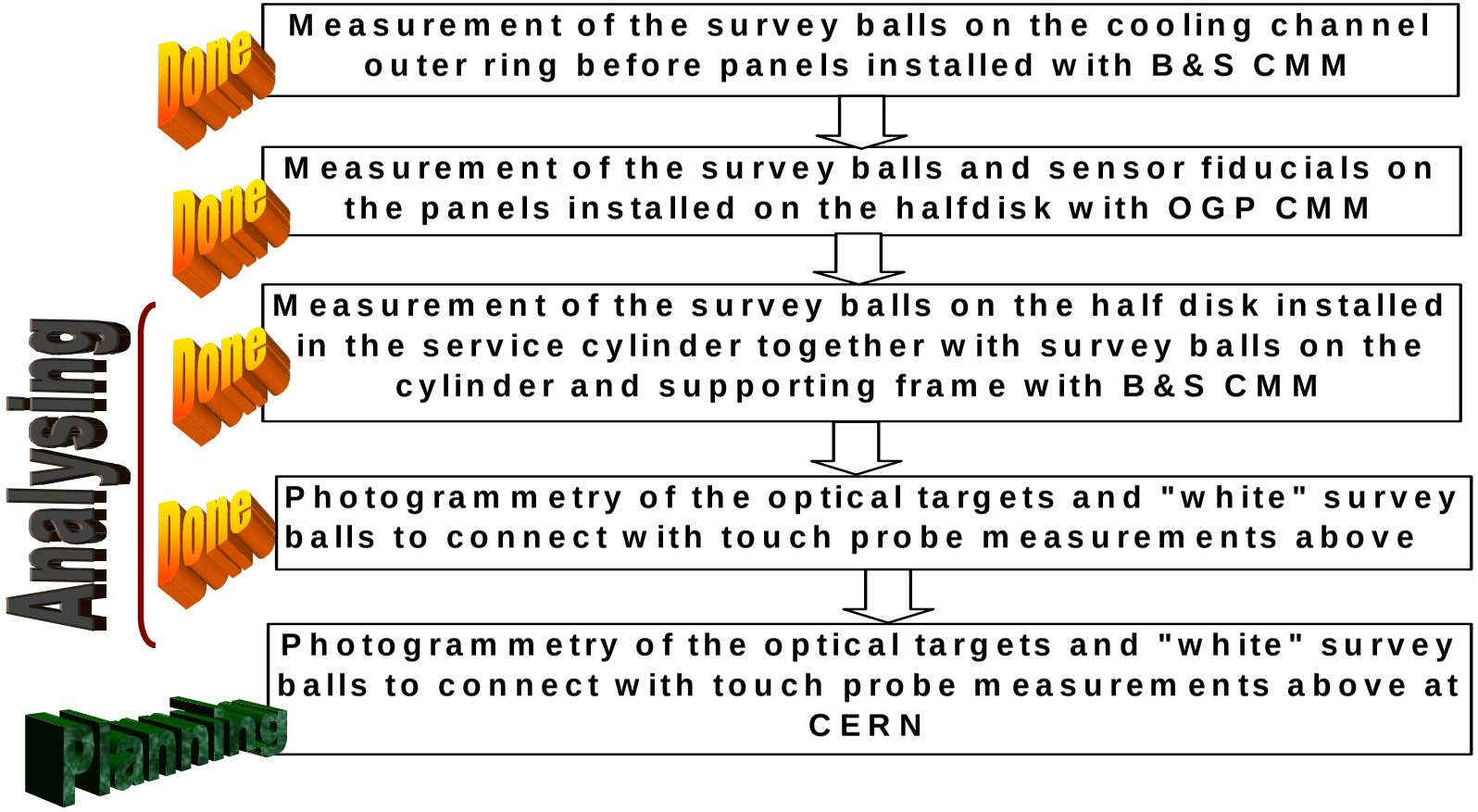
Status of CMS 07 Pilot Run Forward Pixel Detector Survey

A. Gritsan, *M. Kubantsev*,

M. Roman, N. Tran

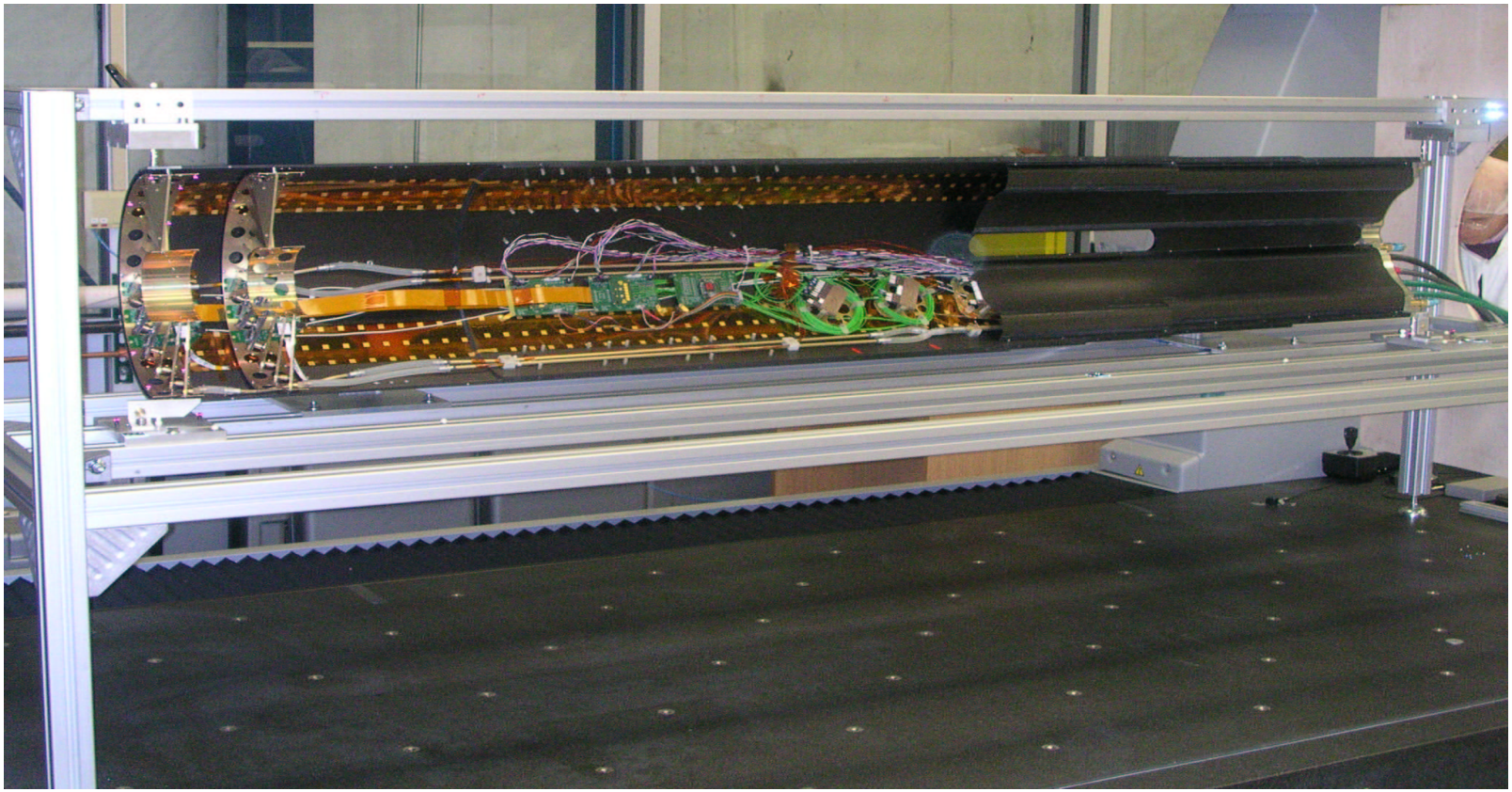
CMS 07 Pilot Run Forward Pixel Detector Survey Plan

MK 01/02/07 **07 Pilot Run Survey Flow Chart**

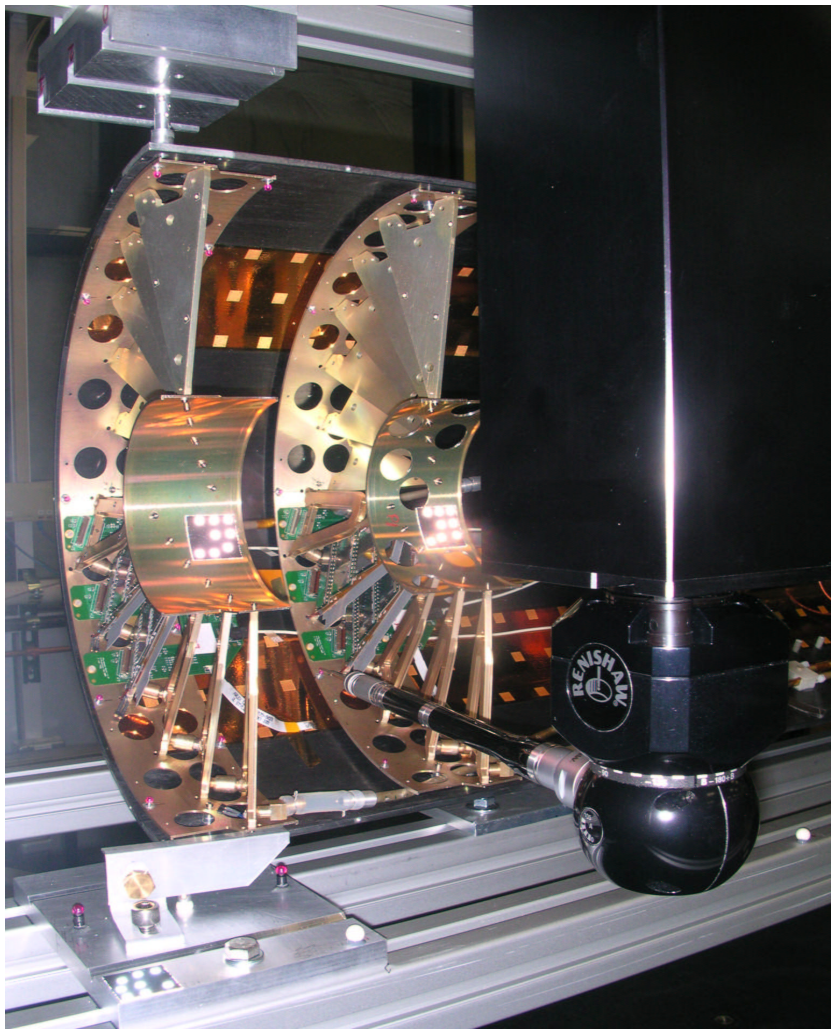


CMS 07 Pilot Run Forward Pixel Detector Survev: Touch Probe

The pilot Run Service Cylinder with two Half Disks installed in the supporting frame on the CMM ready to survey



CMS 07 Pilot Run Forward Pixel Detector Survey: Touch Probe



- **Touch probe measurements of the half disk survey balls**
- **Upper supporting legs and additional frame survey balls are seen**
- **Touch probing will be replaced by photogrammetry of targets seen on the photo for Physics Run full half disks**
- **Photogrammetry exposure was made for the targets and white survey balls to verify and connect two methods**

CMS 07 Pilot Run Forward Pixel Detector Survey Data

DATE	jan	11	7		
TIME	4:17pm				
PART	NAME	:	twin_cal_tool		
REV	NUMBER	:			
SER	NUMBER	:			
STATS	COUNT	:	1		
File 091					
**********	Flatness	of	two	support	plates
DIM	LOC1=	LOCATION	OF	PLANE	PLN1
Z	0	0	0		
FL	0.0816	0	0.0816		
	Cones	and	slots	after	preliminary
**********	alignment	to	structure	**********	
DIM	LOC2=	LOCATION	OF	CONE	CON1
X	0	0	0		
Y	0	0	0		
Z	-1.5	-1.5	0		
RN	0.0067	0	0.0067		
DIM	LOC3=	LOCATION	OF	CONE	CON2
X	0	0	0		
Y	2121.347	2121.29	0.057		
Z	-1.5	-1.5	0		
RN	0.0083	0	0.0083		
DIM	LOC5=	LOCATION	OF	POINT	SLOT1_EFF_CEN
X	0.1224	-0.083	0.2054		
Y	-0.0336	-0.004	-0.0296		
Z	396.9919	397	-0.0081		
DIM	LOC4=	LOCATION	OF	POINT	SLOT2_EFF_CEN
X	-0.2781	-0.386	0.1079		
Y	2121.2616	2121.292	-0.0304		
Z	396.984	397	-0.016		
	Cones,	slots	and	reference	spheres
*******	after	final	alignment	to	support 'structure
DIM	LOC24=	LOCATION	OF	CONE	CON1
X	0	0	0		
Y	0	0	0		
Z	-1.4359	-1.5173	0.0814		
DIM	LOC25=	LOCATION	OF	CONE	CON2

- **These CMM data analyzed at Fermilab and JHU to obtain positions of the disk sensors relative to supporting leg balls and overall structure**
- **The photogrammetry data are available for comparison and further use to connect with survey at CERN**

CMS 07 Pilot Run Forward Pixel Detector Survey Data

Available on CMS information server

CMS IN 2007/012

CMS Internal Note

The content of this note is intended for CMS internal use and distribution only

February 14, 2007

Optical Survey Analysis of the CMS Forward Pixel Detector and Application to Alignment with Tracks

A.V. Gritsan, N. Tran

Johns Hopkins University, Baltimore, Maryland, USA

M. Kubantsev

Northwestern University, Evanston, Illinois, USA

CMS 07 Pilot Run Forward Pixel Detector Survey Data

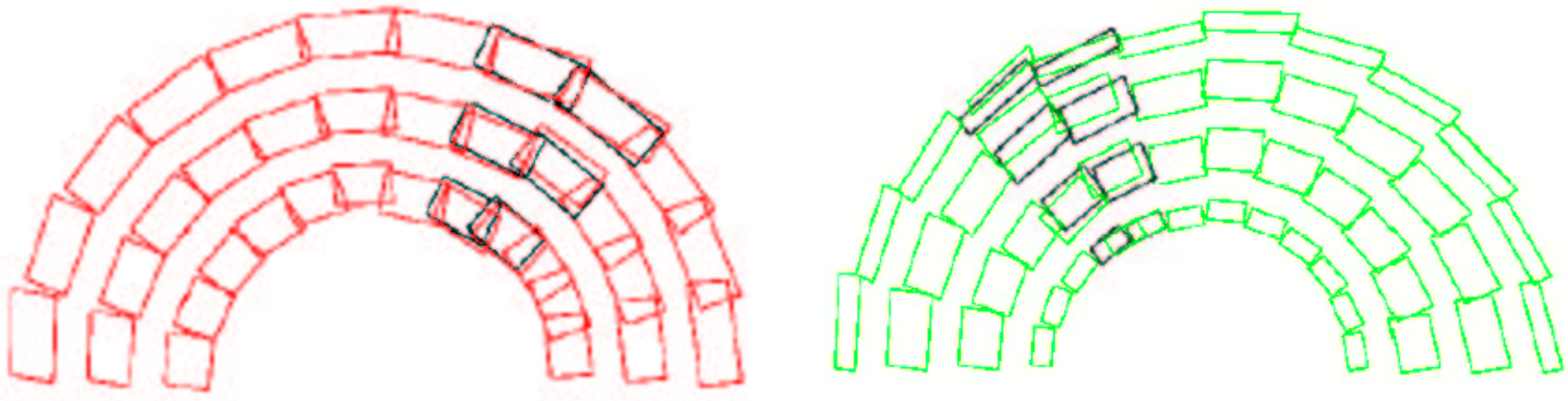
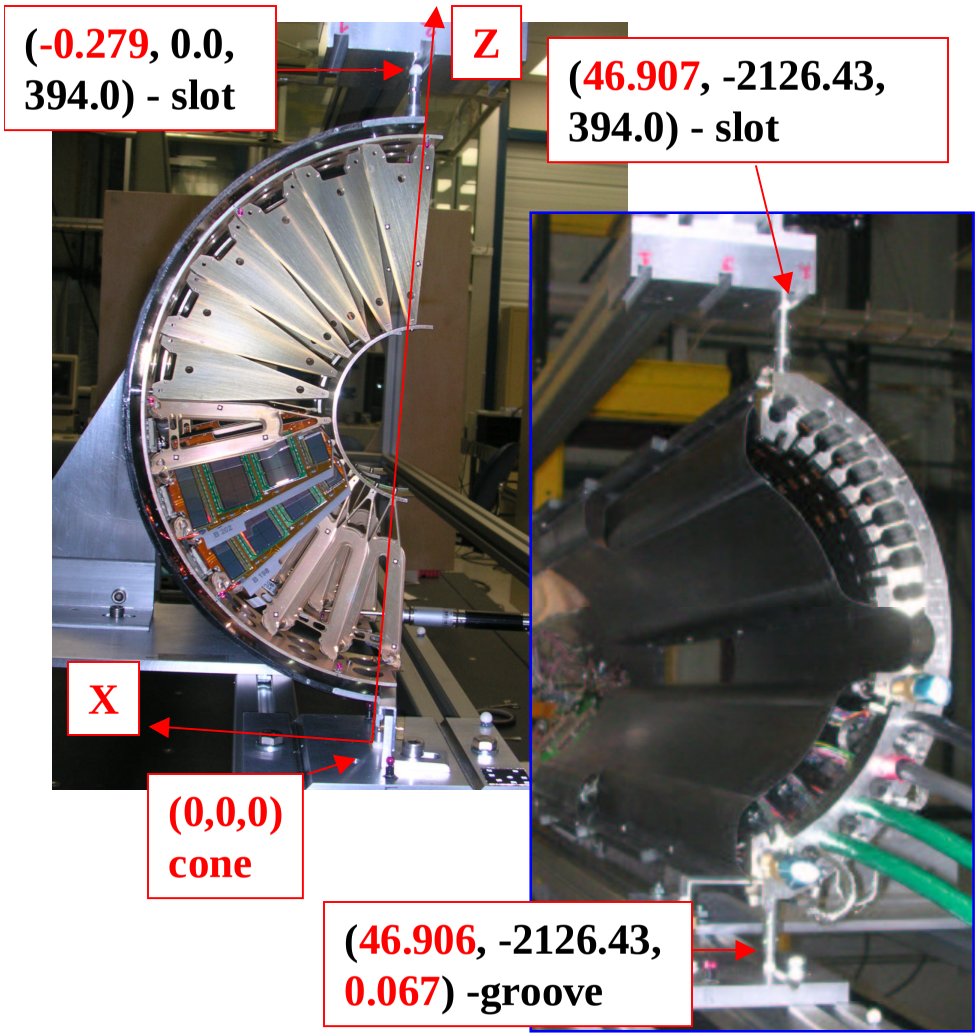


Illustration of comparison between relative sensor positions with the nominal and measured alignment parameters for the P2 half disk survey. Both sensor and panel displacements are displayed with a magnification factor of 50.

Displacements of the measured half disk positions with respect to the nominal full half disk geometry (microns)

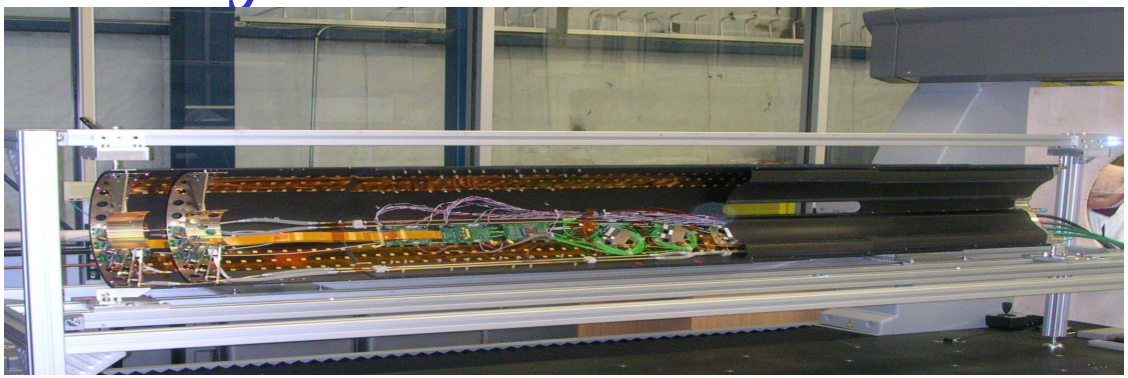
P1	160.4	59.1	-13.3
P2	62.5	3.5	145.

CMS 07 Pilot Run Forward Pixel Detector Survey: support leg positions



- **X-Y-Z coordinates of the half disk balls and service half cylinder supporting leg balls are surveyed with nominal accuracy of ~ 20 microns.**
- **However deformations of the half cylinder and half disks need to be taken into account (~100 microns) –**
- **Final survey will be made at CERN**

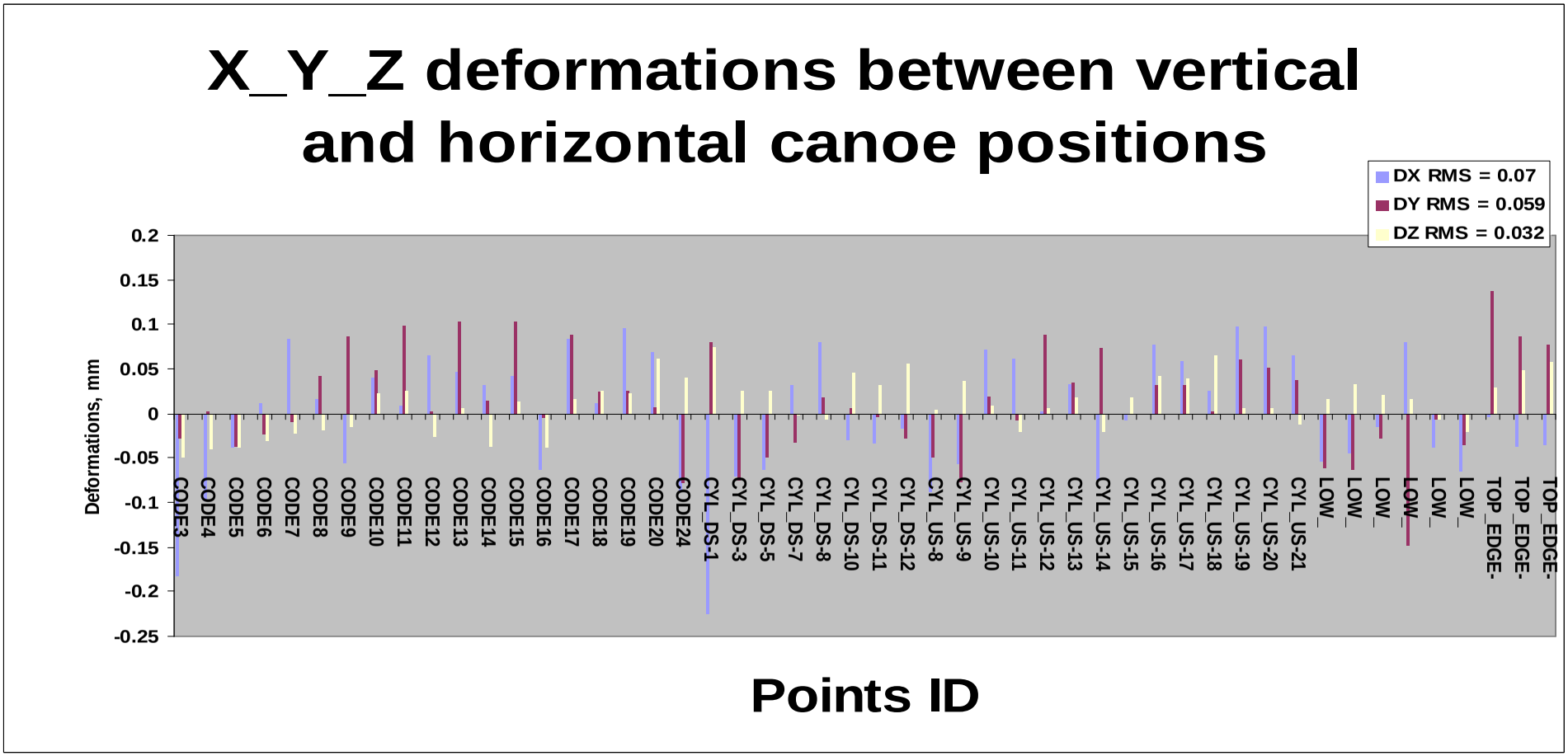
CMS 07 Pilot Run Forward Pixel Detector Survey: estimation of half cylinder deformations



MK 01/16/07

Pilot run half cylinder with photogrammetry targets after the session and placed in the test crate with half disks removed

CMS 07 Pilot Run Forward Pixel Detector Survey: estimation of half cylinder deformations



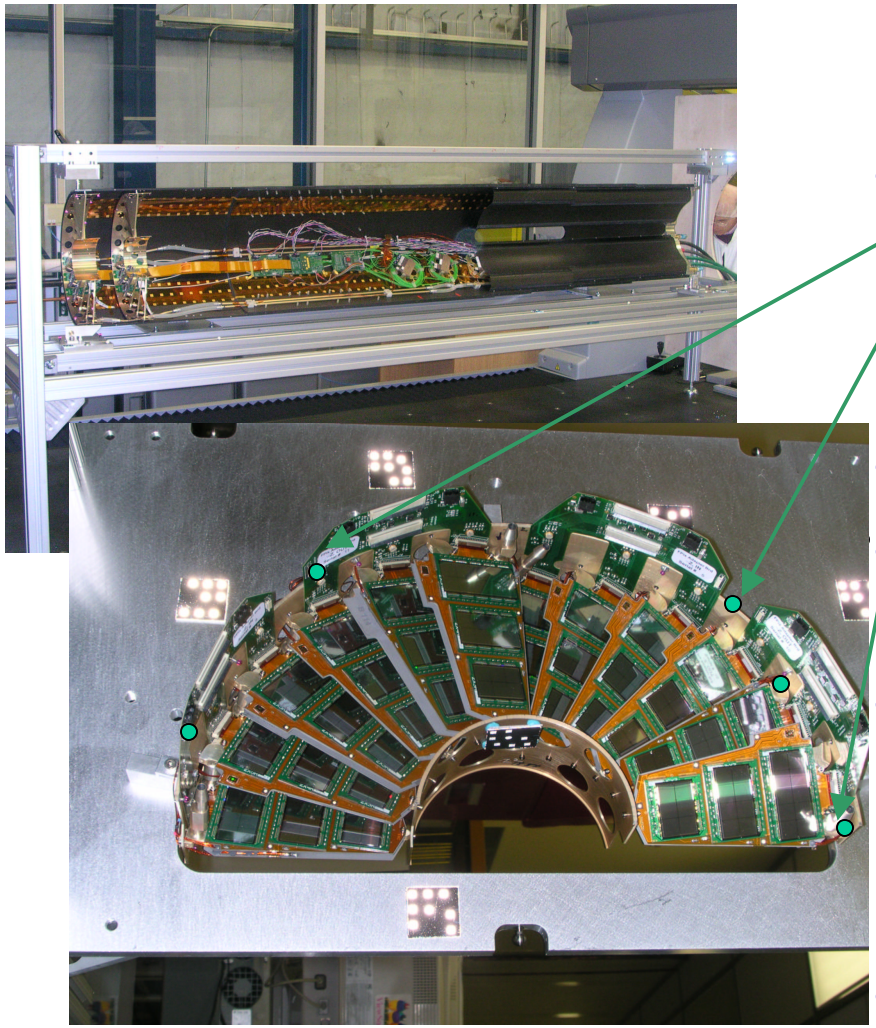
CMS 07 Pilot Run Forward Pixel Detector Survey: Further Steps

- **Finish implementation of the Fermilab photogrammetry data**
- **Plan, prepare and make photogrammetry survey at CERN (further slides)**
- **Apply developed survey procedure at Fermilab for Physics Run half disks and service half cylinder**

STEP I: Half Cylinder Survey at CERN

- **Survey half-disks relative to half-cylinder after re-installation will be done by photogrammetry.**
- **Photogrammetry issues: 1mm and 3 mm targets are used at FERMILAB, however at CERN 1 mm targets can not be surveyed: need to change the procedure.**
- **Suggestion: add 3-mm targets on the half disks and survey them together with 1-mm targets – eliminate need to see 1 mm targets at CERN.**

STEP I: Half Cylinder Survey at CERN



- Add 3 mm targets (~10/half-disk) on the inner surface of the half-disk and survey them with photogrammery
- Add end flange targets (below)
- The same time explore further CERN capabilities
- Learn how to use the transporting and installation fixture to make survey: what needed to be added (J. Howell)
- Schedule and required time (a few hours?) are to be evaluated

STEP II: Support rail survey

- **Need to find out exactly how the support rails will be surveyed: is it fully on the CERN crew?**
- **Need to understand and analyze these survey data(format, data base and so on)**
- **Connect this survey with our results and global CMS coordinate system**

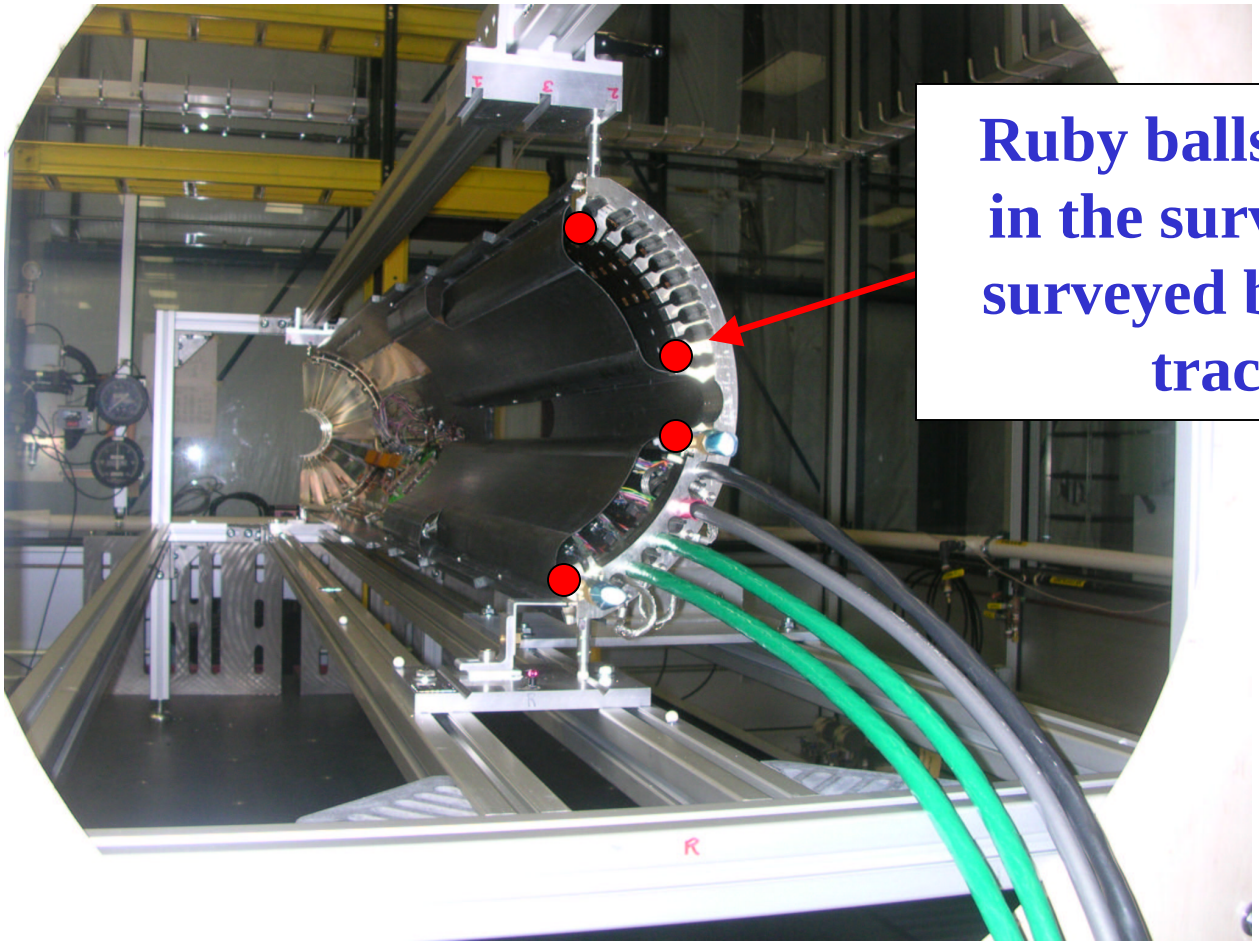
STEP III: Final Survey during Installation

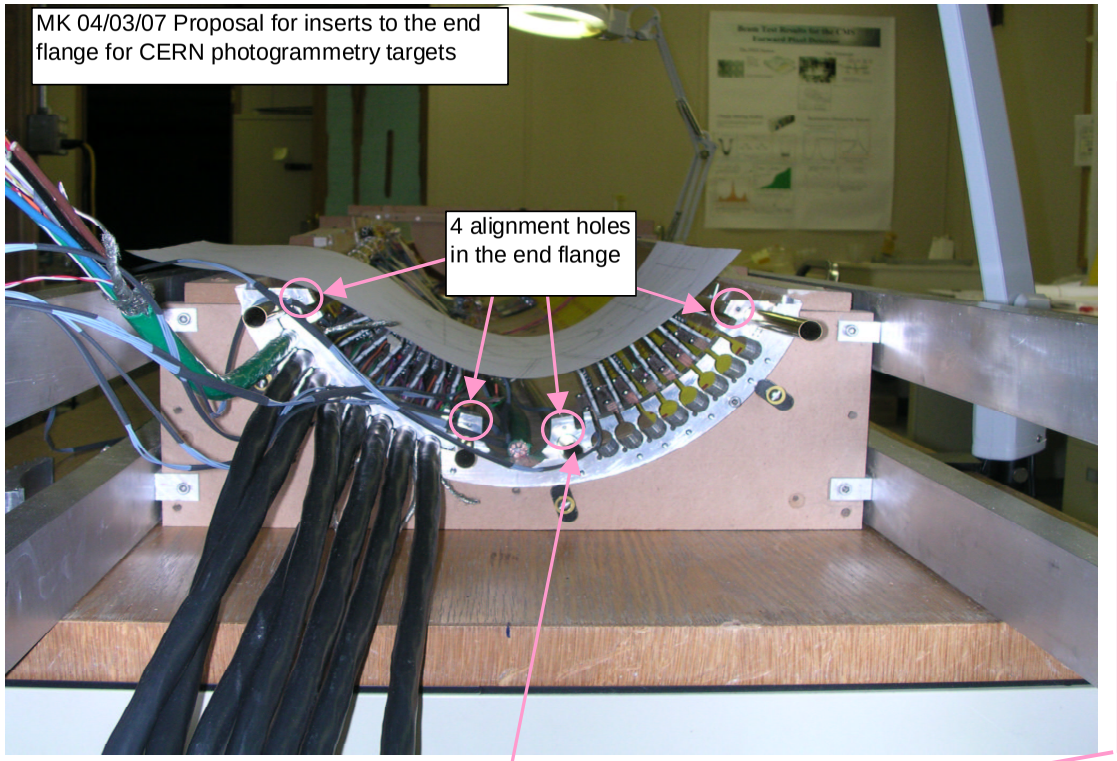
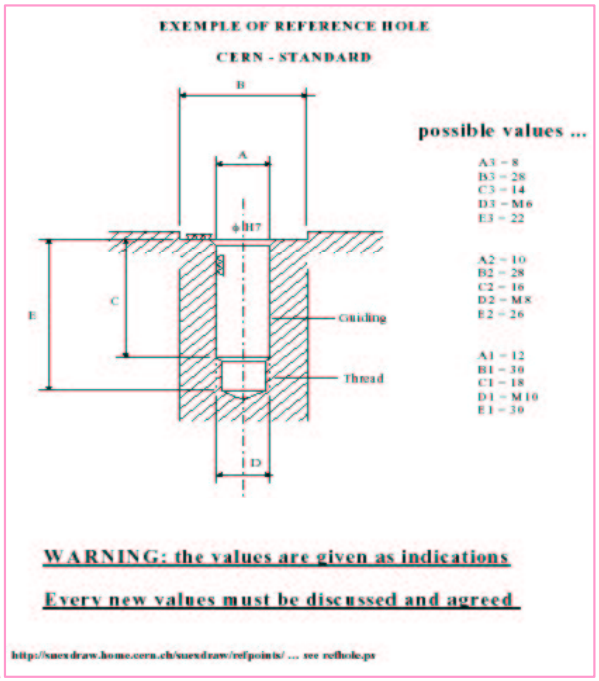
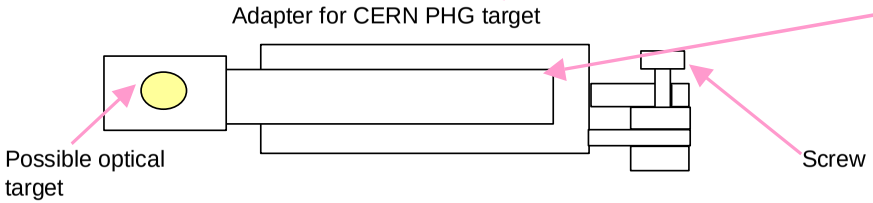
- **Use Engineering Run to establish full and consistent procedure, including schedule and time required**
- **Proposal: as the half-cylinder and rails are surveyed we only need to verify final position of the detector using what available (quick and simple! – no time to spare)**
- **Namely, we have four survey holes in the end flange (NEXT SLIDE). There are two options suggested:**

  A. insert existing 2.5 mm ruby balls and measure their positions using LASER TRACKER;

  B. make adapters to install CERN standard photogrammetry targets into these holes
- **This targets are to be surveyed together with half cylinder at CERN (at step I)**
- **Need to verify visibility and space for targets after cabling!**

STEP III: Final Survey during Installation: Option A



Ruby balls inserted in the survey holes: surveyed by a laser tracker

STEP III: Final Survey during Installation: Option B