

NuFact05

June 21-28, 2005

Frasucatti, Italy

FFAG & Acceleration



Topics to be discussed

- ◆ FFAG Muon Accelerator
- ◆ FFAG Proton Driver
- ◆ FFAG high rep. rate booster/stacking for beta beam (unstable nuclei)

Constraints



Scaling FFAG: $B(r, \theta) \propto r^k f(\theta)$

◆ All of beam optics parameters are scaled with momentum variation.

– beta func., dispersion, etc. $\propto p^{\frac{1}{k+1}} \propto r$

◆ Acceleration


– variable frequency

– stationary bucket

◆ Because momentum compaction is constant.

Breaking the scaling law

 tunes are varied and/or

 path length is varied

◆ long. acceleration

— acceleration in neighboring transition
gamma (Gutter acceleration)

— slippage = 0 (Isochronous : mom. func.
= 0 for $\beta \sim 1$)



Muon acceleration ($\beta=1$)

- ◆ tunes are largely varied.
 - linear optical elements
- ◆ path length variation is minimized.

Non-scaling



Proton driver ($\beta < 1$)

- ◆ tunes are slightly or not varied.
 - non-linear optical elements
- ◆ path length is varied. (free parameter)

Semi-scaling

Resonance Crossing

📌 Important for FFAG design (both for scaling and non-scaling)

📌 Experiments

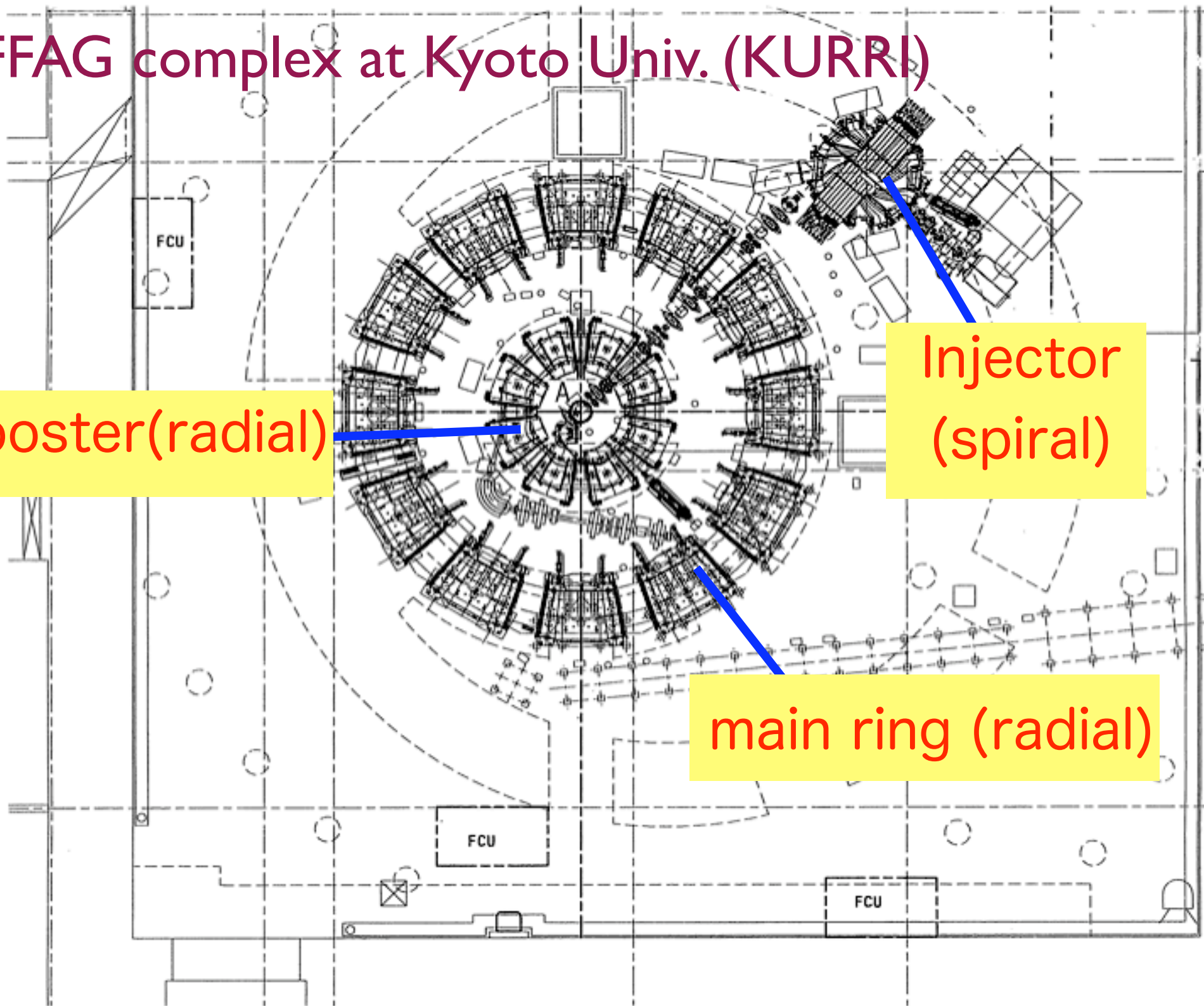
- ◆ Non-linear (>3rd) ← Aiba
 - Adiabatic Parameter : good measure >7
- ◆ Half integer ← Machida
- ◆ Integer ?

FFAG complex at Kyoto Univ. (KURRI)

booster(radial)

Injector
(spiral)

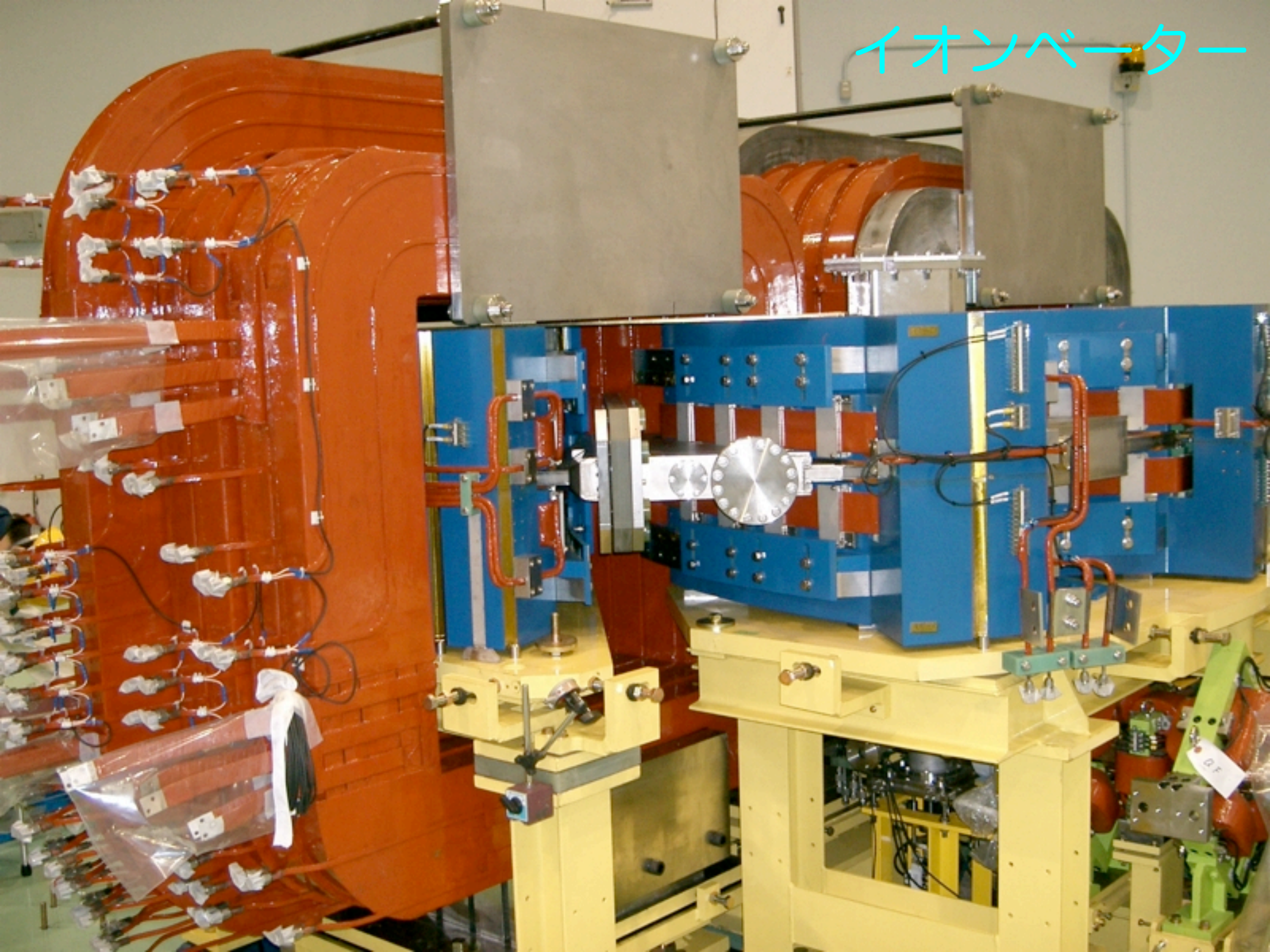
main ring (radial)



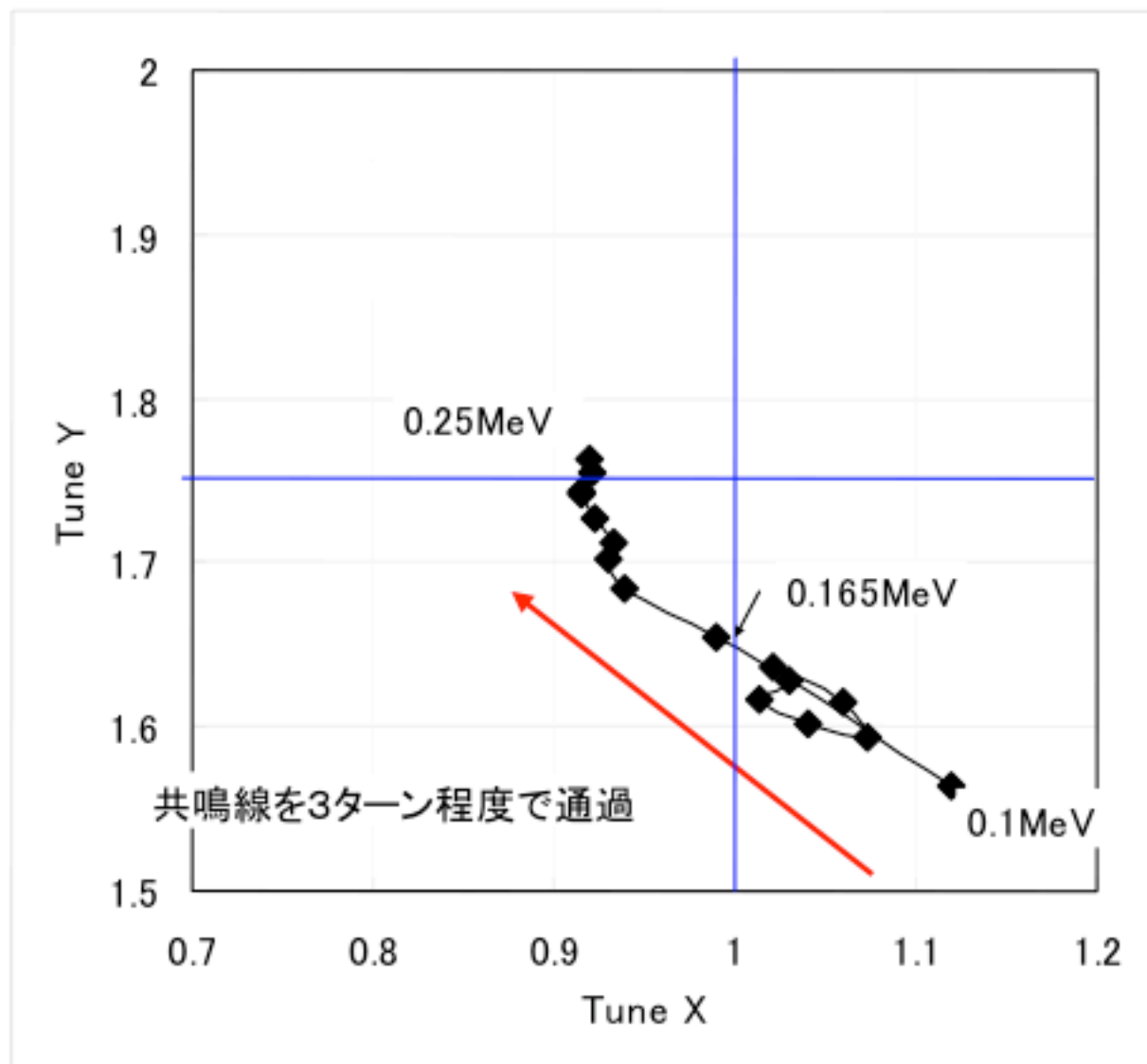
Parameters of the Accelerator Complex

	Injector	Booster	Main ring
E_{inj}	100keV	2.5MeV	20MeV
E_{ext}	2.5MeV	20MeV	150MeV
Lattice type	Spiral	Radial DFD	Radial DFD
Acc. scheme	Induction	rf	rf
# of cells	8	8	12
k value	0-2.5	4.5	7.6
coil/pole	coil	coil	pole
P_{ext}/P_{inj}	5.00	2.84	2.83
R_{inj}	0.60m	1.42m	4.54m
R_{ext}	0.99m	1.71m	5.12m

イオンベーター



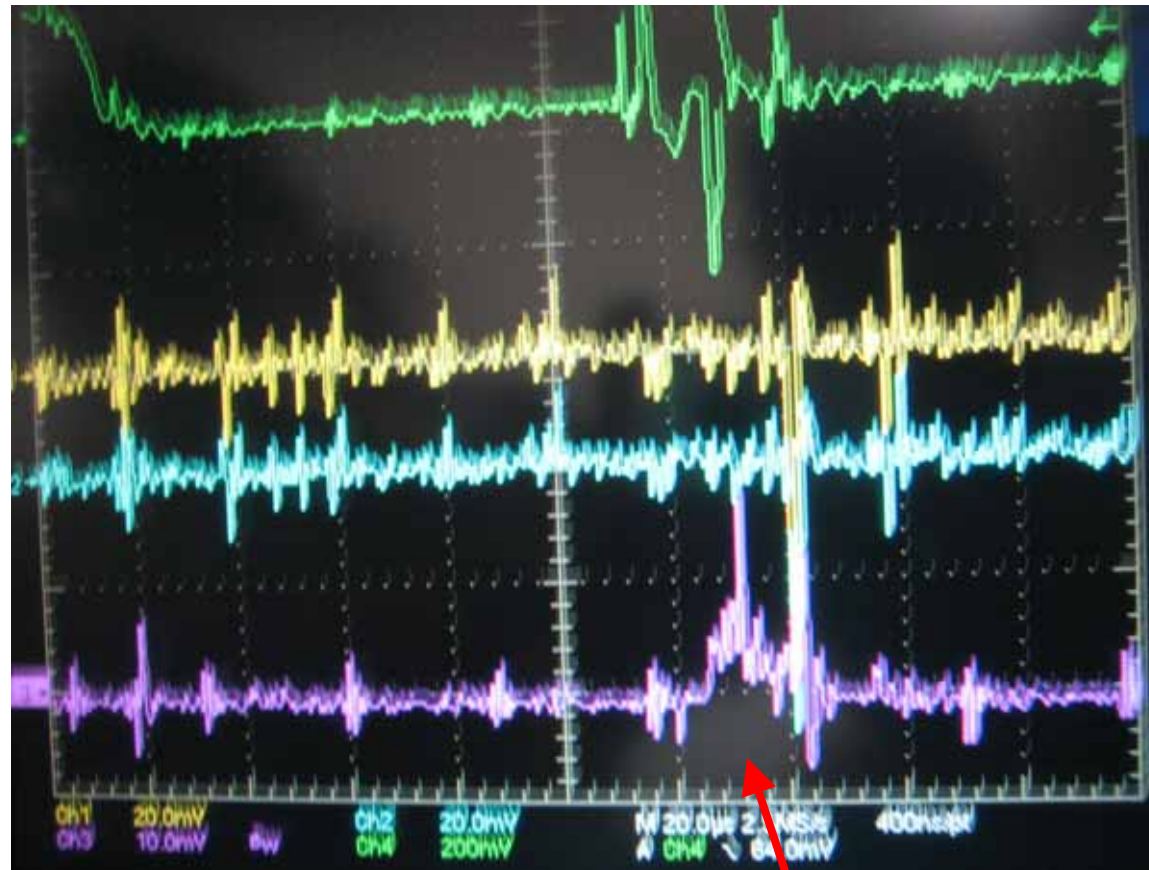
イオン β (トリムなし)コミッションの軌道解析



三菱電機・先端総研・田中
2005-3-26

- ①100keV入射で
250keV程度までビー
ム加速可能
- ②165keVで水平方向
線形共鳴を通過する

FFAGイオンベータからビーム出射に成功



イオン源ビーム出力(DCCT)

出射上側ファラデーカップ
(軌道が上側にずれた時に衝突)

出射下側ファラデーカップ
(軌道が下側にずれた時に衝突)

イオンベータデフレクタ後の
ファラデーカップ
(出射ビーム0.12mA)

ビーム入射

加速 約 $120\mu s$

出射ビーム


2005年6月14日(月)16時00分

入射エネルギー100keV、加速エネルギー250keV、加速ビーム電流0.25mA、出射ビーム電流0.12mA


加速電圧 : 入射時($7\mu s$)2.6kV、加速時($120\mu s$)0.9kV、出射時($7\mu s$)2.6kV

Discussion on FFAG

(Design, Engineering etc.)

 Muon Acceleration

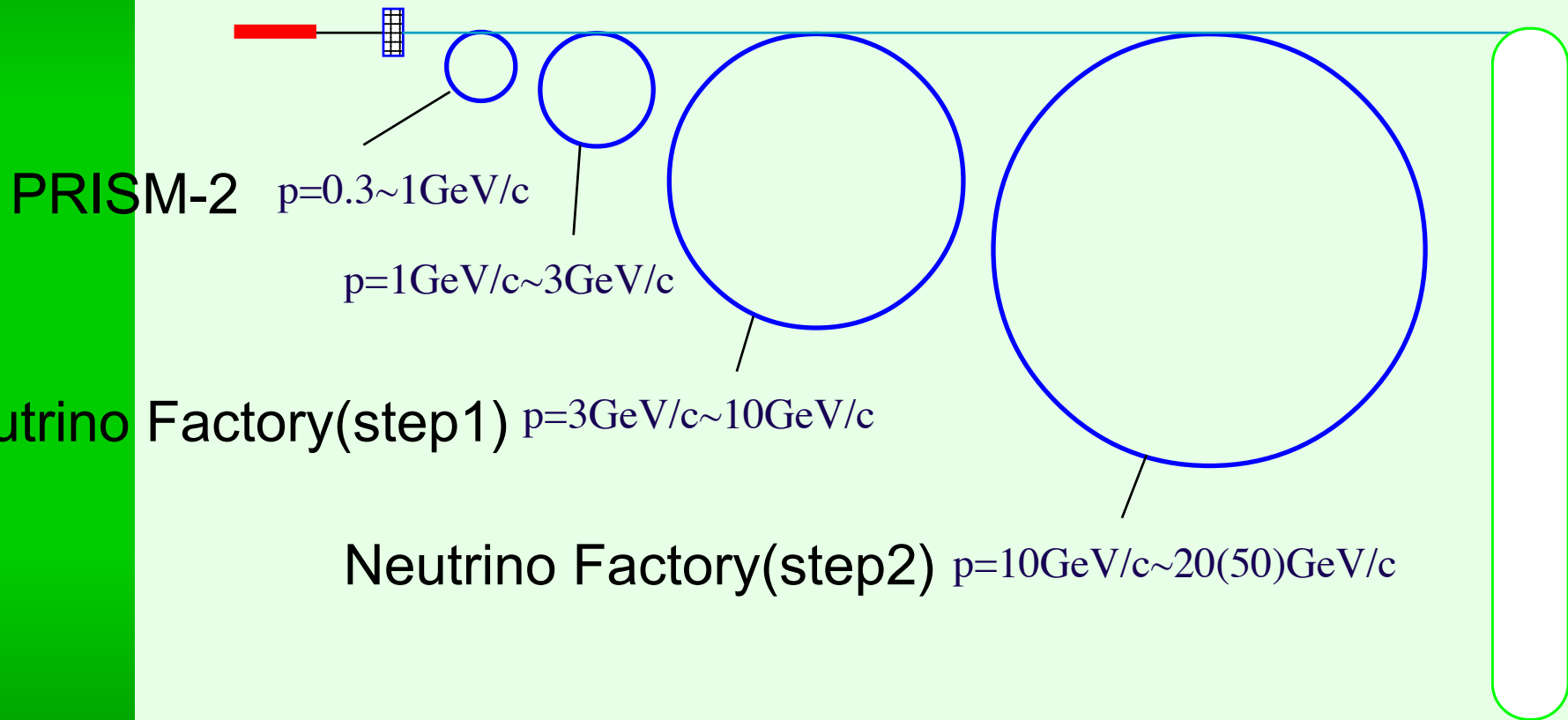
◆ F. Meot

 Proton Acceleration

◆ S. Ruggiero, G. Rees



FFAG Chain



Ni-doped amorphous MA with external B

Q ~ x50

Rp ~ x15

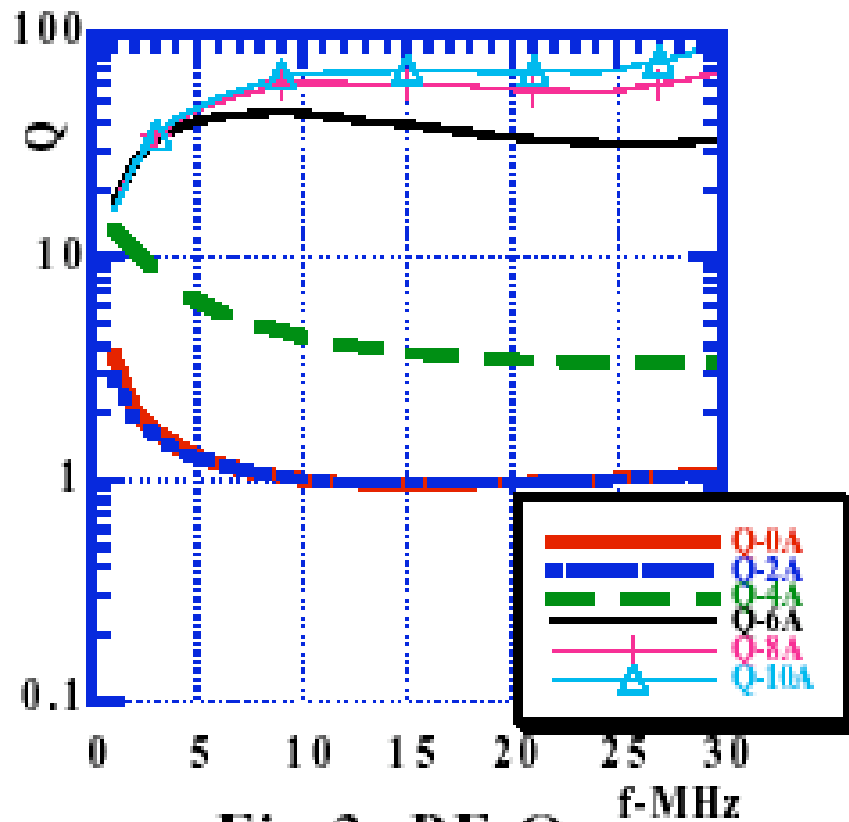


Fig.3 PF-Q

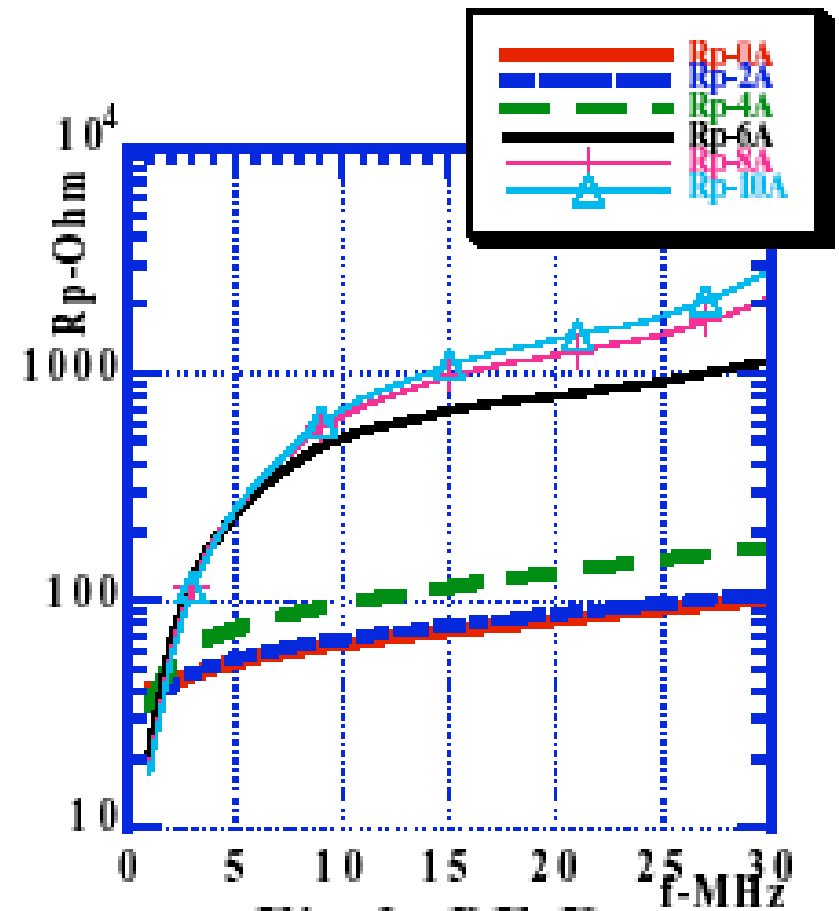
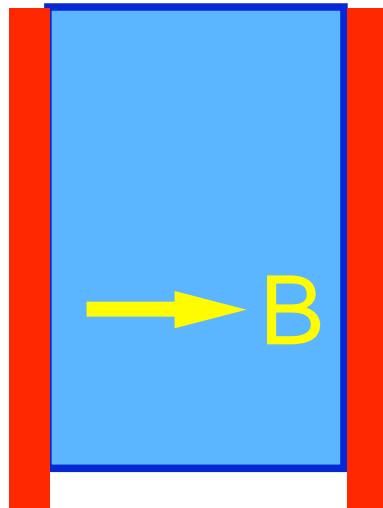
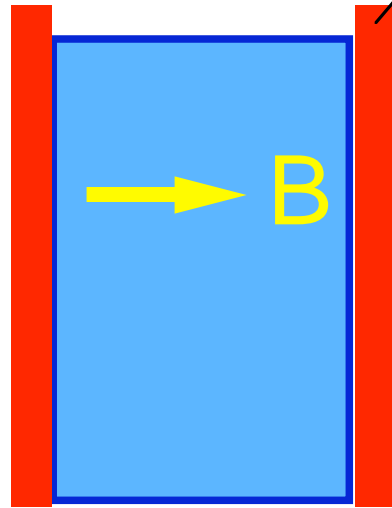


Fig.2 PF-Rp

Permanent Magnet

$B \sim 0.5-1 \text{ kG}$



FFAG05 in Japan

- 📌 Date Nov. 20th (Sun.) - 26th (Sat.) , 2005
- 📌 Place Kumatori, Osaka
- 📌 Host KURRI (Kyoto Univ. Research Reactor Institute)

