FFAG-TRIUMF 2004

FFAG Project

Practical Design

- Objects
  - Proton Driver
  - Electron Driver
  - Cancer Therapy
  - Muon Acceleration

Proton Driver

- Energy 1GeV
- Beam Current 1mA
- Repetition 1kHz(25Hz)

Proton Cancer Therapy

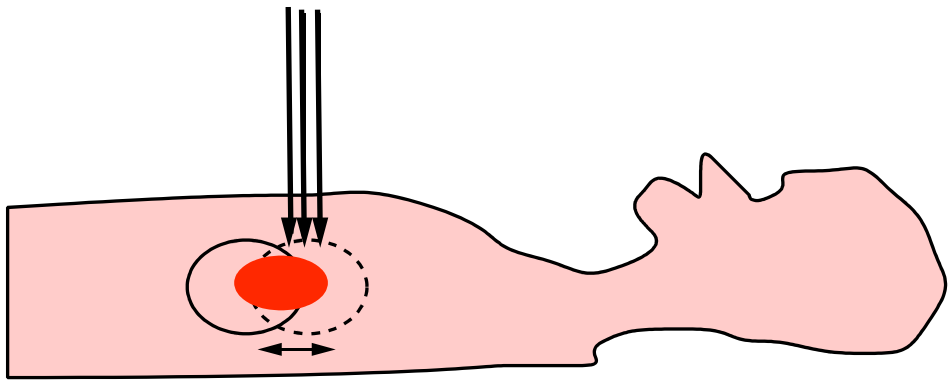
- Machine so far;Synchrotron,Cyclotron
- In order to make it more public, We need,
  - more beam
  - more compact size
  - less maintenance ability
  - less expensive cost

Beam Intensity

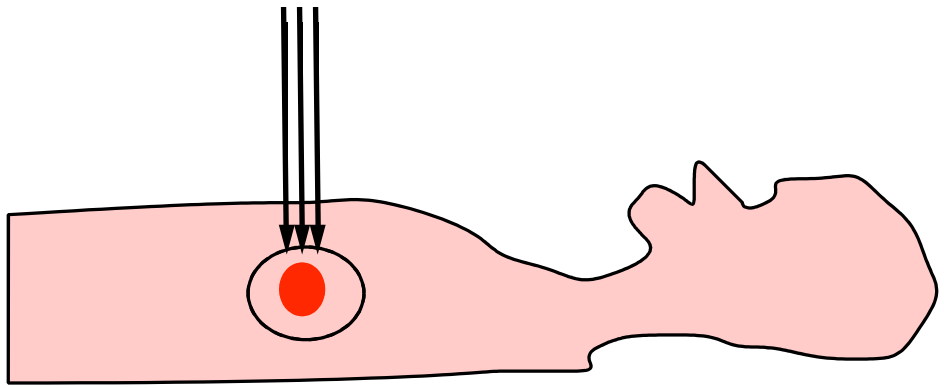
- Dose Rate(required); 5 Gy/min(250MeV)
- Duty Factor; 0.3 (respiration synchronization)

呼吸性移動を伴う臓器への照射

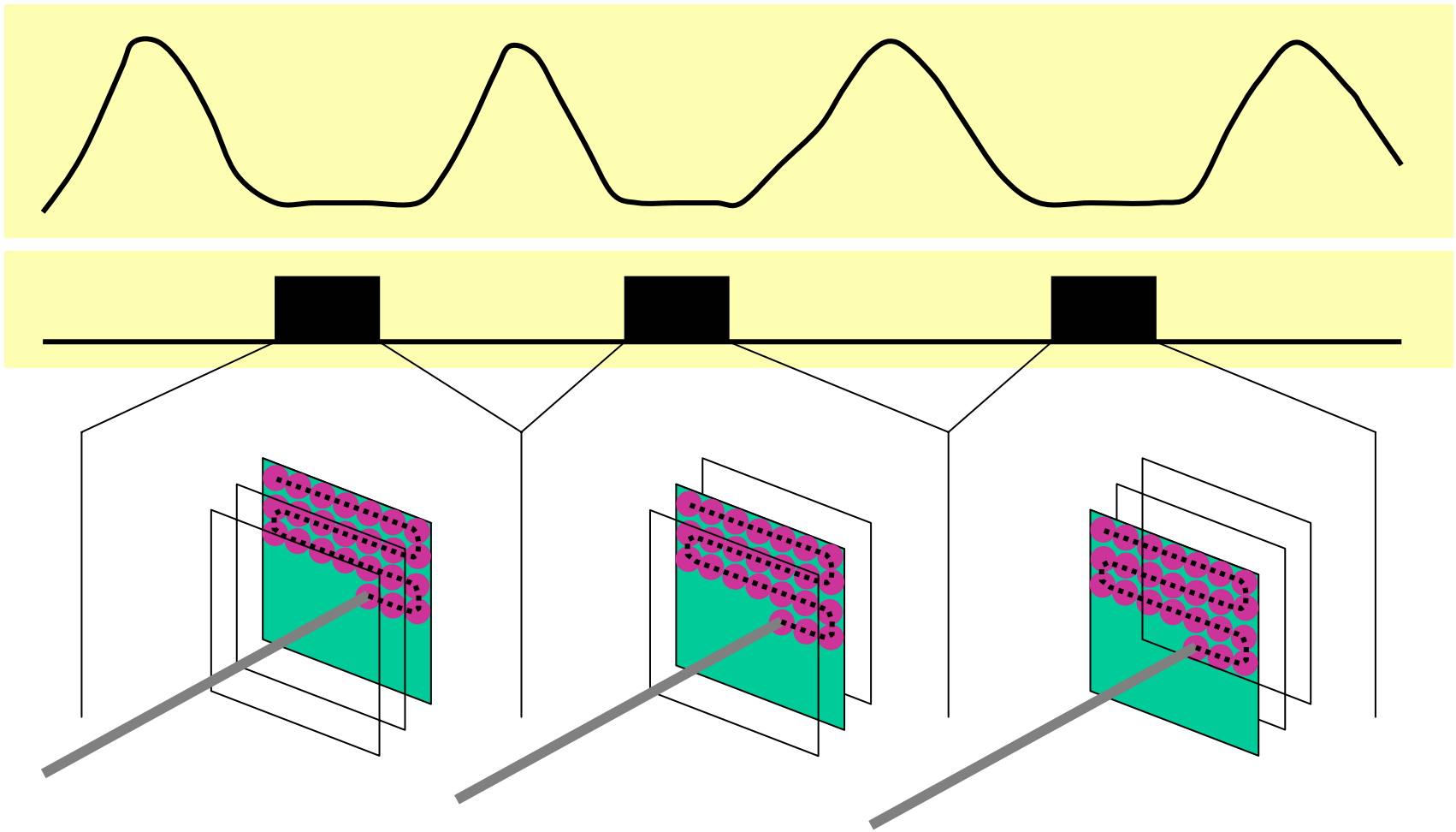
動きにより照射範囲が広がる



短いゲート内に必要線量の照射ができれば照射範囲が限定できる



呼吸同期に対応するスキャンニング照射



Beam Current

5Gy/min. & synchronize to respiration

- 0.1 Gy = 10E11 protons (250eV)

$$N_p = \frac{5}{60} \times \frac{10^{11}}{0.1} \times \frac{1}{0.3} = 2.8 \times 10^{11} \text{protons / sec}$$

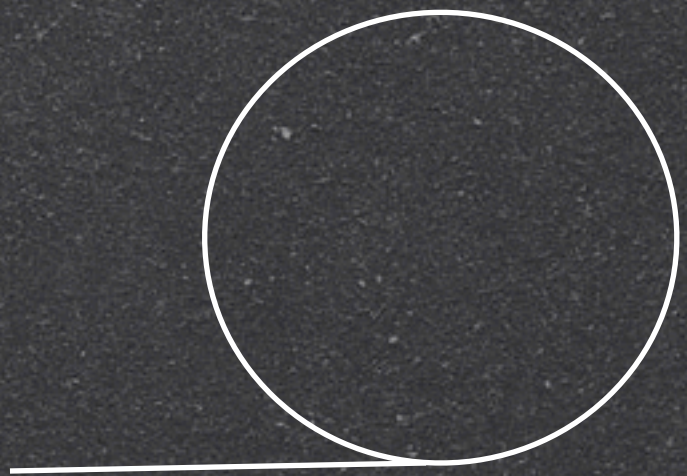
$$= 44.5 \text{ nA}$$

Space Charge Limit

- Synchrotron; Injection Energy ~ 7MeV
- Space Charge Limit ~ 4 x 10E11 ppp

10 times less!

Synchrotron is not enough.



Radiation hazard

Cyclotron : no problem for beam intensity, however

- Hands on Maintenance;Golden Rule

  Beam Loss < 1w/m (Ep>100MeV)

  Beam Power ~ 11 W

Beam Extraction Efficiency >90%

---> Hard for Compact Cyclotron

Summary of proton therapy machine

- Synchrotron

  Beam Intesity is not enough (respiration mode)

- Cyclotron

  Radiation Problem

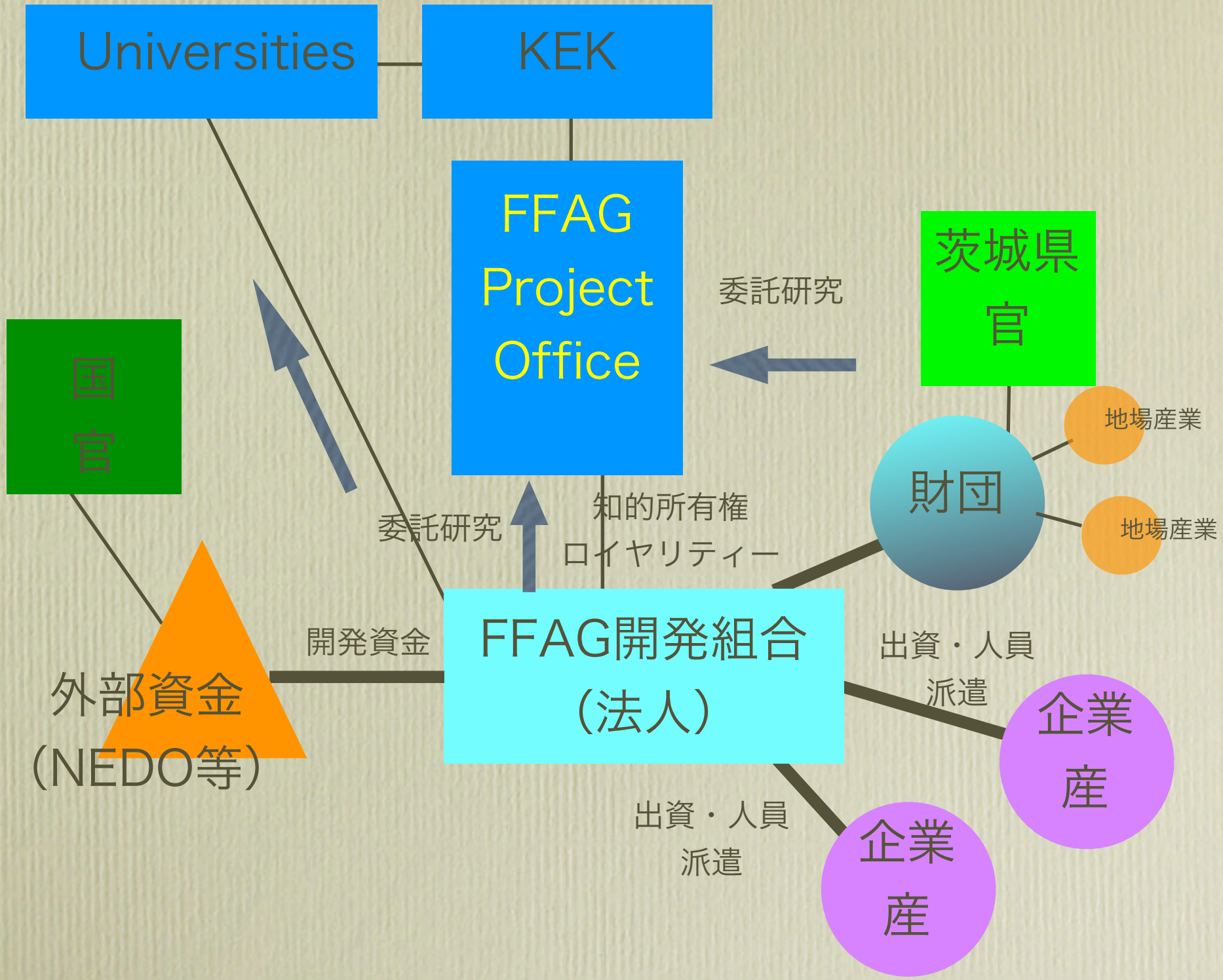
FFAG Project Office

at KEK (conceptual)

- Task

Fundamental Sudies and Applications of FFAG

- Proton Driver
- Electron Driver
- Cancer Therapy
- Muon Acceleration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外部資金
(NEDO等)
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企業
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