Definition of the ALICE Coordinate System and Basic Rules for Sub-detector Components Numbering

Abstract

This document outlines the ALICE coordinate system, azimuthal and polar angle definitions and gives basic guidance for the logical numbering of the detector components. The ALICE coordinate system is defined in accordance with the LHC (former LEP) rules. The LHC rules are also adopted by the other LHC experiments and some of the external services, for example the CERN optical survey group. The definitions in this document are applicable for the ALICE software and detector groups.

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1 Coordinate System Definition

The ALICE coordinate system is a right-handed orthogonal Cartesian system with point of origin ***x, y, z = 0*** at the beams interaction point (IP). The axis, azimuthal angle φ and polar angle θ are defined as follows:

- ***x axis*** - perpendicular to the mean beam direction, aligned with the local horizontal and pointing to the accelerator centre. Positive x is from the point of origin toward the accelerator centre (visual aid: Saleve mountain), negative x is from the point of origin outward (visual aid: Jura mountain);
- ***y axis*** - perpendicular to the x axis and the mean local beam direction, pointing upward. Positive y is from the point of origin upward, negative y is from the point of origin downward;
- ***z axis*** - parallel to the mean beam direction. Positive z is from the point of origin toward RB24 (visual aid: the town of Bellegarde), negative z is from the point of origin toward RB26 (visual aid: the town of Gex). In ALICE the muon arm is at negative z;
- ***azimuthal angle φ*** - increases counter-clockwise from x ($\varphi = 0$) to y ($\varphi = \pi/2$) with the observer standing at positive z and looking in direction RB26 (Gex);
- ***polar angle θ*** - increases from z ($\theta = 0$) to x,y plane ($\theta = \pi/2$) to –z ($\theta = \pi$).

The conversion from spherical to Cartesian coordinates is done through:

$$x = r \sin\theta \cos\varphi$$

$$y = r \sin\theta \sin\varphi$$

$$z = r \cos\theta$$

The inverse conversion – Cartesian to spherical coordinates is:

$$r = \sqrt{(x^2 + y^2 + z^2)}$$

$$\theta = \arccos z/r$$

$$\varphi = \arctan y/x$$

A sketch of the ALICE coordinate system is shown in Fig.1

2 Detector Sides

The following labels and acronyms are used for the ALICE detector sides:

- upstream (positive z, toward RB24) and downstream (negative z, toward RB26) of IP are labeled ***A*** and ***C***;
- elements around and at z = 0 are labeled ***B***;
- the detector parts at positive x are labeled as Inside (***I***) and at negative x as Outside (***O***);
- the upper part at positive y is labeled as Up (***U***) and the lower part at negative y as Down (***D***).

3 Numbering Principles

General: All ALICE sub-detector components are to be numbered starting from zero.

Rotational Numbering: Counter-clockwise (coinciding with the direction of increase of the angle φ) on the side ***A*** of the detector with the observer looking toward side ***C*** and clockwise on side ***C*** of the detector with the observer looking toward side ***A***. This way, sub-detectors which have mirror symmetry with respect to the x,y plane will have the same part numbers facing each other on the two sides of the detector. If a sub-detector part is sectioned by the x axis, it will be number 0, otherwise the first sub-detector part at positive y will be number 0.

Linear Numbering: The counting increases from side ***A*** to side ***C,*** opposite to the z axis direction, without interruption in the middle at z = 0.

Radial Numbering: The counting increases with increasing radius.

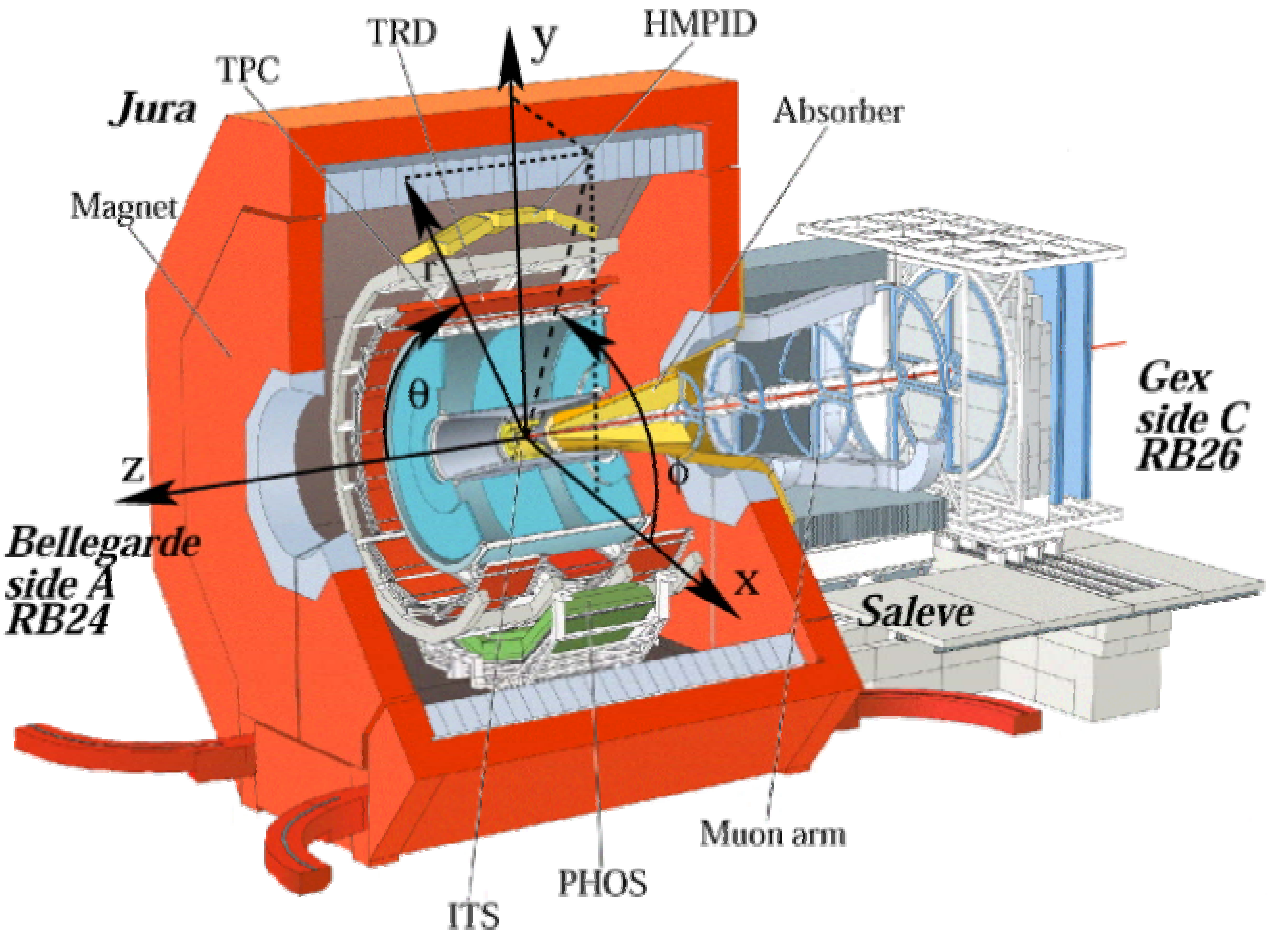

Fig1. Definition of the ALICE coordinate system axis, angles and detector sides.