

WORKSHOP 2020 2-6 November 2020

Lecture #8: basic imaging of VLBI



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GOALS

- Make dirty and CLEANed images from a VLBI dataset
- Visualization of the CASA imaging products
- Analysis of the results in the image plane
- Export your images (also as FITS)





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l,m = directional cosines

u,v = coordinates (defined as perpendicular to the source)

Key issue: the uv-plane is not continuously filled (**sparse arrays**) – so direct FT of V(u,v) is not possible.





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We know this! To recover B we have "just" to deconvolve the D(I,m) term





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Basics of a standard CLEANing process (e.g. Högbom/Clark algorithms):

- 1. Initialize a residual map to the dirty image
- **2.** Start cleaning loop: identify strongest component in residual map as a delta component
- **3**. Add this point source to the model = clean component list
- **4**. Convolve the point source with the beam and subtract a fraction (the loop gain, typically 10%) of that from residual map
- 5. If stopping criteria are not reached, do next iteration



Image credits: DARA tutorials (A. Richards, J. Radcliffe, D. Small) <u>http://www.jb.man.ac.uk/DARA/unit4/Workshops/EVN_continuum_part</u> _2.html

Finally = Convolve the model by an estimate of the main lobe of the dirty beam (the "CLEAN beam") and add residual map to make the final "restored" image -- what we call "CLEANed image"



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"Undeconvolved" image (dirty image)



Deconvolved image with Högbom CLEANing algorithm





CASA <4>: default tolean -----> default(tclean)

(it corresponds to IMAGR in AIPS)

CASA < 4 >: inp tclea > inp(tclea	an an)			
# tclean :: Radio	Int	erferometric	Image R	econstruction
vis	=		- #	Name of input visibility file(s)
selectdata	=	True	#	Enable data selection parameters
field	=		#	field(s) to select
SPW	=		#	spw(s)/channels to select
timerange	=		#	Range of time to select from data
uvrange	=		#	Select data within uvrange
antenna	=		#	Select data based on antenna/baseline
scan	=		#	Scan number range
observation	=		#	Observation ID range
intent	=		#	Scan Intent(s)
datacolumn	=	'corrected'	#	Data column to image(data,corrected)
imagename	=		#	Pre-name of output images
imsize	=	[100]	#	Number of pixels
cell	=	['1arcsec']	#	Cell size
phasecenter	=		#	Phase center of the image
stokes	=	'Ι'	#	Stokes Planes to make
projection	=	'SIN'	#	Coordinate projection (SIN, HPX)
startmodel	=		#	Name of starting model image
specnode	=	'mfs'	#	Spectral definition mode
			#	(mfs,cube,cubedata, cubesource)
reffreq	Ξ		#	Reference frequency
gridder	=	'standard'	#	Gridding options (standard, wproject,
			#	widefield, mosaic, awproject)
vptable	=		#	Name of Voltage Pattern table
pblimit	- 7	0.2	#	>PB gain level at which to cut off
			#	normalizations
deconvolver	=	'hogbom'	#	Minor cycle algorithm (hogbom,clark,multis
		-	#	cale,mtmfs,mem,clarkstokes)
restoration	=	Irue	#	Do restoration steps (or not)
restoringbeam	-	LJ	#	Restoring Deam shape to use. Default is the PSF main lobe
pbcor	=	False	#	Apply PB correction on the output restored
outlierfile	=		#	Name of outlier-field image definitions
weighting	=	inaturali	#	Weighting scheme (natural,uniform,briggs)
uvtaper	-	IJ	#	uv-taper on outer baselines in uv-plane
niter	=	0	#	Maximum number of iterations
usenask	=	'user'	#	Tupe of mask(s) for deconvolution: user.
			#	pb. or auto-multithresh
mask	=		#	Mask (a list of image name(s) or region
			#	file(s) or region string(s))
pbmask	=	0.0	#	primary beam mask
restart	-	True	#	True + Re-use existing images False +
i cocal c	-	n ue	#	Increment imagename
sauamodal	_	'none'	#	Antione to save model visibilities (none
SavenUUEI	-	none	#	virtual, modelcolumn)



select measurement set (MS)

select field (if there are multiple in MS)

you can exclude the outer noisy channels (if not already flagged)

If you ran applycal, you have generated a CORRECTED column: that's the one you want to image!

If you split the target into a new MS using the CORRECTED column, then you have only the DATA column, which is the calibrated one

CASA <4>: inp tolea > inp(tolea	an an)			
# tolean :: Kadio Vis	=	terterometric	Image Ki	Name of input visibility file(s)
SPIRIT DALLA	-	1.0.1.00		ename nata seren non naralleters
field	- 2		#	field(s) to select
spw	=		#	spw(s)/channels to select
etnier ange	-			Mange of time to select from Data
uvnange	=		#	Select data within uvrange
antenna	=		#	Select data based on antenna/baseline
scan	=		#	Scan number range
observation	=		#	Observation ID range
intent	=		#	Scan Intent(s)
datacolumn	=	'corrected'	#	Data column to image(data,corrected)
тнауенане	-			rre-name or output images
imsize	=	[100]	#	Number of pixels
cell	=	['1arcsec']	#	Cell size
phasecenter	=		#	Phase center of the image
stokes	=	'Ι'	#	Stokes Planes to make
projection	=	'SIN'	#	Coordinate projection (SIN, HPX)
startmodel	=		#	Name of starting model image
specnode	=	'mfs'	#	Spectral definition mode
			#	(mfs,cube,cubedata, cubesource)
reffreq	=		#	Reference frequency
gridder	=	'standard'	#	Gridding options (standard, wproject,
			#	widefield, mosaic, awproject)
vptable	=		#	Name of Voltage Pattern table
pblimit	=	0,2	#	>PB gain level at which to cut off normalizations
deconvolver	=	'hogbom'	# #	Minor cycle algorithm (hogbom,clark,multi: cale,mtmfs,mem,clarkstokes)
restoration	=	True	#	Do restoration steps (or not)
restoringbeam	=	[]	# #	Restoring beam shape to use. Default is the PSE main lobe
pbcon	=	False	#	Apply PB correction on the output restored image
outlierfile	_		#	Name of outlier-field image definitions
weighting	-	'natural'	#	Weighting scheme (natural uniform briggs)
uvtaper	-	[]	#	uv-taper on outer baselines in uv-plane
niter	=	0	#	Maximum number of iterations
usenask	=	'user'	# #	Type of mask(s) for deconvolution: user,
mask	=		" # #	Mask (a list of image name(s) or region file(s) or region string(s))
pbmask	F	0.0	#	primary beam mask
restart	=	True	# #	True : Re-use existing images. False Increment imagename
savemodel	=	'none'	# #	Options to save model visibilities (no , virtual, modelcolumn)



Select image size in pixel

Cell size in arcsec (see syntax!)

Phase center in J2000 coords (if the source is not at the center)

<pre>t tolean: : Radio Interferometric Image Reconstruction vis :: Radio Interferometric Image Reconstruction it :: Radio Interferometric Image Reconstruction vis :: Radio Interferometric Image Reconstruction second :: : : : : : : : : : : : : : : : : :</pre>	CASA < 4 >: inp_tclea	n			
<pre>* Colean :: kadlo interferometric image reconstruction vis = '' * Name of input visibility file(s) selectidata = True * Enable data selection parameters field = '' * field(s) to select spw = '' * spw(s)/channels to select from data uvrange = '' * Select data within uvrange antenna = '' * Select data within uvrange observation = '' * Doservation ID range intent = '' * Doservation ID range intent = '' * Doservation ID range insize = L100J * Number of pixels cell = ['larcsec'] * Call size phasecenter = '' * Pre-name of output images imagename = '' * Pre-name of output images insize = L100J * Number of pixels cell = ['larcsec'] * Cell size phasecenter = '' * Phase center of the image projection = 'SIN' * Coordinate projection (SIN, HPX) startmodel = '' * Name of starting model image specoade = 'mfs' * Spectral definition mode reffreq = '' * Reference frequency gridker = 'standard' * Gridding options (standard, wproject, * widefield, mosaic, awproject) vptable = '' * Name of Voltage Pattern table pblimit = 0.2 * >PB gain level at which to cut off * normalizations deconvolver = 'hogbom' * Minor cycle algorithm (hogbom,clark,multis cale.mfrfs,men,clarkstokes) restoration = True * Do restoration steps (or not) restoringbeam = [] * Restoring beam shape to use. Default is * the PSF main lobe pbcor = False * Apply PB correction on the output restored * image outlierfile = '' * Name of voltier-field image definitions weighting = 'natural' * Weighting scheme (natural.uniform.briggs) uvtaper = [] * uv-taper on outer baselines in uv-plane niter = 0 * Maximum number of iterations usemask = '' * Type of mask(s) for deconvolution; user, * pb, or auto-multithresh mask = '' * Type of mask(s) for deconvolution; user, * pb, or auto-multitinesh * the so or segion string(s) or region * file(s) or region string(s) (or perion * file(s) or segion string(s) (or perion * fi</pre>	> inp(tclea	n) Turi		T D	
vis = True * Name of input Visionity file(s) spw = '' * Enable data selection parameters spw = '' * Enable data selection parameters spw = '' * Enable data selection parameters spw = '' * Range of time to select uvrange = '' * Select data within uvrange anternna = '' * Select data based on anterna/baseline scan = '' * Select data based on anterna/baseline scan = '' * Data column to image(data,corrected) inagename = '' * Data column to image(data,corrected) inagename = '' * Pre-name of output images insize [''''''''''''''''''''''''''''''''''''	# tolean :: Radio	Int	erferometric	Image K	econstruction
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observation = '' # Observation ID range intent = '' # Scan Intent(s) datacolumn = 'corrected' # Data column to image(data,corrected) imagename = '' # Pre-name of output images imsize = [100] # Number of pixels cell = ['Iarcsec'] # Cell size phasecenter = ''' # Phase center of the image projection = 'SiN' # Coordinate projection (SIN, HPX) startmodel = ''' # Name of starting model image specmode = ''' # Spectral definition mode gridder = ''' # Spectral definition mode reffreq = ''' # Spectral definition mode gridder = ''' # Spectral definition mode pblimit = 0.2 * SPE gain level at which to cut off pblimit = 0.2 * PE gain level at which to cut off restoringbeam = I'' # Name of outlier.field image definitions widefield mosaic, awproject) # Do restoration steps (or not) restoringbeam = I'' # Name of outlier.field	scan	=		#	Scan number range
<pre>intent = '' # Scan Intent(s) datacolumn = 'corrected' # Data column to image(data,corrected) imagename = '' # Pre-name of output images Imsize = [1000] # Number of pixels cell = ['larcsec'] # Cell size phasecenter = '' # Phase center of the image coll = '' # Phase center of the image '' # Name of starting model image specmode = 'mfs' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode (mfs,cube,cubedata, cubesource) reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, wptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off</pre>	observation	Ξ		#	Observation ID range
<pre>datacolumn = 'corrected' # Data column to image(data,corrected) imagename = '' # Pre-name of output images Imsize = [100] # Number of pixels cell = ['larcsec'] # Cell size phasecenter = '' # Phase center of the image the seconde = '' # Phase center of the image projection = 'SIN' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode (mfs,cube,cubedata, cubesource) reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, wptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off normalizations deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is the PSF main lobe pbcor = False # Apply PB correction on the output restored image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Name of outlier-field image definitions meter = 0 # Maximum number of iterations image outlierfile = '' # Name of iterations image outlierfile = '' # Make of unter-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # waiter on outer baselines in uv-plane image image = '' # Tupe of mask(s) for deconvolution; user, # pb, or auto-multithresh mask = '' # Make (a list of image name(s) or region file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True; Re-use existing images, False : Increment imagename # Options to save model wisibilities (none</pre>	intent	=		#	Scan Intent(s)
<pre>imagename = '' # Pre-name of output images Imsize = [100] # Number of pixels cell = ['iarcsec'] # Cell size phasecenter = '' # Phase center of the image projection = 'SIN' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode (mfs.cube.cubedata, cubesource) reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, wptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >Pg an level at which to cut off normalizations deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis cale,mtmfs,mem,clarkstokes) restoration = True # Do restoration on the output restored image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # water of outlier-field image definitions mask = '' # Maximum number of iterations image image image = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : Ture : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use existing images. False : Ture = 0 # True # True : Re-use model visibilities (none # True # True : Re-use model visibilities (none # True # True</pre>	datacolumn	=	'corrected'	#	Data column to image(data,corrected)
<pre>insize = [100] # Number of pixels cell = ['larcsec'] # Cell size phasecenter = '' # Phase center of the image projection = 'SIN' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode</pre>	imagename	=		#	Pre-name of output images
<pre>cell = ['larcsec'] # Cell size phasecenter = '' # Phase center of the image projection = 'SIN' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specaode = 'mfs' # Spectral definition mode (mfs.cube.cubedata, cubesource) reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, widefield, mosaic, awproject) vptable = '' # Name of Voltage Pattern table pblimit = 0.2</pre>	1ms1ze	=	11001	#	Number of Pixels
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<pre>projection = 'SIN' # Coordinate projection (SIN, HPX) startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode (ffs_cube_cubedata, cubesource) gridder = 'standard' # Gridding options (standard, wproject,</pre>			1.7.1		Challes Dianas ha make
<pre>startmodel = '' # Name of starting model image specmode = 'mfs' # Spectral definition mode (mfs.cube.cubedata, cubesource) reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, vptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off normalizations deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is the PSF main lobe pbcor = False # Apply PB correction on the output restored image</pre> outlierfile = '' # Name of outlier-field image definitions uvtaper = [] # Name of outlier-field image definitions mask = '' # Maximum number of iterations mask = '' # Mak (a list of image name(s) or region file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : Increment imagemane # Options to save model wisibilities (none	projection	=	'SIN'	#	Coordinate projection (SIN_HPX)
<pre>start childer in the start child word in the start is the st</pre>	et entmodel	1	510	#	Name of starting model impos
<pre>specular = bills = bills</pre>	anocrado	-	'mfo'	#	Spectral definition mode
<pre>reffreq = '' # Reference frequency gridder = 'standard' # Gridding options (standard, wproject, vptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off</pre>	specanote	-	INTS	# #	
reffreq = ** Reference frequency gridder = '* * Gridding options (standard, wproject, * vptable = '' * Mame of Voltage Pattern table pblimit = 0.2 * > deconvolver = '' * Name of Voltage Pattern table intermediations * > > > deconvolver = '' * Name of Voltage Pattern table restoration = '' * Name of Voltage Pattern table restoration = '' * Minor cycle algorithm (hogbom,clark,multis restoringbeam = '' * Minor cycle algorithm (hogbom,clark,multis restoringbeam = [] * Restoring beam shope to use. Default is restoringbeam = [] * Restoring beam shope to use. Default is restoringbeam = [] * Name of outlier-field image definitions weighting = 'natural' * Weighting scheme (natural,uniform,briggs) uvtaper				#	(Mts,cube,cubedata, cubesource)
gridker = 'standard' # Gridding options (standard, wproject, widefield, mosaic, awproject) vptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off mormalizations = ''at point is cale,mtmfs,mem,clarkstokes) deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis cale,mtmfs,mem,clarkstokes) restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is pbcor = False # Apply PB correction on the output restored weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Maximum number of iterations mask = ''' # Mask (a list of image name(s) or region mask = ''' # Mask (a list of image name(s) or region mask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : more # True : Re-use existing images. False :	rettreq	7		#	Reference frequency
<pre>widefield, mosaic, awproject) vptable = '' # Name of Voltage Pattern table pblimit = 0,2 # >PB gain level at which to cut off</pre>	gridder	=	'standard'	#	Gridding options (standard, wproject,
<pre>vptable = '' # Name of Voltage Pattern table pblimit = 0.2 # >PB gain level at which to cut off normalizations deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is pbcor = False # Apply PB correction on the output restored image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Maximum number of iterations niter = 0 # Maximum number of iterations mask = '' # Type of mask(s) or region mask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : Increment imagename Tore # Toppe' # Do restored initions # Toppe for the set of the</pre>				#	widefield, mosaic, awproject)
pblimit = 0.2 # >PB gain level at which to cut off deconvolver = 'hogbom' # Ninor cycle algorithm (hogbom,clark,multis	vptable	=		#	Name of Voltage Pattern table
<pre># normalizations # normalizations # normalizations deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam steps to use. Default is pbcor = False # Apply PB correction on the output restored image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Aximum number of iterations niter = 0 # Maximum number of iterations mask = '' # Mask (a list of image name(s) or region file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : Increment imagename </pre>	pblimit	Ξ	0.2	#	>PB gain level at which to cut off
<pre>deconvolver = 'hogbom' # Minor cycle algorithm (hogbom,clark,multis restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is pbcor = False # Apply PB correction on the output restored image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Maximum number of iterations isemask = '' # Mask (a list of image name(s) or region file(s) or region string(s)) pbmask = 0,0 # primary beam mask restart = True # True : Re-use existing images. False : auvemedel = 'one' # One' # One of the string in the st</pre>				#	normalizations
<pre>restoration = True # cale.mtmfs.mem.clarkstokes) restoringbeam = [] # Cale.mtmfs.mem.clarkstokes) restoringbeam = [] # Cale.mtmfs.mem.clarkstokes) restoringbeam = [] # Cale.mtmfs.mem.clarkstokes) pbcor = False # Do restoration steps (or not) # Restoring beam shape to use. Default is # the PSF main lobe # Apply PB correction on the output restored # image outlierfile = '' # Name of outlier-field image definitions # User i # Tupe of mask(s) for deconvolution; user, # pb.or auto-multithresh mask = '' # Mask (a list of image name(s) or region # file(s) or region string(s) i # file(s) or region string(s) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : # Increment imagename # Dotions to save model visibilities (nome # Do</pre>	deconvolver	=	'hogbom'	#	Minor cycle algorithm (hogbom,clark,multis
restoration = True # Do restoration steps (or not) restoringbeam = [] # Restoring beam shape to use. Default is pbcor = False # Apply PB correction on the output restored wighting = '' # Name of outlier-field image definitions weighting = '' # Weighting scheme (natural, uniform, briggs) uvtaper = [] # User' mask = '' # Maximum number of iterations mask = '' # Mask (a list of image name(s) or region pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : aurone # # True : Re-use existing images. False :			-	#	cale.mtmfs.mem.clarkstokes)
restoringbeam = [] # Restoring beam shape to use. Default is the PSF main lobe pbcor = False # Apply PB correction on the output restored # image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural.uniform.briggs) uvtaper = [] # uv-taper on outer baselines in uv-plane niter = 0 # Maximum number of iterations usemask = '' # Type of mask(s) for deconvolution: user, mask = '' # Mask (a list of image name(s) or region file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : # Increment imagename # Uptions to save model visibilities (nome	restoration	=	True	#	Do restoration steps (or not)
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pbcor = False # Apply PB correction on the output restored outlierfile = '' # Name of outlier-field image definitions weighting = '' # Weighting scheme (natural, uniform, briggs) uvtaper = [] # uv-taper on outer baselines in uv-plane niter = 0 # Maximum number of iterations usenask = '' # Tupe of mask(s) for deconvolution: user, mask = '' # Mask (a list of image name(s) or region pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images, False : savemadel = ''onne' # Uptions to save model visibilities (none	1 COCCI Trigodam			#	the PSE main lobe
outlierfile = '' alse # image outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural.uniform.briggs) uvtaper = [] # uv-taper on outer baselines in uv-plane niter = 0 # Maximum number of iterations usemask = '' # Type of mask(s) for deconvolution: user, # pb, or auto-multithresh mask = '' # Mask (a list of image name(s) or region # file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images, False : # Increment imagename savemodel = ''onne' # Dires to save model visibilities (none	phoon	1	Falsa	#	Applu PR connection on the output restored
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outlierfile = '' # Name of outlier-field image definitions weighting = 'natural' # Weighting scheme (natural,uniform,briggs) uvtaper = [] # Weighting scheme (natural,uniform,briggs) niter = 0 # Maximum number of iterations usenask = '' # Maximum number of iterations mask = '' # Tupe of mask(s) for deconvolution: user, mask = '' # Mask (a list of image name(s) or region pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images, False : savemodel = ''onne' # Uncrement imagename					Image
<pre>weighting = 'natural'</pre>	outlignfile	_		#	Name of outlier-field image definitions
<pre>merginumg = natural</pre>	unighting	-	Instant!	#	Mame of outlier field image definitions
uvtaper = [] # uvtaper on outer baselines in uv-plane niter = 0 # Maximum number of iterations usenask = 'user' # Type of mask(s) for deconvolution: user, mask = '' # Mask (a list of image name(s) or region pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images, False : savemodel = 'none' # Dorement imagename	weighting	-	naturai	#	weighting scheme (natural,uniform,Dr1998)
<pre>niter = 0 # Maximum number of iterations usemask = 'user' # Type of mask(s) for deconvolution: user, # pb, or auto-multithresh mask = '' # Mask (a list of image name(s) or region # file(s) or region string(s)) # pimary beam mask restart = True # True : Re-use existing images. False : # Increment imagename savemadel = 'oppe' # Options to save model visibilities (nope </pre>	uvtaper	-	L J	#	uv-taper on outer baselines in uv-plane
<pre>usemask = 'user' # Type of mask(s) for deconvolution: user,</pre>	niter	=	0	#	Maximum number of iterations
<pre># pb, or auto-multithresh mask = '' # Mask (a list of image name(s) or region # file(s) or region string(s)) pbmask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : # Increment imagename savemodel = 'none' # Options to save model visibilities (none)</pre>	usenask	=	'user'	#	Type of mask(s) for deconvolution: user.
<pre>mask = '' # Mask (a list of image name(s) or region</pre>				#	pb. or auto-multithresh
<pre>mask = 0.0 # primary beam mask restart = True # True : Re-use existing images. False : # Increment imagename savemodel = 'none' # Options to save model visibilities (none)</pre>	mask	=		#	Mask (a list of image name(s) or region
pbmask = 0.0 # primary beam mask = 0.0 # primary beam mask = 0.0 # primary beam mask = restart = True # True : Re-use existing images. False : # Increment imagename = 'none' # Ontoins to save model visibilities (none	PROPERTY				file(s) or region string(s))
restart = True # True : Re-use existing images. False : # Increment imagename savemodel = 'none' # Ontions to save model visibilities (none	obmask	_	0.0	#	ninaru beam mask
restart = True # True : Re-use existing images. False : # Increment imagename savemodel = 'none' # Options to save model visibilities (none	Punask	-	0.0	#	hi tilai A nealli liiask
restart – rrue + rrue ; neruse existing images, faise ; # Increment imagename savemodel = 'none' # Ontions to save model visibilities (none	neetont	_	True		Tous + Po-use evicting impage Esles +
* Increment Imagename savemodel = 'none' # Options to save model visibilities (none	i caldfil	-	mue	#	nue , ne use existing images, faise ; Incomment imageneme
is avenue = nune + nun uns in save muner VISIDITITIES (none	apuemedel	_	'nono'	#	Increment Indgendme Options to spue model visibilities (none
# virtual modelcolump)	SaveMUUEI	-	none	#	uirtual modelcolumn)



Image parameters

Lecture #8 Cristiana Spingola @spingola in mattermost

$$ext{cell} pprox rac{180}{\pi N_{ ext{s}}} imes rac{1}{\mathcal{D}_{ ext{max}}[\lambda]} \ [ext{deg}]$$

Field of view = image size

Check bandwidth and time smearing for your specific dataset + primary beam + expected size of your source

Nyquist sampling = N_s = 3 o 5 pixels across the main lobe of the beam

Max baseline in lambda units (D_{max}) - you can find it using PLOTMS (amp vs uvwave) check Benito's Lecture (#2)





 Ok for standard MFS cleaning of radio continuum observations
 stockes projection startmodel

 MFS = multi-frequency synthesis = gridding different freqs on same uv-grid (it takes spectral dependency of the source into account, see Ivan's talk)
 gridker

 MFS = multi-frequency synthesis = gridding different freqs on same uv-grid (it takes spectral dependency of the source into account, see Ivan's talk)
 gridker

 Set max number of iterations niter = 0 produces a DIRTY IMAGE
 outlierfile wighting niter

(= no deconvolution)

If you select niter >0 other parameters are unlocked for setting the minor cycles, threshold etc.

CASA <4>: inp_tclea	'n				
<pre>+> inp(tclea # tclean tt Radio</pre>	n) Int	erferometric	Image R	econstruction	
vis	=	•••••	#	Name of input visibility file(s)	
selectdata	=	True	#	Enable data selection parameters	10
field	=		#	field(s) to select	6.30
spw	=		#	spw(s)/channels to select	
timerange	=		#	Range of time to select from data	5.55
uvnange	=		#	Select data within uvrange	200
antenna	=		#	Select data based on antenna/baseline	
scan	=		#	Scan number range	
observation	=		#	Ubservation IU range	283
Intent	7		#	Scan Intent(s)	
datacolumn	=	'corrected'	#	Data column to image(data,corrected)	
imagename	=		#	Pre-name of output images	
imsize	=	[100]	#	Number of pixels	
cell	=	['1arcsec']	#	Cell size	
phasecenter	=		#	Phase center of the image	
stokes	=	.1.	#	Stokes Planes to make	
projection	=	'SIN'	#	Coordinate projection (SIN, HPX)	
startmodel	=		#	Name of starting model image	
specinode	-	'Mts'	#	Spectral definition mode	
reffreq	=		#	Reference frequency	
gridder	=	'standard'	#	Gridding options (standard, wproject,	
- I				wiyerieiy, mosaic, awproject/	۳.
vptable	Ξ		#	Name of Voltage Pattern table	
pblimit	Ξ	0.2	#	>PB gain level at which to cut off	
			#	normalizations	
deconvolver	=	'hogbom'	#	Minor cycle algorithm (hogbom,clark,multis	
			#	Cale,mtmfs,mem,clarkstokes/	Γ.
restoration	=	True	#	Do restoration steps (or not)	
restoringbeam	=	[]	#	Restoring beam shape to use. Default is	
			#	the PSF main lobe	
pbcon	=	False	#	Apply PB correction on the output restored	
			#	image	
outlierfile	=		#	Name of outlier-field image definitions	
weighting	=	'natural'	#	Weighting scheme (natural, uniform, briggs)	
uvtaper	=	[]	#	uv-taper on outer baselines in uv-plane	
niter	=	0	#	Maximum number of iterations	
USCHRISK	-	user		rgpe or mask(s) for deconvolucion, user,	Γ
maok	_		#	po, or auto-multithresh Maek (a list of image pame(a) or region	
INCON	-		#	file(e) on region strips(e)	
nhmask	-	0.0	# #	nrimaru beam mask	
Pondory	-	V+V	π		
restart	=	True	#	True : Re-use existing images. Fals	1
			#	Increment imagename	×
savemodel	=	'none'	#	Options to save model visibilities war	λ.
			#	virtual, modelcolumn)	Ê.





Natural = more weight to short baselines (\rightarrow larger beam) Uniform = more weight to long baselins (\rightarrow smaller beam)

Briggs weighting: it uses the "robust" parameter, which is between -2 and 2 Note that robust = 0.5 in CASA corresponds to robust = 0 in AIPS

Here select weighting scheme	
(natural, uniform, briggs)	
and uvtaper	

Check out these two!

Restart = remember to change the name of each image you create **Savemodel** attaches a MODEL_COLUMN to your MS

CASA <4>: inp tolea	an m			
<pre># tclean :: Radio</pre>	ni) Int	erferometric	Image R	econstruction
vis	=		#	Name of input visibility file(s)
selectdata	=	True	#	Enable data selection parameters
field	=		#	field(s) to select
spw	=		#	spw(s)/channels to select
timerange	=		#	Range of time to select from data
uvnange	=		#	Select data within uvrange
antenna	=		#	Select data based on antenna/baseline
scan	=		#	Scan number range
observation	=		#	Ubservation IU range
intent	-		#	Scan Intent(s)
datacolumn	=	'corrected'	#	Data column to image(data,corrected)
imagename	=		#	Pre-name of output images
imsize	=	[100]	#	Number of pixels
cell	=	['larcsec']	#	Lell size
phasecenter	Ξ	1.1.1	#	Phase center of the image
STOKES	Ξ	L ICTNU	#	Stokes Flanes to Make
projection		51M	#	Name of starting model image
startmoder	-	'mfs'	#	Spectral definition mode
SPECIAL	_	MI S	#	(mfs.cube.cubedata. cubesource)
reffreq	=		#	Reference frequency
gridder	=	'standard'	#	Gridding options (standard, wproject.
a			#	widefield, mosaic, awproject)
vptable	=		#	Name of Voltage Pattern table
pblimit	=	0.2	#	>PB gain level at which to cut off
			#	normalizations
deconvolver	=	'hogbom'	#	Minor cycle algorithm (hogbom,clark,multis
		-	#	_cale,mtmfs,mem,clarkstokes)
restoration	=	Irue	#	Do restoration steps (or not)
restoringbeam	- 7	LJ	#	Kestoring Deam snape to use. Default is
nhoon	_	Ealoa	#	Opply PD composition on the systematic postered
pucon	-	Faise	#	image
				****J*
outlierfile	=		#	Name of outlier-field image definitions
weighting	=	'natural'	#	Weighting scheme (natural,uniform,briggs)
uvtaper	-	IJ	#	uv-taper on outer baselines in uv-plane
niter	=	0	#	Maximum number of iterations
usemask	=	'user'	#	Type of mask(s) for deconvolution: user,
			#	pb, or auto-multithresh
mask	=		#	Mask (a list of image name(s) or region
- hu - lu	_	0.0	#	file(s) or region string(s))
pomask	-	V.V	#	primary beam Mask
restart	=	True	#	True : Re-use existing images. False :
a su	_	In such	#	Increment imagename
Savemodel	=	none	#	uptions to save model visibilities (none,



CASA <**18**>: go tclean -----> go(tclean) Executing: tclean()

In the Logger there is the info on what is going on

	vis	=	'b0128.calibrate	d.ms	/' # Name of input visibility file(s)
	selectdata	=	Ťrue	#	Enable data selection parameters
1	field	=		#	field(s) to select
	spw	Ξ		#	spw(s)/channels to select
	timerange	Ξ	1.1	#	Range of time to select from data
	uvrange	=		#	Select data within uvrange
	antenna	=	11	#	Select data based on antenna/baseline
	scan	=	1.1	#	Scan number range
	observation	=	1.1	#	Observation ID rance
	intent	-	1.1	#	Scan Intent(s)
	11100110				
Г	datacolumn	=	'data'	#	Data column to image(data,corrected)
	imagename	=	'dirty'	#	Pre-name of output images
	imsize	=	[2048]	#	Number of pixels
	cell	=	['0,002arcsec']	#	Cell size
L					Phase center of the image
	stokes	=	'I'	#	Stokes Planes to make
	projection	=	'SIN'	#	Coordinate projection (SIN, HPX)
	startmodel	=		#	Name of starting model image
	specnode	=	'mfs'	#	Spectral definition mode
				#	(mfs,cube,cubedata, cubesource)
	reffreq	=		#	Reference frequency
					<u> </u>
	gridder	=	'standard'	#	Gridding options (standard, wproject,
				#	widefield, mosaic, awproject)
	vptable	=		#	Name of Voltage Pattern table
	pblimit	=	0,2	#	>PB gain level at which to cut off
				#	normalizations
	deconvolver	=	'hogbom'	#	Minor cycle algorithm (hogbom, clark, multis
			-	#	cale,mtm+s,mem,clarkstokes)
	restoration	=	Irue	#	Do restoration steps (or not)
	restoringbeam	=	ĽJ	#	Restoring beam shape to use. Default is
				#	the PSF main lobe
	pbcon	=	False	#	Apply PB correction on the output restored
				#	image
-					
	weighting	=	'natural'	#	Weighting scheme (natural uniform briggs)
L	m. ignoing		F1		
	niter	=	0	#	Maximum number of iterations
	usenask	=	'user'	#	Type of mask(s) for deconvolution: user,
				#	pb, or auto-multithresh
	mask	=		#	Mask (a list of image name(s) or region
				#	file(s) or region string(s))
	pbmask	=	0.0	#	primary beam mask
	restart	=	True	#	True : Re-use existing images. False :
				#	Increment imagename
	savemodel	=	'none'	#	Options to save model visibilities (none,
				#	virtual, modelcolumn)



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Sector And Sector

CASA < 19 >:	viewer
>	viewer()

Select the image that you want to inspect:

dirty.image

(selectraster image)





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Man Andrews



This is the dirty image

This target is a jetted AGN that is gravitationally lensed into 4 images















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The source is not at the phase center: Let's zoom on the source





Select PROPERTIES (if there isn't, go to the top menu and select view → regions)





Graphic interface: Viewer STATISTICAL PROPERTIES OF THAT REGION Click on "statistics" in the "Regions" box





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tvis)	= 'ЬО	128.calibra	ated.ms/	" # Name of input visibility file(s	nit
selectdata field spw timerange uvrange antenna scan observati intent	= = = = = = = = = = = =	True	# E # s # R # s # s 0 # 0	hable data selection parameters ield(s) to select pw(s)/channels to select ange of time to select from data ielect data within uvrange ielect data based on antenna/baseline ican number range bearvation ID range ican Intent(s)	
datacolumn imagename imsize cell	= = 'cle = = ['0.	'data' an.nat' [2048] 002arcsec']	# I # F # N] # C	lata column to image(data,corrected) re−name of output images lumber of pixels iell size	
stokes projection startmodel specmode reffreq	-	'I' 'SIN' 'mfs'	# 9 # 0 # 9 # 9 # R	itokes Planes to make ioordinate projection (SIN, HPX) lame of starting model image pectral definition mode (mfs,cube,cubedata, cubesource) leference frequency	use
gridder vptable pblimit	= 'sta = =	ndard' 0.2	# 0 # # N # >	iridding options (standard, wproject, widefield, mosaic, awproject) Jame of Voltage Pattern table PB gain level at which to cut off normalizations	res
deconvolver restoration restoring pbcor	= 'h = ;beam = =	ogbom' True [] False	" # # # # # # #	linor cycle algorithm (hogbom,clark,m ultiscale,mtmfs,mem,clarkstokes) lo restoration steps (or not) estoring beam shape to use, Default is the PSF main lobe upply PB correction on the output restored image	sav cal cal par
outlierfile weighting	= = 'na	'' tural'	# Ւ # # և #	lame of outlier-field image definitions leighting scheme (natural,uniform,briggs)	

uv-taper on outer baselines in uv-

[]

uvtaper

		-	100000		Managana anakan at separatana
11 UE	a .	-	0.4	#	haximum number of iterations
	yain Abaaba1d	Ξ.	0.1	#	Character through 14
	threshold	Ξ.	0.0	#	Stopping threshold
	nsigma	Ξ.	0.0	#	Multiplicative factor for rms-based
				#	threshold stopping
	cycleniter	Ξ.	-1	#	Maximum number of minor-cycle
				#	iterations
	cyclefactor	=	1.0	#	Scaling on PSF sidelobe level to
	-			#	compute the minor-cycle stopping
				#	threshold.
	minosffraction	=	0.05	#	PSE fraction that marks the may depth
	intriport r dooron		****	#	of cleaning in the minor cucle
	maxmallenant i on	_	A 0	#	DCE finantian that manks the minimum
_	Maxpstfraction	Ξ.	0+0		For fraction that warks the winimum
	interactive	-	True	#	Modifu masks and parameters at
	Theor de erre	-	11 GC		hoarry masks and parameters at
ISP	ask	=	'user'	#	Type of mask(s) for deconvolution:
			0001	#	user ob or auto-multithresh
	maak	_		#	Maek (a list of image name(e) on
	MOON	Ξ.		#	mask (a fisc of finage fiame(s) of
	a hara a h	_	0.0		region file(s) or region suring(s) /
	pomask	Ξ.	0.0	#	primary beam mask
host	ant	_	Теџа	#	True + Pa-use evicting images False
est	arc	-	nue	#	t Increment increment
			1	#	: Increment Imagename
save	model	=	none	#	Uptions to save model visibilities
			_	#	(none, virtual, modelcolumn)
alc	res	=	Irue	#	Calculate initial residual image
alc	psf	=	True	#	Calculate PSF
bana	allel	=	False	#	Run major cycles in parallel

Sector Constant





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Sector Charles

	##### Begin Task: tclean #####
Chack the logger!	tclean(vis="b0128.calibrated.ms/",selectdata=True,field="",spw="",timerange="",
Check the logger:	uvrange="",antenna="",scan="",observation="",intent="",
	datacolumn="data",imagename="clean.nat",imsize=[2048],cell=['0.002arcsec'],phasecenter="",
	<pre>stokes="I",projection="SIN",startmodel="",specmode="mfs",reffreq="",</pre>
	nchan=-1,start="",width="",outframe="LSRK",veltype="radio",
	restfreq=[],interpolation="linear",gridder="standard",facets=1,chanchunks=1,
	wprojplanes=1, vptable="", usepointing=False, mosweight=True, aterm=True,
	psterm=False,wbawp=True,conjbeams=True,cfcache="",computepastep=360.0,
	rotatepastep=360.0,pblimit=0.2,normtype="flatnoise",deconvolver="hogbom",scales=[],
	<pre>nterms=2,smallscalebias=0.6,restoration=True,restoringbeam=[],pbcor=False,</pre>
Here you can read your inputs	<pre>outlierfile="",weighting="natural",robust=0.5,npixels=0,uvtaper=[],</pre>
	<pre>niter=100000,gain=0.1,threshold=0.0,nsigma=0.0,cycleniter=-1,</pre>
	cyclefactor=1.0,minpsffraction=0.05,maxpsffraction=0.8,interactive=True,usemask="user",
	<pre>mask="",pbmask=0.0,sidelobethreshold=3.0,noisethreshold=5.0,lownoisethreshold=1.5,</pre>
	<pre>negativethreshold=0.0, smoothfactor=1.0, minbeamfrac=0.3, cutthreshold=0.01, growiterations=75,</pre>
	dogrowprune=True,minpercentchange=-1.0,verbose=False,restart=True,savemodel="none",
	calcres=True, calcpsf=True, parallel=False)
	Verifying Input Parameters
	MS : b0128.calibrated.ms/ [Opened in readonly mode]
	NRows selected : 256096
	Leap second table TAI_UTC seems out-of-date.
	\cdot Until the table is updated (see the CASA documentation or your system admin),
	times and coordinates derived from UTC could be wrong by 1s or more.
	Define image coordinates for [clean.nat] :
	Impars : start
	Shape : [2048, 2048, 1, 1]Spectral : [1.63172e+09] at [0] with increment [2.55996e+08]
	Set Gridding options for [clean.nat] with ftmachine : gridft
	Set imaging weights : Natural weighting
	Set Deconvolution Options for [clean.nat] : hogbom
	Set Iteration Control Options
Creating the beam: here you can	Make PSF
· · · · · · · · · · · · · · · · · · ·	[clean.nat] Theoretical sensitivity (Jy/bm):0.0311187
see vour beam size	Beam : 0.0121181 arcsec, 0.00806336 arcsec, 8.29284 deg
000 your bourn 0120	PBMath init to Airy scaled to diameter = 25
	vi2 : Evaluating Primary Beam model onto image grid(s)



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A viewer window opens

As this is the first step of cleaning, therefore this corresponds to the dirty image

Use the regions to create the mask (double click in the image to create the region)

Note: we create a mask to help and speed up the deconvolution process





CLEANing stopping criteria

- Number of iterations (not the best criterion as you may end up doing too much or too little cleaning)
- Negative peak identified
- Smallest peak identified below a threshold which can be noise-based (e.g. 3 x rms)
- Visually = when your residuals contain only noise this means that you cleaned all the flux density of the source





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Check the logger!

Muno I Di
[clean.nat] Theoretical sensitivity (Jy/bm):0.0311187
Beam : 0.0121181 arcsec, 0.00806336 arcsec, 8.29284 deg
PBMath init to Airy scaled to diameter = 25
vi2 : Evaluating Primary Beam model onto image sill()
Run Major Cycle 1
[clean.nat] Peak residual (max,min) over full image . (0.0100001, 0.00100007,
[clean.nat] Total Model Flux : 0
[clean.nat] Initializing new mask to 0.0 for interactive drawing
[clean.nat] Number of pixels in the clean mask : 0 out of a total of 4.1943e+06 pixels. [0 %]
[clean.nat.mask] Mask modified from 0 pixels to 737 pixels
[clean.nat] Mask changed interactively.
[clean.nat] Peak residual (max,min) within mask (0.0163534,0) (ver full image : (0.0163534,-0.00405397)
[clean.nat] Total Model Flux : 0
Run Minor Cycle Iterations
[clean.nat] Run Hogbom minor-cycle CycleThreshold=0.00416663, CycleNiter=100, Gain=0.1
[clean.nat] iters=0->39 [39], model=0->0.0282109, peakres=0.0163534->0.00416491, Reached cyclethreshold.
Completed 39 iterations.
Run Major Cvcle 2
[clean.nat.mask] Mask modified from 737 pixel
[clean.nat] Mask changed interactively.
[clean.nat] Peak residual (max.min) within mask (0.0041649,0) over full image : (0.0041649,-0.00234448)
[clean.nat] Total Model Flux : 0.0282109
Run Minor Cycle Iterations
[clean.nat] Run Hogbom minor-cycle CycleThreshold=0.00106116, CycleNiter=100, Gain=0.1
[clean.nat] iters=0->100 [100], model=0.0282109->0.0526445, peakres=0.0041649->0.00147647, Reached cycleniter.
Completed 139 iterations.
[clean.nat.mask] Mask modified from 1281 pixes to 1001 pixel
[clean.nat] Mask changed interactively.
[clean.nat] Peak residual (max.min) within mask : (0.00147648,-2.16617e-05) over full image : (0.00147648,-0.0012918
[Clean.nat] Total Model Flux : 0.0526445
Run Minor Cycle Iterations
[clean.nat] Run Hogbom minor-cycle CycleThreshold=0.000376187, CycleNiter=100, Gain=0.1
[clean.nat] iters=0->100 [100] model=0.0526445->0.0635712, eakres=0.00147648->0.000804764. Reached cycleniter.
Completed 239 iterations.



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Example

new emission at lower surface brightness comes out while doing interactive cleaning:

add a box on the new emission and continue cleaning



TIPS

The flux density in the logger should be always increase (as shown in a previous slide) Change the mask if you are cleaning a negative region of the image (no boxes on negative areas!!)





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Example

The surface brightness within the mask (white contours) is lower than that outside the mask:

this can be a good moment to **stop** cleaning



Inspect CLEANed image &co.

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.image .mask .model .pb .psf .residual .sumwt restored (CLEANed) image mask used during cleaning (your regions) model = clean components primary beam point spread function (dirty beam) residual image (data-model) single px image containing sum of the weights

We can take a look at them using the task VIEWER (Select the image \rightarrow Raster image \rightarrow Use the arrows in the box "Animators" to see each of them)



Inspect CLEANed image Eco.

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.image .mask .model .pb .psf .residual .sumwt restored (CLEANed) image mask used during cleaning (your regions) model = clean components primary beam (empty because no PB correction has been applied) point spread function (dirty beam) residual image (data-model) single px image containing sum of the weights



ě



Inspect CLEANed image & co.

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Put all images on the same scale (e.g. that of the clean.image) to make a proper comparison selecting "Global Color Settings" in the "Data display options

٠	•	Data Display Opt	tions								
		clean.nat.image-r	raster								
		display axes									
		hidden axes									
		basic settings									
	aspec	t ratio	fixed world								
	pixel t	reatment	edge								
	resam	ipling mode	nearest								
	Data	Range	000200052, 0.0138469]								
	Scalir	ig Power Cycles	-2								
	Color	Мар	Rainbow 2								
		cking									
		als									
	axis label properties										
	beam ellipse										
		lge									
	app	y .									
		Global Color Se	ettings								
	auto ap	ply	close								





Inspect CLEANed image &co.

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To save the image you can use the button "Print" and choose location and format of your hard copy





Inspect CLEANed image & co.

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0 2

Histogram

Doppler

RADIO

Npts

432

Rms

3.811241e-03

region count

next

0

Animators

Regions

Fit File

Draw a region in the image and check its properties

For example: we can draw a Polygon to inspect the properties of the brightest lensed image







Export your images as FITS files

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<pre># exportfits ::</pre>	Convert a	a CASA image	to a	FITS file
imagename	=		#	Name of input CASA image
fitsimage	=		#	Name of output image FITS file
velocity	=	False	#	Use velocity (rather than frequency)
_			#	as spectral axis
optical	=	False	#	Use the optical (rather than radio)
			#	velocity convention
bitpix	=	-32	#	Bits per pixel
minpix	=	0	#	Minimum pixel value (if minpix >
			#	maxpix, value is automatically
			#	determined)
maxpix	=	-1	#	Maximum pixel value (if minpix >
			#	maxpix, value is automatically
			#	determined)
overwrite	=	False	#	Overwrite pre-existing imagename
dropstokes	=	False	#	Drop the Stokes axis?
stokeslast	=	True	#	Put Stokes axis last in header?
history	=	True	#	Write history to the FITS image?
dropdeg	=	False	#	Drop all degenerate axes (e.g. Stokes
			#	and/or Frequency)?

If you prefer to visualize your images using other tools, you can export them as FITS files using the task **EXPORTFITS**

Note that the VLBI images can have the keyword NAXIS = 4, which is an issue for some plotting python modules. You can just drop the stoke axis using **dropstokes = True** (also **dropdeg = True)**

					SAC	• • •			clea	in.fits	
File Object Value WCS Physical Image Frame 1	X X x	clean.fit B0128+4 0.21	s 43 5227	Y Y	0	SIMPLE BITPIX NAXIS NAXIS1 NAXIS2 NAXIS3 NAXIS4 EXTEND BSCALE		T -32 4 2048 2048 1 1 1 1.000000000000000000000000000000	/Standard /Floating /PHYSICAL	<pre>FITS point (32 bit) = PIXEL*BSCALE +</pre>	BZERO
file edit		view	frame	bin	zoom	BZERO BMAJ	=	0.00000000000E+00 3.366144115312E-06			
						BPA BTYPE BUNIT EQUINO UNPOLI LATPOLI PC1_1 PC1_1 PC1_1 PC3_1 PC4_1 PC3_1 PC4_2 PC3_2 PC3_2 PC4_2 PC3_2 PC4_3 PC4_3 PC4_4 PC3_4 PC4_4 PC3_4 PC4_4 PC3_4 PC4_4 PC3_4 PC4_4 PC3_4 PC4		8.292842864990E+00 'Intensity' 'B0128+43' 'Jy/beam' 2.0000000000000000000000000000000 4.397028333330E+01 1.8000000000000000000000000000000000000	/Brightne:	ss (pixel) unit	
-0.0001		0.0004	0.00	11 (0.0020	0.0033		0.0049 0.0067	0.0088	0.0112	

THANKS TO OUR SPONSORS:





JUMPING JIVE Joint Institute for VLBI ERIC





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