Coordinate system for the barrel of the $\overline{\text{P}}$ANDA electromagnetic calorimeter

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This coordinate system has not been formally approved at a meeting of the EMC group yet, but was agreed upon via e-mails between all involved parties.

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1 Introduction

The purpose of this system is to unmistakably identify the position of the crystal-detector units in the barrel part of the electromagnetic calorimeter (EMC) of the $\overline{\text{P}}$ANDA target spectrometer.

The identifier consits of three parts and which are independently assigned. During production, partial identifiers can be used, e. g. if the final position of an alveole on the slice is not yet determined.

The three parts are:

1. Slice position or slice label

2. Alveole position on slice
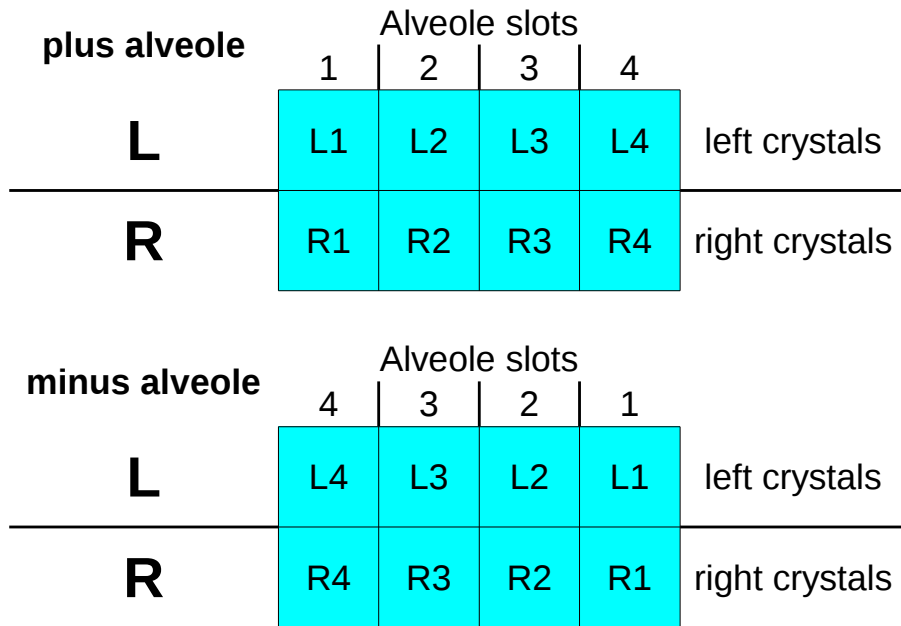
3. Crystal position in alveole

plus alveole

Alveole slots				
	1	2	3	4	
L	L1	L2	L3	L4	left crystals
R	R1	R2	R3	R4	right crystals

minus alveole

Alveole slots				
	4	3	2	1	
L	L4	L3	L2	L1	left crystals
R	R4	R3	R2	R1	right crystals

Figure 1: Illustration of the slot identifiers when looking at the beam-facing side of an alveole.

The parts are separated by a hyphen/minus[1] "-" and described independently in the following sections.

2 Crystal position in alveole

An alveole consists of a 2×4 grid, so there are eight crystals per alveole. An exception is the alveole type 11^+ alias `11p`, who only has a 2×3 grid. The positions in the slots are evenly distributed between to crystal shapes known as left and right. This is used for the position labelling within an alveole. The identifier consists of the two characters:

1. A capital letter, either `L` or `R`, depending on whether the slot in the alveole is shaped for a left (`L`) or right (`R`) crystal.

2. A digit between `1` and `4` to designate which of one the left or right slots is used. For the "plus" alveoles, the numbers are assigned from left to right, when looking at the beam-facing side of the alveole and turning the alveole so that the row of right crystals is at the bottom. For the "minus" alveoles, the numbers are assigned in the opposite direction.

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[1]Unicode character 0x002D.

Figure 2 illustration:

	SM1	SM2			SM3			SM4			SM5			SM6			SM7		
L / R (e)	7me	6me	5me	4me	3me	2me	1me	1pe	2pe	3pe	4pe	5pe	6pe	7pe	8pe	9pe	10pe	11pe	e
L / R (d)	7md	6md	5md	4md	3md	2md	1md	1pd	2pd	3pd	4pd	5pd	6pd	7pd	8pd	9pd	10pd	11pd	d
L / R (c)	7mc	6mc	5mc	4mc	3mc	2mc	1mc	1pc	2pc	3pc	4pc	5pc	6pc	7pc	8pc	9pc	10pc	11pc	c
L / R (b)	7mb	6mb	5mb	4mb	3mb	2mb	1mb	1pb	2pb	3pb	4pb	5pb	6pb	7pb	8pb	9pb	10pb	11pb	b
L / R (a)	7ma	6ma	5ma	4ma	3ma	2ma	1ma	1pa	2pa	3pa	4pa	5pa	6pa	7pa	8pa	9pa	10pa	11pa	a
	7m	6m	5m	4m	3m	2m	1m	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p	

super modules (top), *crystal shape left/right* (left), *alveole position* (right), *alveole type* (bottom)

$\overline{p}$

Figure 2: Illustration of the alveole labelling on a slice when looking at the beam-facing side of a slice.

The allowed identifiers are therefore L1, L2, L3, L4, R1, R2, R3, and, R4. The distribution of identifiers is illustrated in figure 1. The positions L4 and R4 are not used for alveoles of type 11p.

3 Alveole position on slice

The identifier for a position on the slice is composed of one number and two letters. The number and the first letter describe the type of the alveole, although it is different from the nomenclature used in other documents for the barrel.

There are 18 different types of alveoles used in the barrel that differ in shape. The are seven "minus" types of alveoles labelled 7^- to 1^- and eleven "plus" types of alveoles labelled 1^+ to 11^+. An alveole type 0 does not exist.

The minus sign cannot be used in the position label as it is already used to separate the several identifier parts (see section 1). Also, in most situations it would require extra effort to ensure that the superscript is displayed properly. For the position label of an alveole on the slice, the superscript $+$ is therefore replaced by the lowercase letter p and the superscript $-$ by the lowercase letter m.

The number and letter of the alveole type are the first two parts of the position label and range from 7m to 11p. There are five alveoles of each type, so the third part (second letter) is used to tell them apart. The individual alveole position is identified by one of the lowercase letters a, b, c, d, and, e.
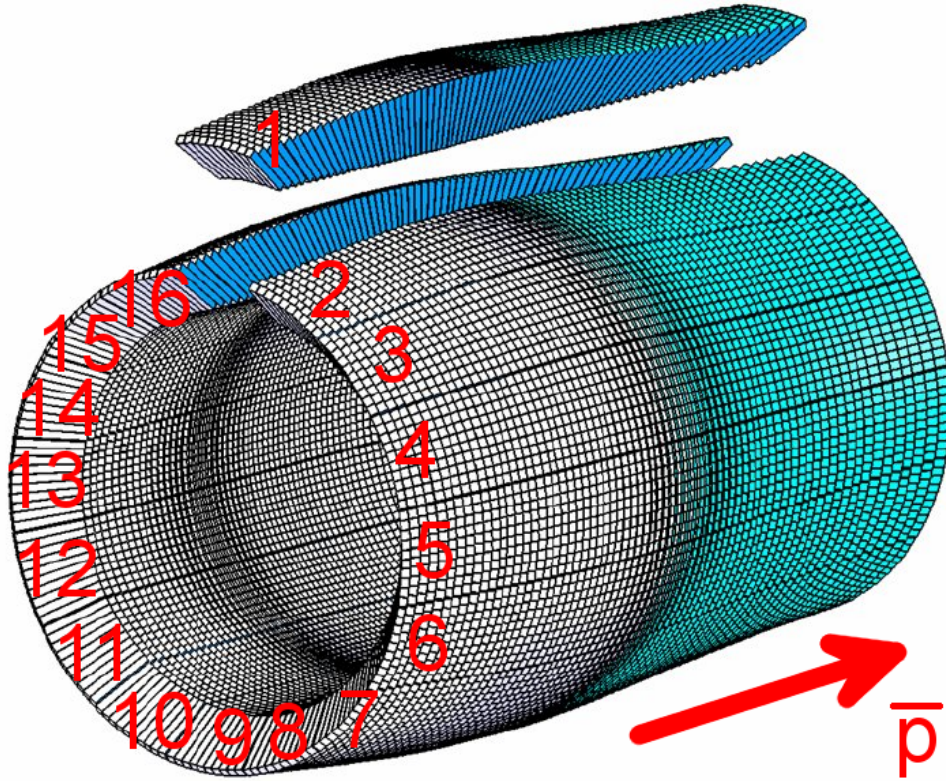
Figure 3: *Preliminary* illustration of the slice labelling within the barrel. Original picture taken from EMC TDR.

These letters are assigned in a way that if the beam-facing side of the slide is aligned so that the antiproton beam travels from left to right and the bottom row of crystals is composed of "right" crystals (see section 2 for details), the bottom row of alveole positions is labelled `a`, the rows above are labelled consecutive to the alphabet up to `e` for the top row. Figure 2 illustrates this schema.

The three parts directly cocatenated without any intermediate character. Examples of valid position labels are `5md`, `1ma`, `6pe`, and, `11pc`.

The alveoles are grouped into seven super-modules, but the information described above is sufficient for unambiguous identification, so adding the super-modules would increase the length of the position identifier without providing necessary additional information.

4 Slice labels and positions

The slices are numbered from `1` to `16`. The number `1` is assigned to the top-right position when looking at the barrel following the direction of the antiproton beam, i. e. in such a way that the alveoles of type `7m` are the closest and the ones of type `11p` are the farthest. The positions are

counted clock-wise, see figure 3 for an illustration. Slice number `1` is a special slice because it contains an opening for the target station. The other slices are identical.

   TODO: See if better image is available. If not, check if better image can be generated from CAD drawings.

5 Examples

Valid complete position labels:

- `1-3me-L4`

- `5-2pc-R3`

- `12-11pa-L1`

Reminder: During assembly, partial identifiers may be used.

Examples of invalid identifiers:

- `M-11pd-R4`: Alveoles of type `11p` do not have slots `L4` and `R4`

- `H-5bm-L3`: Wrong order within alveole position identifier (correct: `H-5mb-L3`)

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