

Coordinate confirmation for JWST Program 8846

Goal: separation between different coordinates should be smaller than Target Acquisition FOV. For 8846: TA is NIRSPEC WATA BOTS: 1.6"x1.6" FOV. For target to not fall out of acquisition FOV, coordinates difference should be less than half that of FOV width i.e. <0.8 arcsecond. (<https://jwst-docs.stsci.edu/jwst-near-infrared-spectrograph/nirspec-operations/nirspec-target-acquisition/nirspec-wide-aperture-target-acquisition#gsc.tab=0>)

In [58]:

```
from astropy import units as u
from astropy.coordinates import SkyCoord, Angle
from astropy.time import Time
import warnings
warnings.filterwarnings('ignore')
```

Three targets:

2M2139: (CFBDS J213926+022023): new target for program 8846

- 2MASS (and APT): RA = 324.86153900 deg; Dec = 2.33963800 deg; Pmra = 485.9 mas/yr; Pmdec = 124.8 mas/yr; Epoch: J2000.0 (SIMBAD)
- GAIA: RA = 324.8636290242733 deg; Dec = 2.340170017593518 deg; pmra = NaN; Pmdec = NaN; Epoch: 2016.0 (GAIA)
- PS1: RA = 324.862927 deg, dec= 02.339991 deg, pmra = 490.6 mas/yr, pmdec = 126.6 mas/yr, Epoch: 2010.79 (UltracoolSheet/Vizier)

PSO 318: (PSO J318.5338-22.8603, 2MASS J21140802-2251358): observed with 1275

- 2MASS (and APT): RA = 318.53344000 deg; Dec = -22.85995500 deg, Pmra = 136.3 mas/yr; Pmdec = -144.3 mas/yr, Epoch: J2000.0 (RA = 21h 14m 08.02560s; -22d 51m 35.8380s) (SIMBAD)
- PS1 (PanSTARR): RA = 318.5335 deg; Dec = -22.8600 deg; pmra = 138.2 mas/yr; pmdec = -150.1, Epoch: 2008.4594935 (Vizier)
- GAIA: NaN
- 1275: RA = 21h 14m 8.2776s; Dec = -22d 51m 39.24s; pmra = 136.3 mas/yr; pmdec = 144.3 mas/yr; Epoch: 2023.3 (APT)

2M1126: (DENIS J112639.9-500355): Already used GAIA coords.

- GAIA (and APT): RA = 171.65484488705087 deg, dec = -50.06323211342603 deg; pmra = -1589.907 mas/yr; pmdec = 450.777 mas/yr; Epoch: 2016.0 (GAIA)
- 5474: identical to GAIA
- 3930: RA = 11h 26m 36.3600s, Dec = -50d 03m 45.36s; pmra = -1589.2 mas/yr; pmdec = 451.0 mas/yr; Epoch: 2020.83 (APT)

1. 2M2139 Coord Confirmation

- No previous program
- GAIA coords do not have proper motions
- calculate GAIA epoch coordinates first, and then observation epoch
- large difference --> NEED ATTENTION

In [65]:

```
# 2mass (apt)
coord2139_2mass = SkyCoord(ra=324.86153900*u.deg,
                             dec=2.33963800*u.deg,
                             obstime=Time(2000.0, format='jyear'),
                             pm_ra_cosdec=485.9 *u.mas/u.yr, pm_dec=124.8*u.mas/u.yr)

# gaia (no pmra, pmdec) : CHECK PMRA AND PMDEC, inaccurate
coord2139_gaia = SkyCoord(ra=324.8636290242733*u.deg,
                             dec=2.340170017593518*u.deg,
                             obstime=Time(2016.0, format='jyear'),
                             pm_ra_cosdec=0.0*u.mas/u.yr, pm_dec=0.0*u.mas/u.yr)

# Panstarr
coord2139_ps1 = SkyCoord(ra=324.862927000*u.deg,
                             dec=2.339991000*u.deg,
                             pm_ra_cosdec=490.6*u.mas/u.yr, pm_dec=126.6*u.mas/u.yr,
                             obstime=Time(2010.79, format='jyear'))
```

In [66]:

```
# set the nominal epoch to GAIA epoch
obsTime1 = Time('2016-01-01')

# apply obsTime to get new observing coordinates
coord2139_2mass_obs = coord2139_2mass.apply_space_motion(new_obstime=obsTime1)
coord2139_gaia_obs = coord2139_gaia.apply_space_motion(new_obstime=obsTime1)
coord2139_ps1_obs = coord2139_ps1.apply_space_motion(new_obstime=obsTime1)

print('2M2139 Coordinate at', obsTime1)
print('Separation between APT and GAIA: {0}'.format(coord2139_2mass_obs.separation(coord2139_gaia_obs)))
print('Separation between APT and PS1: {0}'.format(coord2139_2mass_obs.separation(coord2139_ps1_obs)))

# set the nominal epoch to close to observation date
obsTime2 = Time('2026-10-04')

# apply obsTime to get new observing coordinates
coord2139_2mass_obs = coord2139_2mass.apply_space_motion(new_obstime=obsTime2)
coord2139_gaia_obs = coord2139_gaia.apply_space_motion(new_obstime=obsTime2)
coord2139_ps1_obs = coord2139_ps1.apply_space_motion(new_obstime=obsTime2)

print('\n2M2139 Coordinate at', obsTime2)
print('Separation between APT and PS1: {0}'.format(coord2139_2mass_obs.separation(coord2139_ps1_obs)))
```

2M2139 Coordinate at 2016-01-01 00:00:00.000
Separation between APT and GAIA: 0.26854489916923996 arcsec
Separation between APT and PS1: 2.874257462187509 arcsec

2M2139 Coordinate at 2026-10-04 00:00:00.000
Separation between APT and PS1: 8.27072679506465 arcsec

2. PSO 318

- one previous program: 1275, 2MASS and PS1 coords
- no GAIA coords

In [61]:

```
# 2mass (apt)
coordpso318_2mass = SkyCoord(ra= 318.53344000*u.deg,
                             dec= -22.85995500 *u.deg,
                             obstime=Time(2000.0, format='jyear'),
                             pm_ra_cosdec=136.3*u.mas/u.yr, pm_dec=-144.3*u.mas/u.yr)

# panstarr
coordpso318_ps1 = SkyCoord(ra=318.53380*u.deg,
                           dec=-22.86032*u.deg,
                           obstime=Time(2008.4594935, format='jyear'),
                           pm_ra_cosdec=138.2 * u.mas/u.yr, pm_dec=-150.1*u.mas/u.yr)

# program 1275 jwst
coordpso318_1275 = SkyCoord(ra=Angle('21:14:8.2776', unit=u.hourangle),
                             dec=Angle('-22:51:39.24', unit=u.deg),
                             obstime=Time(2023.3, format='jyear'),
                             pm_ra_cosdec=136.3 * u.mas/u.yr, pm_dec= -144.3*u.mas/u.yr)
```

In [62]:

```
# set the nominal epoch to be close the observing day for this target
obsTime = Time('2025-09-22')

# apply obsTime to get new observing coordinates

coordpso318_2mass_obs = coordpso318_2mass.apply_space_motion(new_obstime=obsTime)
coordpso318_ps1_obs = coordpso318_ps1.apply_space_motion(new_obstime=obsTime)
coordpso318_1275_obs = coordpso318_1275.apply_space_motion(new_obstime=obsTime)

print('PSO 318 Coordinate at', obsTime)
print('Separation between APT and PS1: {0}'.format(coordpso318_2mass_obs.separation(coordpso318_ps1_obs)))
print('Separation between APT and ID1275: {0}'.format(coordpso318_2mass_obs.separation(coordpso318_1275_obs)))
```

PSO 318 Coordinate at 2025-09-22 00:00:00.000

Separation between APT and PS1: 0.20709491138756544 arcsec

Separation between APT and ID1275: 0.3098425398502976 arcsec

3. 2M1126 Coord Confirmation

- three previous program: 3939, 4668, 5474
- already using GAIA coord in APT

In [63]:

```
# gaia (apt)
coord1126_gaia = SkyCoord(ra=171.65484488705087*u.degree,
                           dec=-50.06323211342603*u.degree,
                           obstime=Time(2016.0, format='jyear'),
                           pm_ra_cosdec=-1589.907 *u.mas/u.yr, pm_dec=450.777*u.mas/u.yr)

# program 3930 jwst
coord1126_3930 = SkyCoord(ra=Angle('11:26:36.3600', unit=u.hourangle),
                           dec=Angle('-50:03:45.36', unit=u.deg),
                           obstime=Time(2020.83, format='jyear'),
                           pm_ra_cosdec=-1589.2 * u.mas/u.yr, pm_dec= 451.0 *u.mas/u.yr)
```

In [64]:

```
# set the nominal epoch to be close the observing day for this target
obsTime = Time('2026-04-28')

# apply obsTime to get new observing coordinates
coord1126_gaia_obs = coord1126_gaia.apply_space_motion(new_obstime=obsTime)
coord1126_3930_obs = coord1126_3930.apply_space_motion(new_obstime=obsTime)

print('2M1126 Coordinate at', obsTime)
print('Separation between APT and ID3930 for: {0}'.format(coord1126_gaia_obs.separation(coord1126_3930_obs)))
```

2M1126 Coordinate at 2026-04-28 00:00:00.000

Separation between APT and ID3930 for: 0.10933997220771585 arcsec