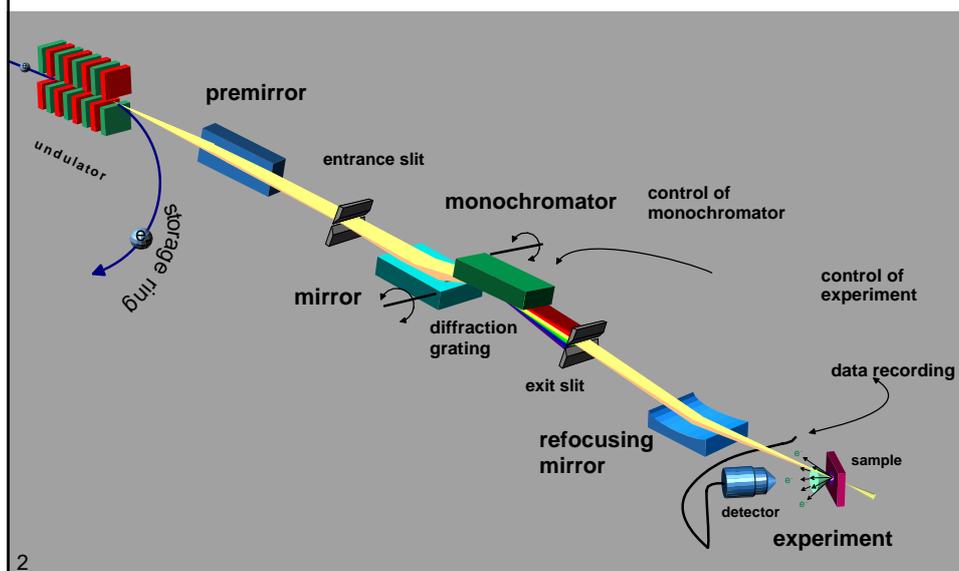


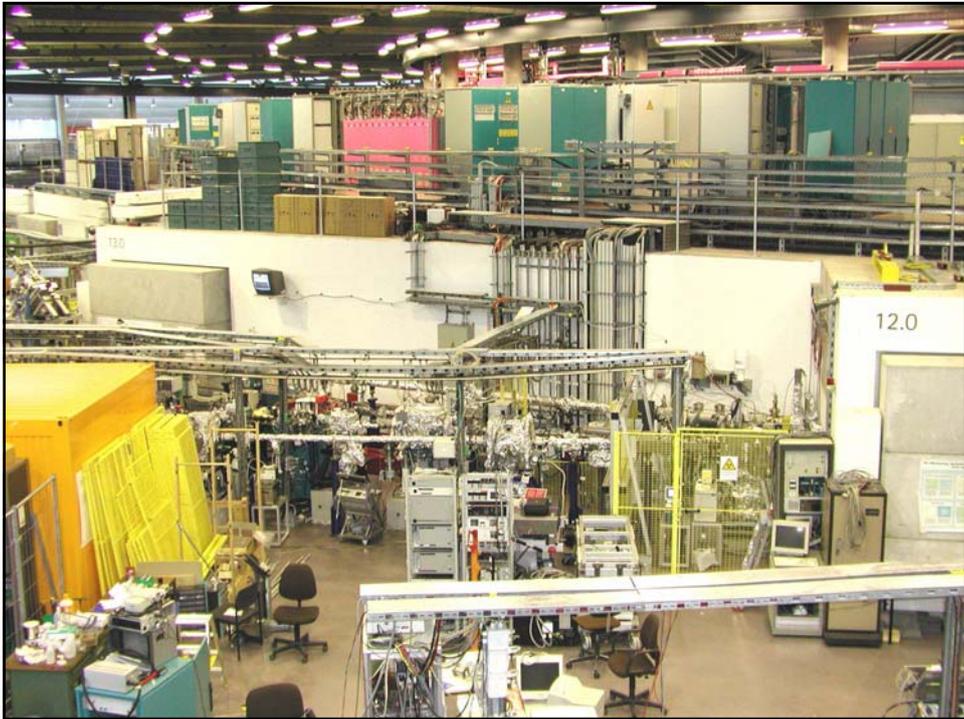
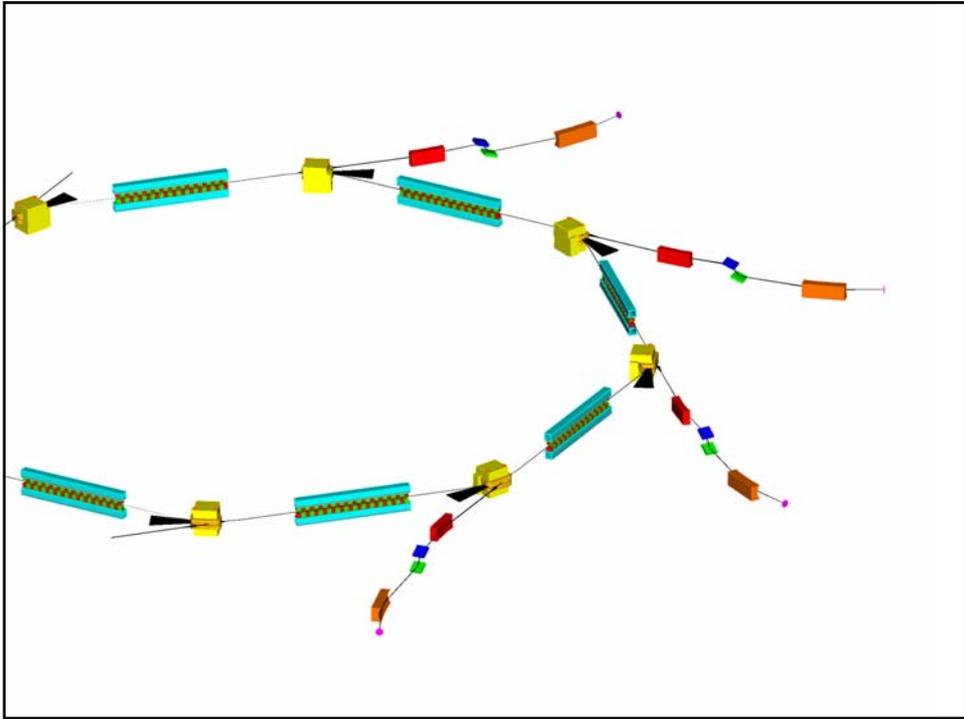
The new Synchrotron Optomechanics at BESSY

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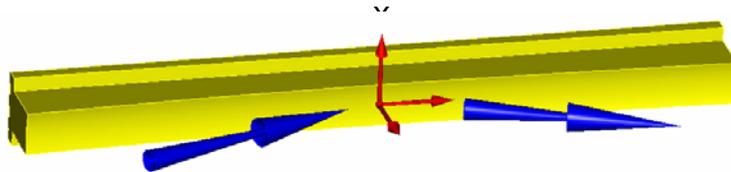
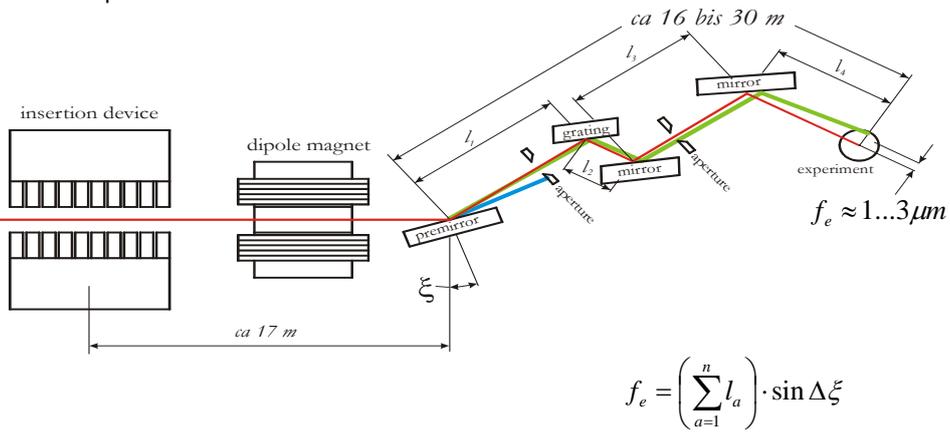


A Typical Beamline Layout





- Degree of freedom?
- Stroke?
- Step resolution?
- Acceptable error motions?
- Acceptable modes of vibrations?

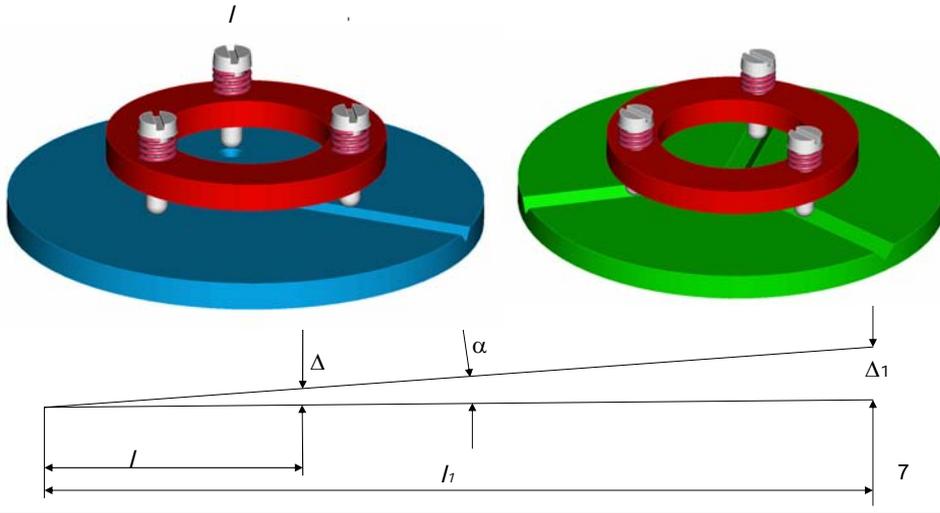


Requirements of Accuracy of Movement of a Mirror (SMU)

moving direction	stroke	reproducibility	resolution
rotation X	2,4 mrad	10 nrad	10 nrad
translation X	2 mm	1 μm	0.06 μm
rotation Y	4.3 mrad	50 μrad	0,3 μrad
translation Y	50 mm	5 μm	1.5 μm
rotation Z	9 mrad	25 μrad	0,3 μrad
translation Z	-	-	-

Kinematic Couplings

Reproducibility: linear $1\mu\text{m}$, angular ?



Baugruppen Komp

Aus dem großen Angebot von Newport's Standard-Komponenten lassen sich zahlreiche Baugruppen erstellen. Auf Anfrage können diese Komponenten von Newport montiert und mit folgenden Genauigkeiten geliefert werden.

Die Linientische der Serie M-BMS-M-ILS lassen sich zu XYZ-Baugruppen mit hoher Stabilität montieren und ermöglichen es damit, große Lasten in drei Achsen zu positionieren.

Die Baugruppe aus Coaxialen der Serie M-BGM lässt sich mit einer "Sphäre of Confusion" von 200 μm ausgerichtet werden.

Rotationschse der Serie M-URM können bis auf $\pm 20 \mu\text{m}$ Achsenmitt der Rotationsachse ausgerichtet werden.

Rotationschse der Serie M-IRM können vertikal an Vertikaltischen der Serie M-ILS montiert werden und bieten hohe Genauigkeit zu geringem Preis.

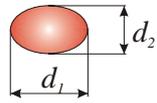
X-Z-Baugruppe aus M-UTM-Tischen können mit einer Ortsgenauigkeit von $\pm 100 \mu\text{m}$ ausgerichtet werden und bieten Verstärker bis 150 mm .

Eine XY-Baugruppe mit Linientische der M-UTM-Serie ist eine kostengünstige Lösung, wenn geringe Lasten exakt positioniert werden sollen. Diese Positionierchse mit einer Ortsgenauigkeit von $\pm 50 \mu\text{m}$ ausgerichtet werden.

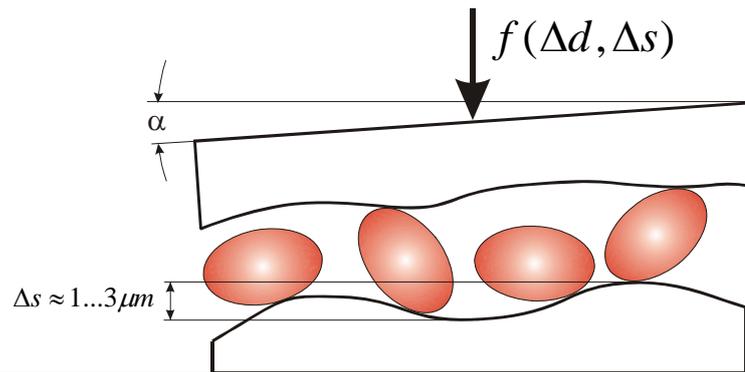
Die Linientische der VP-Serie können auch an einem kompakteren rechteckigen Positionierchse montieren.

Die Linientische der PM500-Serie können mit einer Ortsgenauigkeit von $\pm 100 \mu\text{m}$ ausgerichtet werden.

Random Error Motions



$$\Delta d = d_1 - d_2 \approx 1\mu m$$



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 s

Accuracy of Commercial Linear Roller Bearings

All SCHNEEBERGER frictionless tables are manufactured as standard with the accuracies indicated in the tables. Measurement is in the unloaded state on a flat surface. The tolerance figures in the tables are for single axis.

Straightness of Travel in μm over Stroke Length; Laterally

Flatness of Travel in μm over Stroke Length; at Top

Parallelism in μm of Table Surfaces; in Middle Position

Type	L	L			
NK	25-50	25-50	2	2	5
	55-100	55-100	3	2	10
	105-160	105-160	3	3	15
	165-310	165-310	4	3	20
	315-510	315-510	4	4	25

Accuracy

Straightness and Flatness
The tolerance for Straightness and Flatness of travel is dependent on the various frictionless table models, the size, the length etc. This tolerance is shown above in chapter 7.1. Closer tolerances can be supplied on request.

Parallelism
The tolerances shown in the tables are achieved by measuring the frictionless tables in the middle position. For this purpose the frictionless tables are placed unloaded on a flat surface.

Height Tolerance
The height tolerance is $\pm 0,1$ mm. On request, most types can be supplied in matched pairs to $\pm 0,01$ mm.

SCHNEEBERGER
LINEAR TECHNOLOGY

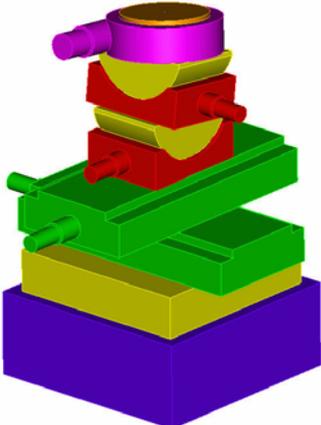
Technical information

Bohrung d	Maximaler Radialschlag (K_{ia})		Toleranzklasse					Kegelrollenlager			
	über	bis	Radiallager (außer Kegelrollenlagern)					P5	CLB		
			P5	SP	P4A	PA9A	PA9B	UP			
mm			μm								
-	18		4	3	1,3	1,3	1,3	1,5	5	-	
18	30		4	3	2,5	2,5	1,5	1,5	5	2,5	
30	50		5	4	2,5	2,5	2	2	6	3,5	
50	80		5	4	2,5	2,5	2	2	7	3,5	
80	120		6	5	2,5	2,5	-	3	8	3,5	
120	150		8	6	4	5	-	3	11	4	
150	180		8	6	6	5	-	3	11	4	
180	250		10	8	7	5	-	4	13	5	
250	315		13	10	-	-	-	5	-	-	
315	400		17	12	-	-	-	6	-	-	
400	500		19	12	-	-	-	7	-	-	
500	630		22	15	-	-	-	8	-	-	

Stacks of Singel Axis Stages

advantages

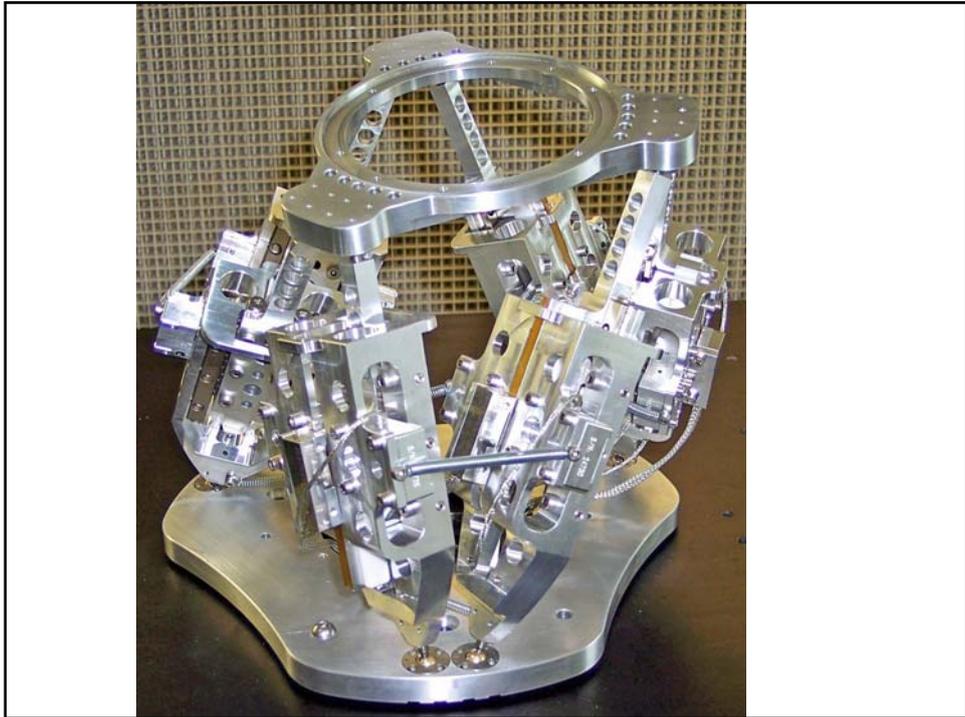
- modular
- large stroke



disadvantages

- sequential combination
- friction
- limit of accuracy 1 μ m
- random error motions





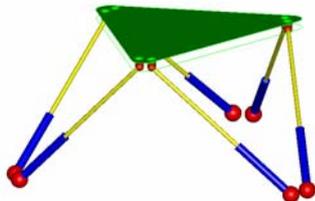
Hexapod

advantages

- DOF 6
- high stiffness
- low mass

disadvantages

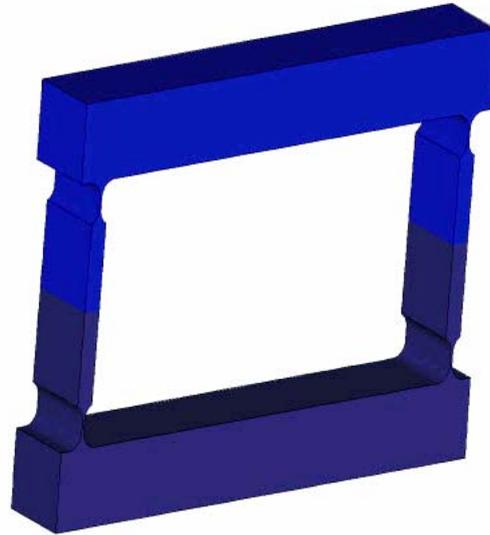
- six motor drives are always necessary
- no intuitively manually movable
- lost of accuracy of the single axes



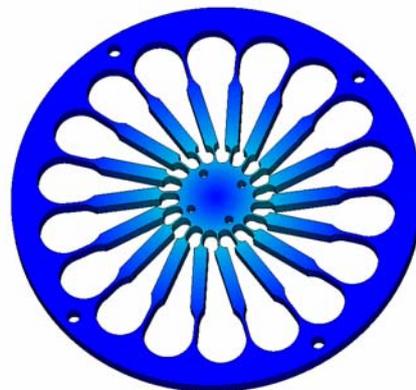
potential of improvements

- Cartesian strut topology
- play free joints
- drives

Parallelogram

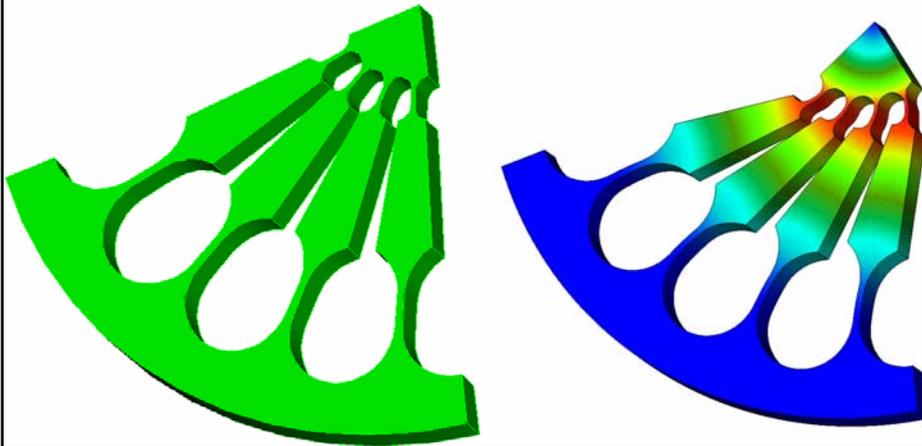


Rotational Pattern of Double Joined Struts

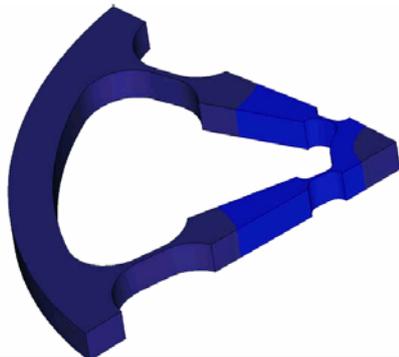


18

Segments of a Rotational Strut Pattern



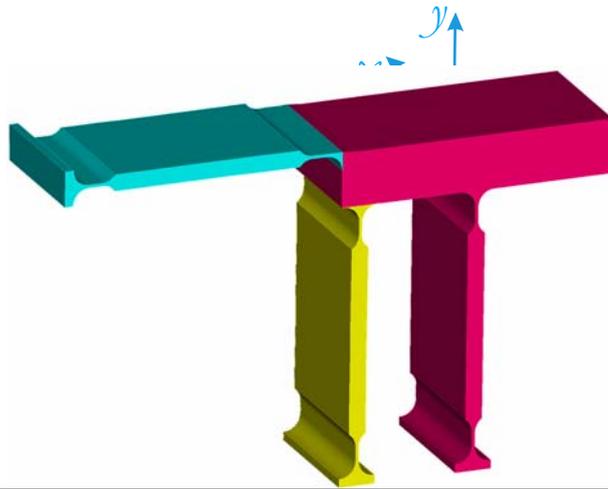
Parallelogram Stage



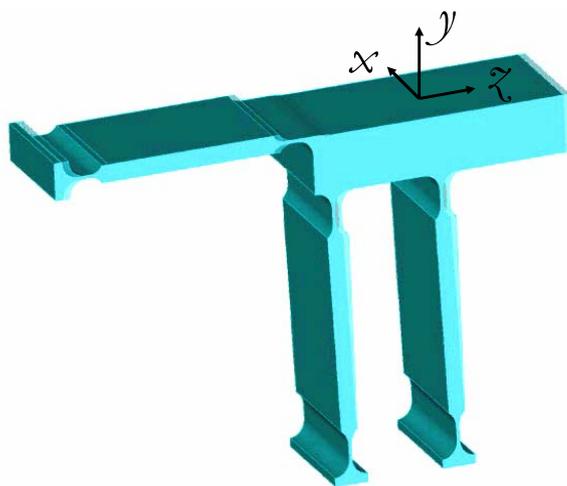
Trapezoid Stage

Combination of a Parallelogram with a Trapezoid

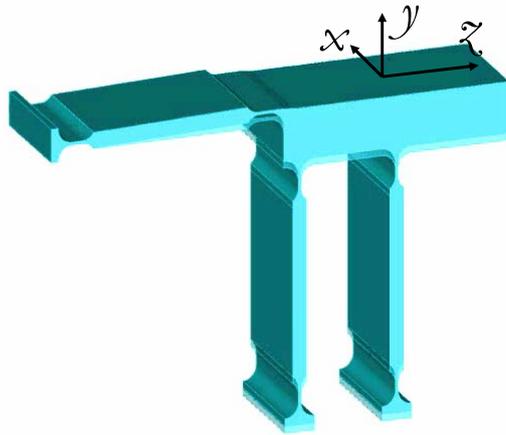
DOF 3



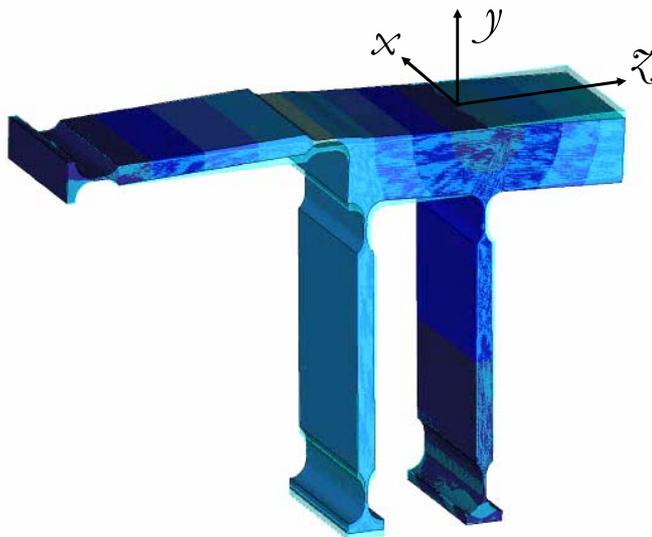
Translation in Z-Direction

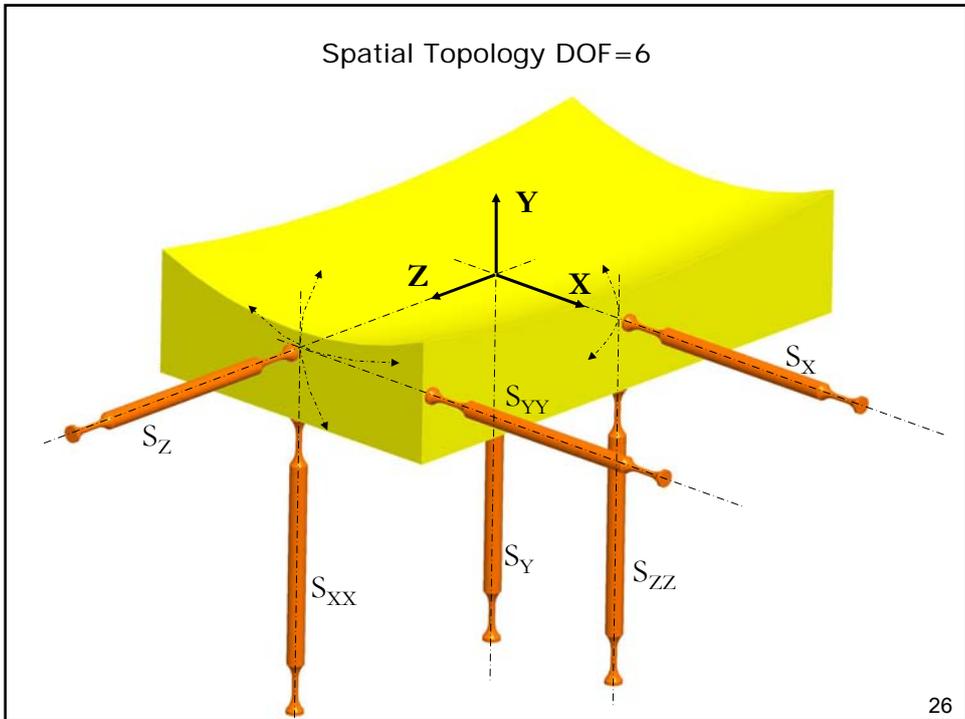
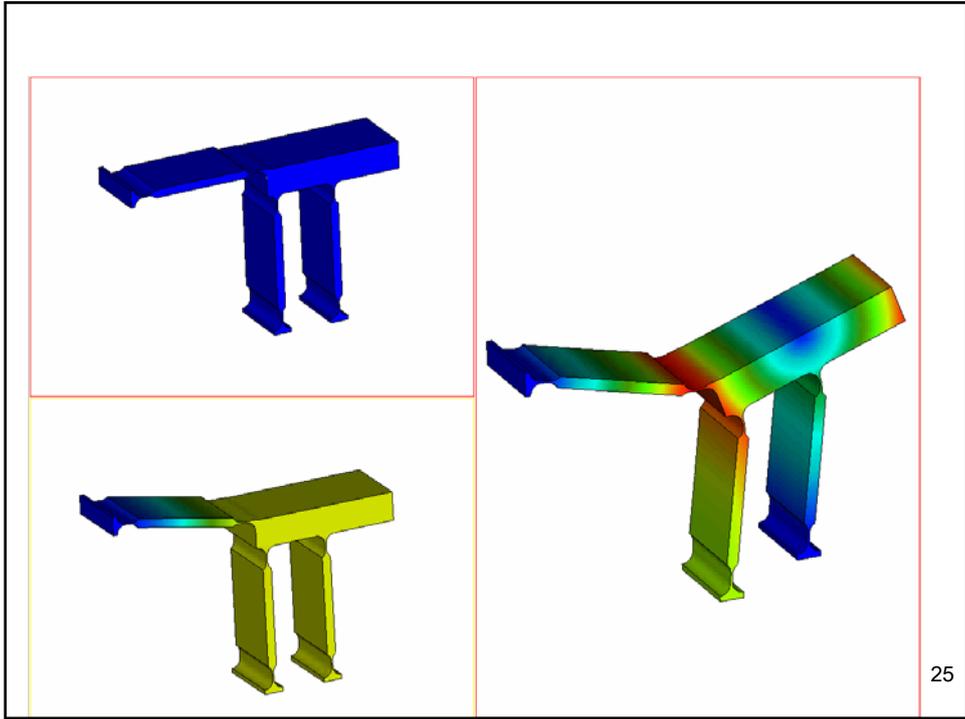


Translation in Y-Direction

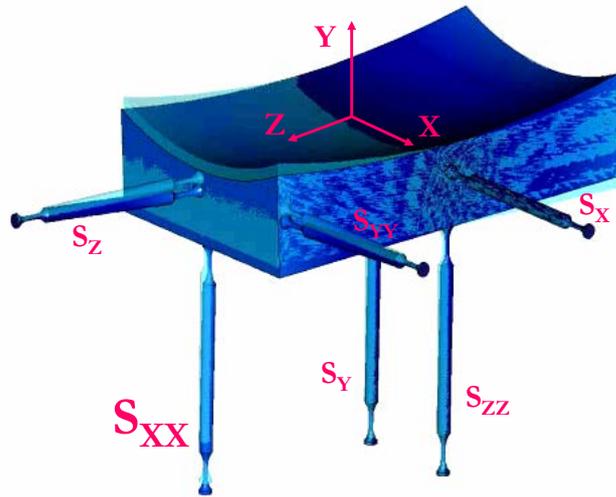


Rotation around X



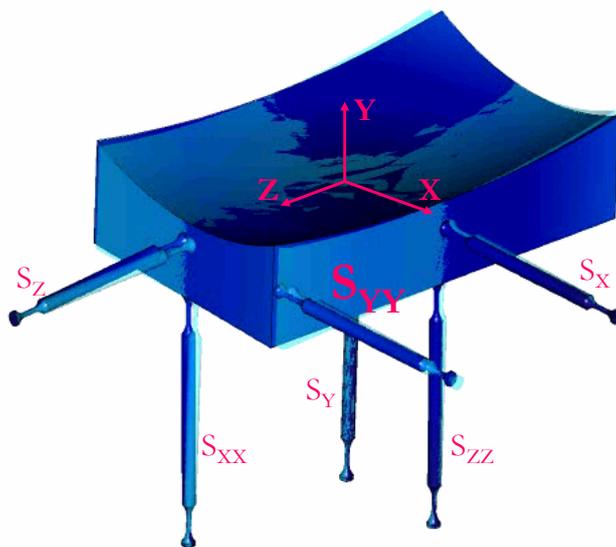


Rotation around X



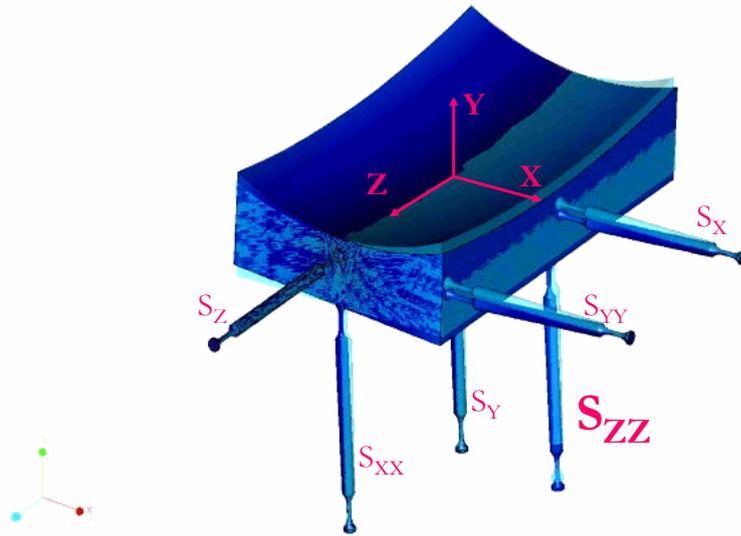
Rotation around Y

Frame 2 of 36



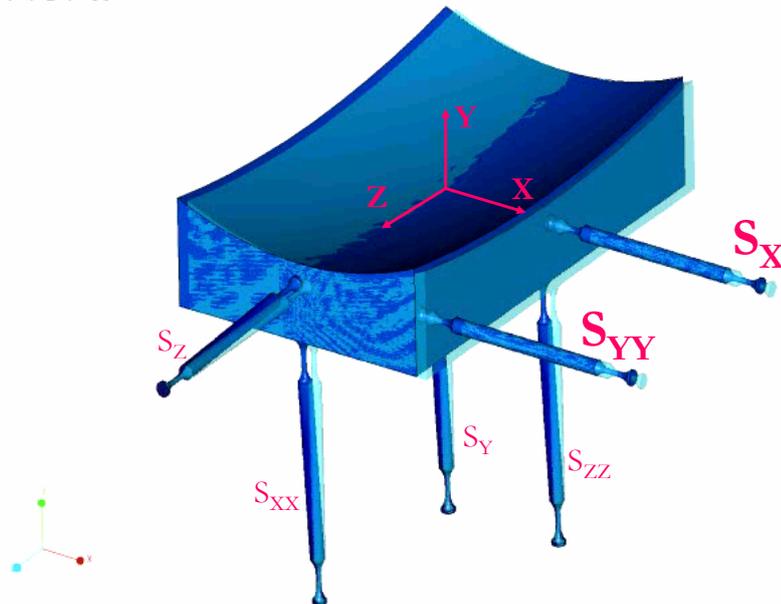
Rotation around Z

Frame 2 of 36



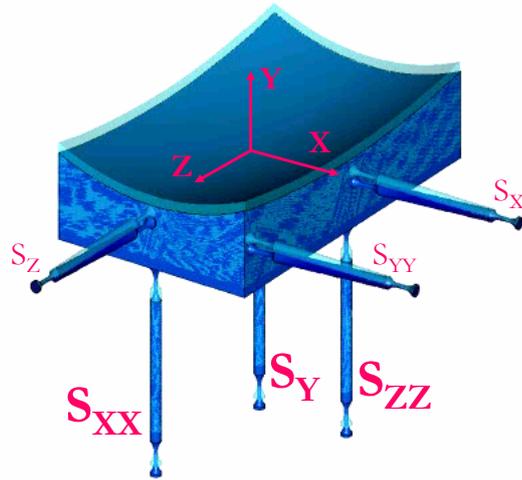
Translation in X-Direction

Frame 2 of 36



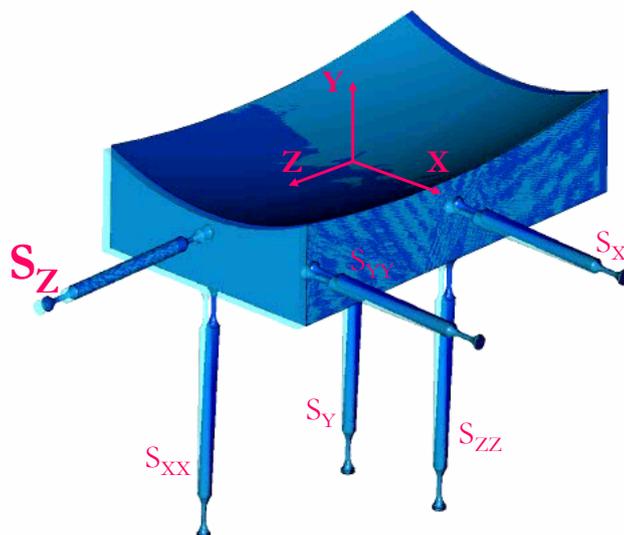
Translation in Y-Direction

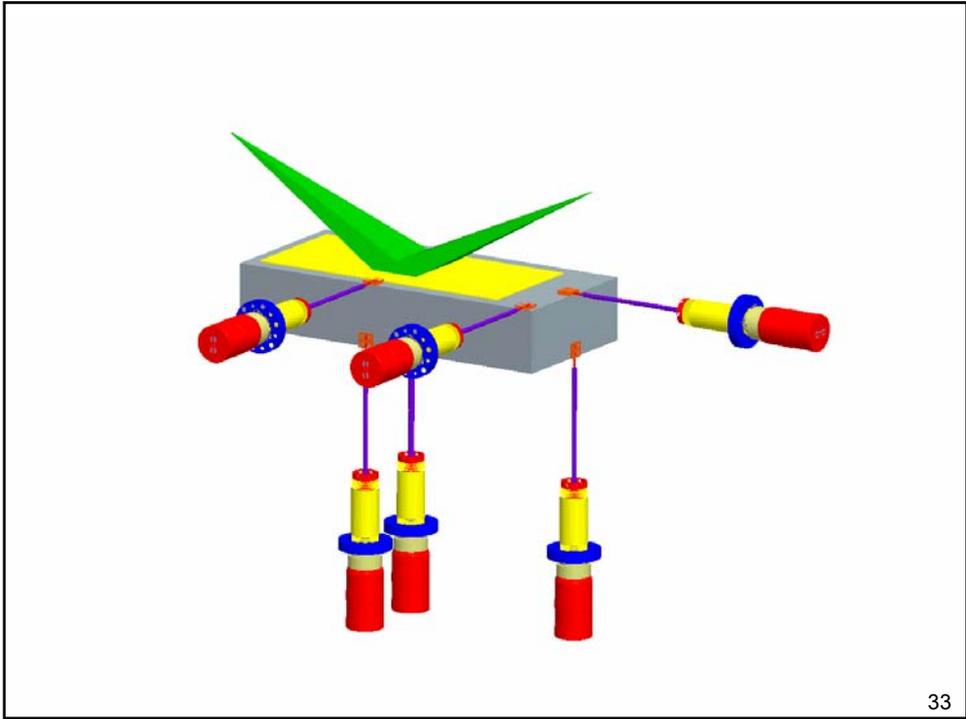
Frame 2 of 36



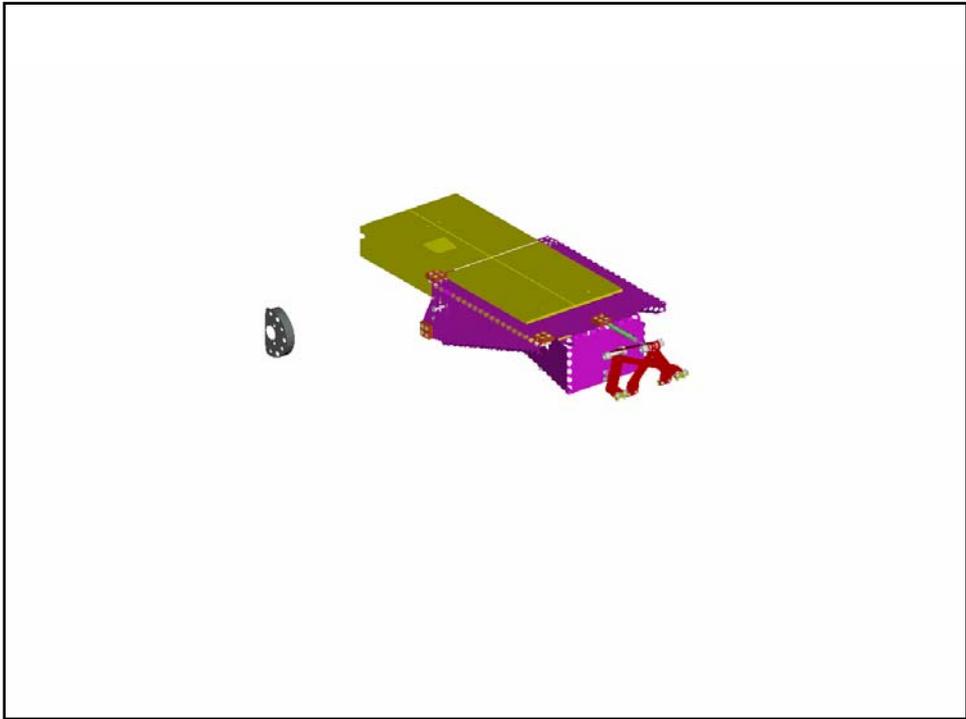
Translation in Z-Direction

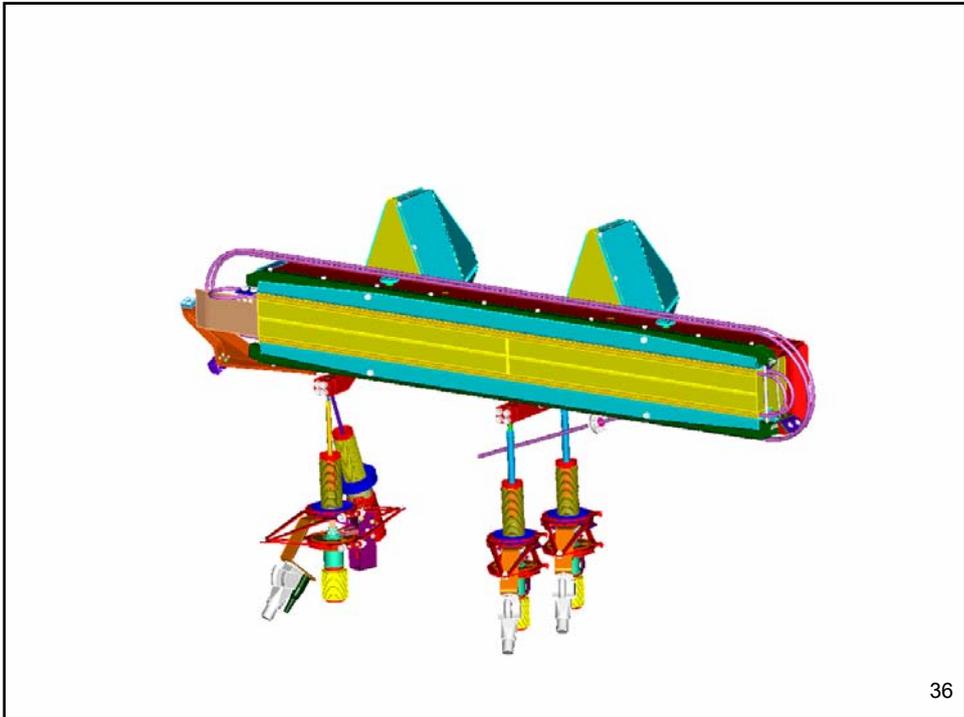
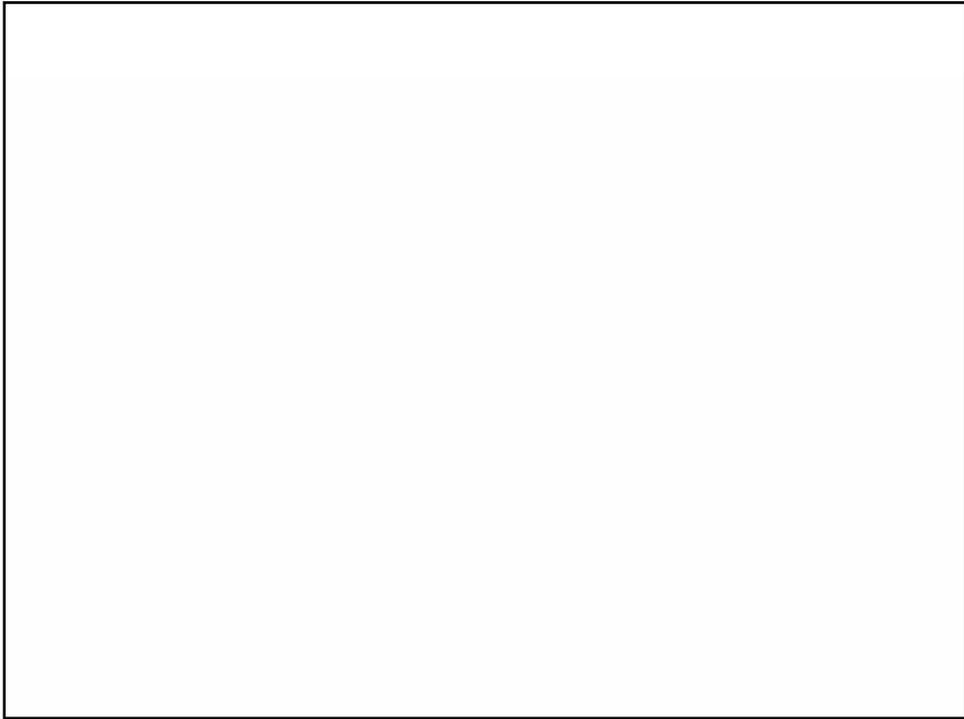
Frame 2 of 36

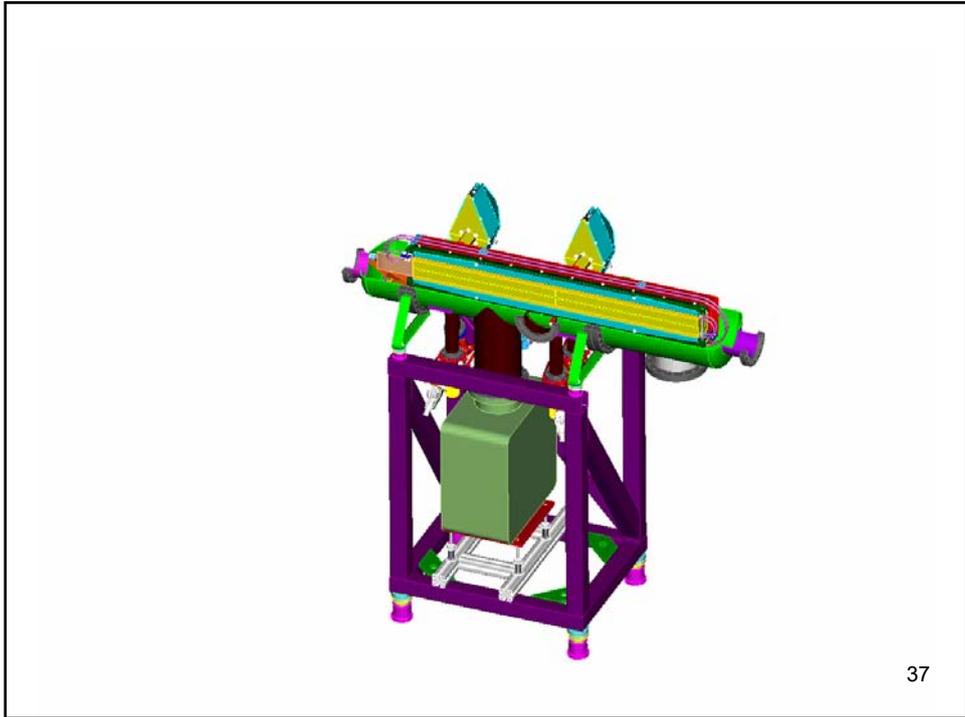


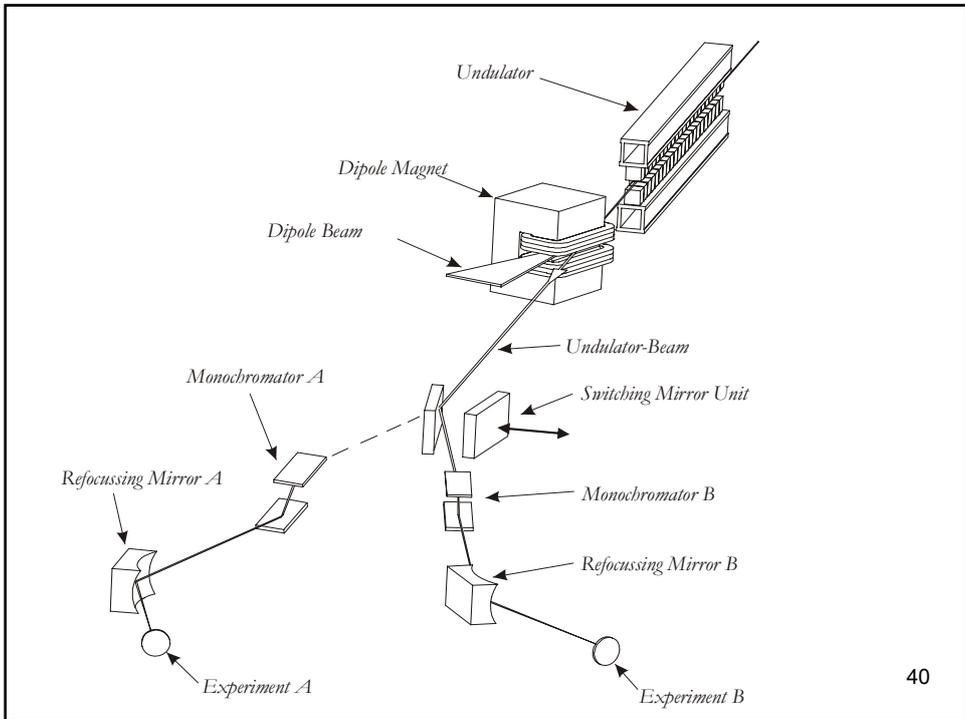
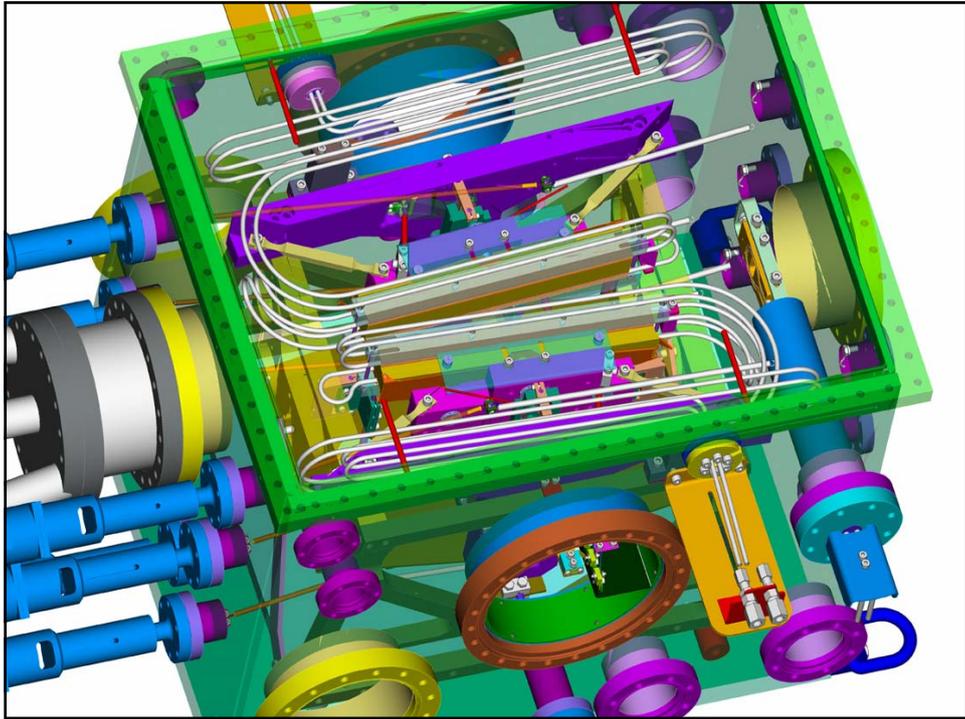


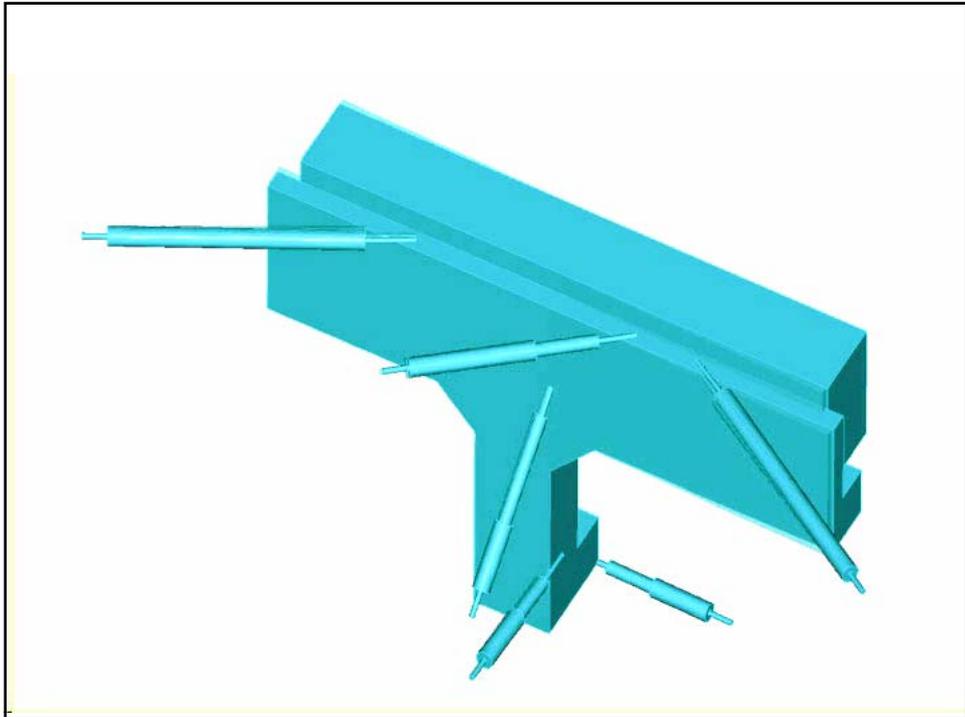
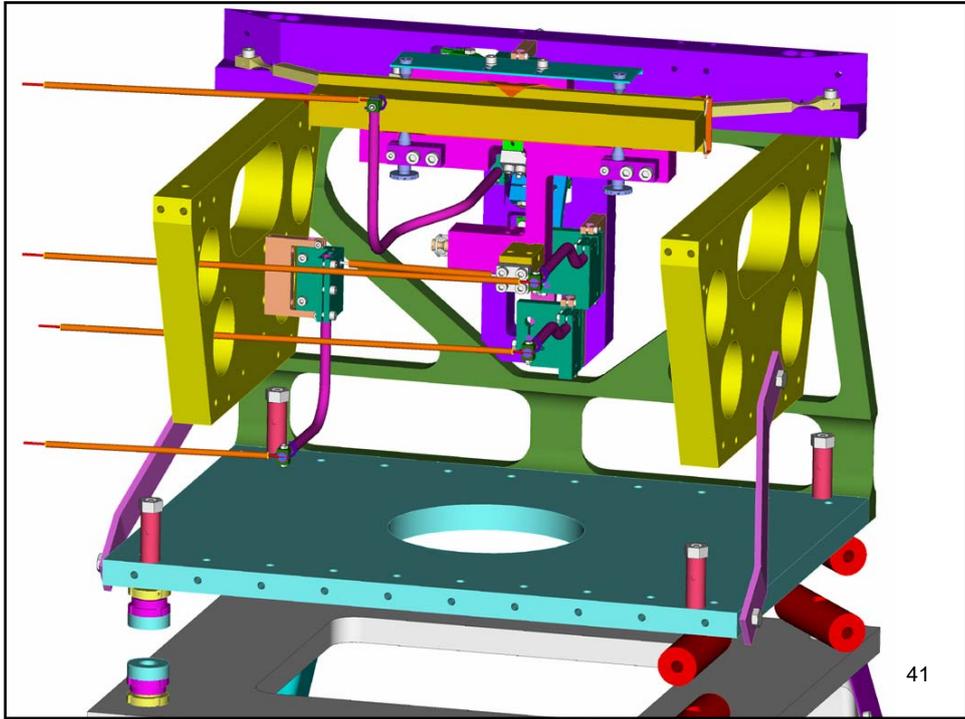
33

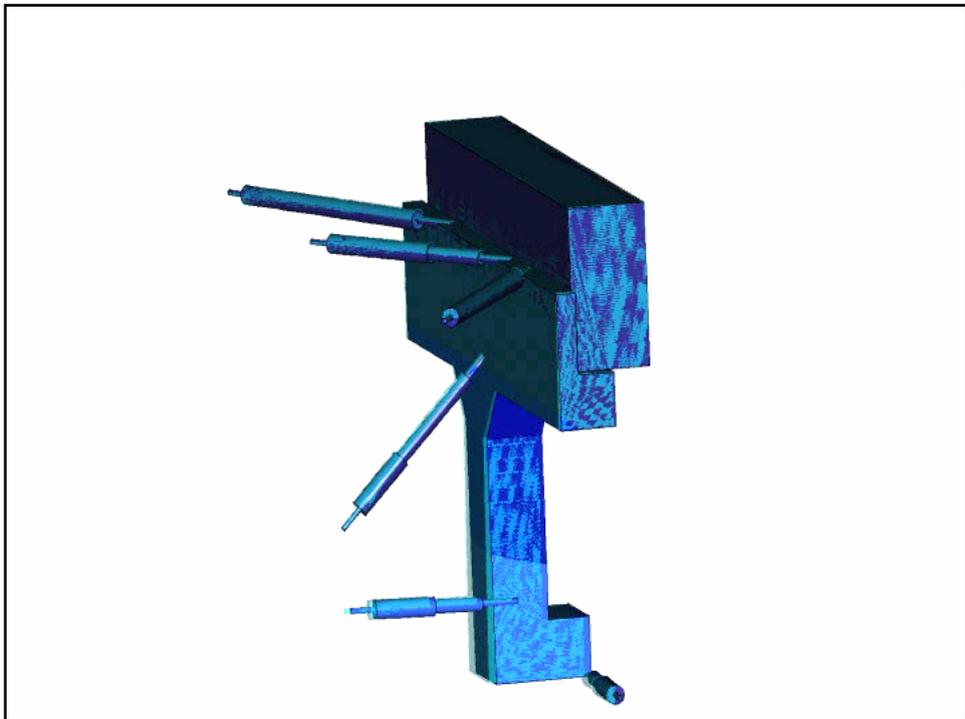
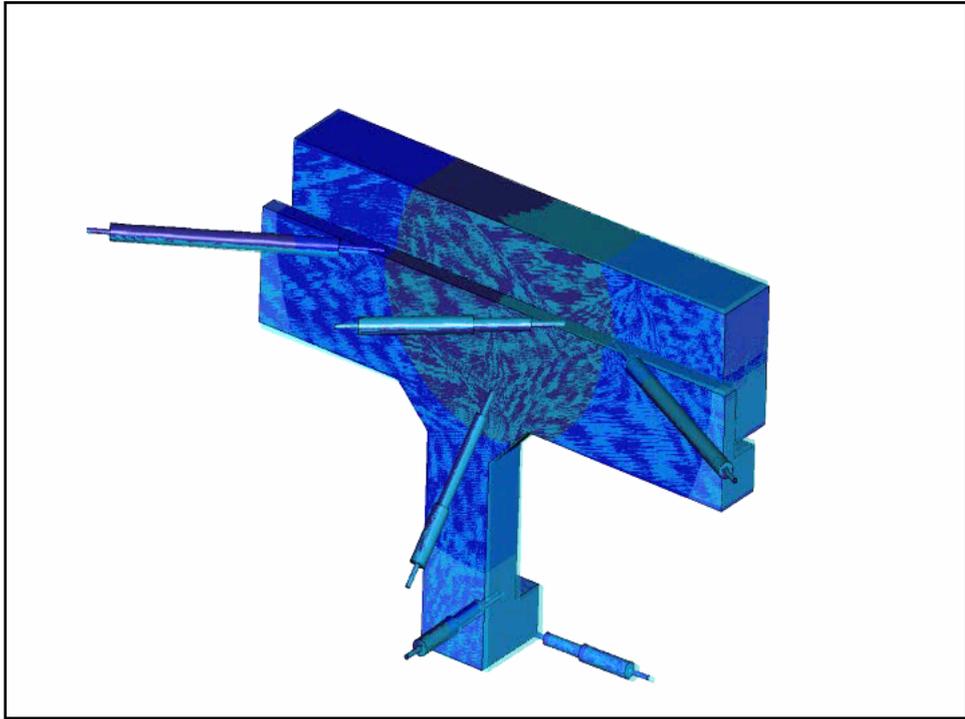


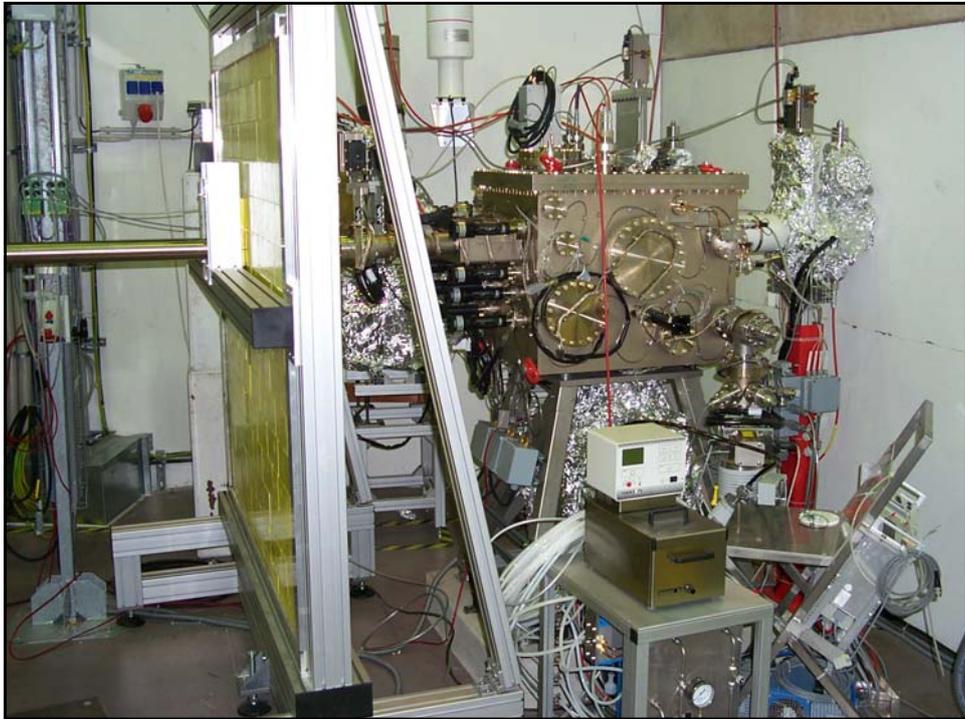
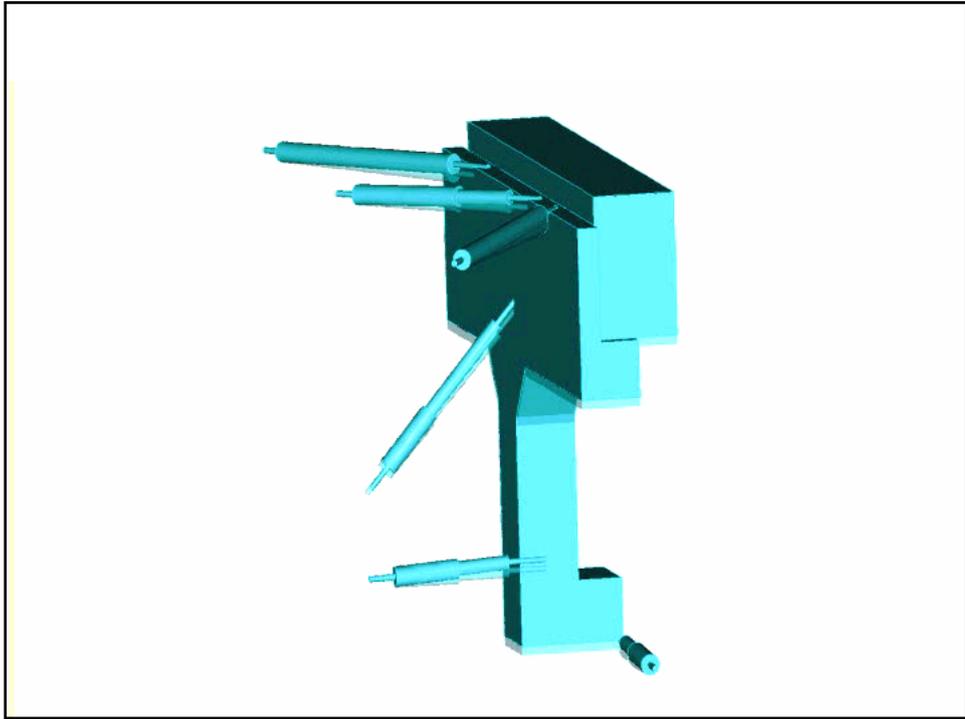


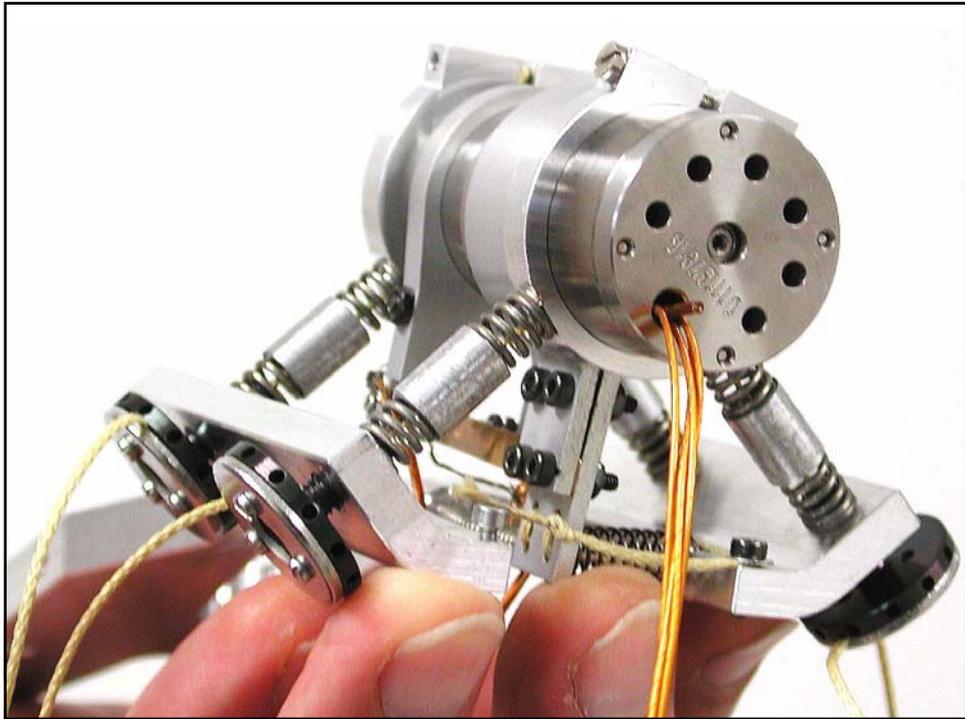
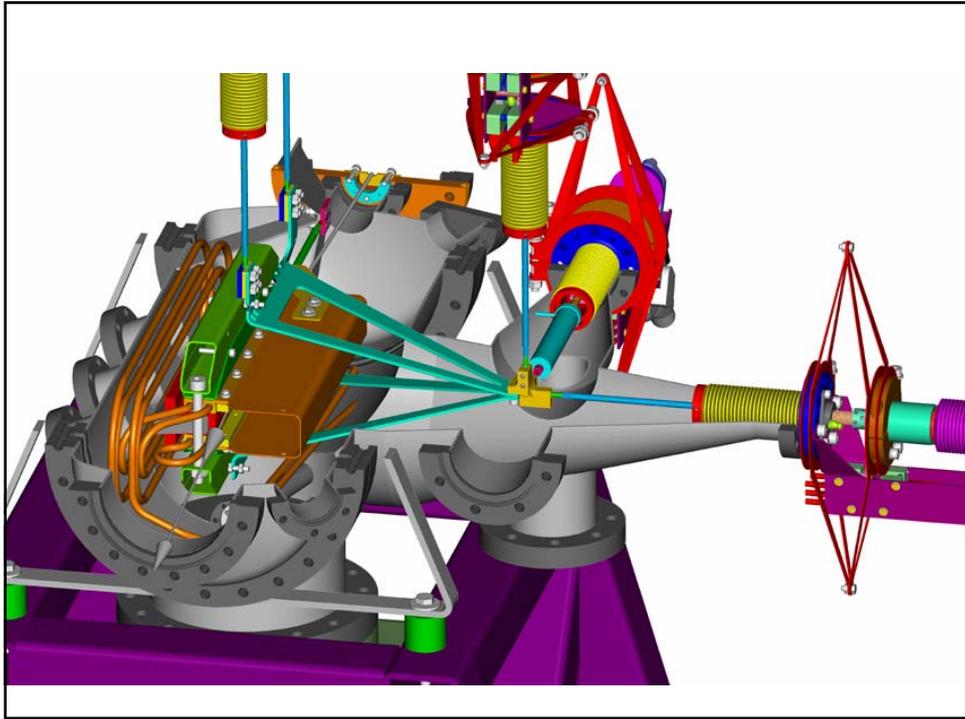


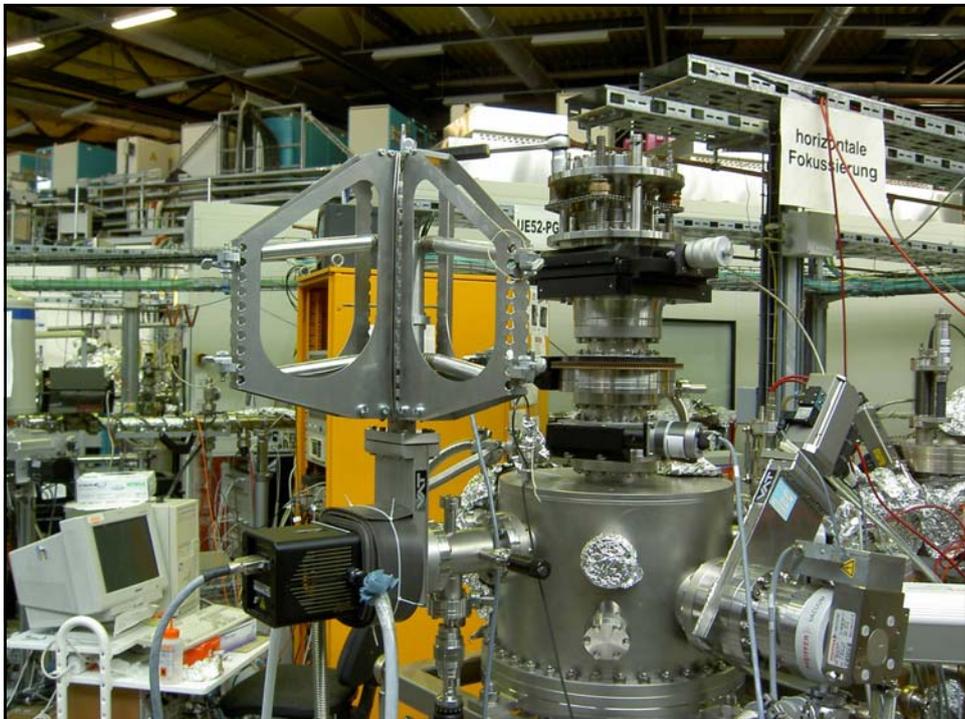
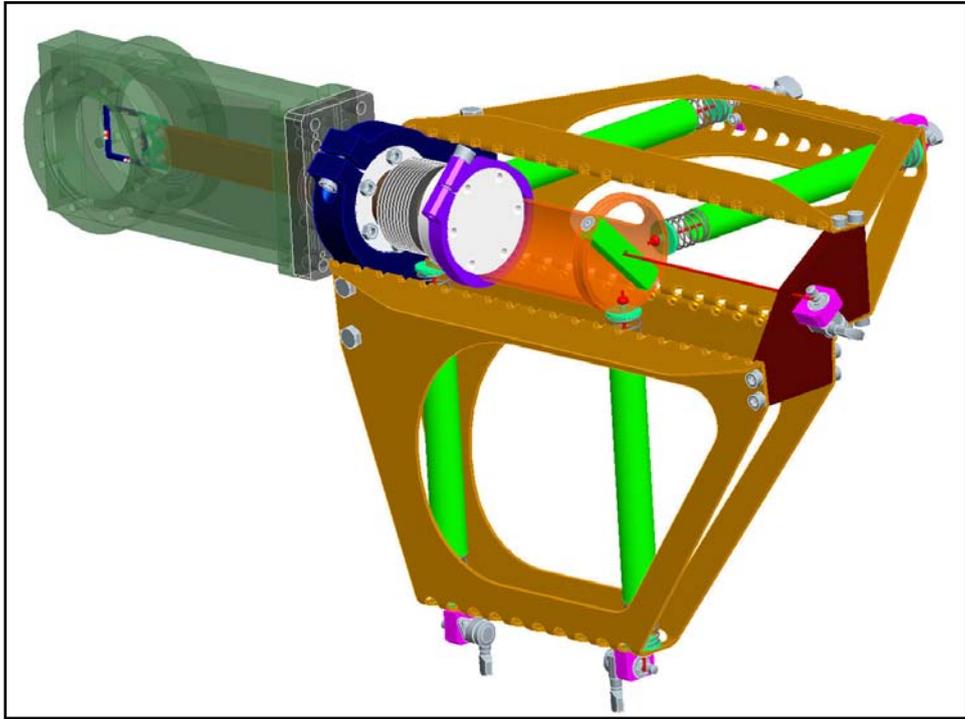


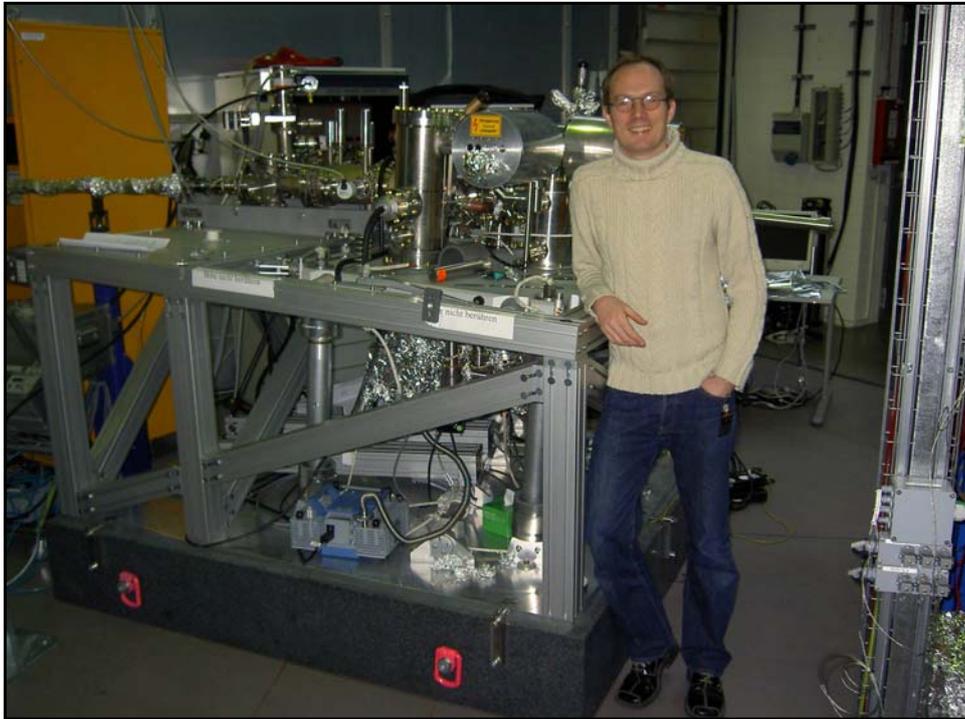
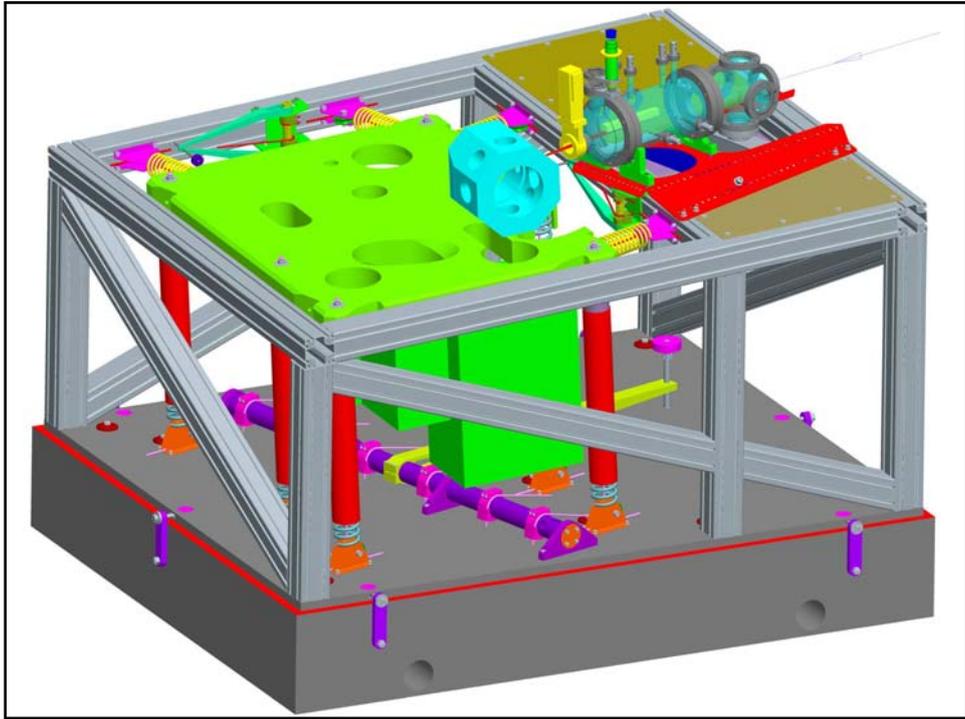


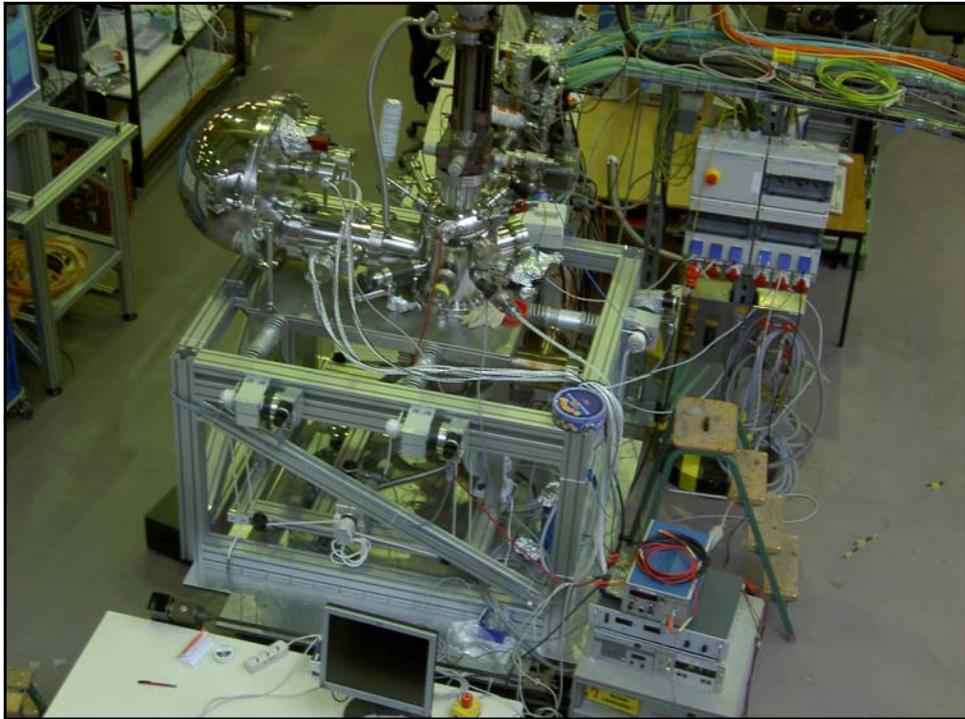
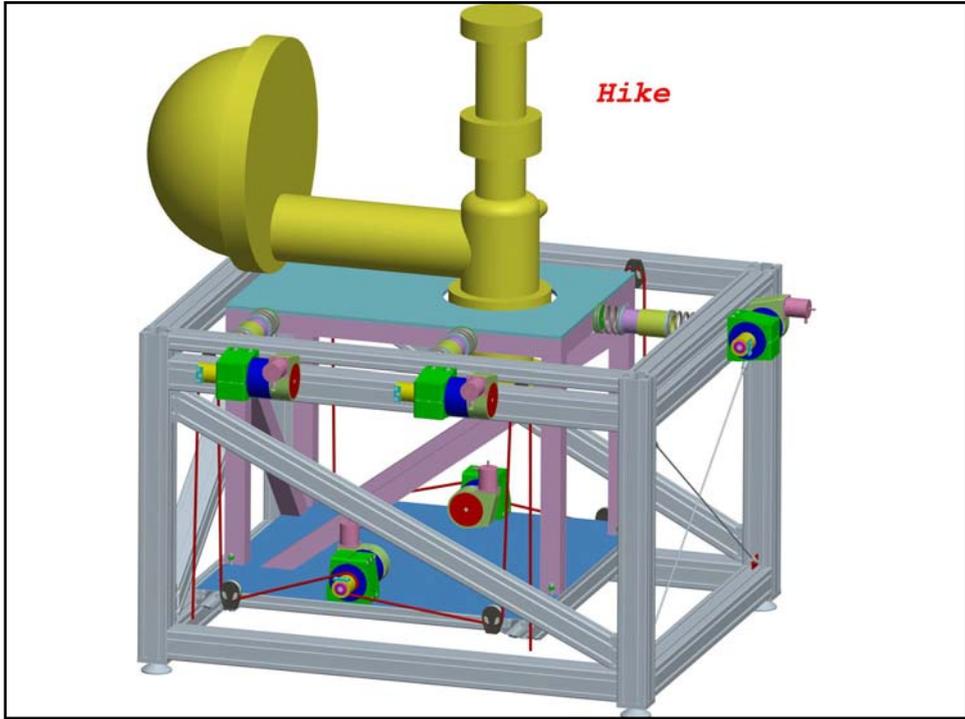




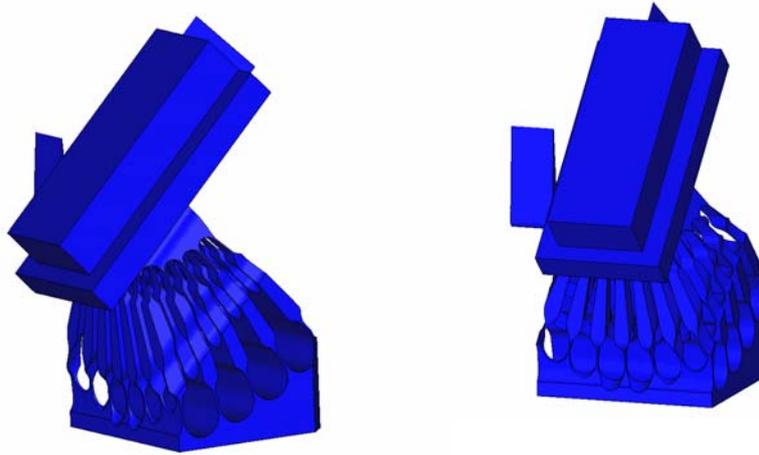




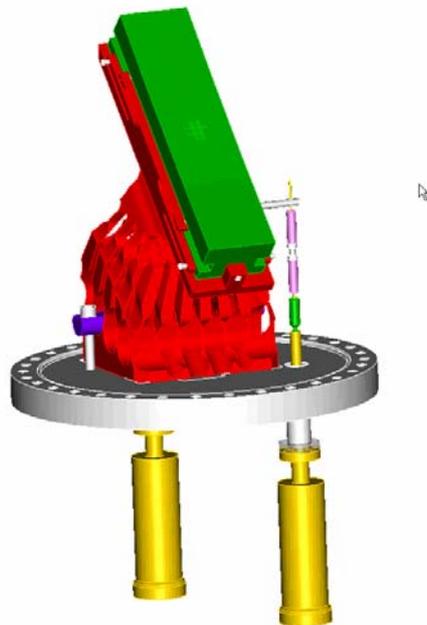




zwei Drehungen um Achsen, die in der Spiegeloberfläche liegen



55



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