Coordinates and Time

astropy

astropy.time

Python's built-in `datetime` package handles standard dates, times, but doesn't support astronomical formats (e.g., JD, MJD) or precise timing

The `astropy.time` subpackage adds this support

Key object: `Time`

```python
import astropy.time as atime
atime.Time
```

astropy.time

astropy.time

```
>>> time = atime.Time(58086.182, format='mjd')
```

astropy.time

```
>>> time = atime.Time(58086.182, format='mjd')
>>> print(time.jd)
2458086.682
```

astropy.time

```
>>> time = atime.Time(58086.182, format='mjd')
>>> print(time.jd)
2458086.682
>>> print(time.datetime)
datetime.datetime(2017, 11, 29, 4, 22, 4, 800000)
```

astropy.time

```
>>> time = atime.Time(58086.182, format='mjd')
>>> print(time.jd)
2458086.682
>>> print(time.datetime)
datetime.datetime(2017, 11, 29, 4, 22, 4, 800000)
>>> atime.Time.now()
<Time object: scale='utc' format='datetime'
value=2017-11-28 12:42:27.939562>
```

astropy.coordinates

For representing and transforming astronomical coordinates and velocities

Key object: `SkyCoord`

```python
import astropy.coordinates as coord
coord.SkyCoord(ra=210.6*u.deg,
               dec=-19.3*u.deg)
```

astronomical coordinates

astronomical coordinates

units   degrees, hours, radians

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format 153.51241, "+21:03:16.734", π/4

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format   153.51241, "+21:03:16.734", π/4

representations   Spherical (angles and distance), Cartesian, …

astronomical coordinates

units	degrees, hours, radians
format	`153.51241, "+21:03:16.734",` $\pi/4$
representations	Spherical (angles and distance), Cartesian, …
frames	ICRS (J2000 equatorial), Galactic, Alt-Az, …

astronomical coordinates

astronomical coordinates

units   `coord.SkyCoord(ra=210.6*u.deg,`

astronomical coordinates

units

```
coord.SkyCoord(ra=210.6*u.deg,
                  dec=-19.3*u.deg)
```

format

astronomical coordinates

units

```
coord.SkyCoord(ra=210.6*u.deg,
                dec=-19.3*u.deg)
```

format

representations

astronomical coordinates

units

```
coord.SkyCoord(ra=210.6*u.deg,
                dec=-19.3*u.deg)
```

format

```
coord.SkyCoord(ra=0.5 * u.hourangle,
                dec=np.pi/4 * u.radian)
```

representations

frames

astronomical coordinates

astronomical coordinates

```
coord.SkyCoord(ra="21:53:11.85",
```

astronomical coordinates

```
coord.SkyCoord(ra="21:53:11.85",
                dec="-19:31:51.4",
```

format

astronomical coordinates

units

```
coord.SkyCoord(ra="21:53:11.85",
               dec="-19:31:51.4",
               unit=(u.hourangle,
                     u.degree))
```

format

representations

astronomical coordinates

units

```
coord.SkyCoord(ra="21:53:11.85",
                dec="-19:31:51.4",
                unit=(u.hourangle,
                      u.degree))
```

format

representations

frames

astronomical coordinates

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
```

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg,
```

format

astronomical coordinates

units

```python
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg,
               distance=100*u.pc)
```

format

```python
coord.SkyCoord(x=-82.9*u.pc,
               y=-48.7*u.pc,
               z=27.5*u.pc,
               representation='cartesian')
```

representations

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg,
               distance=100*u.pc)
```

format

```
coord.SkyCoord(x=-82.9*u.pc,
               y=-48.7*u.pc,
               z=27.5*u.pc,
               representation='cartesian')
```

representations

frames

astronomical coordinates

astronomical coordinates

units   `coord.SkyCoord(ra=210.4341*u.deg,`

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg)
```

format

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg)
```

format

```
coord.SkyCoord(l=2.,*u.deg,
               b=70.2*u.deg,
               frame='galactic')
```

representations

astronomical coordinates

units

```
coord.SkyCoord(ra=210.4341*u.deg,
               dec=15.93*u.deg)
```

format

```
coord.SkyCoord(l=2.,*u.deg,
               b=70.2*u.deg,
               frame='galactic')
```

representations

frames

astropy.coordinates

Also handles array data (quantities):

```
coord.SkyCoord(ra=[210.6, 135.3]*u.deg,
               dec=[25.62, -19.3]*u.deg)
```