WP8: ColMat

Ralph W. Aβmann

Yearly Meeting EuCARD

Paris – May 11-13, 2011

ColMat Participants

(EuCARD WP8 – Joint Research Activity)

ColMat Collaborators

LHC Accelerator Research Program (US government funding):

Milestones - Schedule

Mile-stone	Description/title	Nature	Delivery month	Comment
8.1.1	1st annual ColMat review meeting	O	M12	done
8.1.2	2nd annual ColMat review meeting	O	M24	done
8.1.3	3rd annual ColMat review meeting	O	M36	
8.1.4	Final ColMat review meeting	O	M48	
8.2.1	Functional specification LHC of beam loss and collimator design	R	M12	Simulations and design completed. done
8.2.2	Upgrade LHC collimator specification	R, D	M24	Materials characterized and tested. Review of results and specification.
8.2.3	Functional specification FAIR of beam loss and collimator design	R	M12	Simulations and design completed. done
8.3.1.1	LHC type collimator designed	R	M20	warm collimator done
8.3.1.2	LHC type collimator constructed	P	M26	done
8.3.1.3	LHC type collimator tested	R	M30	
8.3.2.1	FAIR type collimator designed	R	M24	cryogenic collimator done
8.3.2.2	FAIR type collimator constructed	P	M36	done

… fully on track

WP8 Meeting at GSI: Sep 2010

ColMat WP8 Meeting

from **Monday 13 September 2010 (08:00)**
to **Tuesday 14 September 2010 (18:00)** (Europe/Berlin)
at **Landhotel Johanneshof**
chaired by: ***Ralph Assmann / Jens Stadlmann***

Description: **** Do you need a single hotel room or a taxi? *****
**** PLEASE LET US KNOW AS SOON AS POSSIBLE, not later than 03.09.2010 ****

--> p.karampougiouki@gsi.de

Participants: Ralph Assmann; Vittorio Boccone; Lars Bozyk; Nicola Mariani; Edil Mustafin; Erich Neubauer; Alexander Ryazanov; Jens Stadlmann; Naeem Tahir; Adina Toader; Marilena Tomut; Christina Trautmann; Ludger Weber; Daniel Wollmann

Material: Dinner

Monday 13 September 2010 | Tuesday 14 September 2010 |

Monday 13 September 2010

top

12:00	Working Lunch
13:30->*13:40*	**Welcome (Jens Stadlmann)**
13:40->*14:00*	**AIT (Erich Neubauer)** slides
14:00->*14:30*	**CERN (Nicola Mariani)** slides
14:30->*15:00*	**EPFL (Ludger Weber)** slides
15:00->*15:30*	**GSI (Lars Bozyk)** slides
15:30->*16:00*	**Kurchatov (Alexander Ryazanov)** slides
16:00	coffee break

WP 8.1

WP8 Meeting at GSI: Sep 2010

16:45->*17:15* **Lancaster & Manchester University (A. Toader)** slides

09:00->*09:45* **Highlight Talk 1 (i.g. CERN Collimator Performance in LHC, R. Assmann / A. Bertarelli)** slides

09:45->*10:30* **Highlight Talk 2 (i.g. Material Research at GSI, C. Trautmann / M. Tormuth)** slides

10:30	Coffee Break

10:45->*11:00* **Final Remarks (Jens Stadlmann / Ralph Assmann)**

11:00->*11:30* **(transfer to GSI)**

11:30->*12:30* **GSI-Tour**

12:30	Lunch

13:30->*15:00* **Material Research Tour**

WP 8.1

GOBIERNO DE ESPAÑA | MINISTERIO DE CIENCIA E INNOVACIÓN

CSIC IFIC - INSTITUTO DE FÍSICA CORPUSCULAR

Jobs

WP 8.1

INSTITUTO DE FISICA CORPUSCULAR – IFIC

PRE or POST DOCTORAL POSITION

"Exploring and extending LHC beam intensity limits with collimation"

The LHC is extending the state-of-the-art in stored beam energy by almost three orders of magnitudes. Its intensity and performance is predicted to be limited by the achievable cleaning and control of unavoidable beam halo. Therefore, an upgrade program is foreseen during the first period of LHC operation. This program is supported by the European Organization for Nuclear Research (CERN) and the EU FP7 program EuCARD (European Coordination for Accelerator Research and Development).

In the framework of this project we are looking for a PhD student or a Postdoc who would participate in simulations and beam measurements on beam halo, intensity reach, collimation efficiency and upgrades. The student will be employed by the Instituto de Fisica Corpuscular IFIC in Valencia, Spain. The student is expected to spend a significant part of his time at CERN to collaborate in the tasks of LHC beam measurements and simulations.

IFIC is a High Energy Physics Institute where ongoing research activities include experimental and theoretical work with application in near-term and far-future projects, offering the possibility to work on a rich scientific environment at the forefront of a broad range of High Energy Physics studies. IFIC has also a number of groups working in the field of Medical Physics covering accelerator and detector developments and image reconstruction.

Applicants must have at least a degree in Physics or Engineering at the time of the recruitment and have to submit curriculum vitae including a statement of research interest. Applications should be sent, no later than middle of December 2009, to

Dr. A. Faus-Golfe
Instituto de Física Corpuscular IFIC
Ed. Institutos de Investigación de Paterna
Aptdo. 22085
E-46071 Valencia
Spain

For further information, please contact: Dr. A. Faus-Golfe (afaus@ific.uv.es) or Dr. R. Assmann (ralph.assmann@cern.ch)

More information about EuCARD and the LHC collimation upgrade project can be found at:
http://www.cern.ch/lhc-collimation-project/
http://www.cern.ch/EuCARD/activities/research/WP8/

Candidate started

University of Malta (PhD):

Topic: Fast Automatic Algorithm for Optimizing Positions of LHC Collimator Jaws
Field: Accelerator Technology

The LHC feedback system will rely on beam losses measurements and intensity information and will implement a modern optimization procedure as it is presently used at the Tevatron. However, it must be extended to the unprecedented needs of the LHC in terms of storage intensity and required accuracy. Hence the need for the fast automatic algorithm for optimizing the positions of the LHC collimator jaws.

This project will involve the following:
- setup and running of the LHC collimators
- participation in phase 1 LHC collimator setup test (using the CERN and SLAC prototypes)
- establishing the technical specification for the Beam Loss Monitors (BLM) automatic algorithm tuning
- establish a theoretical model of the collimators and implement the middle level software controls (using Matlab, C or any other programming language)
- studying the crosstalk of the BLMs (complexity modelling of the collimators and relevance to beam dynamics).
- testing of the BLM based setup and implementation into LHC commissioning
- possibly also participate in BPM based setup tests

Filled: 2 students

thanks Nicholas…

Technical Results

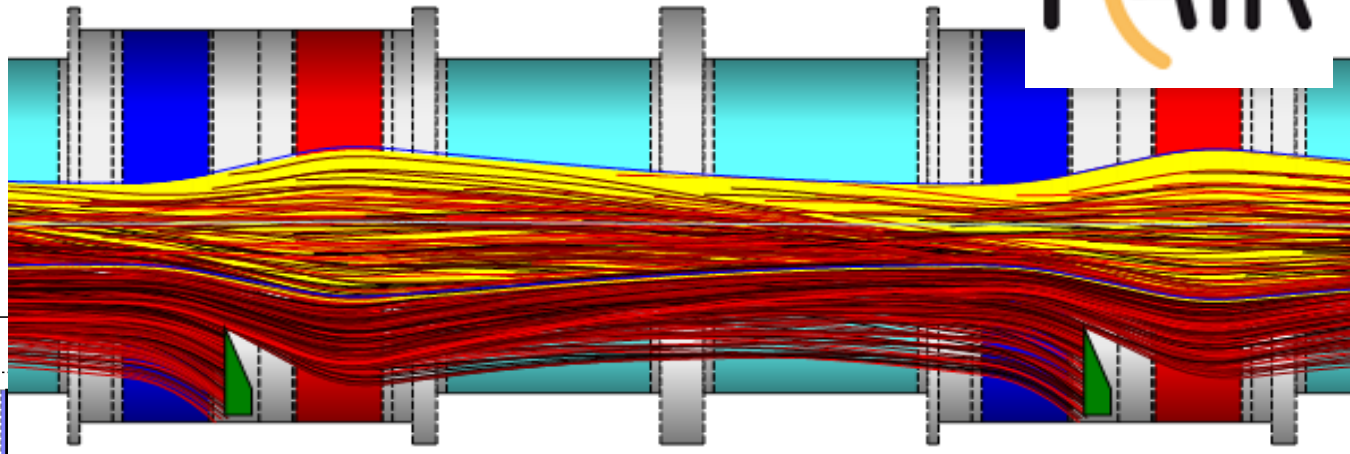
- Two highlight talks will address some major results.
- Lorenzo Peroni: "Innovative Collimator Materials"
  - Crucial work for developing more robust materials for new accelerators or upgrades of existing accelerators (e.g. HL-LHC, HE-LHC).
  - Tests will be done in HiRadMat → Ilias Efthymiopoulos.
- Daniel Wollmann: "Collimator with Beam Diagnostics Functionality"
  - Crucial work for reaching tightest collimator settings in the LHC → nominal beta* and ultimate intensity.
  - Tests ongoing in SPS at CERN.
- Will discuss other selected results of ColMat:
  - First cryo-collimator at GSI
  - Improved collimator controls with University Malta
  - Sound measurements in LHC with University Graz

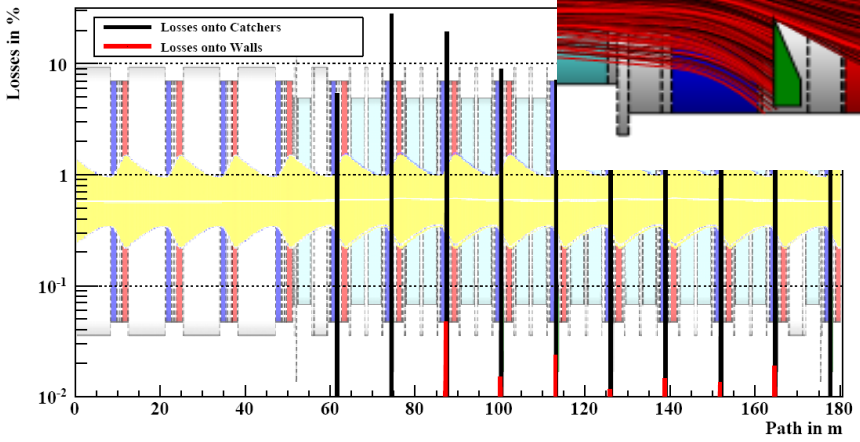
Selected ColMat Results

- First cryo-collimator at GSI
- Improved collimator controls with University Malta
- Sound measurements in LHC with University Graz

SIS100 Lattice

- SIS100 lattice has been optimized to reach a maximum catching efficiency
- Loss distribution is strongly localized between the quadrupoles where the ion catcher will be installed

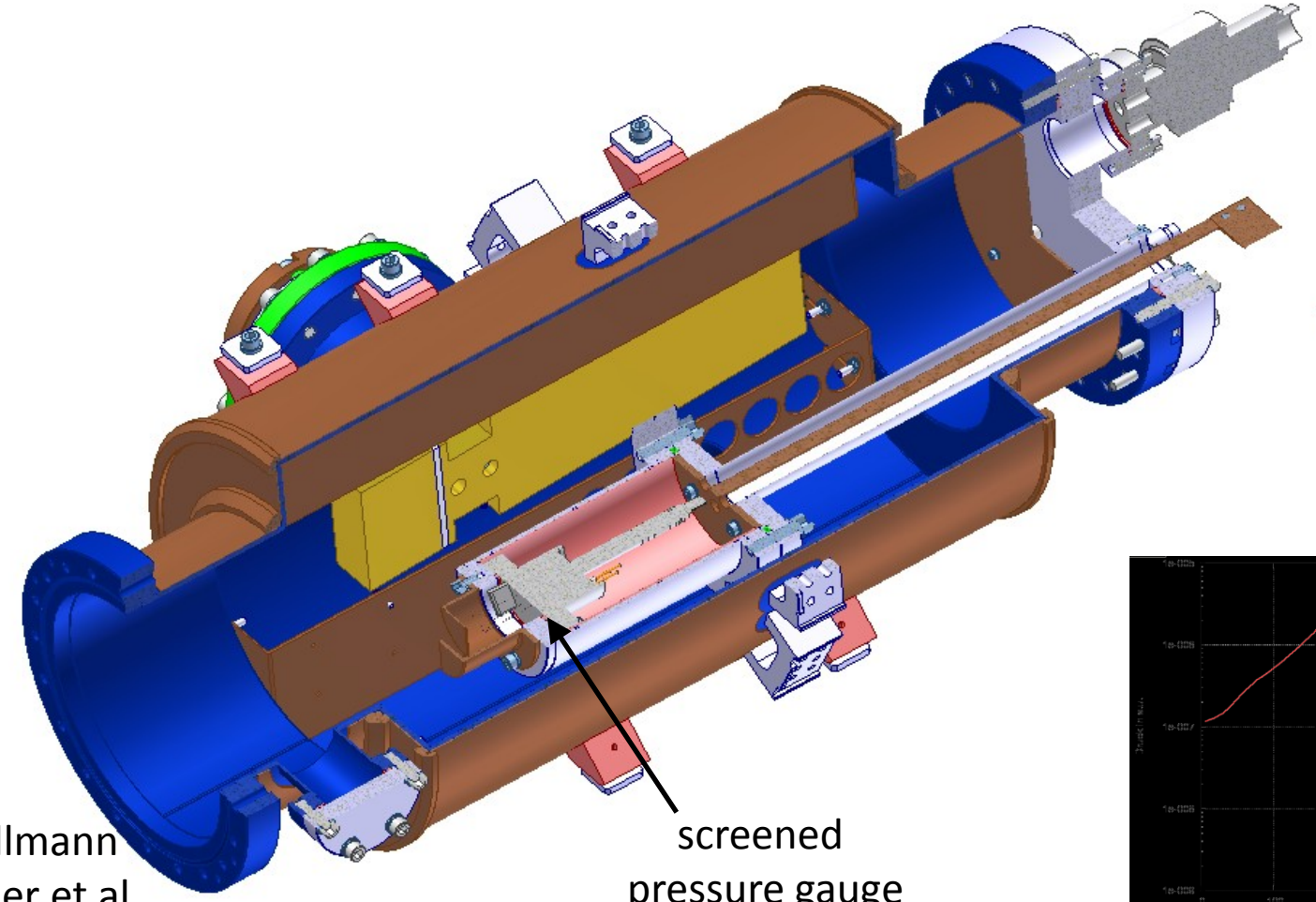




$U^{28+} \rightarrow U^{29+}$

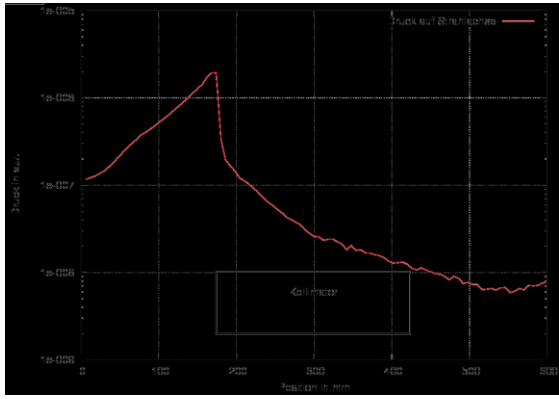
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype

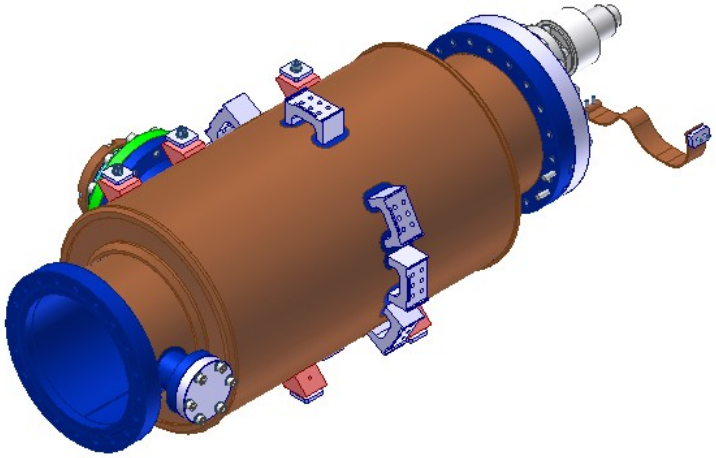


J. Stadlmann
P. Spiller et al

screened
pressure gauge

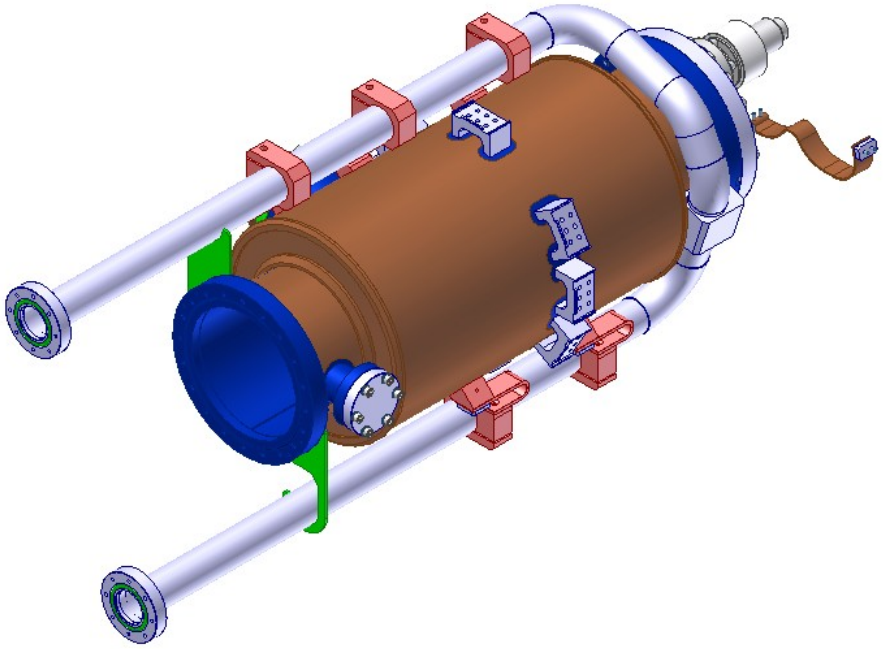


Cryocatcher Prototype



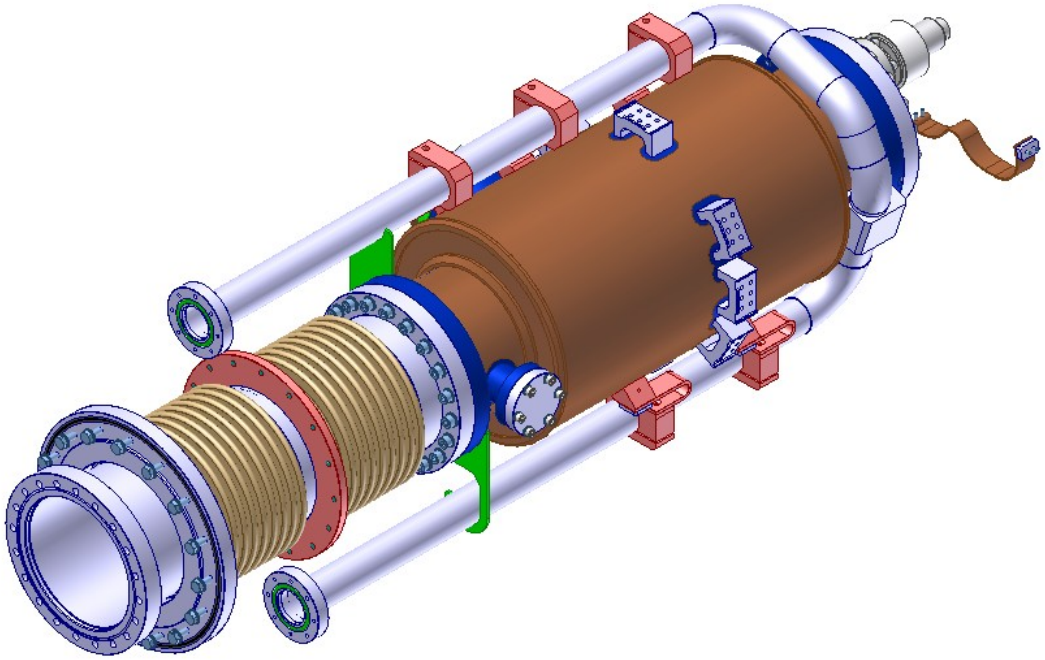
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



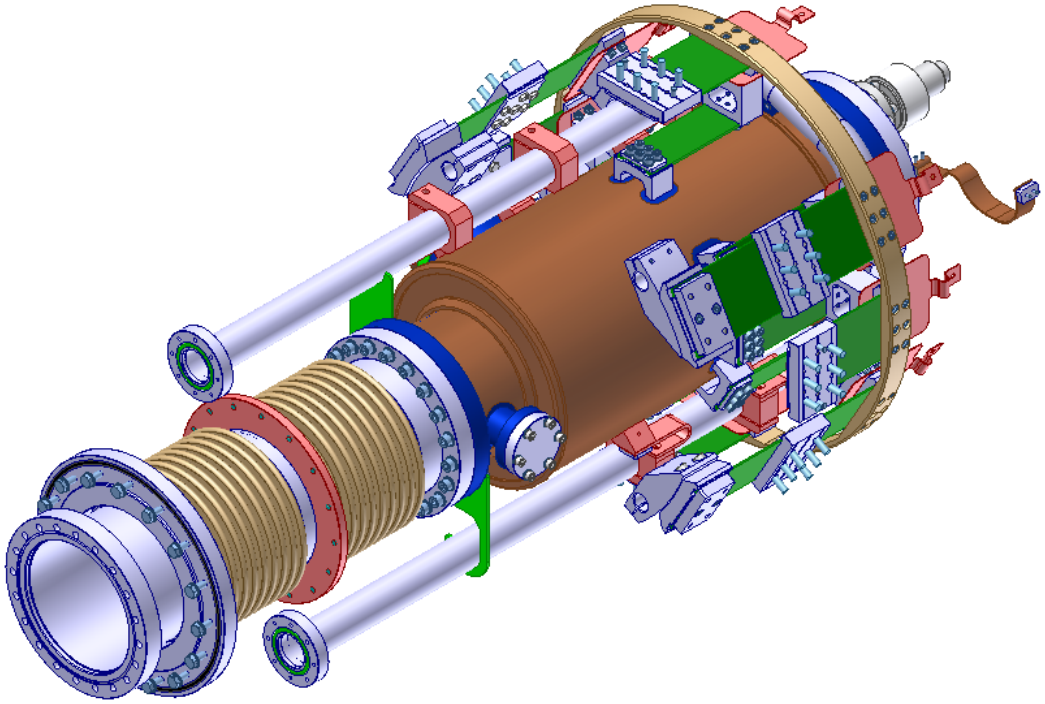
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



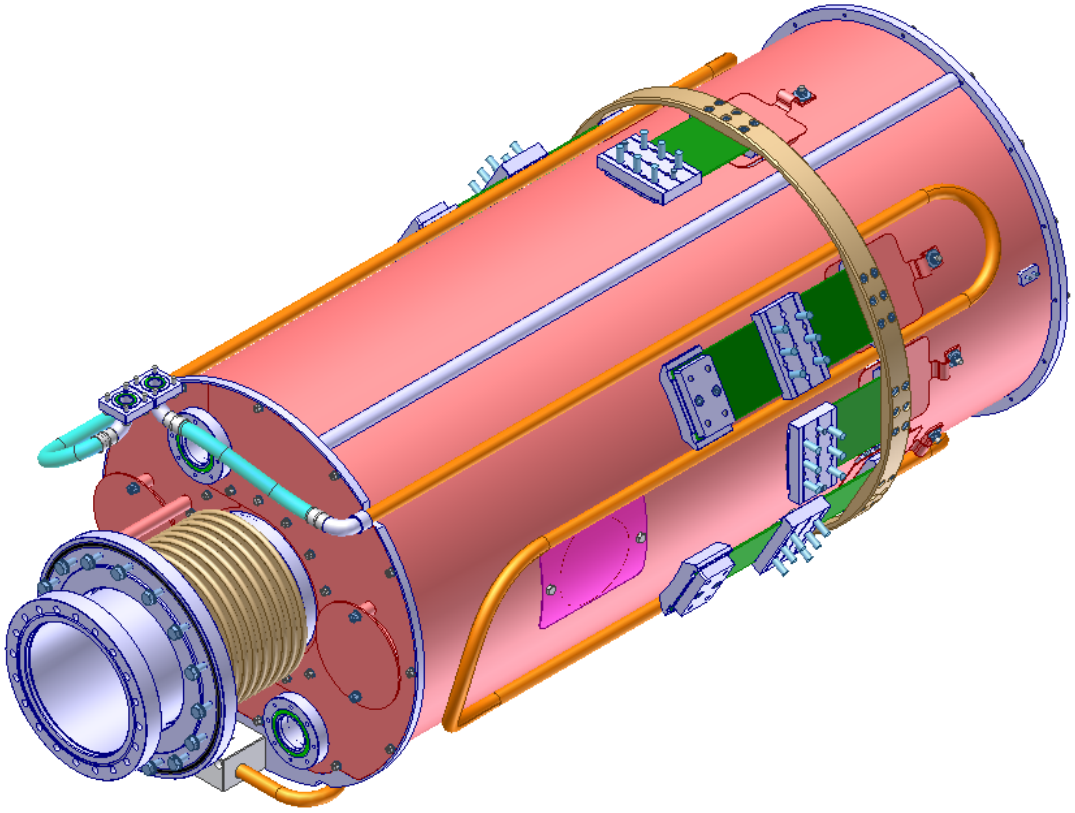
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



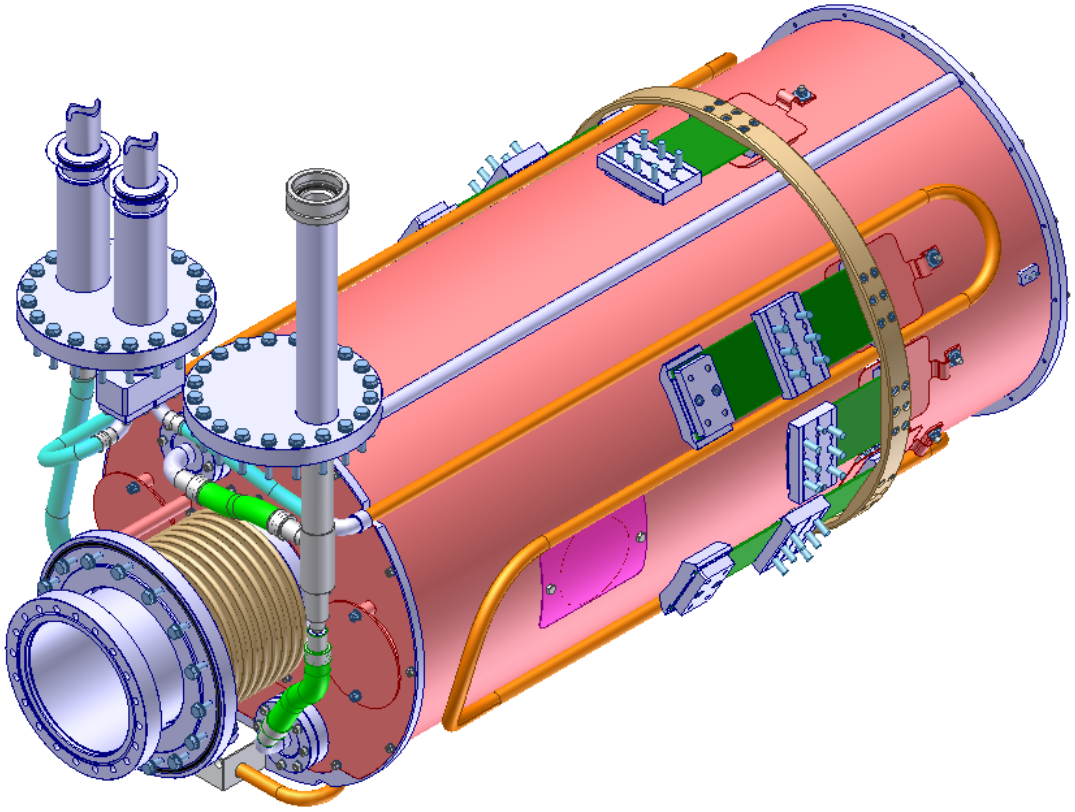
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



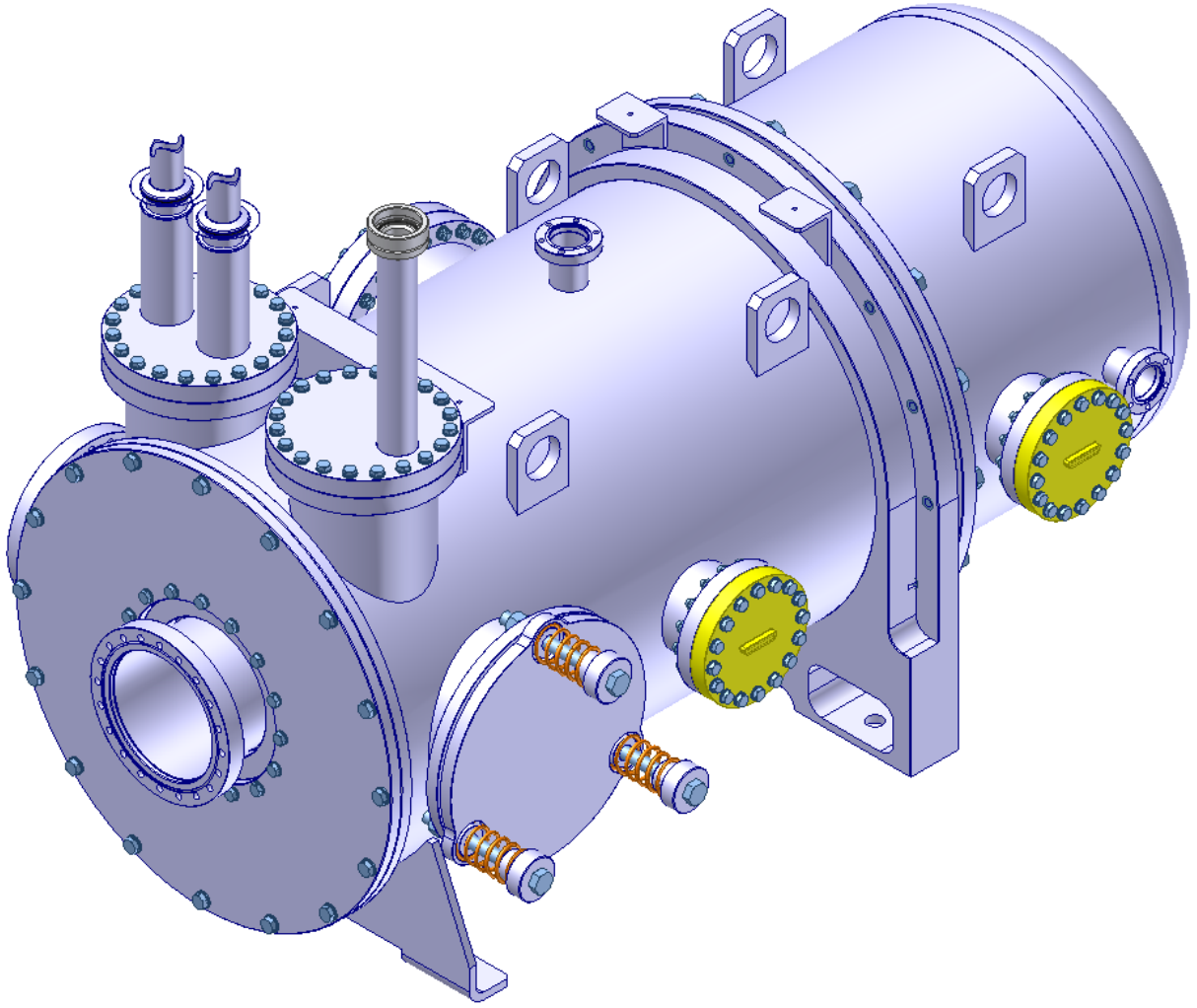
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



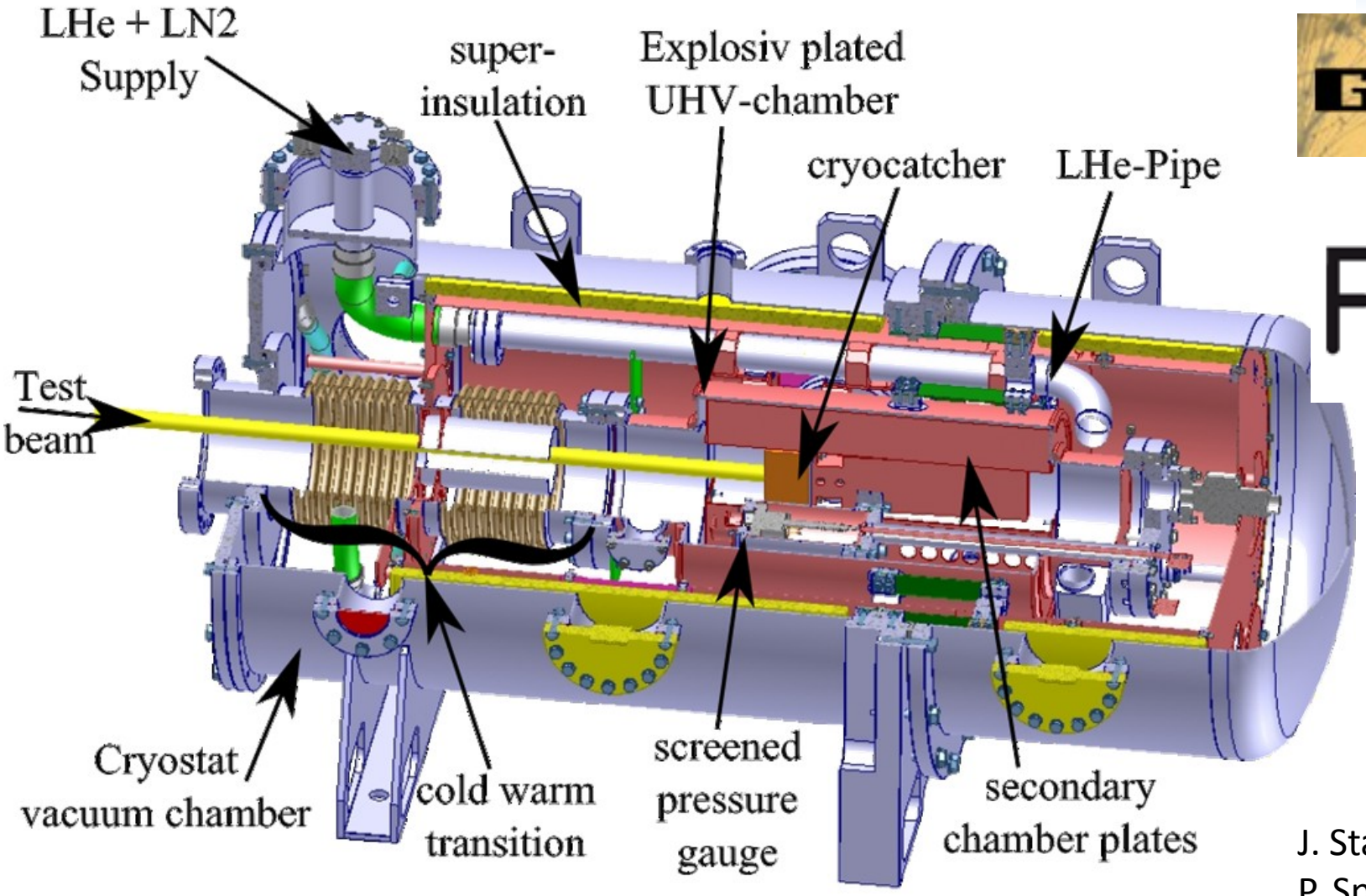
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype



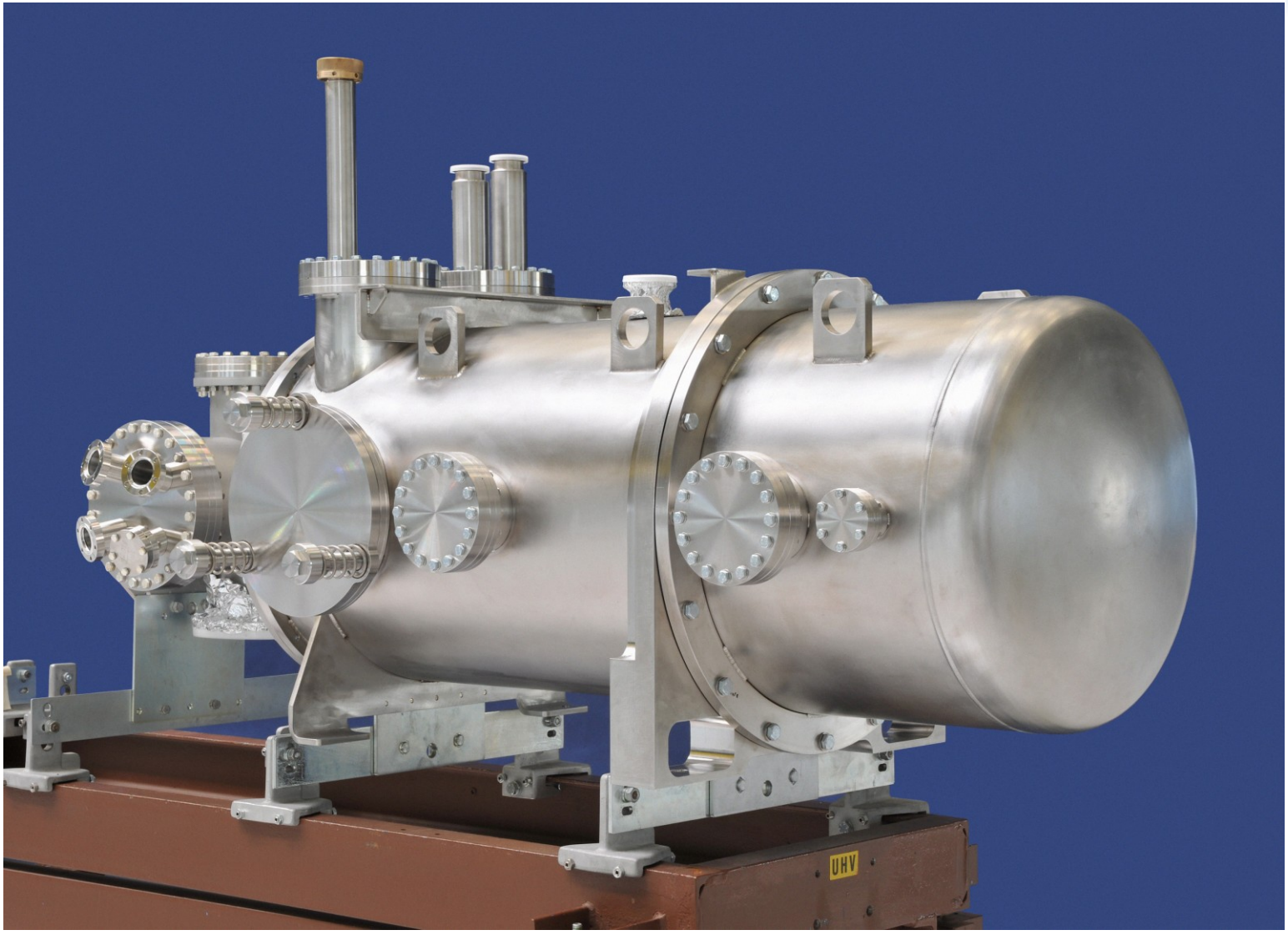
J. Stadlmann
P. Spiller et al

Cryocatcher Prototype – Questions?



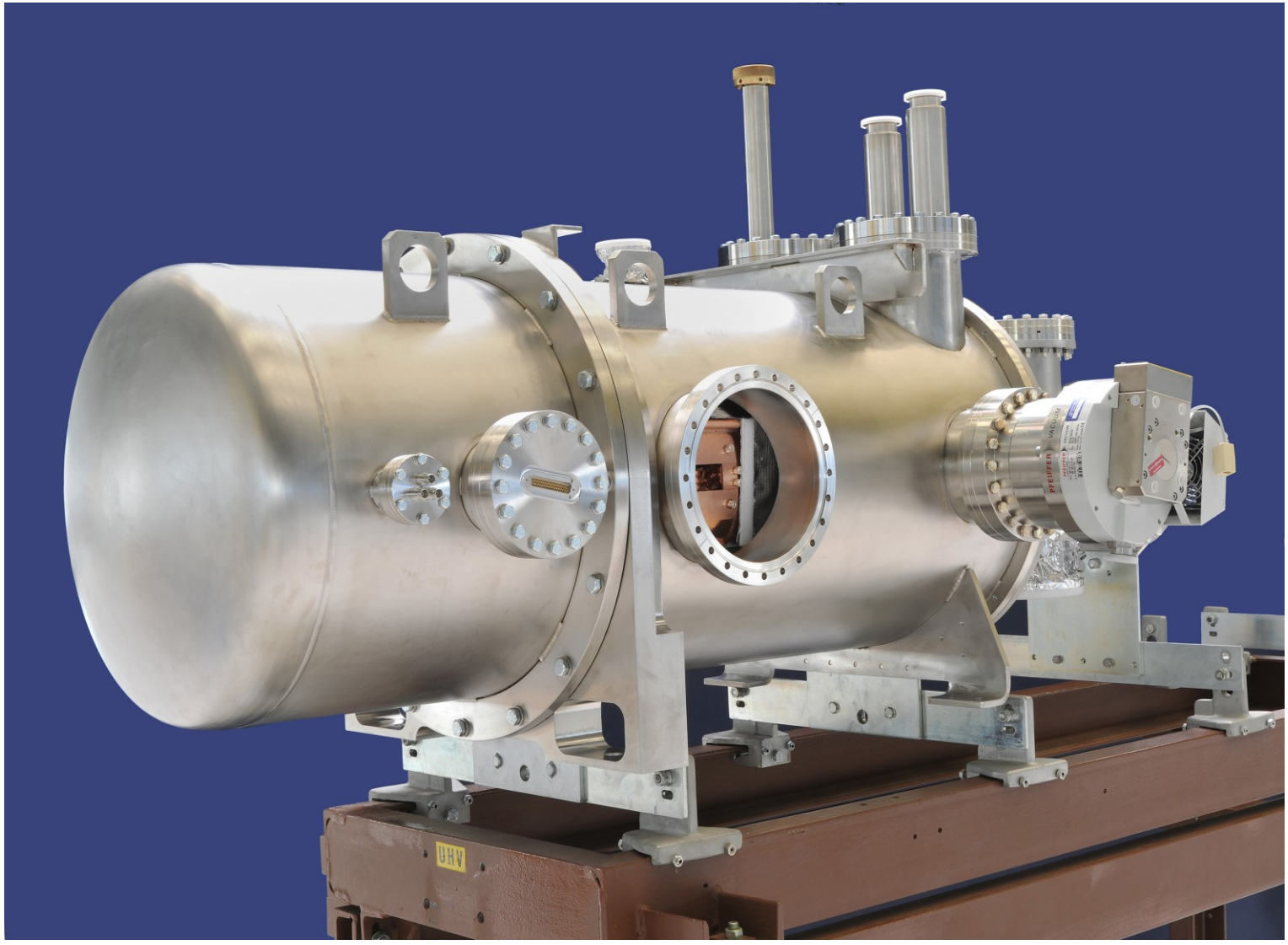
J. Stadlmann
P. Spiller et al

Now at GSI



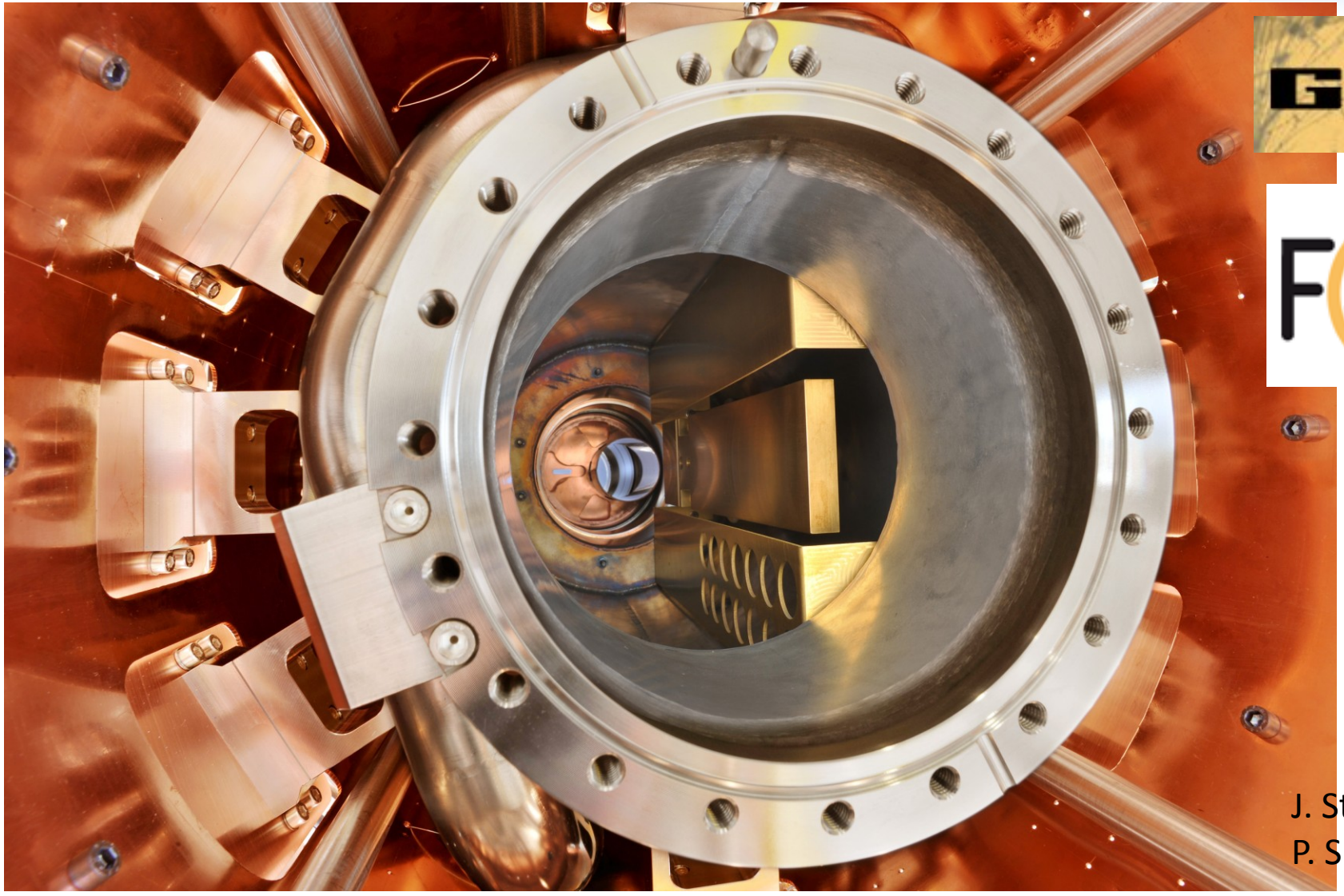
J. Stadlmann
P. Spiller et al

Now at GSI



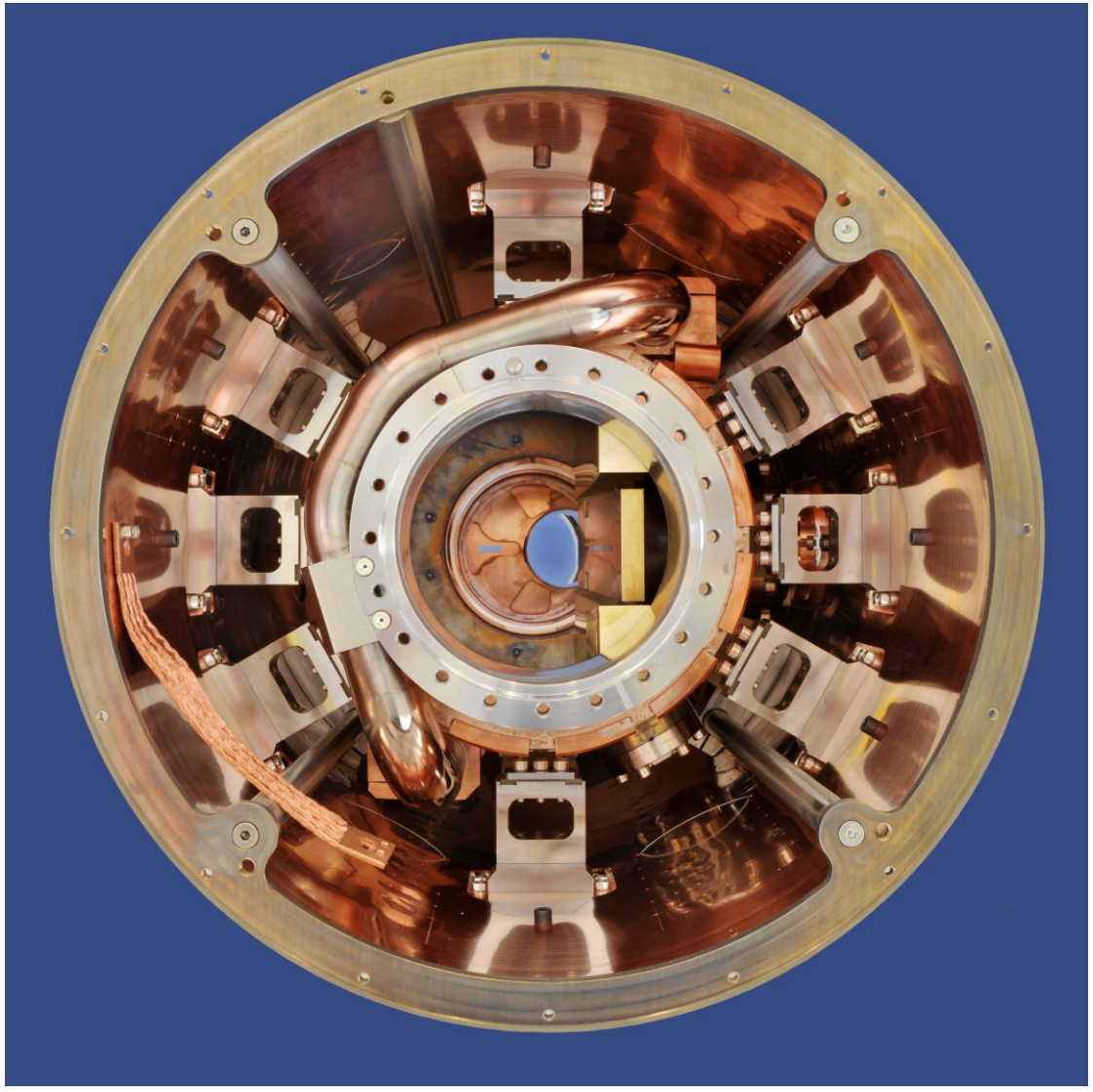
J. Stadlmann
P. Spiller et al

Now at GSI



J. Stadlmann
P. Spiller et al

Now at GSI



J. Stadlmann
P. Spiller et al

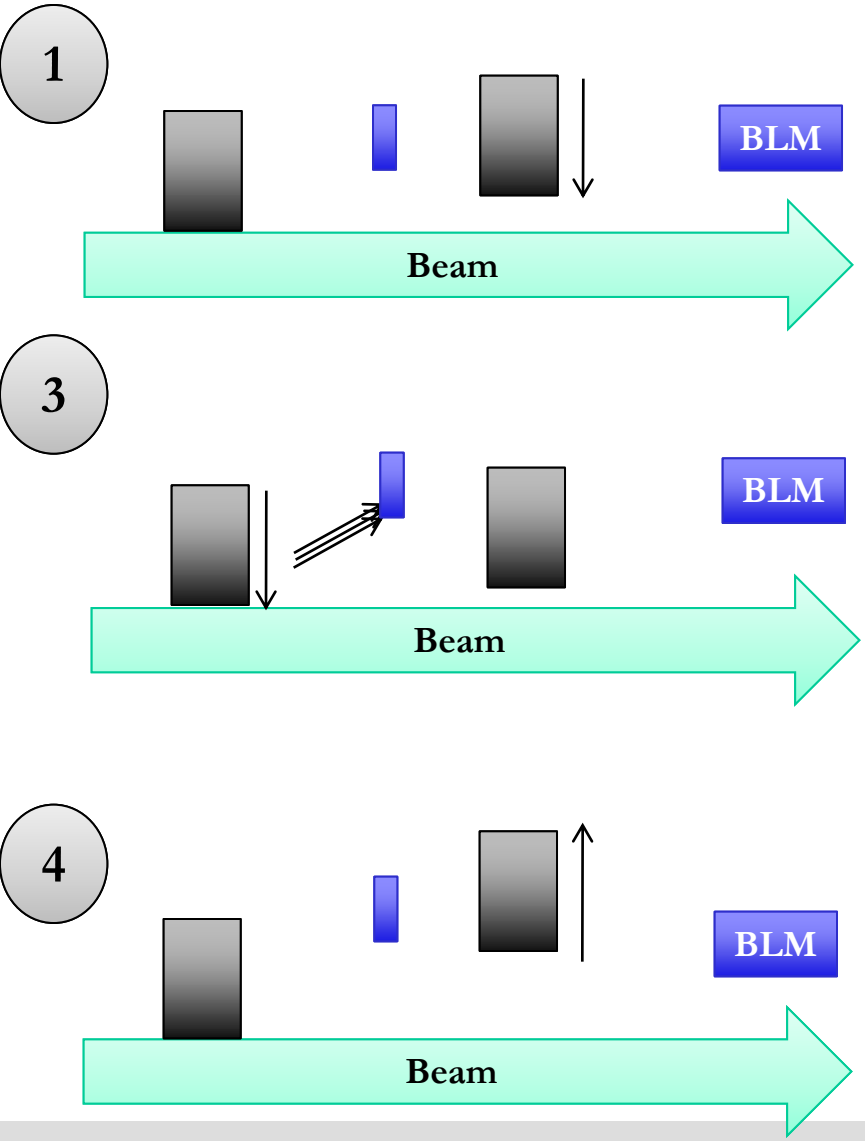
Now at GSI

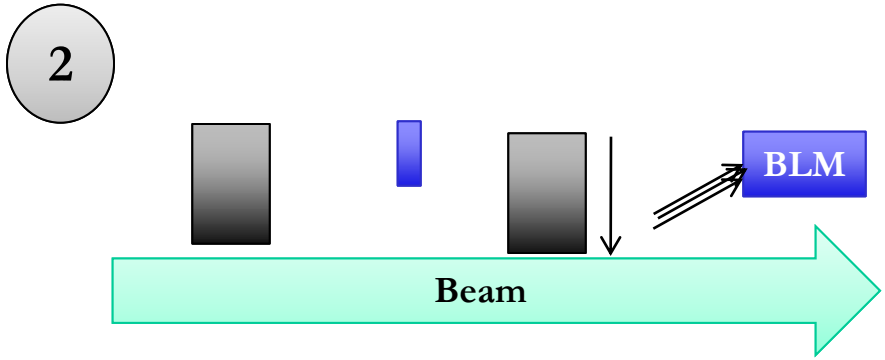
- Possible highlight talk at next EuCARD meeting
- Much more details then…
- Also, GSI plans article for newsletter

Selected ColMat Results

- First cryo-collimator at GSI
- Improved collimator controls with University Malta
- Sound measurements in LHC with University Graz

Collimator Setup Procedure





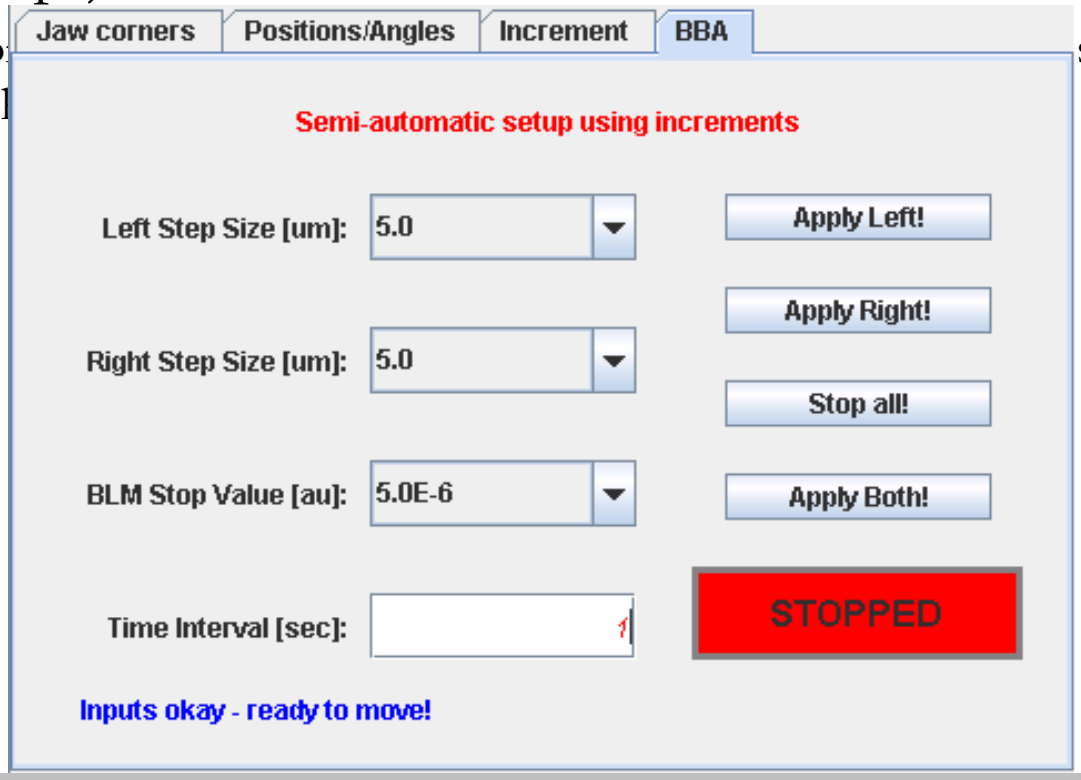
1. Define beam edge by hor, ver or skew reference collimator
2. Center collimator i
3. Re-center reference collimator

   Beam size: $\sigma_i = \frac{x_i^{L,m} - x_i^{R,m}}{(N_0^{k-1} + N_0^{k+1})/2}$
4. Open collimator to $N_i \cdot \sigma_i$

D. Wollmann

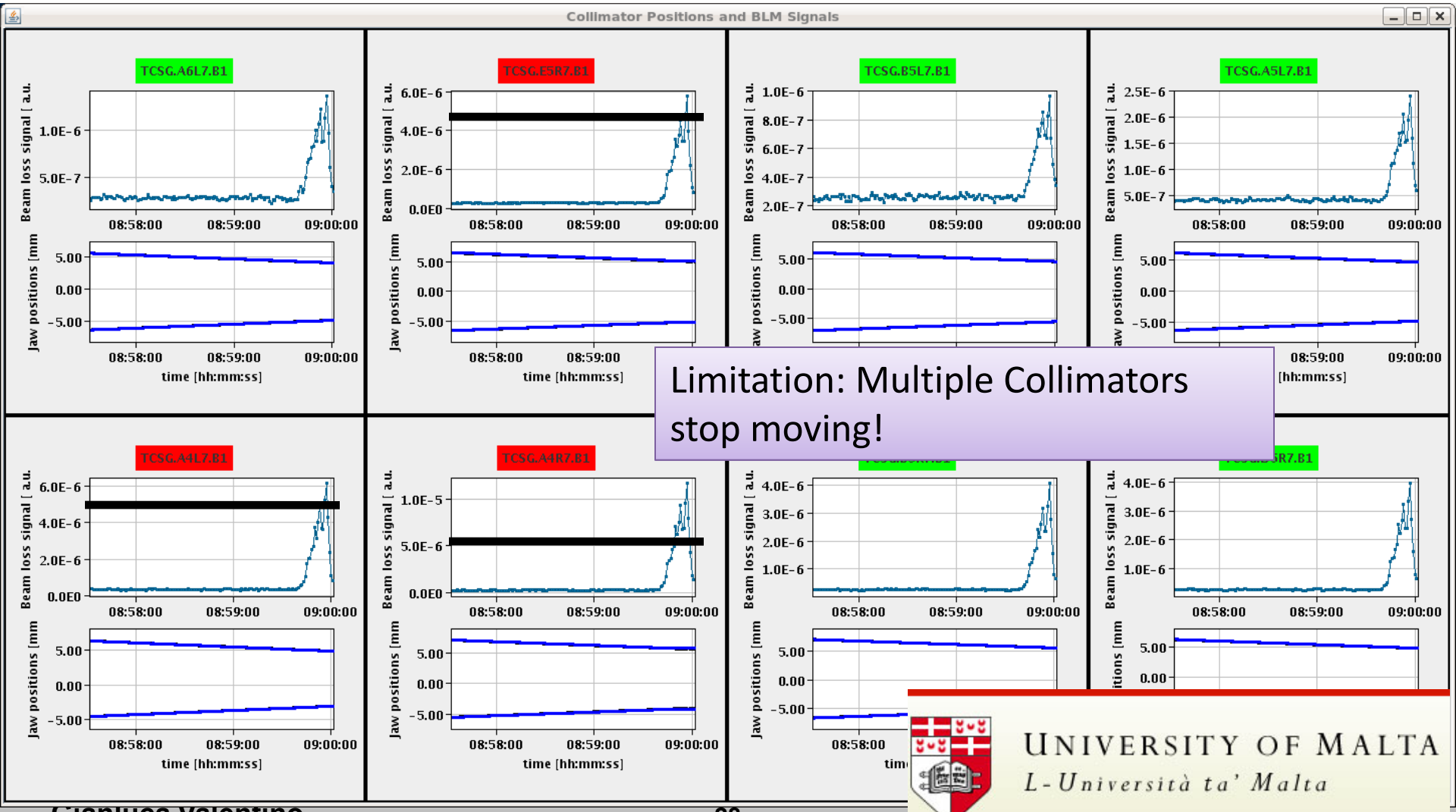
Semi-Automatic Feature

- Introduction of a semi-automatic feature:
- Automatic step-wise movement of collimator jaws (can choose from 5 – 100 μm steps)
- The software auto signal exceeds a user-defined thresl



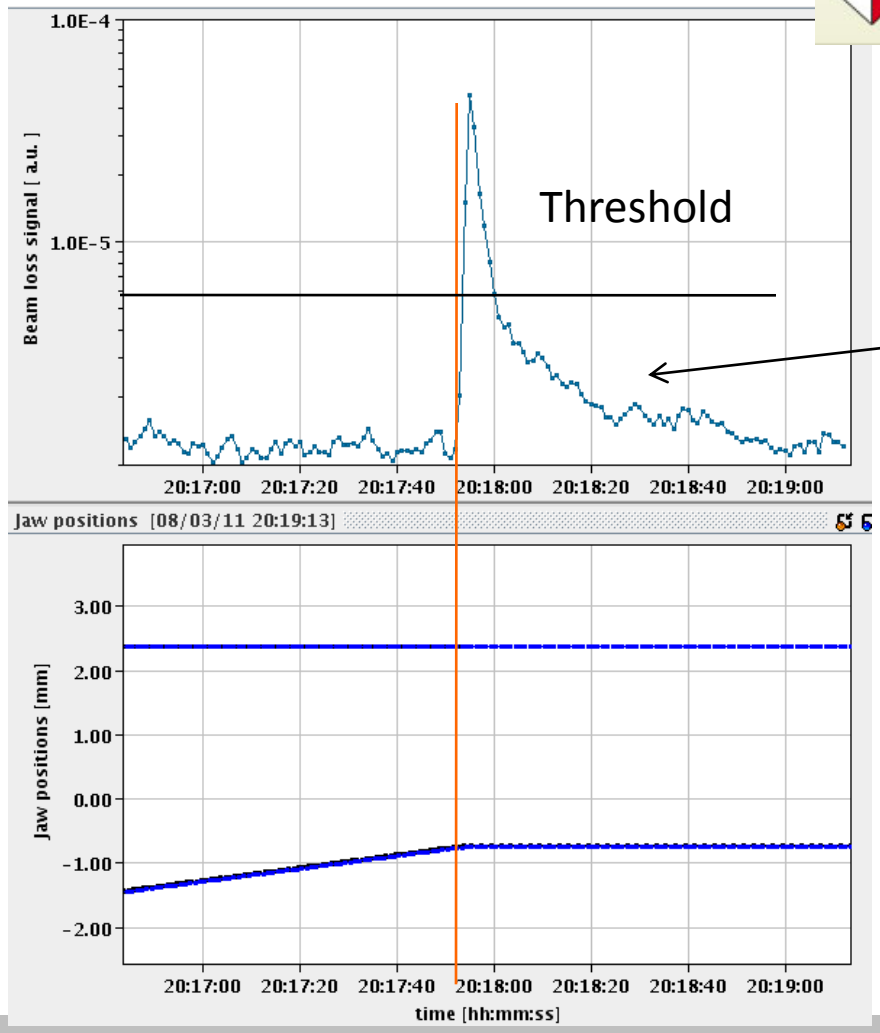
Initialization Procedure

1) Move collimators in parallel to the beam by class (TCSG, TCLA, TCT) and plane



UNIVERSITY OF MALTA
L-Università ta' Malta

2) Setup each collimator in sequence (define reference edge using TCP in plane)



Interesting:
See 40s decay of loss spike!

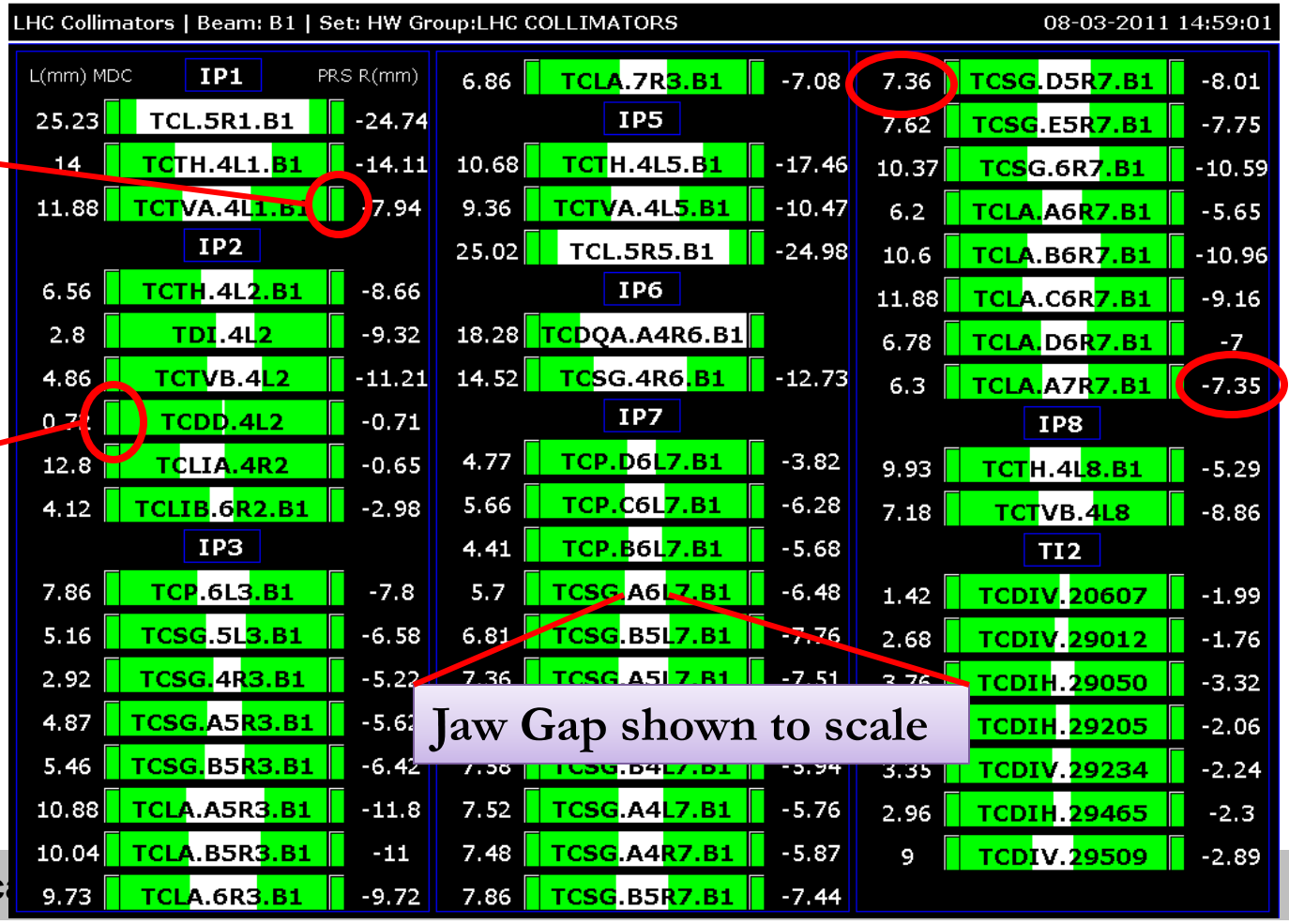
Fine adjustment after initialization

Automatic stop after crossing BLM threshold

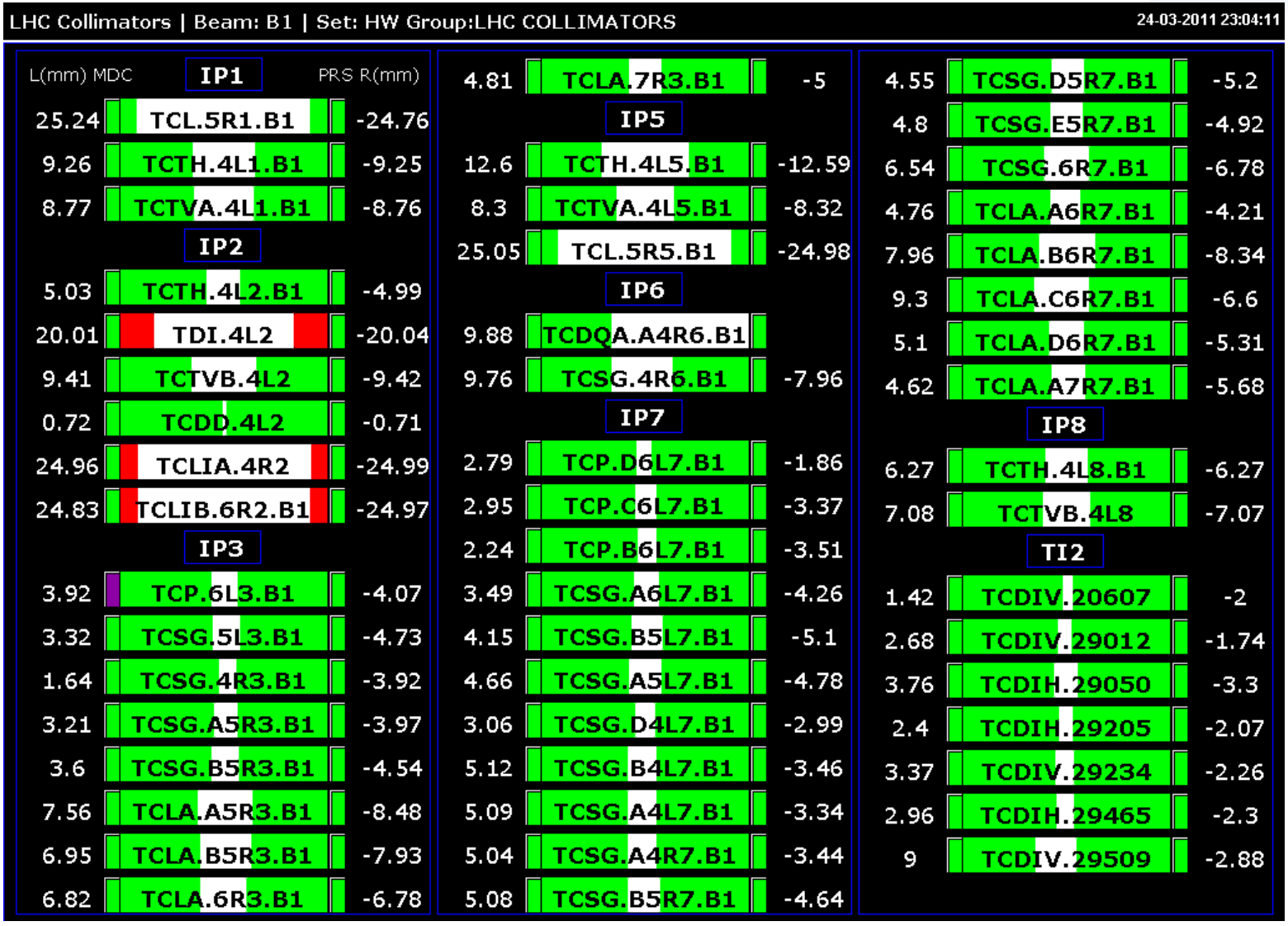
D. Wollmann

Collimation Vistar

- Improved Collimator fixed status display (available in the CCC and online)
- Modifications of the collimator status display by **E. Veyrunes** and **S. Redaelli** done by **G. Valentino** with input from collimation team and BE/OP



Setup In Action



Benefits

- Much more reliable setup
- More accurate setup
  (no human error)
- More efficient LHC operation → several days of LHC beam time was saved

Selected ColMat Results

- First cryo-collimator at GSI
- Improved collimator controls with University Malta
- Sound measurements in LHC with University Graz

New: University of Music and Dramatic Arts Graz, Austria

University of Music and Dramatic Arts Graz
Prof: **R. Höldrich**, PhD student: **Daniel Deboy**
Supported by Austrian Government

Microphones have been installed in the LHC tunnel to enable the acoustic detection of beam impacts on collimators.

Investigation of the acoustics in the LHC tunnel:

- *Noise coming from various equipment is expected and has to be distinguished from sounds which emanate from the beam itself. Of course, due to the vacuum, only secondary wave propagation can be investigated.*
- *The multi-path propagation due to reflections in the tunnel system must be taken into account.*
- *A comprehensive study will investigate which beam parameters are detectable in the acoustic domain. For example, the revolution frequency of the beam is about 11 kHz. Modulations in this signal may be proportional to beam quality factors.*
- *Regarding the collimators, algorithms to localize impacts and to quantify their strength are the major goal of the thesis.*
- *Referential test recordings will be made at the LHC using microphones but also other sensorial signals.*
- *Time delays between signals recorded from several positions in the tunnel should give a good estimate of the impact position.*

New: University of Music and Dramatic Arts Graz, Austria

University of Music and Dramatic Arts Graz
Prof: **R. Höldrich**, PhD student: **Daniel Deboy**
Supported by Austrian Government

Microphones have been installed in the LHC tunnel to enable the acoustic detection of beam impacts on collimators.

Develop a monitoring system for the control room of the LHC:

- *System will primarily give information about accidental beam impacts and their position.*
- *A simple auditory display alerting the operator and may also use other online data to detect accidental impacts.*

Data taken from the collision experiments can also be sonified to improve an intuitive understanding for particle physicists:

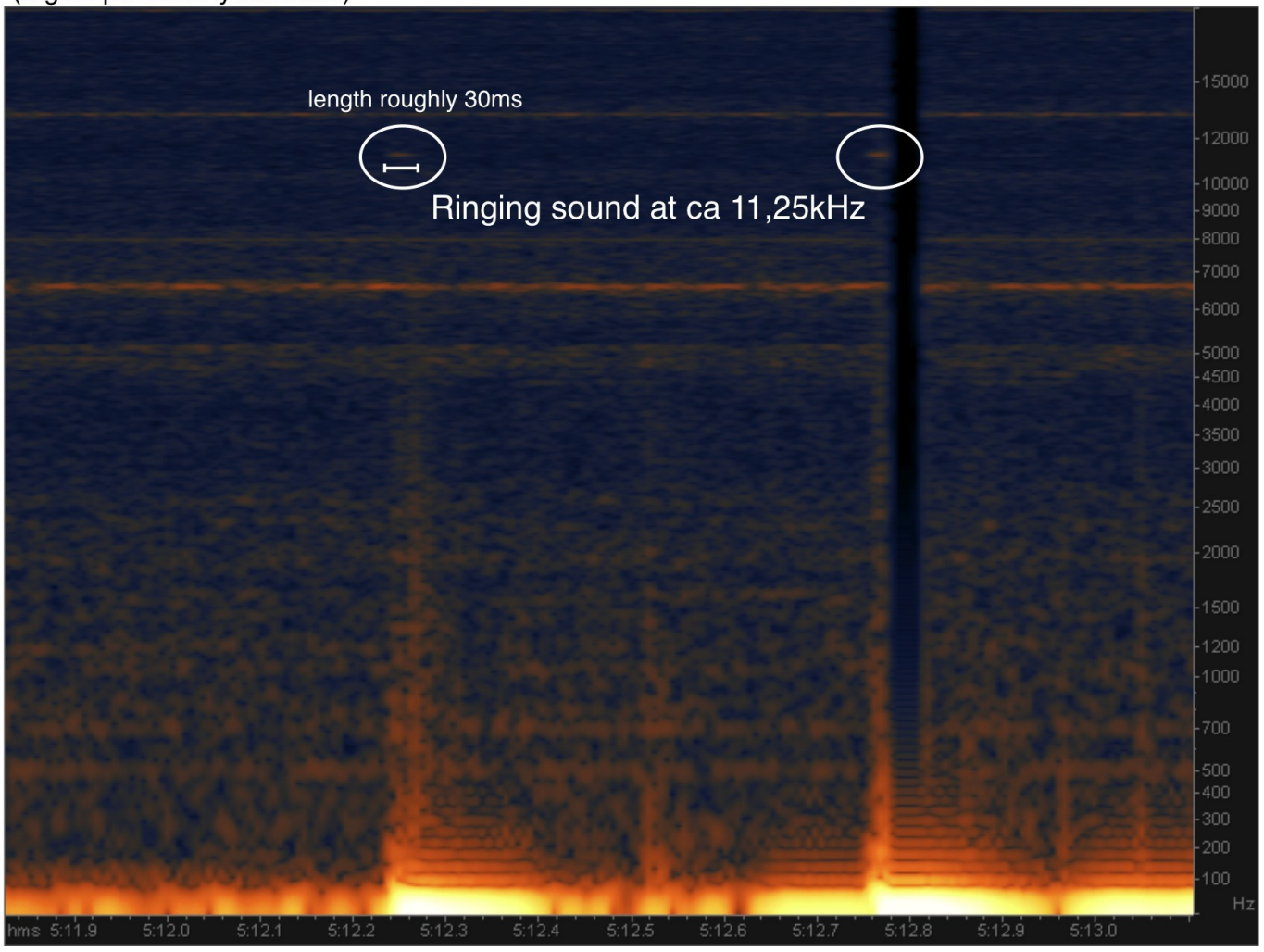
- *Sonification of collision experiments as a tool for localization of particle tracks in addition to the visualization.*
- *Artistic approaches like media installations in exhibitions. Sonify whole collision events seen as an entity rather than single particle-tracks. The microcosm exhibition at CERN can be a place where such installations would nicely fit in.*

→ Thanks to Svet for including the activity in contract.

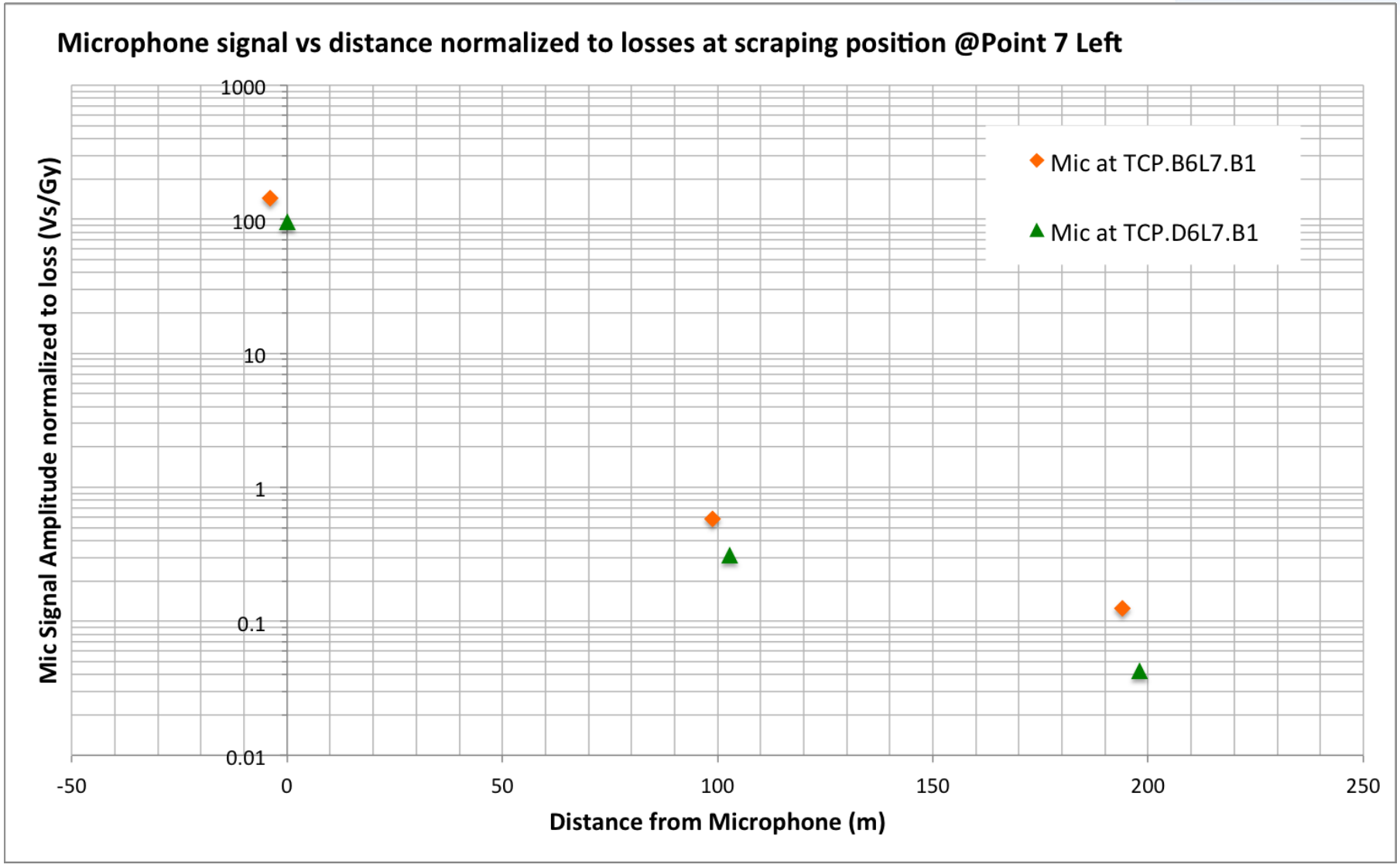
Sound Analysis LHC

Spectrogram of Mic Signal at Loss event P3 right

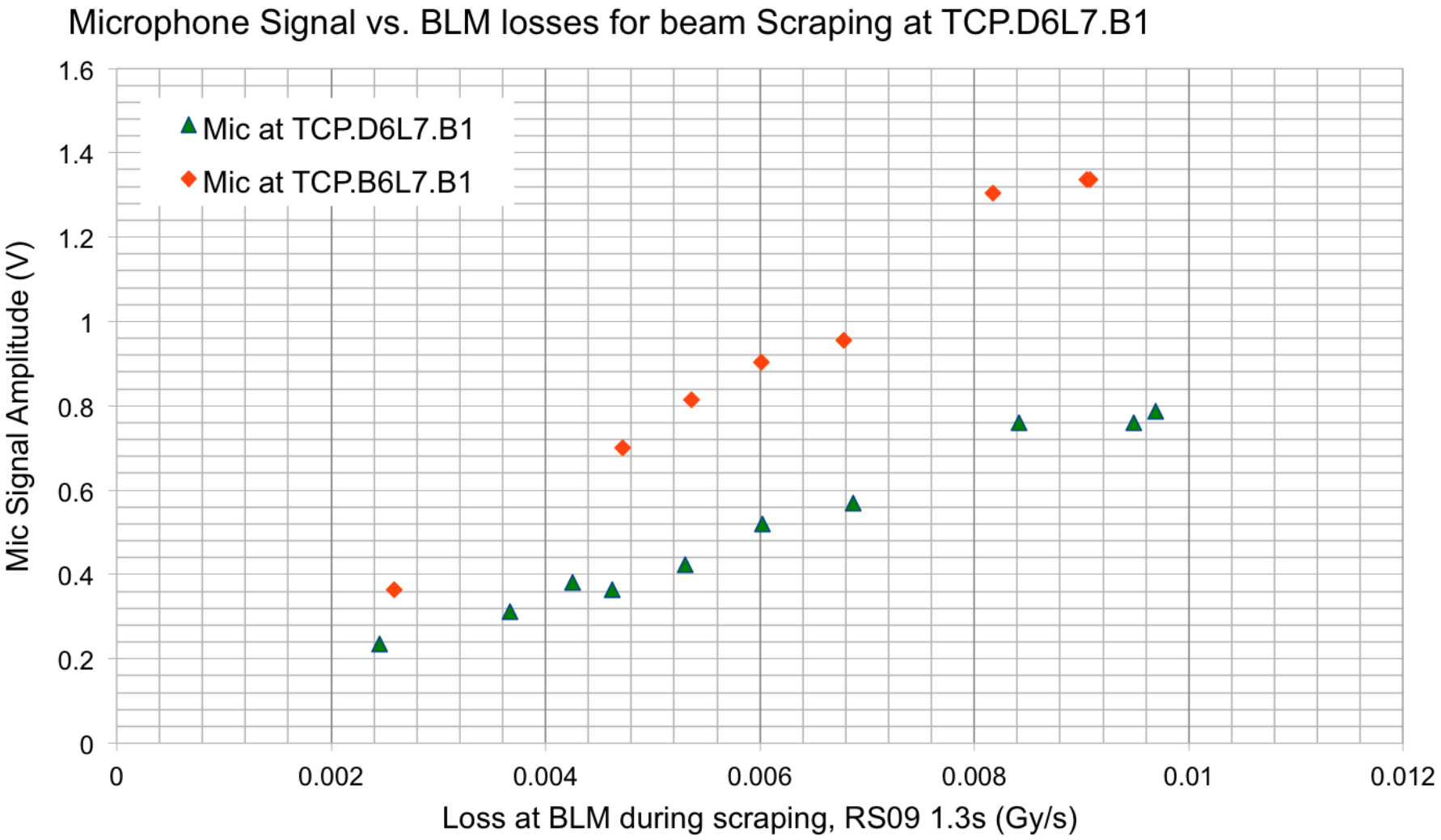
(Signal particularly distorted)



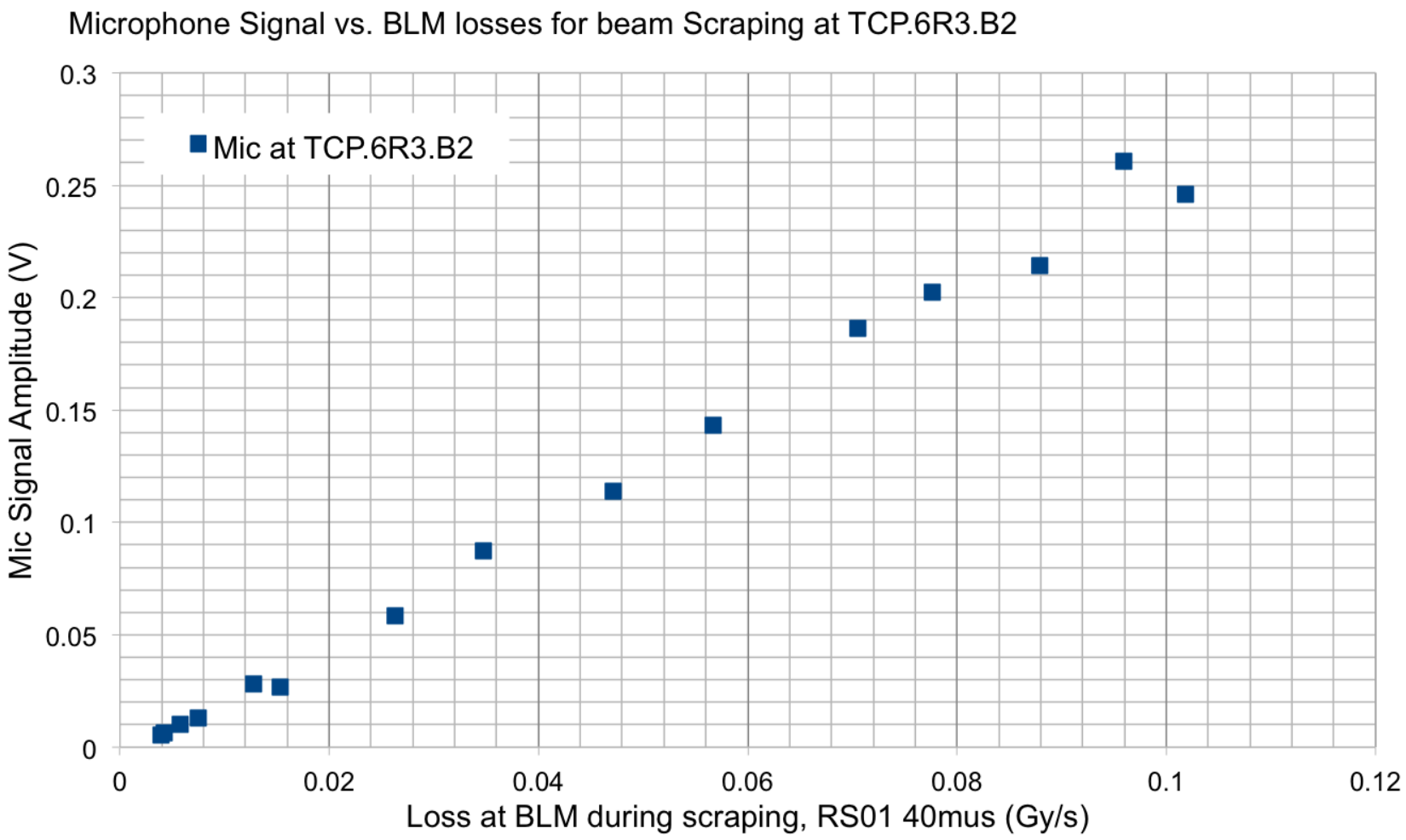
Sound Analysis LHC



Sound Analysis LHC



Sound Analysis LHC



Sounds…

Collimator movement

Sound scraping

Beam ringing

Evacuation siren

Used for damage detection on collimators…

Summary

- ColMat is publishing with concrete, steel and diamond composites (of course also on paper)
- Happy with ColMat progress:
  - New and innovative materials (see highlight)
  - 2nd generation warm collimators with BPM's (see highlight)
  - Innovative cyrogenic collimators (GSI)
  - Faster and more accurate setup → LHC profiting today (Malta)
  - Sound detection → In case something happens… (Graz)
  - Massive simulation: gain factor ~100 (Manchester)
  - New simulation initiatives (Valencia, JAI, Manchester)
  - Radiation damage studies (Kurchatov, GSI)
  - Crystal collimation (INFN)