

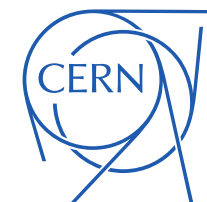
## FCC-hh Synchrotron Radiation Effects: The new ANKA facility for desorption measurement



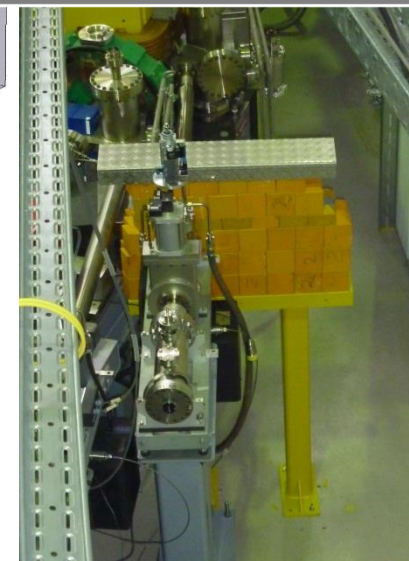
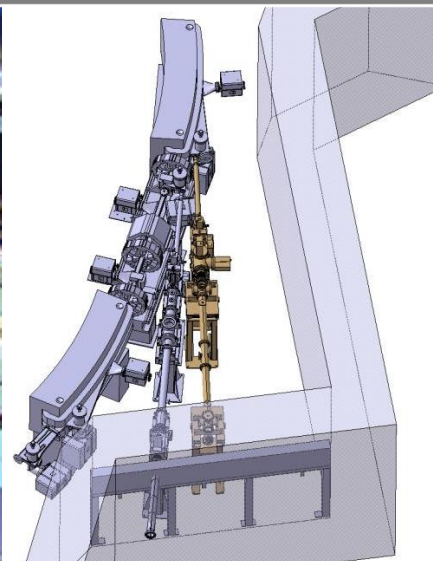
S. Casalbuoni, E. Huttel, D. Saez de Jauregui,  
IBPT, KIT

V. Baglin, C. Garion, M. Gil Costa\*, R. Kersevan,  
TE-VSC, CERN,  
\*CIEMAT

L. A. González Gómez,  
INFN



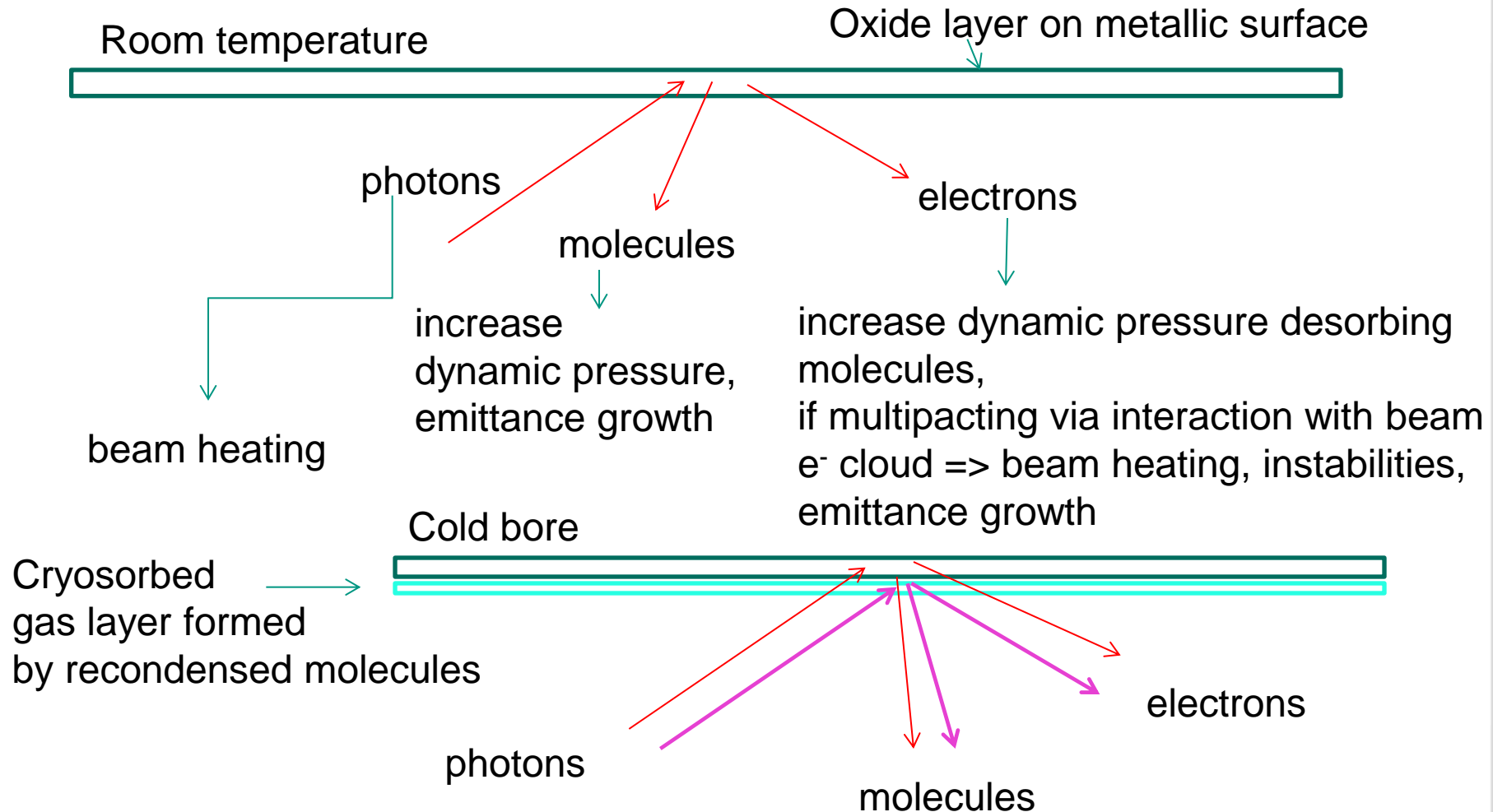
Institute for Beam Physics and Technology



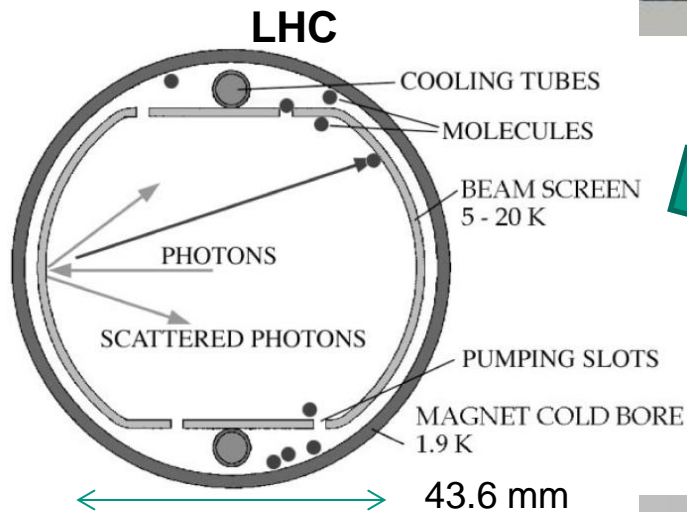
# Outline

- **Synchrotron radiation effects**
- **Remedies: examples LHC and FCC-hh arc beam chamber**
- **ANKA**
- **Facility for desorption measurements within EuroCirCol**
- **Summary and Outlook**

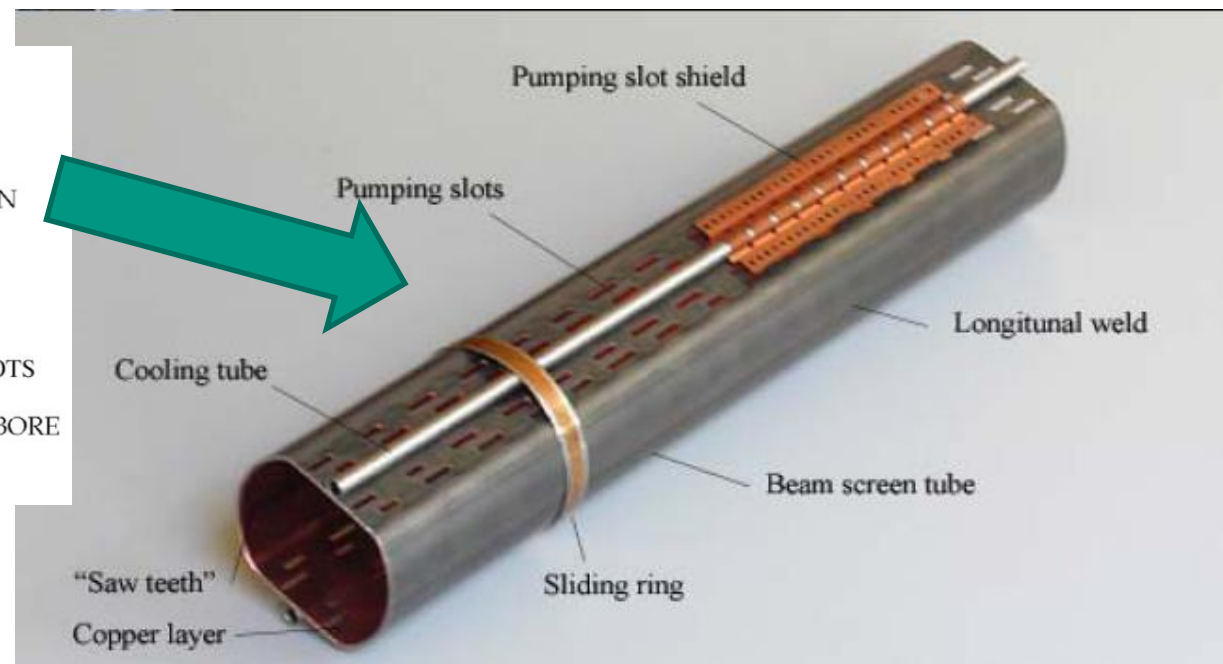
# Synchrotron Radiation Effects



# Remedies: LHC



O. Gröbner, Vacuum 60 (2001) 25-34

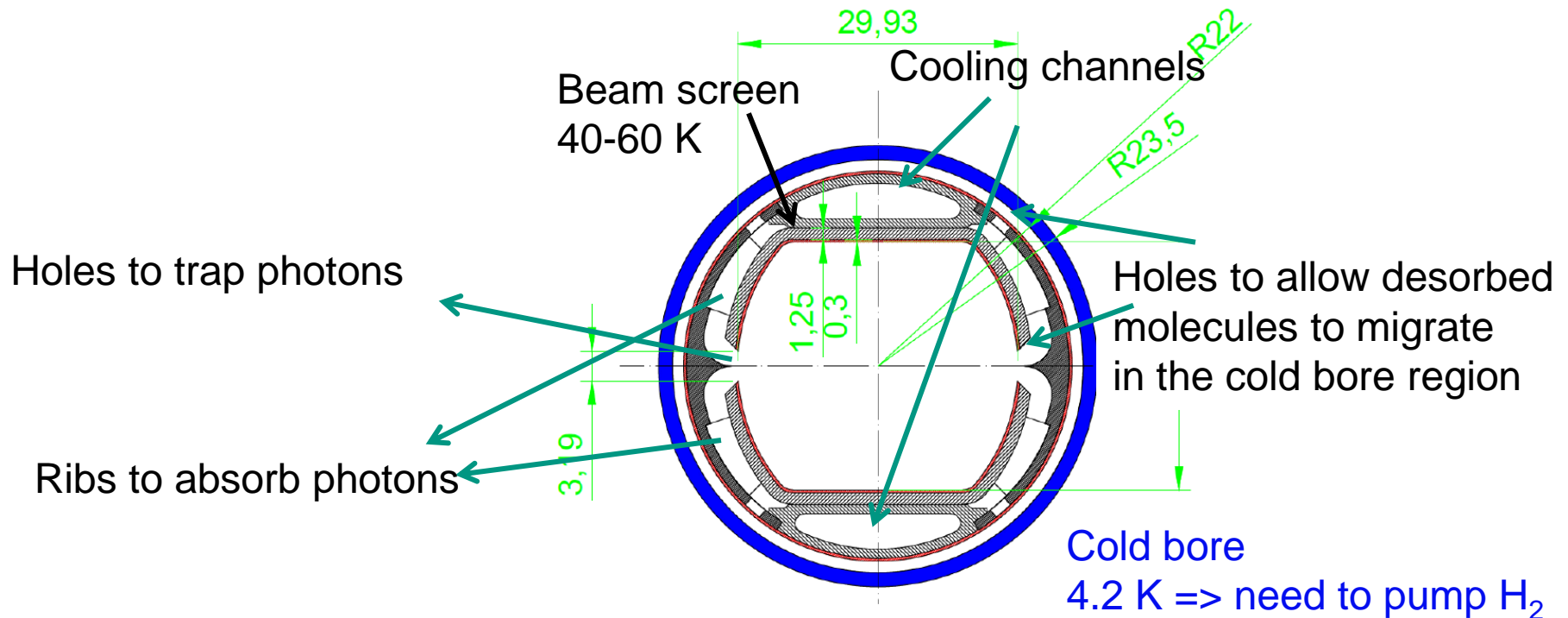


- Beam screen to protect cold bore from beam heating
- Cooling tubes to balance the beam heat load
- Slots in the beam screen to guide the molecules in the colder region where no primary particle desorption
- Saw tooth structure reduces the forward scattered photons

synchrotron rad. = 0.17 W/m/aperture  
 Tot. Power = 0.007 MW

F. Zimmermann et al., HF2014, Beijing, China (THP3H1)

# Remedies: FCC-hh, preliminary design



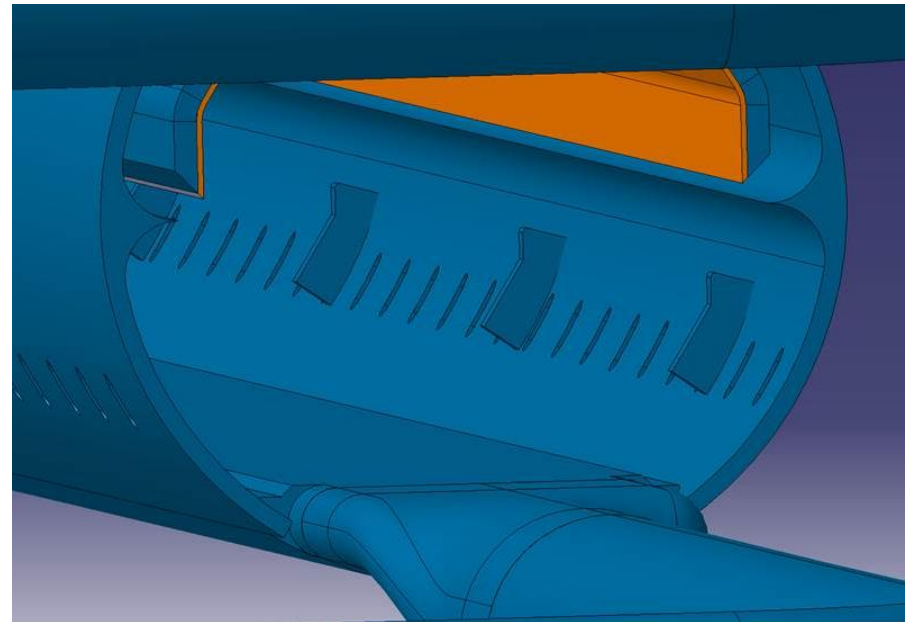
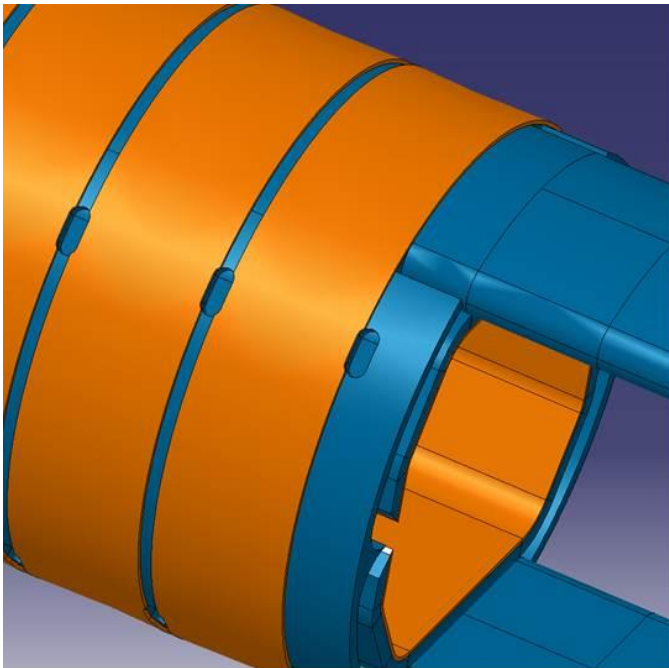
C. Garion, 3<sup>th</sup> EuroCircol WP4 meeting, Orsay, France, 2015

synchrotron rad. = 28 (44) W/m/aperture

Tot. Power = 4.8 (5.8) MW

F. Zimmermann et al., HF2014, Beijing, China (THP3H1)

# Remedies: FCC-hh, preliminary design

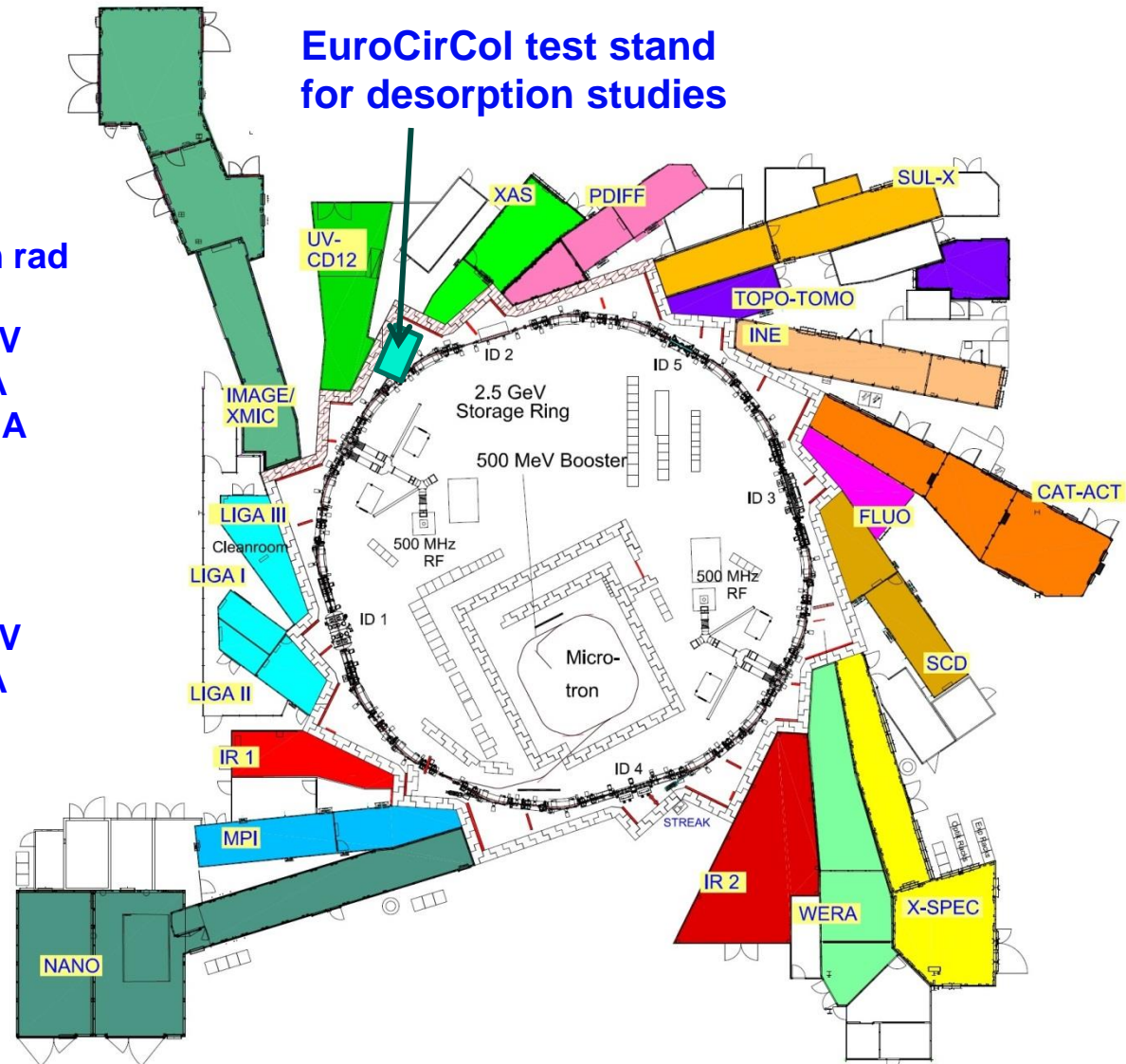


# ANKA Beam Parameters

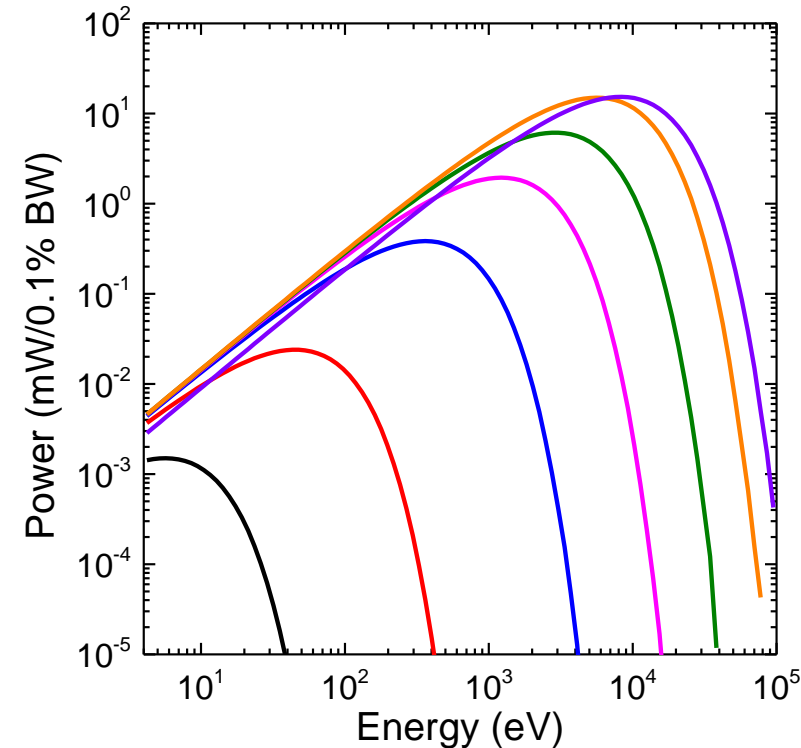
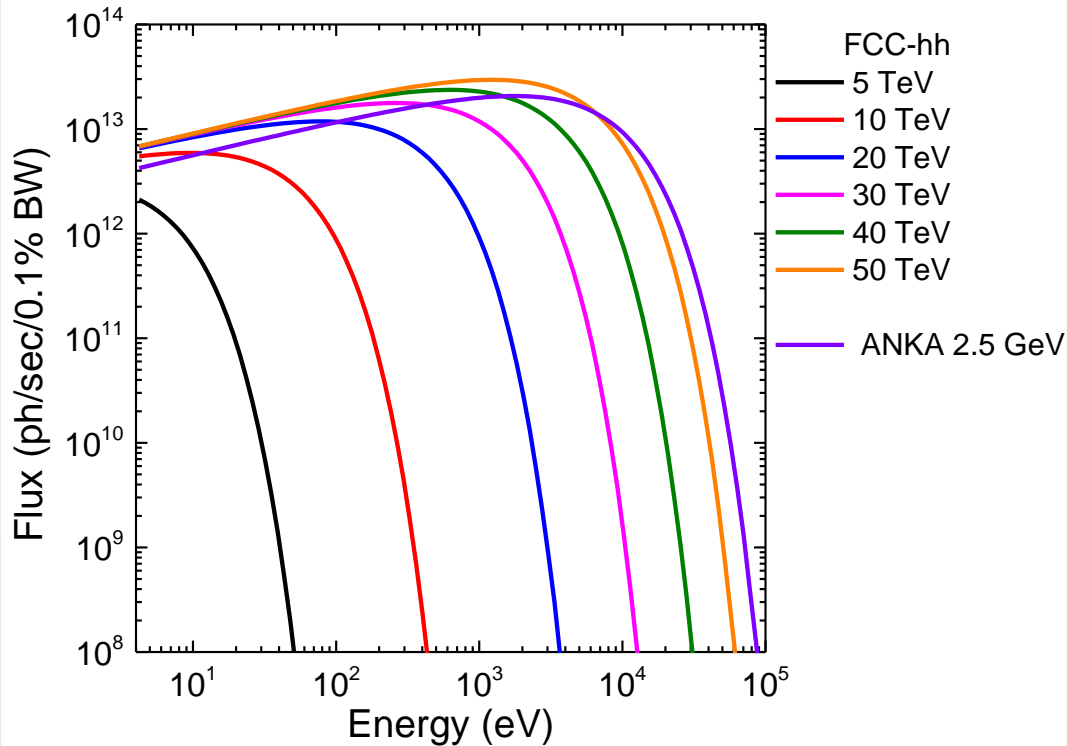
**Emittance:** 40 nm rad  
**Circumference:** 110.4 m  
**Energy:** 2.5 GeV  
**Current:** 200-100 mA  
**Optics:** 4x2 DBA  
**DP-field:** 1.5 T

## Dedicated shifts

**Energy:** 0.5-2.5 GeV  
**Current:** < 200 mA



# Comparison spectra and power



From 1 cm long arc of orbit in FCC-hh and 1 mm arc of orbit in ANKA, normalized to 1m length of orbit for FCC-hh and 1 cm for ANKA

Average beam current  
 500 mA FCC-hh  
 200 mA ANKA

Simulations performed with Synrad §

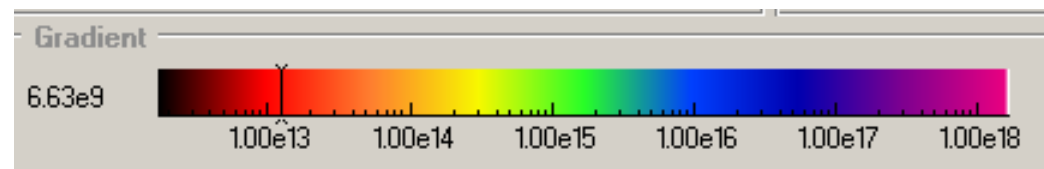
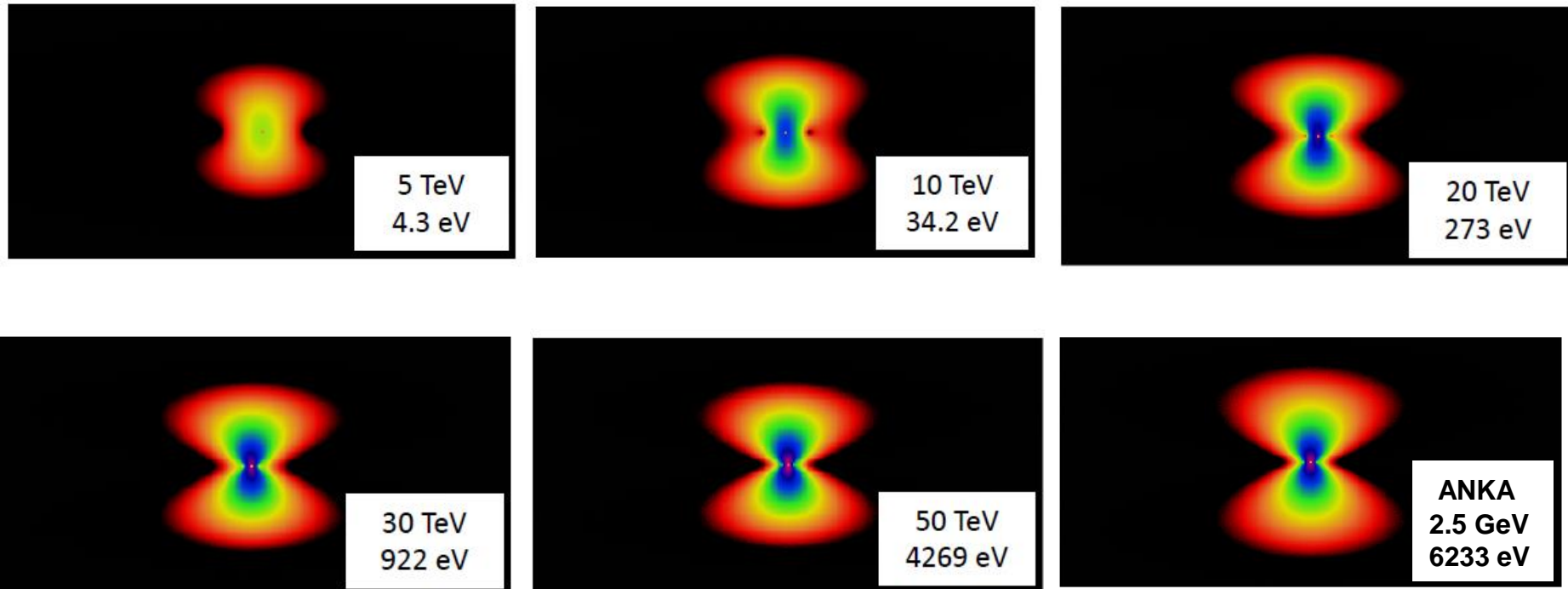
§ M. Ady, R. Kersevan, M. Grabski, IPAC15.

<http://test-molflow.web.cern.ch/node/107>



# Comparison spatial distribution flux density

0.4 mm x 0.4 mm at 10 m FCC-hh  
at 1 m ANKA

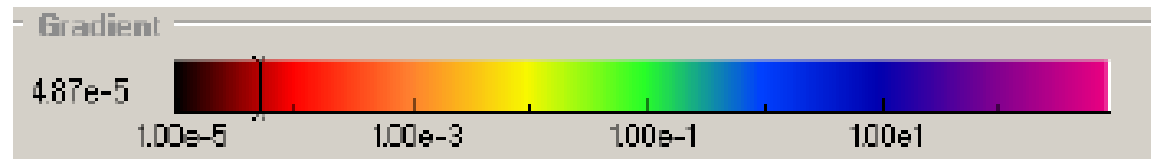
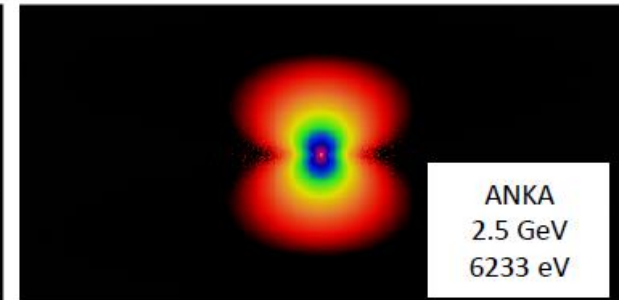
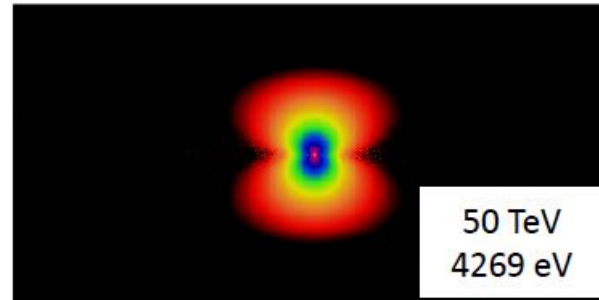
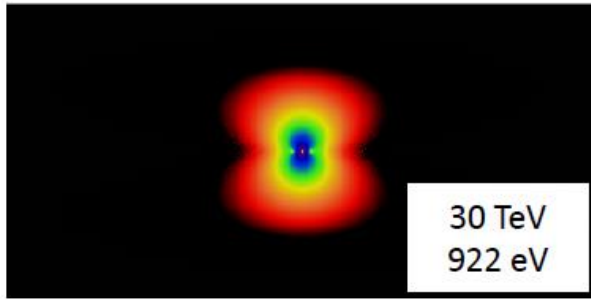
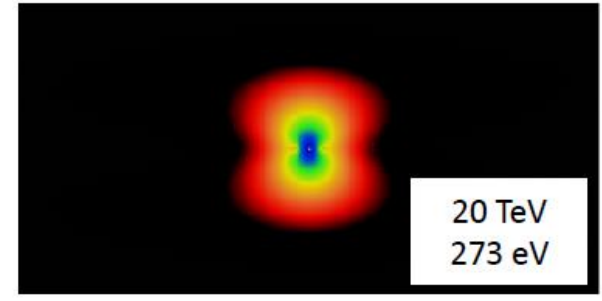
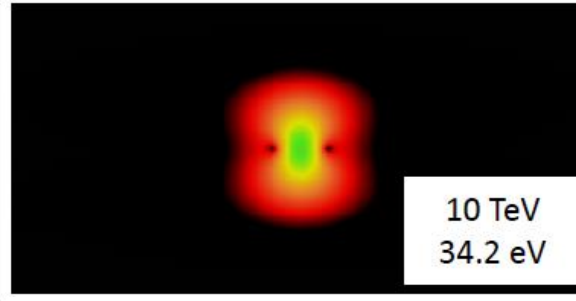
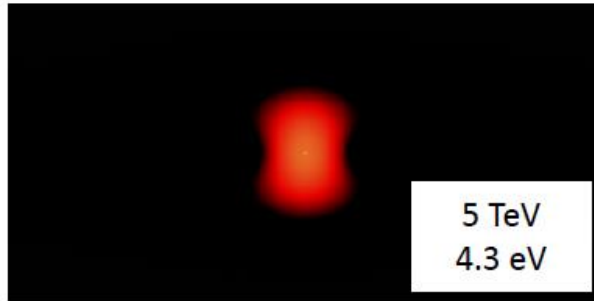


Flux (ph/sec/cm<sup>2</sup>)

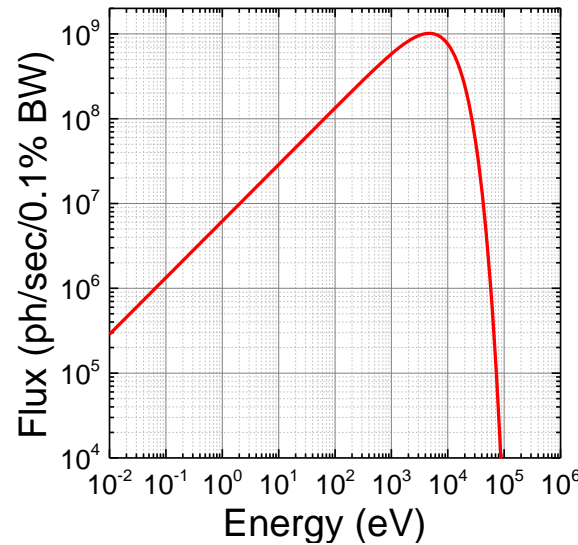
Calculated with Synrad.

# Comparison spatial distribution power density

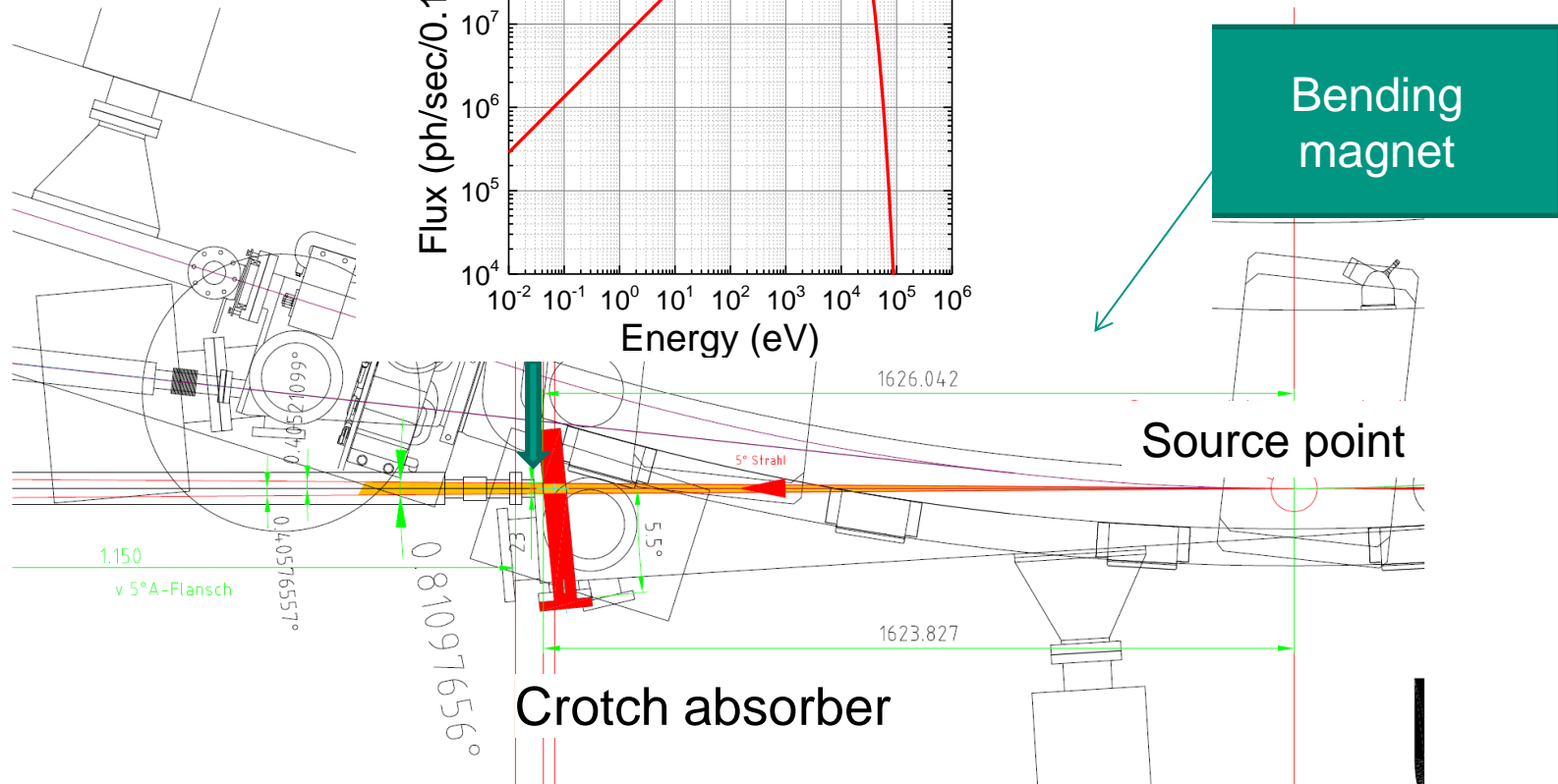
0.4 mm x 0.4 mm at 10 m FCC-hh  
at 1 m ANKA



Calculated with Synrad.



$E_c = 6.233\text{keV}$

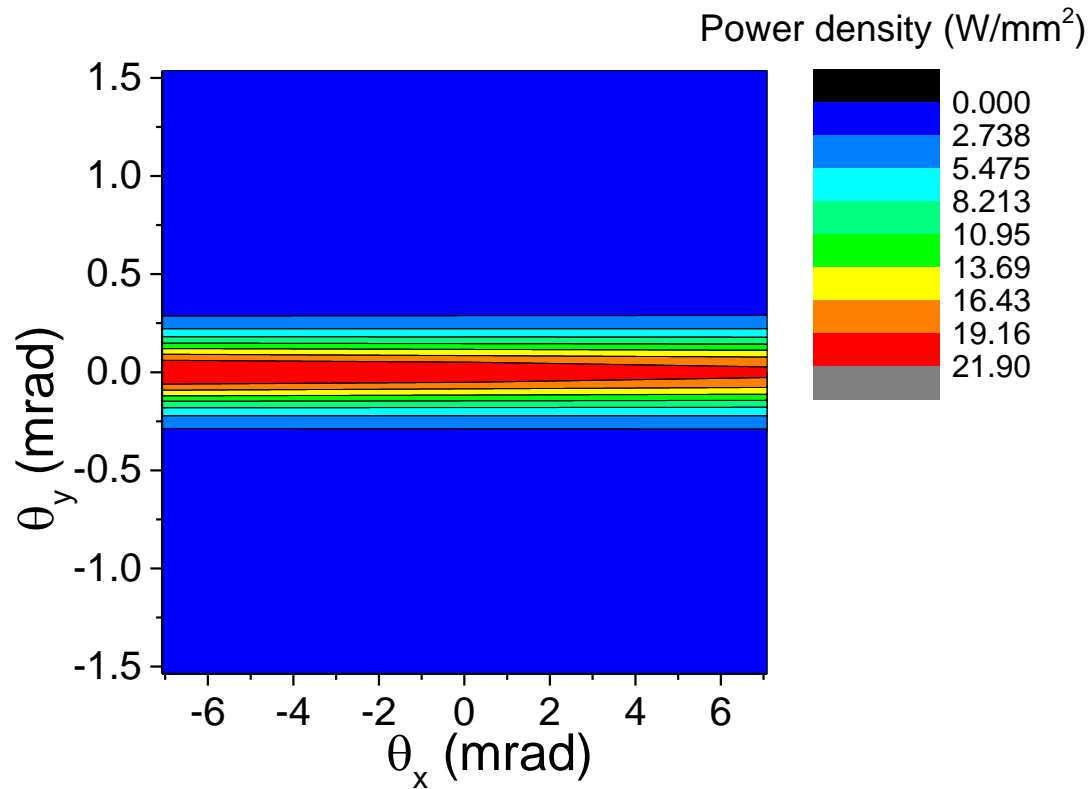


Simulations performed with SPECTRA<sup>s</sup>

<sup>s</sup>T. Tanaka and H. Kitamura, J. Synchrotron Rad. 8, 1221 (2001).

Cross-checked with Synrad.

# Power density after crotch absorber



$E = 2.5 \text{ GeV}$

$I = 200 \text{ mA}$

$\beta_x = 1.3 \text{ m}$

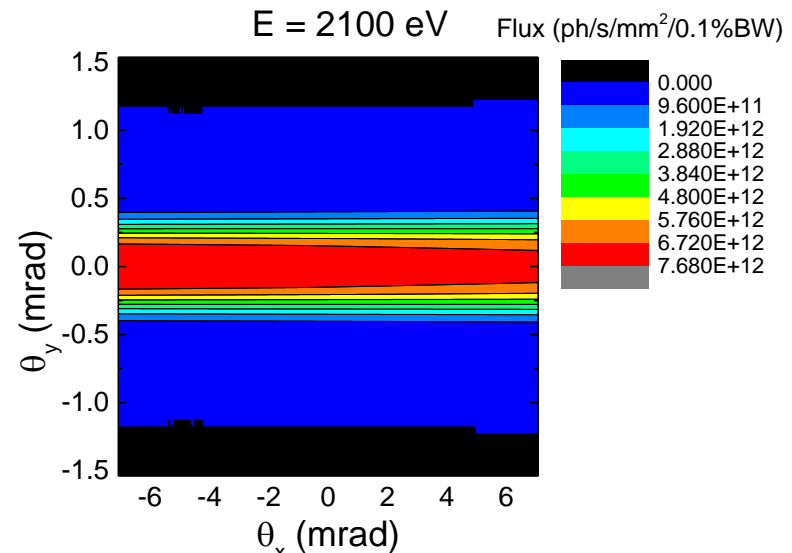
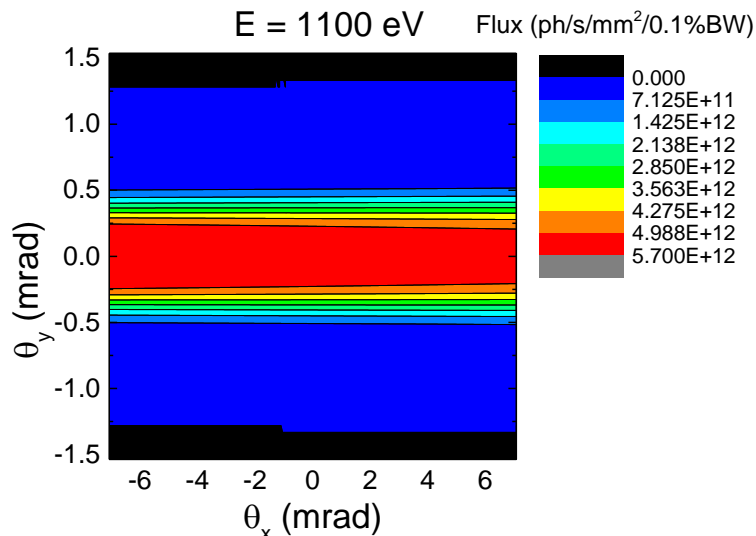
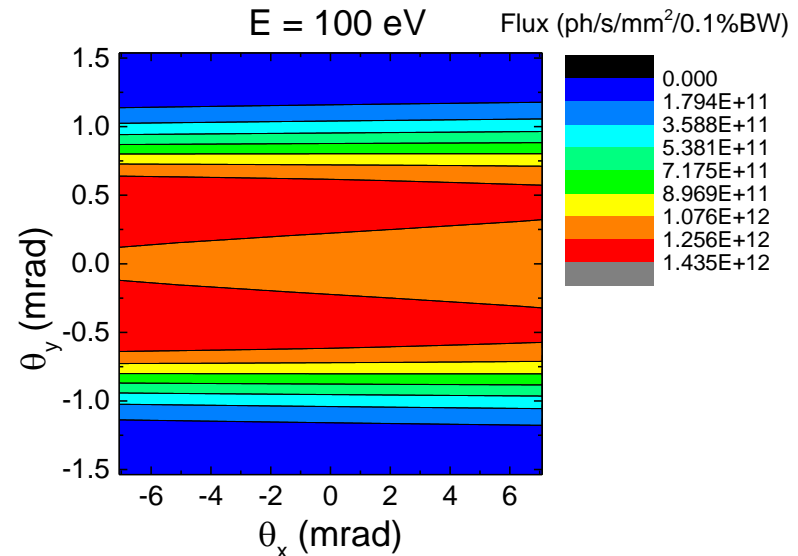
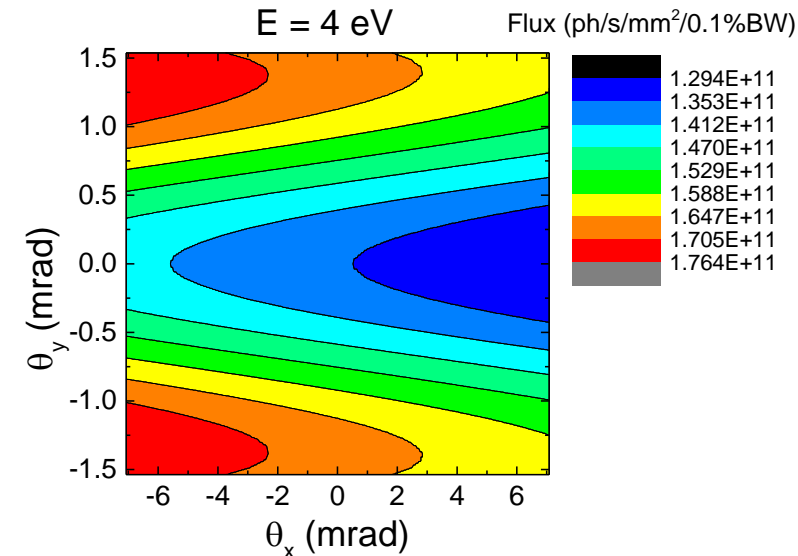
$\beta_y = 22.7 \text{ m}$

$\eta_x = 0.1 \text{ m}$

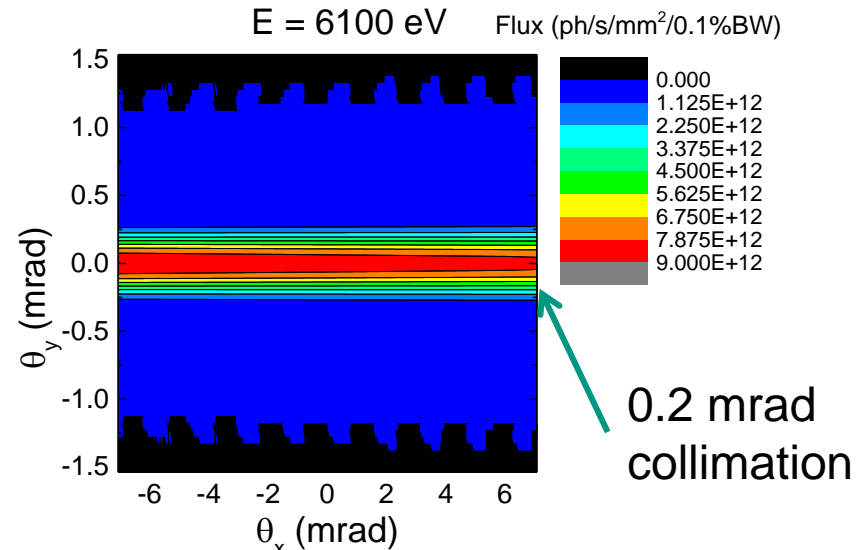
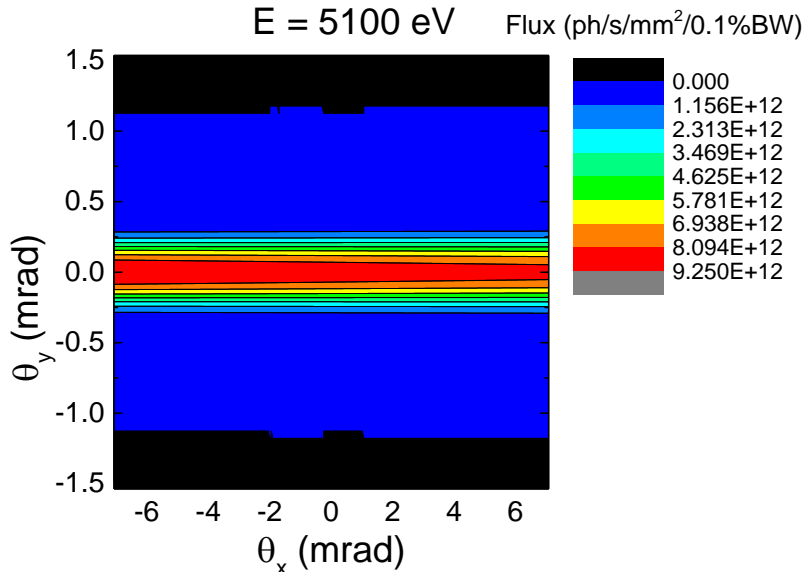
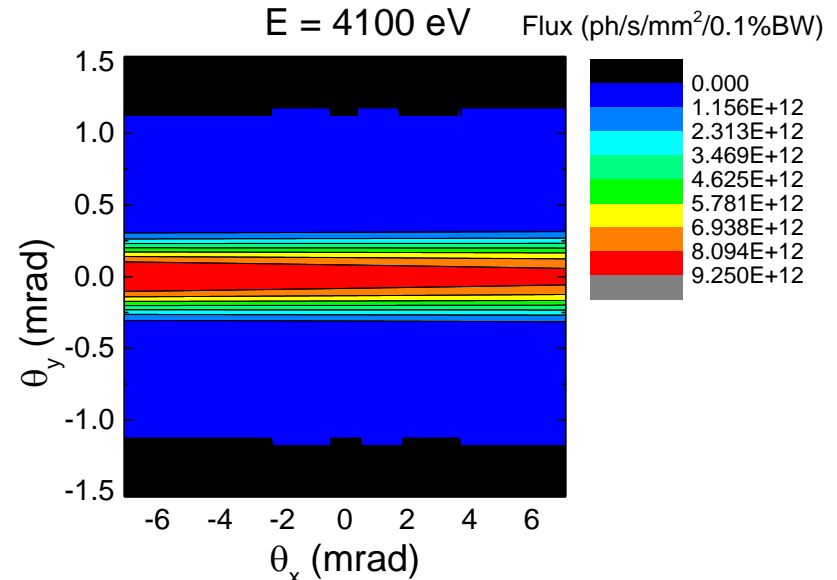
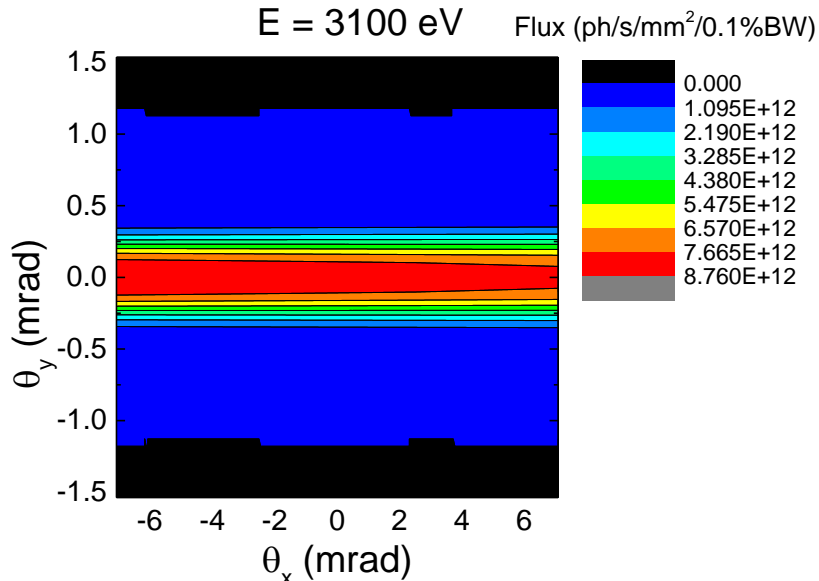
Simulations performed with SPECTRA

Cross-checked with Synrad.

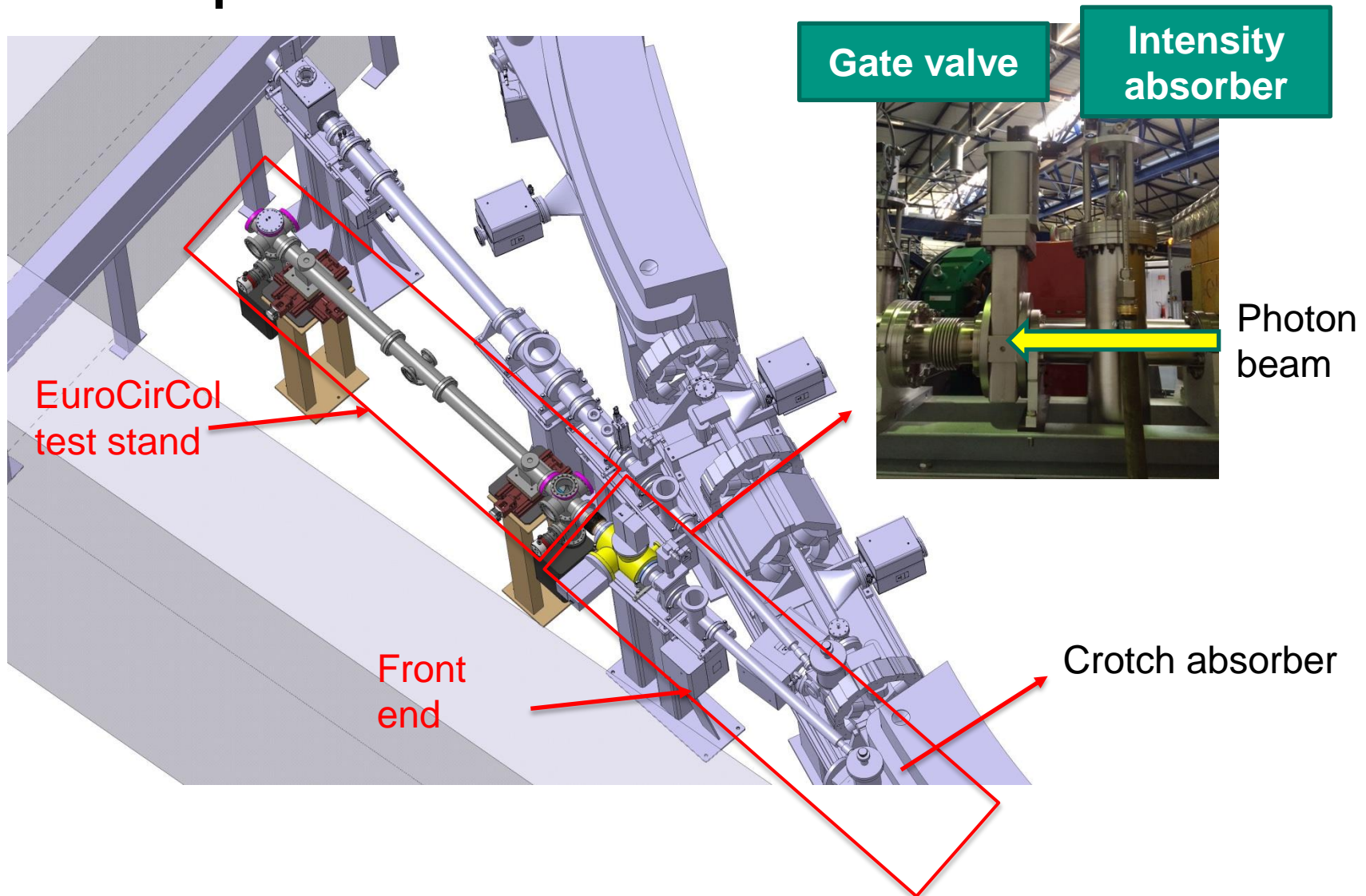
# Spatial spectral distribution after crotch absorber



# Spatial spectral distribution after crotch absorber



# The new ANKA facility for desorption measurements



# Goal within EuroCirCol

Validate the baseline of the preliminary design of the FCC-hh arc vacuum system for the prototype.

## Measurements of:

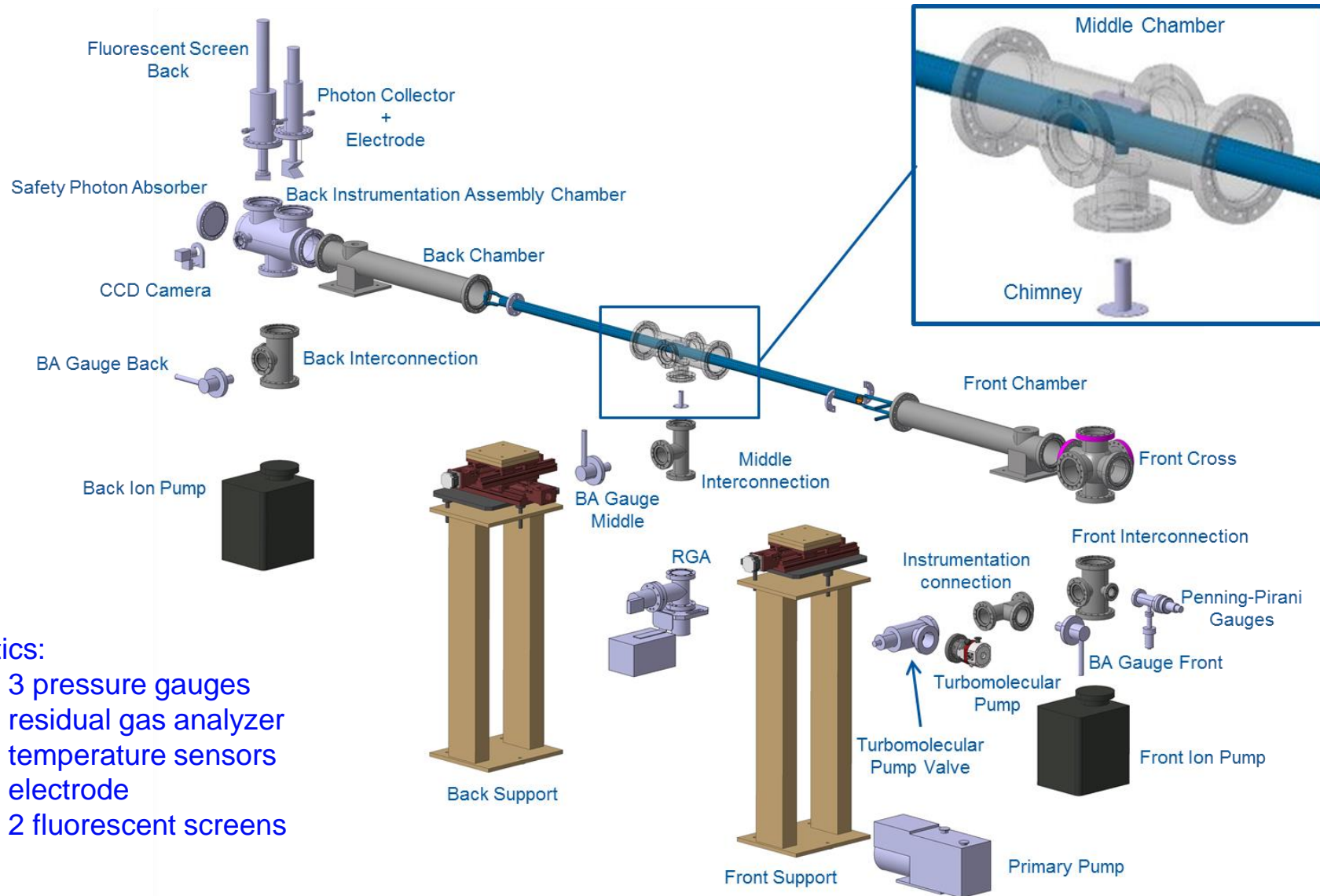
- Synchrotron radiation heat load spatial distribution
- Total and partial pressure and amount of desorbed molecules as a function of accumulated beam dose
- Photoelectrons from low energy photons reflected from the beam screen

Guideline EuroCirCol WP4 Task4.6 (EuroCirCol Proposal, H2020-INFRADEV-1-2014-1) :

*“ANKA at KIT will be responsible for the “**beam qualification**” of the beam-screen **prototype** supplied by CERN (D- 4.2). The goal is to determine **synchrotron radiation heat loads** and **photo-electrons** generation inside the **beamscreen prototype**.”*



# EuroCirCol test stand

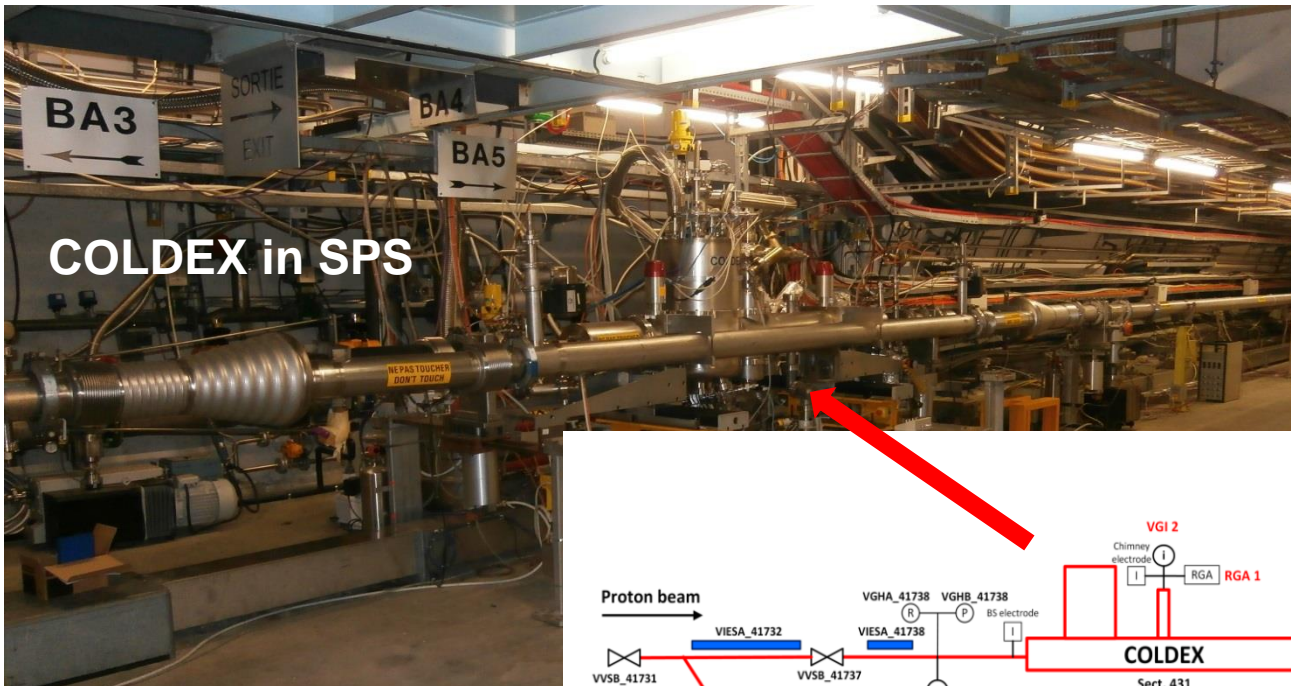


## Diagnostics:

- 3 pressure gauges
- residual gas analyzer
- temperature sensors
- electrode
- 2 fluorescent screens

# COLDEX

- First idea put COLDEX...or cold chamber
- COLDEX is in SPS since February 2014 (R&D HL-LHC)
- Cold chamber out of EuroCirCol timing: Final report Feb-Jun 2018 (FCC Conceptual Design Study by End 2018)



R. Salemme, WEPHA006, IPAC2015

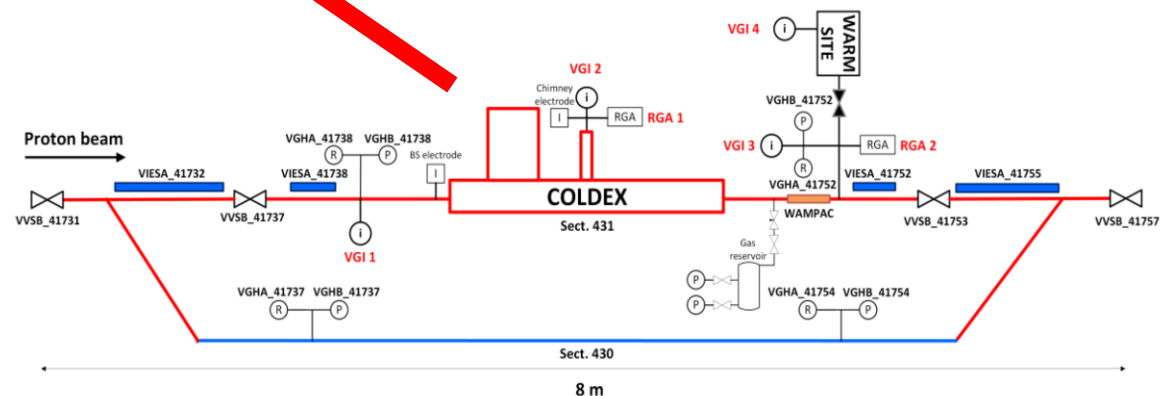
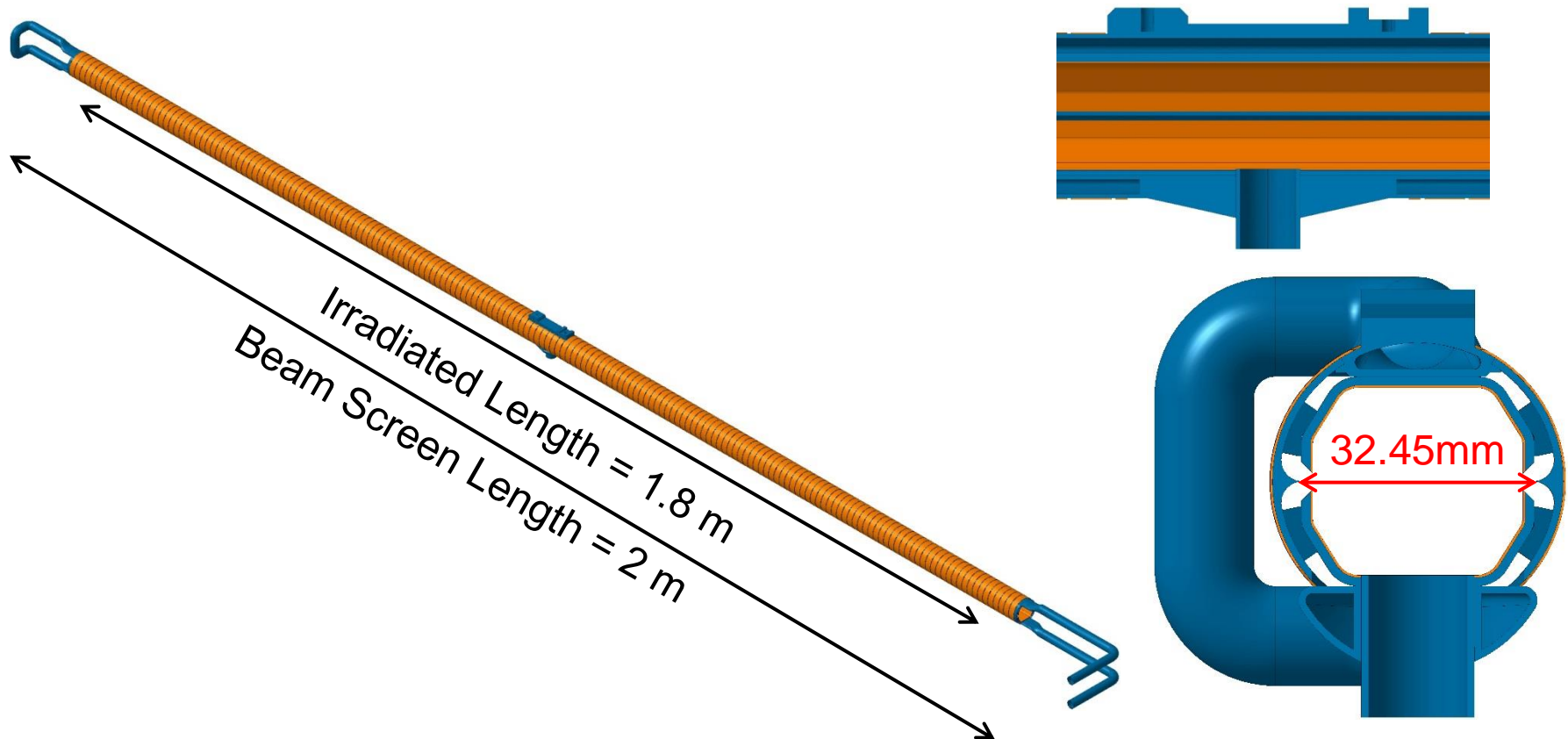


Figure 2: SPS/LSS4 vacuum sectors 430 and 431 during COLDEX operation.

# First test at ANKA within EuroCirCol

- Warm chamber with geometry as proposed design FCC-hh (baseline)

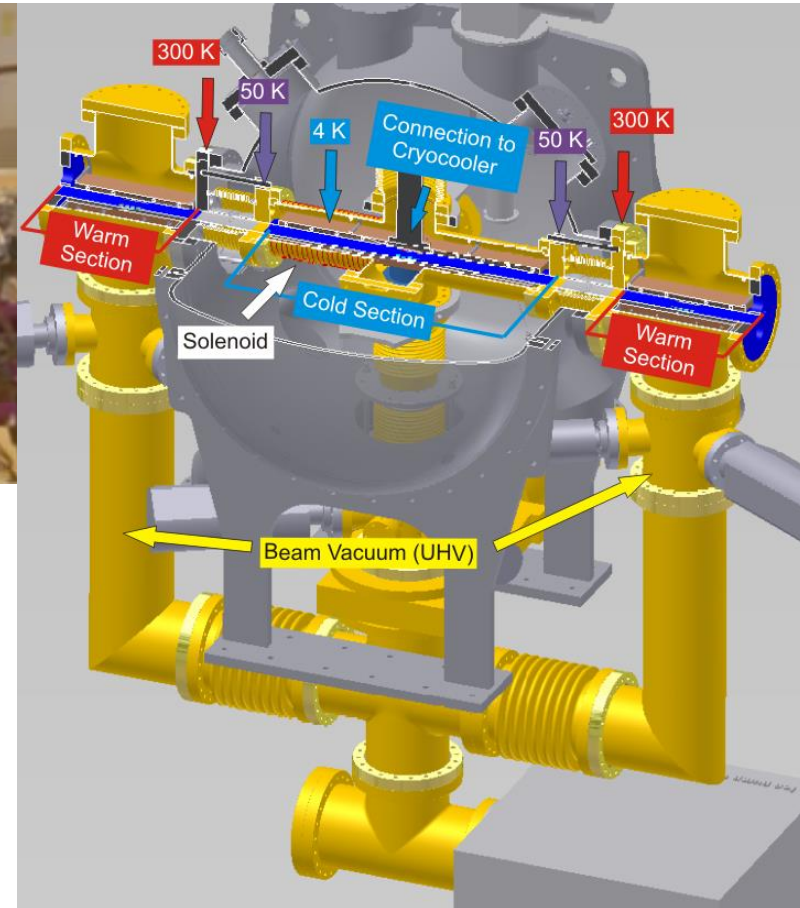


**For more details on the design of the FCC-hh arc vacuum chamber, please see talk of C. Garion.**

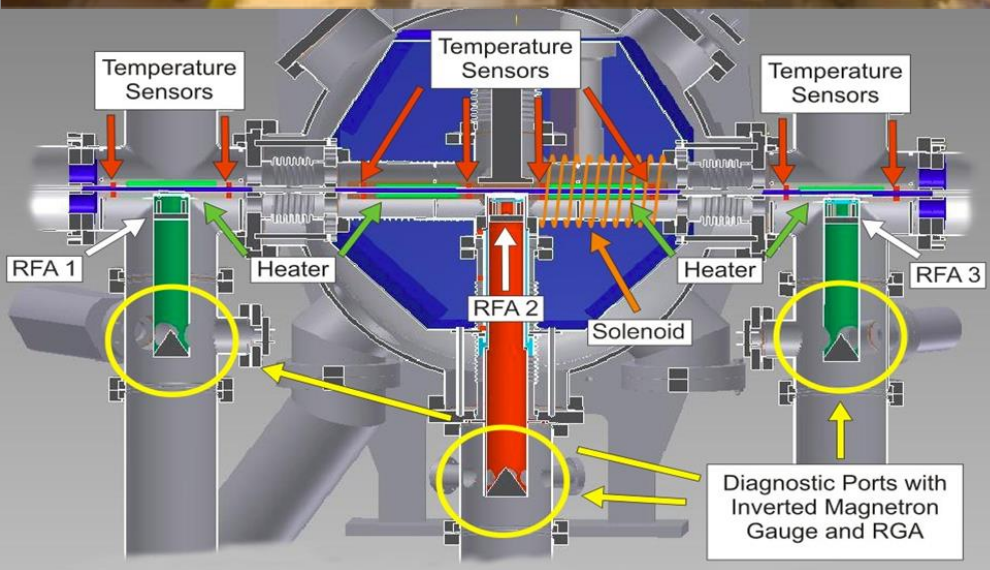
- **A new facility for desorption measurements at ANKA is under construction**
- **First test at ANKA: EuroCirCol test stand**
- **What next?**
  - **Cold chamber test upgrading EuroCirCol test stand with LN cooling or cryocooler?**
  - **Cold chamber test with experience from COLDEX and COLDDIAG?**

# COLDDIAG: Experience from ANKA

COLDDIAG at DIAMOND LIGHT SOURCE



S. Gerstl et al., PRSTAB, 17, 103201 (2014)  
R. Voutta et al., IPAC15



# Acknowledgments

- Thanks for supporting the project to:  
F. Perez (ALBA)  
P. Chiggiato (CERN)  
R. Cimino (LNF-INFN)  
E. Bründermann, A.-S. Müller, R. Ruprecht (KIT)
- Thanks to TE-VSC, CERN for partial support of the traveling costs allowing me to participate to this meeting
- Thanks to all of you for your attention!