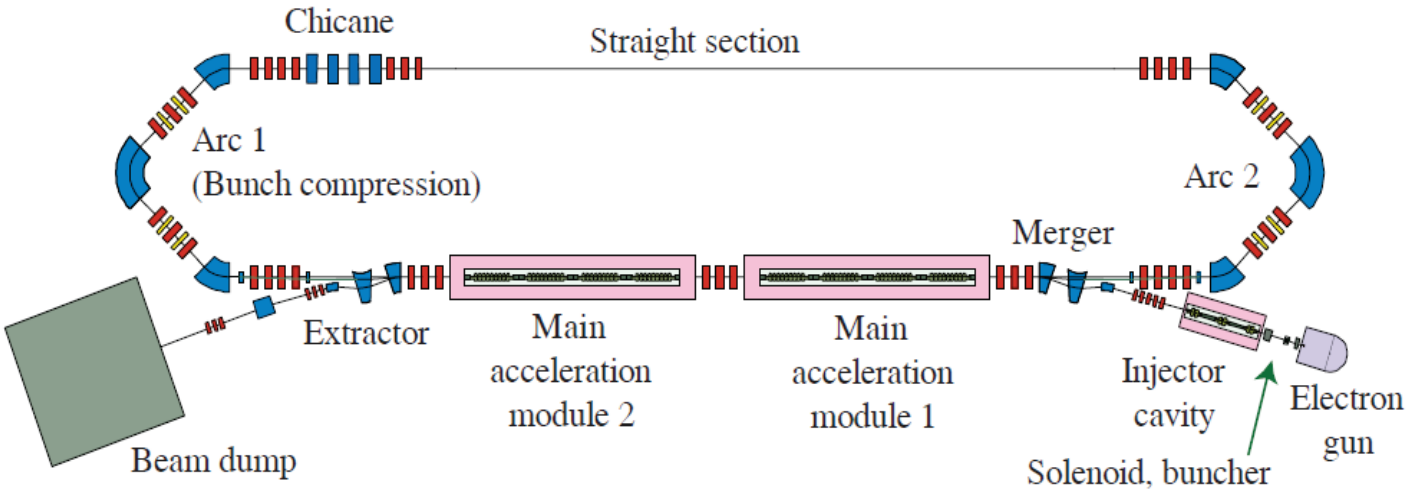
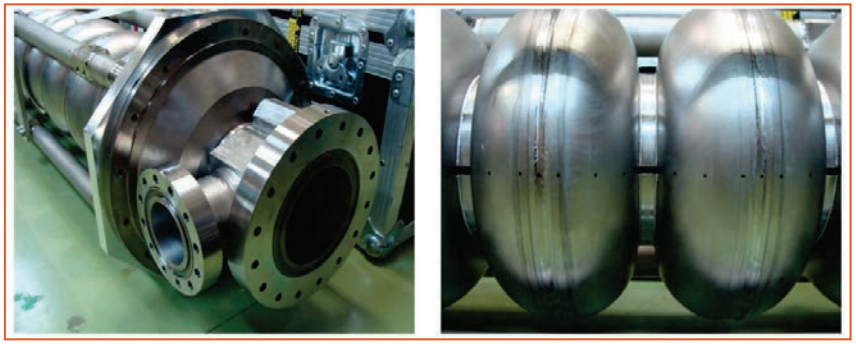
Vertical test diagnostics and simulation studies for 9-cell cERL cavities

Enrico Cenni (SOKENDAI, KEK), Takaaki Furuya. Hiroshi Sakai, Kensei Umemori, Kenji Shinoe, Masato Sato (KEK), Masaru Sawamura (JAEA)

国立大学法人
総合研究大学院大学
The Graduate University for Advanced Studies [SOKENDAI]

- cERL cavities
- Description of the mapping system
- Some measurement results
- Comparison with simulation results
- Summary





Frequency	1300 MHz	Coupling	3.8 %
Rsh/Q	897 Ω	Qo x Rs	289 Ω
Ep/Eacc	3.0	Hp/Eacc	42.5 Oe/(MV/m)

1.5xTESLA cavities

Motivation

Mapping system:

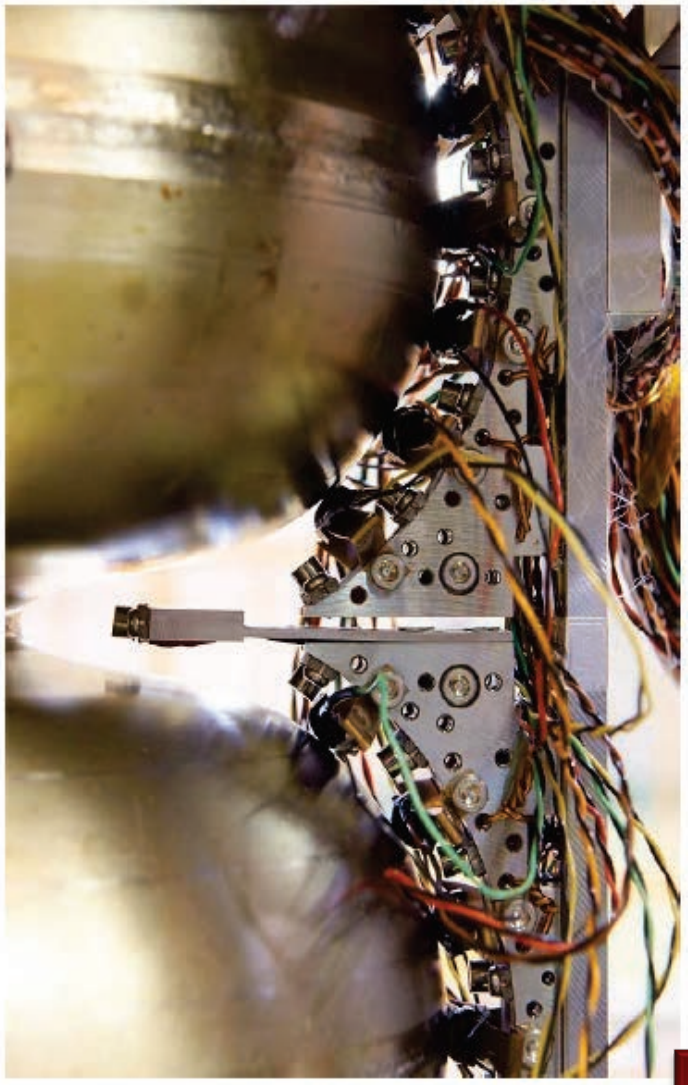
- Due to the high Epeak/Eacc ratio, field emission could be a major problem for cavity performance. A rotating mapping system was designed in order to precisely detect X-rays.
- The data analysis can give some clues about the location of the emitters and the electron trajectories inside the cavity.

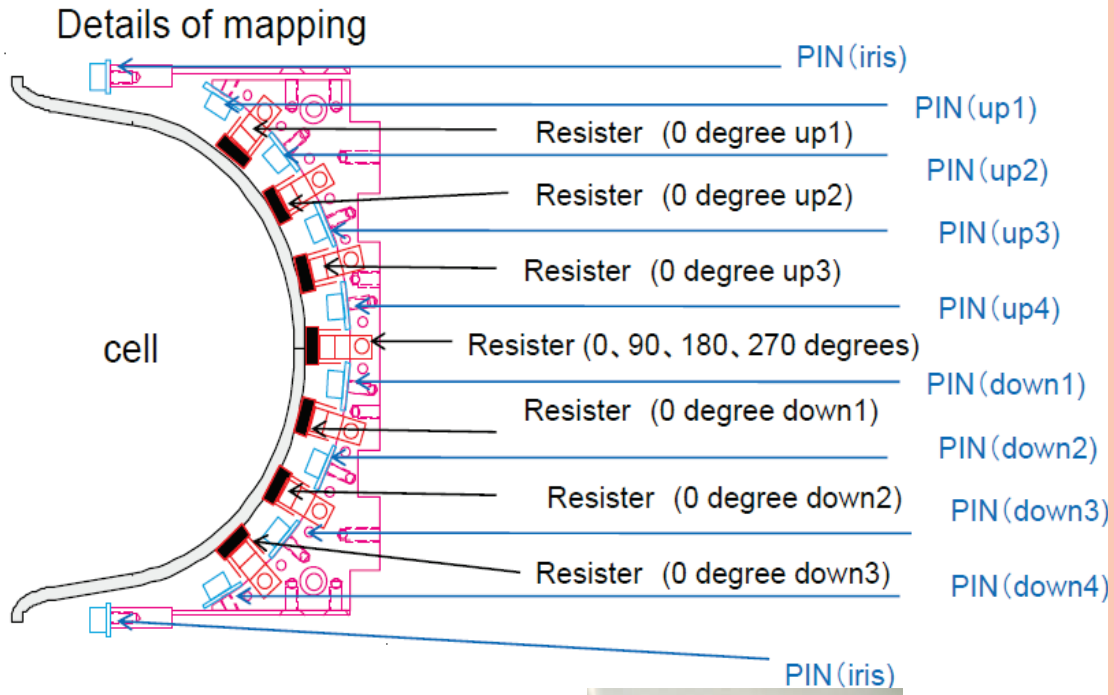
Simulation:

- A particle tracking code is used to calculate the electron trajectories and the deposited energy on the cavity inner surface.

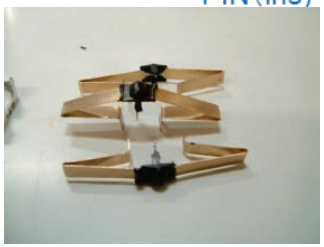
Final Goal: **A better understanding of the field emission**

Rotating mapping system





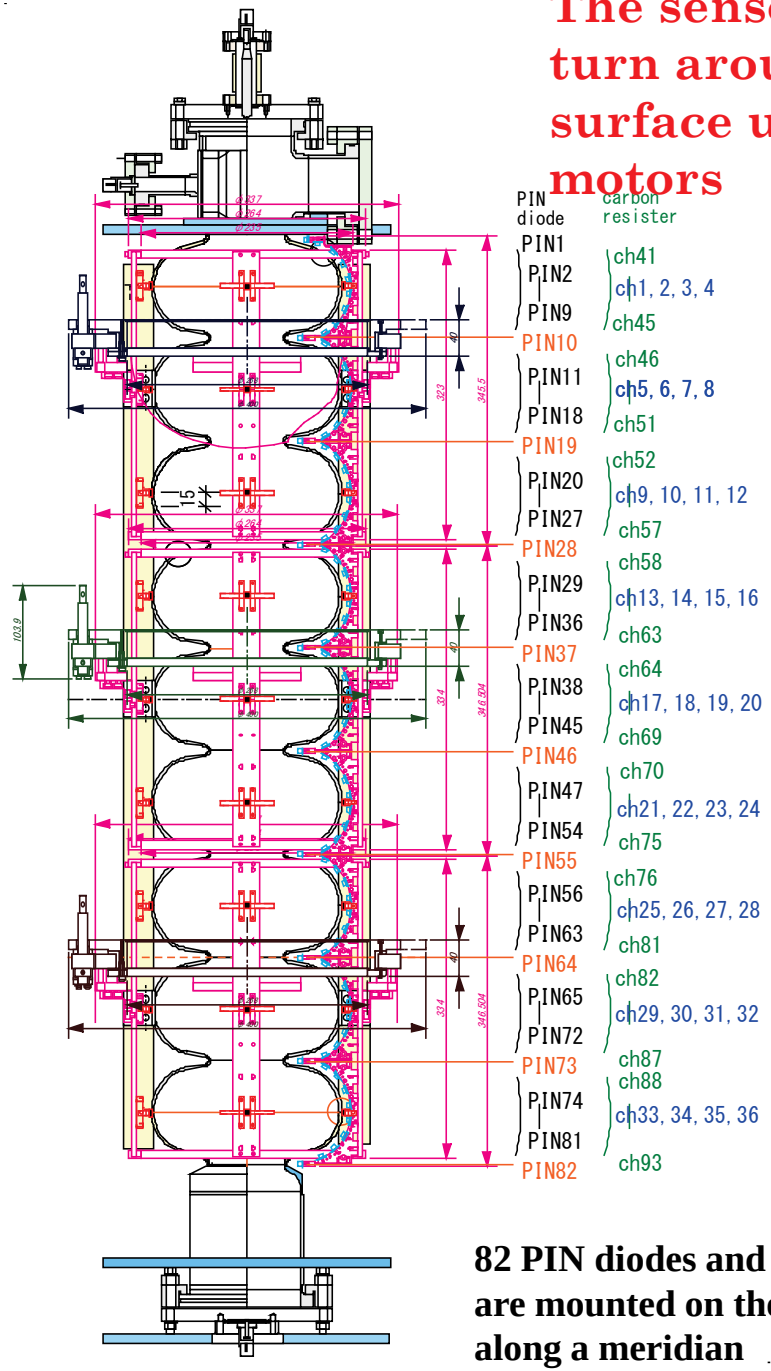
PIN diodes for X-ray detection



Carbon resistors for temperature measure

Figures of merits

- Resolution 0.5°
- Small number of sensors

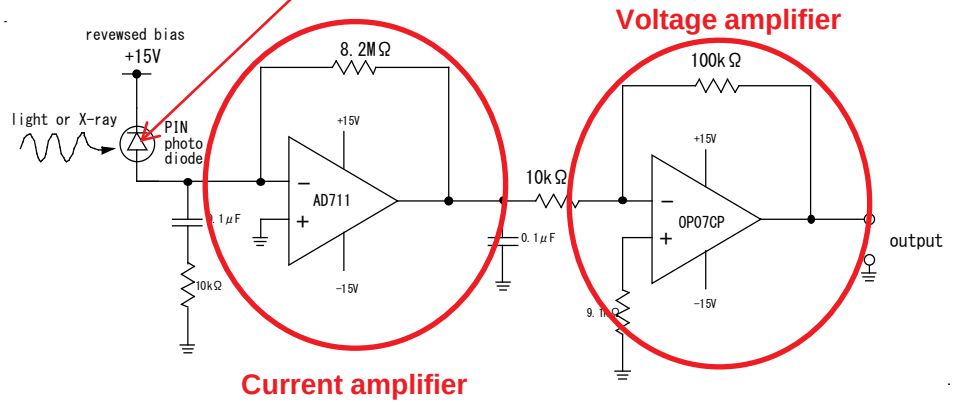


The sensor array can turn around the cavity surface using stepping motors

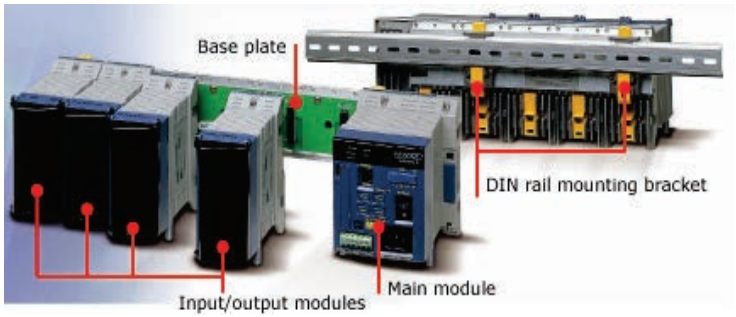
82 PIN diodes and 93 Carbon resistors are mounted on the mapping system along a meridian

Rotating mapping system specification

X-ray detection	82 PIN diodes	S1223 Hamamatsu
Temperature measure	93 Carbon resistors	Allen-Bradley 50Ω
Rotation time per turn	2.5 min	
Angular resolution	0.5°	
Acquisition time	0.5 s (0.1 s)	MW100 Yokogawa



MW100 Logging system (Yokogawa)



Acquisition time 0.5 s (to reduce the AC noise)

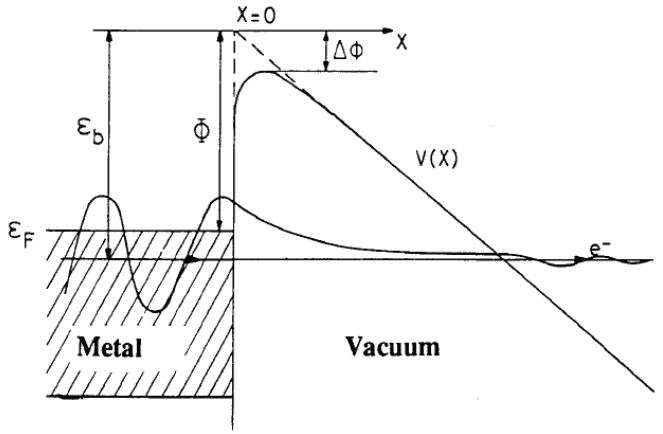
Simulation code

- E-M field is calculated with SuperFish
- Electron trajectories are tracked using relativistic equation of motion (modified Fishpact)

$$I = S.\frac{A.\beta^2.E^2}{\Phi}\exp(-B\frac{\Phi^{3/2}}{\beta.E})$$

$$A = 1.54.10^{-6}$$

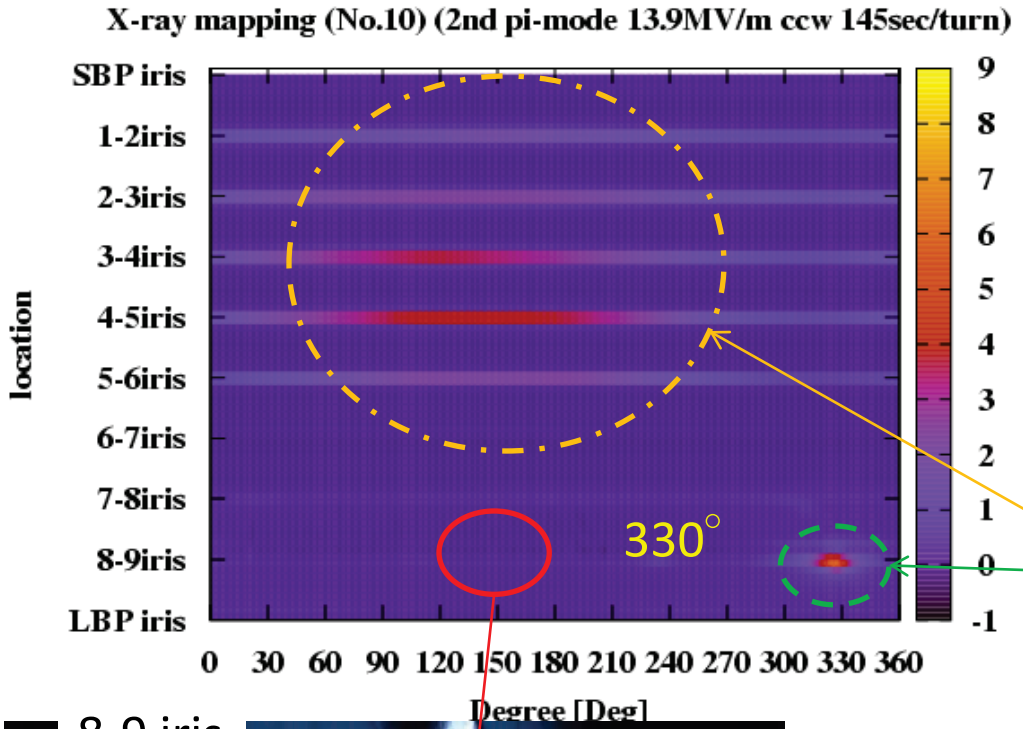
$$B = 6.83.10^{9}.$$

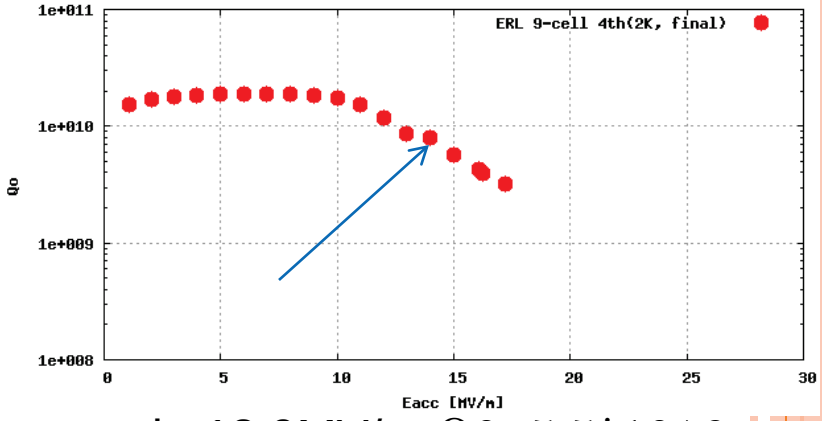


- Using the Fowler-Nordheim equation and the electron energy from the simulation results, it is possible to calculate the deposited energy in the inner surface of the cavity
- We plan to implement EGS5 calculation in order to simulate Niobium effect on energy deposition

X-RAY MEASUREMENTS AND SIMULATION RESULTS

X-ray mapping data

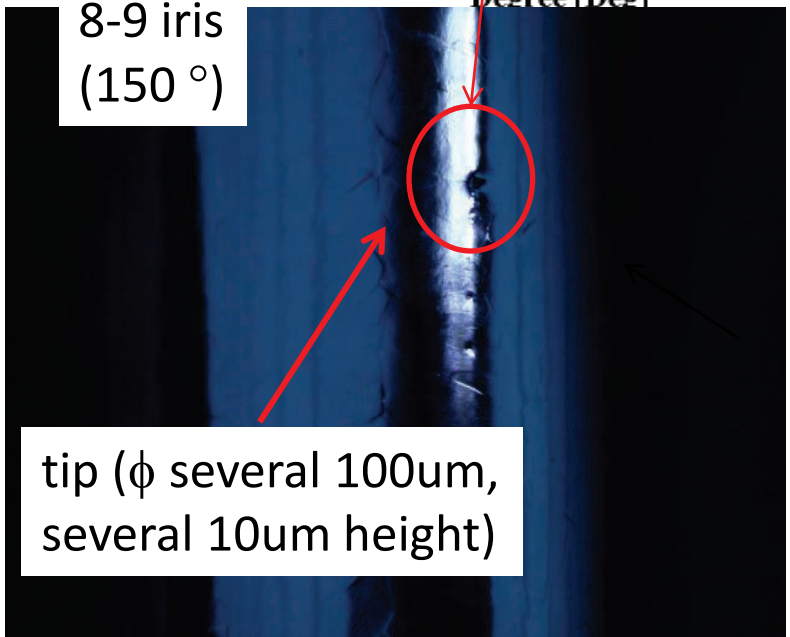


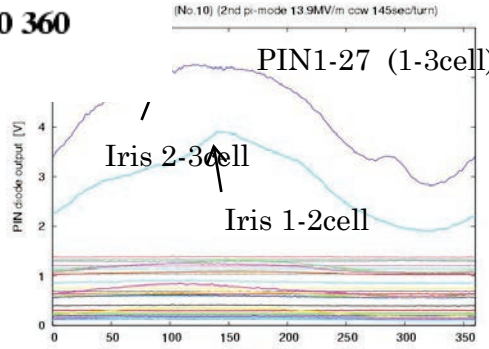


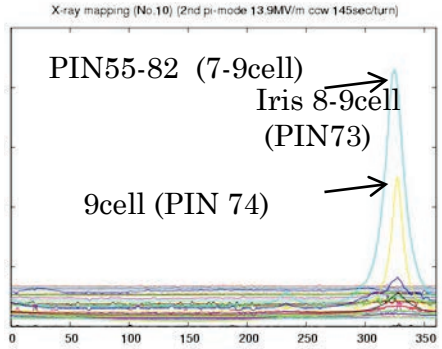
π-mode 13.9MV/m Q0=5.5*10^9

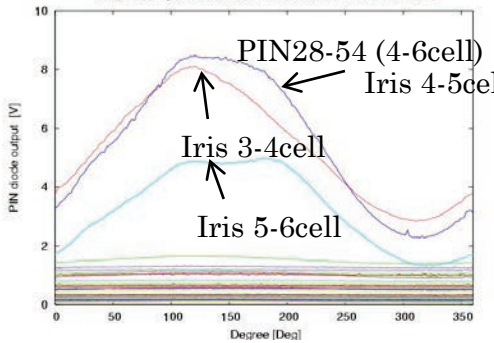
DATA FROM MAPPING SYSTEM

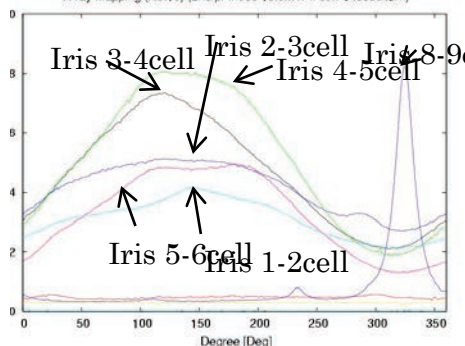
- Broad peak on the 150° meridian
- Sharp x-ray spot at 330° on the 8-9iris

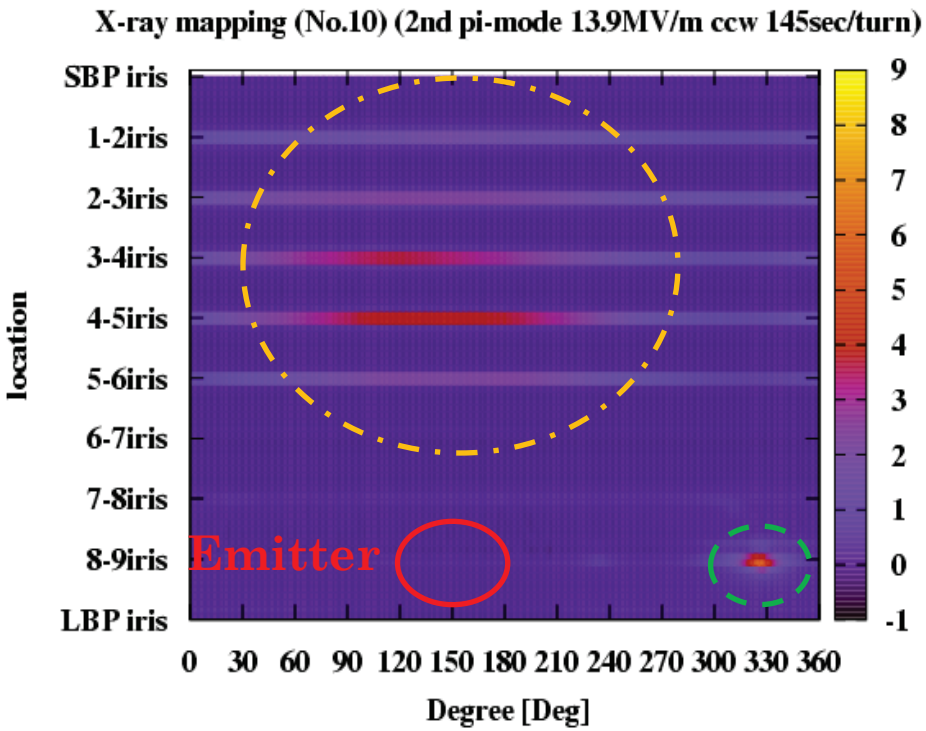








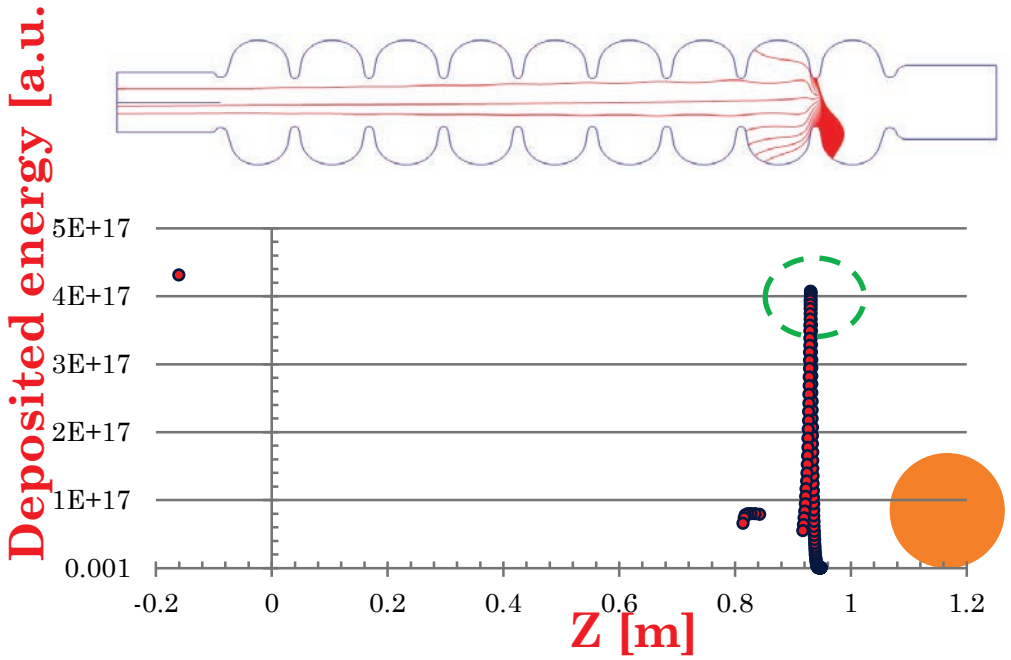




Comparison between mapping data and simulation results

DATA FROM MAPPING SYSTEM

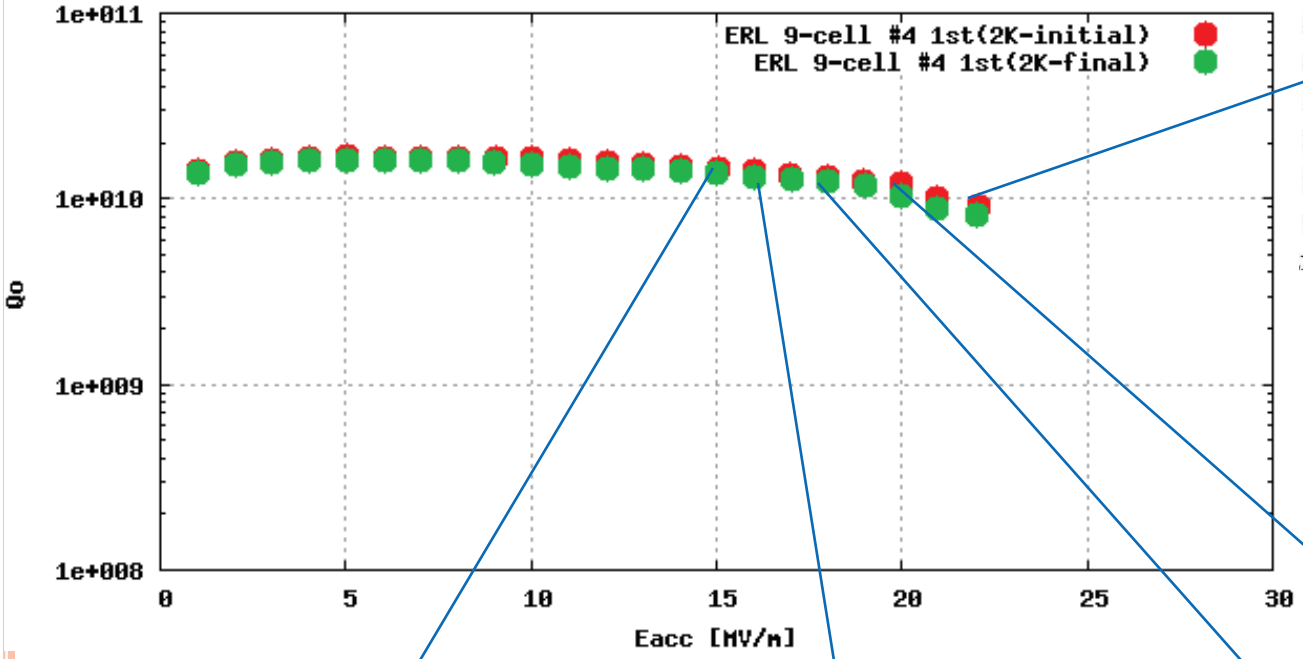
π-mode 13.9MV/m

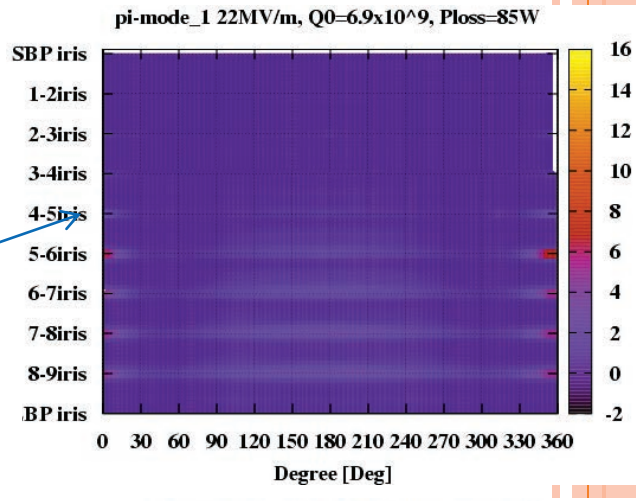


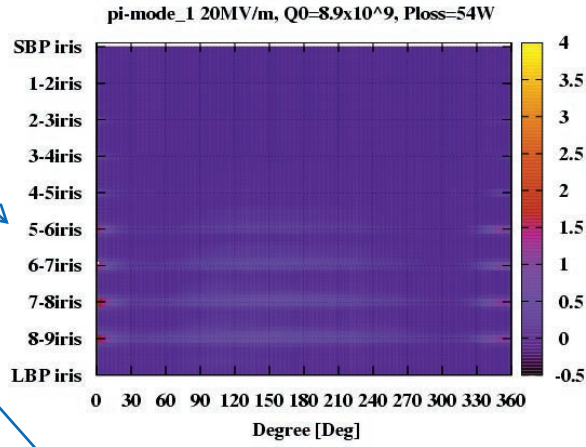
SIMULATION RESULTS ON THE 330° MERIDIAN

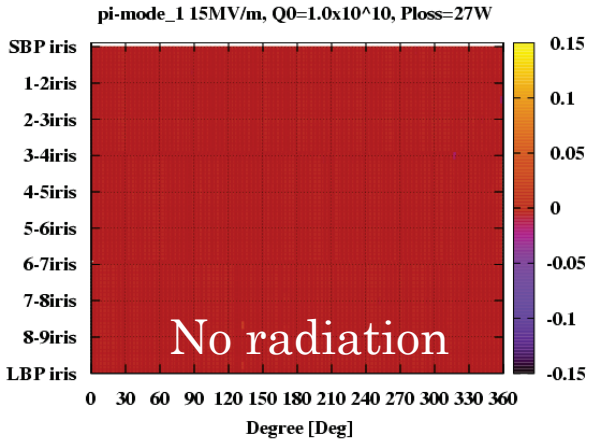
- A sharp peak is obtained on the 8-9iris cell
- Some trajectories run near the iris on 150° meridian, some shower could be created by striking the iris surface.

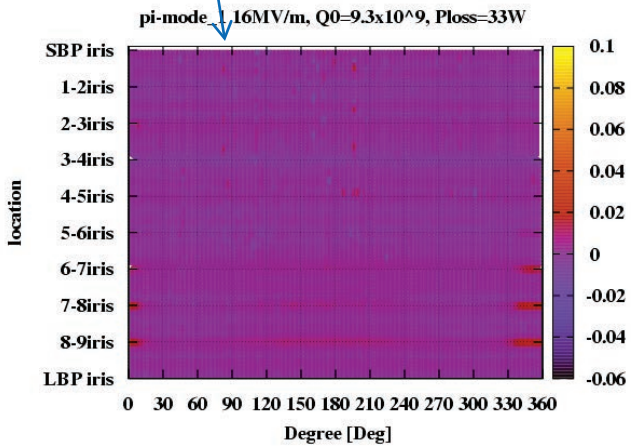
Field emission on-set detection

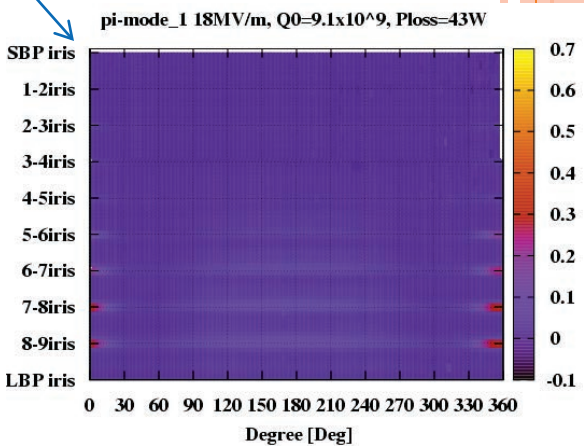


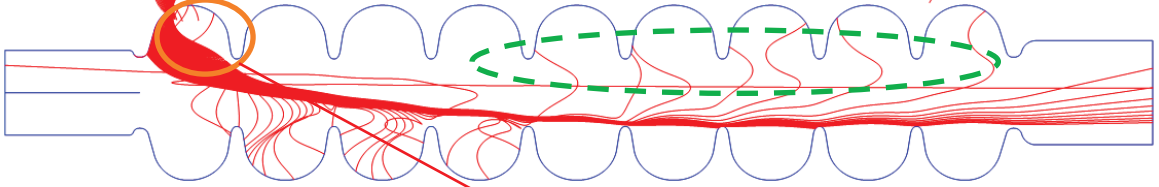




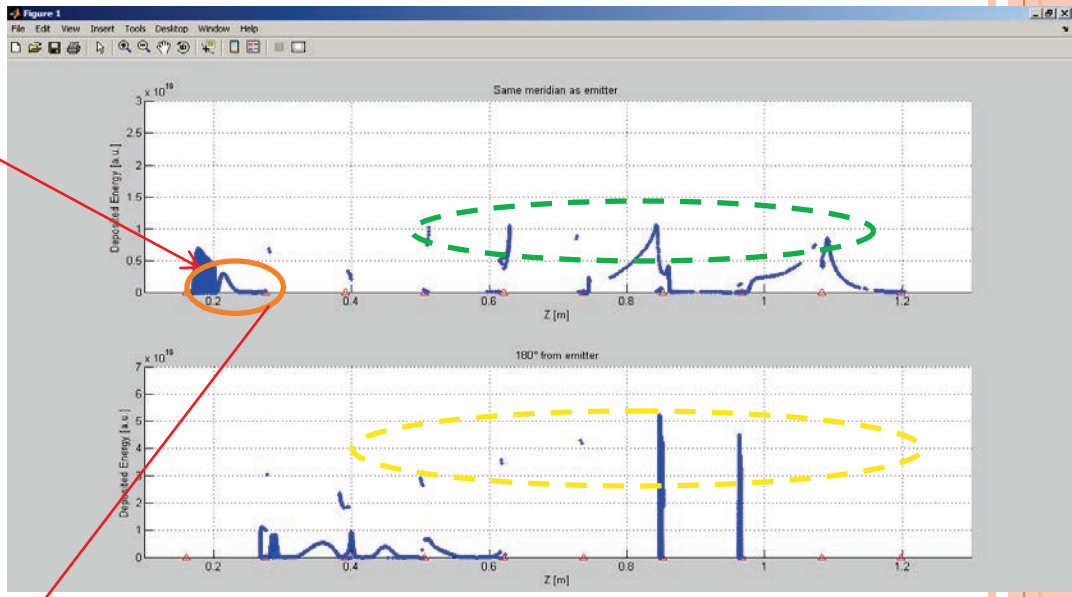




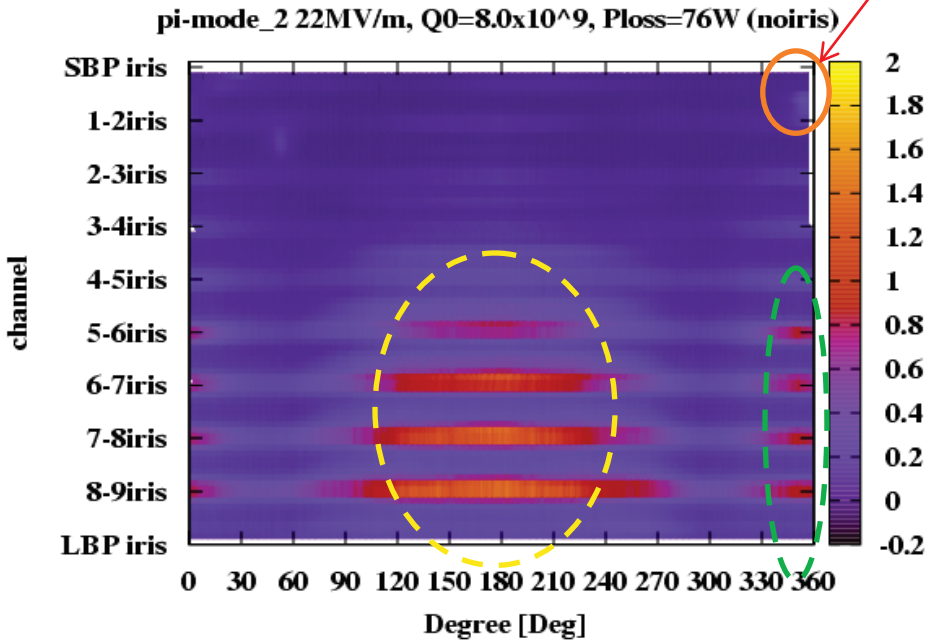




π-mode 22MV/m



DATA FROM MAPPING SYSTEM



SIMULATION RESULTS

Emitter located on SBP-1cell Iris can give some rough agreement with mapping data

Summary

- A rotating mapping system capable of 0.5° angular resolution is used during vertical test
- The mapping system is able to detect X-rays with enough resolution to detect X-ray traces along the cavity surface
- Sharp and broad peak can be detected giving hints on the location of the emitters
- Simulation codes for data analysis are under development, even at this stage it catches the “trends” of the measures

THANK YOU FOR YOUR ATTENTION

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- **Professor Furuya, Sakai-san, Umemori –san, Sawamura-san, Shinoe-san and Sato-san**
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