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Summary of KURRI collaboration meeting

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24 September 2013

We discussed

- Goals
  - three subjects
- Foil scattering
  - bump magnets
- Beam line to ERIT and ADSR
  - bending magnet to ERIT
  - quadrupole magnet to ADSR
- Schedule
  - Sometime this winter

Goal of the KURRI-FFAG experiment

- Can FFAGs have similar magnitude of space charge tune shift/spread as synchrotrons?
  - Resonance lines are more dense in tune space.
  - Could be large ratio between horizontal and vertical beam size?
- Can we keep large ratio of beam size to accommodate more particles?
- How space charge affects ionisation cooling?

Want to finish before doing experiments

- Modelling of capture process in longitudinal
    - maximise peak intensity to give the maximum tune shift.
- Modelling of multi-turn injection process in 3D with foil scattering.
- Modelling of space charge effects in 3D at the first few ms.
- Understanding diagnostics.
    - Beam profile measurement by scraper.

Tools

- OPAL
    - 3D field map
    - 3D space charge
    - foil scattering
- Simpsons
    - 3D space charge
    - foil scattering
- ORBIT

Simpsons as an example

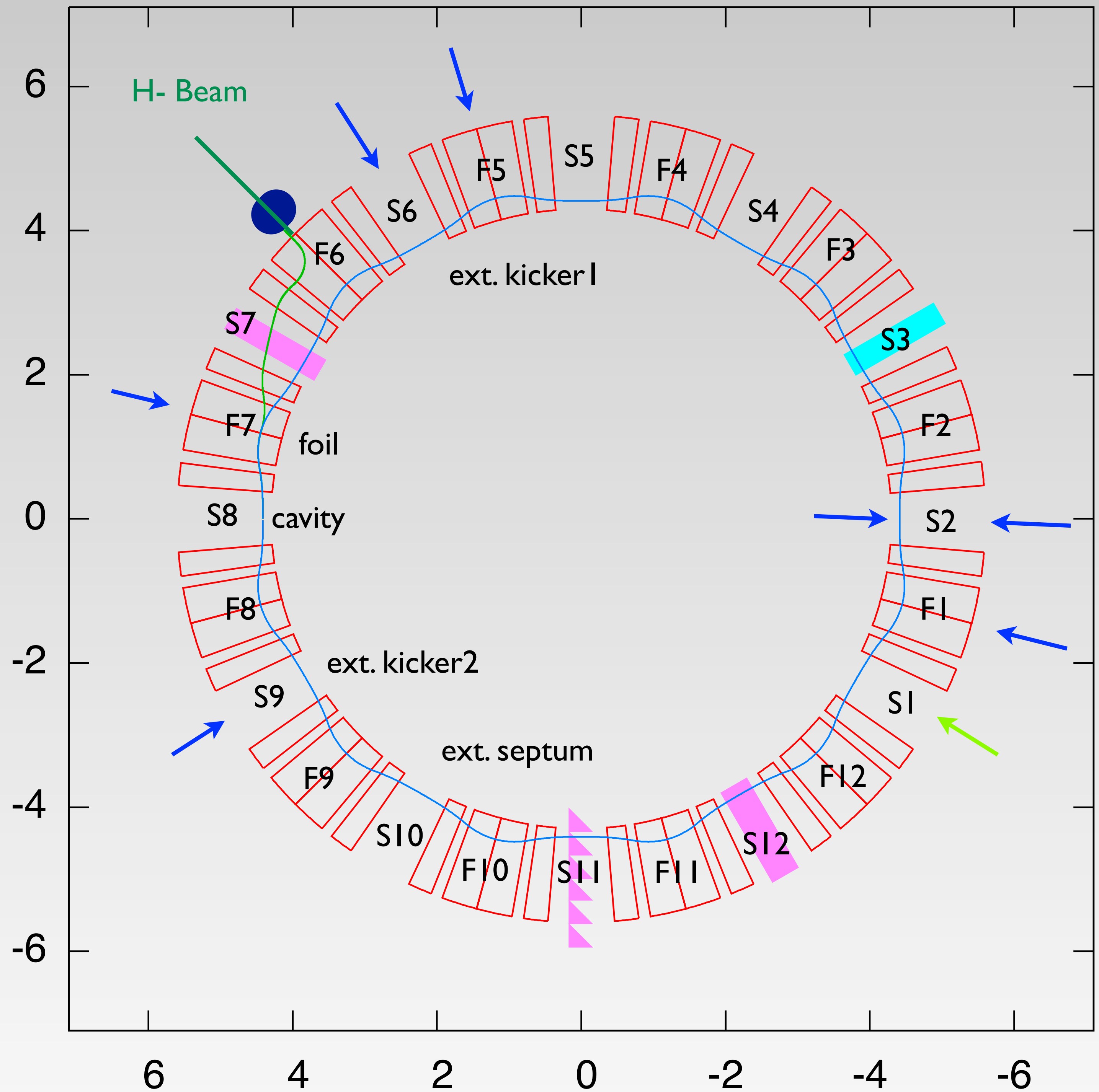
- Actively used for J-Parc and CERN-PS.
  - Simple scattering model (tested for ERIT) seems to work.
  - Simply I did not spend time for KURRI modelling.

Plan after Cyclotron conference

- Decide whether we should go ahead (Mori, Prior, Meot, Machida, others at Cyclotron conference/FFAG workshop).
- A couple of weeks long beam time in December 2013.

29 Aug 2013 Y. Ishi

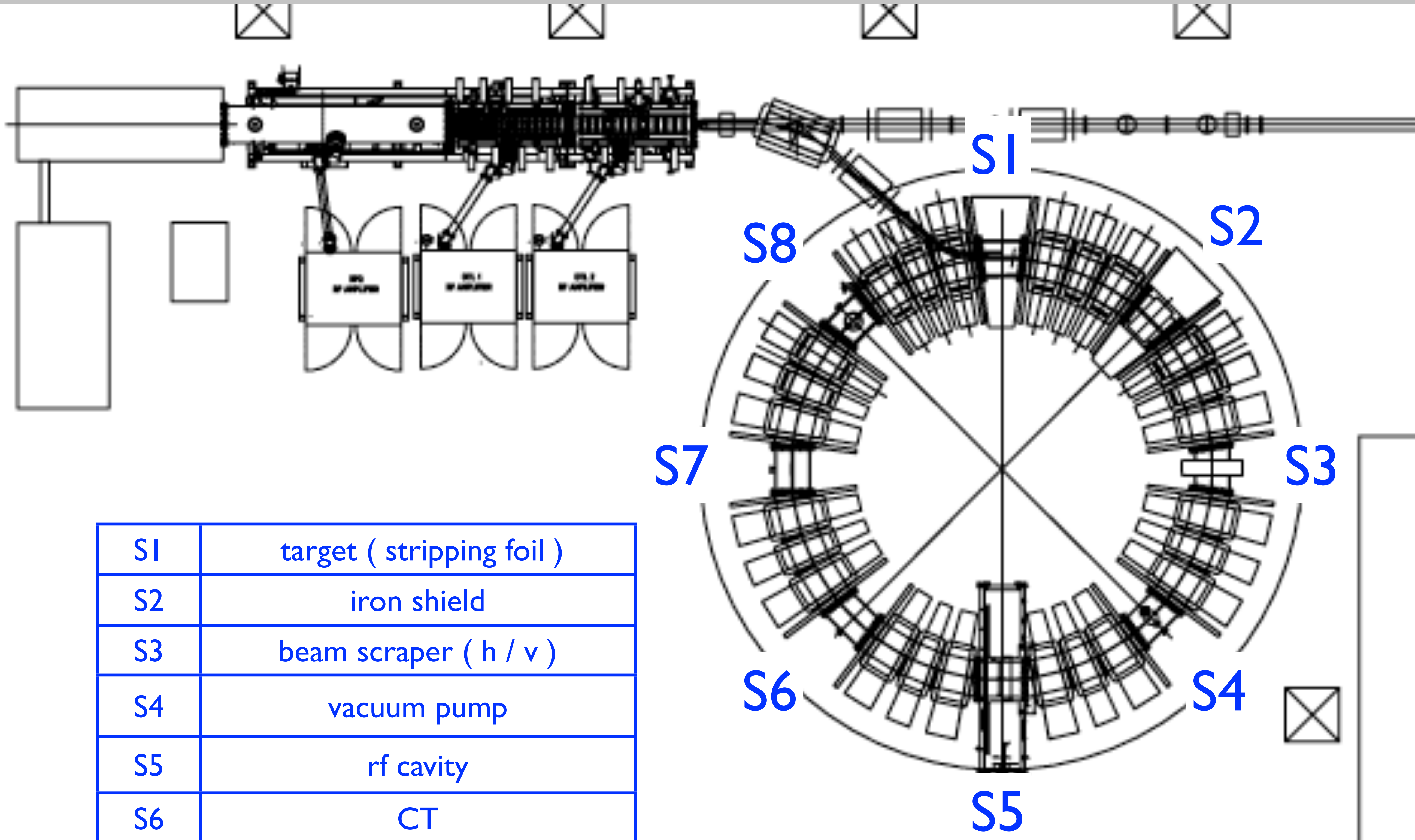
Available Monitors in ADSR-FFAG Ring



List of monitors

7 ports for radial probes (blue arrow, ICF70)
4 portable radial probes remote cntrl'd
2 portable radial probes manual cntrl'd
1 unportable radial probe (green arrow)
3 bunch monitors
1 faraday cup / 1 screen monitor
1 perturbator

S1	radial probe
F1	radial probe
S2	radial probe / hor. perturbator
S3	vert. perturbator
F5	radial probe
S6	radial probe
(F6)	Faraday cup / screen monitor
S7	bunch monitor
F7	radial probe
S9	radial probe
S11	bunch mon.(array of triangle plates)
S12	bunch monitor



S1	target (stripping foil)
S2	iron shield
S3	beam scraper (h / v)
S4	vacuum pump
S5	rf cavity
S6	CT
S7	bunch monitor
S8	vacuum pump, viewing port

S-Pod

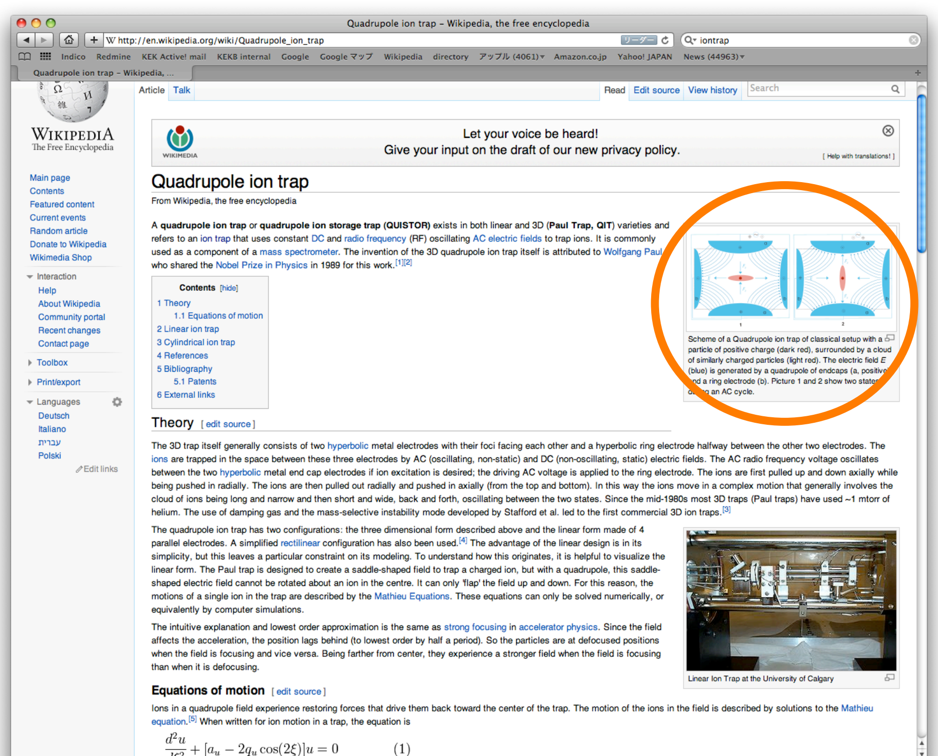
another experiment at Hiroshima University in Japan

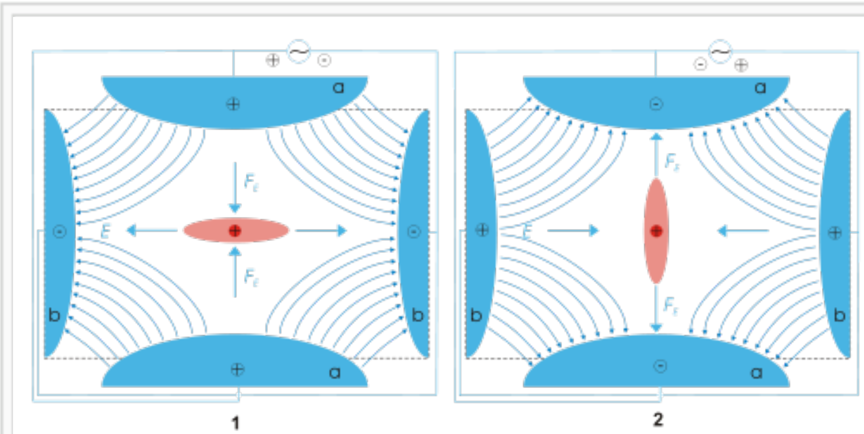
- We have discussed at FFAG 12 in Osaka.
- Much progress for the last several months.
- To be published shortly.

Slides from Cyclotron 2013 (1)
H. Sugimoto (KEK)

Use a Paul Trap?

- Paul trap found in Wikipedia.





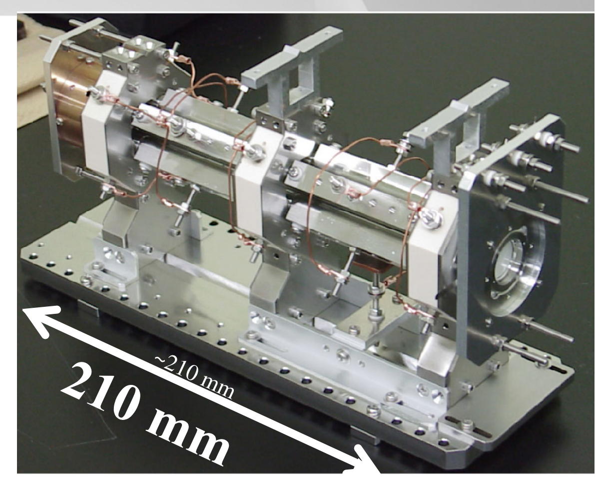
Scheme of a Quadrupole ion trap of classical setup with a particle of positive charge (dark red), surrounded by a cloud of similarly charged particles (light red). The electric field *E* (blue) is generated by a quadrupole of endcaps (a, positive) and a ring electrode (b). Picture 1 and 2 show two states during an AC cycle.

http://en.wikipedia.org/wiki/Main_Page

Slides from Cyclotron 2013 (2)
H. Sugimoto (KEK)

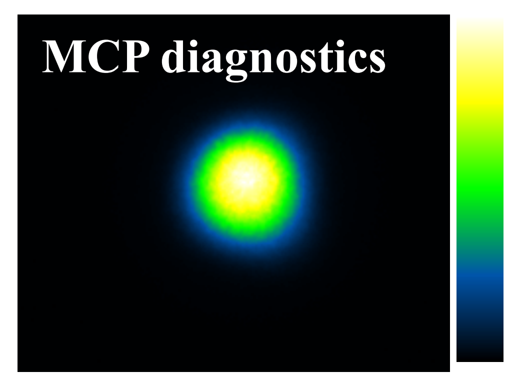
Advantages

- <u>Very compact and low cost</u>
  - Several tens of thousands dollars for the whole system

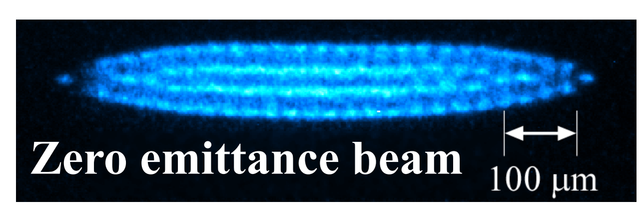


- <u>High flexibility of fundamental parameters</u>
  - Beam density, operating point, lattice function, etc.

- <u>High resolution & high precision measurements</u>
  - Faraday cup, micro-channel plate
    Laser induced fluorescence (LIF)



- <u>Radio-activation free</u>
  - Experiment with any strong beam instability.



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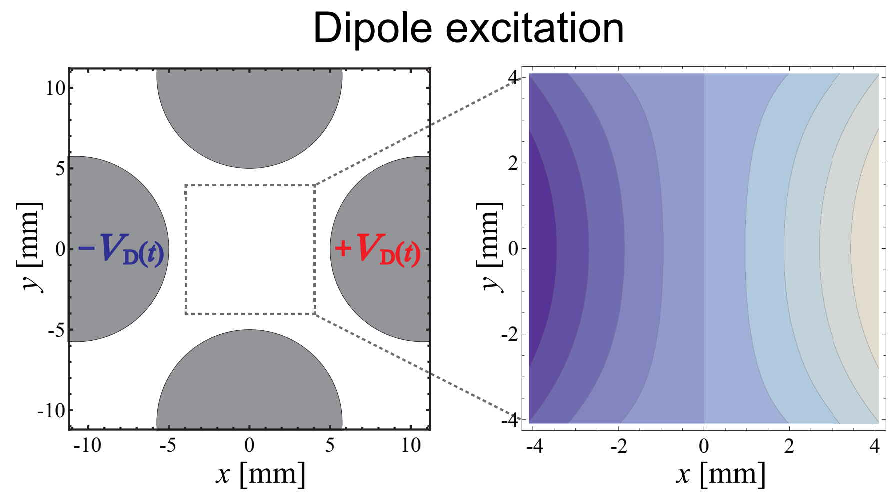
Slides from Cyclotron 2013 (3)

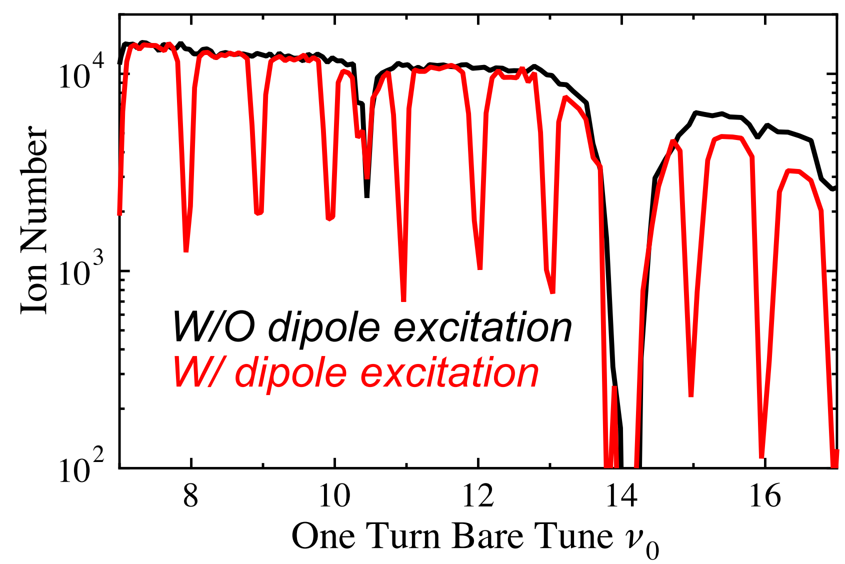
H. Sugimoto (KEK)

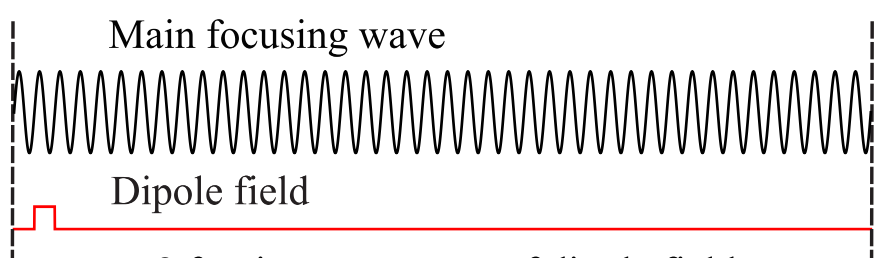
S-POD Application to Integer Resonance Crossing

S.L.Sheehy *et al.*, IPAC'13 2677.

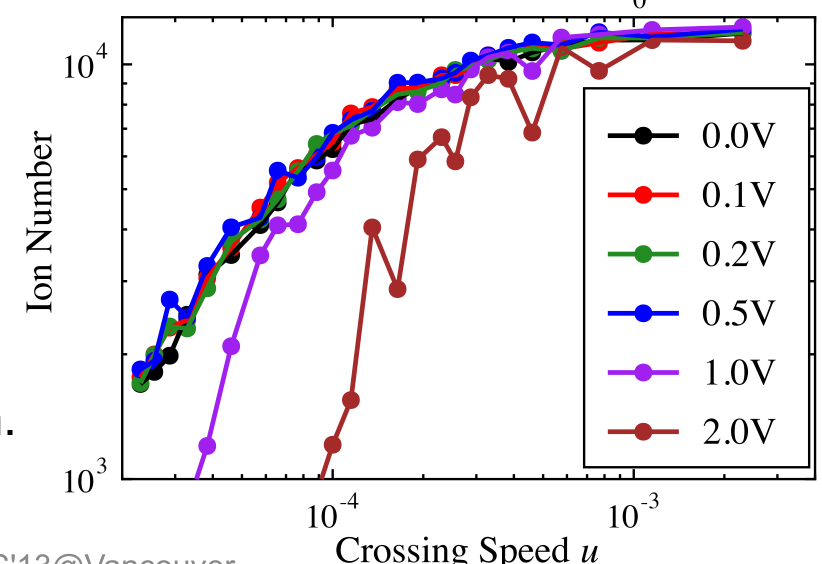
- Crossing of multiple integer resonances in EMMA NS-FFAG.







Dipole perturbation wave to emulate unexpected field from the injection septum.



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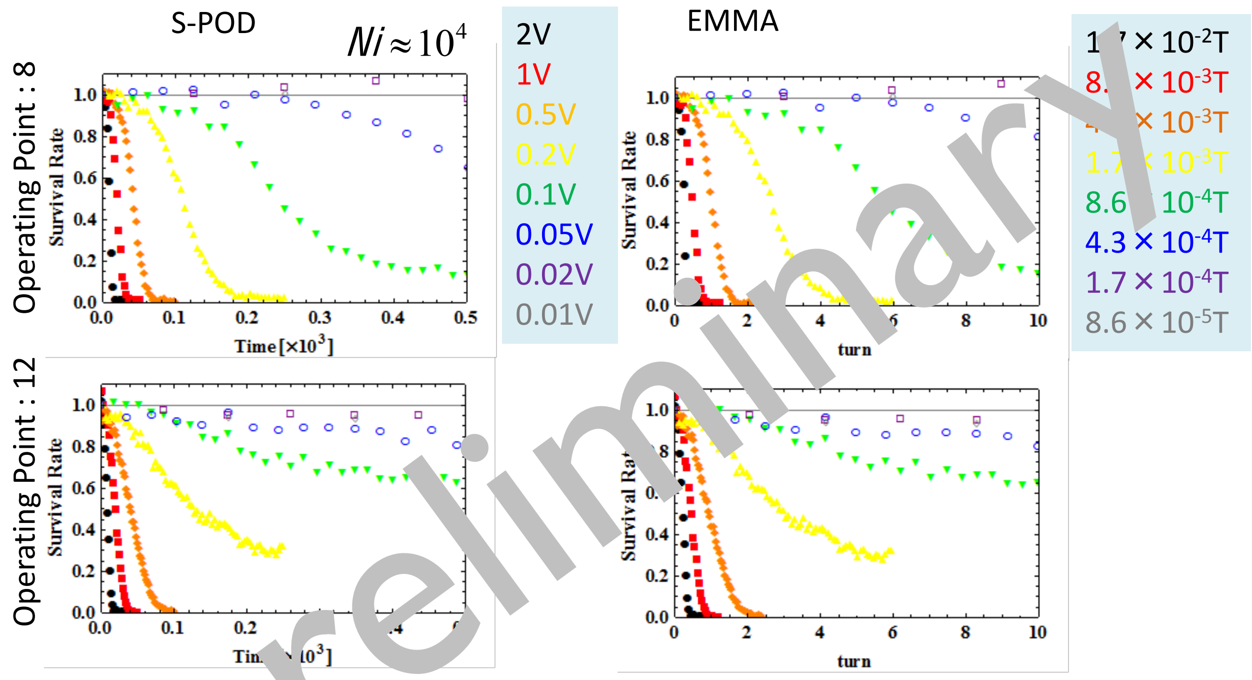
From S-Pod collaboration meeting (1)
K. Moriya (Hiroshima University)

S-Pod reproduces very similar results of EMMA.

Time evolution at integer resonance

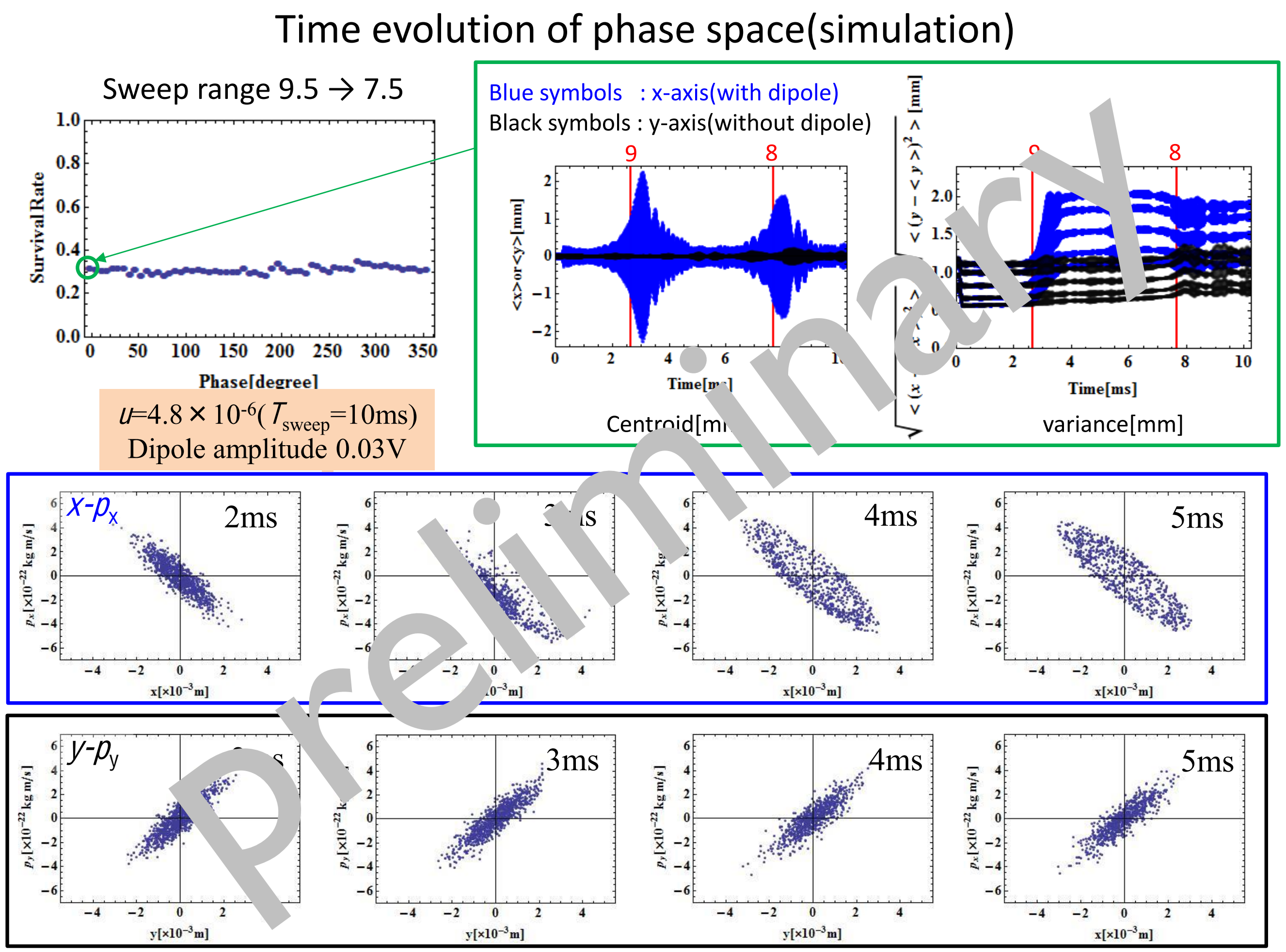


The left panels show S-POD results and the right panels show EMMA results.
The top panels show time evolution at n=8, the bottom panels show time evolution at n=12.

The abscissa axis of these graphs can be normalized
with the product of dipole amplitude and duration time.

From S-Pod collaboration meeting (2)
K. Moriya (Hiroshima University)

We believe amplitude dependent tune shift from higher order multipoles causes smearing after integer tune crossing.



In EMMA, tune spread due to natural chromaticity and momentum spread causes smearing after integer tune crossing.