PHOS alignment

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ALICE off-line week

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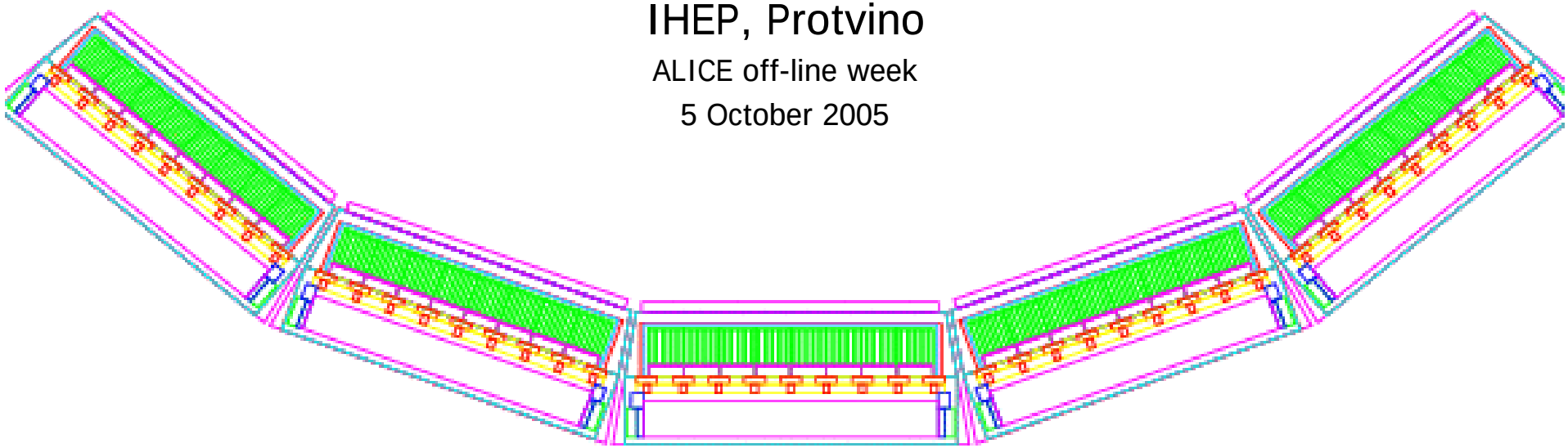
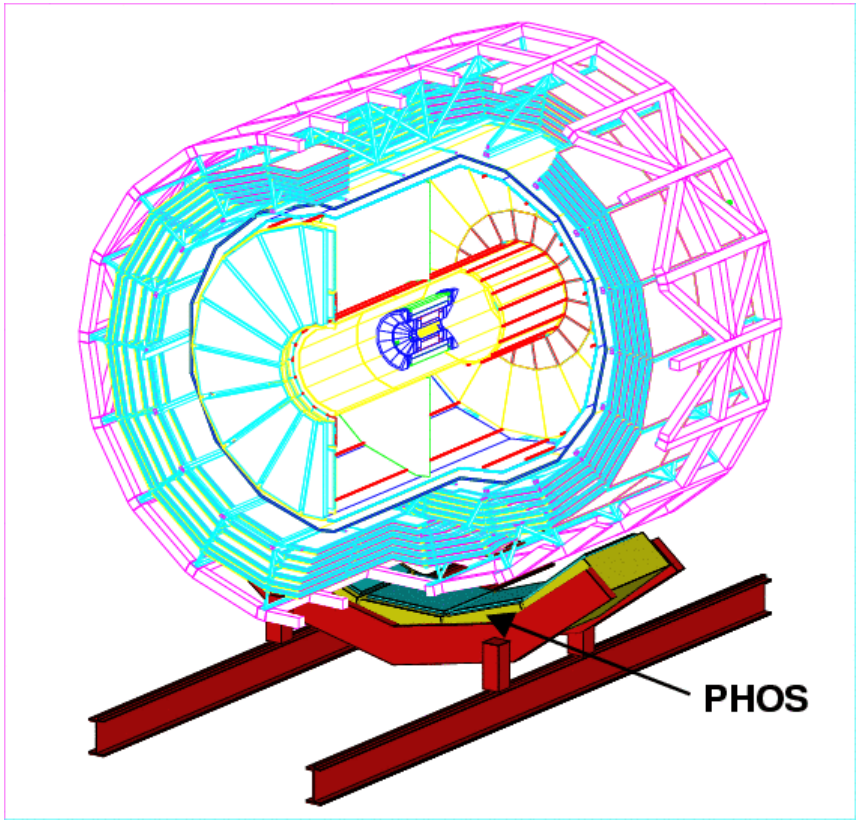


PHOS geometry

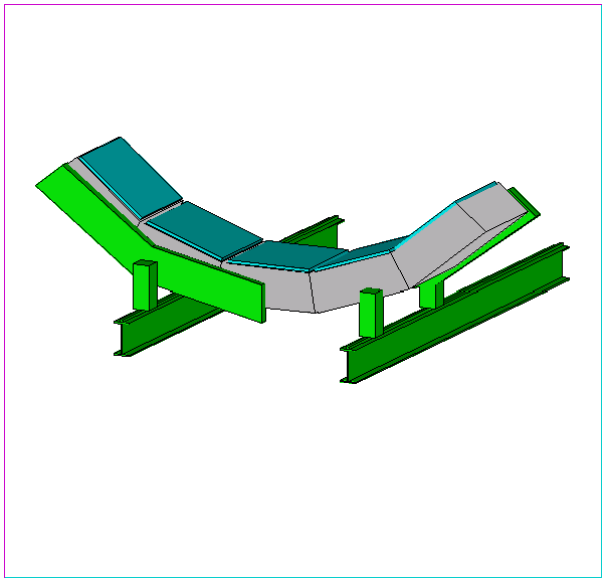


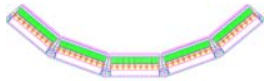
PHOS has 5 modules

Each module consists of EMC and CPV

1 EMC module contains 3584 crystals

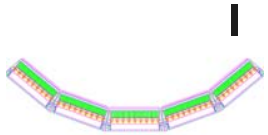
1 CPV module contains 7168 pads





Requirements for alignment

- Coordinate resolution of PHOS is 1-2 mm
- Internal structure of the modules is fixed and not a subject of survey nor alignment:
  - Crystals are assembled into modules in a hard structure with known position up to few tens of microns
  - Relative position of CPV and EMC is fixed
- Modules are attached to a cradle and may need geometry parameters to store to CDB:
  - (x,y,z) of the module reference point (center?) in MARS
  - Rotation matrix of the modules in MARS
- For particle identification the track extrapolation from TPC to PHOS is needed. Module position w.r.t. TPC is to be known to a precision not better than 1 mm.
- Required precision can be provided by the optical survey which is valid until deinstallation of the detector.

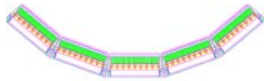


Alignment data structure

class AliPHOSAlignData

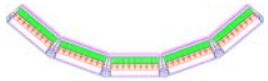
```
protected:
  Float_t fModuleCenterPosition[5][3]; // xyz position of a module centers in MARS
  Float_t fModuleAngles[5][3][2];      // Polar and azimuth angles for 3 axes of EMC
                                       // modules in MARS

public:
  Float_t GetModuleCenterPosition(Int_t module, Int_t ixyz)
  Float_t GetModuleOrientation    (Int_t module, Int_t ixyz, Int_t iangle)
  void SetModuleCenterPosition(Int_t module, Int_t ixyz, Float_t pos)
  void SetModuleAngle          (Int_t module, Int_t ixyz, Int_t iangle, Float_t angle)
```

Size of the object: 45 floats



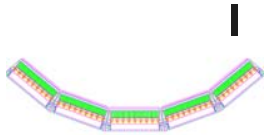
Existing geometry implementation in PHOS

- Simulation geometry is still ideal and calculated from a minimum set of parameters
- All PHOS modules are positioned in ALICE with 3 parameters:
  - Distance from IP to PHOS front cover (460 cm)
  - Angle between modules (20 degrees)
  - Number of modules (5)
- Cells of the modules (56×64) are produced by division of the modules into elements with fixed size (2.26 cm)
- All other parameters are calculated from 3 basic ones:
  - Position azimuth angle of individual modules (-40°, -20°, 0°, 20°, 40°)
  - (x,y,z) for individual module position in MARS
  - Rotation matrix (AliModule::AliMatrix()) of module orientation in MARS (φ_1, θ_1, φ_2, θ_2, φ_3, θ_3)
  - Normal to the modules point strictly to IP, i.e. φ_1=0°, φ_2=0°, θ_2=0°, φ_3,=90°
- All transformations from global to local system and vice versa are reduced to rotation around z-axis



Changes towards real geometry

- AliPHOSGetter: to add AlignData() to retrieve AliPHOSAlignData from CDB
- AliPHOSGeometry: to add a new data member AliPHOSAlignData *fAlignData
- In AliPHOSGeometry::Init() modify to retrieve fAlignData from CDB via AliPHOSGetter::AlignData()
- Calculate position coordinates (x,y,z) and orientation angles (φ_1, θ_1, φ_2, θ_2, φ_3, θ_3) of individual modules
- Modify AliPHOSGeometry::GetGlobal() to calculate rec.point position in MARS with real rotation matrices
- Modify AliPHOSGeometry::Global2Local() to transform the point position in MARS into local system of module



Conclusion

- PHOS alignment is rather simple and reduced to 45 parameters.
- Optical survey is enough to provide the necessary precision
- Container class with alignment data is ready
- Alignment data will be retrieved from CDB similar to calibration data (see Boris' talk yesterday)
- Changes in PHOS geometry are localized to about 5 functions and should be done ASAP