PAUL SCHERRER INSTITUT

PSI

'Εστία

Estia

EUROPEAN SPALLATION SOURCE

Sven Schütz :: ESTIA Instrument Engineer :: PSI

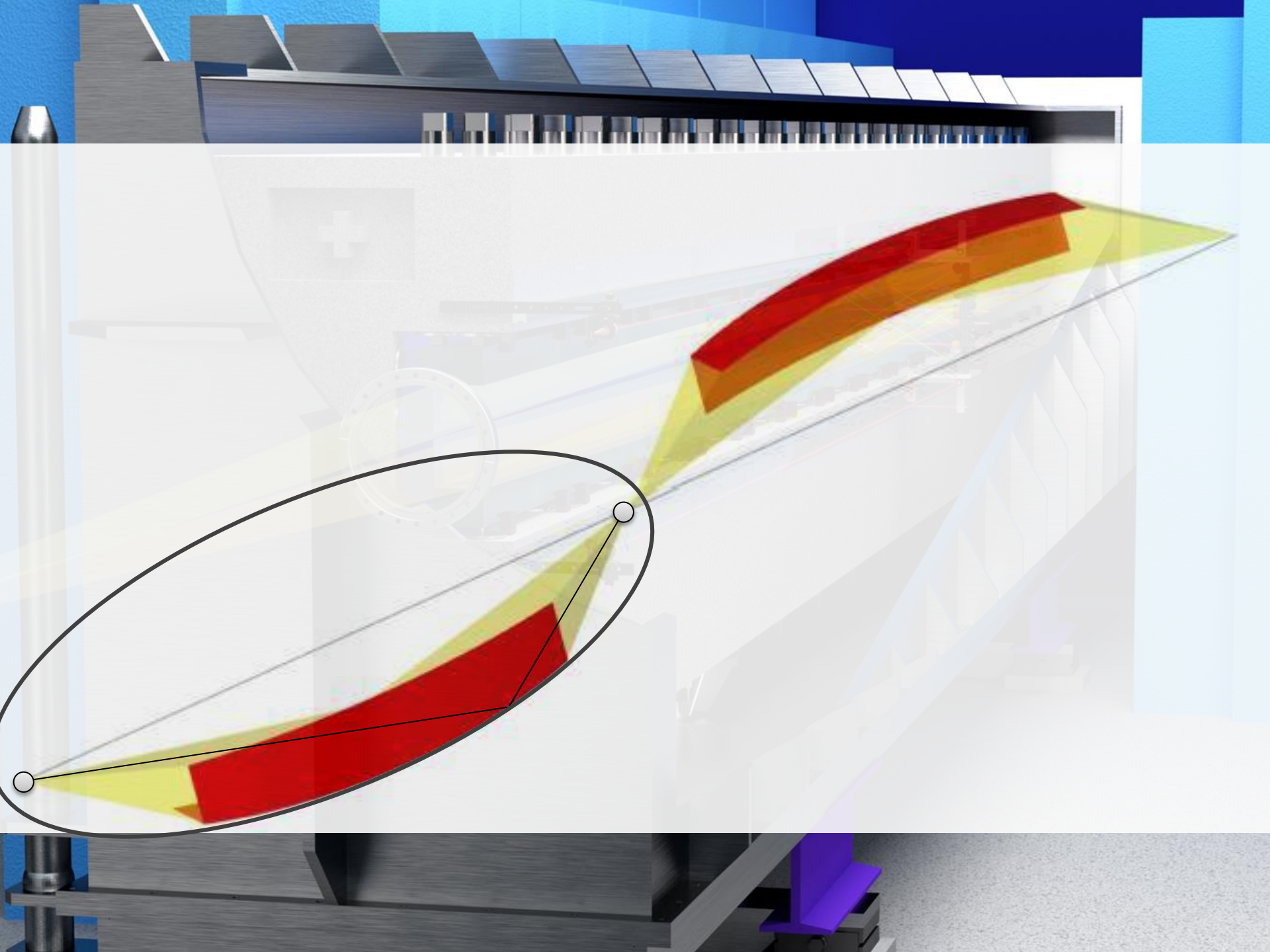
ESTIA - The ESS Small Sample Reflectometer

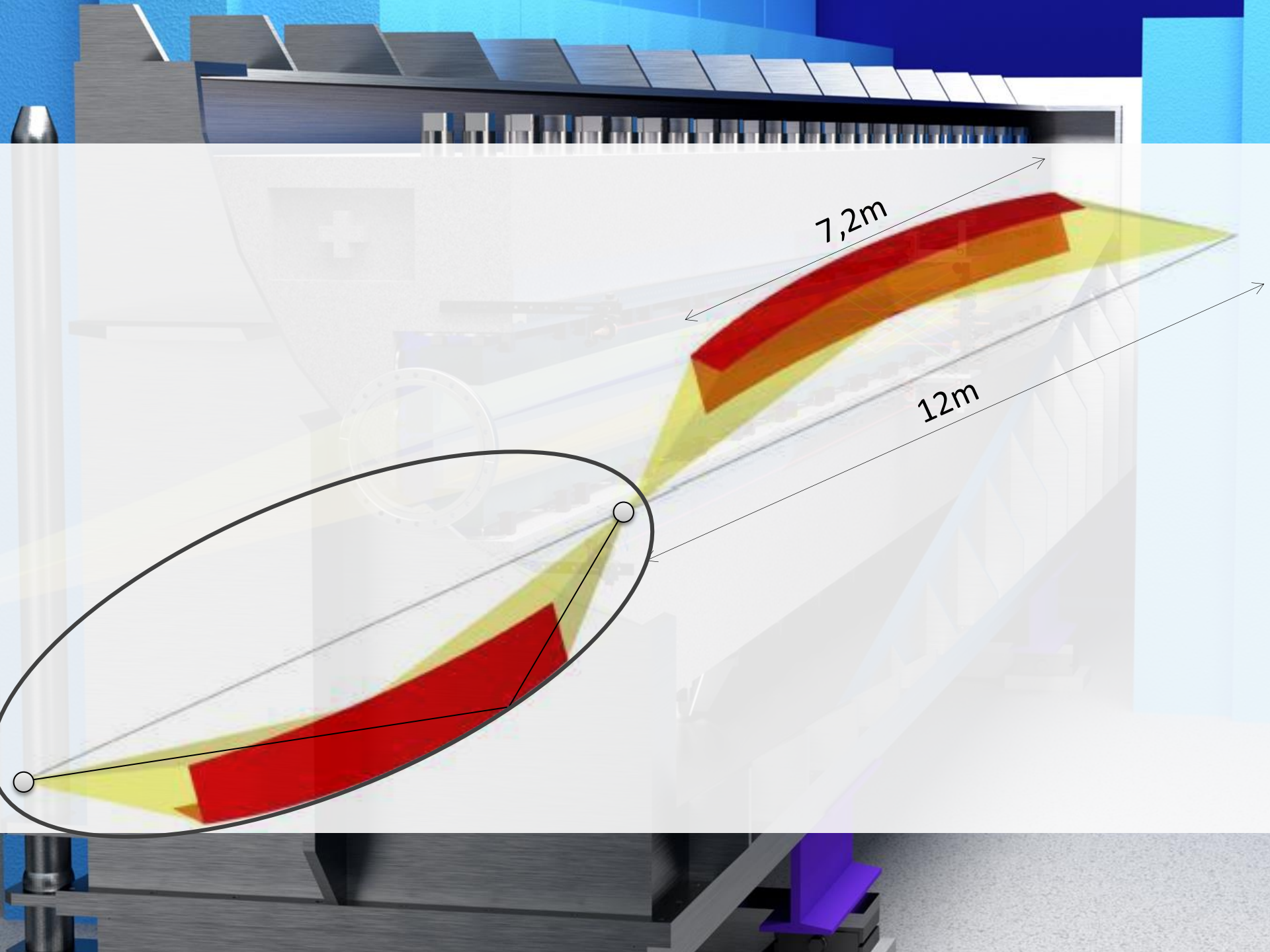
Micron Alignment with Absolute Interferometry

DENIM :: ESS :: 19.09.2016

Overview

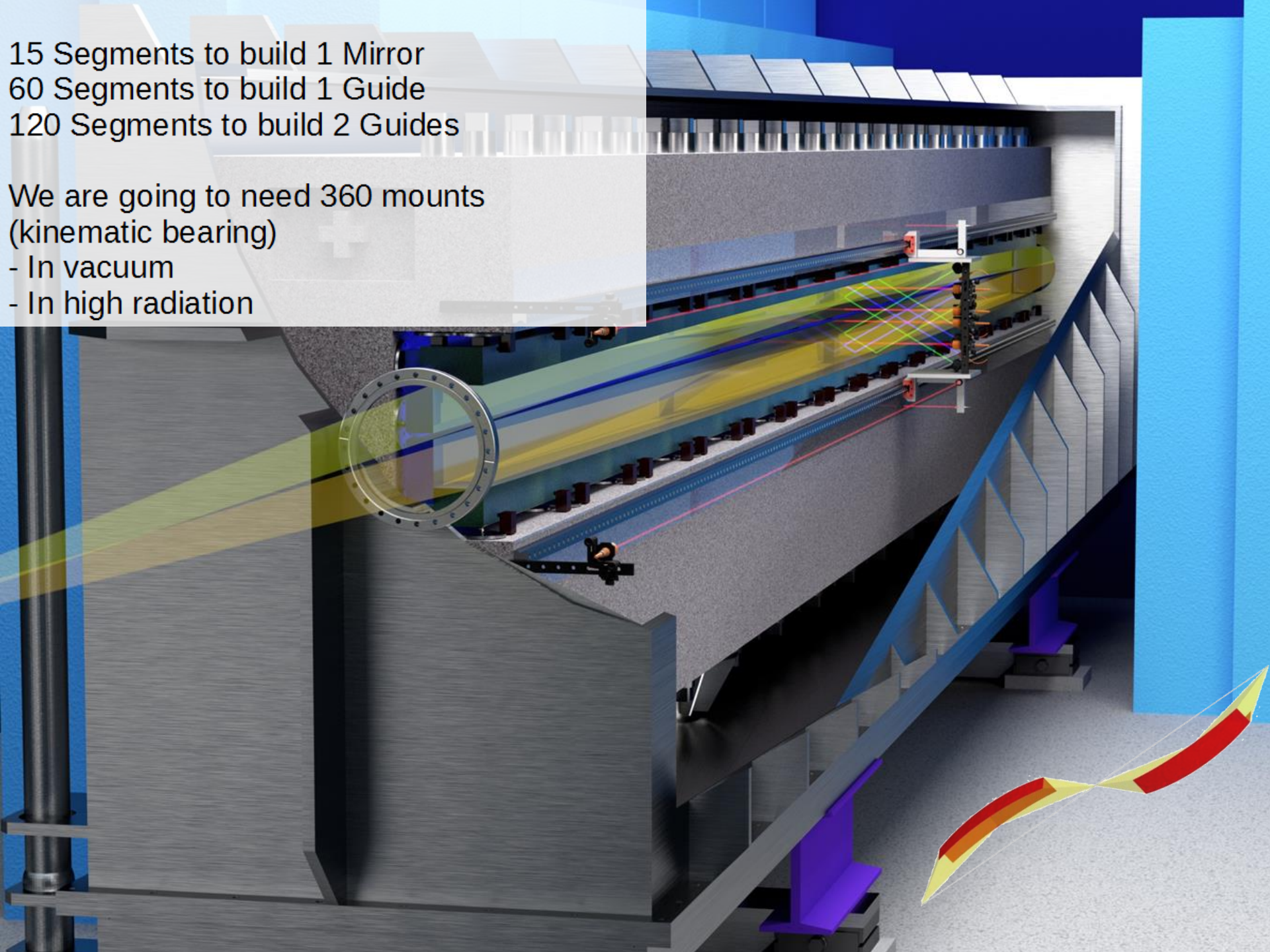
- Concept of Refocusing Optics
- ESTIA Requirements and Measurement Application
- Used Interferometer System




7,2m
12m

15 Segments to build 1 Mirror
60 Segments to build 1 Guide
120 Segments to build 2 Guides

We are going to need 360 mounts
(kinematic bearing)
- In vacuum
- In high radiation



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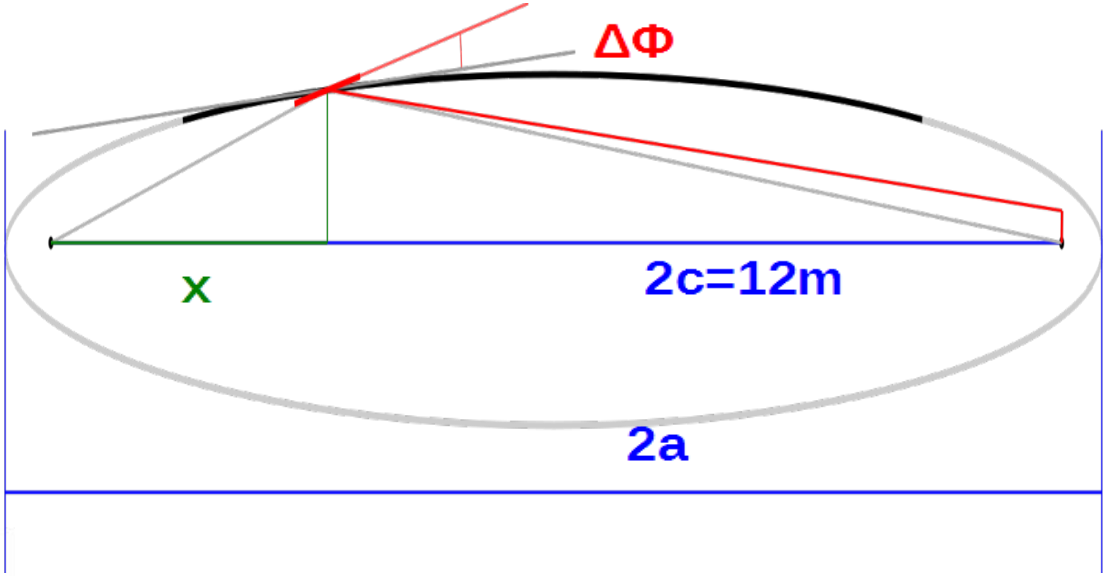
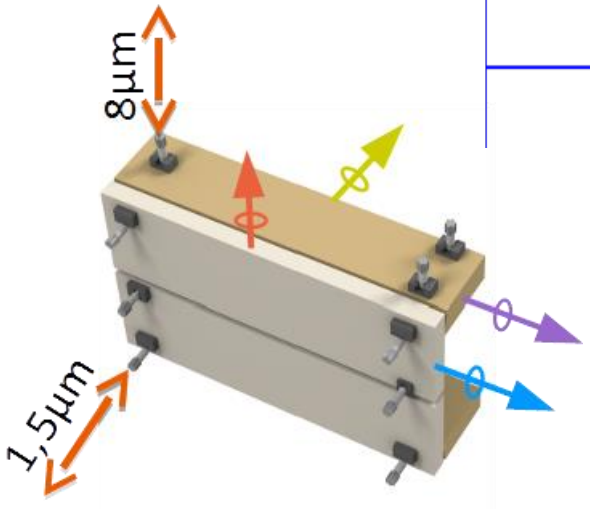
Precision for Focusing Optics





$$\Delta = L \cdot \sin(2\Delta\varphi)$$

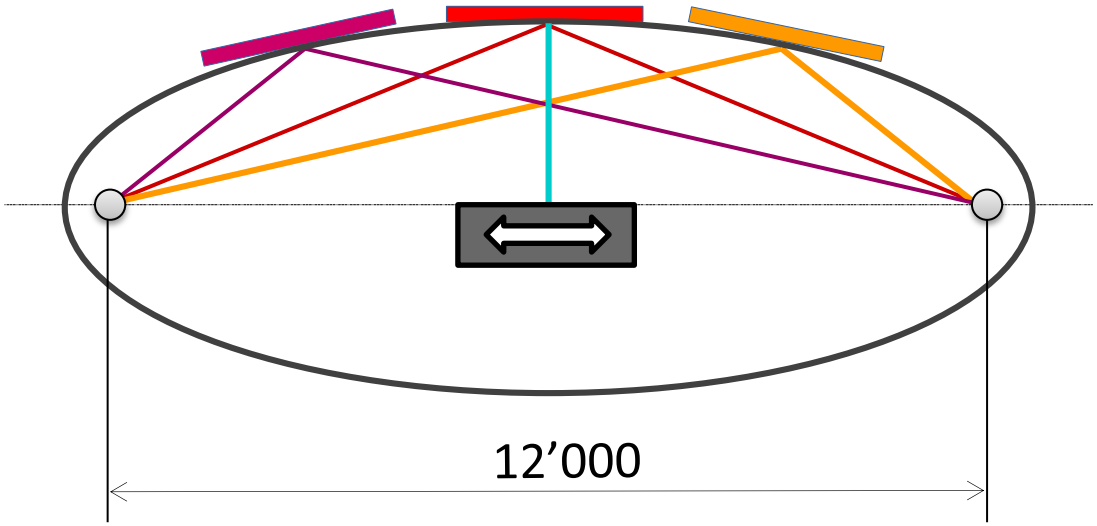
$$L = a(2 - x/c)$$

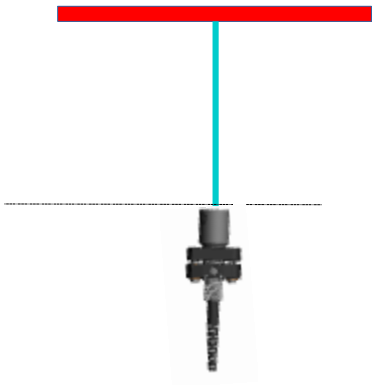
based on 3 mm x 1 mm footprint at 1.0°
(Δ_x=60 µm / Δ_z=1 mm)

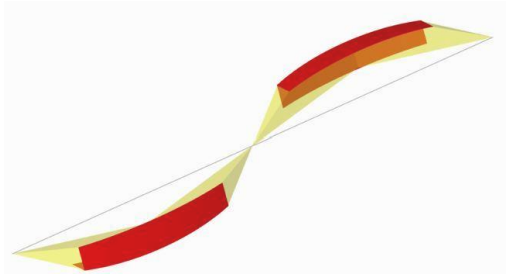
	$\Delta\varphi_V$	$\Delta\psi_V$	$\Delta\varphi_H$	$\Delta\psi_H$
Angular accuracy [µrad]	3	3000	50	200
Holder accuracy [µm]	1.5	>50	25	8

Interferometer Alignement

- **Measurement cart** with a translation parallel to the C-axis
  - C-axis is appropriate defined or cart position is controlled
- Position measurement with an **absolute-interferometer**
  - **Collimator** normal to C-axis

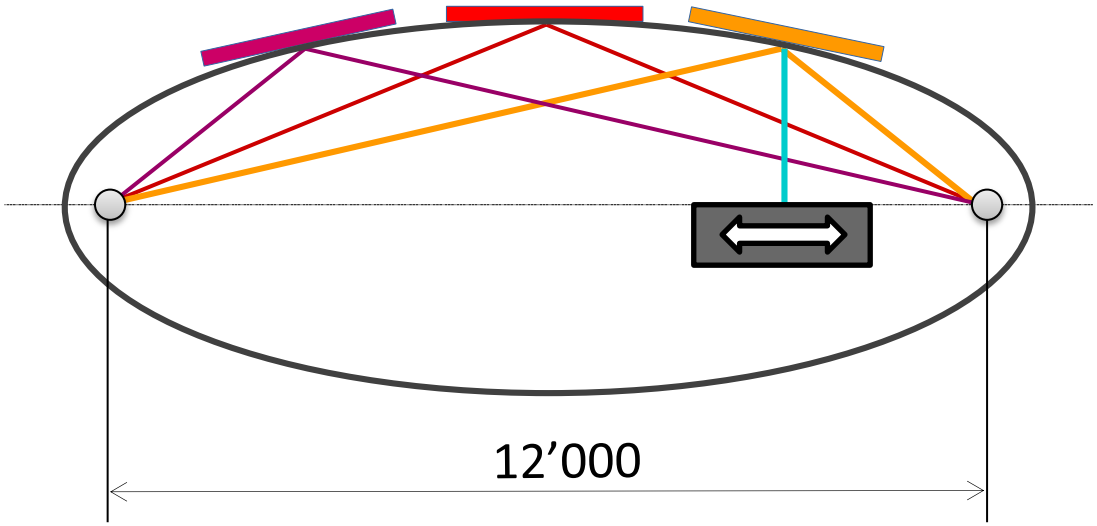


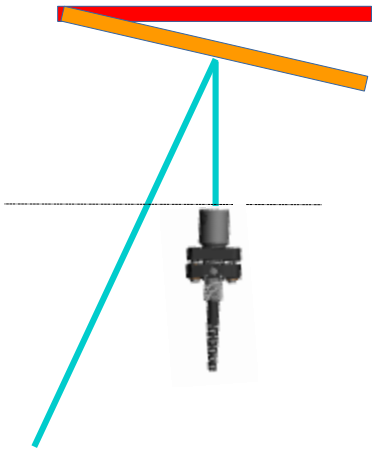


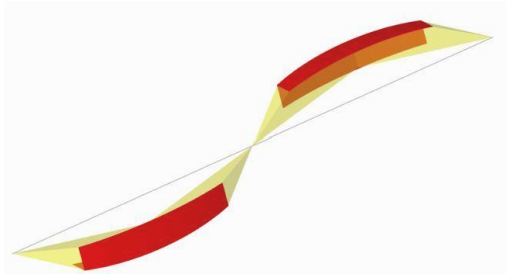


Interferrometer Algnment

- Measurement cart with a translation parallel to the C-axis
- Position measurement with an absolute-interferometer
  - **Collimator** normal to C-axis
  - Beam is not reflected back!

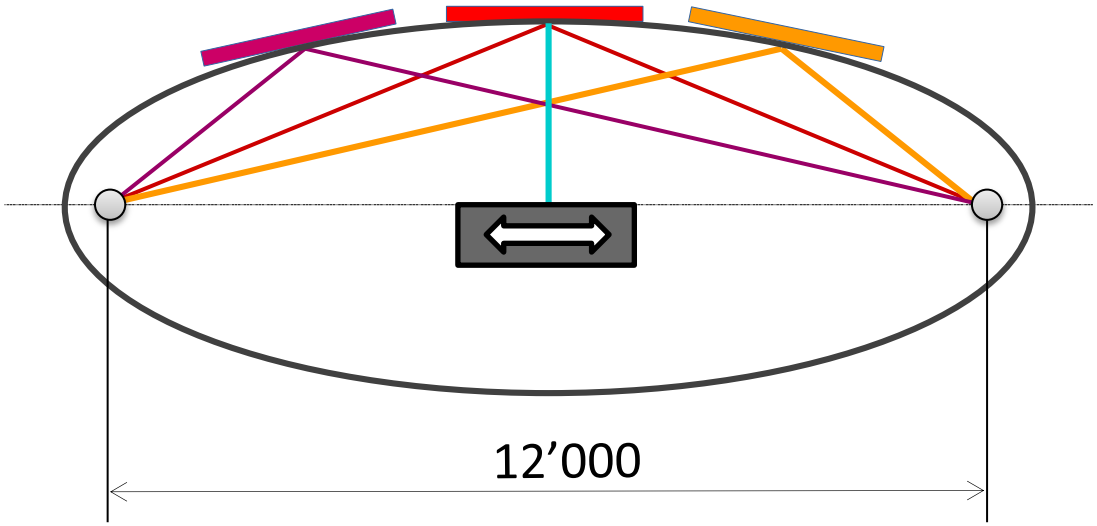


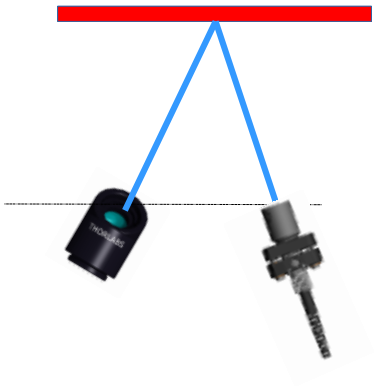


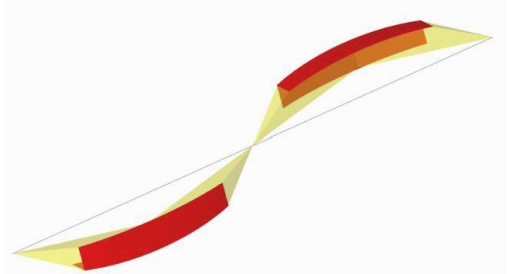


Required Precision

- Measurement cart with a translation parallel to the C-axis
- Position measurement with an absolute-interferometer
  - **Collimator** is tilted
  - **Corner cube** reflects the beam







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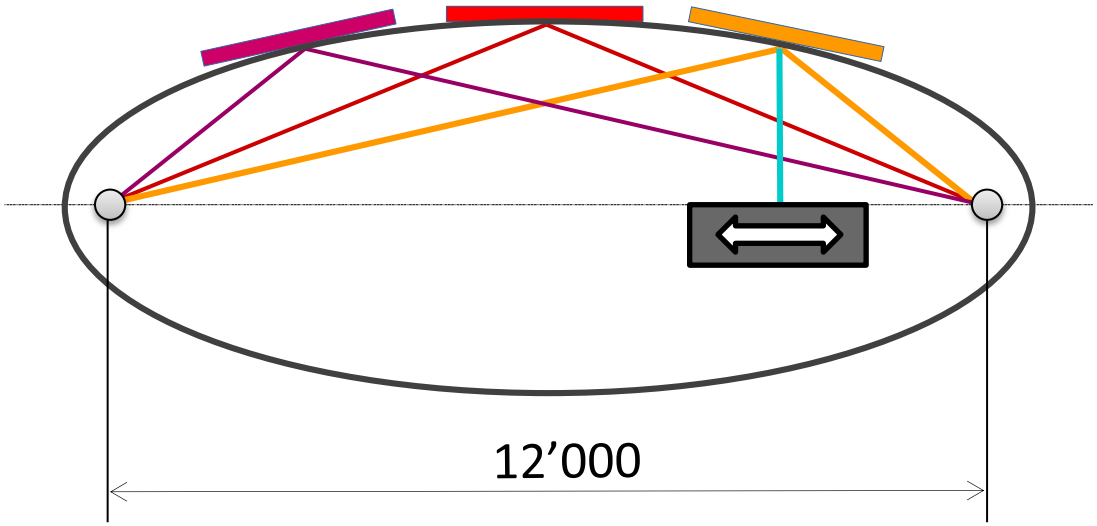

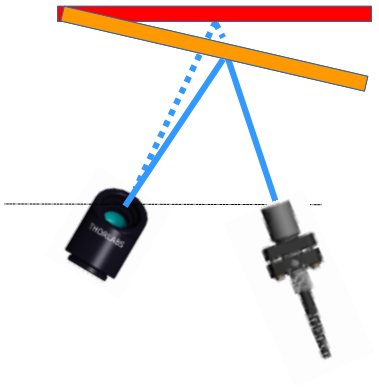

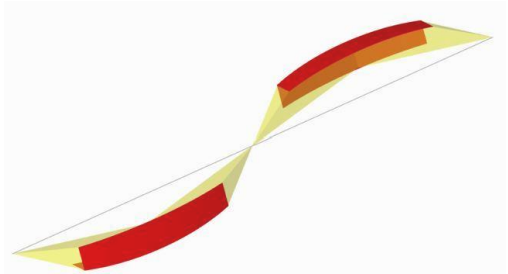

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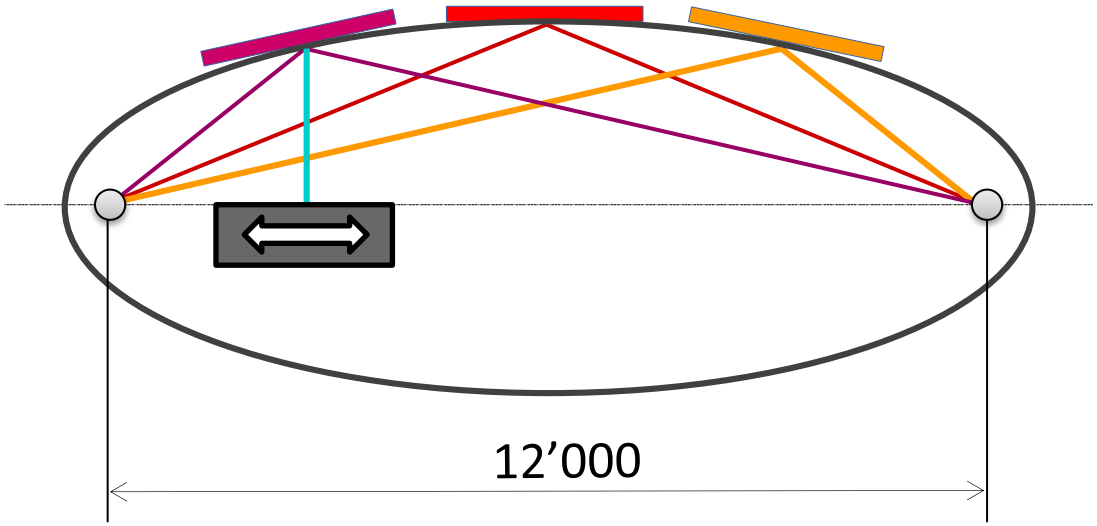
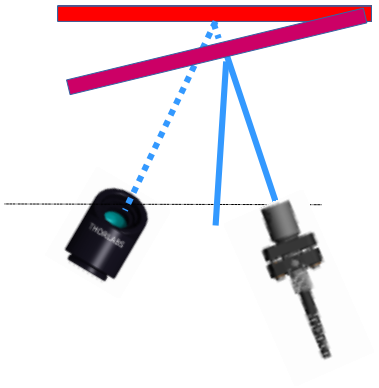
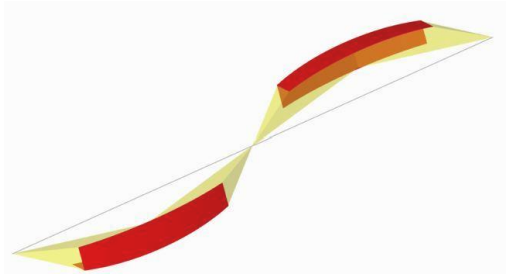
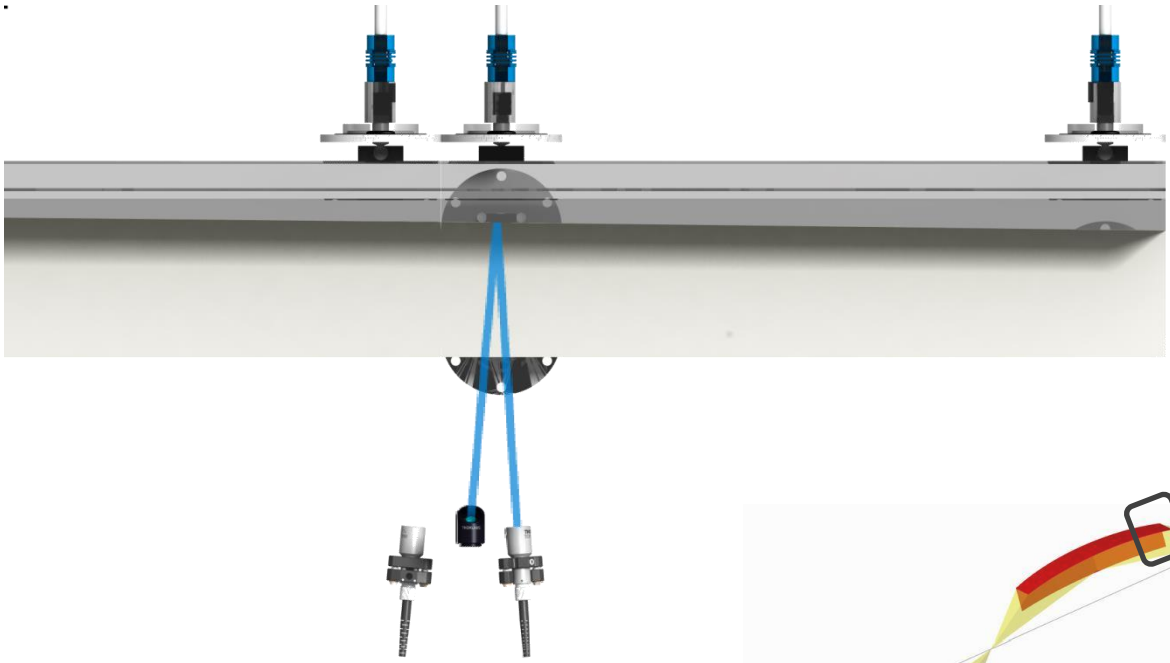


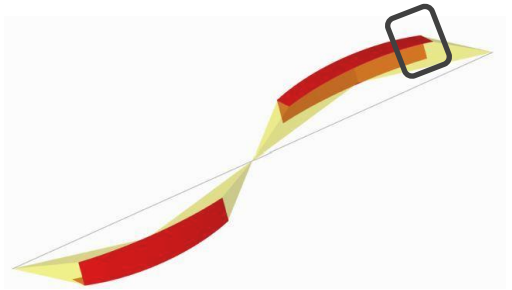




Measurement Setup

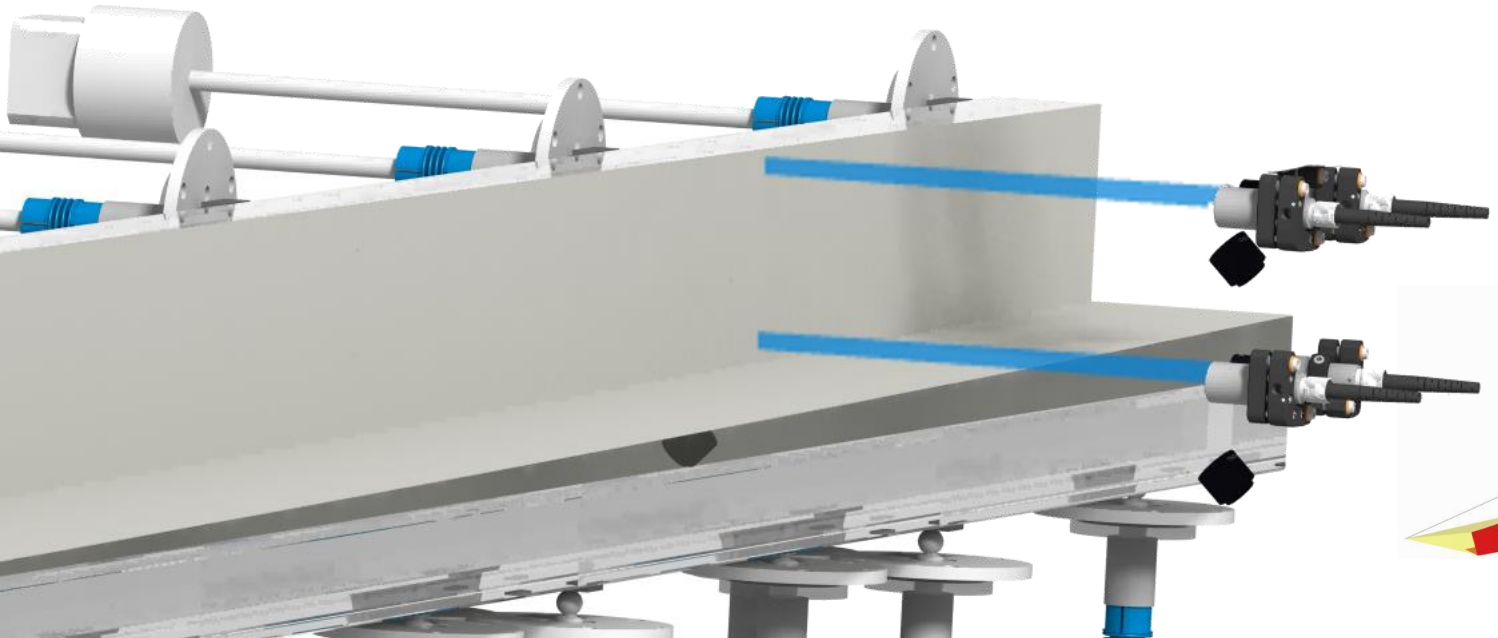
- Measurement of a side-segment
  - Top view
- One active and one blind collimator

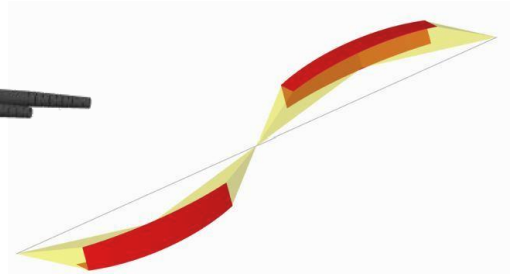




Measurement Setup

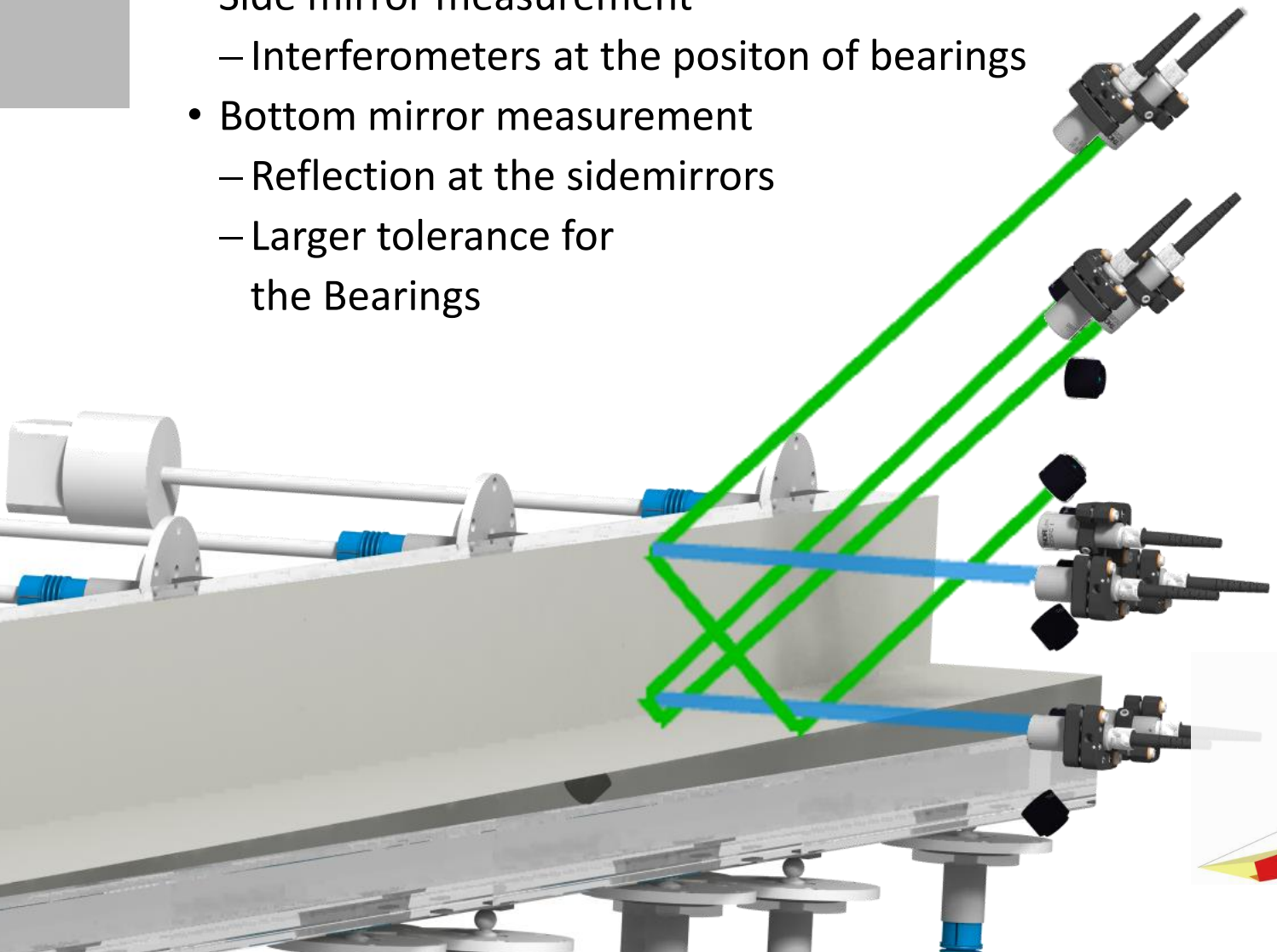
- Side mirror measurement
  - Interferometers at the positon of bearings

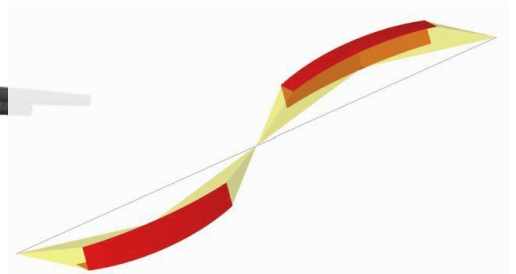




Measurement Setup

- Side mirror measurement
  - Interferometers at the positon of bearings
- Bottom mirror measurement
  - Reflection at the sidemirrors
  - Larger tolerance for the Bearings





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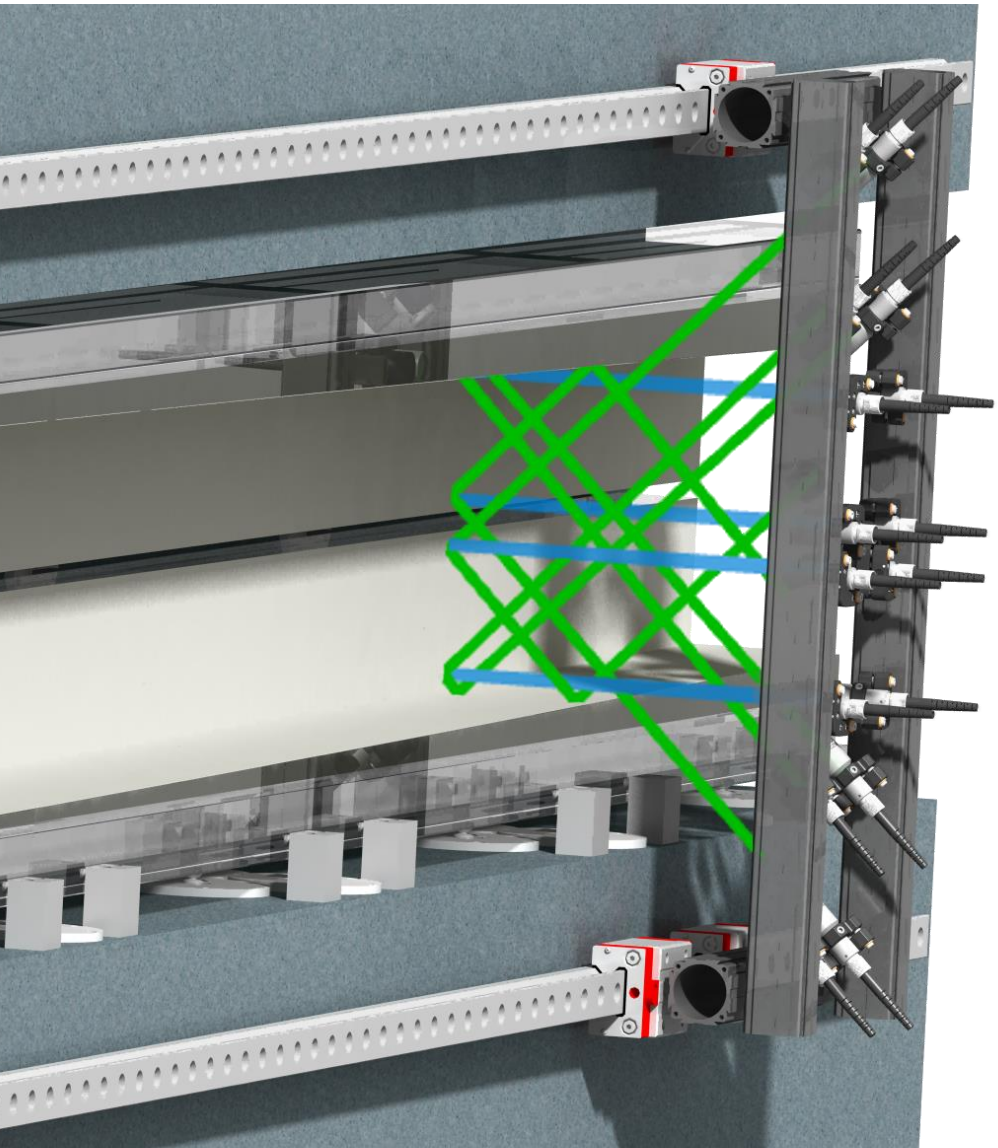

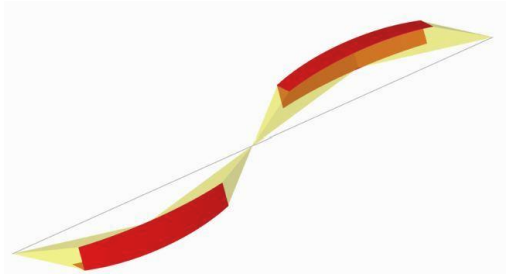

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Measurement Setup

ETALON Absolute-Interferometer

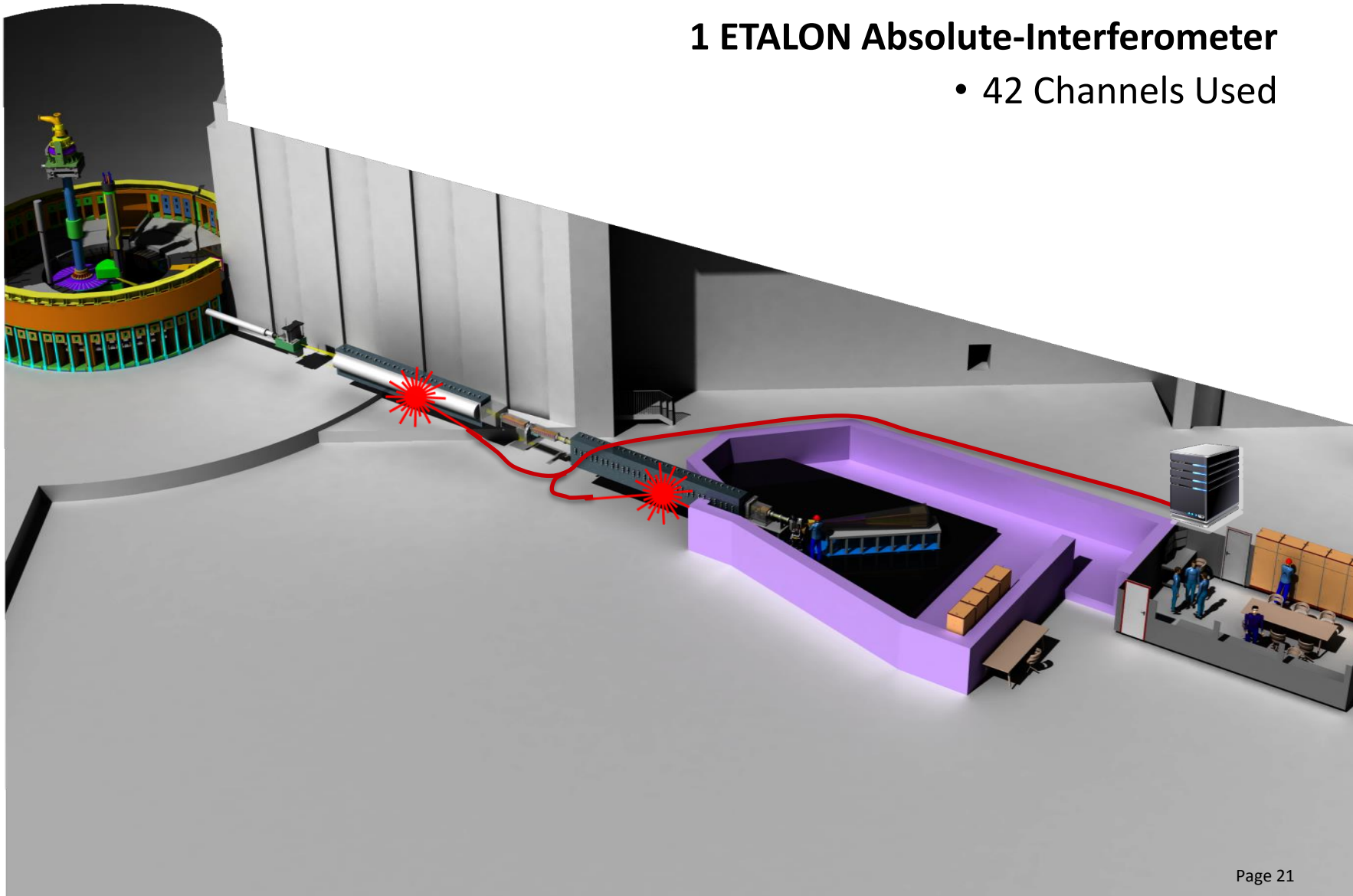
- Measurement uncertainty

  U(95%)=0.5 ppm
- Measurement range up to 20 m
- Number of channels 8-100
- Laser class II m, eye save
- Traceability calibrated gas spectrum
- Compensation Temperature, Pressure, Humidity
- Vibration measurement <500kHz

Standalone Solution

1 ETALON Absolute-Interferometer

- 42 Channels Used



Networksolution

1 ETALON Absolute-Interferometer

- Max. 124 Channels

Wir schaffen Wissen – heute für morgen

Our thanks goes to

- Jochen Stahn
- Uwe Filges
- Dieter Graf
- Christine Klauser

and every body participating in various discussions for their support!

R & D Project

- Analysis of vacuum to the guide system
- Testing the metrology-cart segment measuring
- Testing the metrology cart positioning concept
- Comparing different actuator concepts
- Carrier Bearings
  - Structural integrity
  - Heat input analysis