



# Design of a cryo-cooled artificial channel-cut crystal monochromator for European XFEL

Xiaohao Dong <sup>a)</sup>, Deming Shu <sup>b)</sup>, Harald Sinn <sup>a)</sup>

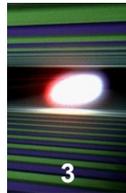
a) European XFEL GmbH, Hamburg, D-22761, Germany

b) Argonne National Laboratory, Argonne, IL 60439, U.S.A

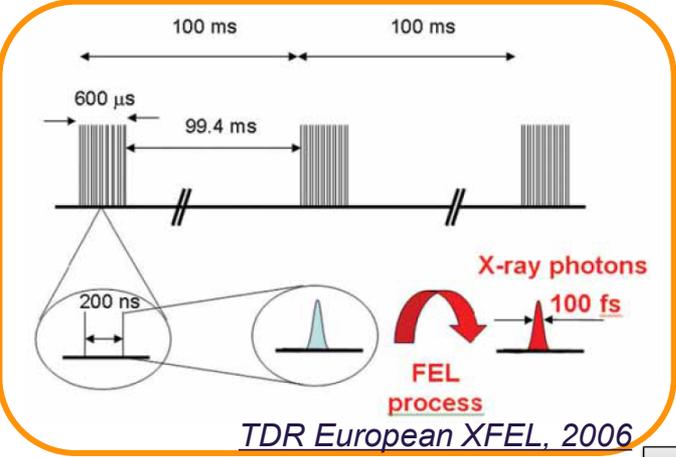
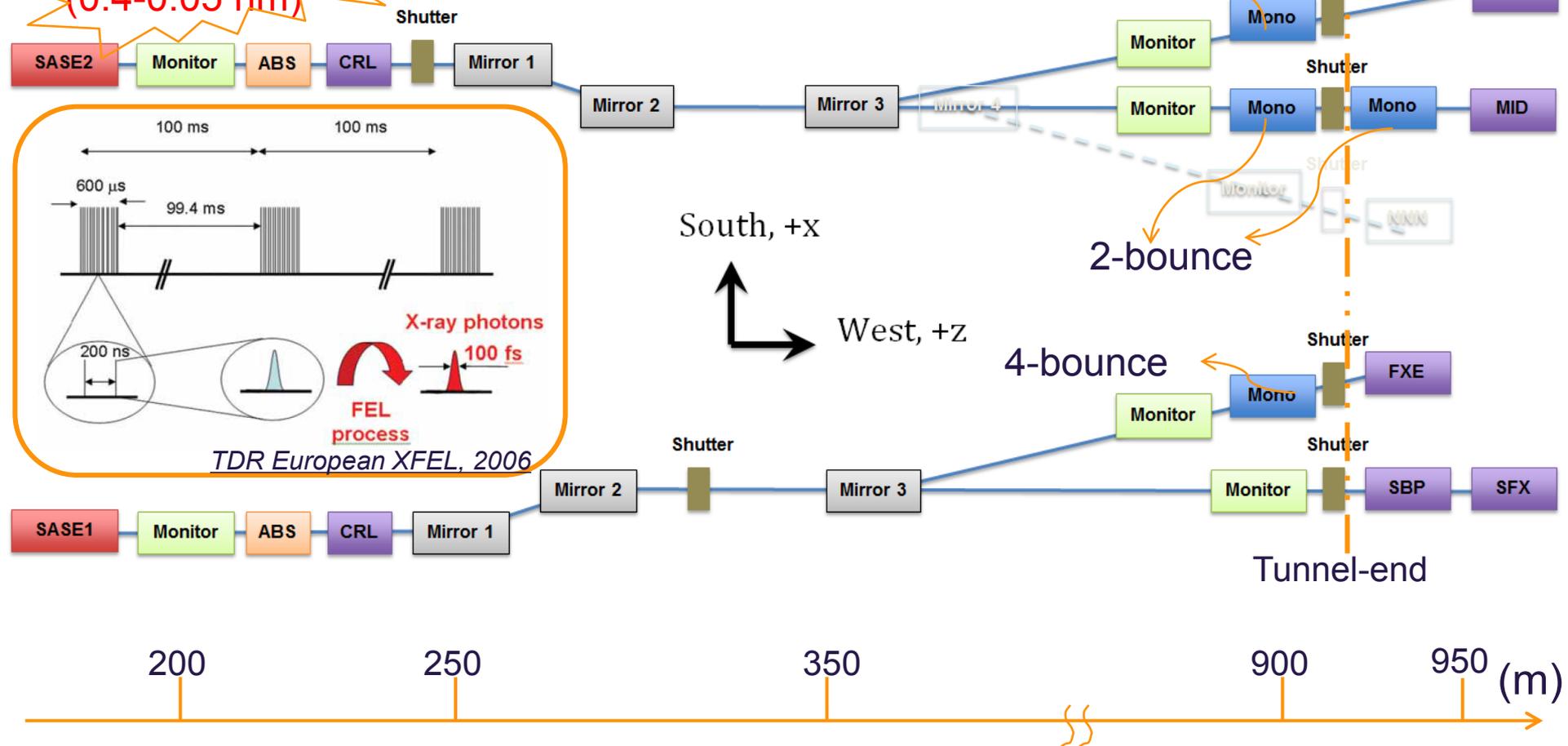
*Mechanical Engineering Design of Synchrotron Radiation Equipment and Instrumentation 2014, 20th - 24th October 2014, Melbourne*

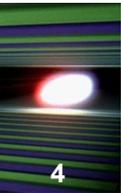
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3-25 keV  
(0.4-0.05 nm)



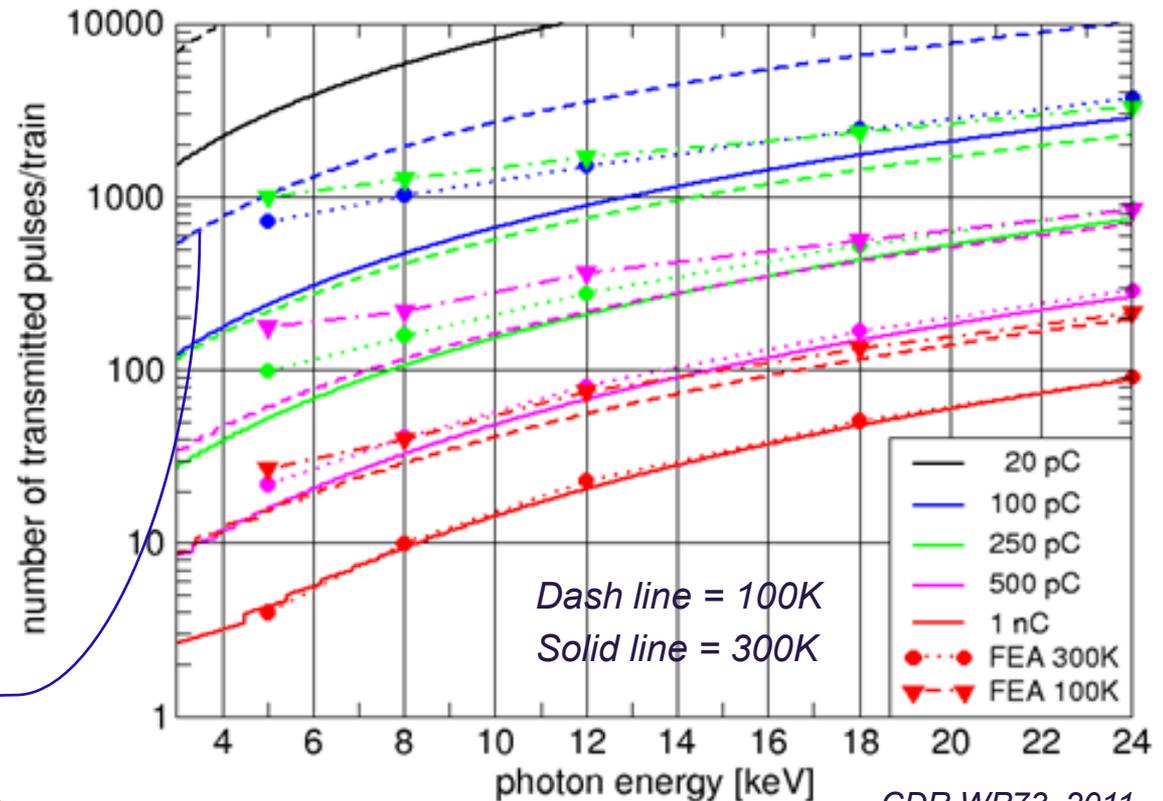


## Artificial Channel-cut type

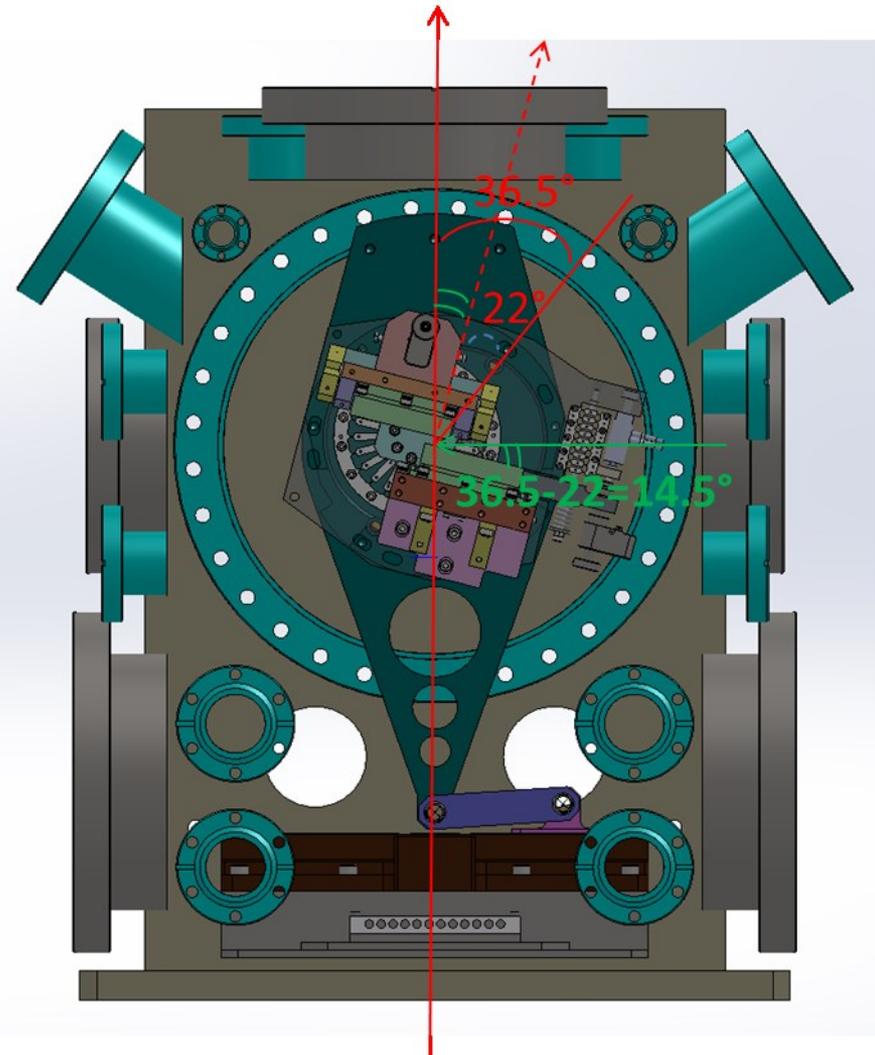
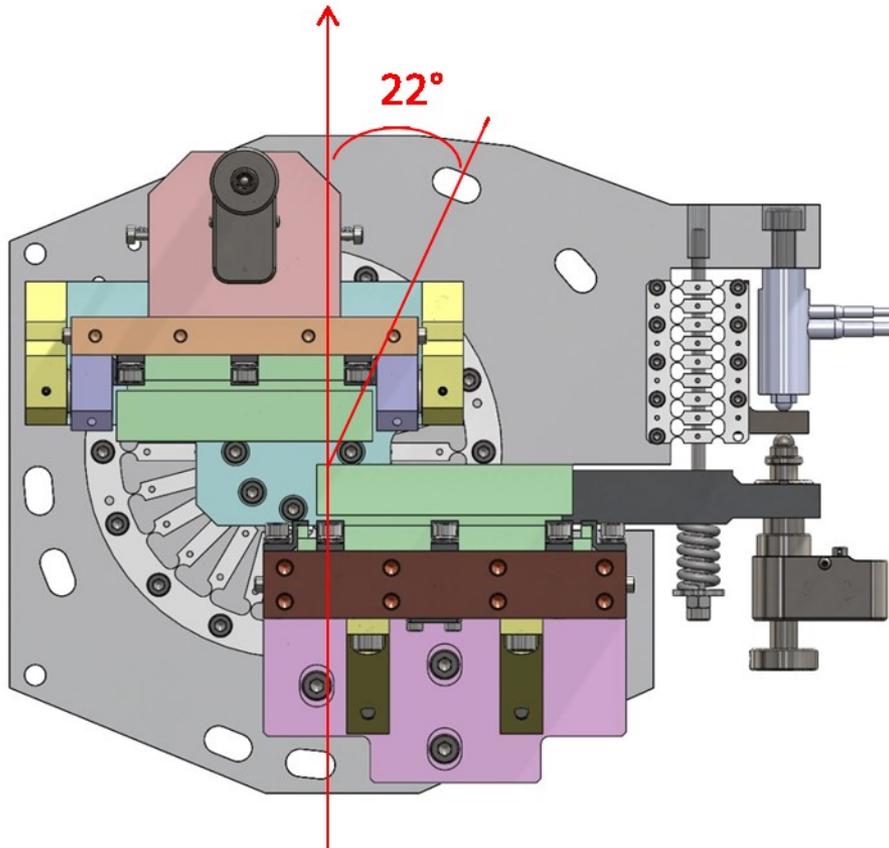
Enhanced stability-  
Minimizing vibrations  
due to a long beam  
transport line

High quality polishing  
surface-Minimizing  
wavefront distortions

*Transmitted pulses at  
100K 5x more than  
the ones at 300K*

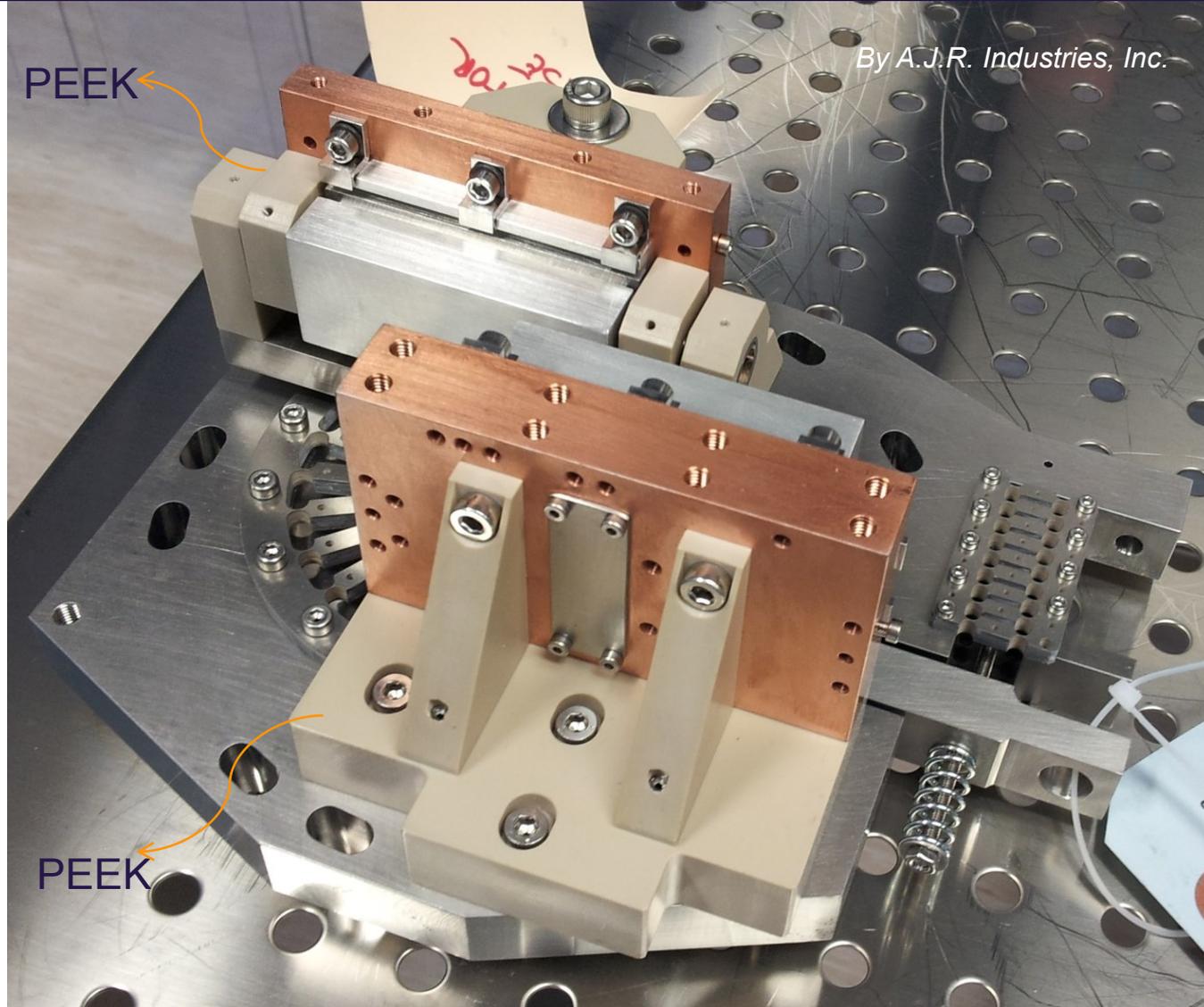
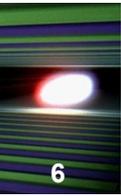


Both crystals are cryogenically cooled—  
Connecting directly to the cold plate:  
to minimize deviation (angle variation)



*Si(111) & Si(220): 60x28(25)x12 mm;  $\Delta E/E = 10^{-4}$   
*Si(311) & Si(511) compatible**

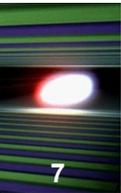
# Manufactured prototype (May 2014)



*By A.J.R. Industries, Inc.*

PEEK

PEEK



Pulse-tube Cry-cooler  
Based on He-gas

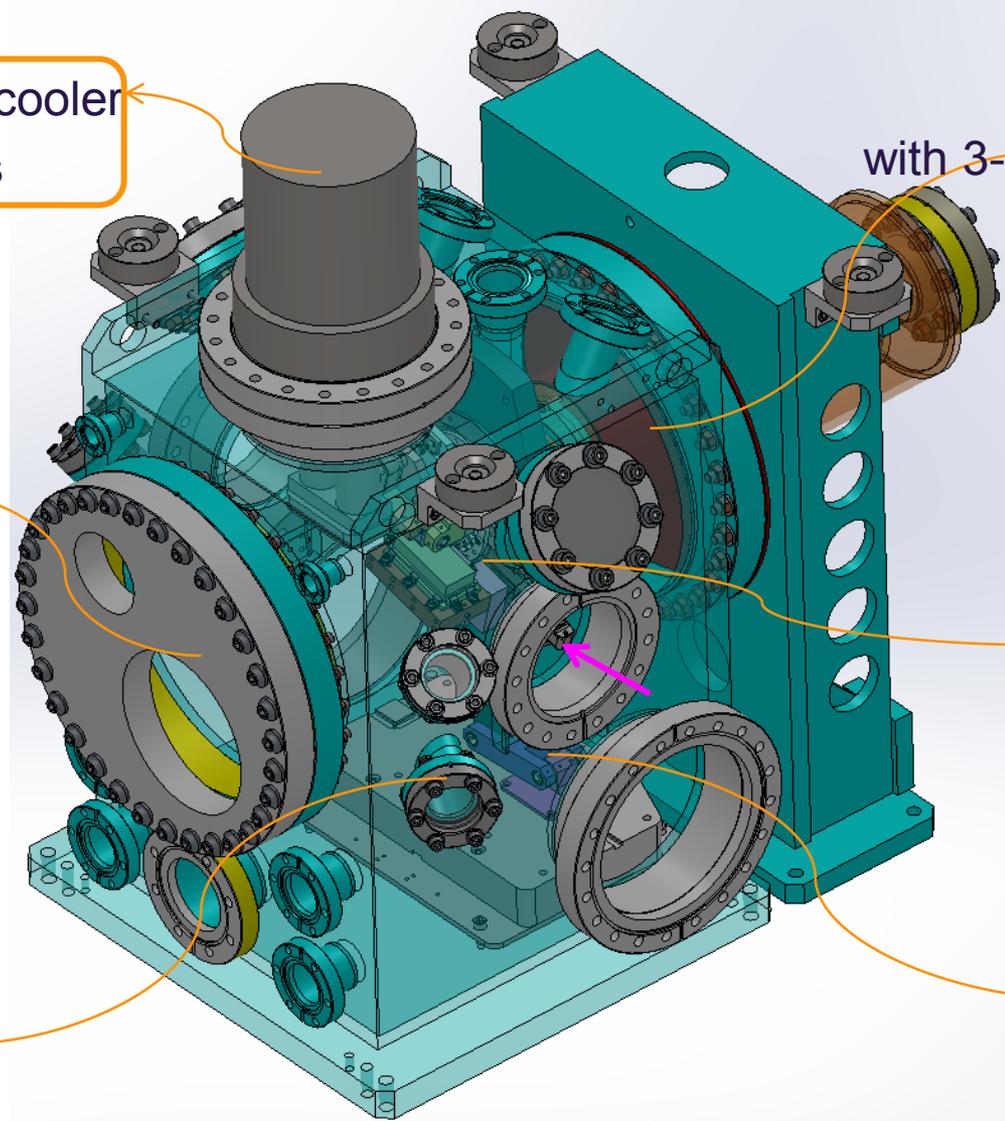
rotation shaft  
with 3-set ceramic bearings

Assembly window

ACCM mechanism

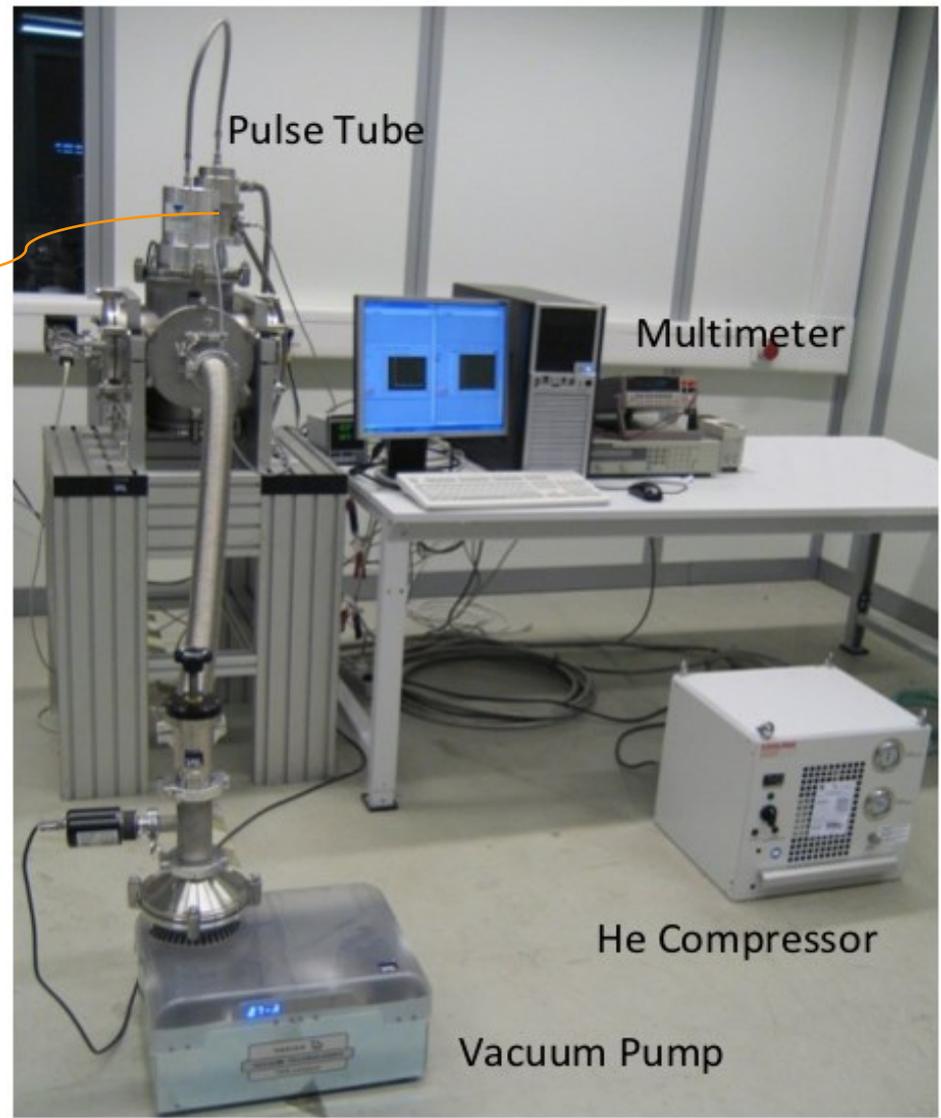
Optical  
Alignment port

Sine-bar driver

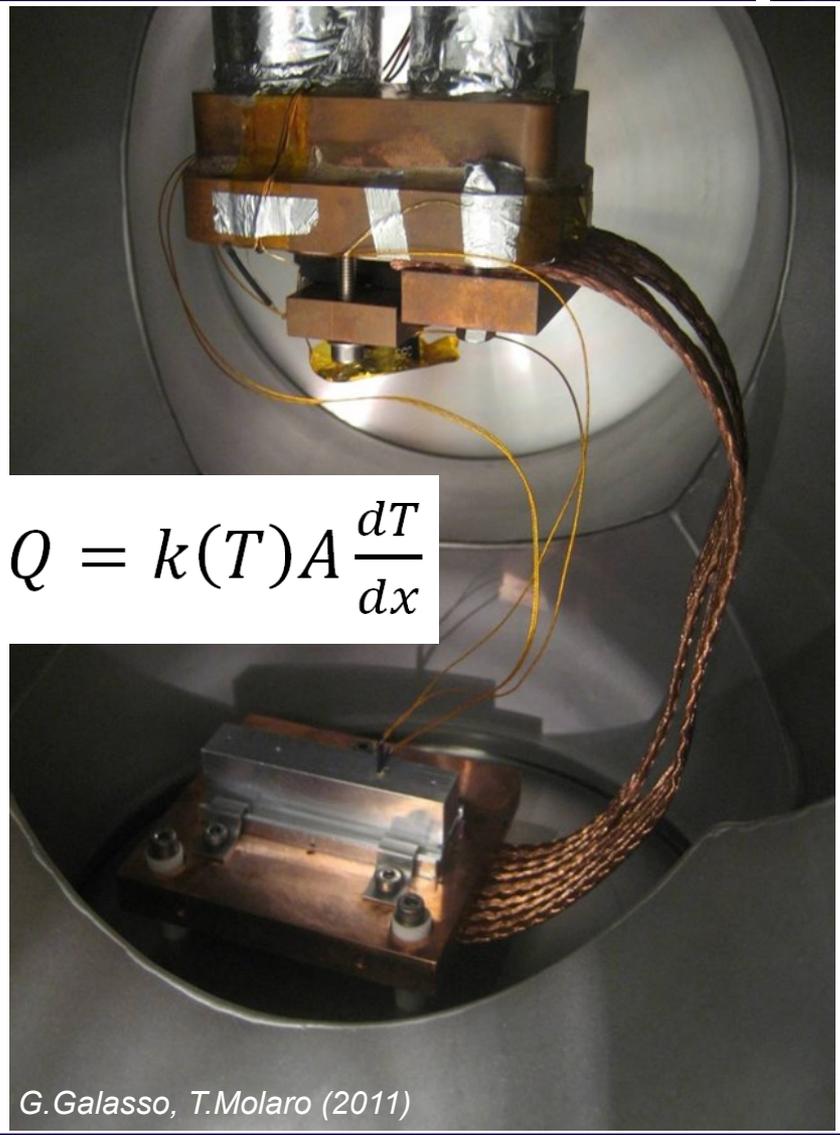
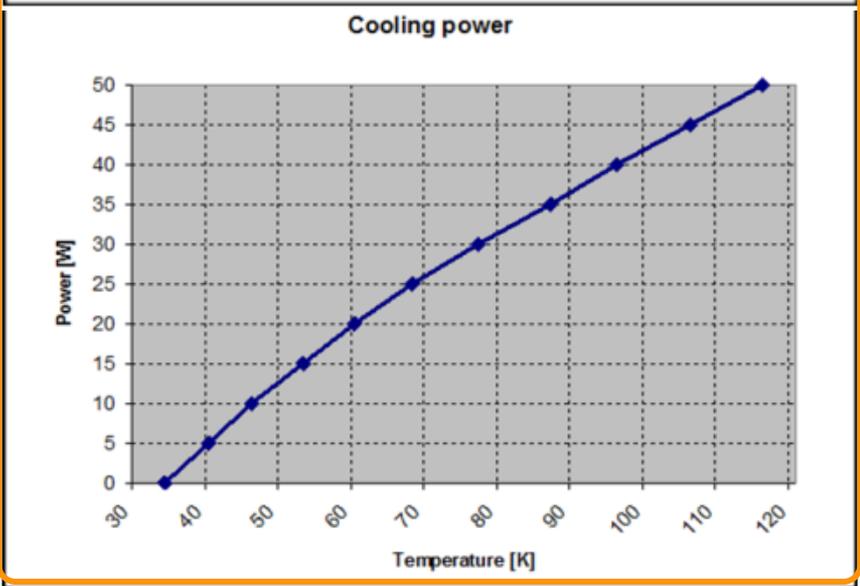
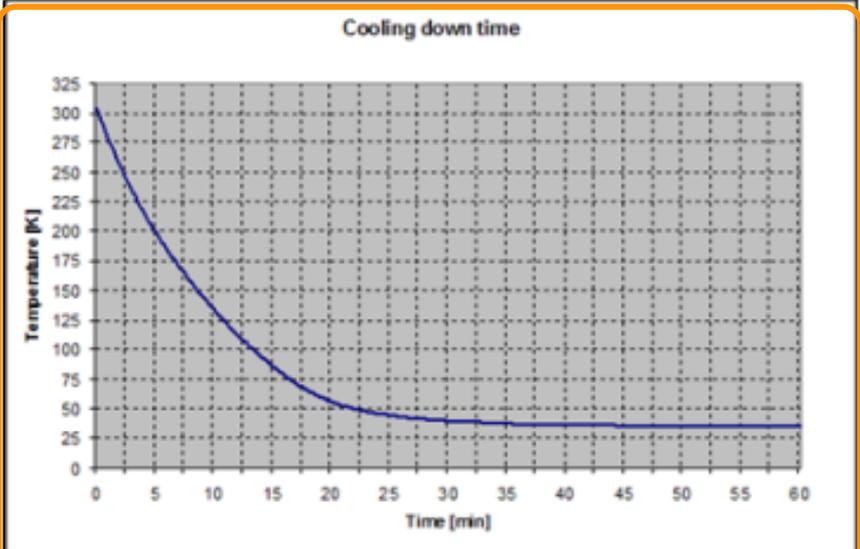
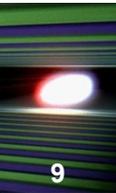




G. Galasso, A. Kukla (2010)

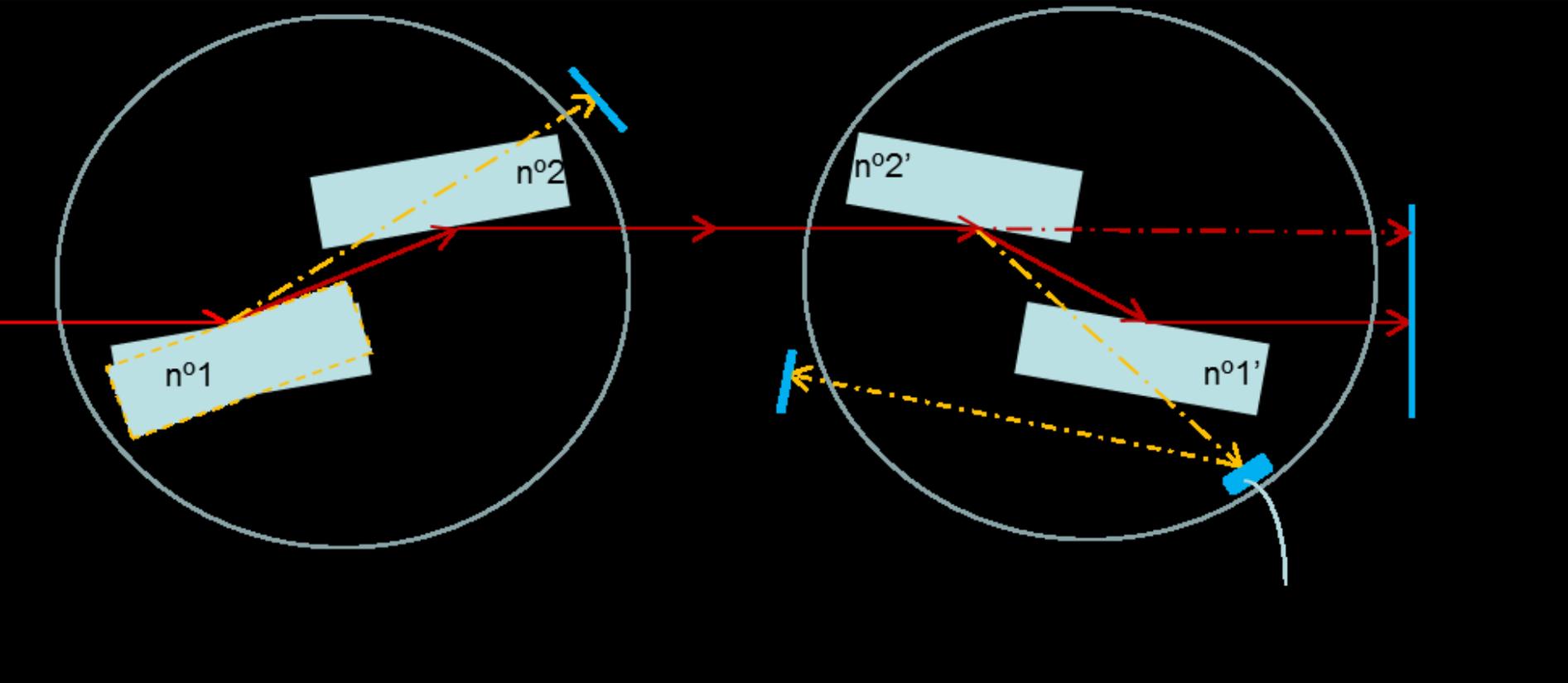
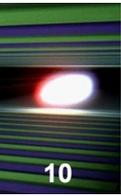


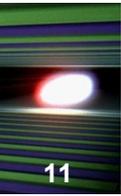
# Steady thermal behavior (Cryo-cooler test)



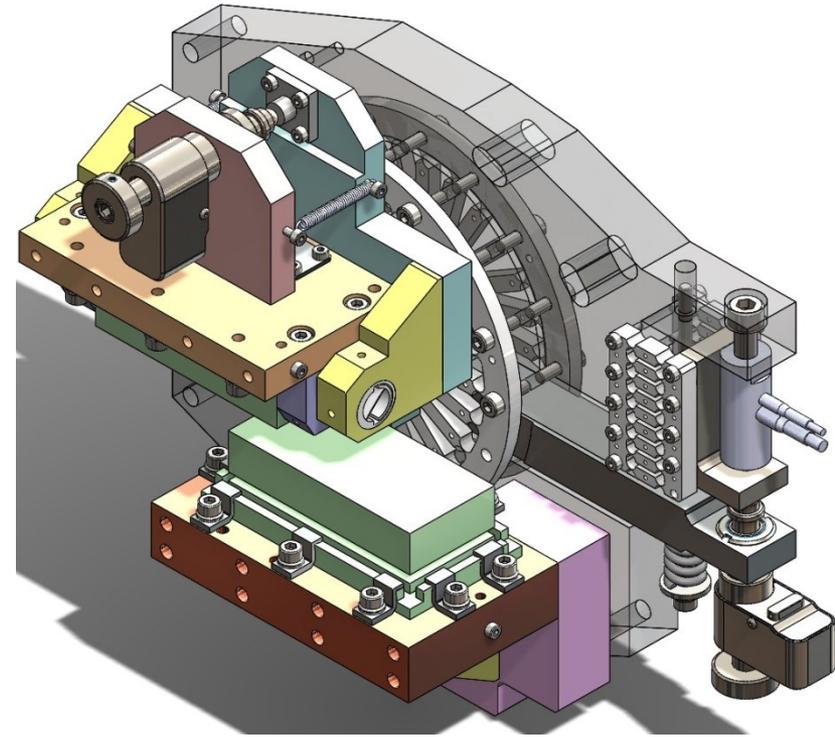
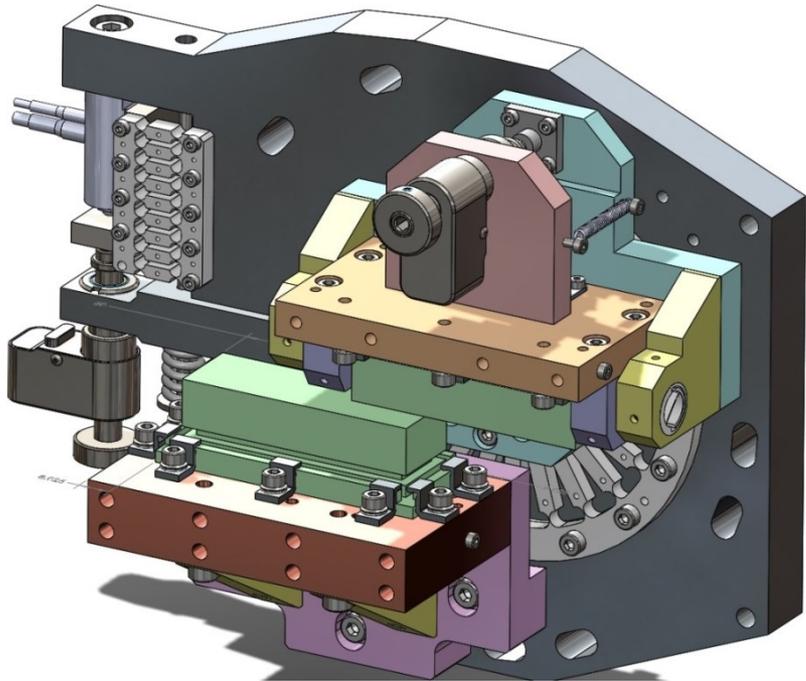
$$Q = k(T)A \frac{dT}{dx}$$

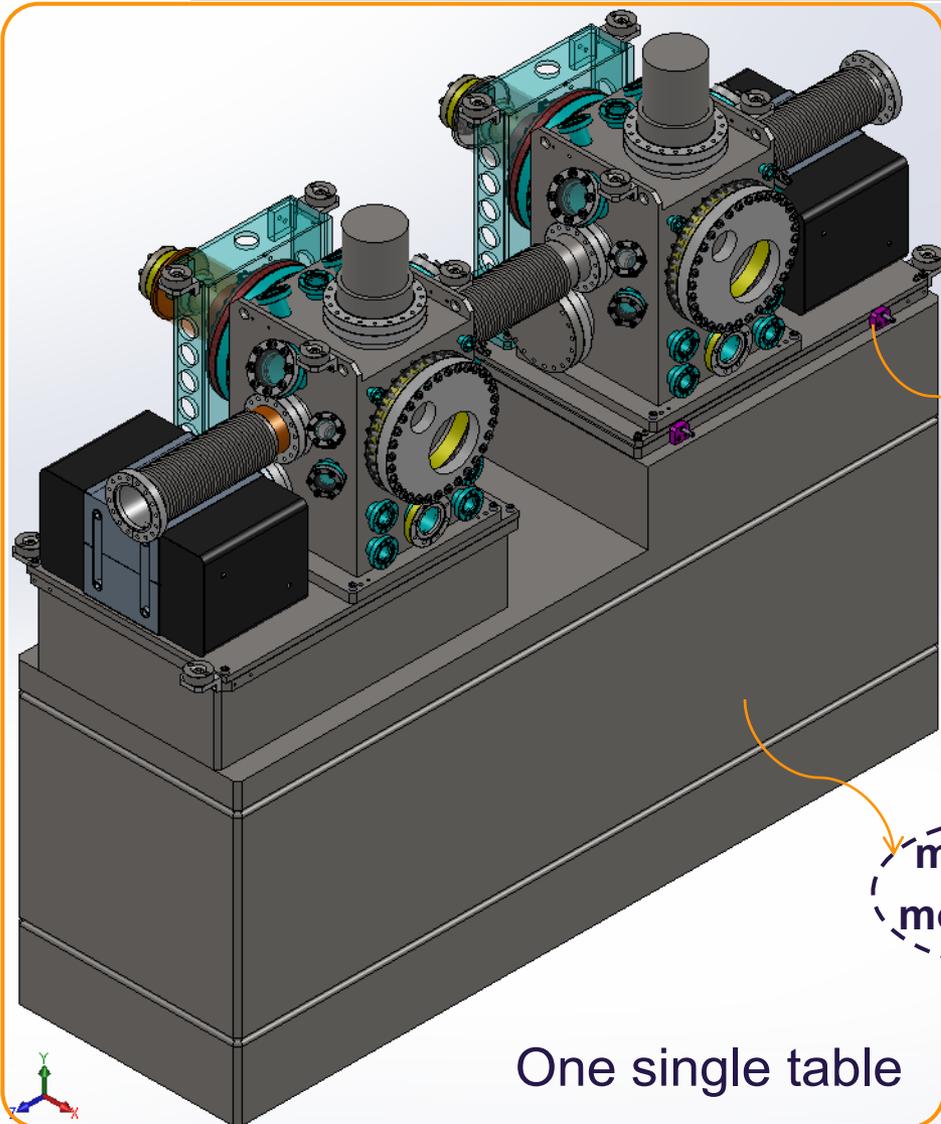
G.Galasso, T.Molaro (2011)



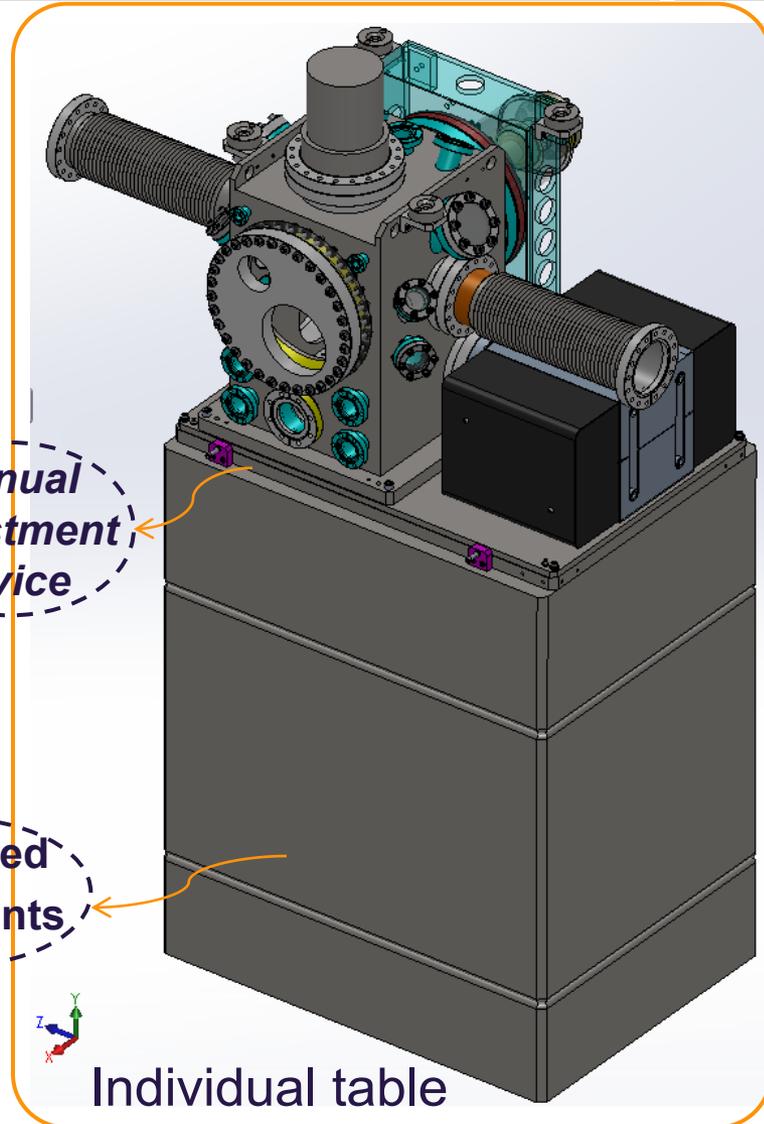


## Mirrored configuration





One single table

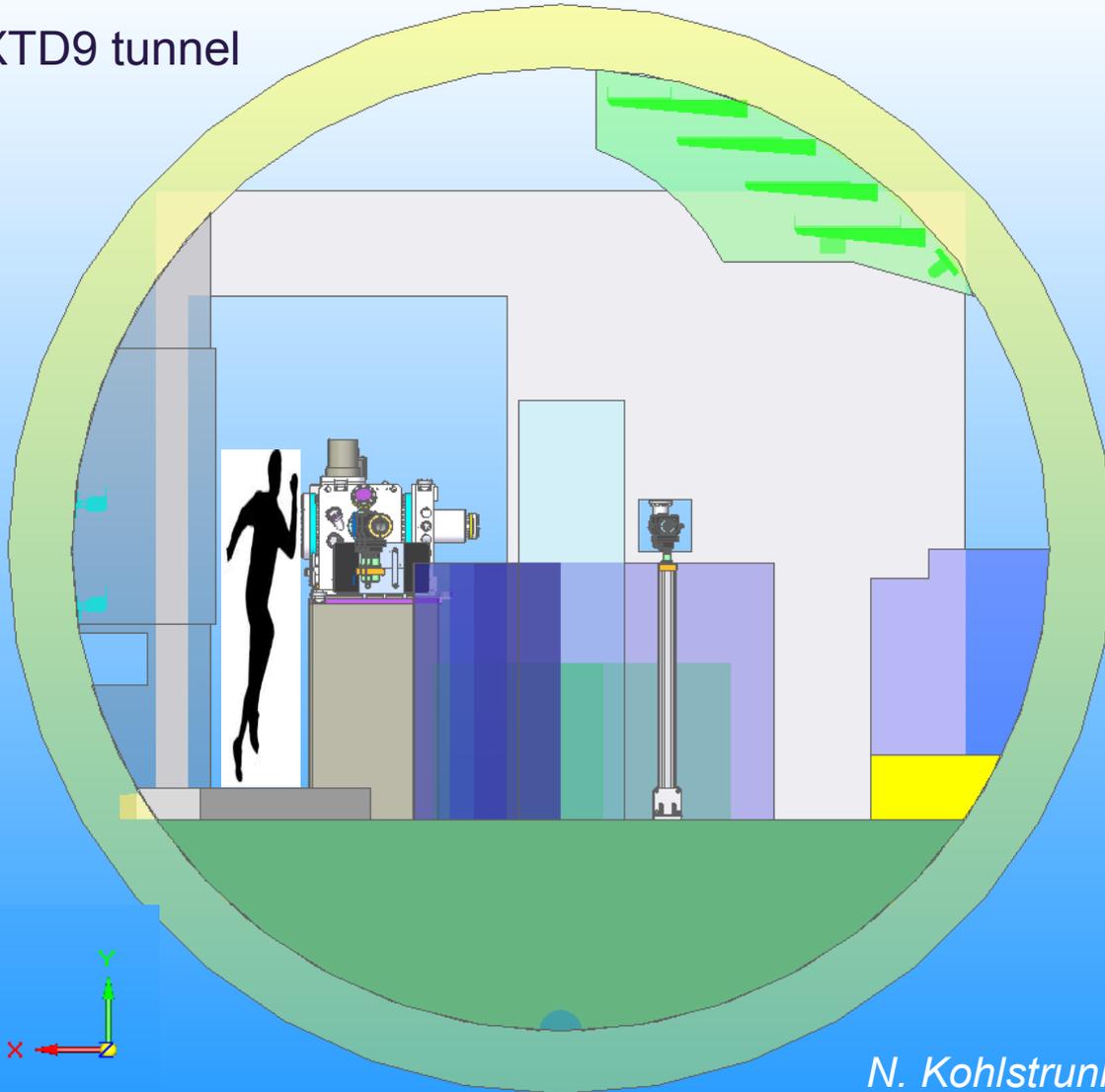


Individual table

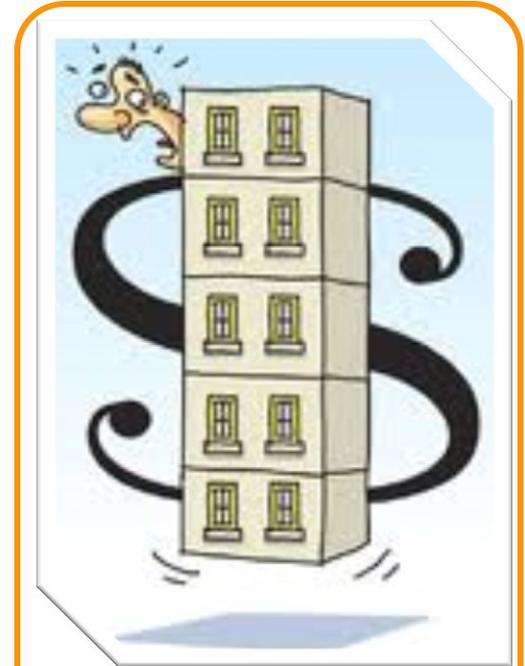
manual  
adjustment  
device

motorized  
movements

XTD9 tunnel



N. Kohlstrunk



“Space in the instruments hall is much more expensive...”  
- A beamline Scientist



Many thanks  
to G. Galasso etc. for feasibility studies of the cooling performance of the pulse tube cooler...  
to all the related colleagues in our group and European XFEL for this in-house project...  
to S. Narayanan & W. Yang at APS, and V. Srinivasan at LCLS, etc., for feedback and discussion...  
to the arrangement of the work for others agreement No.857Y2 between Uchicago Argonne LLC and European XFEL. Work at Argonne is supported by the U.S. Department of Energy, Office of Science, under Contract No. DE-AC02-06CH11357.