STAR Coordinate System

(October 11, 1993 by Howard Matis, LBL)

The STAR standard coordinate system will be a right-handed Cartesian system. All future publications and documents should use the following conventions. In addition all programs, drawings, etc. in active use should be modified. The standard STAR coordinate system is defined by:

- Positive y is up.
- The origin of the coordinate system is located at the center of the solenoid (iron). The direction y is perpendicular to the axis of the solenoid. The y-z plane is vertical and positive y points opposite (as closely as possible) the direction of gravity.
- Positive x points approximately south and away from center of the RHIC accelerator. Positive z points westward.
- The direction of the RHIC beam is defined by a view looking down upon the accelerator. At our detector the clockwise beam travels toward positive z and the counter-clockwise beam moves toward negative z.

The event coordinate system is defined by the following:

- The origin is at the best fit to the vertex of the main interaction.
- The event coordinate system z axis is the best fit to the direction of the two interacting beam particles.
- A translation of the STAR coordinate system is made to the event vertex.
- The z axis of the STAR coordinate system is then rotated around the vertex to align it with the event coordinate z axis. The angle of rotation is in the plane defined by the two z axes.

Alternative coordinate systems can be used. However, they always should be referred to the main coordinate system. We define the same conventional mathematical formulas as used by Aleph. These definitions of variables should be used in all STAR documents.

- Polar coordinates where the spherical variables (r, θ, ϕ) are defined by:

$$x = r \sin\theta \cos\phi$$
$$y = r \sin\theta \sin\phi$$
$$z = r \cos\theta$$

where

$$-180° \leq \phi \leq 180°.$$

- Cylindrical Coordinates, (ρ, Φ, z) are similarly defined:

$$x = \rho\cos\Phi$$
$$y = \rho\sin\Phi$$
$$z = z$$

where $-180° \leq \Phi \leq 180°$.

In addition, detectors shall be called east or west depending on which side of the plane z=0 that they are situated.

Local Coordinate Systems:

They shall be easily transformed into the standard experiment frame. These will be defined later by the appropriate sub-system groups.

Alignment:

- All detectors will have fiducials so that proper alignment can be made. The fiducials should be located such they can be easily surveyed with respect to the alignment fiducials on the magnet.
- The magnet will need to be surveyed to the RHIC accelerator.
- A method will have to be established to survey with respect to the magnet whether the magnet is warm or cool.

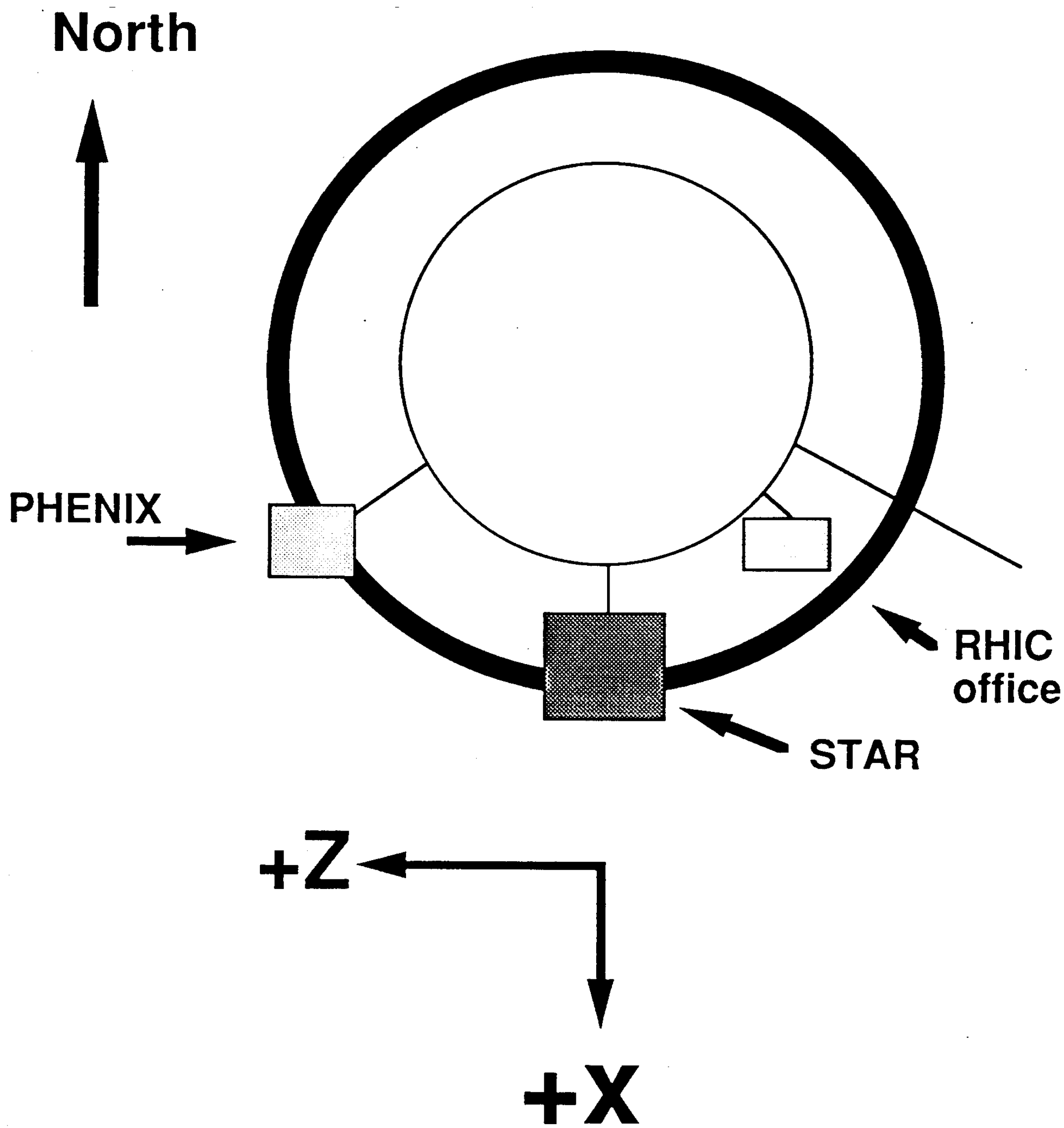
Units:

The official units of STAR are the same as used by GEANT: cm, GeV, GeV/c, kGauss, except for mass which is expressed in kilograms. Angles are expressed in degrees (decimal). Positive magnetic field points in the positive z direction. Temperature is measured in degrees Centigrade. Drawings which can be used by physicists should follow this convention.

Physics quantities:

Physics quantities shall be consistent with the coordinate system. For instance positive rapidity (y) and pseudo-rapidity (η) increase in the positive z direction. In any STAR note or document, variables such as (r,θ, ϕ) should follow the STAR notation.

Spin Variables (*to be defined later*).



Top view of RHIC. The location of STAR is shown in relationship to other buildings. The direction of x and z coordinate system axes is shown in this figure. The y axis (not shown) points out of the page. The origin of the coordinate system is located in the center of the STAR detector.