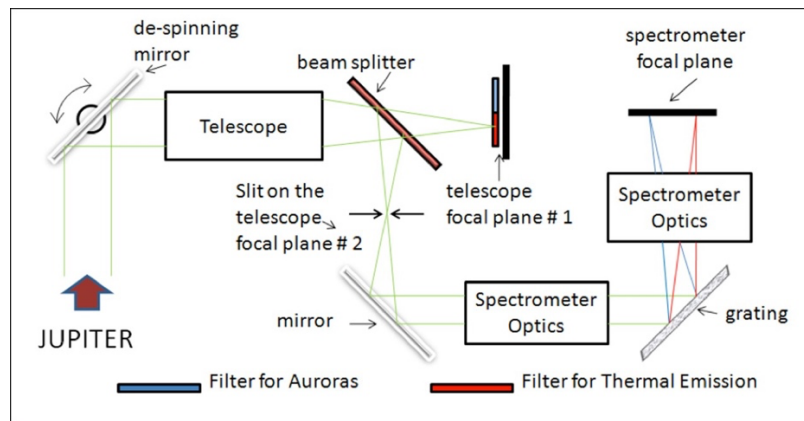


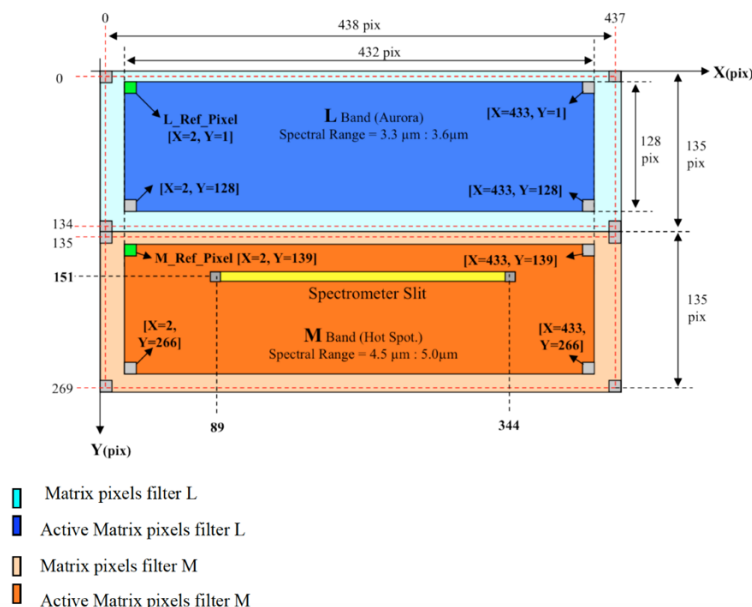
Information Concerning Use of the JIRAM Indexes and Geometry

The Jovian InfraRed Auroral Mapper (JIRAM) was designed for simultaneous imaging and spectral observations. It includes an imager and a spectrometer that share the same optics. Because Juno was spin stabilized it was necessary to provide a de-spinning mirror to compensate for the motion. See Adriani, A. et al., (2017) **JIRAM, the Jovian Infrared Auroral Mapper**, Space Sci Rev (2017) 213:393 – 446, DOI 10.1007/s11214-014-0094-y for further information.

As an add-on instrument to the Juno mission The JIRAM electronics lie outside the vault that protects against radiation. As a result, JIRAM was not expected to last more than a dozen orbits in Jupiter's harsh radiation environment. Instead, it's endurance and resolution have allowed it to be a major asset to the mission.



The layout of the imaging plane contains the spectral slit in the M-band (4.78 μm) array with the L (3.45 μm) and M (4.78 μm) arrays arranged side-by-side.



Problems exist with some posted indexes. Beginning on orbit 43 (2022 July 4), the scan mirror began to malfunction, reducing the number of planned image-spectrum pairs that were on the planet or satellite. Therefore, there may be large numbers of files listed in the N/A index. These files were obtained when the scan mirror was pointing off target. This was especially true when the team was using the L-band (3.45 μm with a 290-nm bandwidth) for H_3^+ auroral observations or the M-band (4.78 μm with a 480-nm bandwidth) for polar thermal emission observations of Jupiter.

Because of this, the user may find indexes that only contain geometry for the solar and sub-spacecraft points. Instead, we are providing this brief introduction to the use of the WebGeocalc tool at the Navigation and Ancillary Information Facility (NAIF) that is located at The Jet Propulsion Laboratory (JPL) <https://naif.jpl.nasa.gov/naif> . By utilizing this tool and computing geometry you are assured of access to the most up-to-date SPICE files.

Input for the WebGeocalc tool

Computing the Solar and Sub-spacecraft Geometry

The two functions listed below generate an index for start times retrieved from the JIRAM product XML labels.

1. Sub-Solar Point - Calculate the sub-solar point on a target as seen from an observer.
2. Sub-observer Point - Calculate the sub-observer point on a target as seen from an observer.

Because the de-spinning mirror was utilized to cancel the image smear due to spacecraft rotation during an exposure, the recorded start time is selected as the best time for pointing the craft.

Example from Orbit 43

START_TIME	Solar Longitude (deg)	Solar Latitude (deg)	Planetographic Longitude(deg)	Planetographic Latitude (deg)	Sub-Point Radius (km)	Altitude or Observer Distance (km)	Phase Angle (deg)	Local True Solar Time
2022-07-04T22:04:17.984Z	199.47	1.94	91.96	-3.63	71476.24	809745.15	107.60	19:10:03
2022-07-04T22:04:48.236Z	199.77	1.94	92.26	-3.62	71476.33	809287.93	107.60	19:10:03
2022-07-04T22:05:18.488Z	200.08	1.94	92.57	-3.61	71476.41	808830.58	107.60	19:10:02
2022-07-04T22:05:48.739Z	200.38	1.94	92.88	-3.60	71476.49	808373.13	107.59	19:10:02
2022-07-04T22:05:48.739Z	200.38	1.94	92.88	-3.60	71476.49	808373.13	107.59	19:10:02
2022-07-04T22:06:18.991Z	200.69	1.94	93.18	-3.59	71476.57	807915.53	107.59	19:10:02
2022-07-04T22:06:18.991Z	200.69	1.94	93.18	-3.59	71476.57	807915.53	107.59	19:10:02
2022-07-04T22:06:49.242Z	200.99	1.94	93.49	-3.58	71476.66	807457.83	107.59	19:10:01
2022-07-04T22:06:49.242Z	200.99	1.94	93.49	-3.58	71476.66	807457.83	107.59	19:10:01
2022-07-04T22:07:19.495Z	201.30	1.94	93.79	-3.57	71476.74	806999.97	107.59	19:10:01

2022-07-04T22:07:19.495Z	201.30	1.94	93.79	-3.57	71476.74	806999.97	107.59	19:10:01
2022-07-04T22:07:49.746Z	201.60	1.94	94.10	-3.56	71476.82	806542.01	107.59	19:10:01
2022-07-04T22:07:49.746Z	201.60	1.94	94.10	-3.56	71476.82	806542.01	107.59	19:10:01
2022-07-04T22:08:19.998Z	201.91	1.94	94.41	-3.56	71476.90	806083.91	107.59	19:10:01
2022-07-04T22:08:19.998Z	201.91	1.94	94.41	-3.56	71476.90	806083.91	107.59	19:10:01
2022-07-04T22:08:50.249Z	202.21	1.94	94.71	-3.55	71476.99	805625.71	107.59	19:10:00

The tool retrieves the needed kernels and returns the parameters needed to generate the tables.

Example: Deriving the Sub-Observer Point (the sub-spacecraft geometry)

Input Values

Calculation type	Sub-Observer Point
Target	JUPITER
Reference frame	IAU_JUPITER
Observer	JUNO
Sub-point type	Near point: ellipsoid
Light propagation	No correction
Time system	UTC
Time format	Calendar date and time
Input times	["2022-07-04T22:04:17.984Z", "2022-07-04T22:04:48.236Z", ..., "2022-07-05T08:40:18.559Z", "2022-07-05T08:40:18.559Z"], items=1170
Position representation	Planetographic (for Jupiter, Re=71492.0 km, Rp=66854.0 km)

Kernels Used

pds/wgc/mk/ground_stations_v0018.tm
pds/wgc/mk/solar_system_v0054.tm
pds/wgc/mk/latest_lsk_v0004.tm
pds/data/jno-j_e_ss-spice-6-v1.0/jnosp_1000/extras/mk/juno_2022_v05.tm

Computing the geometry as seen from JIRAM - Using the Surface Intercept

Calculating the intercept point of the center of the L-band, M-Band or Spectrum

Here the input parameters are the same as for the Spacecraft "point-of-view" and the WGC Surface Intercept is done 3 times.

For **Vector Type** use **Instrument Boresight** and each of the three following values for **Instrument**.

L or M Band - first for JUNO_JIRAM_I_LBAND boresight or Spectrum - JUNO_JIRAM_S

Calculating the intercept point of the four corners of the L-band, M-Band or Spectrum

Here The input parameters are the same as for the Spacecraft "point-of-view" (as shown above) and the WGC Surface Intercept is done 3 times.

For **Vector type** use **Instrument field-of-view** boundary vectors and each of the three following values for **Instrument**.

If, in a band or spectrum, the center or any of the corners lie off the planet or satellite, the tool will return a blank value, which can often be the case for high latitude observations.

An additional tool in understanding the acceptability of selecting the data for your purpose could be to compute an estimated resolution.

Computing the resolution as Altitude (km) * 0.000237767 km/pixel

If **Altitude** is determined as **Observer Distance** for the sub-spacecraft point calculated, the "Computation Method/Ellipsoid/Near point" method would give you **the highest possible resolution** at that time.

These same surface intercepts can also be computed using the SPICE toolkit.

If you want to use SPICE instead of the WebGeocalc tool, the best starting point would be the NAIF "Remote Sensing" hands-on lesson:

<https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fnaif.jpl.nasa.gov%2Fnaif%2Flessons.html&data=05%7C01%7Crbeebe%40nmsu.edu%7Cdaeea127869b4966970d08da53aff490%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637914312506905828%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IjEhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=DgXXvHaDeQc50YQO%2BCgENxWY0cbRJK7Cp4u92P1TWGI%3D&reserved=0>

This lesson has a boresight and boundary vector surface intercept example as the last step, with complete solution and explanations provided. This lesson is available in FORTRAN, C, IDL, MATLAB, and Python (with SpiceyPy).

Note: Some of the above information was supplied by Boris Seminov from NAIF.