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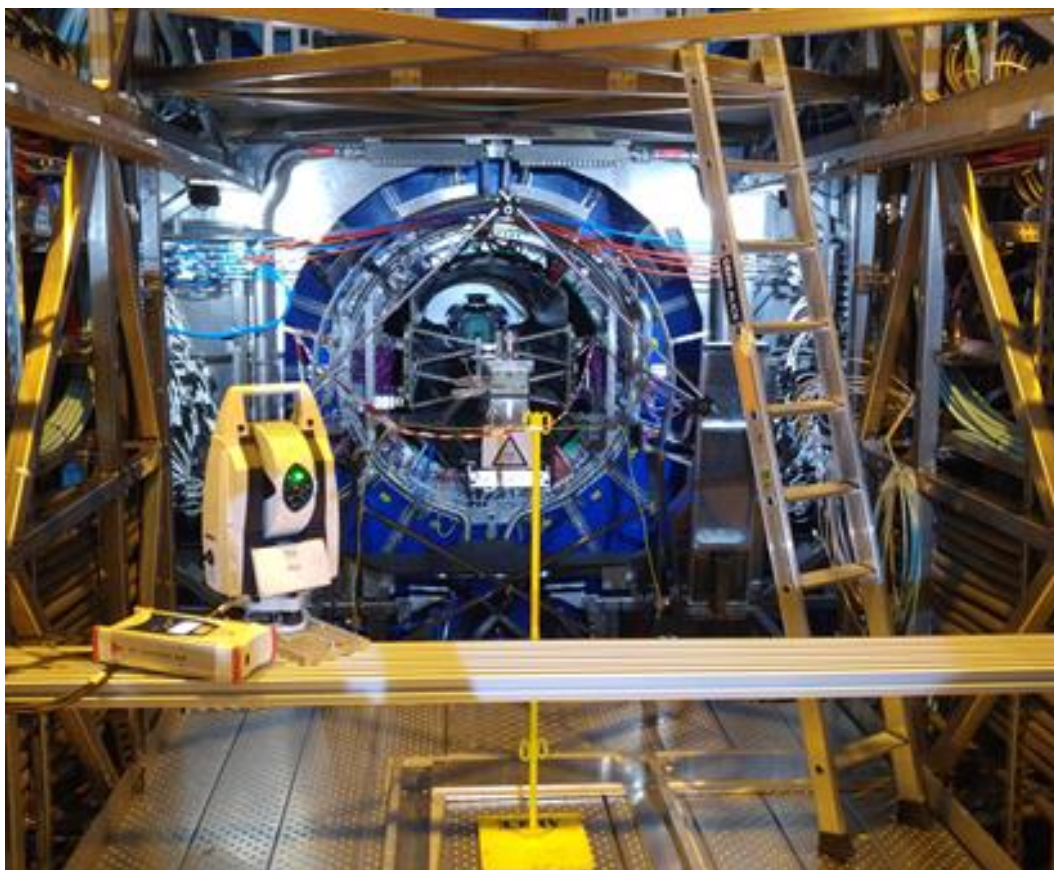
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ALICE**MEASUREMENT OF MFT AND ITS CAGE**Measurement of December 14th, 2020

The EDMS document 2454349, containing this report can be found at the following address:

<https://edms.cern.ch/document/2454349>

1 GENERAL INTRODUCTION

On the demand of Stefano PANEBIANCO, the measurement of MFT inside the ITS Cage after its insertion took place on December 14th, 2020.

The aim of the measurement was to determine the position of the MFT, the ITS Cage and the Beam Pipe supports.

2 ALICE PHYSICIST COORDINATE SYSTEM

Origin: IP (interaction point) ALICE.

Z_{PH}: 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_{PH}: Perpendicular to Z, horizontal. Positive to LHC centre.

Y_{PH}: Perpendicular to X and Z. Right-handed coordinate system.

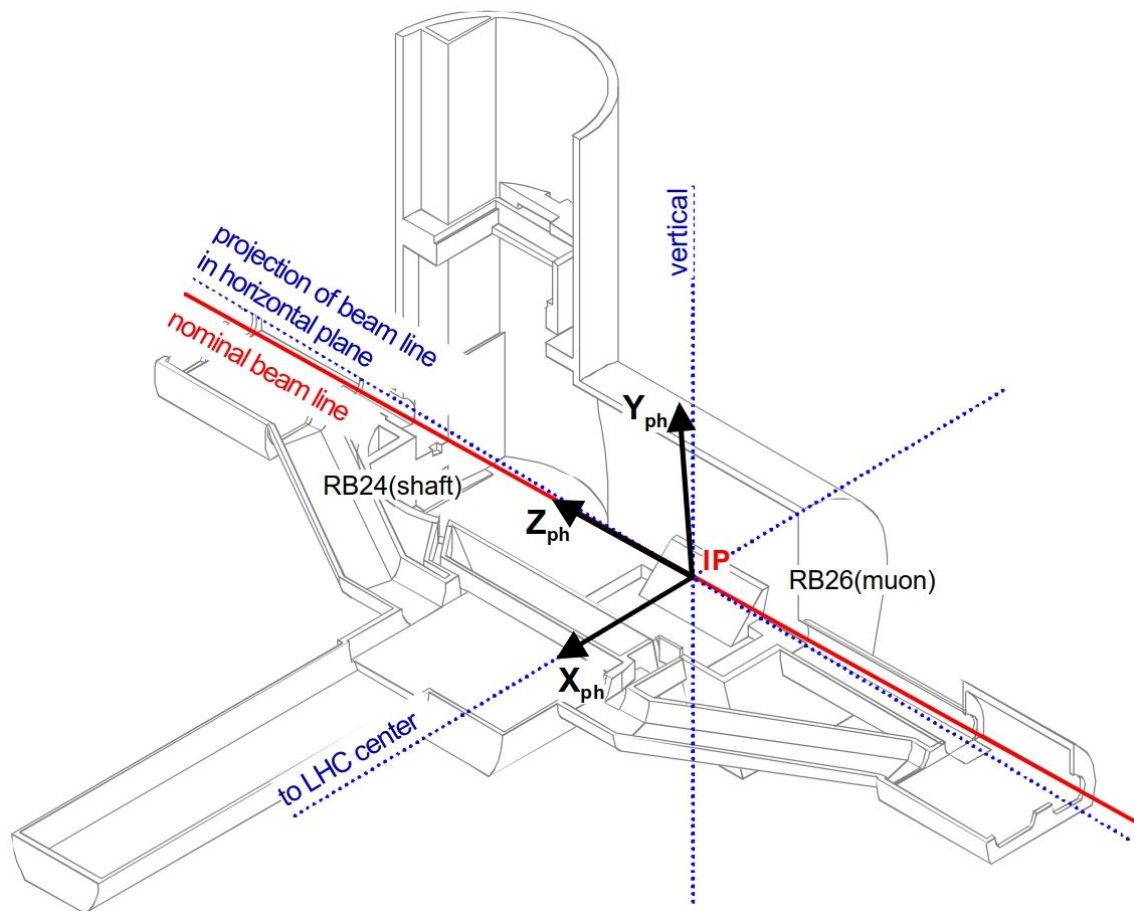


Figure 1 : Definition of the ALICE coordinate system

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

As requested by Stefano PANEBIANCO, the following elements have been measured:

- 4 ITS Cage reference points
- 2 Roller points
- 4 Beam Pipe Support points inside the ITS Cage
- 8 MFT fiducial points

3.1 ITS CAGE

In order to determine the position of the ITS Cage, only 4 points have been measured.

These points are distributed as following:

- 4 points on the Cage (2 on A side & 2 on C side)
- 2 points on the bottom 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.

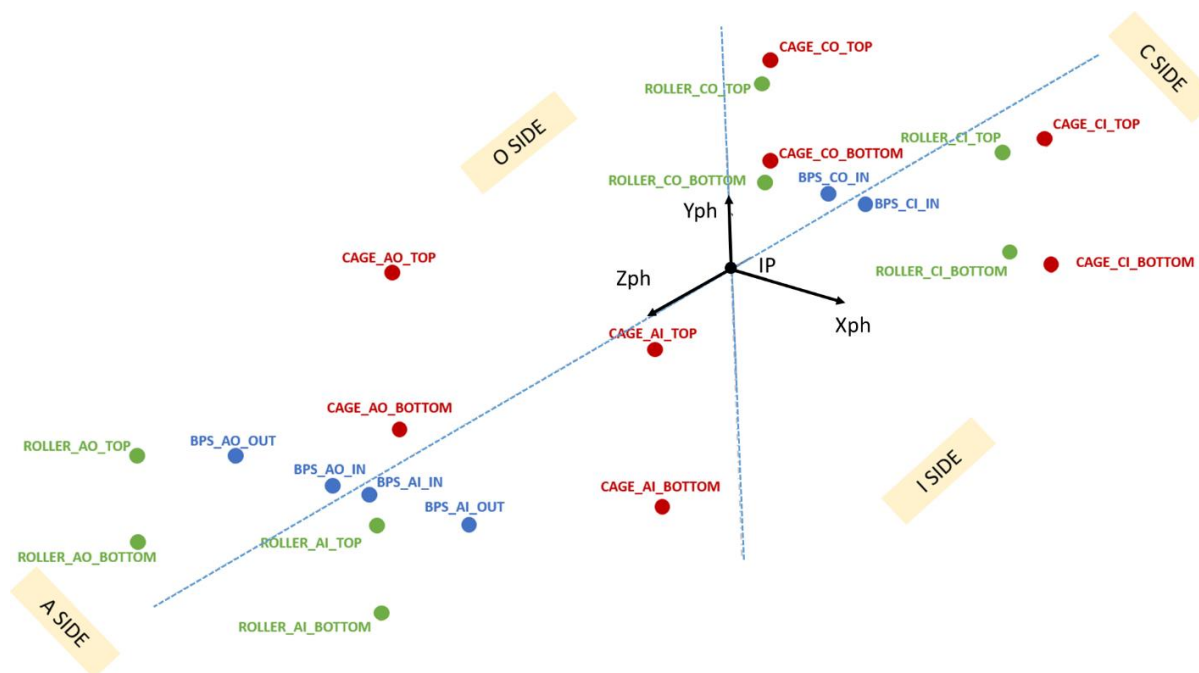


Figure 2 : Distribution of points on ITS cage and beam pipe support inside the Cage

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 MUON FORWARD TRACKER

In order to determine the position of the MFT, 8 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](#)).

In the table of §4.2, the transformed points of the MFT are the points measured during the fiducialisation of the MFT which have been undergone best-fit transformation on the 8 measured fiducial points.

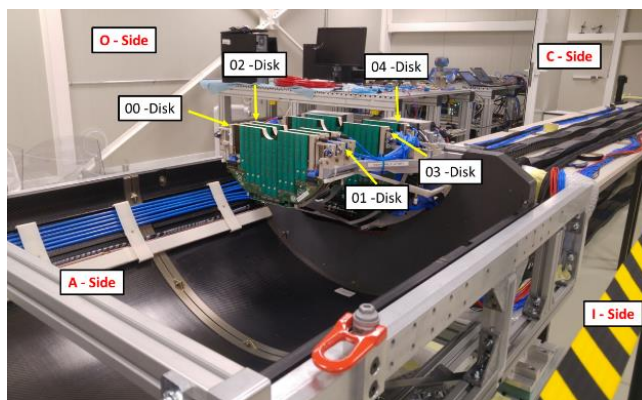


Figure 3 : Bottom half disks of the MFT

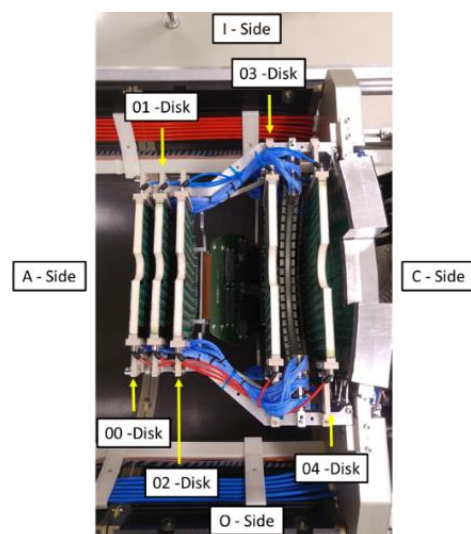


Figure 4 : Top half disks of the MFT

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 σ level.

4.1 RESULTS - ITS CAGE AND BEAM PIPE SUPPORTS

Remark: the coordinates of the point CAGE_CI_TOP should not be used. A problem occurred during the measurement.

ALICE MEASUREMENT OF MFT, ITS CAGE AND BEAM PIPE SUPPORTS December 14th, 2020									
NAME	MEASURED POINTS ON THE CAGE			THEORETICAL COORDINATES			$\Delta = \text{MEAS.} - \text{THEO.}$		
	X [m]	Y [m]	Z [m]	X [m]	Y [m]	Z [m]	ΔX [mm]	ΔY [mm]	ΔZ [mm]
MEASURED POINTS ON THE BEAM PIPE SUPPORT - A SIDE									
BPS_AI_OUT	0.43172	-0.00039	1.82461	0.4325	0.0000	1.8275	-0.8	-0.4	-2.9
BPS_AI_IN	0.04922	-0.00351	1.82447	0.0500	0.0000	1.8275	-0.8	-3.5	-3.0
BPS_AO_IN	-0.05076	-0.00351	1.82437	-0.0500	0.0000	1.8275	-0.8	-3.5	-3.1
BPS_AO_OUT	-0.43316	-0.00023	1.82431	-0.4325	0.0000	1.8275	-0.7	-0.2	-3.2
MEASURED POINTS ON THE CAGE									
CAGE_AI_TOP	0.48148	0.25901	0.98687	0.4830	0.2590	0.9900	-1.5	0.0	-3.1
CAGE_AO_TOP	-0.48414	0.25897	0.98655	-0.4830	0.2590	0.9900	-1.1	0.0	-3.4
CAGE_CI_TOP	0.52215	0.18828	-0.88792	0.5080	0.2080	-0.8695	14.2	-19.7	-18.4
CAGE_CO_TOP	-0.50855	0.20816	-0.87298	-0.5080	0.2080	-0.8695	-0.5	0.2	-3.5
ROLLER_AI_BOTTOM	0.44904	-0.10736	2.27507	0.4489	-0.1070	2.2780	0.1	-0.4	-2.9
ROLLER_AO_BOTTOM	-0.44823	-0.10723	2.27475	-0.4479	-0.1070	2.2780	-0.3	-0.2	-3.2

4.2 RESULTS - MFT

Remark: the transformed points of the MFT are the points measured during the fiducialisation of the MFT ([EDMS No. 2450352](#)) which have been undergone best-fit transformation on the 8 measured fiducial points.

ALICE MEASUREMENT OF MFT, ITS CAGE AND BEAM PIPE SUPPORTS December 14th, 2020									
NAME	MEASURED POINTS ON THE MFT			THEORETICAL COORDINATES			$\Delta = \text{MEAS.} - \text{THEO.}$		
	X [m]	Y [m]	Z [m]	X [m]	Y [m]	Z [m]	ΔX [mm]	ΔY [mm]	ΔZ [mm]
MEASURED POINTS ON MFT									
MFT_TOP_I_00	0.16549	0.02986	-0.44742	0.1660	0.0300	-0.4460	-0.5	-0.1	-1.4
MFT_TOP_I_03	0.17354	0.02996	-0.67127	0.1740	0.0300	-0.6700	-0.5	0.0	-1.3
MFT_TOP_O_00	-0.16659	0.02965	-0.44742	-0.1660	0.0300	-0.4460	-0.6	-0.4	-1.4
MFT_TOP_O_03	-0.17452	0.02969	-0.67116	-0.1740	0.0300	-0.6700	-0.5	-0.3	-1.2
MFT_BOTTOM_I_00	0.16602	-0.03095	-0.44900	0.1660	-0.0300	-0.4460	0.0	-1.0	-3.0
MFT_BOTTOM_I_03	0.17399	-0.03015	-0.67339	0.1740	-0.0300	-0.6700	0.0	-0.2	-3.4
MFT_BOTTOM_O_00	-0.16592	-0.03062	-0.44939	-0.1660	-0.0300	-0.4460	0.1	-0.6	-3.4
MFT_BOTTOM_O_03	-0.17380	-0.02996	-0.67349	-0.1740	-0.0300	-0.6700	0.2	0.0	-3.5
TRANSFORMED POINTS ON MFT									
MFT_TOP_I_01	0.16548	0.02988	-0.48032	0.1660	0.0300	-0.4790	-0.5	-0.1	-1.3
MFT_TOP_I_02	0.16548	0.02990	-0.54482	0.1660	0.0300	-0.5435	-0.5	-0.1	-1.3
MFT_TOP_I_04	0.17347	0.02997	-0.75532	0.1740	0.0300	-0.7540	-0.5	0.0	-1.3
MFT_TOP_O_01	-0.16652	0.02965	-0.48031	-0.1660	0.0300	-0.4790	-0.5	-0.4	-1.3
MFT_TOP_O_02	-0.16652	0.02967	-0.54481	-0.1660	0.0300	-0.5435	-0.5	-0.3	-1.3
MFT_TOP_O_04	-0.17453	0.02973	-0.75531	-0.1740	0.0300	-0.7540	-0.5	-0.3	-1.3
MFT_BOTTOM_I_01	0.16603	-0.03080	-0.48223	0.1660	-0.0300	-0.4790	0.0	-0.8	-3.2
MFT_BOTTOM_I_02	0.16606	-0.03059	-0.54673	0.1660	-0.0300	-0.5435	0.1	-0.6	-3.2
MFT_BOTTOM_I_04	0.17418	-0.02991	-0.75722	0.1740	-0.0300	-0.7540	0.2	0.1	-3.2
MFT_BOTTOM_O_01	-0.16597	-0.03055	-0.48241	-0.1660	-0.0300	-0.4790	0.0	-0.6	-3.4
MFT_BOTTOM_O_02	-0.16594	-0.03034	-0.54691	-0.1660	-0.0300	-0.5435	0.1	-0.3	-3.4
MFT_BOTTOM_O_04	-0.17382	-0.02965	-0.75741	-0.1740	-0.0300	-0.7540	0.2	0.4	-3.4