SAMURAI Overview
(design change & history)

T. Kobayashi（Tohoku Univ.）

design study started ~1997

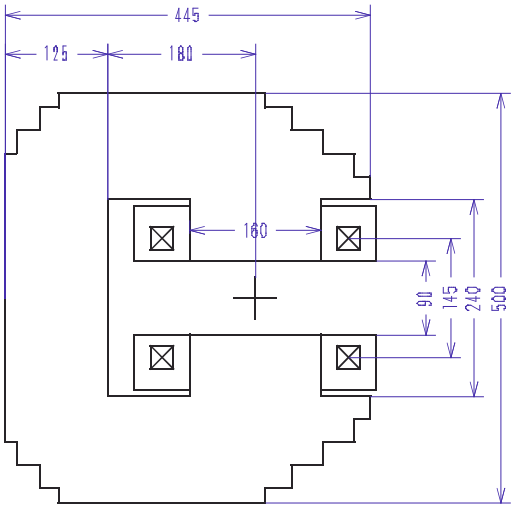
* Purpose
  * Invariant-mass spectroscopy :
    * heavy fragment + projectile-rapidity neutron(s)
      Q_{decay} ~ 10 MeV <-> θ_t ~ ±10.7° , $\Delta p/p_{//}$~±24%
      30 MeV 18.6° 41% @250MeV/A
      -> relatively large angular acceptance for neutron
    * HF + projectile-rapidity proton(s)
      P_{max}/P_{min} >3
      -> large momentum acceptance
  * Decay tagging

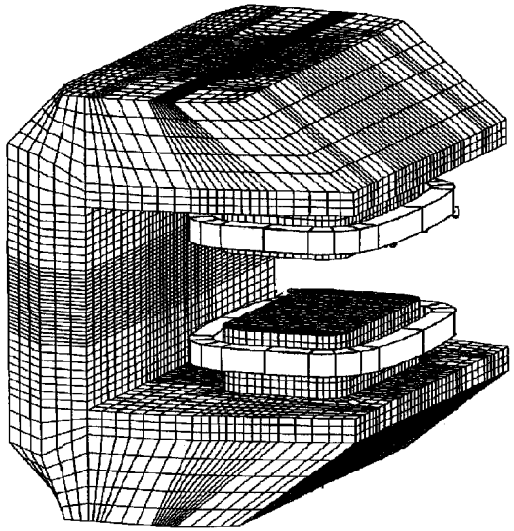
  * Limitation
    * fully stripped ion w/o large redundancy
      <A=80 - 100 ? @RIBF energy

  * PID (mass identification)
    * momentum analysis : σ_p/p ~ 1/500 @A=80 : relatively easy
    * velocity/total energy : ~0.1% : difficult (challenging)

1-2. Magnet Design at this point

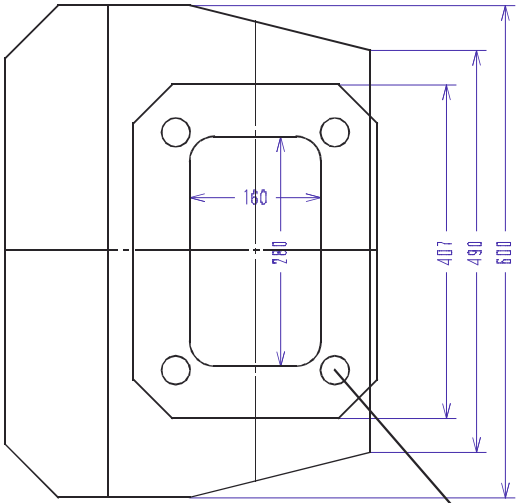
C-type Superconducting Magnet





design by T. Kawaguchi

" Big BO"
"DaiMajin"



with coil link

Pole : 1.6 m (wide) x 2.8 m (long) x 0.9 m (gap)

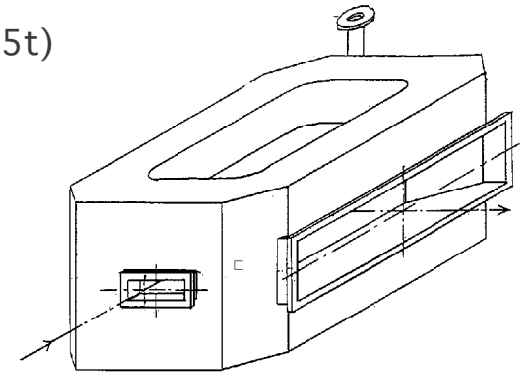
Field : 3.0 T @4.4MAT

Weight : 620 t (585 t + 35t)

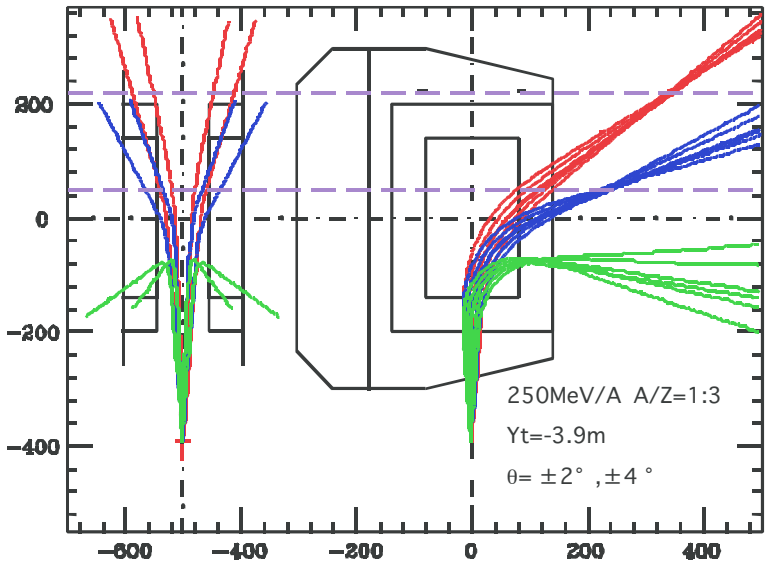
Stored Energy : 36 MJ

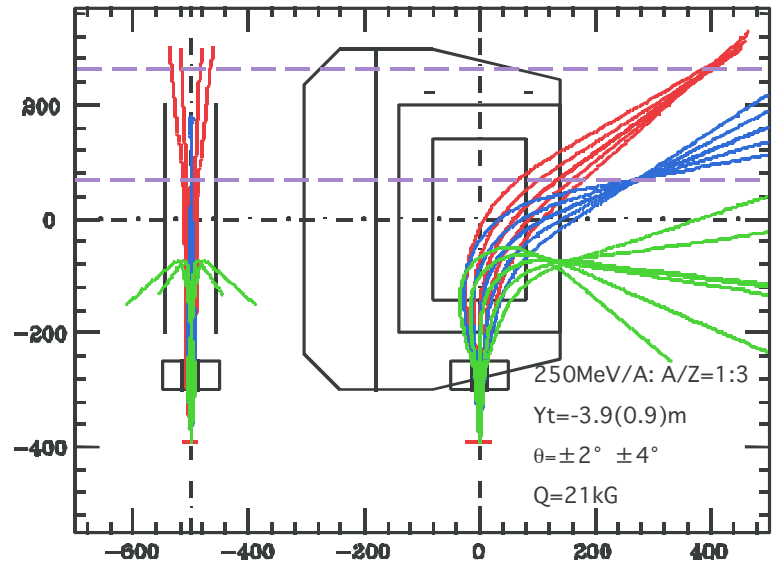
Max Field on coil : 4.0 T

problems: force on the coil



also an origin of SAMURAL pool





Q + D

double focussing for A/Z=2

gap : 90cm(4.4MAT) -> 30cm(1.5MAT)

good for F+proton

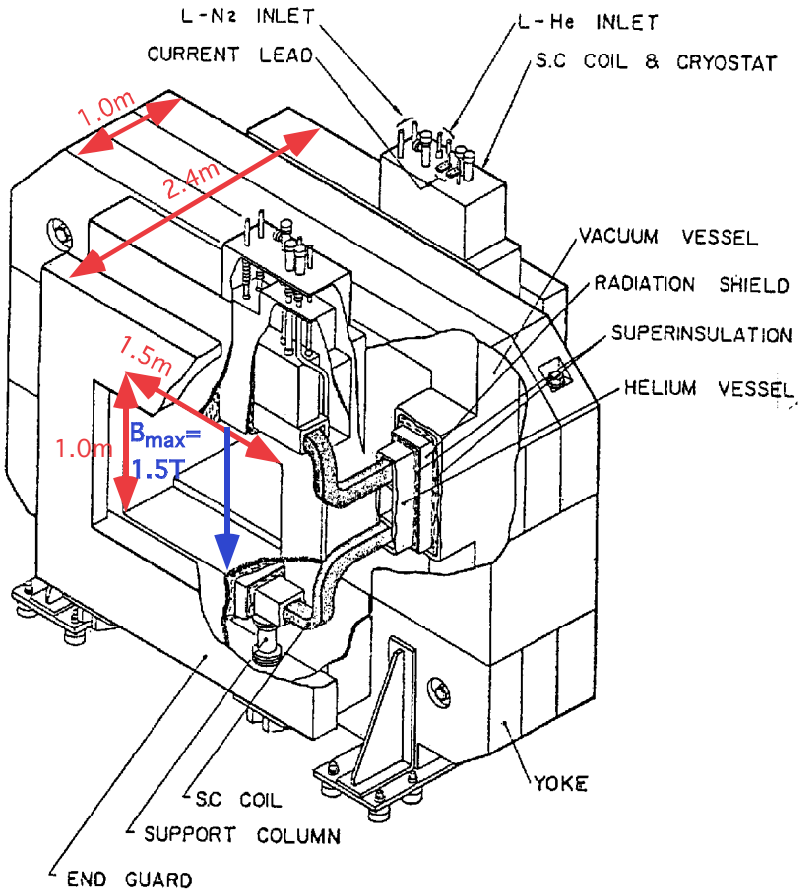
no good for F+neutron

＊Situation

Experimental budget disappears suddenly (?)

＊What we can do :

＊use available magnet with large aperture : Super BENKEI（S-弁慶）



Window Frame-type S.M.

B_{max} ~ 1.5T

BL_{max} ~ 2.3Tm

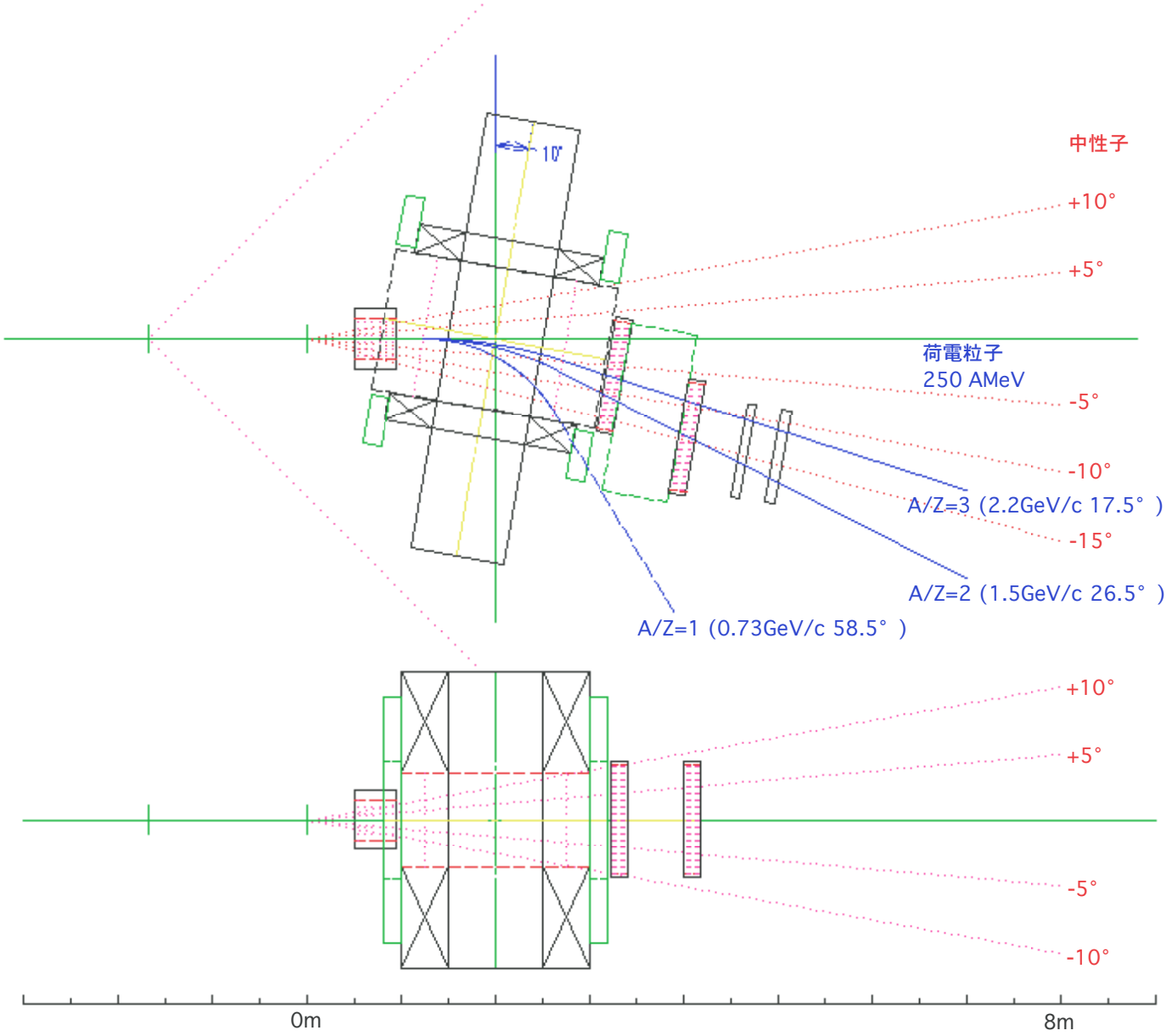
Transport/Installation cost

~100M JPY (1 億円)

Field can be increased by 20-30%

by 100cm gap -> 70-80cm

3-2. example of setup w S-Benkei



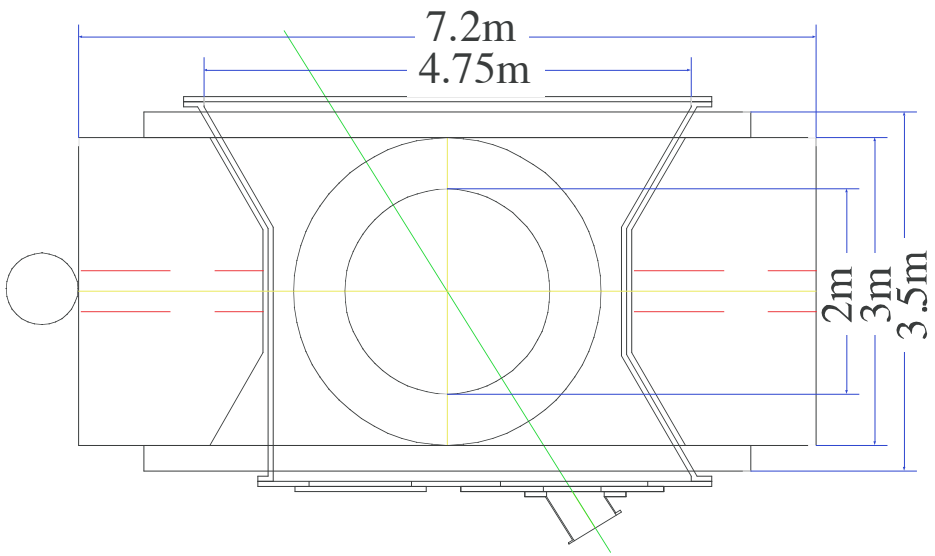
may be a good plan
for light-mass
using 100MJPY

4-1. Re-Design Working Group : Nov-2003~

* Policy : H-type round pole (~HISS @LBL) <- C-type with large fringing field
  * no coil link
    -> gap ~ 80cm from vertical force
  * reduce fringing field as much as possible for detectors
    -> put enough Iron
    -> Field Cramp on high-field magnet
    -> fringing field is comparable to that of R3B (no-iron+correction coil)
  * no tilted pole (like R3B)
    -> lack of flexibility
    -> more angular acceptance at low energy (<FAIR)
  * hole in the return yoke for proton measurement
* Name : DaiMajin (大魔神) -> Samurai（侍）

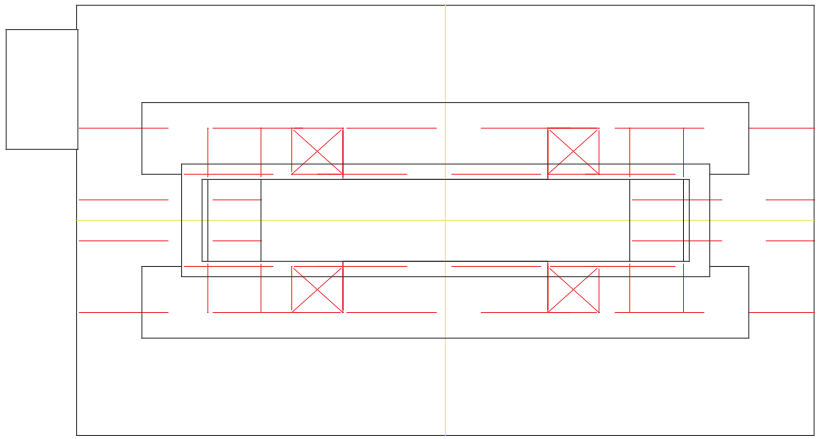
* RIBF WorkShop (26-Dec-2003)
* RIBF Symposium @JPS (Kochi, 28-Sep-2004)

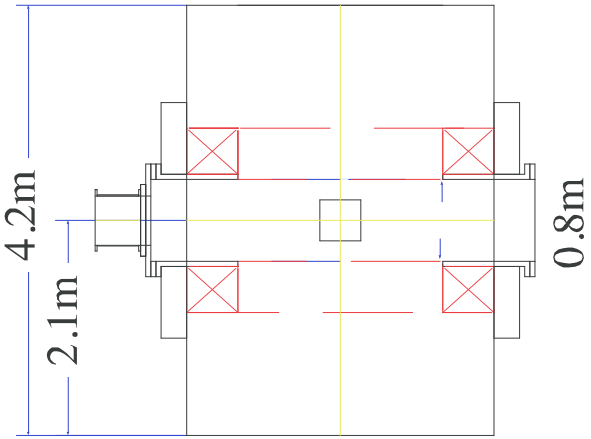
magnet design ~ present design



ポール：	2m diam.、0.8m gap
磁場：	3T @3.6MAT
巻数/電流：	800turn / 4600A
磁場積分値BL：	7 Tm
蓄積 energy:	28MJ
コイル垂直力：	500t
重量：	650t

still use
high current conductor





5.1 : IAC (International Advisory Committee) 18-Nov-2004

5.2 : TAC (International Technical Advisory Committee) 17-Nov-2005

Samurai

The committee is convinced that the Samurai spectrometer is an essential part of the exotic nuclei research where different types of reactions are employed to investigate nuclear matter. Presently, a HISS type of spectrometer is planned with a large gap and a maximum magnetic rigidity of 7 Tm. Tracking detectors for charged particles and a large neutron detector will be used in combination with magnetic rigidity analysis. Since the final magnetic design has not been achieved for the spectrometer, collaboration with the corresponding groups at MSU and GSI is recommended. The design of the R3B dipole optimized for low fringe field components and high momentum resolution might be a solution if scaled to RIKEN energies. The proposed tracking is certainly well suited to achieve the required resolution. The committee suggests reserving enough space directly behind the spectrometer to have the option for higher-resolution experiments either by simply changing the distance of auxiliary detectors or even to install a high resolution spectrometer as it is planned at the high-energy branch of the Super-FRS.

recommendations

*recommend collaboration with MSU, GSI

*design like R3B may be better

*reserve enough space for future high- resolution branch such as super FRS

6. Budget approved

＊Construction period : FY2008 - FY2011

＊Budget : 1.5 G JPY in 4 years
　　４年丸債（Obligatory assurance of national subsidization
　　for a multiyear construction project）

＊Limitation from the budget type
　　＊all the contracts have to be made in the 1st fiscal yesr (FY2008)
　　＊all the detector design in ~6 month
　　-> more or less, conventional-type

＊Budget Usage
　　＊Dipole Magnet (0.87 x G JPY) + Quadrupole Magnet (0.12 x G JPY)
　　＊Detectors & Electronics (~5 G JPY)

7. Construction Team

- Magnet & Infrastructure (H. Sato...)
- Vacuum system & Utilities (H. Otsu...)
- Heavy ion detectors (T. Kobayashi...)
- Neutron detectors NEBULA (T. Nakamura..)
- Proton detectors (K. Yoneda...)
- Deuteron-induced reactions (K. Sekiguchi...)
- TPC (T. Murakami...)

SAMURAI-7

7 members
7 Tm

8. WS Program

- 11/22 : status reports from construction teams
- 11/23: towards 1st experiments

good chance
to
understand what we are doing & what we are going to do
(even) for construction team members

9. Misc.

HISS magnet @LBL constructed by D. Greiner

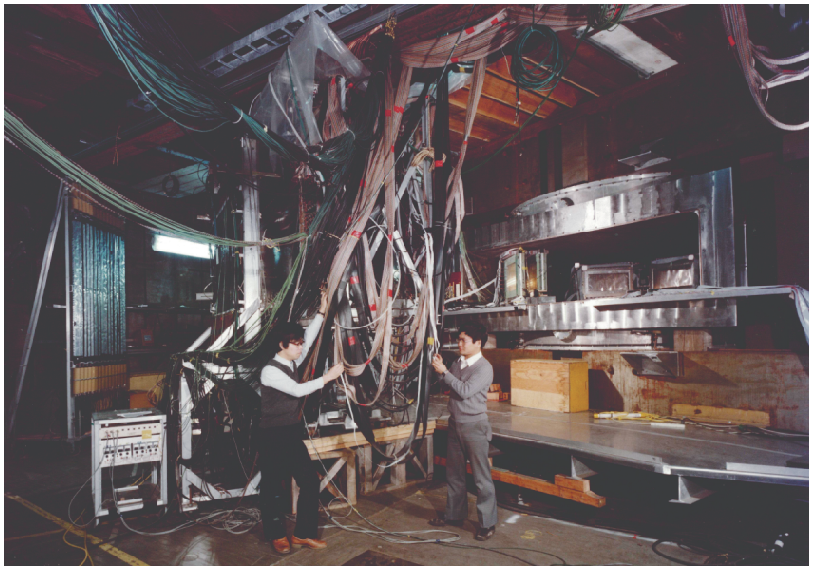
due to its flexibility, expected

various experiments (which were not considered when designed) were performed

including 1st RI beam experiments (by Tanihata)

Samurai

hope ...



O. Hashimoto / Kobayashi
1983
HISS pion experiment
w 2mx1m drift chamber

F. Bieser / Kobayashi
1985
w 2mx1.5m drift chamber