

Content

1. In General .....	2
1.1. Preamble .....	2
2. Model for References for Components .....	2
2.1. Type of Model .....	2
2.2. Naming in General .....	3
2.3. Naming within the Skeleton Models .....	3
2.4. Coordinate System .....	4
3. Required References .....	5
3.1. Deflective Components .....	5
3.2. Electrostatic Septa .....	7
3.3. Focusing and Corrective Components .....	8
3.4. Cavities .....	9
3.5. Diagnostics and Pump Chambers .....	10
3.6. Beam Pipe .....	11
3.7. Branching Vacuum Chambers .....	12
3.8. Components for Beam Diagnostics .....	13
3.9. Superconducting Components .....	14
3.10. Superconductive Multiplets Triple Configuration of Quads for the SFRS .....	15
3.11. Superconductive Multiplets in a Duplex Configuration .....	15
3.12. Hybrid Dipole with a Superconductive Coil .....	15

List of Figures

Figure 1: Names of the „Geometrical Sets“ .....	3
Figure 2: Orientation of the coordinate system .....	4
Figure 3: Reference elements for deflecting components .....	5
Figure 4: References for kicker, bumper or steerer .....	6
Figure 5: References for E-Septa .....	7
Figure 6: Reference elements for focusing and corrective components .....	8
Figure 7: Reference elements for concerning cavities .....	9
Figure 8: Reference elements for diagnostics, vacuum, pump chamber .....	10
Figure 9: Reference elements for beam pipe .....	11
Figure 10: References for branching vacuum chambers .....	12
Figure 11: Reference elements for beam diagnostics components .....	13
Figure 12: Additional references for superconducting components .....	14
Figure 13: References for superconductive magnets in a triple configuration .....	15

List of Abbreviation

Abbreviation	English	German
DMU	Digital Mock Up	Digital Mock Up
MFUS	Magnet Field Up Stream	Magnetfeld Eingang
MFDS	Magnet Field Down Stream	Magnetfeld Ausgang

Abbreviation	English	German
MFC	Magnet Field Center	Magnetfeld Mitte
TIP	Tangent Intersection Point	Tangentenschnittpunkt
COUS	Component beam UpStream	Strahleingang
CODS	Component beam DownStream	Strahlausgang
COC	Component Center	Komponentenmitte
COP	Component functional Point	Funktionale Position der Komponenten
(Referenz) <sub>RT</sub>	index for room temperature	Index für Raumtemperatur

## 1. In General

### 1.1. Preamble

This document describes the modalities for the creation of a necessary „skeleton model“ for DMU-capable components.

In this skeleton model, references for components are created by means of lines, points and radii. The purpose is the simple positioning of components on the beamline. Furthermore is e.g. the positioning of magnet chambers in the magnet easier.

## 2. Model for References for Components

### 2.1. Type of Model

For this skeleton model you have to generate an own model (part) within an assembly (product). The skeleton model stands in the first place of the product and is fixed. It will be represented hidden and does not appear in the parts list. Only wireframe geometries and axes of coordinates are allowed in the skeleton model. These wireframe geometries are archived in “geometrical sets”. Solid bodies respectively surfaces are not tolerable.

The lines of the skeleton must have following properties:

**Color: red**  
**Line type: dotted line**  
**line thickness: 0,25mm**

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx
Date:	2016-08-02	Version:	1.5
			Page 2 of 15

## 2.2. Naming in General

When naming the skeleton models, a „Skeleton\_“ is put in front of the name of the general model.

E.g. VC-1014977-A-000 (-) Strahlrohr (assembly Strahlrohr (English: beam pipe))  
 VC-1014977-S-000 (-) Skeleton\_Strahlrohr (skeleton model within the assembly beam pipe)

## 2.3. Naming within the Skeleton Models

The „geometrical sets“ get unique names. In order to differentiate, whether the skeleton model is a skeleton to support the design or it is a skeleton model, in which component reference points are shown. If both kinds of skeleton models are necessary, you may use two or more “geometrical sets”.

The names for the single „geometrical sets“ are **S-Design** respectively **S-Reference** (see Figure 1).

The differentiation is necessary, because the design skeleton is the basis for the design execution. The component reference represents to the functional layout.

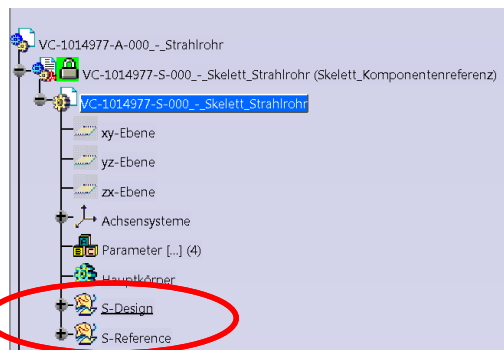


Figure 1: Names of the „Geometrical Sets“

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx	
Date:	2016-08-02	Version:	1.5	Page 3 of 15

## 2.4. Coordinate System

All components must be aligned to a right handed coordinate system (x, y, z) as follows (see Figure 2):

- the x axis corresponds always to the beam direction and
- the z axis points the vertical extension.

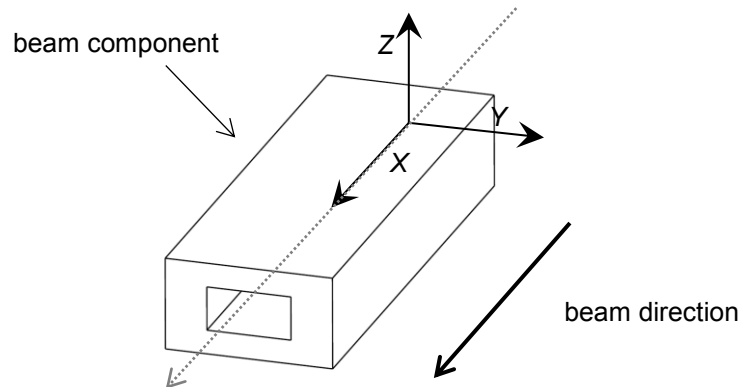


Figure 2: Orientation of the coordinate system

### 3. Required References

#### 3.1. Deflective Components

Depending on the deflection angle the components need different references.

##### 3.1.1. With Large Deflection Angle

Components with a large deflection angle as dipole and magnetic Septa are positioned on the deflected beam. No references are needed for the undisturbed beam in Septa (s. Figure 3):

- Magnetic field upstream (**MFUS**), represented as a point
- Magnetic field downstream (**MFDS**), represented as a point
- Tangents to the deflection radius on the **MFUS** and **MFDS** points represented as lines and the tangents intersection (**TIP**), represented as a point.
- Deflection radius, represented as an arch

References for the vacuum chamber in magnets are given in Chapter 3.7.

Hybrid dipoles with superconductive coils for the SFRS are delivered in an assembly together with the dipole. No extra references are needed.

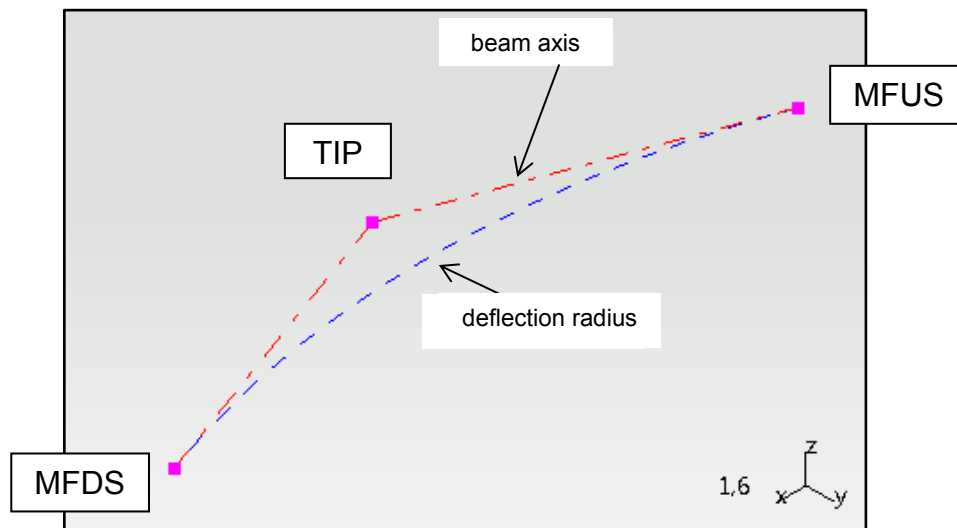


Figure 3: Reference elements for deflecting components

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx	
Date:	2016-08-02	Version:	1.5	Page 5 of 15

### 3.1.2. With Small Deflecting Angle

Components with a small deflecting angle as e.g. Kicker, Bumper or Steerer need the following references (s.Figure 4):

- Magnetic field upstream (**MFUS**), represented as a point
- Magnetic field downstream (**MFDS**), represented as a point
- Center of the magnetic field (**MFC**), represented as a point
- Magnetic axis (connection **MFUS**– **MFDS**), represented as a line

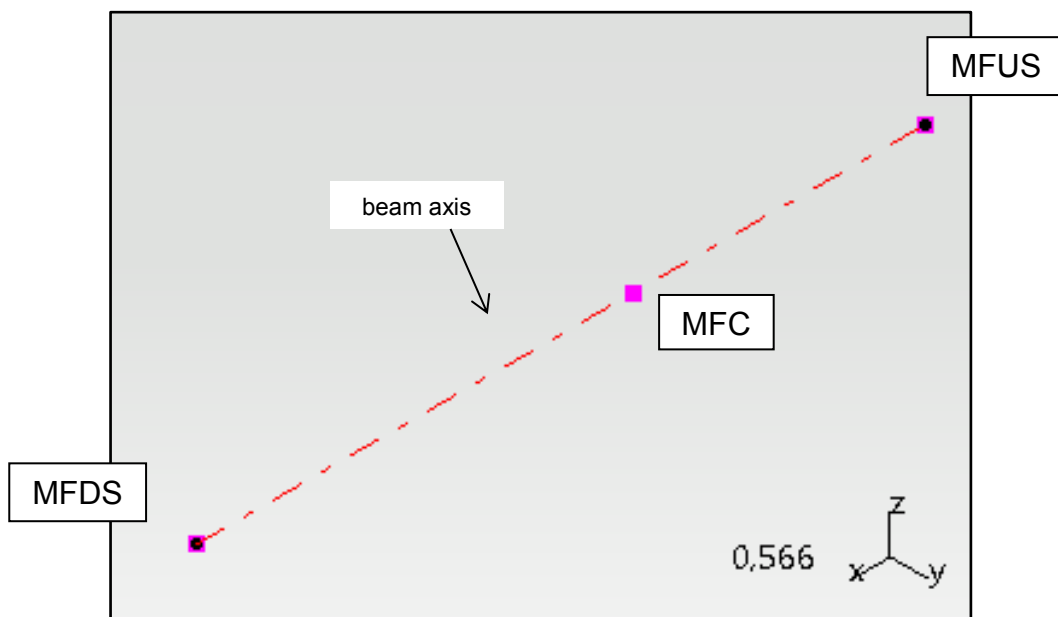


Figure 4: References for kicker, bumper or steerer

### 3.2. Electrostatic Septa

These components are positioned on the straight beam axis. The following references are needed (s. Figure 5):

- Beam upstream (**COUS**) (flange contact surface), represented as a point
- Beam axis represented as a line
- Beam downstream (**CODS**) (flange contact surface), represented as a point
- Center all of the anode and cathode on the beam axis (**COP**) represented as a point
- Direction of nozzle, represented as a line
- Intersection nozzle (flange contact surface) / beam axis, represented as a point
- Length of nozzle (flange contact surface), represented as a point

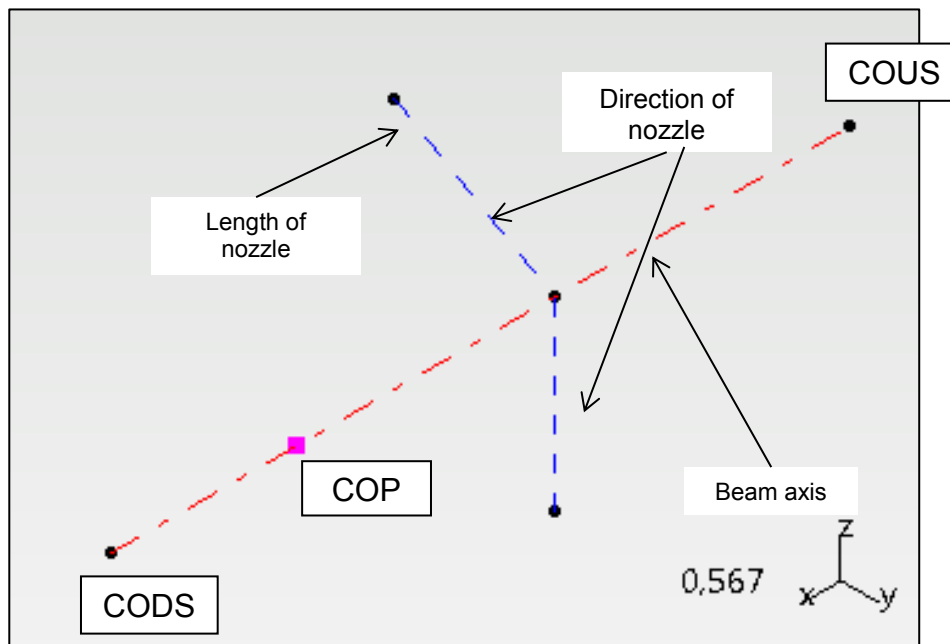



Figure 5: References for E-Septa

	<p style="text-align: center;">Technical Guideline</p>	<p>Number</p>	<p style="text-align: center;">3.75e</p>
<p>ENMI/ENMD</p>	<p style="text-align: center;"><b>Component Reference</b></p>	<p>Status</p>	<p style="text-align: center;">2016-08-02</p>

### 3.3. Focusing and Corrective Components

The following references are needed for quadrupoles and multipoles (see Figure 6):

- Magnetic field upstream (**MFUS**), represented as a point
- Magnetic field downstream (**MFDS**), represented as a point
- Center of the magnetic field (**MFC**), represented as a point
- Beam axis (connection **MFUS**– **MFDS**), represented as a line

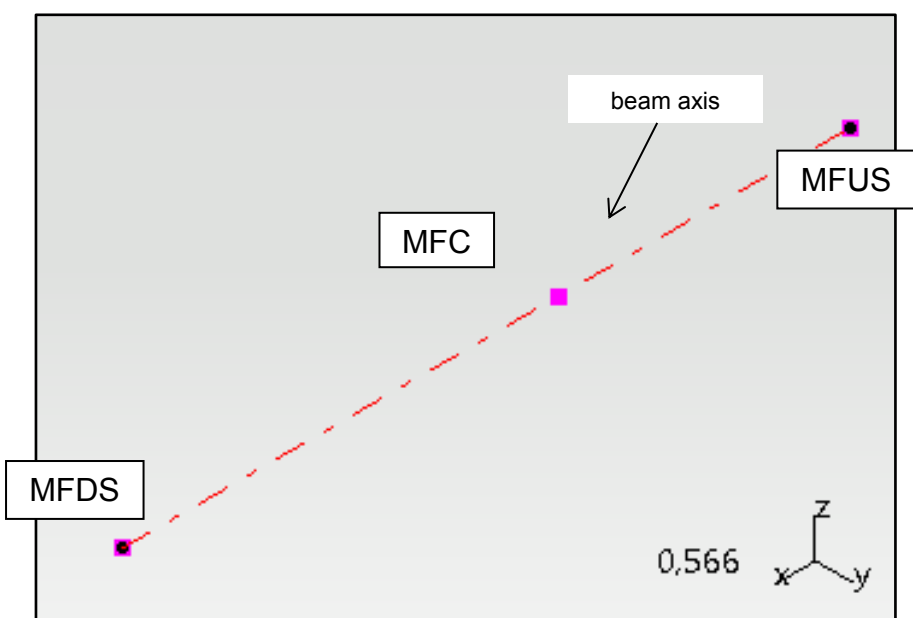


Figure 6: Reference elements for focusing and corrective components

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx	
Date:	2016-08-02	Version:	1.5	Page 8 of 15

### 3.4. Cavities

The following references are needed concerning cavities (e.g. Buncher, IH, RFQ) (s. Figure 7):

- Beam upstream (**COUS**) (flange contact surface), represented as a point
- Beam downstream (**CODS**) (flange contact surface), represented as a point
- Beam axis (connection **COUS** – **CODS**), represented as a line
- Components center on the beam axis (**COC**), represented as a point
- Functional position of the component on the beam axis (**COP**).

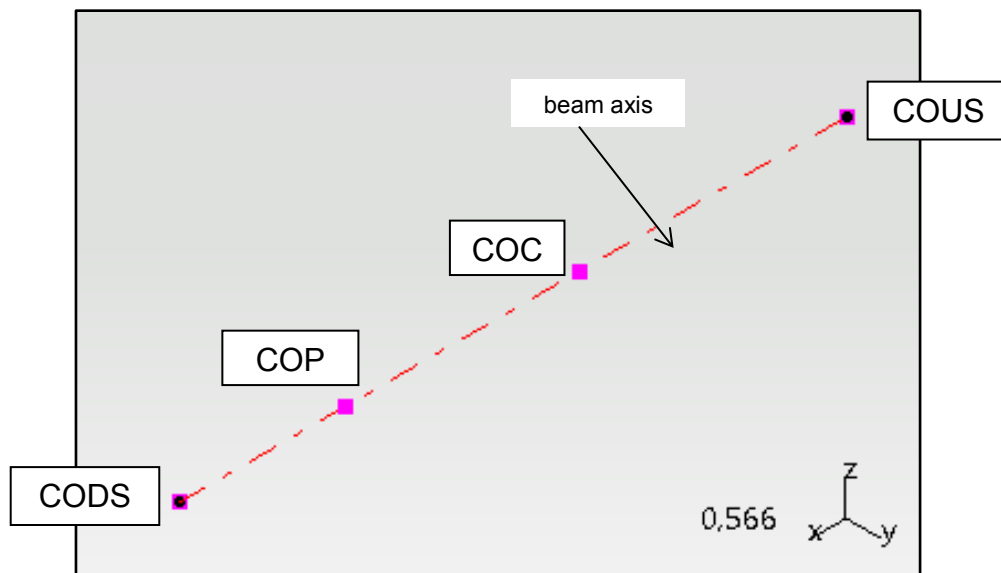


Figure 7: Reference elements for concerning cavities

### 3.5. Diagnostics and Pump Chambers

The following references are necessary for diagnostics and pump chambers (s.Figure 8 ):

- Beam upstream (**COUS**) (flange contact surface), represented as a point
- Beam downstream (**CODS**) (flange contact surface), represented as a point
- Intersection nozzle (flange contact surface) / beam axis, represented as a point
- Length of nozzle (flange contact surface), represented as a point
- Direction of nozzle, represented as a line
- Beam axis (connection **COUS –CODS**), represented as a line
- Component's center on the beam axis (**COC**), represented as a point

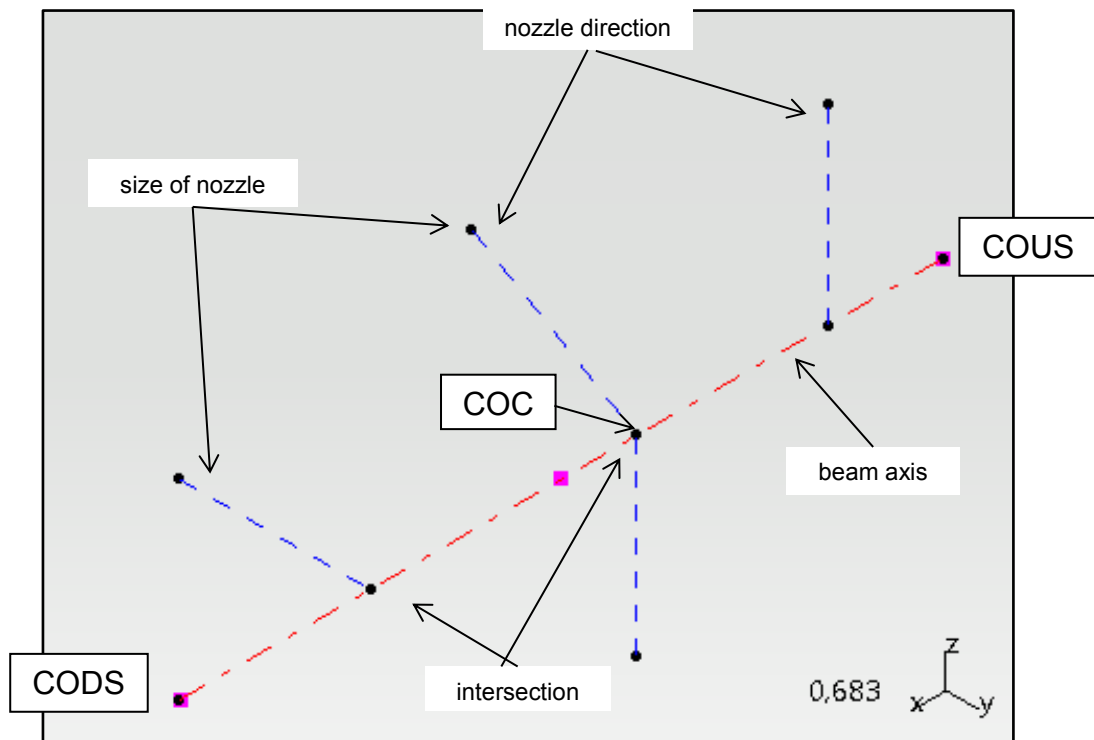


Figure 8: Reference elements for diagnostics, vacuum, pump chamber

### 3.6. Beam Pipe

The following references are needed concerning a beam pipe (s. Figure 9):

- Beam upstream (**COUS**) (flange contact surface, represented as a point)
- Beam downstream (**CODS**) (flange contact surface), represented as a point
- Beam axis (connection beam **COUS** – **CODS**), represented as a line
- Component's center on the beam axis (**COC**), represented as a point

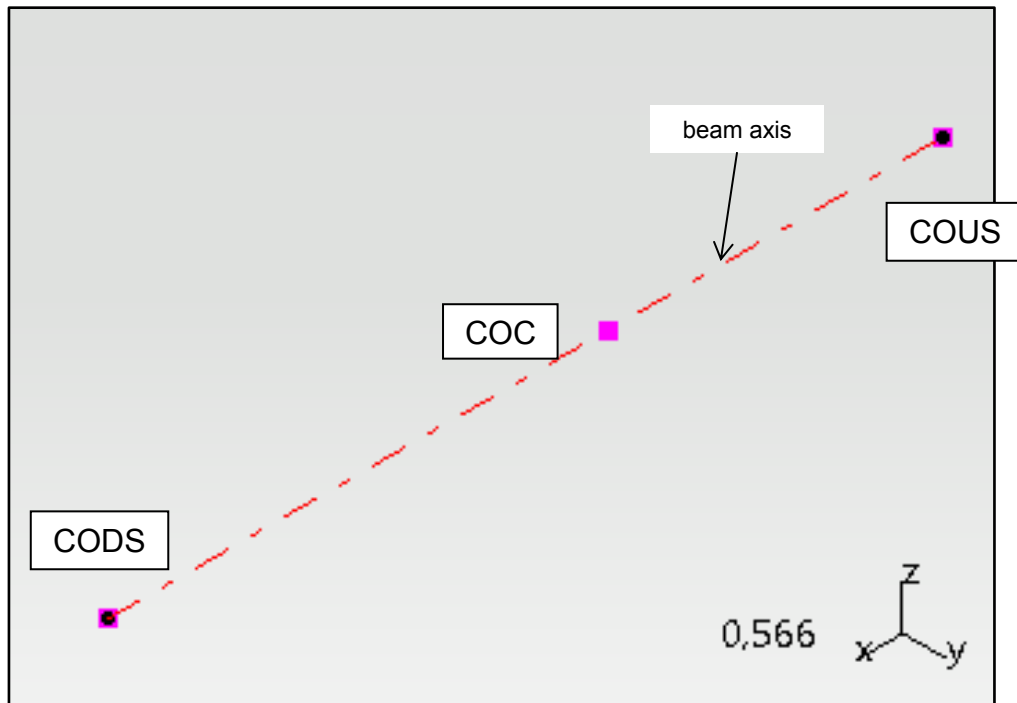



Figure 9: Reference elements for beam pipe

	<p style="text-align: center;">Technical Guideline</p>	<p>Number</p>	<p style="text-align: center;">3.75e</p>
<p>ENMI/ENMD</p>	<p style="text-align: center;"><b>Component Reference</b></p>	<p>Status</p>	<p style="text-align: center;">2016-08-02</p>

### 3.7. Branching Vacuum Chambers

Vacuum chambers in deflecting components must be delivered together with the magnet in an assembly. Following references are needed for positioning a branching chamber in the magnet (s. Figure 10):

- Beam axis of the deflected and the straight beam
- the tangents intersection (**TIP**), represented as a point
- Beam upstream (**COUS**) and downstream **CODS** (flange contact surface, represented as points).

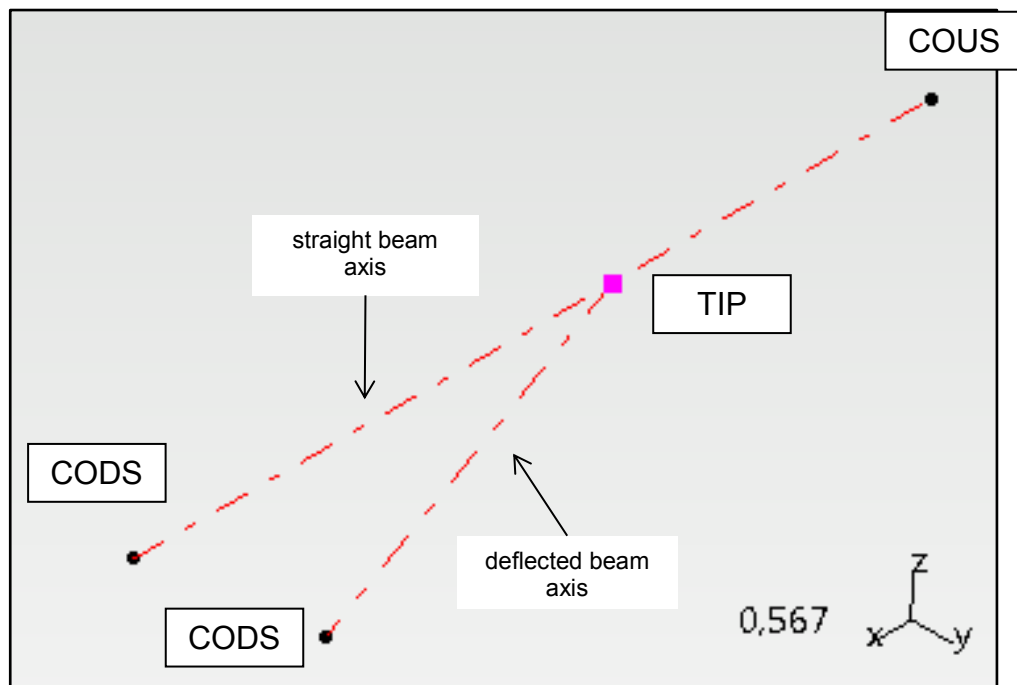


Figure 10: References for branching vacuum chambers

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx	
Date:	2016-08-02	Version:	1.5	Page 12 of 15

### 3.8. Components for Beam Diagnostics

The following references are needed concerning components for beam diagnostics (e.g. beam transformer, position probe) (s.Figure 11):

- Functional position of the component on the beam axis (**COP**), represented as a point
- Beam axis, represented as a line
- Beam upstream (**COUS**) and downstream(**CODS**) (flange contact surface)
- Length of nozzle (flange contact surface), represented as a point
- Direction of nozzle, represented as a line
- Intersection nozzle (flange contact surface) / beam axis, represented as a point

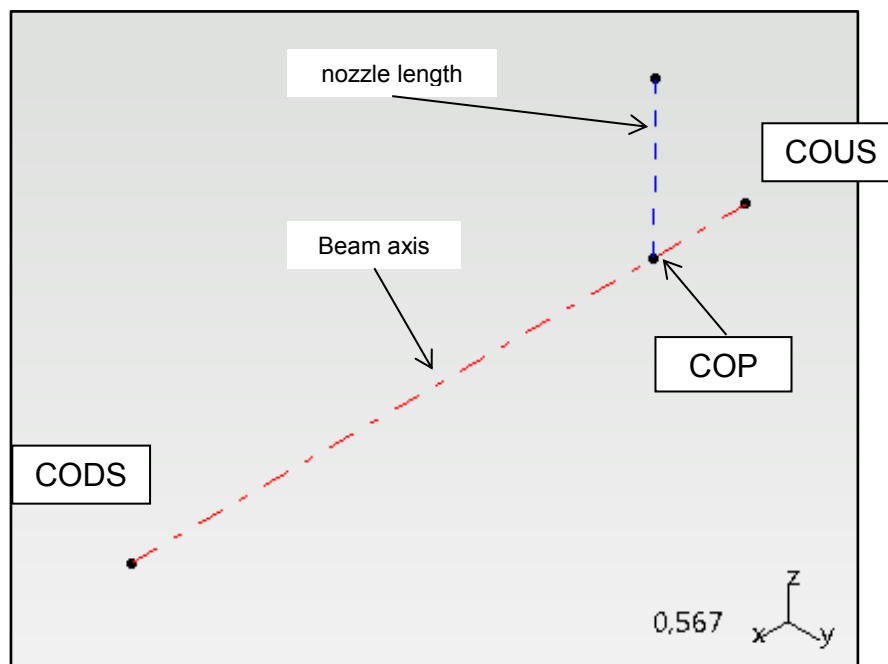


Figure 11: Reference elements for beam diagnostics components

### 3.9. Superconducting Components

Superconducting components with cryonic working temperature are subject to thermal contraction.

For these components that consist of several under components with a particular physical function the following references are needed (additionally to the already specified references) (s. Figure 12):

- Magnetic field center (**MFC<sub>x</sub>**) for every magnet in the component
- Geometrical Magnetic field center (**MFC**) for the entire component group
- Magnetic field center assembly conditions (room temperature) (**MFC<sub>RT</sub>**) (This displacement takes place only when the components are fixed to a common stand in the cryostat)

Example:

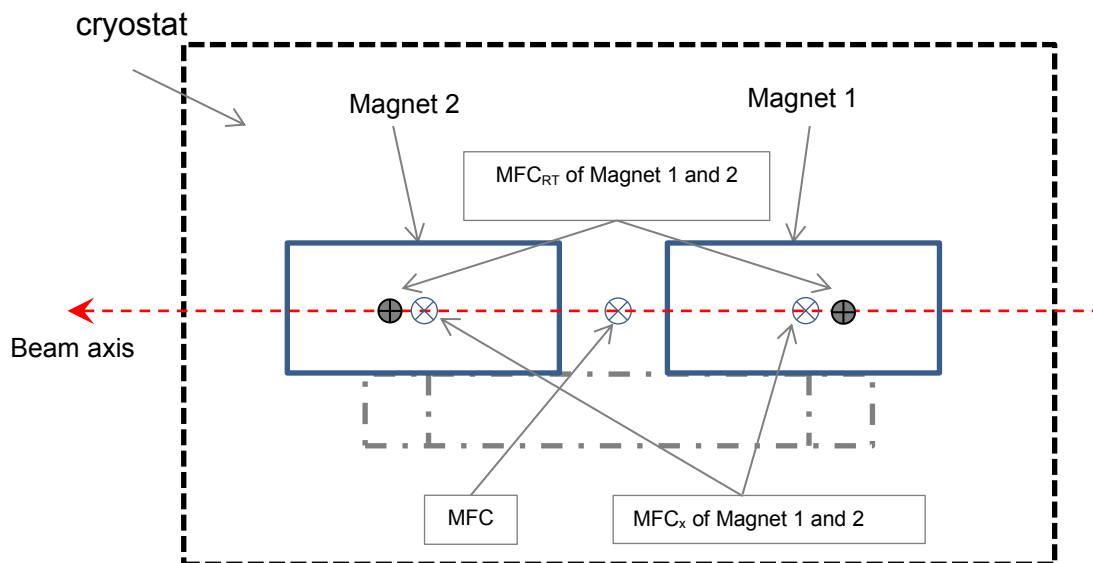



Figure 12: Additional references for superconducting components

	<p style="text-align: center;">Technical Guideline</p>	<p>Number</p>	<p style="text-align: center;">3.75e</p>
<p>ENMI/ENMD</p>	<p style="text-align: center;"><b>Component Reference</b></p>	<p>Status</p>	<p style="text-align: center;">2016-08-02</p>

### 3.10. Superconductive Multipletts Triple Configuration of Quads for the SFRS

In this configuration remains the center of the quadrupole in the middle unchanged. For the positioning following references are needed:

- Magnet fields center (MFC) of the quadrupole in the middle, represented as a point
- beam axis, represented as a line

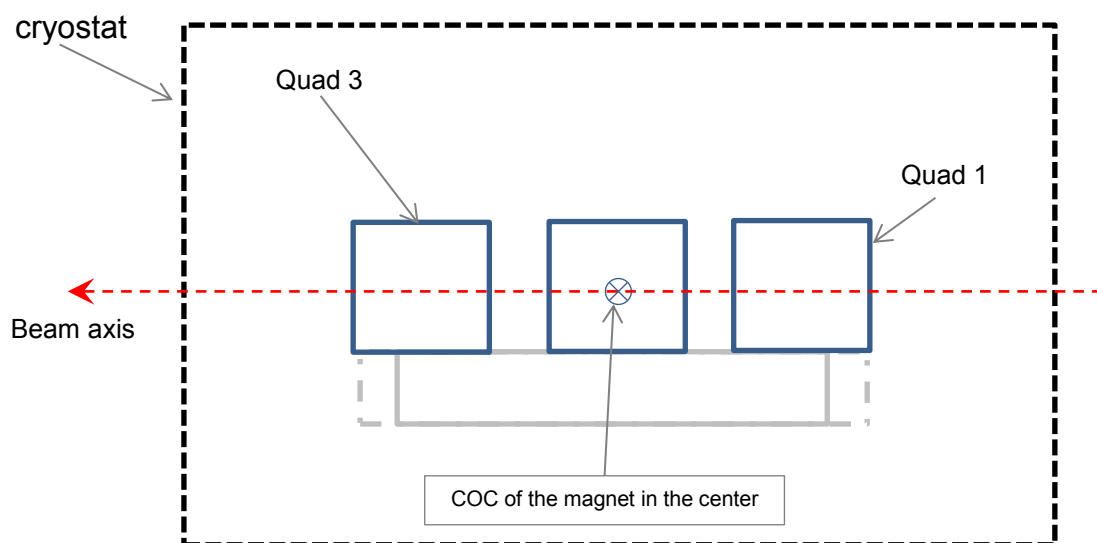


Figure 13: References for superconductive magnets in a triple configuration

### 3.11. Superconductive Multipletts in a Duplex Configuration

References for these components must be clarified with the DMU Department.

### 3.12. Hybrid Dipole with a Superconductive Coil

The model of the coil has to be delivered in an assembly with the dipole magnet. No additional references are needed.

References for components not listed in this document must be clarified with the machine responsible and the DMU Department.

Prepared by:	Will, Zurkan	Doc. Name:	F-TG-ZT-3.75e_Component_Reference_v1_5.docx	
Date:	2016-08-02	Version:	1.5	Page 15 of 15