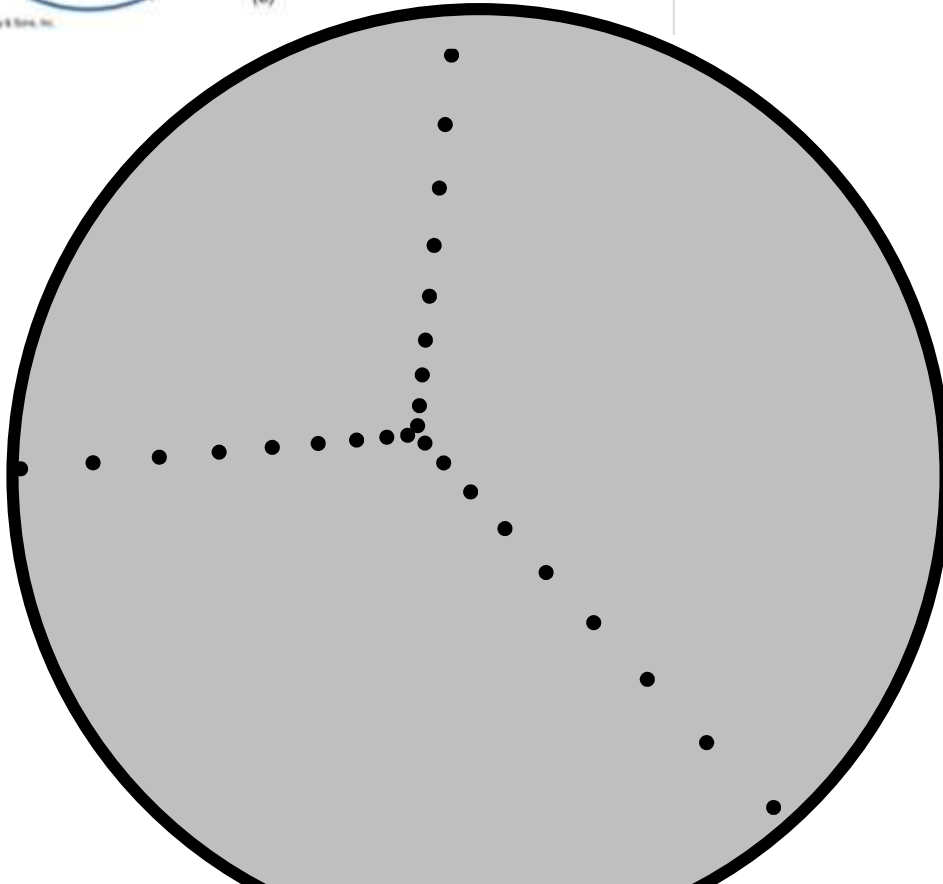
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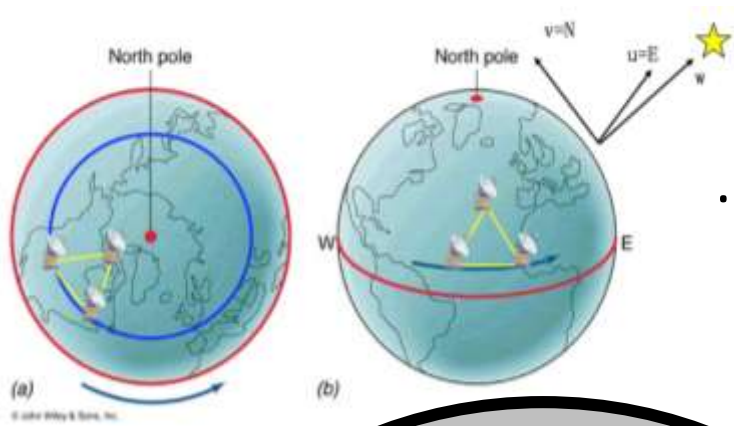
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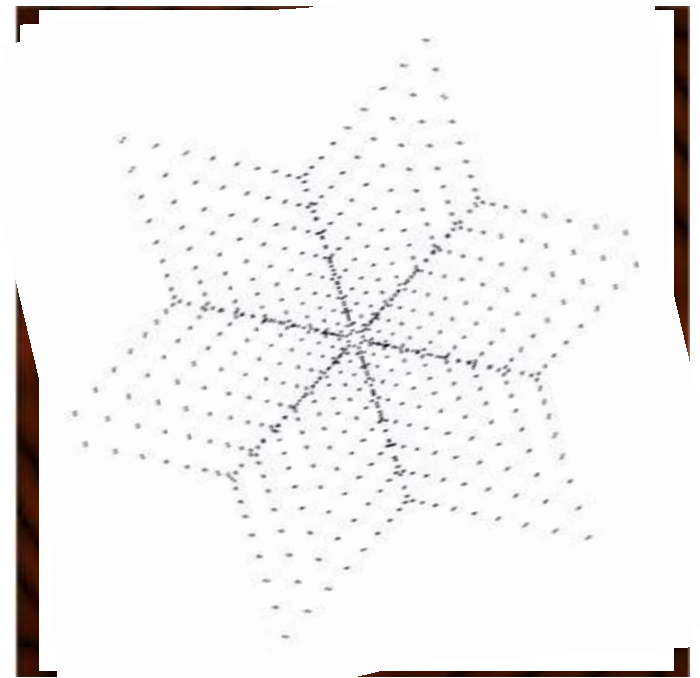
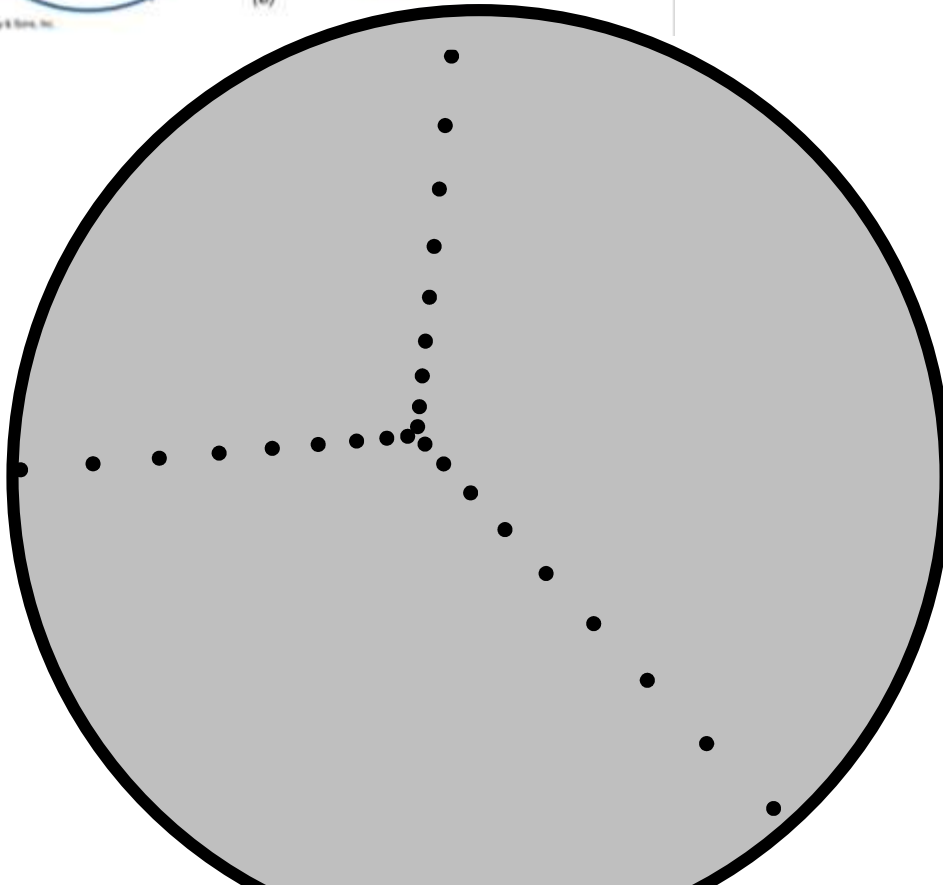
... we can just wait for the Earth to rotate



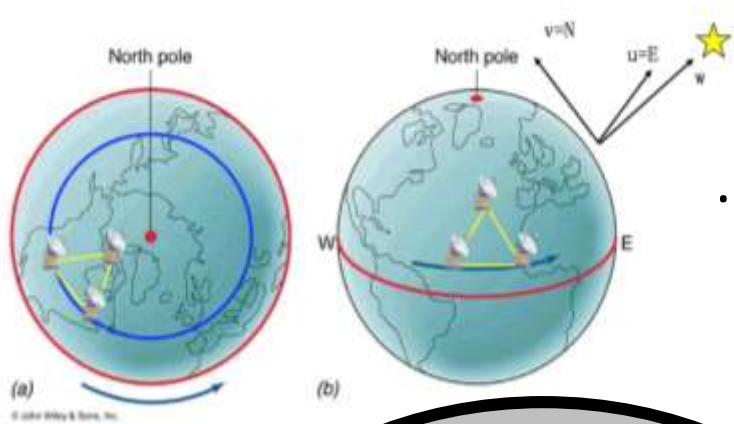
Interferometry – snapshots vs Earth rotation



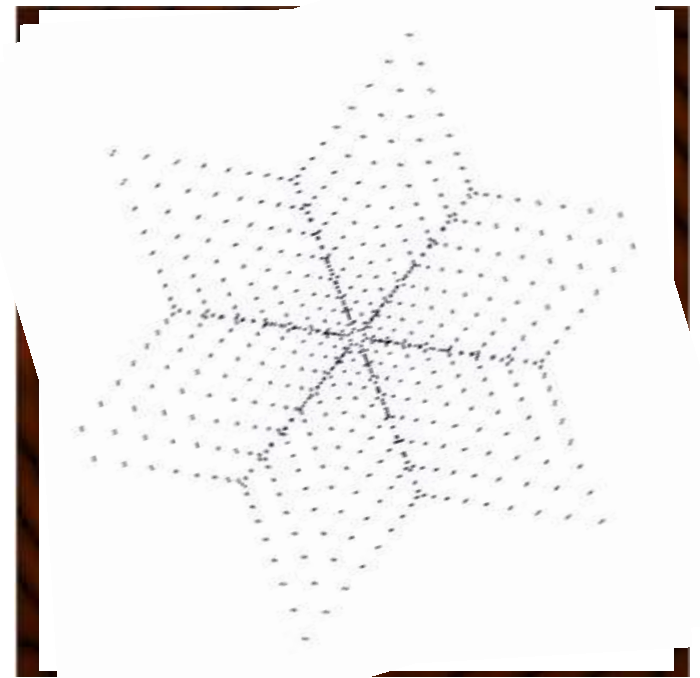
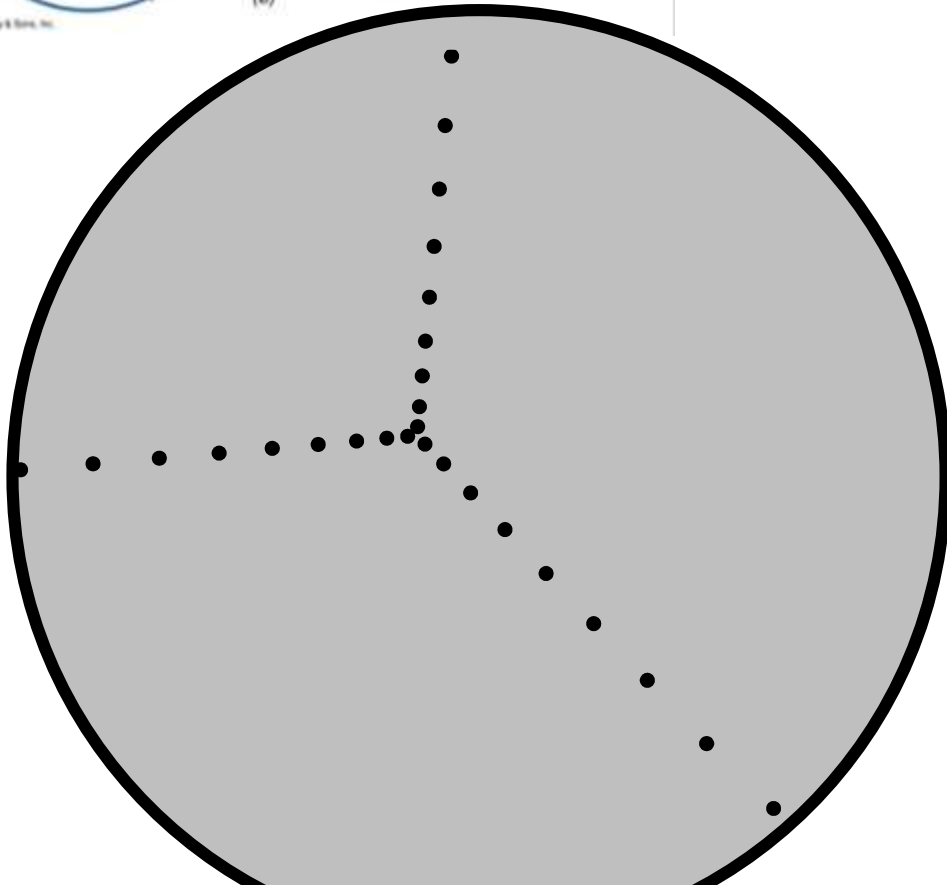
... we can just wait for the Earth to rotate



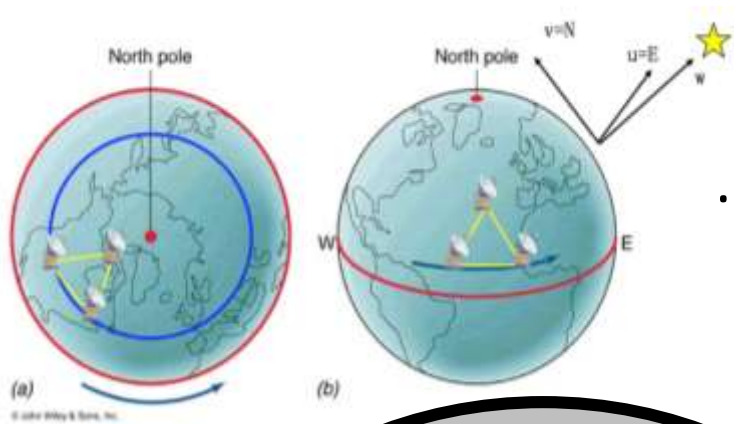
Interferometry – snapshots vs Earth rotation



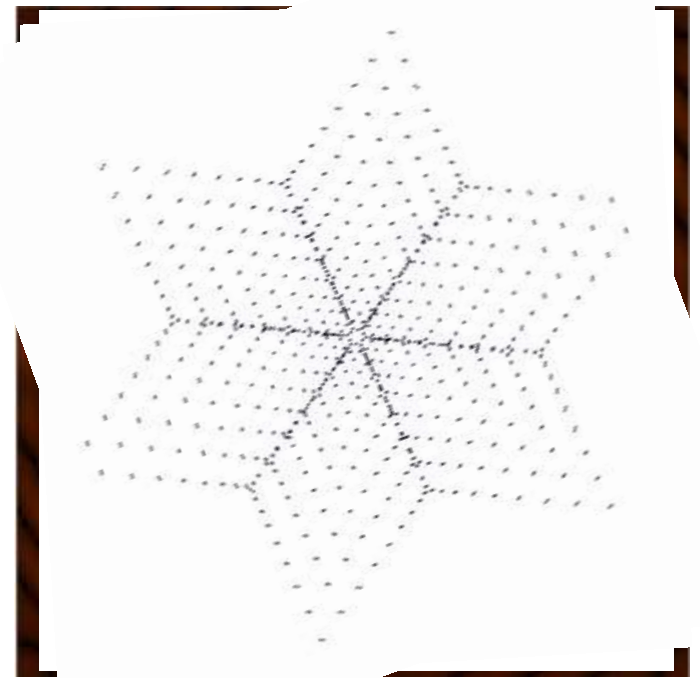
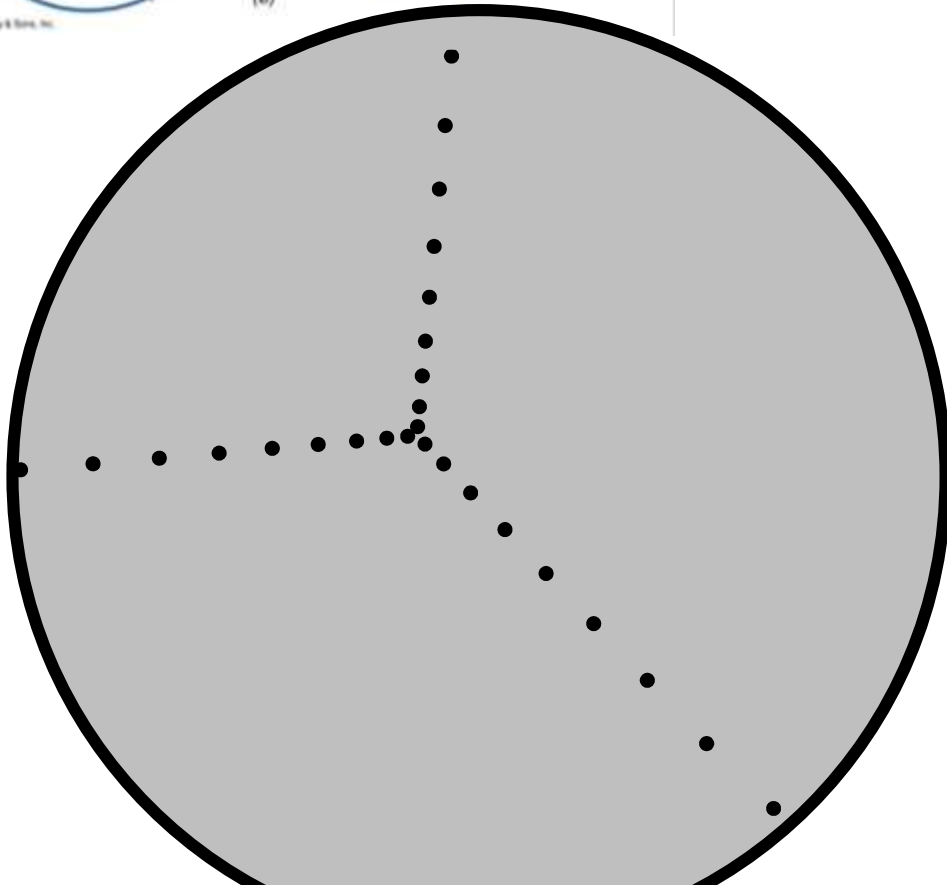
... we can just wait for the Earth to rotate



Interferometry – snapshots vs Earth rotation

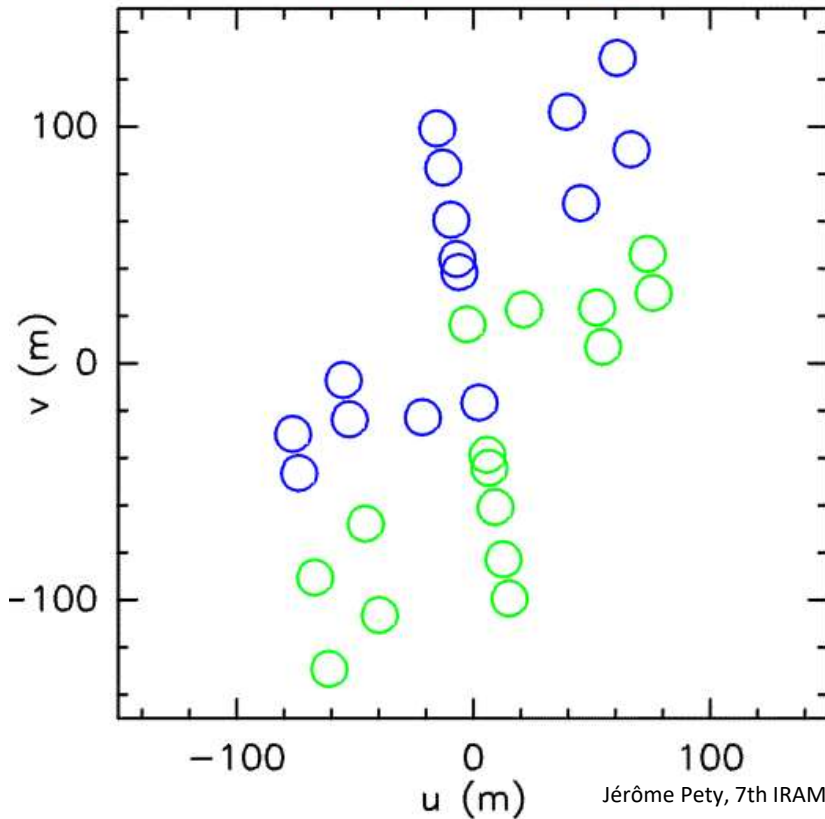


... we can just wait for the Earth to rotate



Earth rotation aperture synthesis and uv - coverage

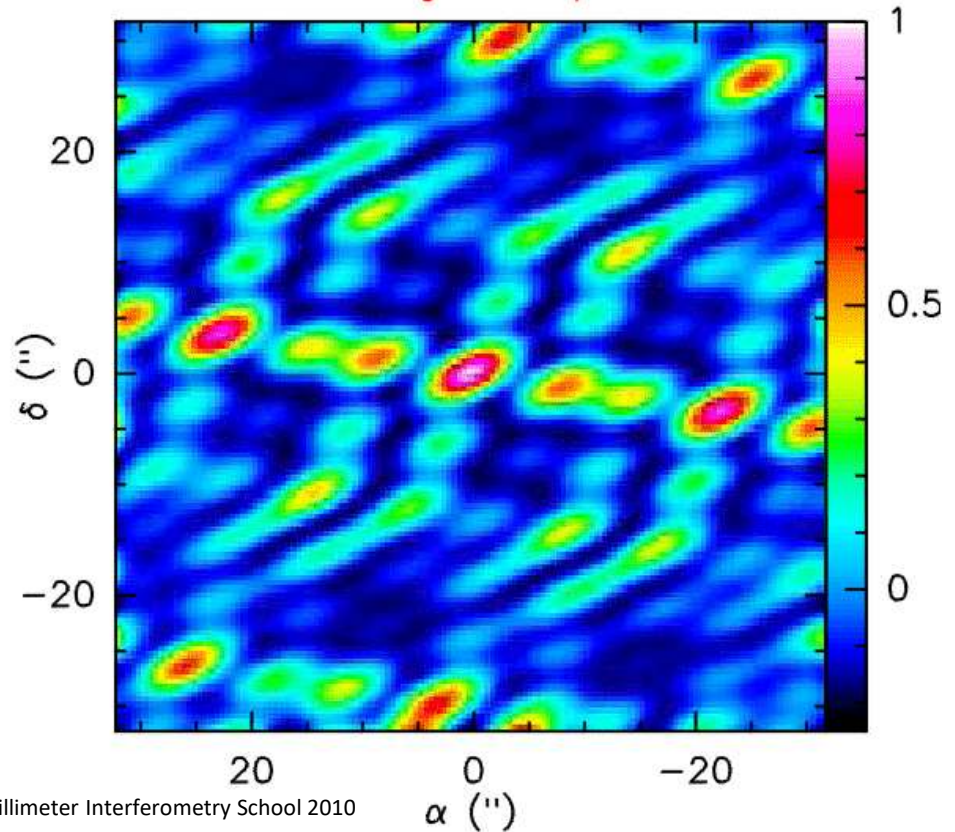
Sampling in the uv plane



Sampling function

$$S(u,v) = \sum \delta(u-u_0, v-v_0)$$

Associated image of a point source

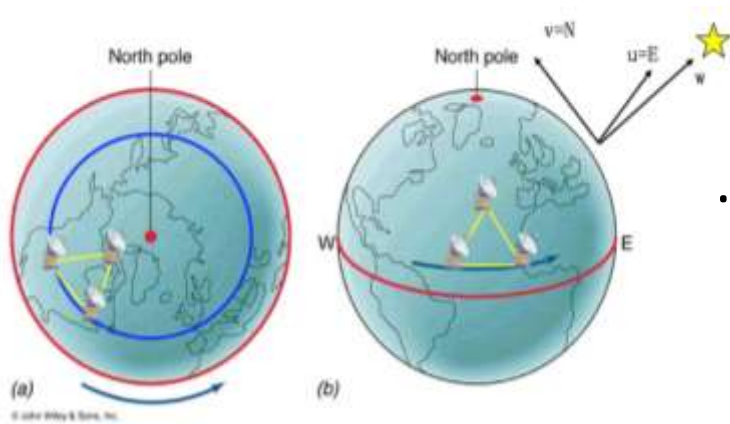


Dirty/synthesized beam / PSF

← FT →

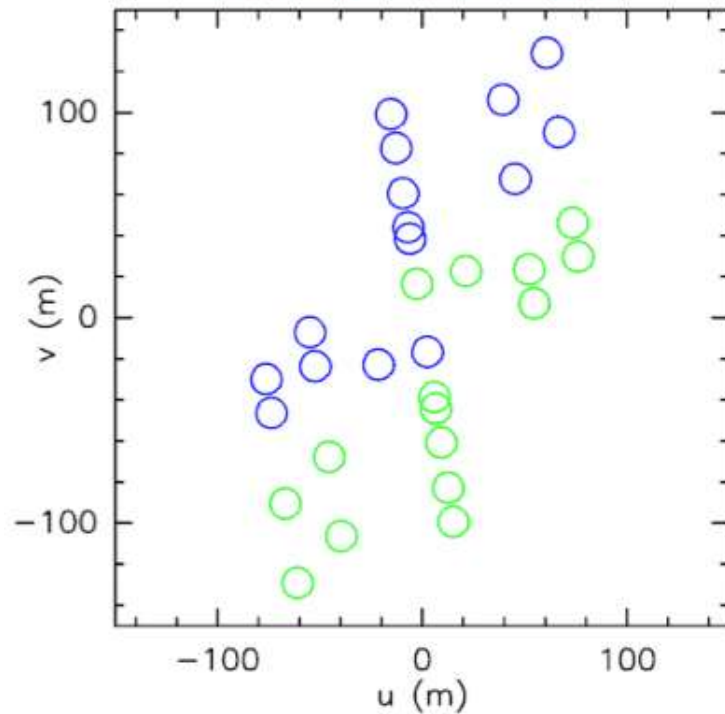
$$B(l,m)$$

Interferometry – snapshots vs Earth rotation

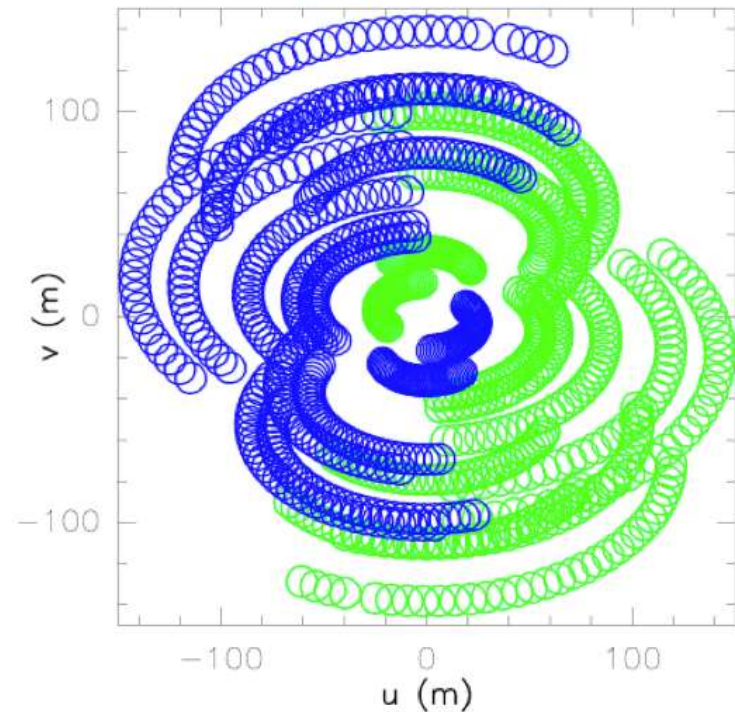


... we can just wait for the Earth to rotate

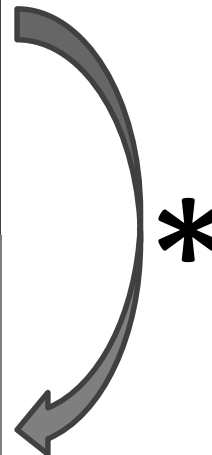
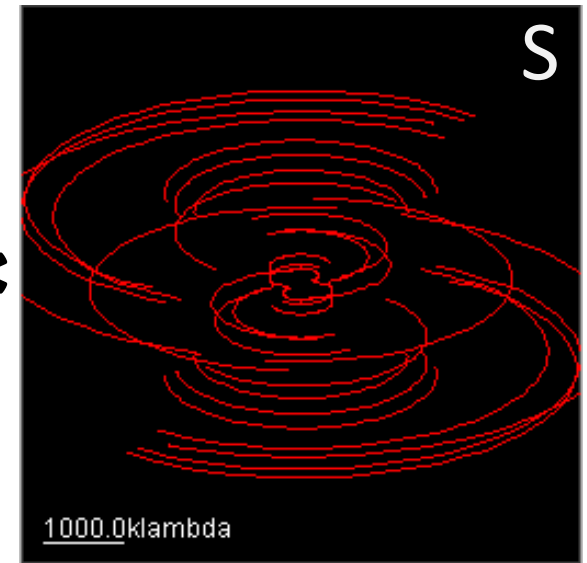
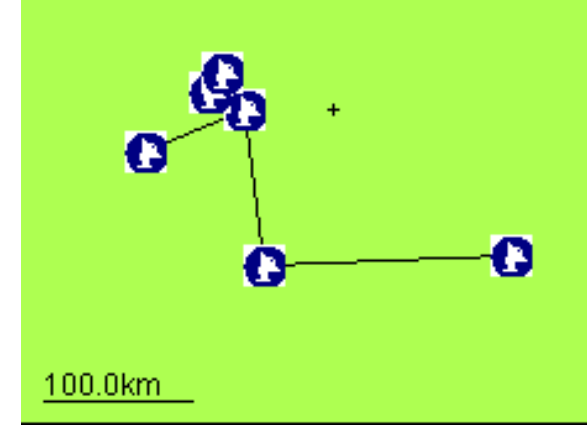
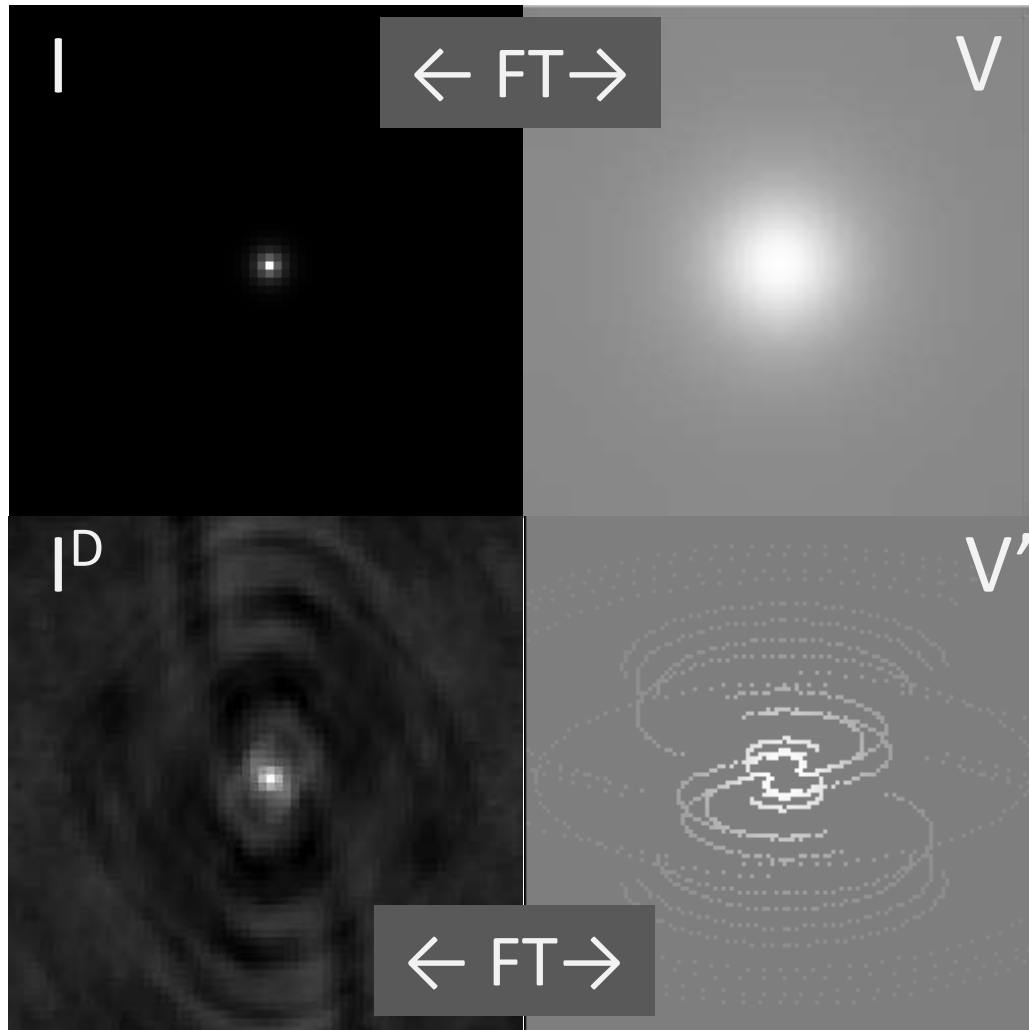
Sampling in the uv plane



Sampling in the uv plane

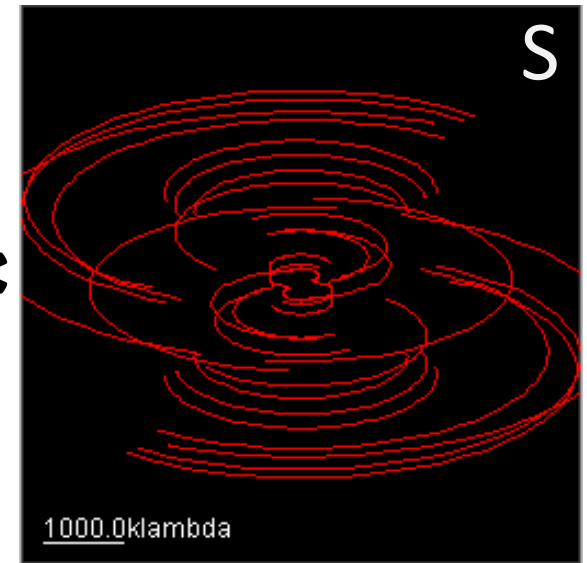
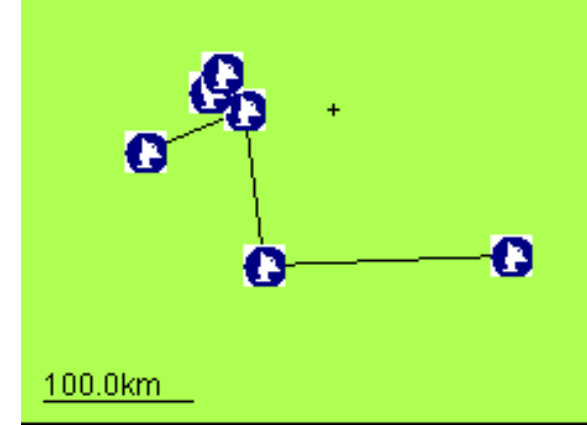
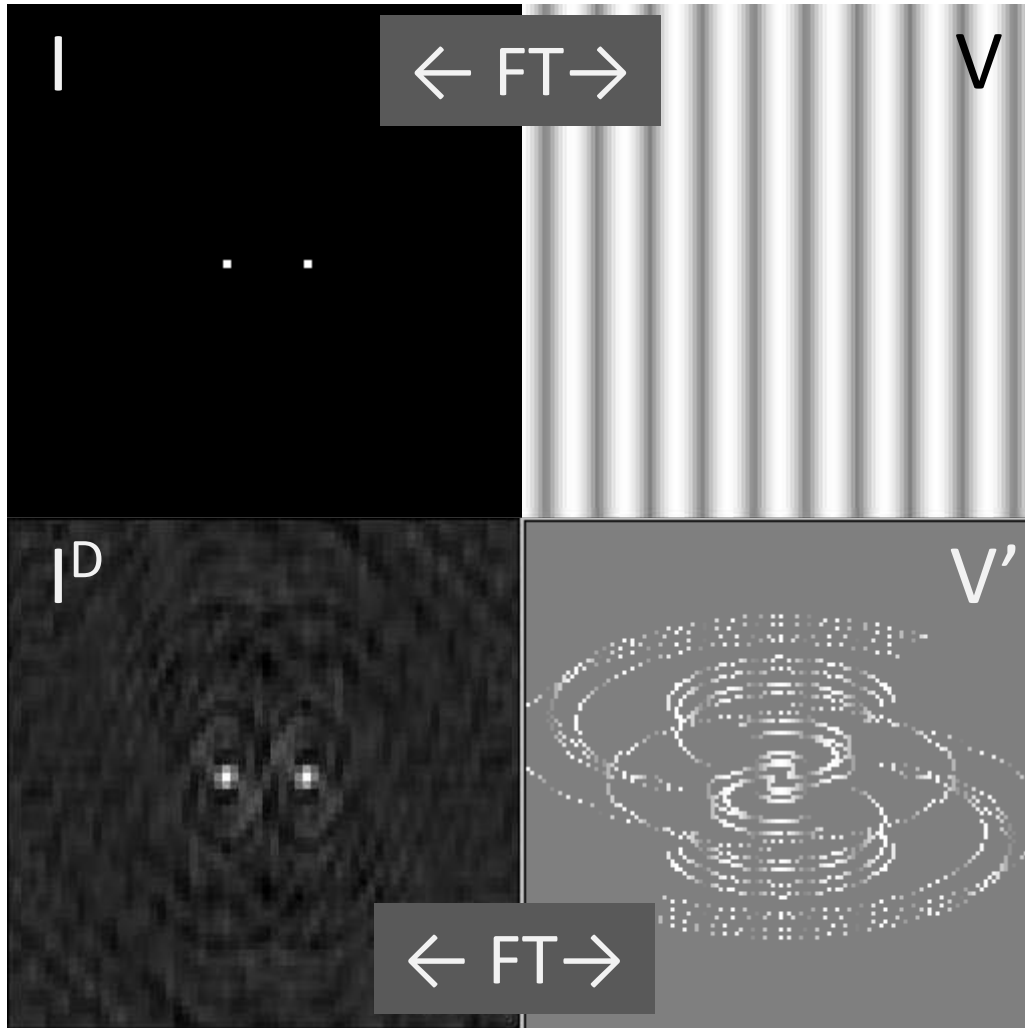


Narrow Gaussian with MERLIN



*

Wide double point source with MERLIN



*

The basic principle in practice

Sampled visibility True visibility Sampling function

$$V^{\prime}(u,v) = V(u,v) \times S(u,v)$$

↑

FT

↓

↑

FT

↓

↑

FT

↓

$$I^{\text{D}}(l,m) = I(l,m) * B(l,m)$$

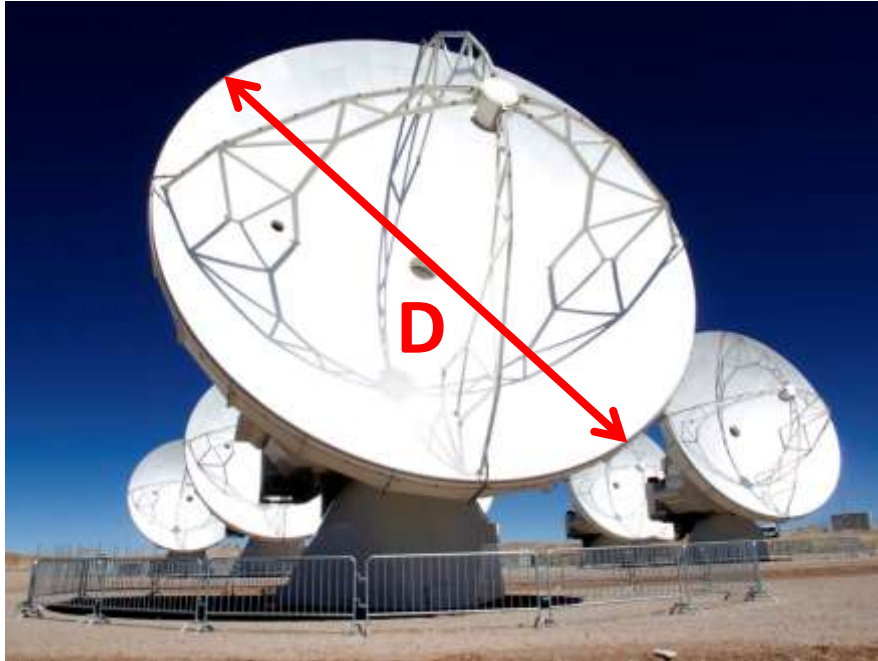
Dirty image

True image

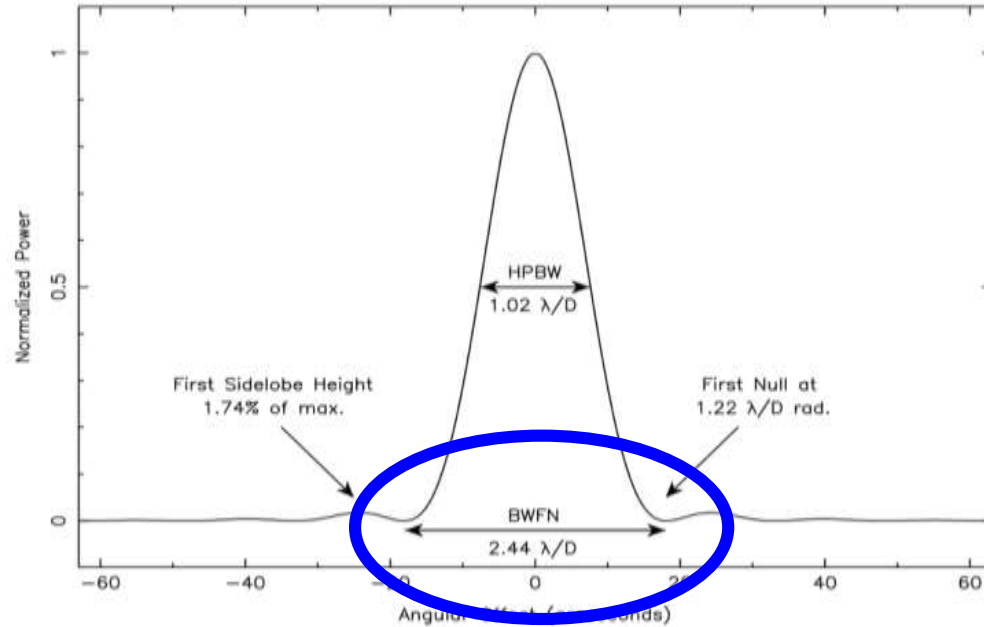
Dirty beam

REMEMBER ... Single-dish response

Single-dish with diameter D



(1D) antenna power response

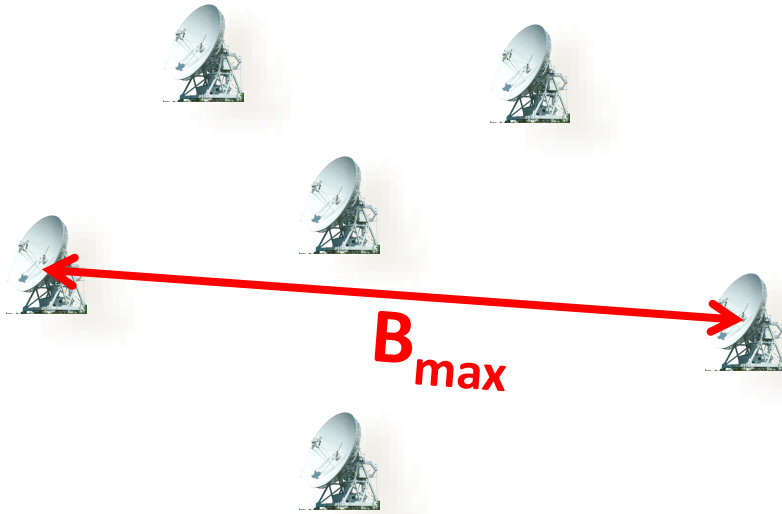


$$PB = 1.22 \frac{\lambda}{D}$$

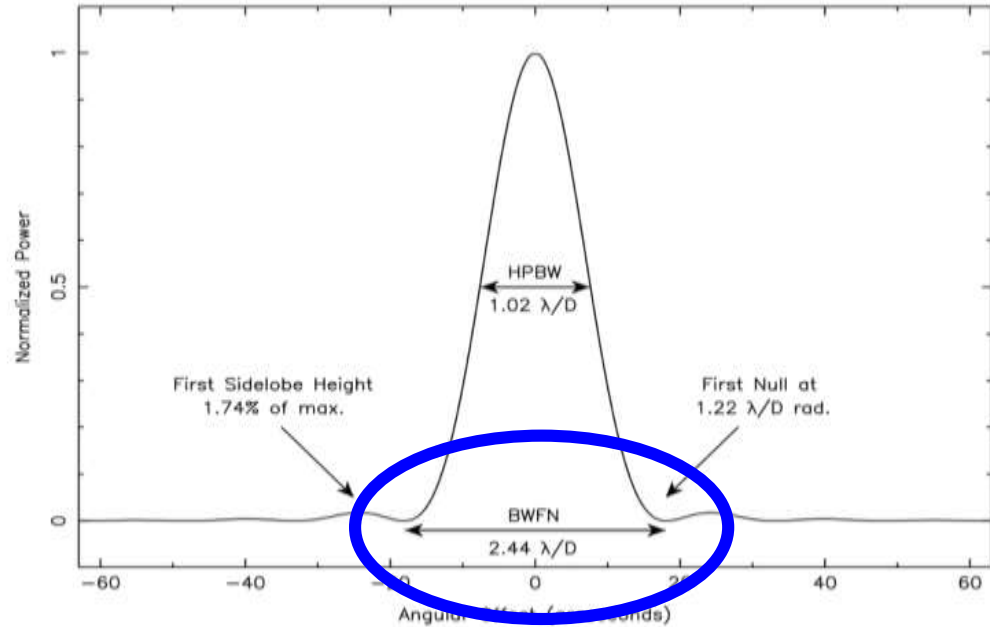
PRIMARY BEAM

Interferometer “response”

Interferometer with baseline B



interferometer power response



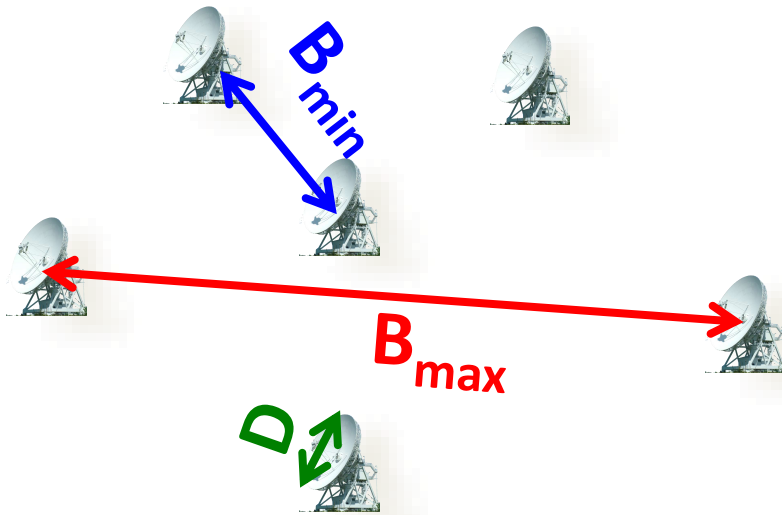
$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

SYNTHESIZED BEAM

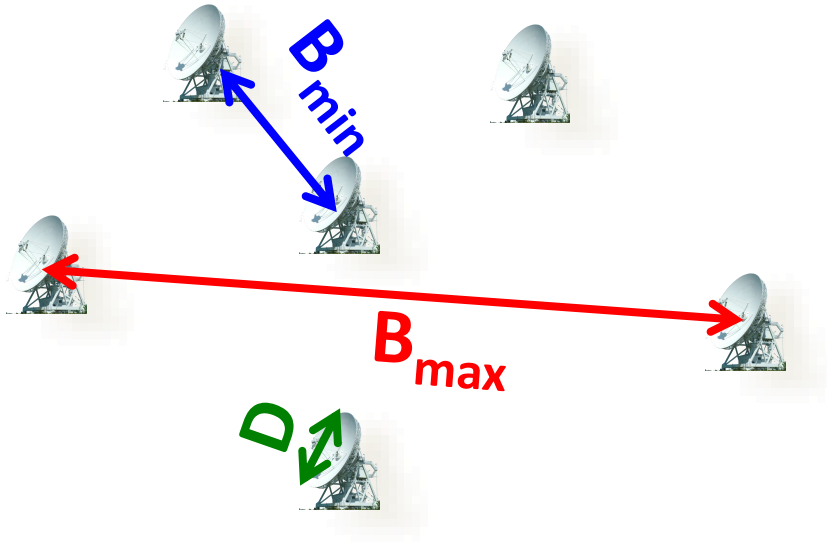
Synthesized beam, primary beam and LAS

SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$



Synthesized beam, primary beam and LAS



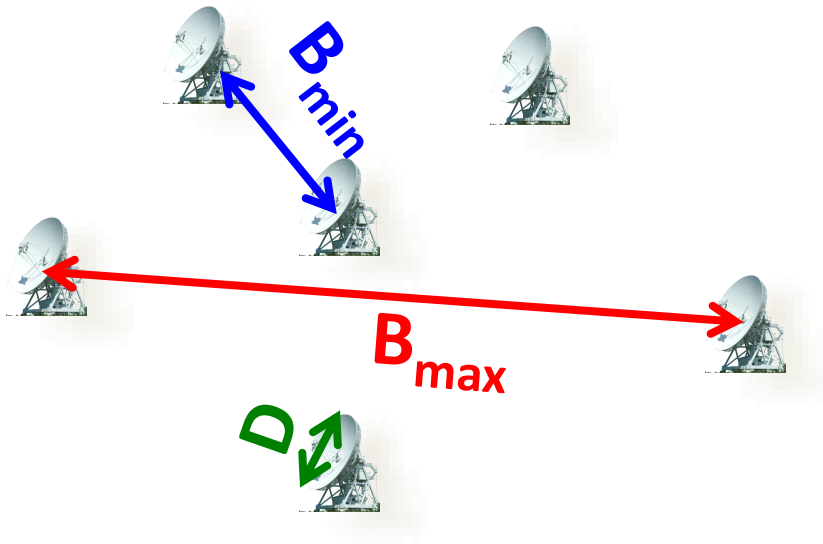
SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{D}$$

Synthesized beam, primary beam and LAS



SYNTHESIZED BEAM

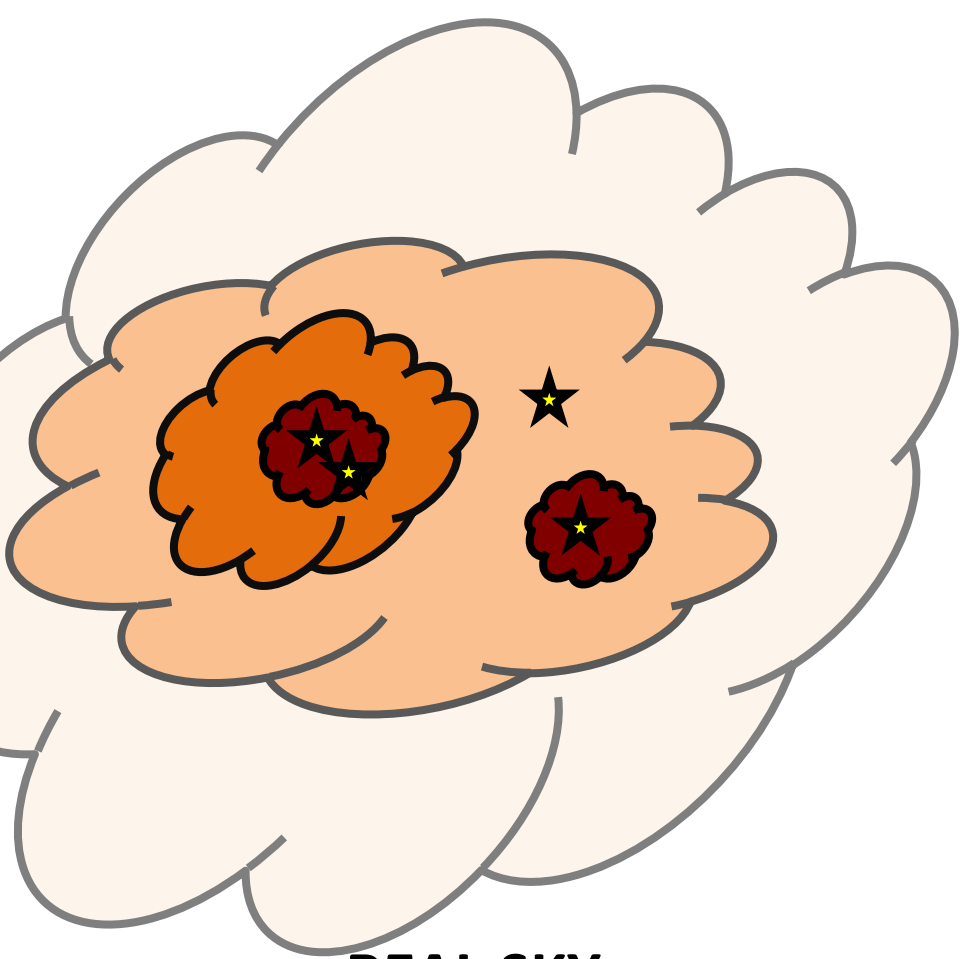
$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

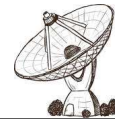
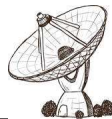
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

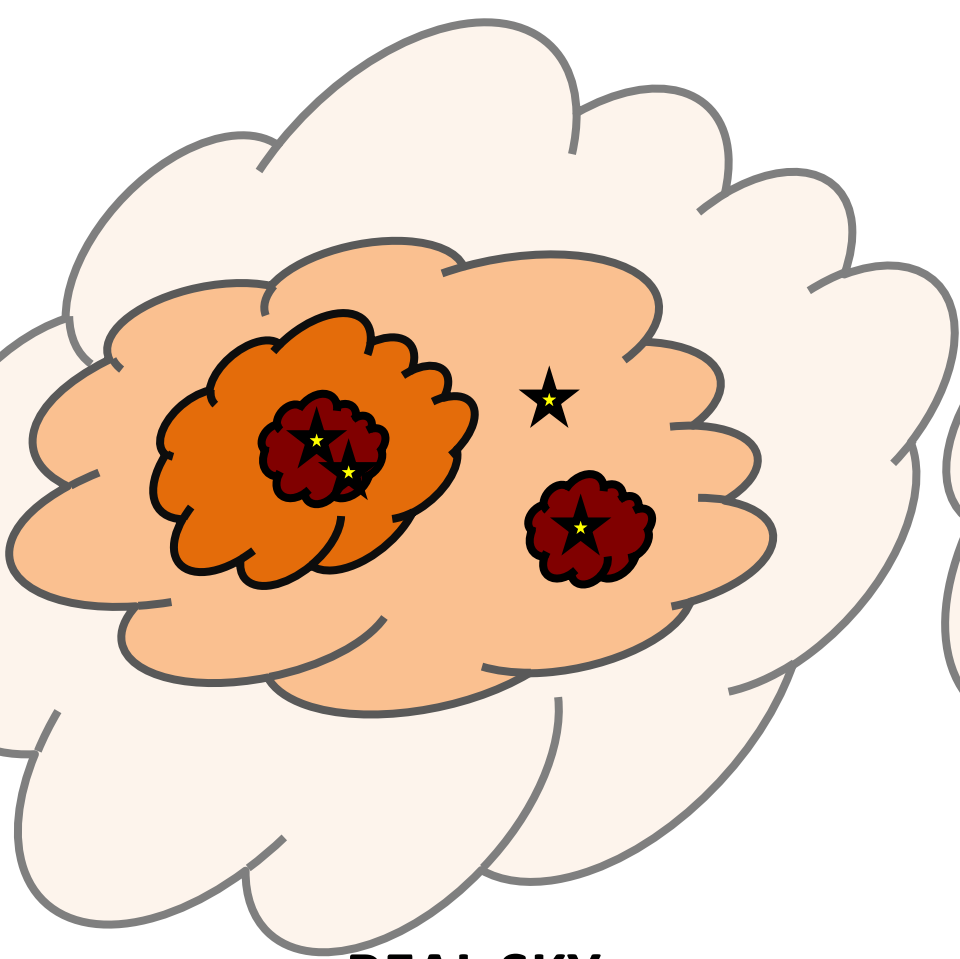
PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

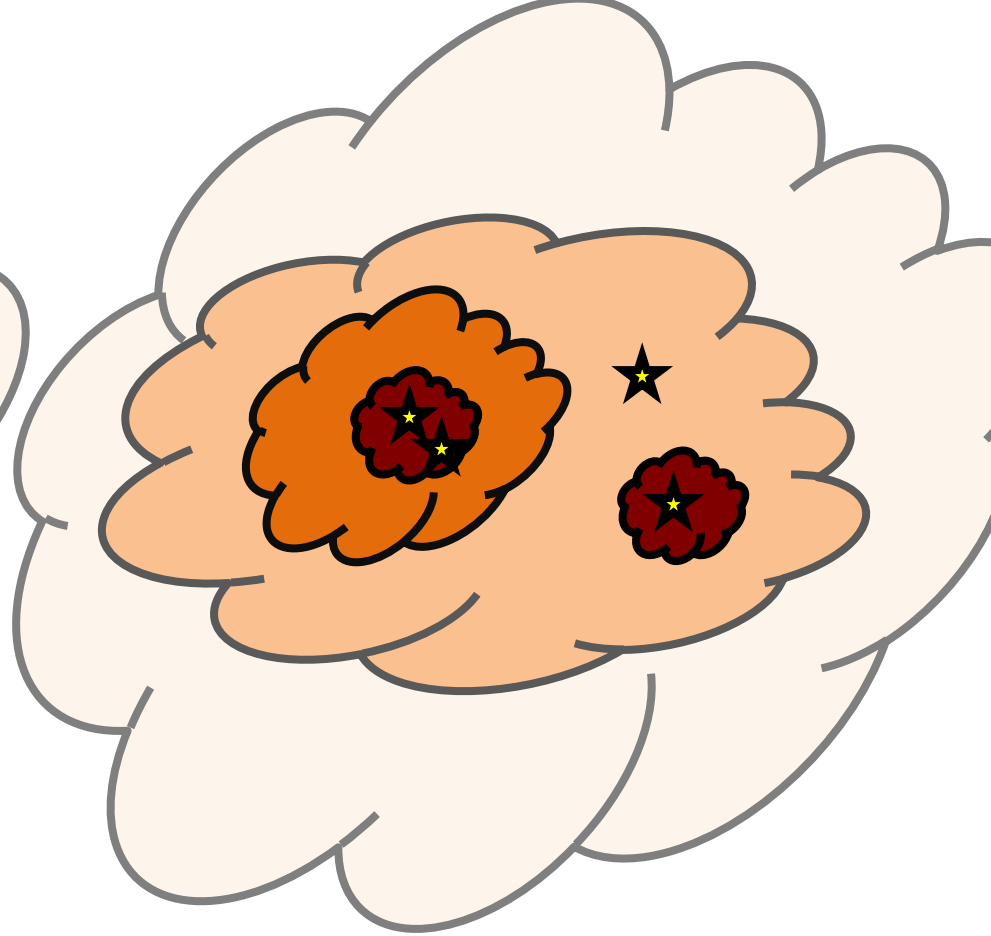


REAL SKY

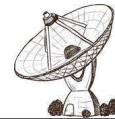
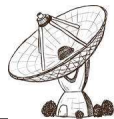


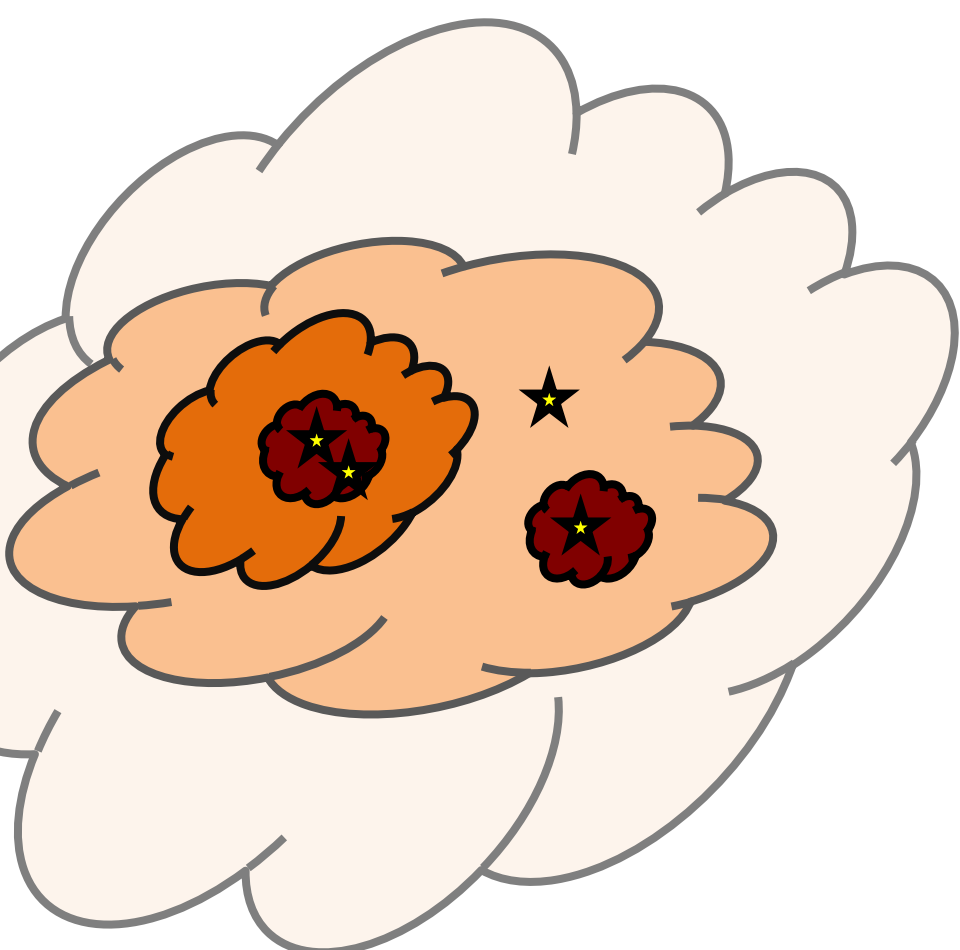


REAL SKY

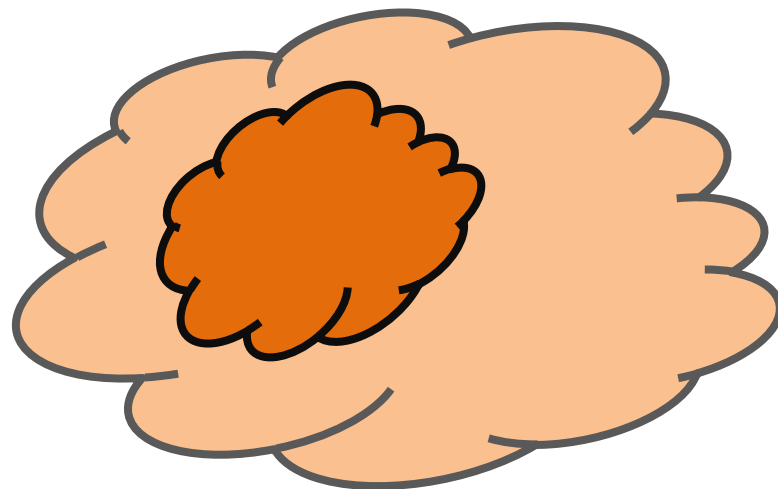


WHAT WE WANT TO OBTAIN



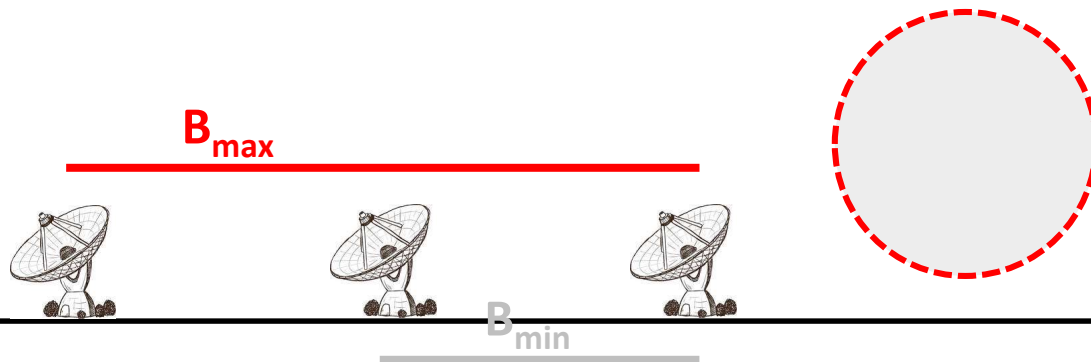


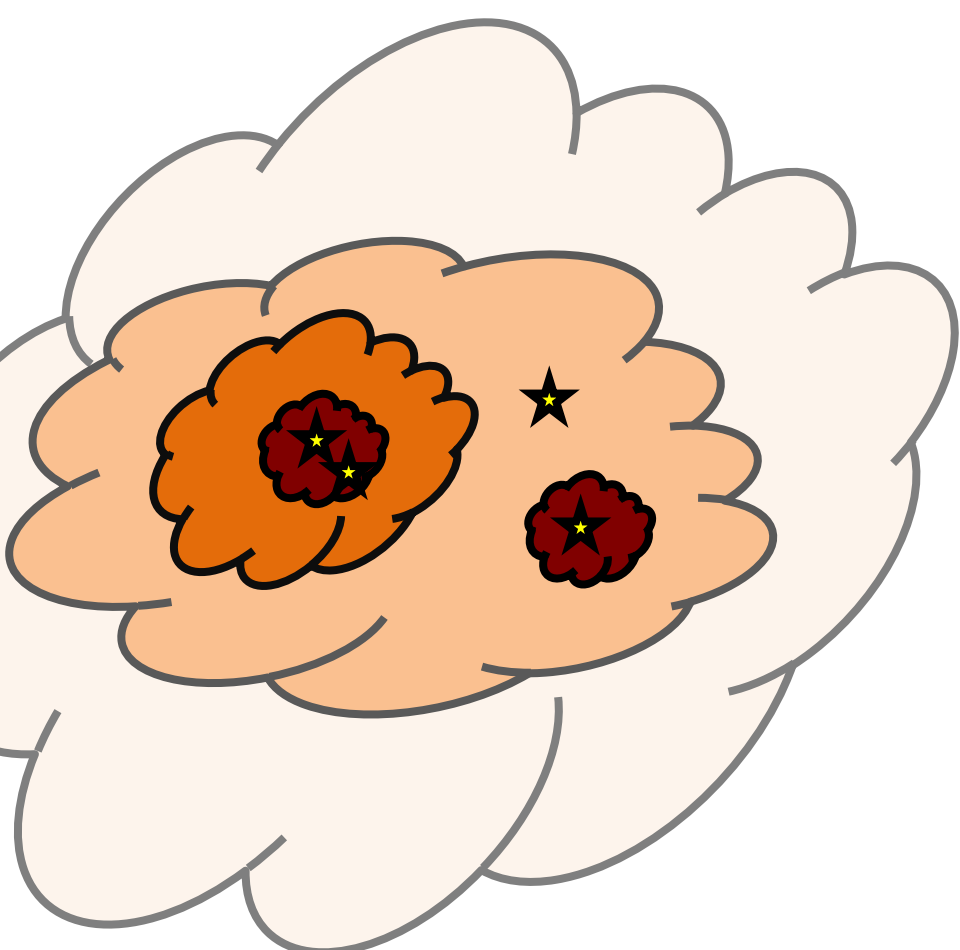
REAL SKY



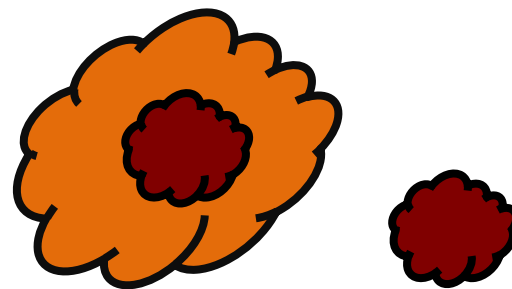
INTERFEROMETER IMAGE

$$\theta_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

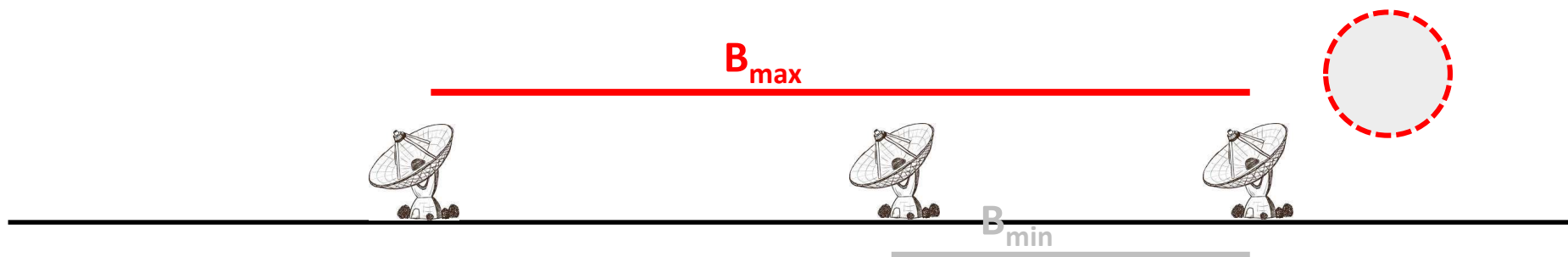


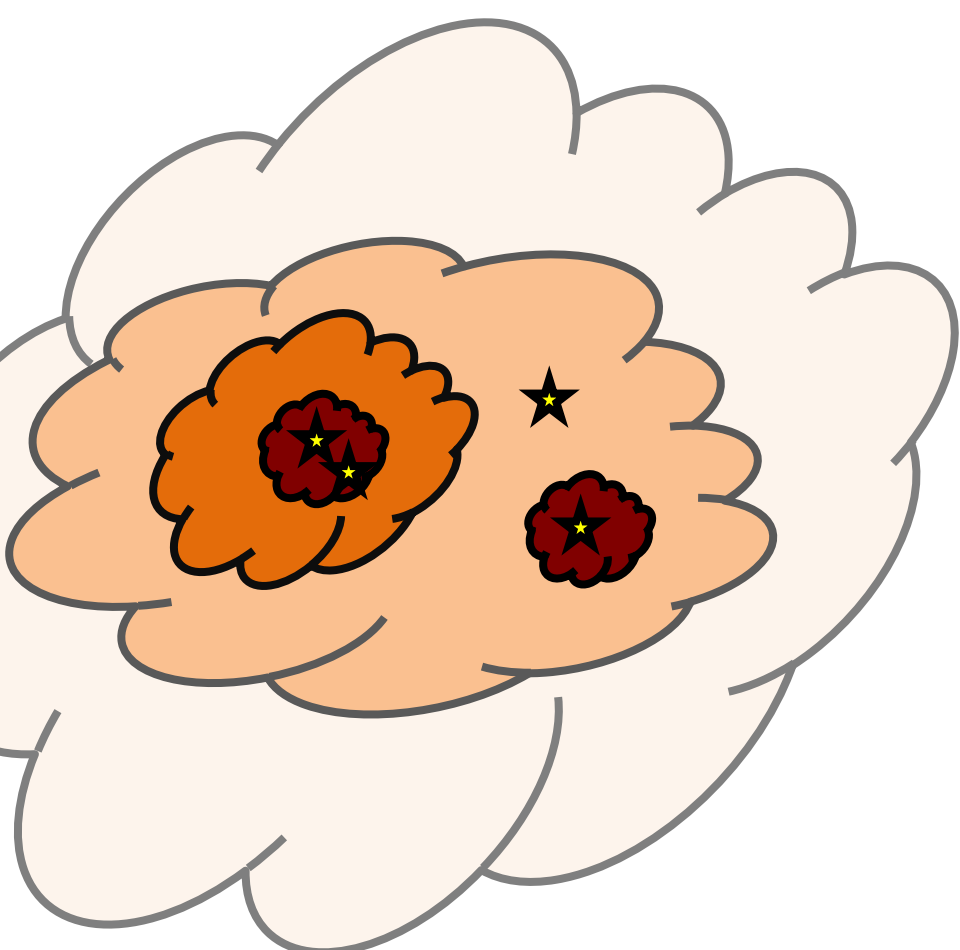


REAL SKY



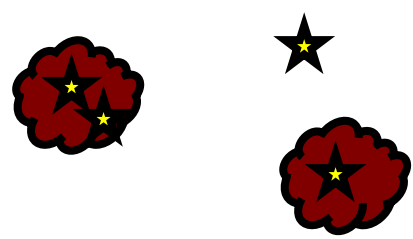
INTERFEROMETER IMAGE





REAL SKY

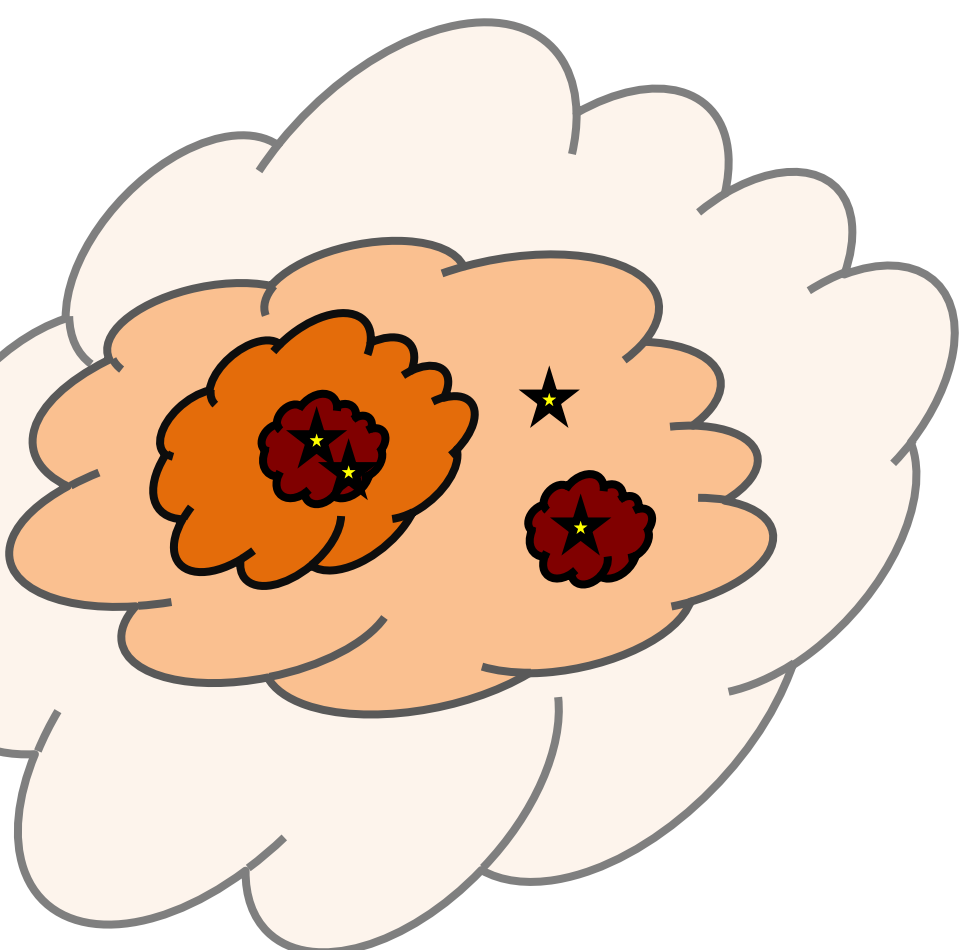
INTERFEROMETER IMAGE



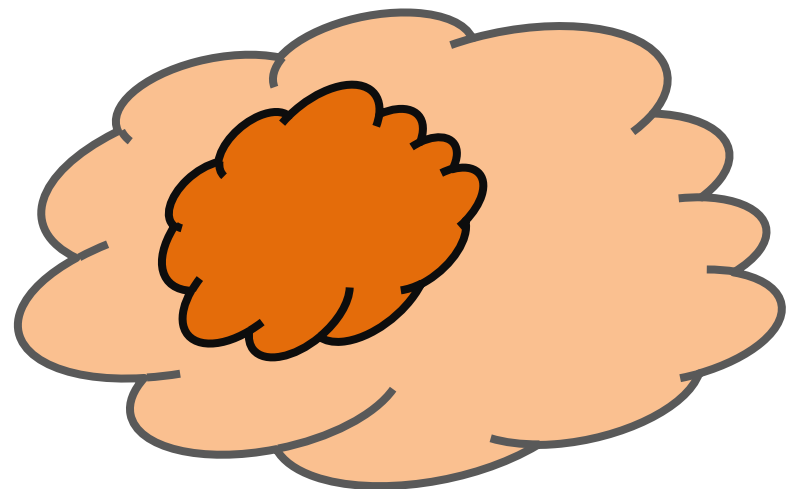
B_{\max}



B_{\min}

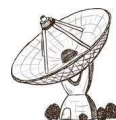


REAL SKY



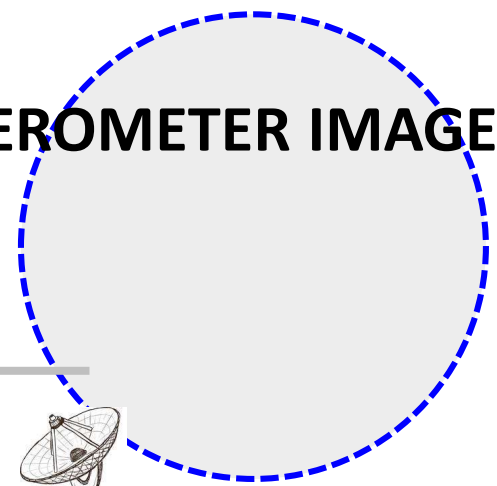
INTERFEROMETER IMAGE

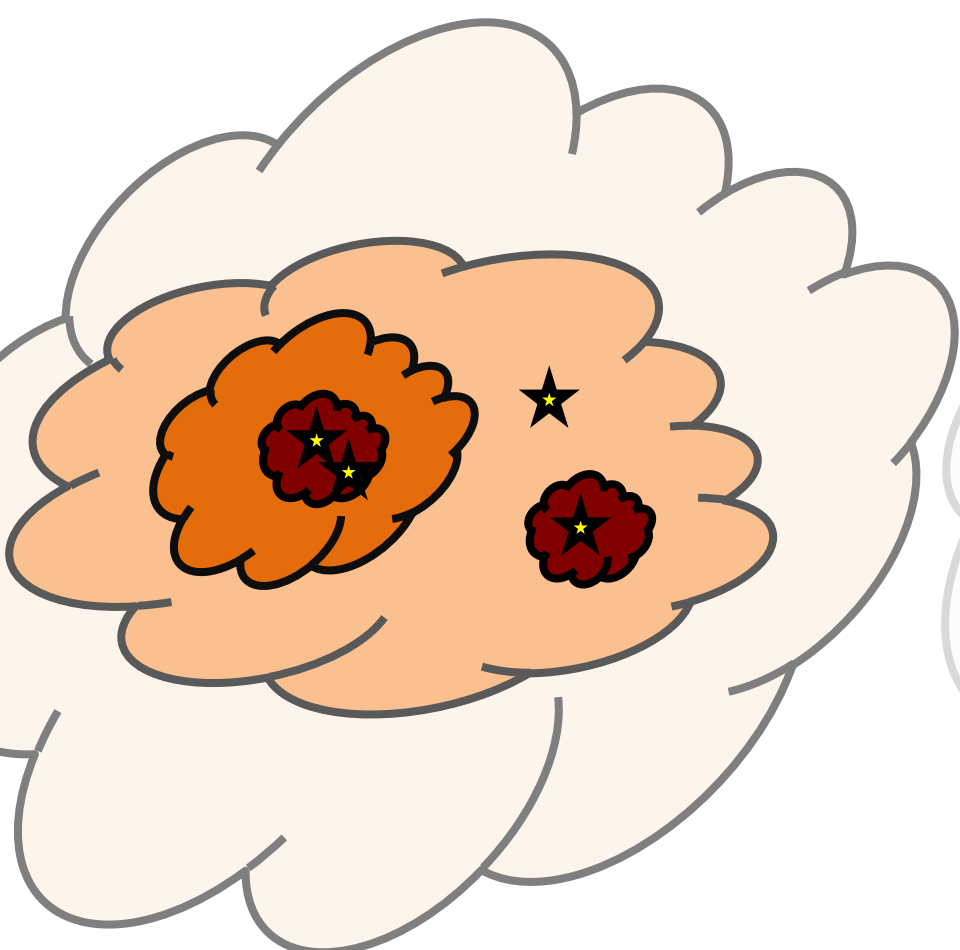
$$LAS = 1.22 \frac{\lambda}{B_{\min}}$$



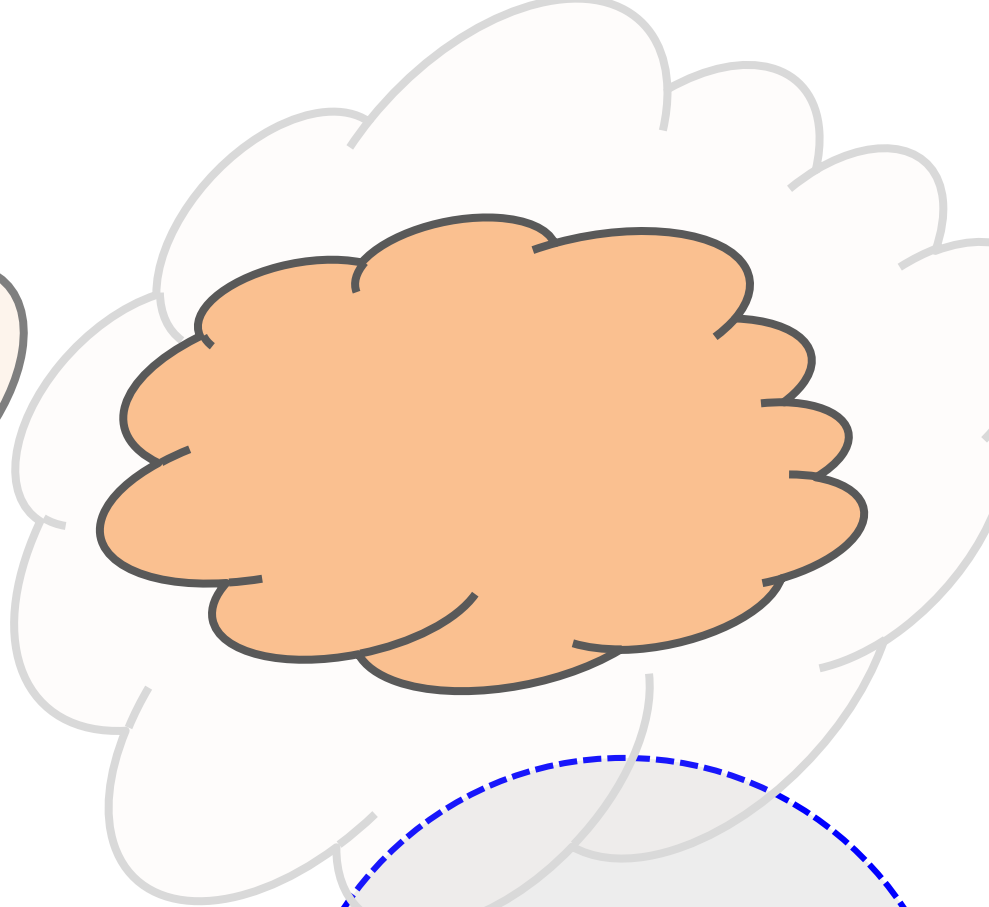
B_{\max}

B_{\min}



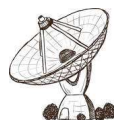
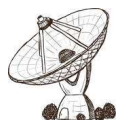


REAL SKY

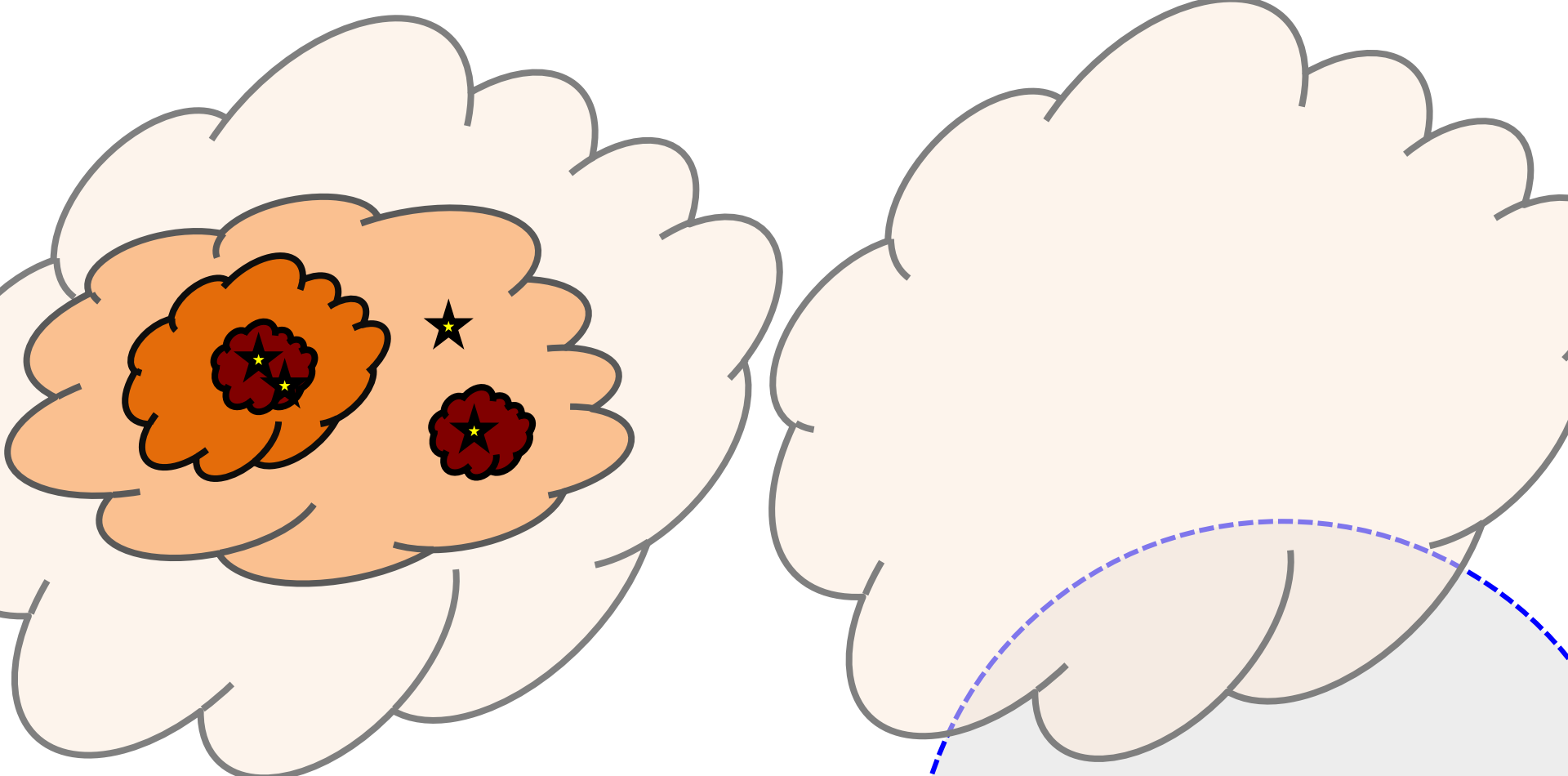


INTERFEROMETER IMAGE

B_{\max}



B_{\min}



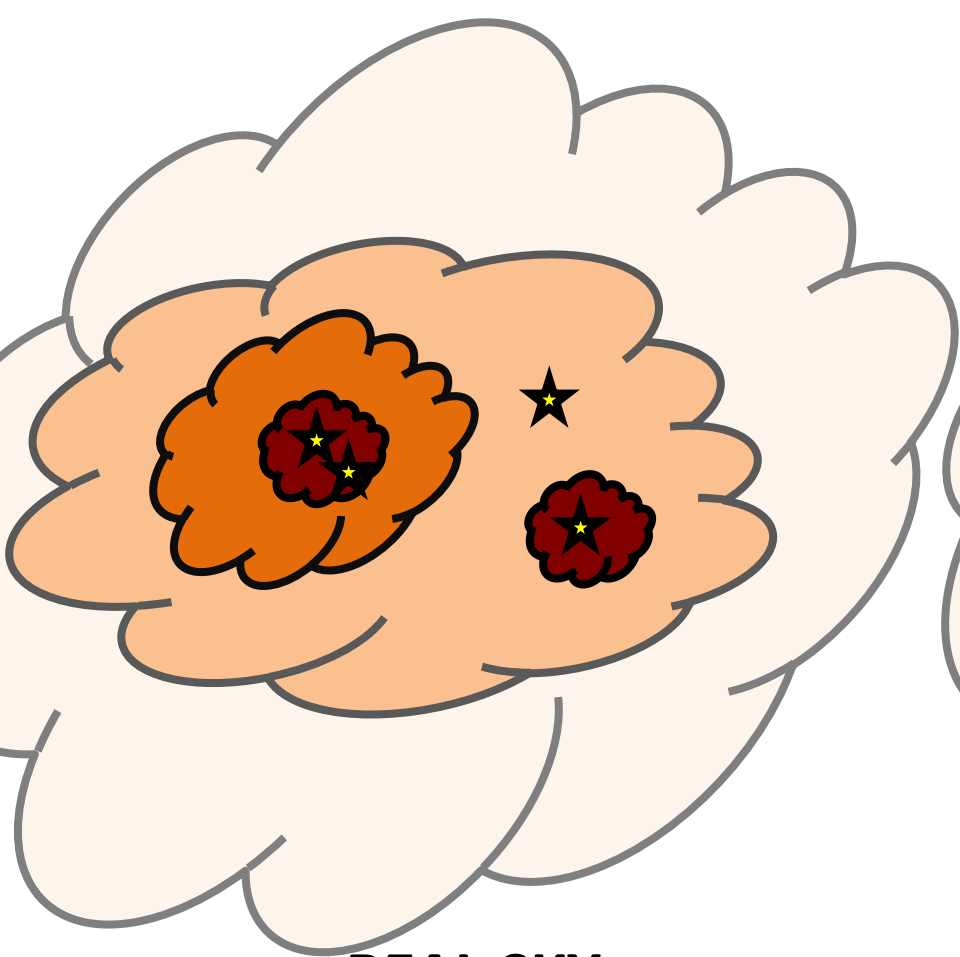
REAL SKY

INTERFEROMETER IMAGE

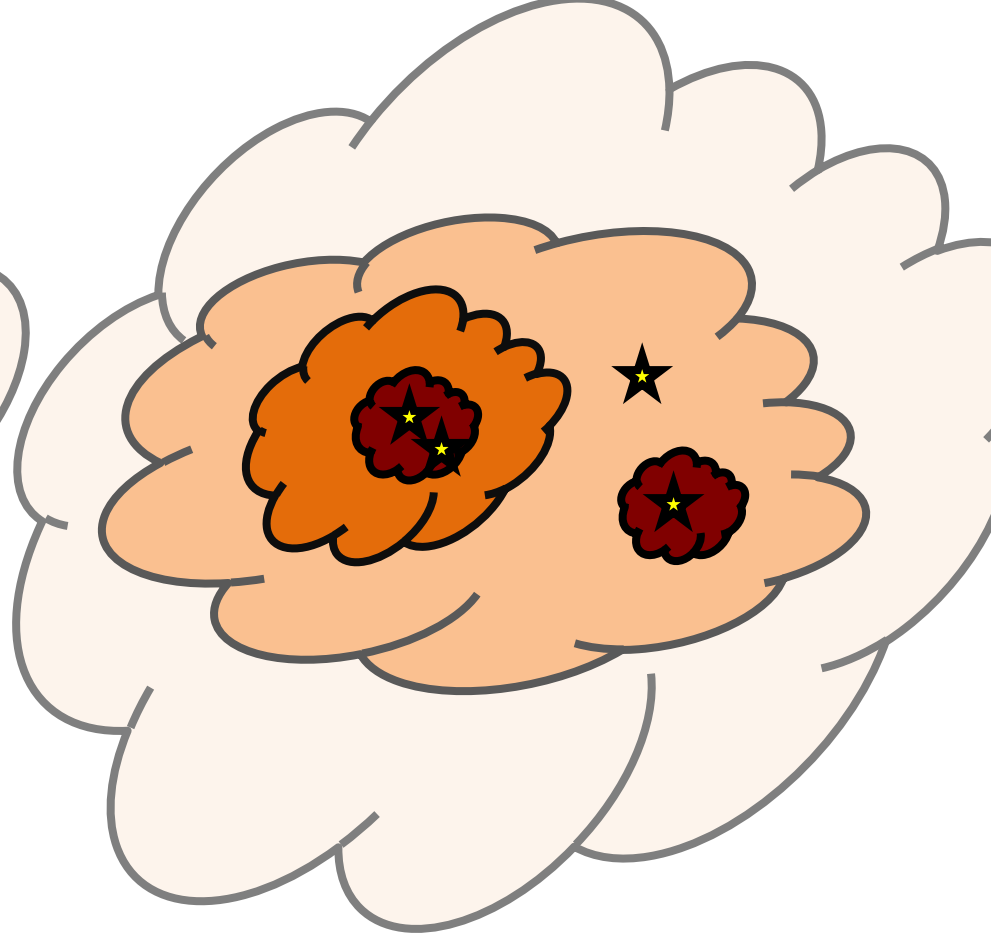
B_{\max}

B_{\min}

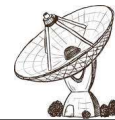




REAL SKY



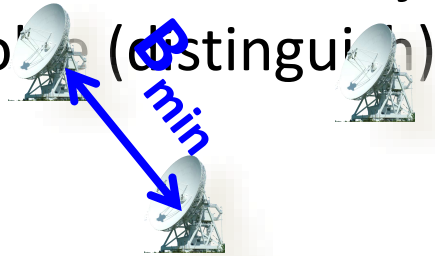
INTERFEROMETER IMAGE



Synthesized beam, primary beam and LAS

a.k.a. angular resolution, PSF, ...

it is the size of the object you want to resolve (distinguish)



a.k.a. maximum angular size ...

the largest size of your object

how big it is

B_{max}



a.k.a. field of view (FOV), ...

the area of the sky you want to observe

SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

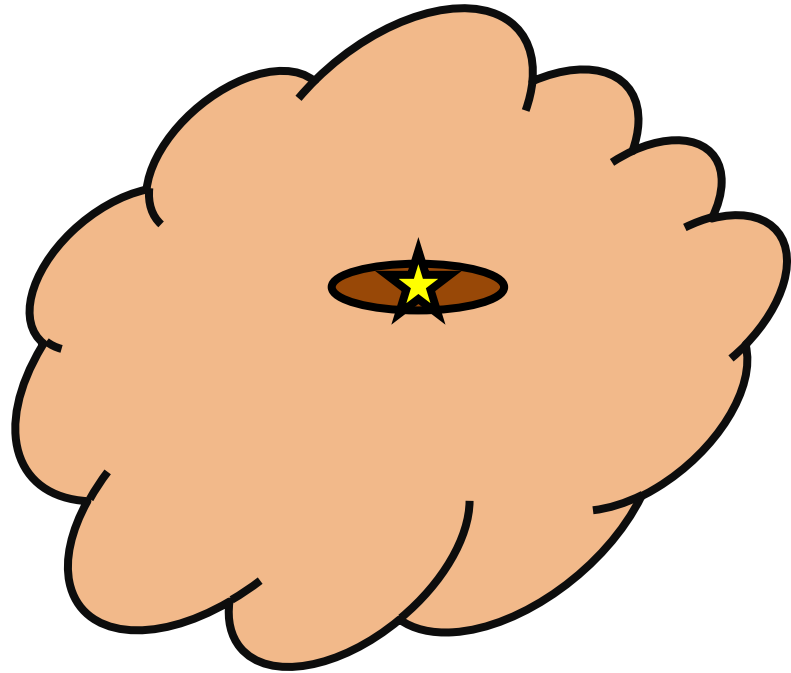
LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

Example I: compact protoplanetary disk



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

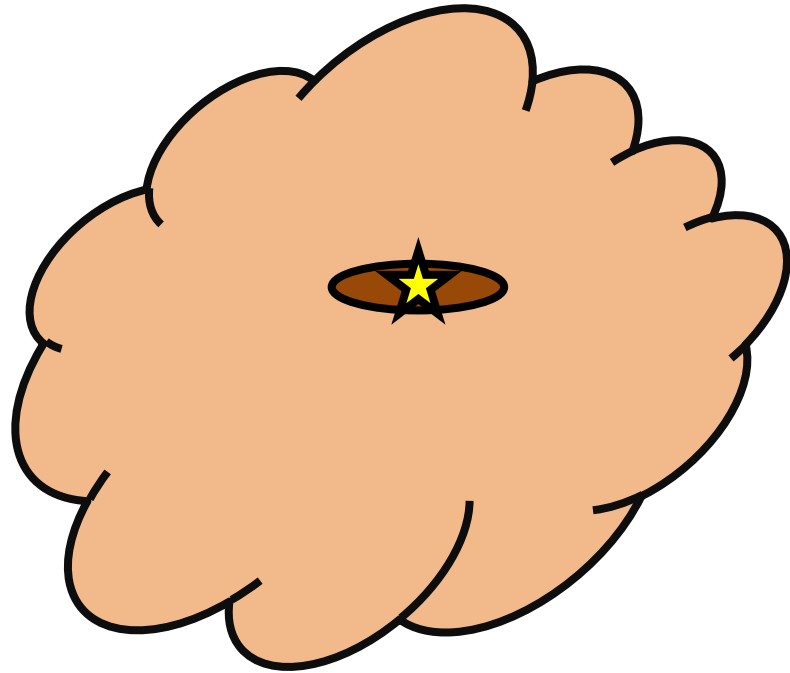
LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

Example I: compact protoplanetary disk



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

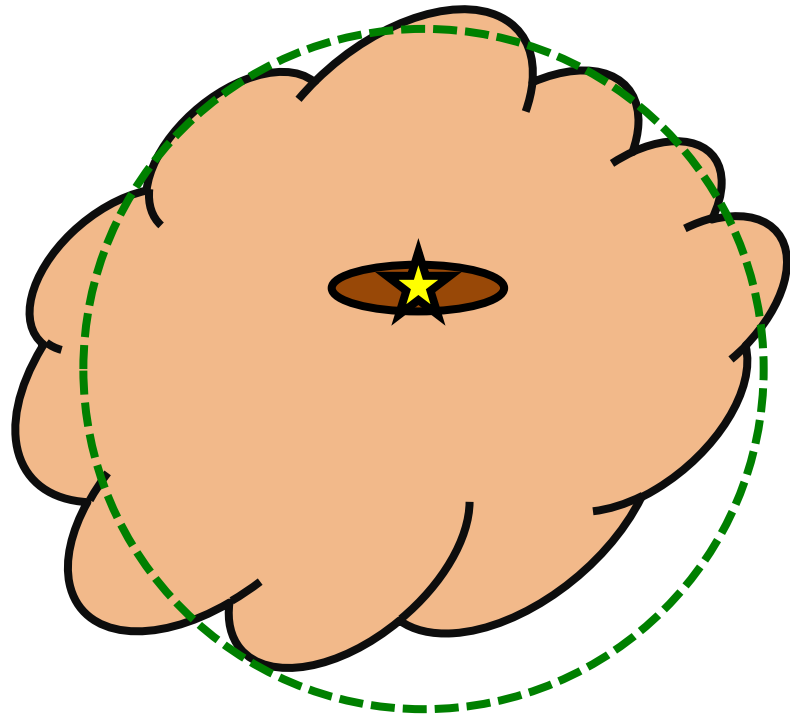
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

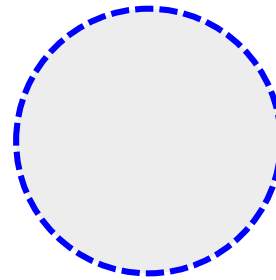


Example I: compact protoplanetary disk



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$



LARGEST ANGULAR SCALE

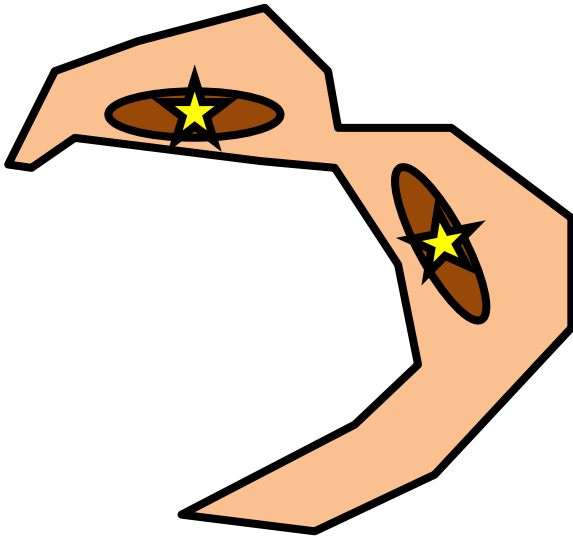
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$



Example II: disks and filament



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

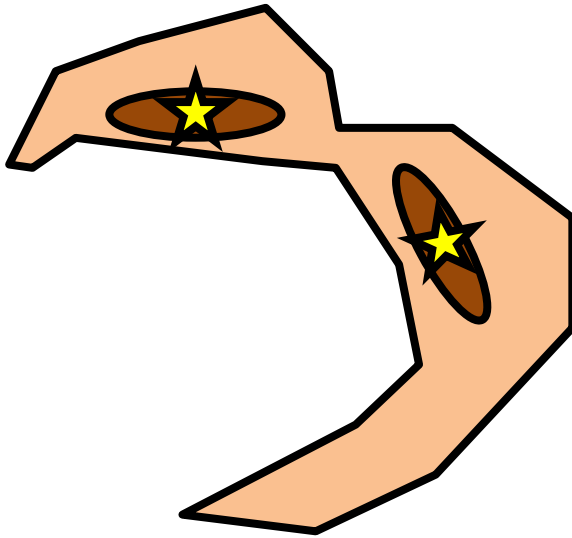
LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

Example II: disks and filament



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

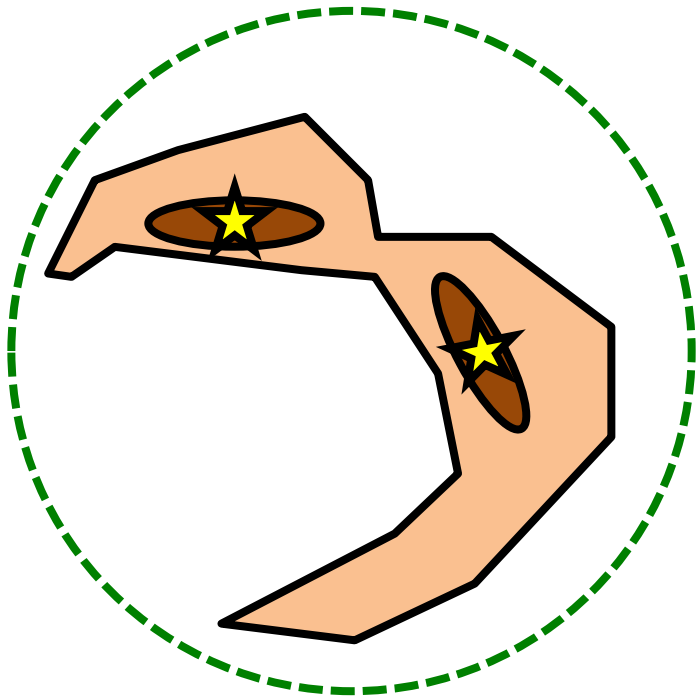
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

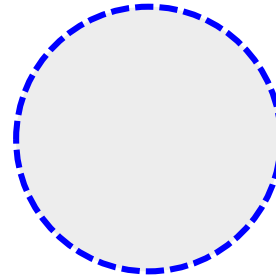


Example II: disks and filament



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

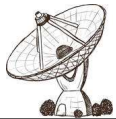


LARGEST ANGULAR SCALE

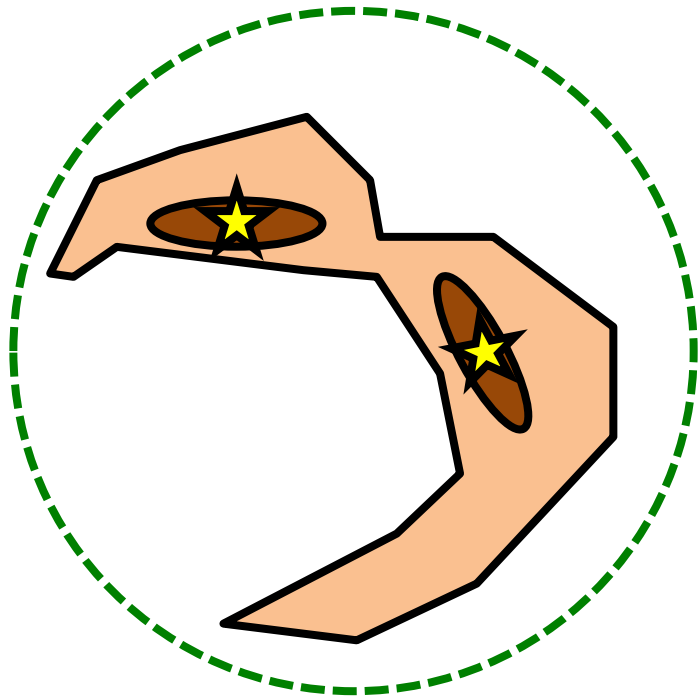
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$



Example II: disks and filament



SYNTHESIZED BEAM

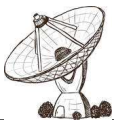
$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

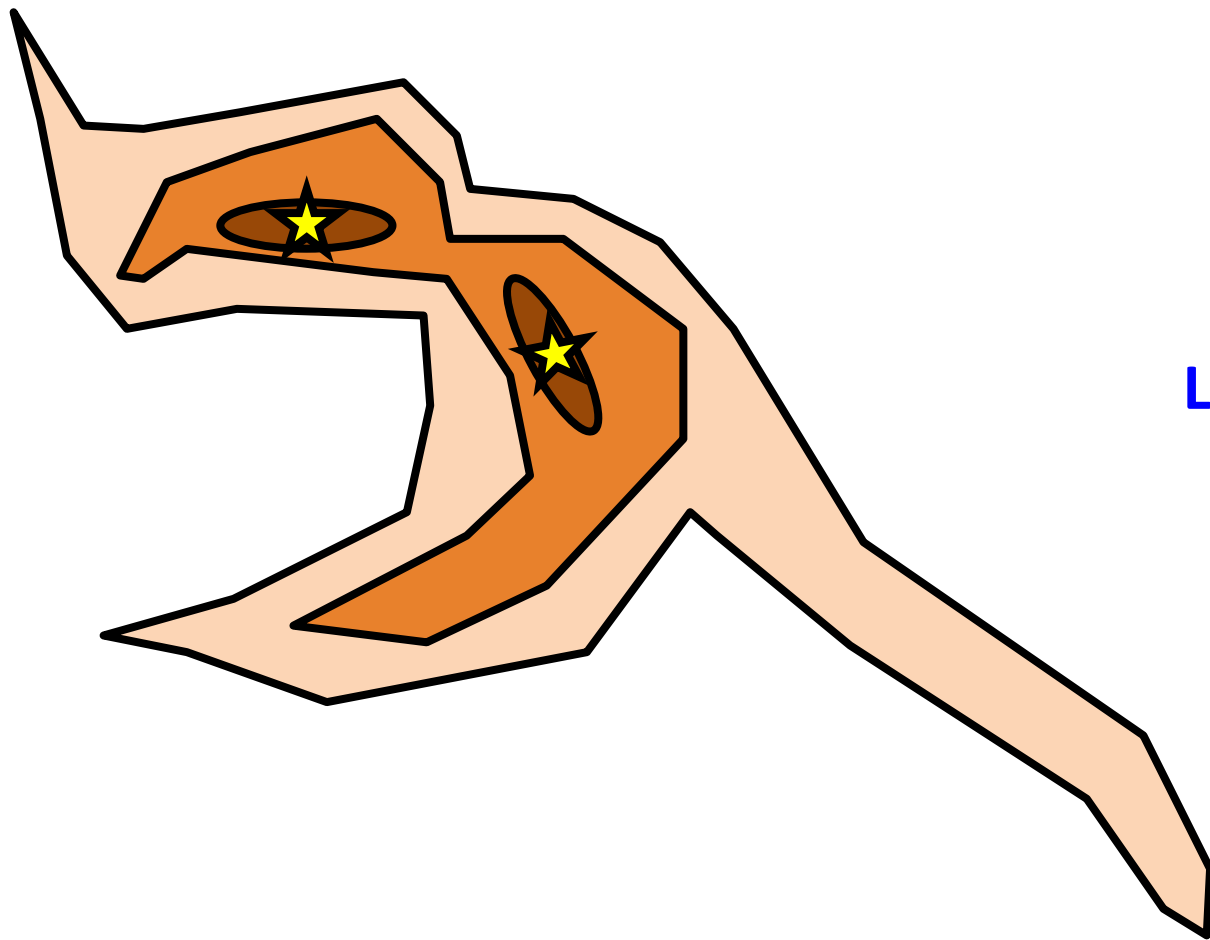
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$



Example III: disks and extended filament



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

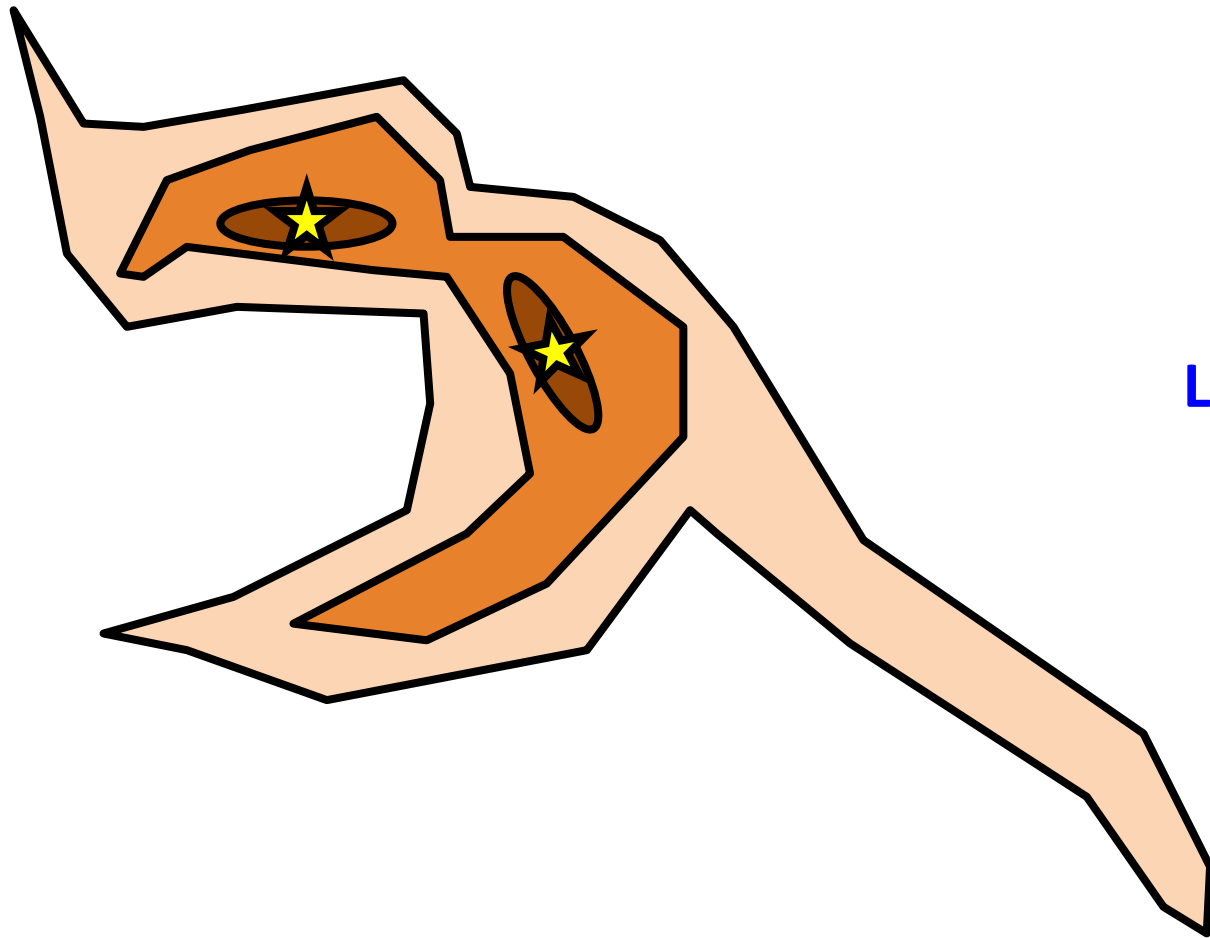
LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

Example III: disks and extended filament



SYNTHESIZED BEAM

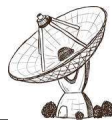
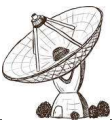
$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

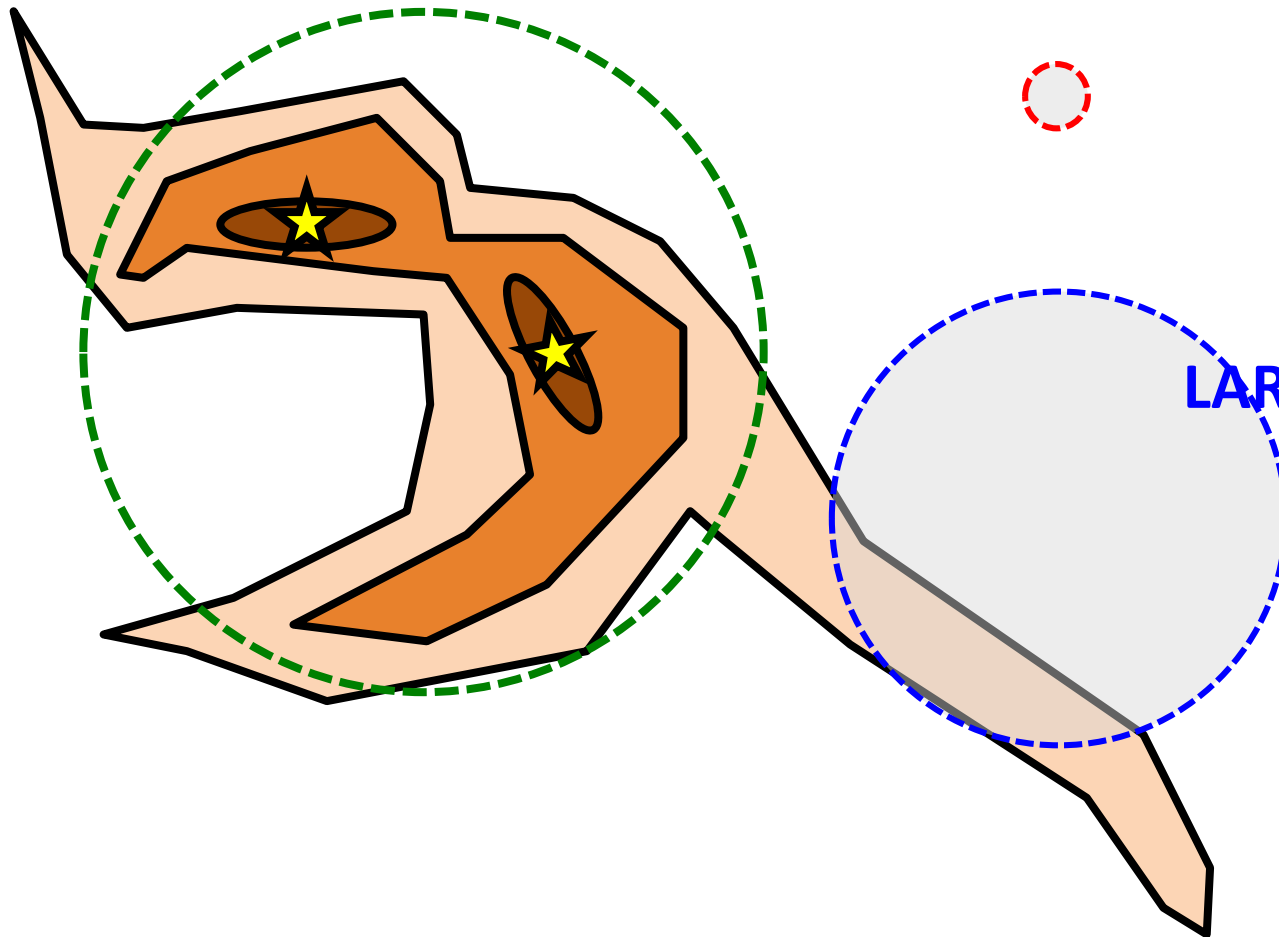
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$



Example III: disks and extended filament



SYNTHESIZED BEAM

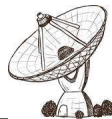
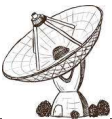
$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

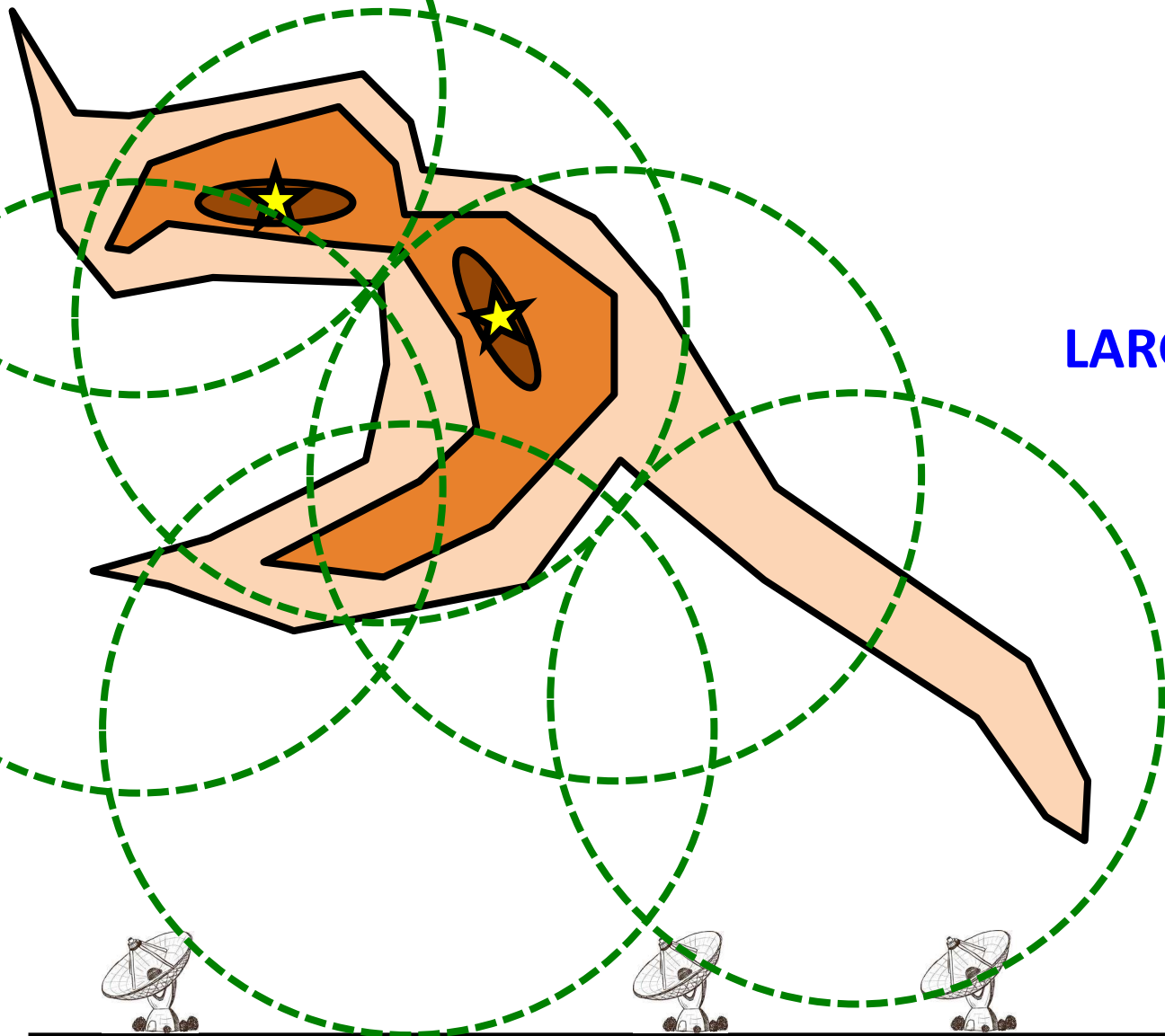
$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$



Example III: disks and extended filament



SYNTHESIZED BEAM

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

LARGEST ANGULAR SCALE

$$LAS = 1.22 \frac{\lambda}{B_{min}}$$

PRIMARY BEAM

$$PB = 1.22 \frac{\lambda}{D}$$

Practical work with the almaOT

Starting the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The title bar indicates the application name and the current project: "ALMA Observing Tool (Cycle5) - Project". The system tray shows the date and time as "Mon 27 Mar 09:48" and the user name as "Alvaro Sanchez".

The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy. The "Project" folder is expanded, revealing a "Proposal" folder, which contains a "Planned Observing" folder. Under "Planned Observing", there is a "ScienceGoal (Science Goal)" folder, which is further expanded to show sub-items: "General", "Field Setup", "Spectral Setup", "Calibration Setup", "Control and Performance", and "Technical Justification".
- Editors:** A panel on the right with tabs for "Spectral", "Spatial", and "Project". The "Project" tab is active, showing a form for "Principal Investigator" with a "Select PI..." button. Below this is the "Main Project Information" section, which includes fields for "Project", "Assigned Priority", and "Project Code" (currently set to "None Assigned").
- Feedback:** A panel at the bottom with tabs for "Validation", "Validation History", and "Log". The "Validation" tab is active, showing a table with columns for "Description" and "Suggestion".

The interface also features a standard menu bar (File, Edit, View, Tool, Search, Help) and a toolbar with various icons for file operations and editing.

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The title bar shows 'ALMA Observing Tool (Cycle5) - Project' and the system tray includes the date 'Mon 27 Mar 09:48' and the user name 'Alvaro Sanchez'. The menu bar contains 'File', 'Edit', 'View', 'Tool', 'Search', and 'Help'. The toolbar features various icons for file operations and editing.

The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy. The 'Field Setup' item is circled in red, and a red arrow points to the text 'FIELD SETUP' below it. The hierarchy includes: Project > Proposal > Planned Observing > ScienceGoal (Science Goal) > General > Field Setup. Other items under ScienceGoal include Spectral Setup, Calibration Setup, Control and Performance, and Technical Justification.
- Editors:** A panel on the right with tabs for 'Spectral', 'Spatial', and 'Project'. The 'Project' tab is active, showing fields for 'Principal Investigator' (with a 'Select PI...' button), 'Main Project Information' (with fields for 'Project', 'Assigned Priority', and 'Project Code' set to 'None Assigned'), and a help icon.
- Feedback:** A panel at the bottom with tabs for 'Validation', 'Validation History', and 'Log'. It contains a table with columns for 'Description' and 'Suggestion'.

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows a "Field Setup" configuration panel. The left sidebar contains a "Project Structure" tree with the following items: Project, Proposal, Planned Observing, ScienceGoal (Science Goal), General, Field Setup (selected), Spectral Setup, Calibration Setup, Control and Performance, and Technical Justification. The "Field Setup" panel includes a "SinglePoint" tab and a "Source" section. The "Source" section contains the following fields and controls:

- Source Name: [Text input field]
- Choose a Solar System Object?: Name of object: Unspecified [Dropdown menu]
- System: ICRS [Dropdown menu] Sexagesimal display?:
- Source Coordinates: RA: 00:00:00.0000 [Text input field] Dec: 00:00:00.000 [Text input field]
- Parallax: 0.00000 [Text input field] mas [Dropdown menu]
- PM RA: 0.00000 [Text input field] mas/yr [Dropdown menu]
- PM DEC: 0.00000 [Text input field] mas/yr [Dropdown menu]
- Source Radial Velocity: 0.000 [Text input field] km/s [Dropdown menu] Isrk [Dropdown menu] z: 0.000000000 [Text input field] Doppler Type: RADIO [Dropdown menu]
- Target Type: Individual Pointing(s) 1 Rectangular Field
- Expected Source Properties: Peak Continuum Flux Density per Synthesized Beam: 0.00000 [Text input field] Jy [Dropdown menu]
- Continuum Polarization Percentage: 0.0 [Text input field] per cent
- Peak Line Flux Density per Synthesized Beam: 0.00000 [Text input field] Jy [Dropdown menu]
- Line Width: 0.00000 [Text input field] km/s [Dropdown menu]

The bottom of the interface features a "Feedback" section with tabs for "Validation", "Validation History", and "Log". Below these tabs is a table with two columns: "Description" and "Suggestion".

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project". The interface is divided into several sections:

- Project Structure:** A tree view on the left showing the project hierarchy: Project > Proposal > Planned Observing > ScienceGoal (Science Goal) > Field Setup (highlighted).
- Editors:** A tabbed interface at the top right with tabs for "Spec", "Spatial", and "Field Setup". The "Spatial" tab is currently selected and circled in red.
- Field Setup Panel:** The main configuration area for the selected field. It contains the following fields and controls:
 - Source Name:** A text input field with a "Resolve" button.
 - Choose a Solar System Object?:** A checkbox.
 - Name of object:** A dropdown menu set to "Unspecified".
 - System:** A dropdown menu set to "ICRS".
 - Sexagesimal display?:** A checked checkbox.
 - Source Coordinates:** Fields for RA (00:00:00.0000) and Dec (00:00:00.000).
 - Parallax:** 0.00000 mas.
 - PM RA:** 0.00000 mas/yr.
 - PM DEC:** 0.00000 mas/yr.
 - Source Radial Velocity:** 0.000 km/s, with a "lsrk" dropdown and a redshift "z" field set to 0.000000000.
 - Doppler Type:** RADIO.
 - Target Type:** Radio buttons for "Individual Pointing(s)" (selected) and "1 Rectangular Field".
 - Expected Source Properties:** Fields for Peak Continuum Flux Density per Synthesized Beam (0.00000 Jy), Continuum Polarization Percentage (0.0 per cent), Peak Line Flux Density per Synthesized Beam (0.00000 Jy), and Line Width (0.00000 km/s).
- Feedback:** A section at the bottom with tabs for "Validation", "Validation History", and "Log". Below these tabs is a table with columns for "Description" and "Suggestion".

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows a "Perspective" view. The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy: Project > Proposal > Planned Observing > ScienceGoal (Science Goal) > Field Setup (selected).
- Editors:** A central panel with tabs for "Spectral", "Spatial", and "Field Setup". The "Field Setup" tab is active, showing a "Spatial Image" view with a black field and a yellow box indicating the field center. Below the image is a color scale bar and a status bar showing "1x", "320, 306", and "0.0".
- Field Setup Parameters:** A panel at the bottom of the "Field Setup" tab containing the following fields:
 - Image Filename: [Empty]
 - FOV Parameters:
 - Representative Frequency (Sky): 0.000 GHz
 - Antenna Diameter: 12m (selected)
 - Antenna Beamsize (HPBW): 0.000 arcsec
- SinglePoint Source Configuration:** A panel on the right side of the interface with the following fields:
 - Source Name: [Empty]
 - Choose a Solar System Object? Name of ob: [Empty]
 - Source Coordinates:
 - System: ICRS (selected)
 - Sexagesimal display?
 - RA: 00:00:00.0000
 - Dec: 00:00:00.0000
 - Source Radial Velocity: 0.000 km/s (selected) | Isrk (selected)
 - Target Type: Individual Pointing(s) 1 Rectangul
 - Expected Source Properties:
 - Peak Continuum Flux Density per Synthesized
 - Continuum Polarization Percentage
 - Peak Line Flux Density per Synthesized Beam
 - Line Width
 - Line Polarization Percentage
 - Field Center Coordinates:
 - Coord Type: Relative Absolute
 - Offset Unit: arcsec
 - #Pointings: 1
 - RA [arcsec]: 0.00000

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The title bar shows the application name and the current project: "ALMA Observing Tool (Cycle5) - Project". The menu bar includes "File", "Edit", "View", "Tool", "Search", and "Help". The toolbar contains various icons for file operations and editing.

The interface is divided into two main panes:

- Project Structure:** A tree view on the left showing the project hierarchy. The "Field Setup" tab is selected under the "ScienceGoal (Science Goal)" folder.
- Editors:** A central pane with three tabs: "Spectral", "Spatial", and "Field Setup". The "Field Setup" tab is active, displaying the configuration panel for a source.

The "Field Setup" panel contains the following fields and options:

- Source:** A text input field for "Source Name" with a "Resolve" button.
- Choose a Solar System Object?:** A checkbox, currently unchecked. The "Name of object" is set to "Unspecified".
- Source Coordinates:** Fields for "System" (set to "ICRS"), "RA" (00:00:00.0000), and "Dec" (00:00:00.000). A "Sexagesimal display?" checkbox is checked. To the right, "Parallax" (0.00000 mas), "PM RA" (0.00000 mas/yr), and "PM DEC" (0.00000 mas/yr) are also set.
- Source Radial Velocity:** Fields for "Source Radial Velocity" (0.000 km/s), "lsrk" (checked), "z" (0.000000000), and "Doppler Type" (RADIO).
- Target Type:** Radio buttons for "Individual Pointing(s)" (selected) and "1 Rectangular Field".
- Expected Source Properties:** Fields for "Peak Continuum Flux Density per Synthesized Beam" (0.00000 Jy), "Continuum Polarization Percentage" (0.0 per cent), "Peak Line Flux Density per Synthesized Beam" (0.00000 Jy), "Line Width" (0.00000 km/s), and "Line Polarization Percentage" (0.0 per cent).
- Field Center Coordinates:** Radio buttons for "Coord Type" (Relative selected, Absolute unselected), "Offset Unit" (arcsec), and "#Pointings" (1).

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows the "Field Setup" configuration panel. The "Project Structure" pane on the left indicates the current configuration is for a "ScienceGoal (Science Goal)".

The "Field Setup" panel includes the following sections:

- Source:** A text input field for the "Source Name" is highlighted with a red box and labeled "Name of the source". A "Resolve" button is located to the right of this field.
- Choose a Solar System Object?:** A dropdown menu currently set to "Unspecified".
- Source Coordinates:** Fields for RA (00:00:00.0000) and Dec (00:00:00.000). A "System" dropdown is set to "ICRS". A "Sexagesimal display?" checkbox is checked.
- Parallax:** 0.00000 mas.
- PM RA:** 0.00000 mas/yr.
- PM DEC:** 0.00000 mas/yr.
- Source Radial Velocity:** 0.000 km/s. A "Doppler Type" dropdown is set to "RADIO".
- Target Type:** Radio buttons for "Individual Pointing(s)" (selected) and "1 Rectangular Field".
- Expected Source Properties:**
 - Peak Continuum Flux Density per Synthesized Beam: 0.00000 Jy
 - Continuum Polarization Percentage: 0.0 per cent
 - Peak Line Flux Density per Synthesized Beam: 0.00000 Jy
 - Line Width: 0.00000 km/s
 - Line Polarization Percentage: 0.0 per cent
- Field Center Coordinates:**
 - Coord Type: Radio buttons for "Relative" (selected) and "Absolute".
 - Offset Unit: arcsec
 - #Pointings: 1

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows the "Field Setup" tab. The "Project Structure" panel on the left shows a tree view with "Field Setup" selected. The "Field Setup" panel contains the following fields and controls:

- Source Name:** A text input field highlighted with a red box and labeled "Name of the source".
- Source Coordinates:** Fields for RA and Dec, both highlighted with red boxes and labeled "Coordinates of the source".
- System:** A dropdown menu set to "ICRS".
- Parallax:** A text input field set to "0.00000" with a unit dropdown set to "mas".
- PM RA:** A text input field set to "0.00000" with a unit dropdown set to "mas/yr".
- PM DEC:** A text input field set to "0.00000" with a unit dropdown set to "mas/yr".
- Source Radial Velocity:** A text input field set to "0.000" with a unit dropdown set to "km/s" and a "lsrk" checkbox.
- Target Type:** Radio buttons for "Individual Pointing(s)" (selected) and "1 Rectangular Field".
- Expected Source Properties:** Fields for "Peak Continuum Flux Density per Synthesized Beam" (0.00000 Jy), "Continuum Polarization Percentage" (0.0 per cent), "Peak Line Flux Density per Synthesized Beam" (0.00000 Jy), "Line Width" (0.00000 km/s), and "Line Polarization Percentage" (0.0 per cent).
- Field Center Coordinates:** Fields for "Coord Type" (Relative selected), "Offset Unit" (arcsec), and "#Pointings" (1).

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows the "Field Setup" configuration panel. The "Project Structure" tree on the left indicates the current configuration is for a "ScienceGoal (Science Goal)".

The "Field Setup" panel includes the following fields and settings:

- Source Name:** A text input field highlighted with a red box and labeled "Name of the source".
- Source Coordinates:** RA and Dec fields, both containing "00:00:00.0000", highlighted with a red box and labeled "Coordinates of the source".
- Source Radial Velocity:** A text input field containing "0.000", highlighted with a red box and labeled "Velocity / redshift".
- System:** Set to "ICRS".
- Parallax:** 0.00000 mas.
- PM RA:** 0.00000 mas/yr.
- PM DEC:** 0.00000 mas/yr.
- Target Type:** Individual Pointing(s) 1 Rectangular Field.
- Expected Source Properties:**
 - Peak Continuum Flux Density per Synthesized Beam: 0.00000 Jy
 - Continuum Polarization Percentage: 0.0 per cent
 - Peak Line Flux Density per Synthesized Beam: 0.00000 Jy
 - Line Width: 0.00000 km/s
 - Line Polarization Percentage: 0.0 per cent
- Field Center Coordinates:**
 - Coord Type: Relative Absolute
 - Offset Unit: arcsec
 - #Pointings: 1

Field setup in the almaOT

ALMA Observing Tool (Cycle5) - Project

File Edit View Tool Search Help

Project Structure

- Project
 - Proposal
 - Planned Observing
 - ScienceGoal (Science Goal)
 - General
 - Field Setup
 - Spectral Setup
 - Calibration Setup
 - Control and Performance
 - Technical Justification

Editors

Spectral Spatial **Field Setup**

Input source details and mapping info or use the Visual Editor on the spatial tab.
You must choose between checking 1 Rectangular Field on all sources or none.
Check 1 Rectangular Field on the first source before adding others to put rectangular mosaics around multiple sources.

SinglePoint

Source

Source Name **Name of the source** Resolve

Choose a Solar System Object? Name of object Unspecified

System ICRS Sexagesimal

Source Coordinates

RA **Coordinates of the source**

Dec **Coordinates of the source**

Parallax 0.00000 mas

PM RA 0.00000 mas/yr

PM DEC 0.00000 mas/yr

Source Radial Velocity km/s **Velocity / redshift** Isrk z 0.000000000 Doppler Type RADIO

Target Type Individual Pointing(s) 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Synthesized Beam **Expected intensity of the source**

Continuum Polarization Percentage per cent

Peak Line Flux Density per Synthesized Beam **Expected intensity of the source**

Line Width km/s

Line Polarization Percentage per cent

Field Center Coordinates

Coord Type Relative Absolute

Offset Unit arcsec

#Pointings 1

Field setup in the almaOT

ALMA Observing Tool (Cycle5) - Project

File Edit View Tool Search Help

Project Structure

- Project
 - Proposal
 - Planned Observing
 - ScienceGoal (Science Goal)
 - General
 - Field Setup
 - Spectral Setup
 - Calibration Setup
 - Control and Performance
 - Technical Justification

Editors

Spectral Spatial **Field Setup**

Input source details and mapping info or use the Visual Editor on the spatial tab.
You must choose between checking 1 Rectangular Field on all sources or none.
Check 1 Rectangular Field on the first source before adding others to put rectangular mosaics around multiple sources.

SinglePoint

Source

Source Name **Name of the source** Resolve

Choose a Solar System Object? Name of object Unspecified

System ICRS Sexagesimal Parallax 0.00000 mas

Source Coordinates RA 00:00:00.0000 PM RA 0.00000 mas/yr

Dec 00:00:00.0000 PM DEC 0.00000 mas/yr

Source Radial Velocity 0.000 km/s Isrk z 0.000000000 Doppler Type RADIO

Target Type Individual Pointing(s) 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Synthesized Beam 0.00000 Jy

Continuum Polarization Percentage 0.0 per cent

Peak Line Flux Density per Synthesized Beam 0.00000 Jy

Line Width 0.00000 km/s

Line Polarization Percentage 0.0 per cent

Field Center Coordinates

Coord Type Relative Absolute

Offset Unit arcsec

#Pointings 1

Coordinates of the source

Velocity / redshift

Expected intensity of the source

Field setup in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows a "Perspective" view. The "Project Structure" pane on the left lists the project hierarchy: Project > Proposal > Planned Observing > ScienceGoal (Science Goal). Under "ScienceGoal", several sub-items are listed: General, Field Setup, Spectral Setup, Calibration Setup, Control and Performance, and Technical Justification. The "Control and Performance" item is circled in red, and a red arrow points from it to the text "CONTROL and PERFORMANCE" located in the bottom left corner of the image.

The "Editors" pane on the right is currently set to the "Field Setup" tab. It contains the following configuration options:

- SinglePoint** (selected)
- Source**
 - Source Name: [Text Field]
 - Source Coordinates
 - System: ICRS (dropdown), Sexagesimal display? [checked]
 - RA: 00:00:00.0000
 - Dec: 00:00:00.000
 - Source Radial Velocity: 0.000 km/s, Isrk [dropdown], z: 0.000000000, Doppler Type: RADIO (dropdown)
 - Target Type: Individual Pointing(s) 1 Rectangular Field
- Expected Source Properties**
 - Peak Continuum Flux Density per Synthesized Beam: 0.00000 Jy (dropdown)
 - Continuum Polarization Percentage: 0.0 per cent
 - Peak Line Flux Density per Synthesized Beam: 0.00000 Jy (dropdown)
 - Line Width: 0.00000 km/s (dropdown)
 - Line Polarization Percentage: 0.0 per cent
- Field Center Coordinates**
 - Coord Type: Relative Absolute
 - Offset Unit: arcsec (dropdown)
 - #Pointings: 1

Control and Performance in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The window title is "ALMA Observing Tool (Cycle5) - Project". The menu bar includes "File", "Edit", "View", "Tool", "Search", and "Help". The toolbar contains various icons for file operations and navigation. The "Project Structure" panel on the left shows a tree view with "Project" expanded to "Planned Observing" and "ScienceGoal (Science Goal)", with "Control and Performance" selected. The "Editors" panel on the right shows the "Control and Performance" configuration panel. The panel contains the following sections and controls:

These parameters are used to control various aspects of the observations, including the required antenna configurations and integration time.

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 \cdot \lambda / D$)	12m 0.000 arcsec	7m 0.000 arcsec	
Number of Antennas	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	16.197 km
Synthesized beamsize	0.000 arcsec	0.000 arcsec	0.000 arcsec
Shortest baseline	0.009 km	0.015 km	0.256 km
Maximum recoverable scale	0.000 arcsec	0.000 arcsec	0.000 arcsec

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

0.00000 arcsec

Largest Angular Structure in source Undefined arcsec

Desired sensitivity per pointing 0.00000 Jy equivalent to Infinity K

Bandwidth used for Sensitivity RepresentativeWindowResolution Frequency Width 0.000000 GHz

Science goal integration time estimate Time Estimate

Override OT's sensitivity-based time estimate (must be justified) Yes No

Control and Performance in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The main window is titled "ALMA Observing Tool (Cycle5) - Project" and shows a "Perspective" view. The left sidebar, labeled "Project Structure", contains a tree view with the following items: Project, Proposal, Planned Observing, ScienceGoal (Science Goal), General, Field Setup, Spectral Setup, Calibration Setup, Control and Performance (highlighted), and Technical Justification. The main area is divided into "Editors" and "Control and Performance" tabs. The "Control and Performance" tab is active and contains the following configuration information:

These parameters are used to control various aspects of the observations, including the required antenna configurations and integration time.

Configuration Information

	12m	7m	TP
Antenna Beamsize ($1.13 \cdot \lambda / D$)	0.000 arcsec	0.000 arcsec	
Number of Antennas	43	10	3
	ACA 7m configuration	Most compact 12m configuration	Most extended 12m configuration
Longest baseline	0.049 km	0.161 km	16.197 km
Synthesized beamsize	0.000 arcsec	0.000 arcsec	0.000 arcsec
Shortest baseline	0.009 km	0.015 km	0.256 km
Maximum recoverable scale	0.000 arcsec	0.000 arcsec	0.000 arcsec

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

0.00000 arcsec

Largest Angular Structure in source Undefined arcsec

Desired sensitivity per pointing 0.00000 Jy equivalent to Infinity K

Bandwidth used for Sensitivity RepresentativeWindowResolution Frequency Width 0.000000 GHz

Science goal integration time estimate Time Estimate

Override OT's sensitivity-based time estimate (must be justified) Yes No

Control and Performance in the almaOT

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 * \lambda / D$) 12m 7m

Number of Antennas 12m 7m TP

	ACA 7m configuration	Most compact 12m configuration	Most extended 12m configuration
Longest baseline	<input type="text" value="0.049 km"/>	<input type="text" value="0.161 km"/>	<input type="text" value="16.197 km"/>
Synthesized beamsize	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>
Shortest baseline	<input type="text" value="0.009 km"/>	<input type="text" value="0.015 km"/>	<input type="text" value="0.256 km"/>
Maximum recoverable scale	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

▼

Largest Angular Structure in source ▼

Control and Performance in the almaOT

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 * \lambda / D$) 12m 0.000 arcsec 7m 0.000 arcsec

Number of Antennas 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	16.197 km
Synthesized beamsize	0.000 arcsec	0.000 arcsec	0.000 arcsec
Shortest baseline	0.009 km	0.015 km	0.256 km
Maximum recoverable scale	0.000 arcsec	0.000 arcsec	0.000 arcsec

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

arcsec **Synthesized beam**

Largest Angular Structure in source arcsec

Control and Performance in the almaOT

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 * \lambda / D$) 12m 7m

Number of Antennas 12m 7m TP

	ACA 7m configuration	Most compact 12m configuration	Most extended 12m configuration
Longest baseline	<input type="text" value="0.049 km"/>	<input type="text" value="0.161 km"/>	<input type="text" value="16.197 km"/>
Synthesized beamsize	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>
Shortest baseline	<input type="text" value="0.009 km"/>	<input type="text" value="0.015 km"/>	<input type="text" value="0.256 km"/>
Maximum recoverable scale	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

arcsec **Synthesized beam**

Largest Angular Structure in source arcsec **Largest angular scale**

Control and Performance in the almaOT

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 * \lambda / D$) 12m 7m

Number of Antennas 12m 7m TP

	ACA 7m configuration	Most compact 12m configuration	Most extended 12m configuration
Longest baseline	<input type="text" value="0.049 km"/>	<input type="text" value="0.161 km"/>	<input type="text" value="16.197 km"/>
Synthesized beamsize	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>
Shortest baseline	<input type="text" value="0.009 km"/>	<input type="text" value="0.015 km"/>	<input type="text" value="0.256 km"/>
Maximum recoverable scale	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>	<input type="text" value="0.000 arcsec"/>

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

arcsec **Synthesized beam**

Largest Angular Structure in source arcsec **Largest angular scale**

SYNTHESIZED BEAM

a.k.a. angular resolution, PSF, ...
it is the size of the object you want
to resolve (distinguish)

$$q_{beam} = 1.22 \frac{\lambda}{B_{max}}$$

Control and Performance in the almaOT

Control and Performance

Configuration Information

Antenna Beamsize ($1.13 * \lambda / D$) 12m 0.000 arcsec 7m 0.000 arcsec

Number of Antennas 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	16.197 km
Synthesized beamsize	0.000 arcsec	0.000 arcsec	0.000 arcsec
Shortest baseline	0.009 km	0.015 km	0.256 km
Maximum recoverable scale	0.000 arcsec	0.000 arcsec	0.000 arcsec

Desired Performance

Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA

0.00000 arcsec — Synthesized beam

Undefined arcsec — Largest angular scale

LARGEST ANGULAR SCALE

a.k.a. maximum angular size, ...
the largest size of your object
how big it is?

$$LAS = 1.22 \frac{\lambda}{B_{\min}}$$

Mosaics in the almaOT

The screenshot displays the ALMA Observing Tool (Cycle5) interface. The window title is "ALMA Observing Tool (Cycle5) - Project". The top menu bar includes "File", "Edit", "View", "Tool", "Search", and "Help". The top toolbar contains various icons for file operations and editing. The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy: Project > Proposal > Planned Observing > ScienceGoal (Science Goal) > General > Field Setup (selected). Other sub-items include Spectral Setup, Calibration Setup, Control and Performance, and Technical Justification.
- Editors:** A central panel with tabs for "Spectral", "Spatial", and "Field Setup". The "Spatial" tab is active, showing a "Spatial Image" with a black background and a yellow rectangular selection box. Below the image is a color scale bar and a status bar showing "1x", "320, 306", and "0.0".
- Field Setup:** A panel on the right with a "SinglePoint" tab. It contains the following fields:
 - Source Name: [Text Field]
 - Choose a Solar System Object? Name of ob: [Text Field]
 - Source Coordinates: System: **ICRS** (dropdown), Sexagesimal display?
 - RA: **00:00:00.0000** (text field)
 - Dec: **00:00:00.000** (text field)
 - Source Radial Velocity: **0.000** (text field), km/s (dropdown), lsrk (dropdown)
 - Target Type: Individual Pointing(s) 1 Rectangul
 - Expected Source Properties:
 - Peak Continuum Flux Density per Synthesized
 - Continuum Polarization Percentage
 - Peak Line Flux Density per Synthesized Beam
 - Line Width
 - Line Polarization Percentage
 - Field Center Coordinates:
 - Coord Type: Relative Absolute
 - Offset Unit: **arcsec** (dropdown)
 - #Pointings: **1** (text field)
 - RA [arcsec]: **0.00000** (text field)

Mosaics in the almaOT

Spectral Spatial Field Setup

Spatial Image

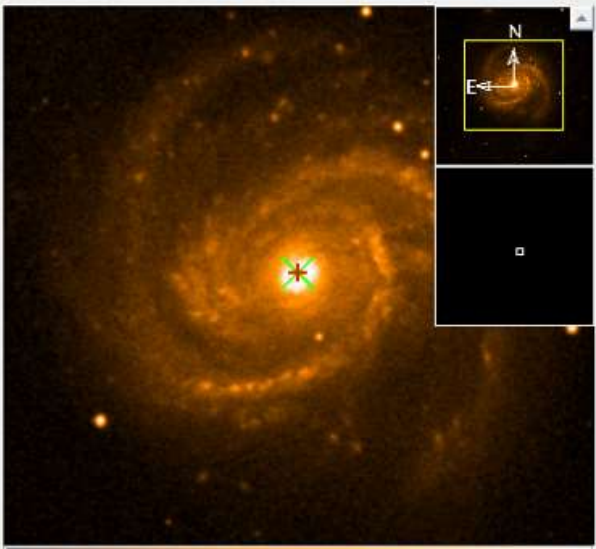


Image Filename `/i/.jsky3/cache/jsky1814992724433392157.fits`

FOV Parameters

Representative Frequency (Sky)

Antenna Diameter

Antenna Beamsize (HPBW)

Show Antenna Beamsize

Image Query

Image Server

Image Size(arcmin)

M100

Source

Source Name

Choose a Solar System Object? Name of object

System Sexagesimal display?

Parallax

Source Coordinates

RA PM RA

Dec PM DEC

Resolved by cdsws.u-strasbg.fr (SIMBAD)

Source Radial Velocity z Doppler Type

Target Type Individual Pointing(s) 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Synthesized Beam

Continuum Polarization Percentage %

Peak Line Flux Density per Synthesized Beam

Line Width

Line Polarization Percentage %

Field Center Coordinates

Custom Mosaic:

PointingPattern: Offset

Offset Unit

#Pointings

RA [arcsec]	Dec [arcsec]
0.00000	0.00000

Mosaics in the almaOT

The screenshot displays the almaOT software interface. The main window is titled "Spatial Image" and shows a large image of the M100 galaxy with a central starburst. A smaller inset image shows a zoomed-in view of the center. The interface includes a toolbar with various icons for image manipulation and a color scale at the bottom of the image window.

The right-hand panel is titled "M100" and contains the following configuration options:

- Source Name:** M100
- Source Coordinates:** RA: 12:22:54.8989, Dec: 15:49:20.570
- Source Radial Velocity:** 1569.779 km/s
- Target Type:** Individual Pointing(s)
- Expected Source Properties:** Peak Continuum Flux Density per Synthesized Beam: 0.00000 Jy, Continuum Polarization Percentage: 0.0%, Peak Line Flux Density per Synthesized Beam: 0.00000 Jy, Line Width: 0.00000 km/s, Line Polarization Percentage: 0.0%
- Field Center Coordinates:** RA [arcsec]: 0.00000, Dec [arcsec]: 0.00000

The "Field Center Coordinates" section is highlighted with a red rounded rectangle. Below the RA and Dec fields, the text "Pointings by hand" is written in red. The "Custom Mosaic" checkbox is unchecked, and the "PointingPattern" is set to "Offset".

RA [arcsec]	Dec [arcsec]
0.00000	0.00000

At the bottom of the interface, there are buttons for "Add Source", "Load from File...", "Export to File...", "Delete Source", and "Delete All Sources".

Mosaics in the almaOT

Interactive mosaic

The screenshot displays the almaOT software interface. The 'Spatial Image' panel on the left shows a color-coded astronomical image of M100, with a red circle highlighting the 'Interactive mosaic' toolbar. The right panel, titled 'M100', contains configuration options for the source. A red rounded rectangle highlights the 'Field Center Coordinates' section, which includes a table for 'Pointings by hand'.

Source Configuration:

- Source Name: M100
- System: FK5 J2000
- RA: 12:22:54.8989
- Dec: 15:49:20.570
- Source Radial Velocity: 1569.779 km/s
- Target Type: Individual Pointing(s)

Field Center Coordinates:

RA [arcsec]	Dec [arcsec]
0.00000	0.00000

FOV Parameters:

- Representative Frequency (Sky): 0.000 GHz
- Antenna Diameter: 12m
- Antenna Beamsize (HPBW): 0.000 arcsec

Image Query:

- Image Server: Digitized Sky (Version II) at ESO
- Image Size(arcmin): 10.0

Break #1

German ARC: ALMA community days (March 2017)