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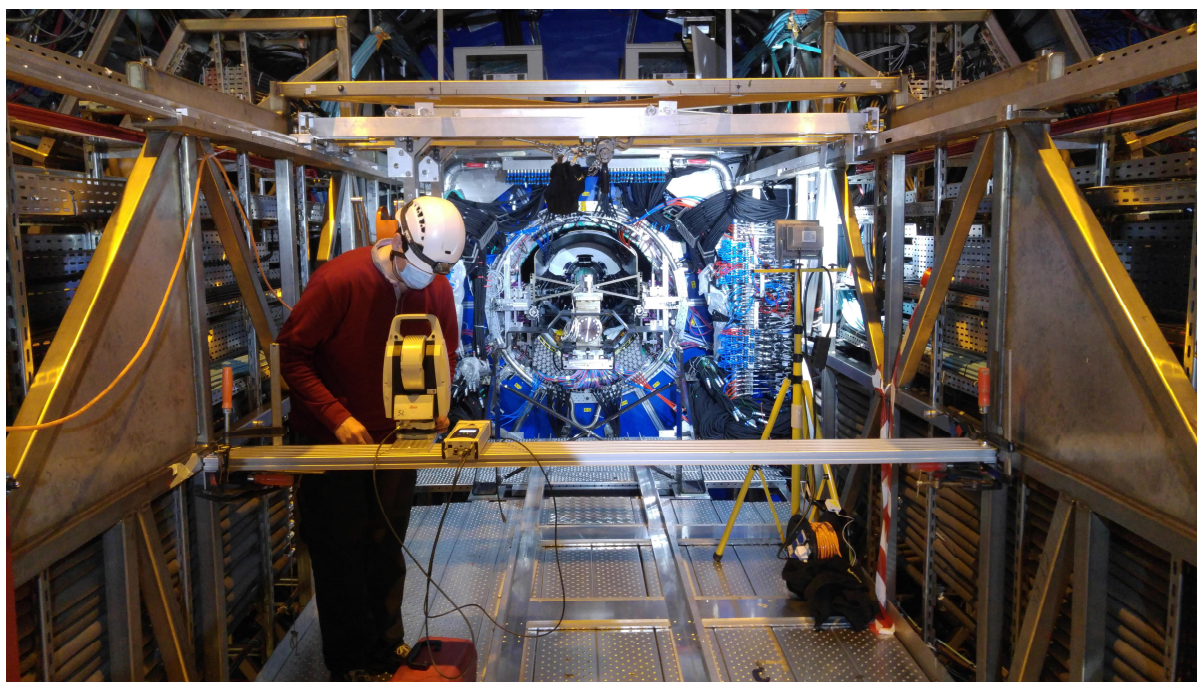
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**ALICE - ITS****MEASUREMENT OF ITS CAGE AND BEAM PIPE  
SUPPORTS AFTER ITS OB BOTTOM INSERTION**Measurement of March 17<sup>th</sup>, 2021

The EDMS document 2510790, containing this report can be found at the following address:

<https://edms.cern.ch/document/2510790>

## 1 GENERAL INTRODUCTION

On the demand of Andres PEREZ, the measurement of the ITS Cage and beam pipe supports after ITS Outer Barrel (OB bottom half) insertion took place on March 17th, 2021.

The aim of the measurement was to determine the position of the ITS Cage and the ITS Outer Barrel (bottom half) before the matching with the top half of the ITS Outer Barrel.

## 2 ALICE PHYSICIST COORDINATE SYSTEM

**Origin:** IP (interaction point) ALICE.

**Z<sub>PH</sub>:** Nominal beamline. Positive in the direction RB24/Shaft. The Z-axis has an inclination of 0.01386rad, going up in the direction RB26/Muon.

**X<sub>PH</sub>:** Perpendicular to Z, horizontal. Positive to LHC centre.

**Y<sub>PH</sub>:** Perpendicular to X and Z. Right-handed coordinate system.

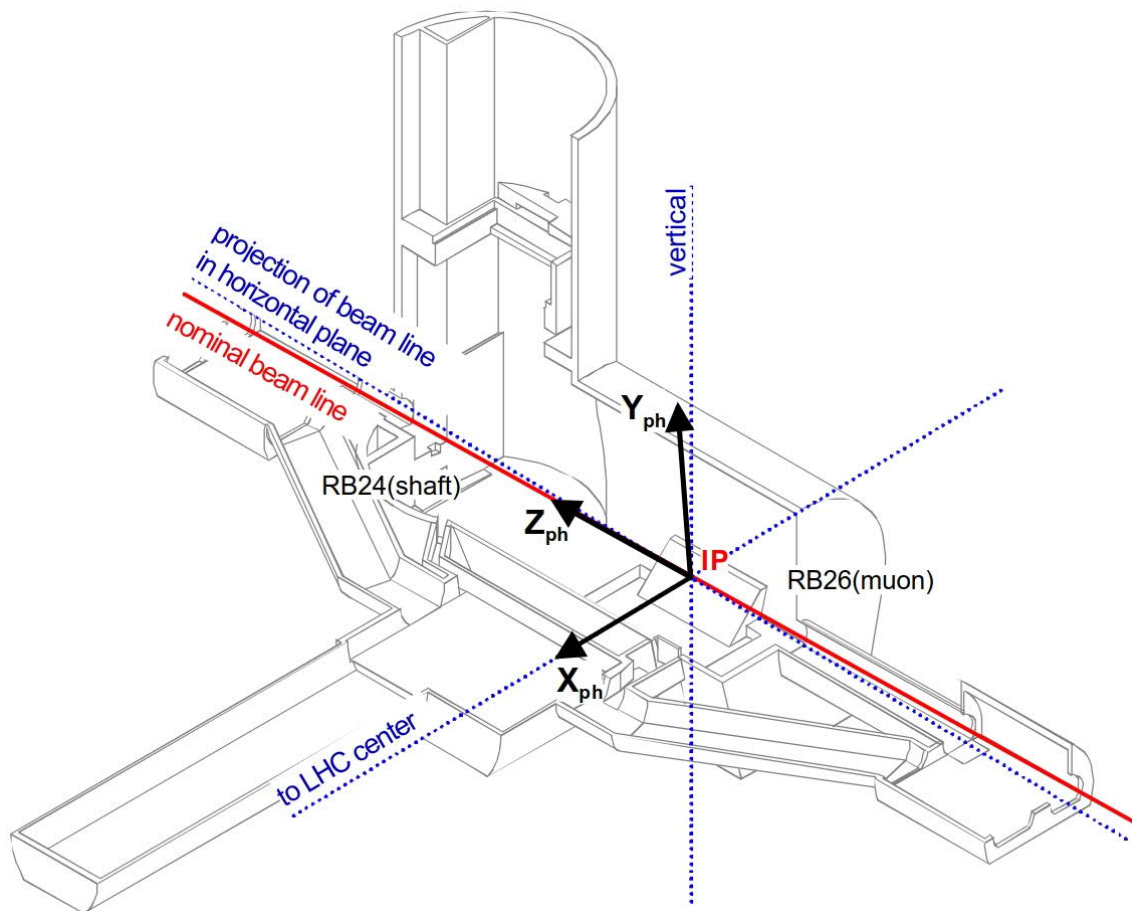


Figure 1 : Definition of the ALICE coordinate system

### 3 DISTRIBUTION OF THE MEASURED POINTS - SURVEY TARGET AND APPLIED ADAPTER

As requested by Andres PEREZ, the following elements have been measured:

- 8 ITS Cage reference points
- 2 Roller points
- 4 Beam Pipe support points inside the ITS Cage
- 6 Outer Barrel points
- 7 MFT fiducial points

#### 3.1 ITS CAGE

In order to determine the position of the ITS Cage, 12 points have been measured.

These points are distributed as following:

- o 8 points on the Cage (4 on A side & 4 on C side)
- o 4 points on the Rollers (A side)

The measured points on the ITS Cage have been named with the following abbreviations:

$\{ROLLER \text{ or } CAGE\}_{YY}_{(\{TOP \text{ or } BOTTOM\}\{IN \text{ or } OUT\})}$

$\{ROLLER \text{ or } CAGE\}$  ROLLER for the measured points on the Roller

CAGE for the measured points on the Cage

$\{YY\}$  A/C - I/O to indicate the position of the measured point

$\{BOTTOM \text{ or } TOP\}$  Only for cage points. Bottom or Top, with respect to the beam line.

All points have been measured with Leica RFI 0.5inch prisms and special 14mm offset survey adapters, which have been provided by Pascal SECOUET.

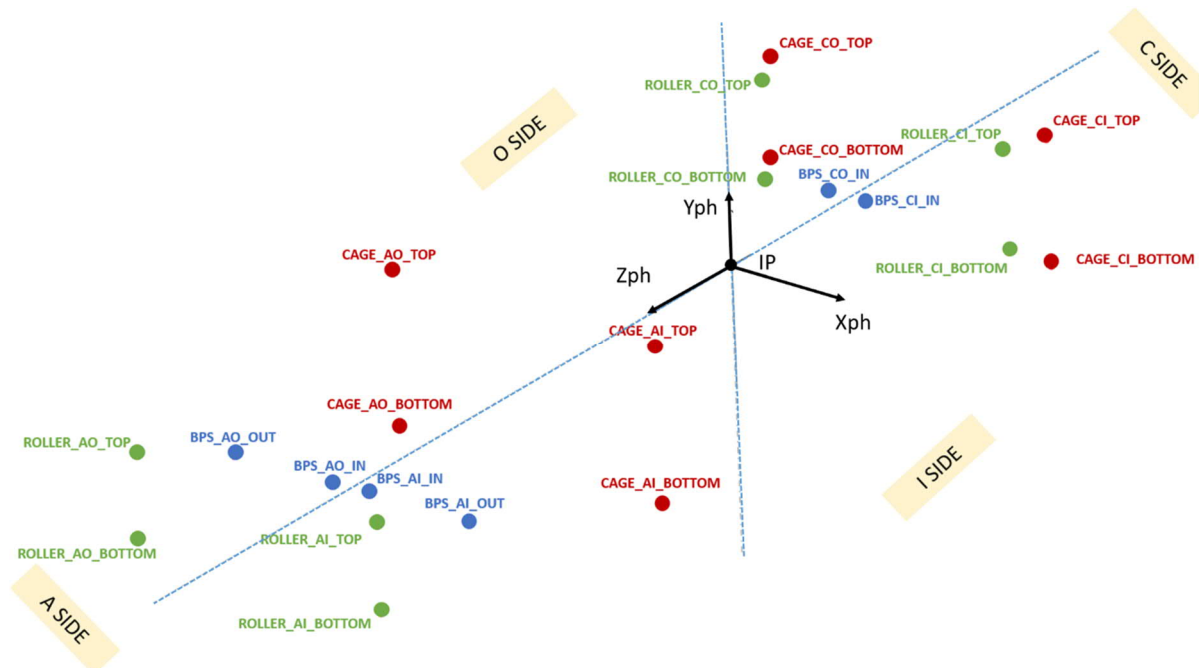


Figure 2 : Distribution of points on ITS cage and beam pipe support inside the Cage



### 3.2 BEAM PIPE SUPPORTS

In order to determine the position of the Beam Pipe support (A side), 4 points have been measured.

The measured points on the Beam Pipe Supports inside the Cage have been named with the following abbreviations:

$$\{BPS\}_{YY}_{IN\ or\ OUT}$$

$\{BPS\}$	BPS for the measured points on the Beam Pipe Support
$\{YY\}$	A/C - I/O to indicate the position of the measured point
$\{IN\ or\ OUT\}$	Only for BPS points. Inner or Outer with respect to the beam axis

These points have been measured with Leica RFI 0.5inch prisms and special 14mm offset survey adapters, which have been provided by Pascal SECOUET.

### 3.3 OUTER BARREL POINTS (BOTTOM HALF)

In order to determine the position of the bottom half barrel, 6 points have been measured.

All points have been measured with Leica RFI 0.5inch prisms and special 14mm offset survey adapters. The distribution of the measured points is illustrated in the following figure as they have been measured during the fiducialisation ([EDMS No. 2504104](#)).

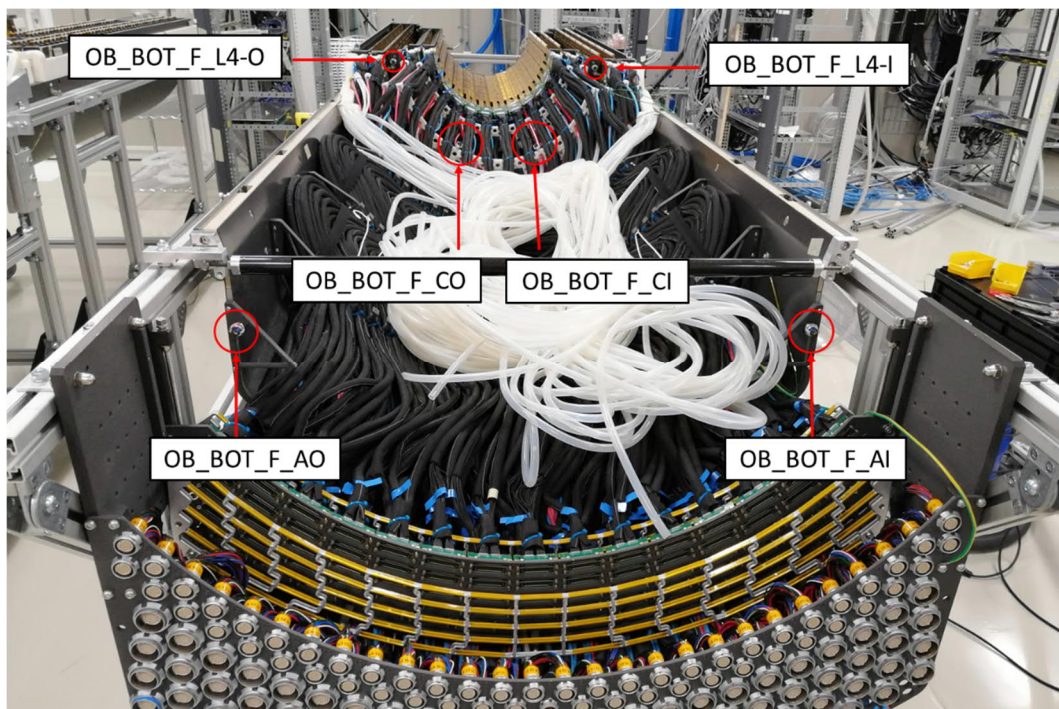


Figure 3 : Distribution of the measured points on the bottom half barrel

### 3.4 MFT fiducials points

In order to determine the position of the MFT, 7 fiducials points have been measured on disks 00 and 03.

The measured fiducial points on the MFT have been named with the following abbreviations:

$\{MFT\}_{(\{TOP\ or\ BOTTOM\})_{\{YY\}}_{\{NN\}}$

$\{MFT\}$	MFT for the measured fiducial points on the Muon Forward Tracker
$\{BOTTOM\ or\ TOP\}$	Bottom or Top part of the MFT, with respect to the beam line
$\{YY\}$	I/O to indicate the side of the measured fiducial point
$\{NN\}$	Number of the half disk from 00 up to 04. (Numbering from A side to C side)

All points have been measured with Leica RFI 0.5inch prisms and special 14mm offset survey adapters. The distribution of the MFT disks is illustrated in the following figures as they have been measured during the fiducialisation ([EDMS No. 2450352](#)).

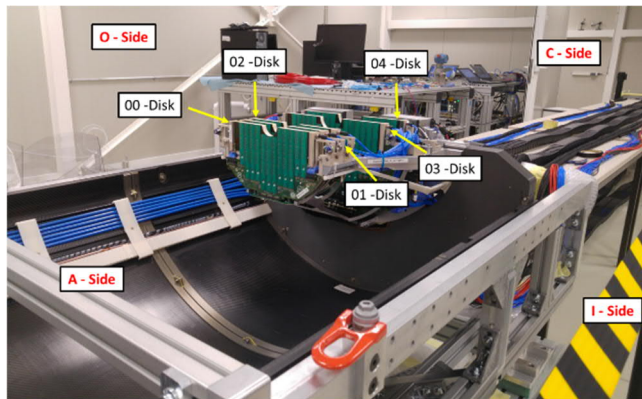


Figure 4 : Bottom half disks of the MFT

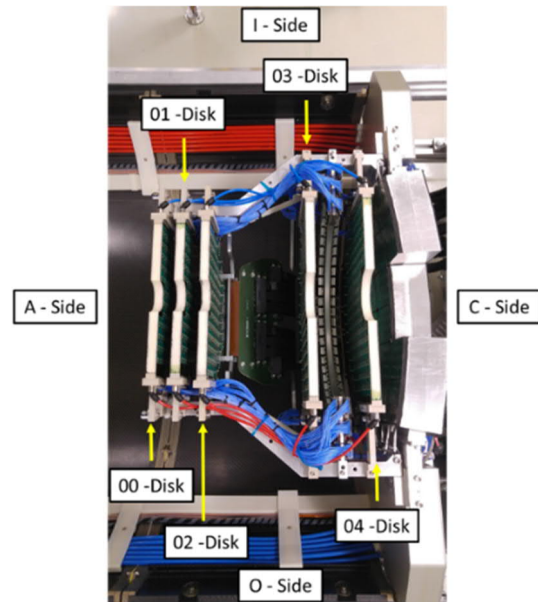


Figure 5 : Top half disks of the MFT

#### 4 RESULTS OF THE MEASUREMENT

In the tables below, measured coordinates are given at the centre of the survey targets in the ALICE Physicist coordinate system, as described in §2. Coordinates are given with precision 0.5mm at  $1\sigma$  level.

Remark: the coordinates of the point CAGE\_AI\_BOTTOM and CAGE\_CO\_BOTTOM should not be used. A problem occurred during the measurement.

ALICE MEASUREMENT OF ITS CAGE AND BEAM PIPE SUPPORTS AFTER ITS OB BOTTOM INSERTION March 17th, 2021									
NAME	MEASURED POINTS ON THE CAGE			THEORETICAL COORDINATES			$\Delta$ = MEAS. - THEO.		
	X [m]	Y [m]	Z [m]	X [m]	Y [m]	Z [m]	$\Delta X$ [mm]	$\Delta Y$ [mm]	$\Delta Z$ [mm]
MEASURED POINTS ON THE BEAM PIPE SUPPORT - A SIDE									
BPS_AI_OUT	0.43177	-0.00018	1.82485	0.4325	0.0000	1.8275	-0.7	-0.2	-2.6
BPS_AI_IN	0.04929	-0.00318	1.82465	0.0500	0.0000	1.8275	-0.7	-3.2	-2.8
BPS_AO_IN	-0.05074	-0.00324	1.82456	-0.0500	0.0000	1.8275	-0.7	-3.2	-2.9
BPS_AO_OUT	-0.43312	-0.00004	1.82466	-0.4325	0.0000	1.8275	-0.6	0.0	-2.8
MEASURED POINTS ON THE CAGE									
CAGE_AO_TOP	-0.48347	0.25916	0.98690	-0.4830	0.2590	0.9900	-0.5	0.2	-3.1
CAGE_AO_BOTTOM	-0.48262	-0.25889	0.98689	-0.4830	-0.2590	0.9900	0.4	0.1	-3.1
CAGE_AI_TOP	0.48150	0.25918	0.98708	0.4830	0.2590	0.9900	-1.5	0.2	-2.9
<i>CAGE_AI_BOTTOM</i>	<i>0.48345</i>	<i>-0.23050</i>	<i>0.98709</i>	<i>0.4830</i>	<i>-0.2590</i>	<i>0.9900</i>	<i>0.5</i>	<i>28.5</i>	<i>-2.9</i>
CAGE_CO_TOP	-0.50848	0.20832	-0.87262	-0.5080	0.2080	-0.8695	-0.5	0.3	-3.1
<i>CAGE_CO_BOTTOM</i>	<i>-0.47956</i>	<i>-0.20758</i>	<i>-0.87261</i>	<i>-0.5080</i>	<i>-0.2080</i>	<i>-0.8695</i>	<i>28.4</i>	<i>0.4</i>	<i>-3.1</i>
CAGE_CI_TOP	0.50787	0.20829	-0.87245	0.5080	0.2080	-0.8695	-0.1	0.3	-2.9
CAGE_CI_BOTTOM	0.50829	-0.20833	-0.87264	0.5080	-0.2080	-0.8695	0.3	-0.3	-3.1
MEASURED POINTS ON THE ROLLERS									
ROLLER_AO_TOP	-0.44790	0.10707	2.27535	-0.4479	0.1070	2.2780	0.0	0.1	-2.7
ROLLER_AI_TOP	0.44856	0.10703	2.27577	0.4489	0.1070	2.2780	-0.3	0.0	-2.2

ALICE MEASUREMENT OF ITS CAGE AND BEAM PIPE SUPPORTS AFTER ITS OB BOTTOM INSERTION March 17th, 2021			
NAME	X [m]	Y [m]	Z [m]
MEASURED POINTS ON ITS OB BOTTOM			
OB_BOT_F_AI	0.41934	-0.23163	2.53772
OB_BOT_F_AO	-0.41784	-0.23089	2.53731
OB_BOT_F_CI	0.11484	-0.22479	1.11746
OB_BOT_F_CO	-0.11239	-0.22523	1.11891
OB_BOT_F_L4-I	0.32129	-0.03001	0.83038
OB_BOT_F_L4-O	-0.32040	-0.03002	0.83050
MEASURED POINTS ON MFT			
MFT_BOTTOM_I_00	0.16624	-0.03083	-0.44877
MFT_BOTTOM_O_00	-0.16575	-0.03044	-0.44913
MFT_BOTTOM_I_03	0.17421	-0.03005	-0.67314
MFT_TOP_I_00	0.16572	0.02996	-0.44863
MFT_TOP_O_00	-0.16650	0.02980	-0.44865
MFT_TOP_I_03	0.17379	0.03002	-0.67245
MFT_TOP_O_03	-0.17434	0.02986	-0.67237