Documentation and report of Astrophysics with Artificial Intelligence(Astropy and AstroML) – Astronomical Coordinates 1 with astropy

Donghun Kim

* **All the information is based on and originated from ‘astropy.org’, ‘atsroml.org’, and ‘wikipedia.org’**

<1> The fundamental knowledge to utilize astropy and astroML for astrophysics

1. Coordinates system.

There are some coordinate systems such as Cartesian coordinate system, cylindrical coordinate system, and spherical coordinate system. Those coordinates are related each other ones and also can be alternated to clarify the object position or calculate something which are changed depending on the coordinate system. Those coordinate systems have each own defined units and also each units can be converted along the process of alternation of coordinate system.

* The sort of the coordinate systems commonly utilized in astronomical community.

1. Horizontal system

This coordinate system is employing the observer’s local horizon as the fundamental plane to measure the location of the observed star. This coordinate system can be expressed with ‘Altitude’ and ‘Azimuth’. The altitude is the angle which is measured by observer from local horizon to observed celestial body, and the azimuth is the angle between the projected vector and the reference vector on the reference plane which is measured from observer’s point to interest point projected perpendicularly onto a reference plane. In addition to it, instead of the altitude, it is possible to utilize the zenith distance which is the angle comparable with the value which is subtracted the altitude (elevation) from the 90 degree.



(Image from: https://en.wikipedia.org/wiki/Horizontal\_coordinate\_system)

1. Equatorial system.

This coordinate system can be implemented in spherical or rectangular coordinates and these ones are defined by the origin at the center of the Earth, the fundamental plane which is projected the Earth’s equator onto the celestial sphere, which is forming the celestial equator, primary direction toward the vernal equinox, and right-handed convention (anti-clockwise direction), which means that the coordinates increase along the northward and the eastward around the fundamental plane.



(Image from: <https://en.wikipedia.org/wiki/Equatorial_coordinate_system>)

1. Ecliptic system

This coordinate system is generally utilized in Solar System to represent the object’s apparent position, orbit, and pole orientation by employing the ecliptic and vernal equinox. This is because almost of the planets and small bodies in Solar system has orbits which are inclined to the ecliptic. The center of this coordinate can be set as one of Sun or Earth. This can be implemented in spherical or rectangular coordinates. However, the significant point is that the celestial equator and the ecliptic are slowly alternated because of the perturbing forces, which means that the primary direction is influenced, so this is not fixed. The slow motion of the Earth, known as axial precession, causes alternation of the coordinate system, which changes the coordinate system westward about the poles of the ecliptic slowly, but continuously. The completion of one circuit of this phenomenon is about 26,000 years.