

esa

JWST is an international partnership between NASA, ESA and the CSA.





Pierre Ferruit (ESA JWST project scientist)

"Preparing JWST era" – S21 EWASS 2017 – Prague – Czech Republic

ESA UNCLASSIFIED - For Official Use









JWST's orbit and field of regard.

Visibility and orientation constraints.

Definitions.

JWST's General Target Visibility Tool (GTVT).

JWST's Coronagraphic Visibility Tool (CVT).

Q/A time.

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 2

•





A lot of material used in this presentation is coming from from STScI's JWST web sites (main resources for getting information):



https://jwst-docs.stsci.edu/display/JPP/JWST+Target+Visibility+Tools (documentation tools) https://jwst-docs.stsci.edu/display/JPP/Specifying+JWST+Position+Angles%2C+Ranges%2C+and+Offsets (definitions)

I have also extracted a lot of information from the presentation "The JWST Target Visibility Tools and the JWST Astronomer's Proposal Tool" given by Bill Blair (JHU/STScI) at the latest Proposal Planning Workshop organized by STScI: <u>https://webcast.stsci.edu/webcast/detail.xhtml?talkid=5616&parent=1</u>

ESA UNCLASSIFIED - For Official Use









Halo orbit period is ~ 6 months

Final details on the orbit depend on launch window

L2 "halo" orbit, keeping the Sun, the Earth and the Moon on the same side of the sunshield.

3/06/2017 | Slide 4







JWST's field of regard





ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 6

+



JWST's field of regard







~39% of full sky observable at any time. 100% sky coverage over 6

months.

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 7



JWST's visibility constraints





3 different categories:

- Always visible.
- Single, long visibility window.
- Two \sim 50-day visibility windows per year.

Main driver: ecliptic latitude of the object.

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 8

jwst JWST's visibility and orientation constraints





It is important to understand that the visibility constraints go handin-hand with some orientation constraints.

+

just JWST's visibility and orientation constraints





Case #1: CVZ

• Always visible but the orientation changes constantly (fixing the orientation is equivalent to fixing when to observe).

• Can only use the roll (+/- 5 degrees) to keep the orientation constant and this corresponds to a little bit more than 10 days (i.e. a given orientation is only available for ~10 days).

• All orientations possible.

jwst JWST's visibility and orientation constraints





Case #2: single visibility window

- Relatively similar to CVZ, constraining the orientation is equivalent to constraining the scheduling.
- A given orientation is available for a limited time.
- Limited range of orientations available.



JWST's visibility constraints





Case #3: 2 visibility periods (low ecliptic angle)

- Very little choice of orientation.
- Can keep a given angle for a
 long time...
 PA values available for (RA,DEC) = (-30.000000, 0.000000)

+





Definitions

FGS1



Observatory PA = 135° V3PA to NCP MIRI NIRCAM (~5°) FGS2

NIRISS

V3PA = reference PA for the observatory

= position angle (PA) of the V3 axis eastward relative to ecliptic north pole when projected onto the sky

= the angle we have been discussing so far...

+

ESA UNCLASSIFIED - For Official Use

NIRSPEC

(~138°)

The set = + 11 = ≤ ≤ 11 11 ≤ ≤ ≤ ≤ 0 11 = ≤ ≤ ≤ 0 × ≤ ≤

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 14

+





European Space Agency

Definitions

jwst









Each instrument has its own reference axis.

NIRSpec has a very different one.

APA = reference PA for a given instrument

= what an observer wantsto know when preparing anobservation with a giveninstrument.

+

ESA UNCLASSIFIED - For Official Use





Allows to compute the visibility periods for an object together with the V3PA and APA angles.

- Simple command-line Python script distributed by STScI (see documentation site for instructions on how to install it).
- Basic input: RA and DEC of the target.

Returns tabulated data (visibility and angles as a function of time) as well as basic plots.





JWST's general target visibility tool



Targe	t													
	ecl	iptic												
RA Dec	lat	itude												
325.678 43.	586 52	.656												
Checked inte	rval [2	018-01-01	, 2021-	-12-31]										
	Window	[days]				Norma	l V3 PA	[deg]		1				
Start		End	Dura	tion	-	Star	t	End		-	RA		Dec	
2018-06-02	20	18-12-21	2	202.00	2	43.928	44	49.84	254	3	325.67800	4	13.58600	
2019-06-02	20	19–12–21	2	201.93	2	44.063	65	50.05	444	3	325.67800	4	13.58600	
2020-06-02	20	20-12-20	2	201.00	2	43.551	57	50.26	286	3	325.67800	4	13.58600	
2021-06-02	20	21–12–21	2	202.00	2	43.750	11	49.65	785	3	325.67800	4	13.58600	
	V3P	Α	NIRCa	m		NIRSp	ec	NI	RISS	5	MIR	I	FGS	
Date	min	max	min	max	I	nin .	max	min	m	ax	min	max	min	max
2018-06-03	240.34	247.36	240.32	247.33	:	17.83	24.85	239.	77 2	46.79	9 245.36	252.3	37 239.09	246.11
2018-06-04	239.22	246.95	239.19	246.93	:	16.70	24.44	238.	65 2	46.38	8 244.23	251.9	237.96	245.70
2018-06-05	238.09	246.55	238.06	5 246.52		15.58	24.04	237.	52 2	45.98	8 243.10	251.5	57 236.84	245.30
2018-06-06	236.96	246.15	236.94	246.12	:	14.45	23.64	236.	39 2	45.58	8 241.98	251.1	235.71	244.90
2018-06-07	235.84	245.75	235.81	245.72	:	13.32	23.24	235.	27 2	45.18	8 240.85	250.7	6 234.59	244.50
2018-06-08	234.93	245.13	234.90	245.11		12.41	22.62	234.	36 2	244.56	5 239.94	250.1	233.68	243.88

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 17

+

ESA UNCLASSIFIED - For Official Use

jwst

ESA | 28/06/2017 | Slide 18

+



JWST's general target visibility tool





A more sophisticated tool responding to the more complex needs of coronagraphy.

- Tool with a GUI distributed by STScI (see documentation site for instructions on how to install it).
- Basic input: RA and DEC of the target.
- Allows to specify the target & companion(s) coordinates and configurations as well as the instrumental configuration.
- In returns, shows the visibility information and the position / orientations with respect to the coronagraph.

Documentation:

https://jwst-docs.stsci.edu/display/JPP/JWST+Coronagraphic+Visibility+Tool+Help



Target Location						
SIMBAD Target R	esolver					
	Search					
ID:						
RA:	 (decimal) 					
Dec:	º (decimal)					
Ecliptic coordina	tes:					
Companions						
PA (°)	Sep (")					
0.00	0.00					
0.00	0.00					
	0.00					
Instrum NIRCam Channel	A V					
Mas	k					
NRCA2_MASK21	OR 📉					
Aperture	PA 🔿 V3 PA					
Date and Samp	ling					
Start date: Octob	per 1, 2018					
Timesteps per ye	ar: 360					
Rolls checked:	20					
Upda	ite Plot					
SA 28/06/2	017 Slide 1					

ESA UNCLASSIFIED - For Official Use



JWST's coronagraphy visibility tool





ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 20

+



JWST's coronagraphy visibility tool



Target Location SIMBAD Target Resolver Observability of HD 218396 HR 8799 Search 400 ID: HD 218396 RA: 346.86964613 ^o (decimal) 350 Dec: 21.13425148 o (decimal) Ecliptic coordinates: 300 (l, b) = (356.7876°, 24.5248°) Companions PA (9) Sep (") E 200 V 45 1.7 ✓ 325 1 / 190 0.65 100 Instrument NIRCam Channel A 50 Mask NRCA4_MASKSWB 0 0 300 Days since Oct 1 2018 Aperture PA V3 PA Date and Sampling - Solar elongation Start date: October 1, 2018 Observable elongations Timesteps per year: 360 Aperture PA Rolls checked: 20 Update Plot 🔄 🚍 0 0 +

ESA UNCLASSIFIED - For Official Use

NRCA4 MASKSWB (640 x 640 pixels, 0.0308 arcsec/pixel) 10 ideal frame) y (arcsec, -1010 x (arcsec, ideal frame) PA: Companion 1 Companion 2 Companion 3

Now with companions and with the projection of the occulting element (NIRCam wedge bar) allowing to see if the companions are vignetted or not.

ESA | 28/06/2017 | Slide 21

+





Thanks for your attention.

Any question?

ESA UNCLASSIFIED - For Official Use

ESA | 28/06/2017 | Slide 22

