Intensity monitor for GARIS

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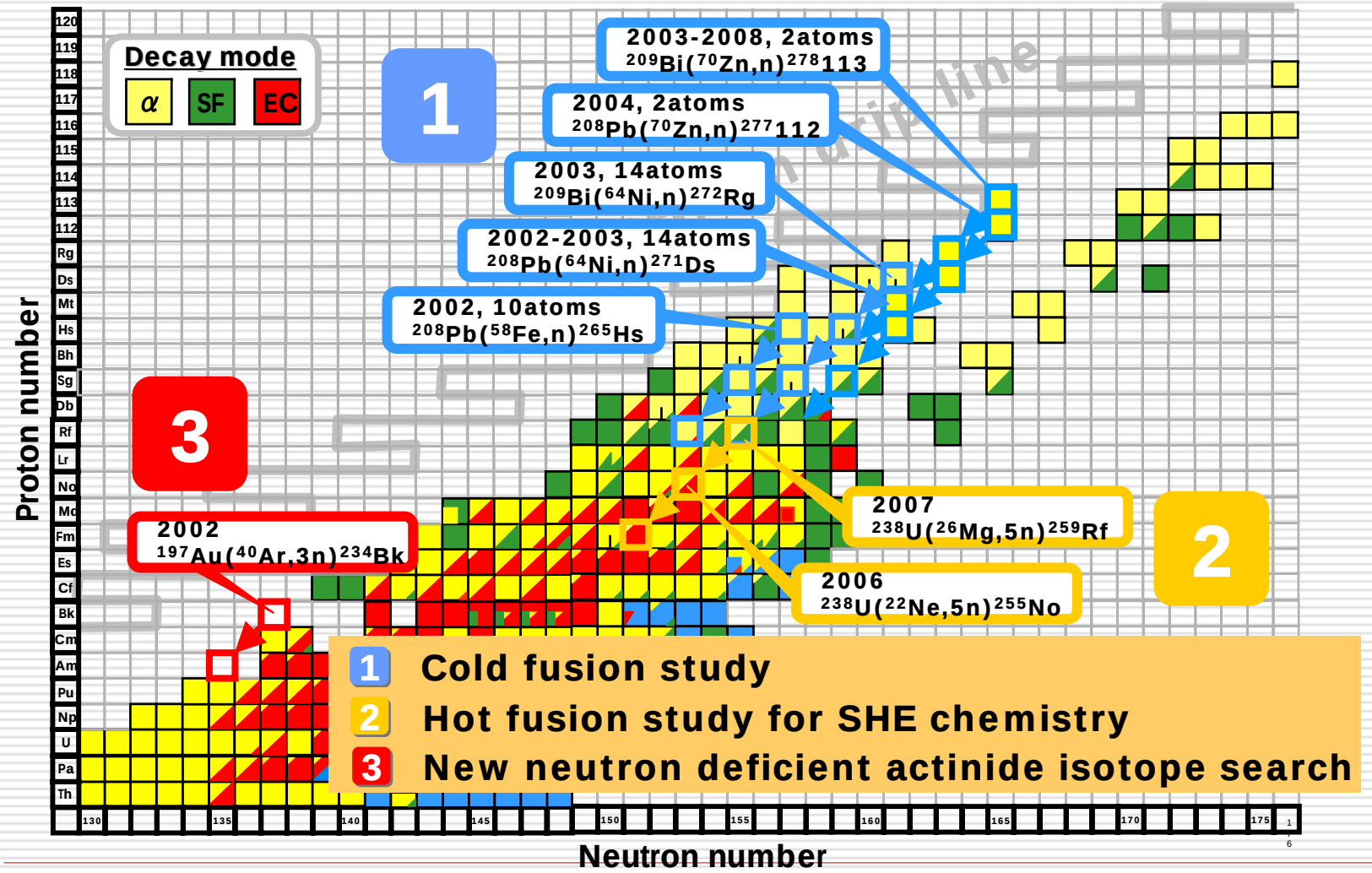
Contents

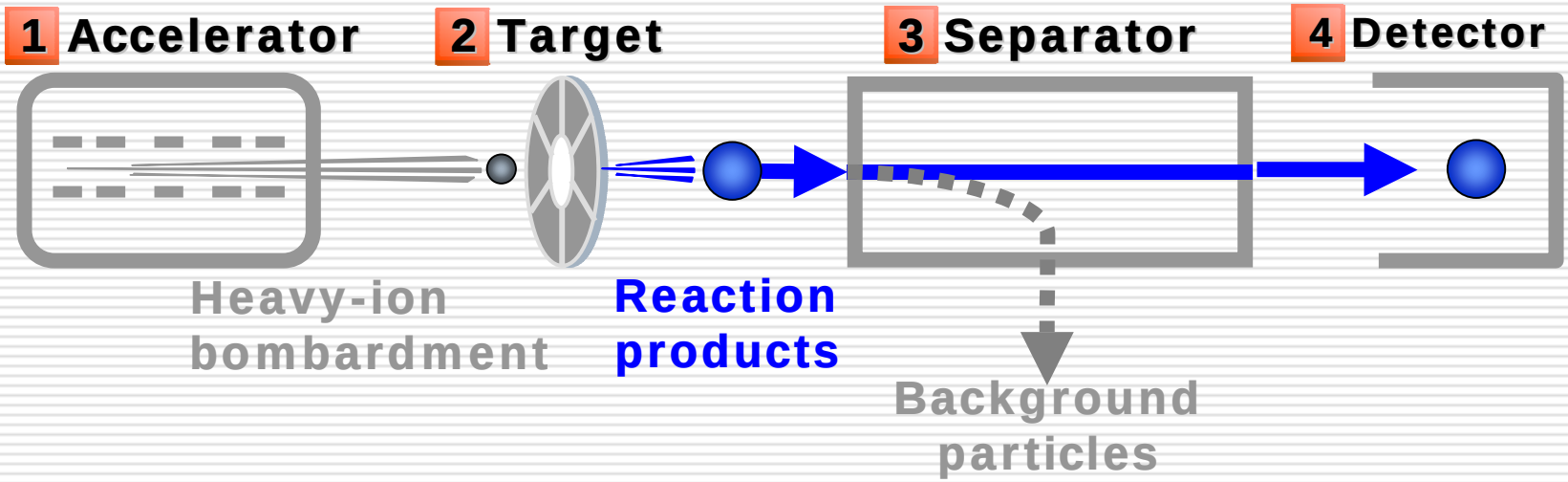
1. SHE study by GARIS
2. Irradiation monitor
   - Phase probe
   - CCD camera
3. Intensity monitor
   - PIN-diode
   - Gas scintillation measurement
4. Summary

1. SHE study @ RIKEN

SHE study by GARIS
(From 2001 to 2008 year)



Experimental method for SHE study



Apparatus for SHE synthesis

1 **Accelerator** to provide intense heavy-ion beam

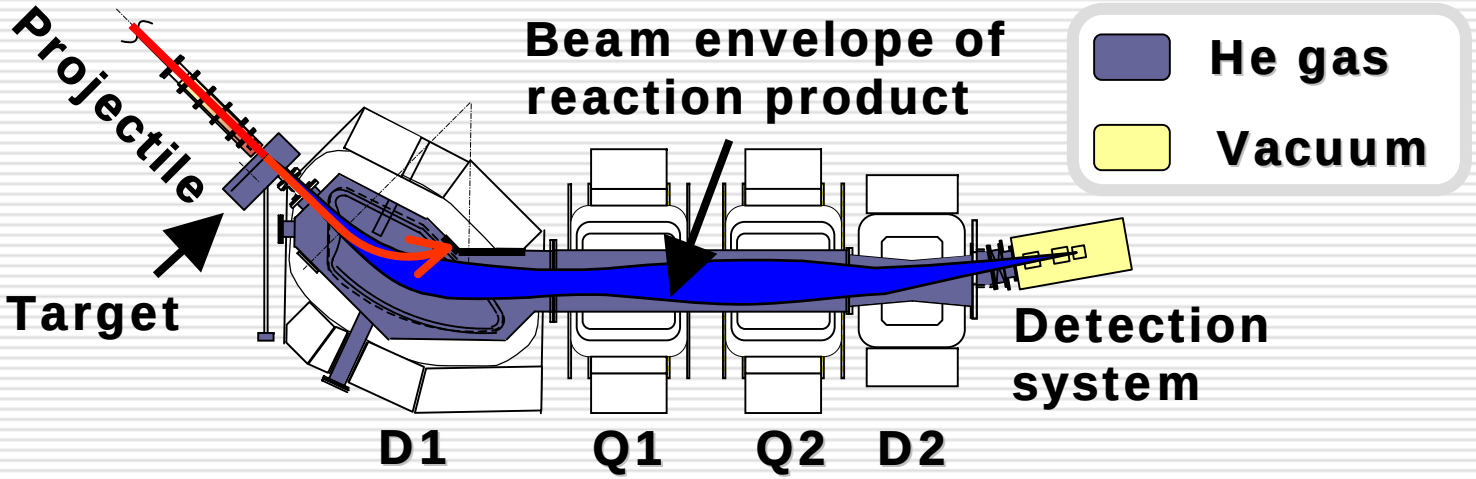
2 **Target** to stand against heavy-ion bombardment

Apparatus for SHE identification

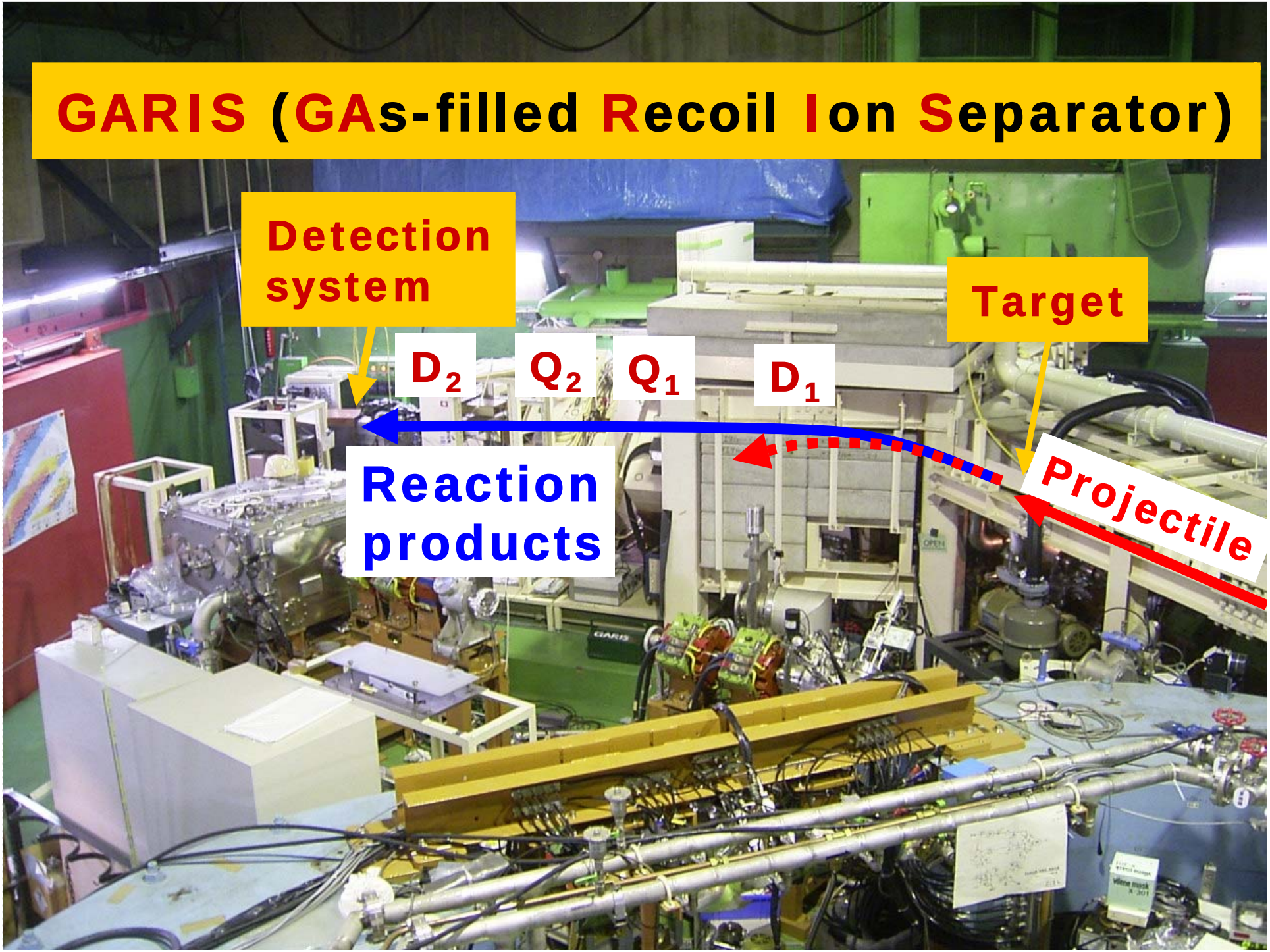
3 **Separator** with good separation and high efficiency

4 **Detector** to identify with one atom

GARIS
(GAs-filled Recoil Ion Separator)

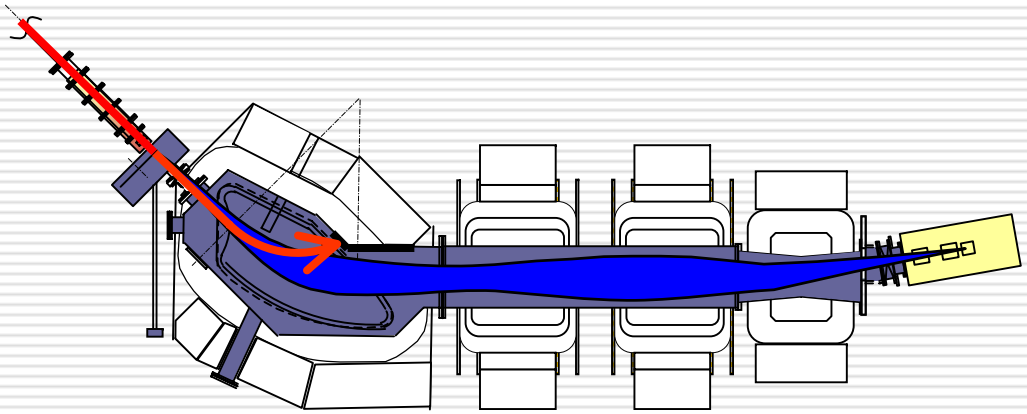


Characteristics of GARIS			
Magnification (X)	-0.76	Total path length	5.76 m
Magnification (Y)	-1.99	Max. $B\rho$	2.16 Tm
Acceptance	12.2 msr	Filled gas	He
Dispersion	0.97 cm / %	Gas pressure	30~80 Pa


GARIS (GAs-filled Recoil Ion Separator)
Detection system
Target
D2
Q2
Q1
D1
Reaction products
Projectile

Monitor around GARIS

1 **Irradiation monitor**



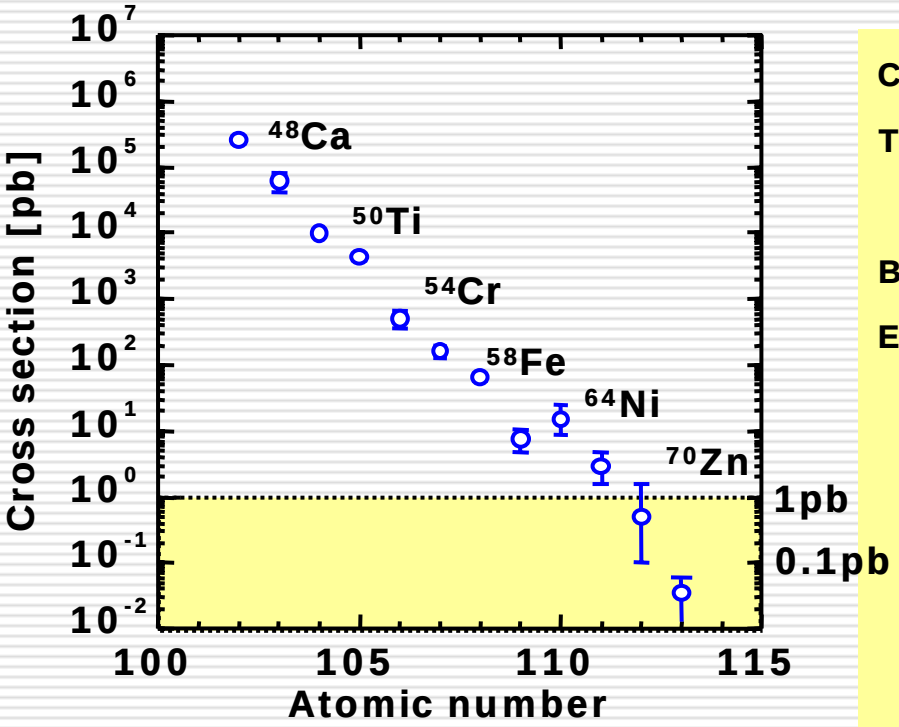
2 **Intensity monitor**

3 **SHE detection monitor**
(Decay energy & time)

3/18(TUE) 9:30 Morimoto's talk

Yield estimation

^{208}Pb,^{209}Bi(HI,n)反応における反応断面積の系統性



Cross Section σ : 0.1 pb (10^{-37} cm^2)

Target Thickness N: 450 μg/cm^2 of ^{209}Bi

(1.2×10^{18} atoms/cm^2)

Beam intensity ϕ : 0.5 pμA (3×10^{12} ions/s)

Efficiency ε : 0.8

$$\text{Yield/s} = N \times \sigma \times \phi \times \varepsilon$$
$$= 2.8 \times 10^{-7}\ /\text{s}$$
$$= 1\ /\ 40\ \text{day}$$

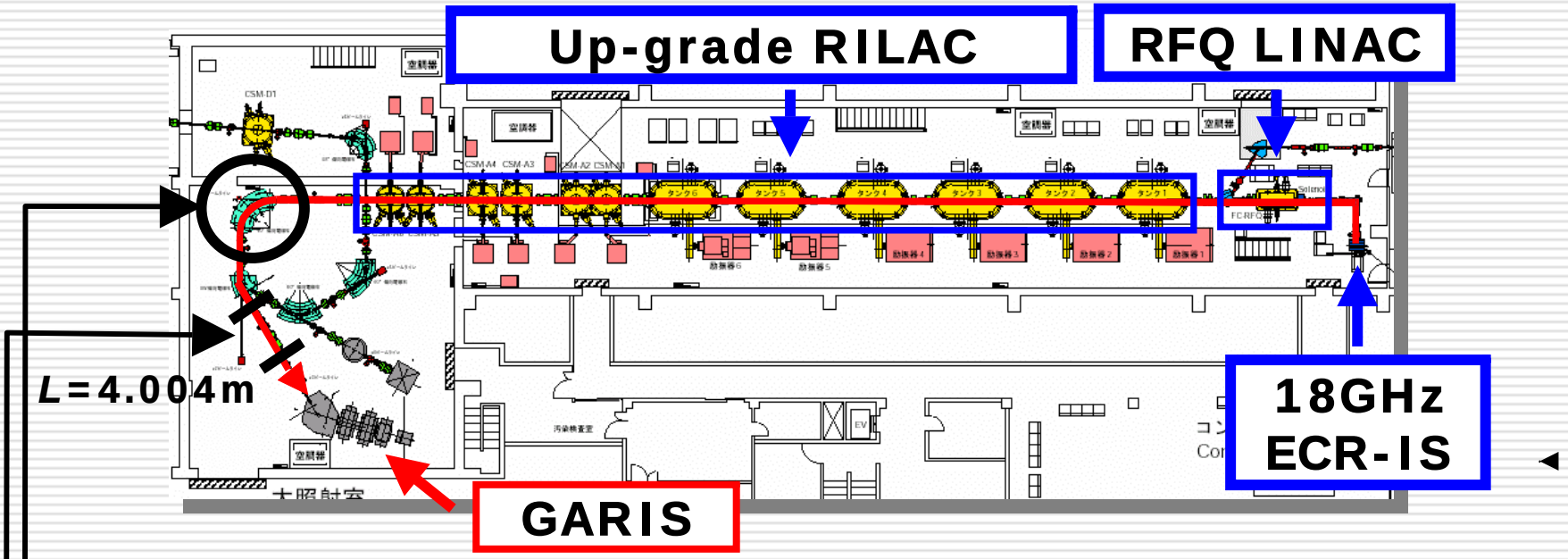
長期間にわたる実験条件の
安定性が必要不可欠

S. Hofmann, Rep. Prog. Phys. 61, 639(1998).
S. Hofmann, private communication.

2. Irradiation monitor

- Phase probe
- CCD camera

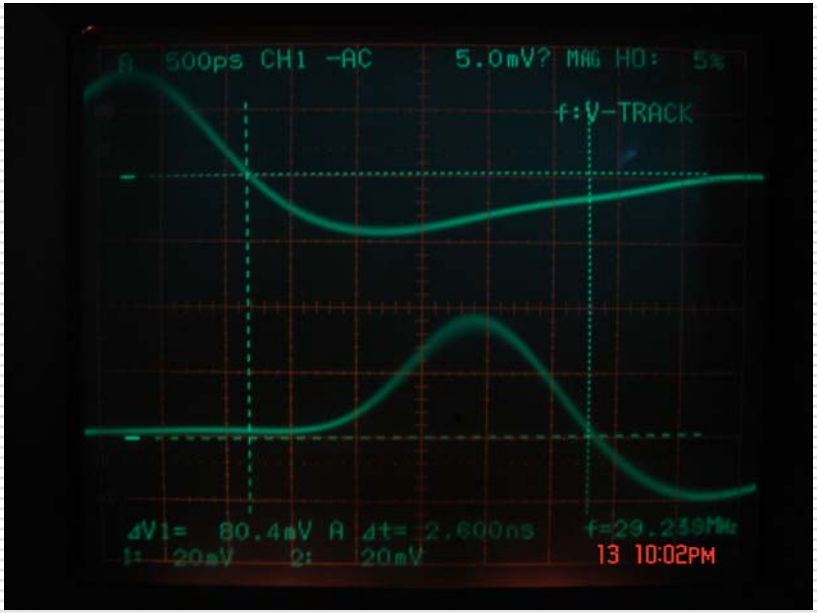
RILAC
(RIKEN Heavy-ion linear accelerator)



Beam energy monitor

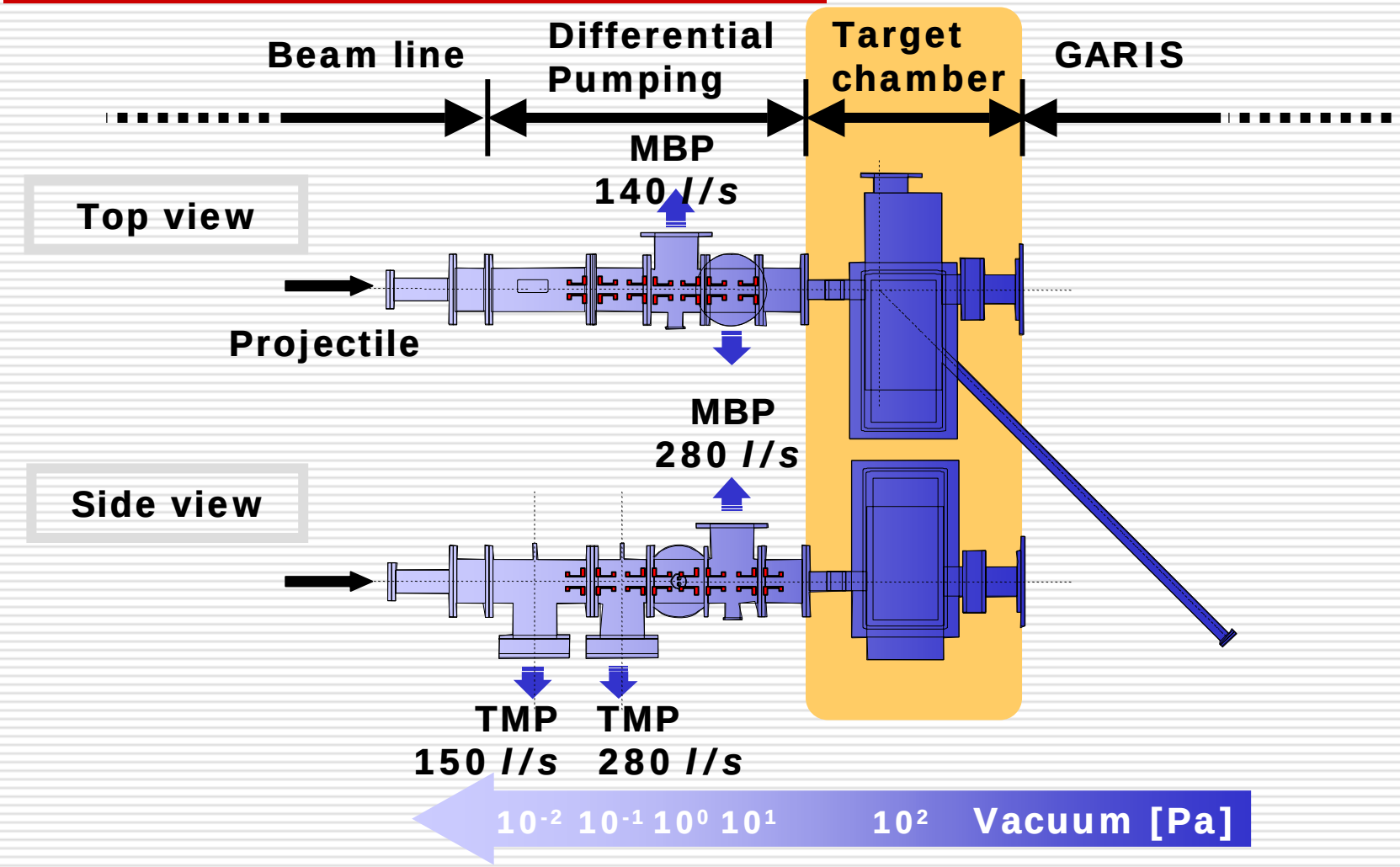
1. *B*ρ measurement of 90° bending magnet
2. TOF measurement by phase probe

Energy measurement by phase probe

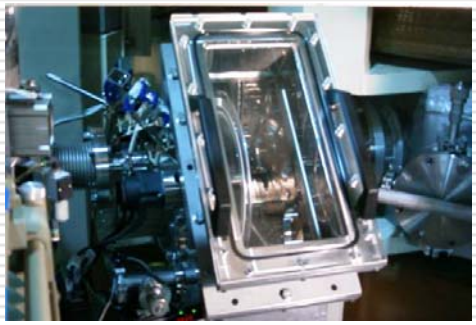


$\delta E = 0.15\%$

Gas-cooled rotating target



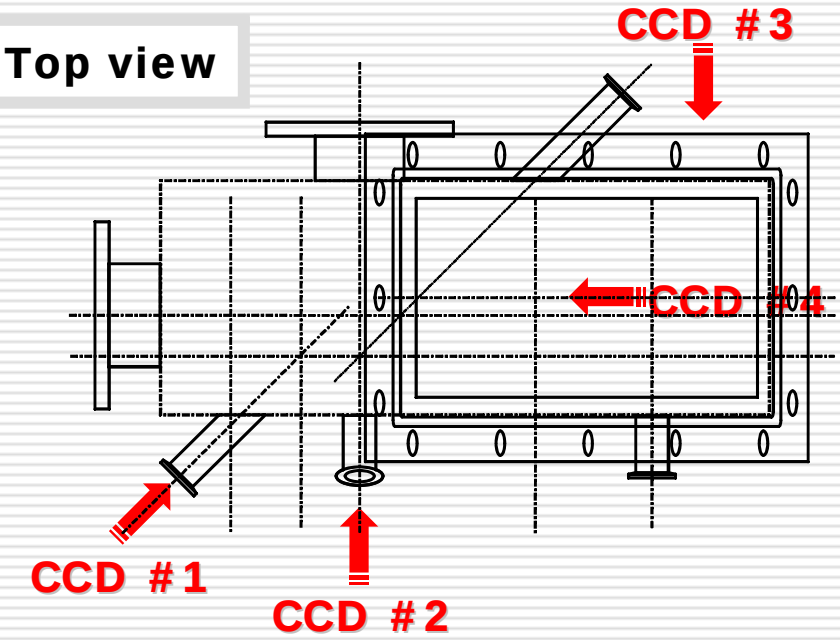
Target chamber, rotating wheel, and sector target frame



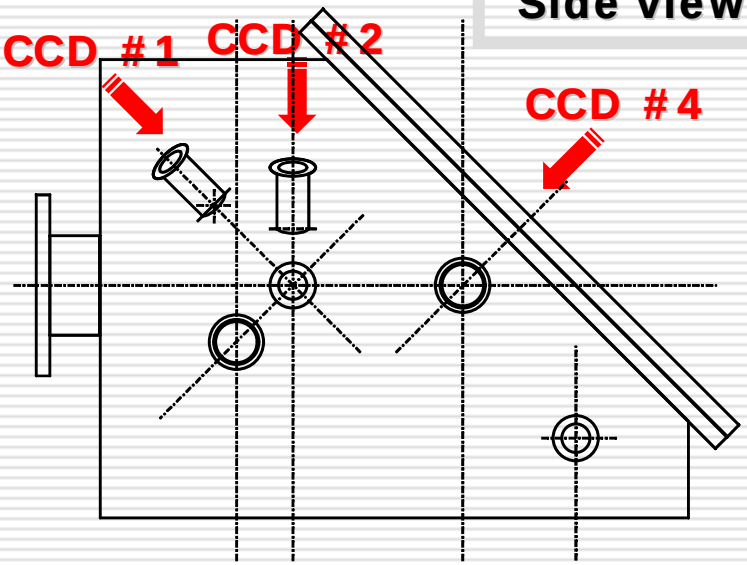

Parameters of target system	
Target area	7.85 cm^2
Number of target frame	16
Diameter of wheel	30.0 cm
Rotating speed	3000 rpm
Duty cycle	76 %

Irradiation monitor by CCD camera

Top view



Side view



CCD #1

CCD #2

CCD #3

CCD #4

Irradiation monitor by CCD camera

CCD camera
MTV-34K0N(秋月電子通商, Japan)
¥7,800

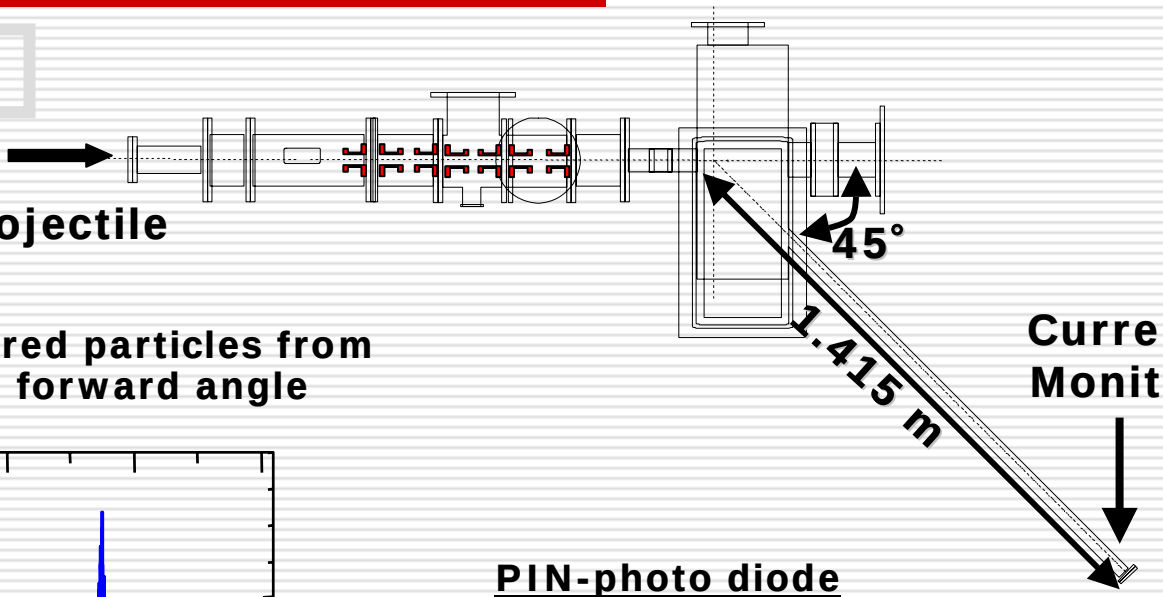
1. Irradiation monitor
2. Status monitor of Target
3. Stability monitor of Accelerator & Ion source

3. Intensity monitor

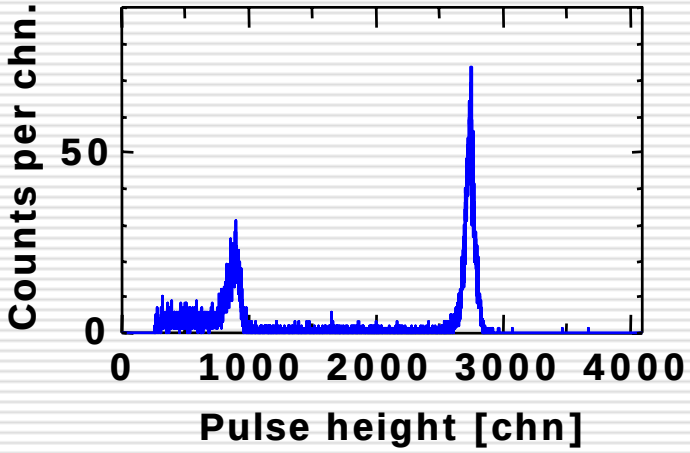
- PIN diode
- Gas scintillation measurement

Intensity monitor by PIN-diode

Top view



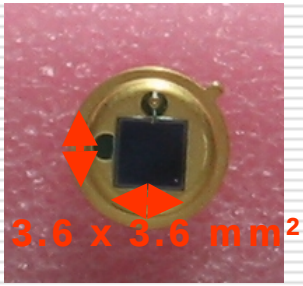
Elastically scattered particles from the target at 45° forward angle



PIN-photo diode

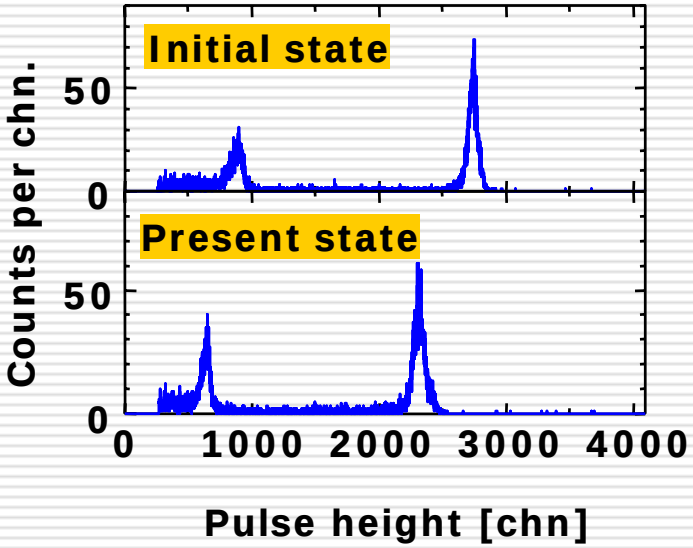
S1223(Hamamatsu, inc, Japan)

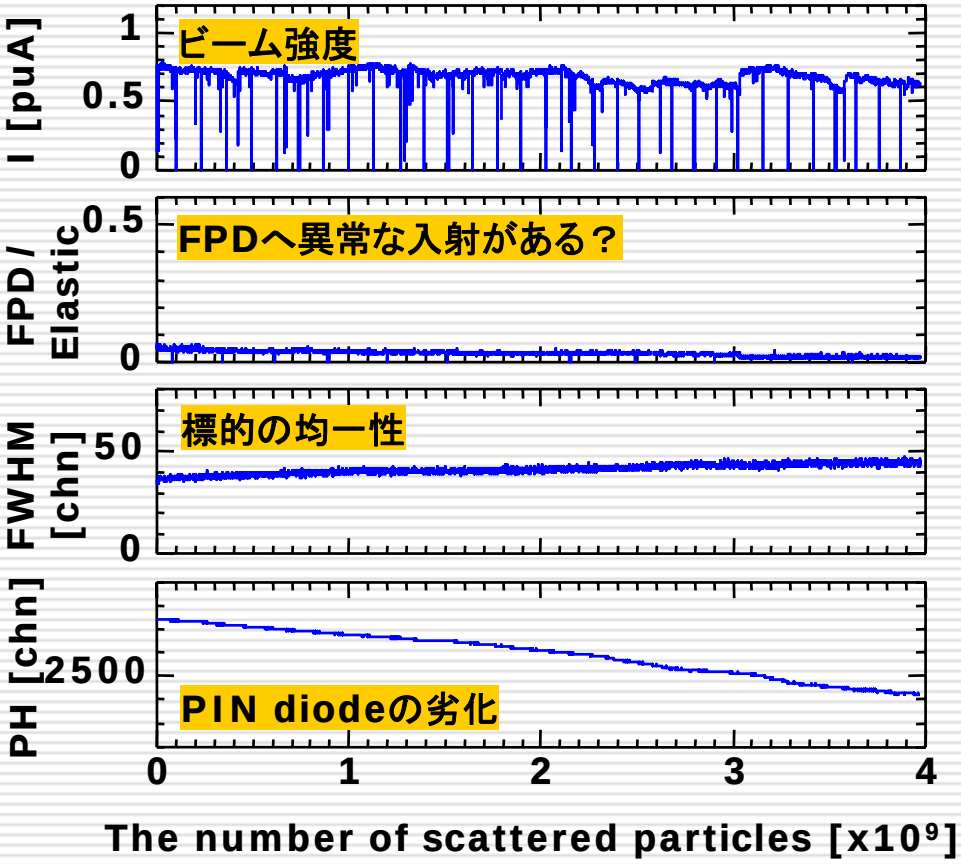
¥1,500



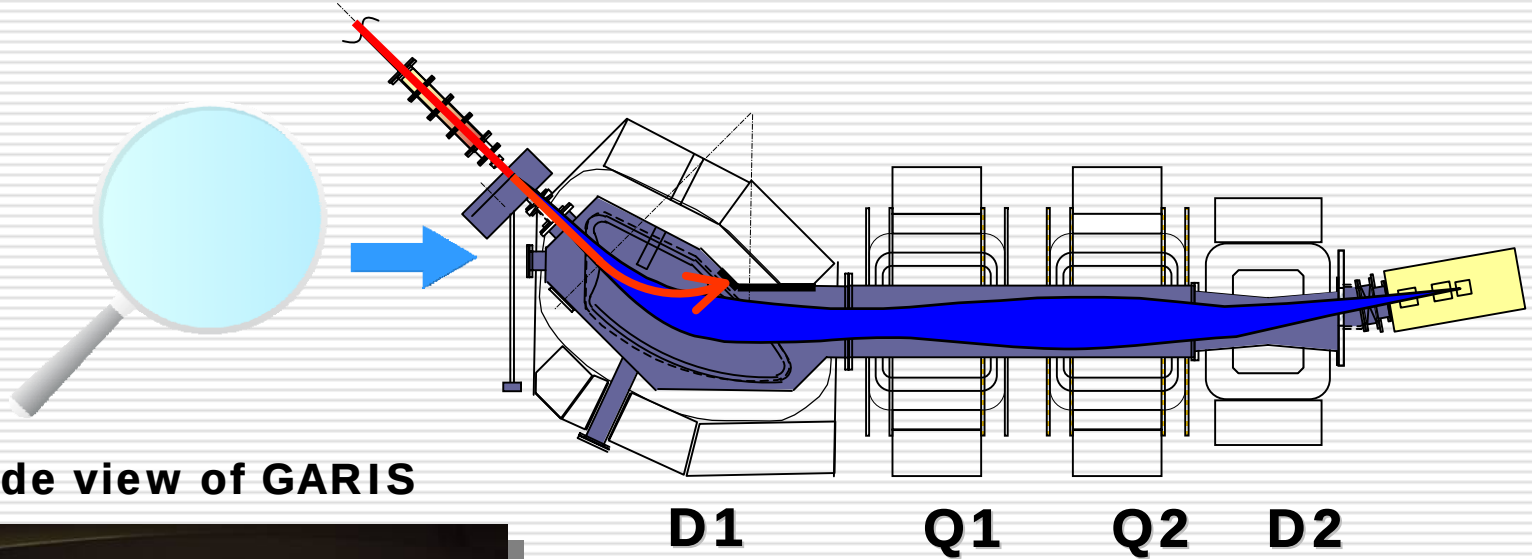
$\Omega = 6.47 \times 10^{-6}$ sr

Status of the target





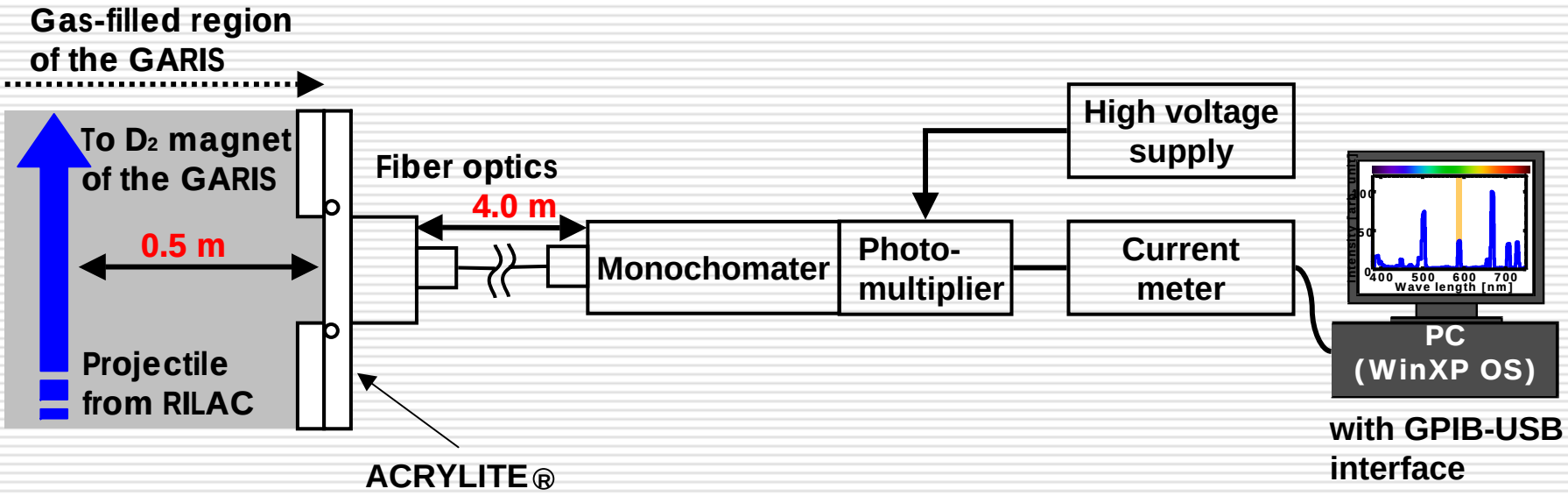
Gas scintillation

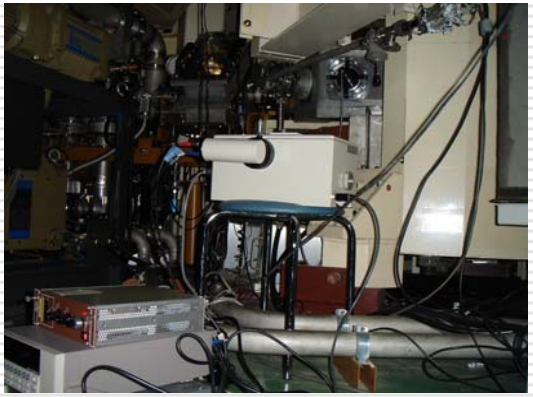


- Inside view of GARIS

Gas scintillation along beam trajectory

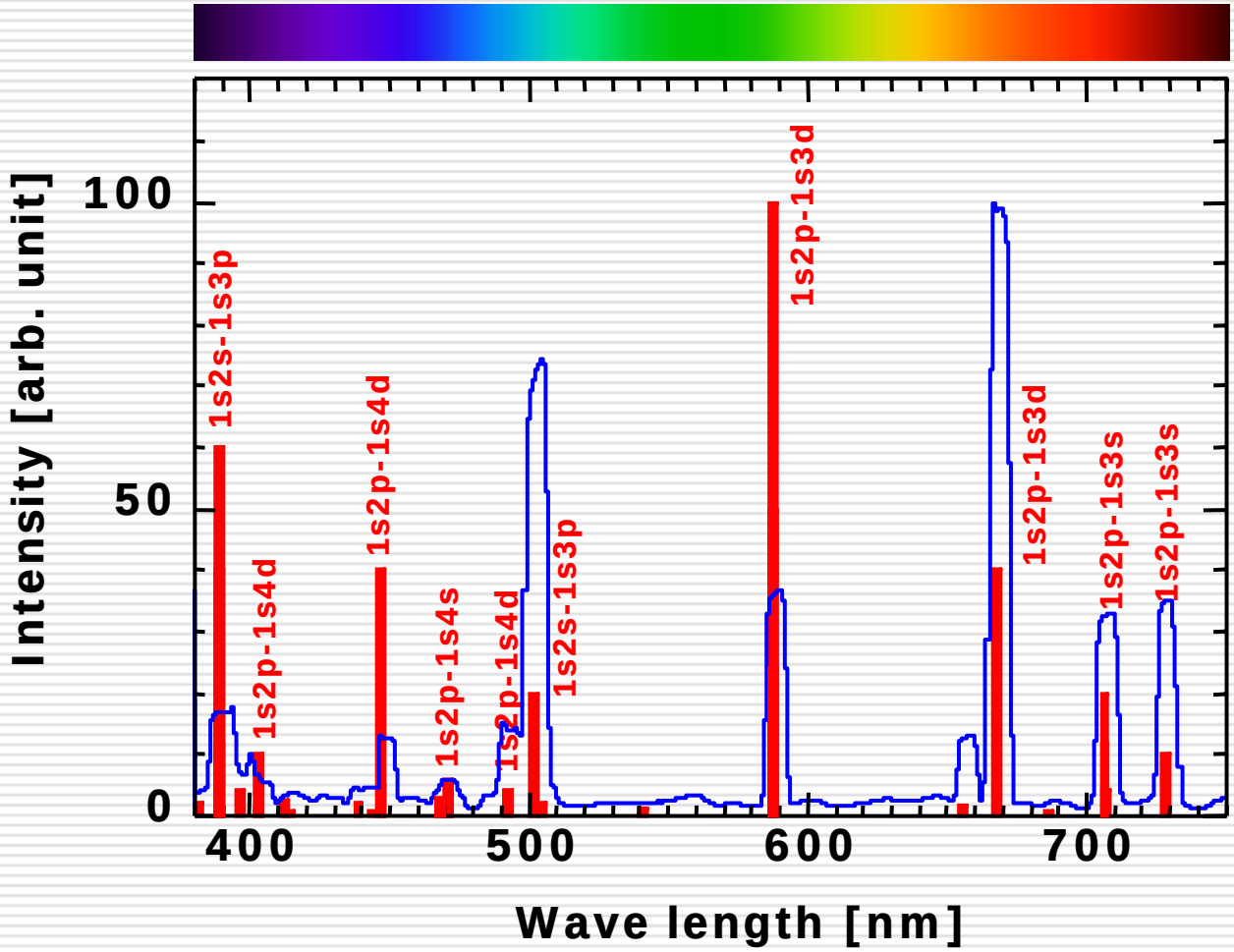
Measurement of gas scintillation



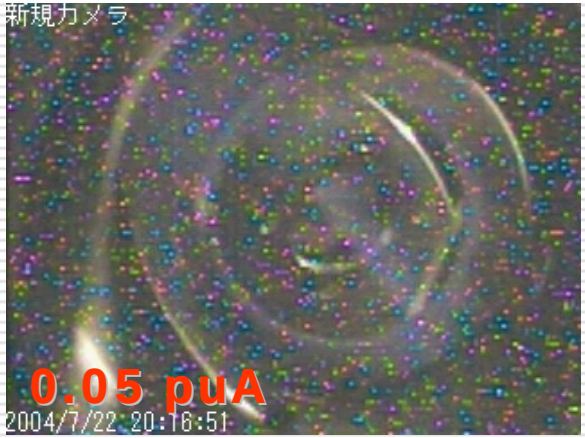


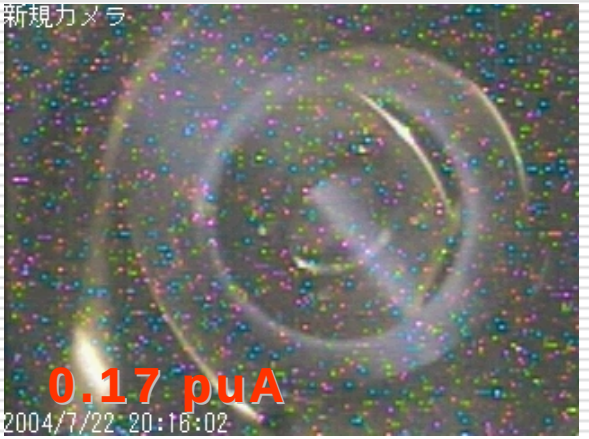
Keithley Picoammeter
Model 6485

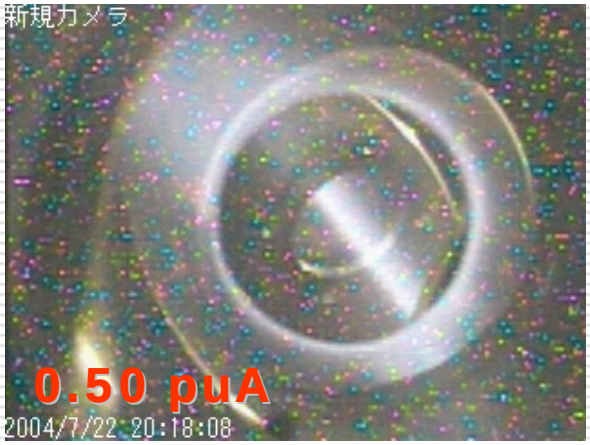
Intensity distribution



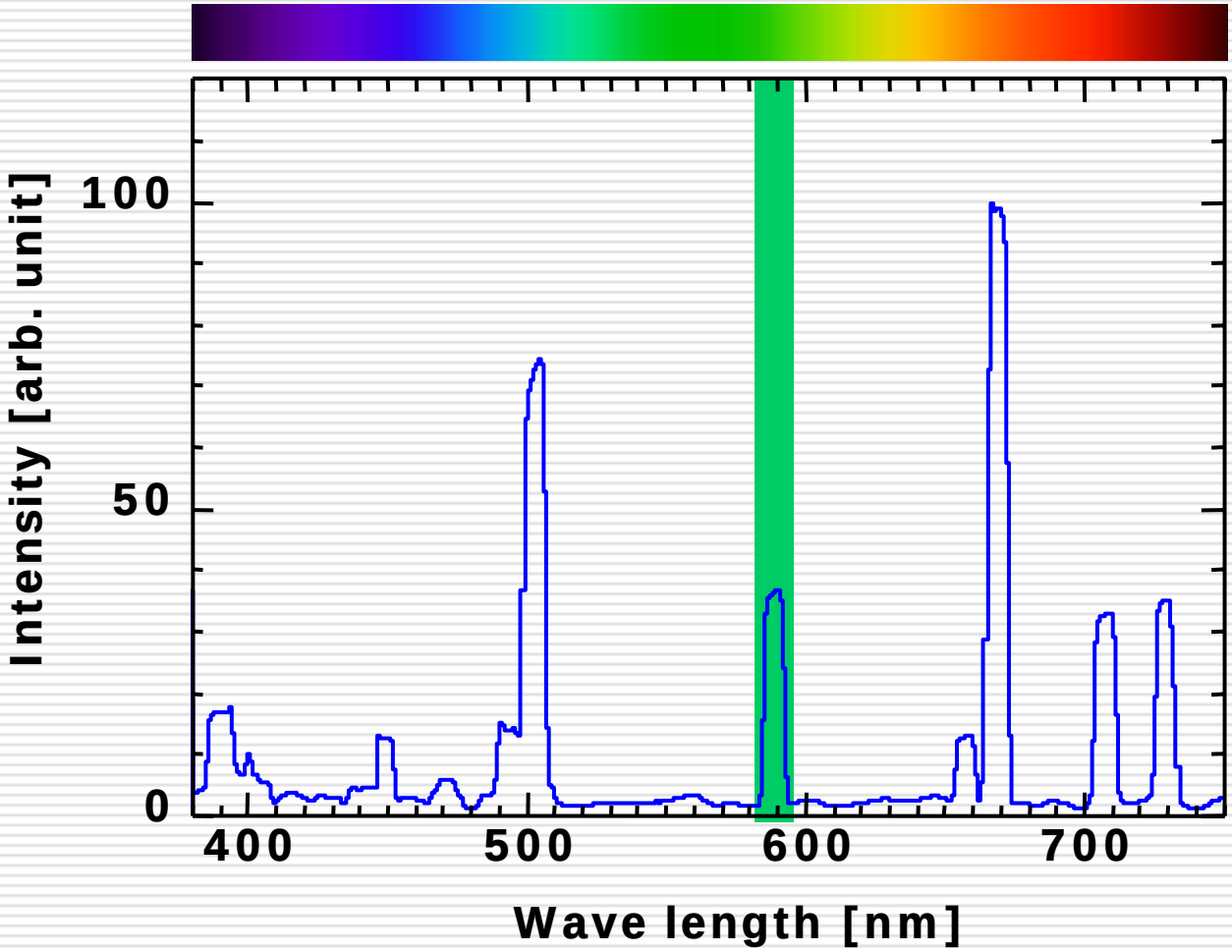
Very rough intensity monitor



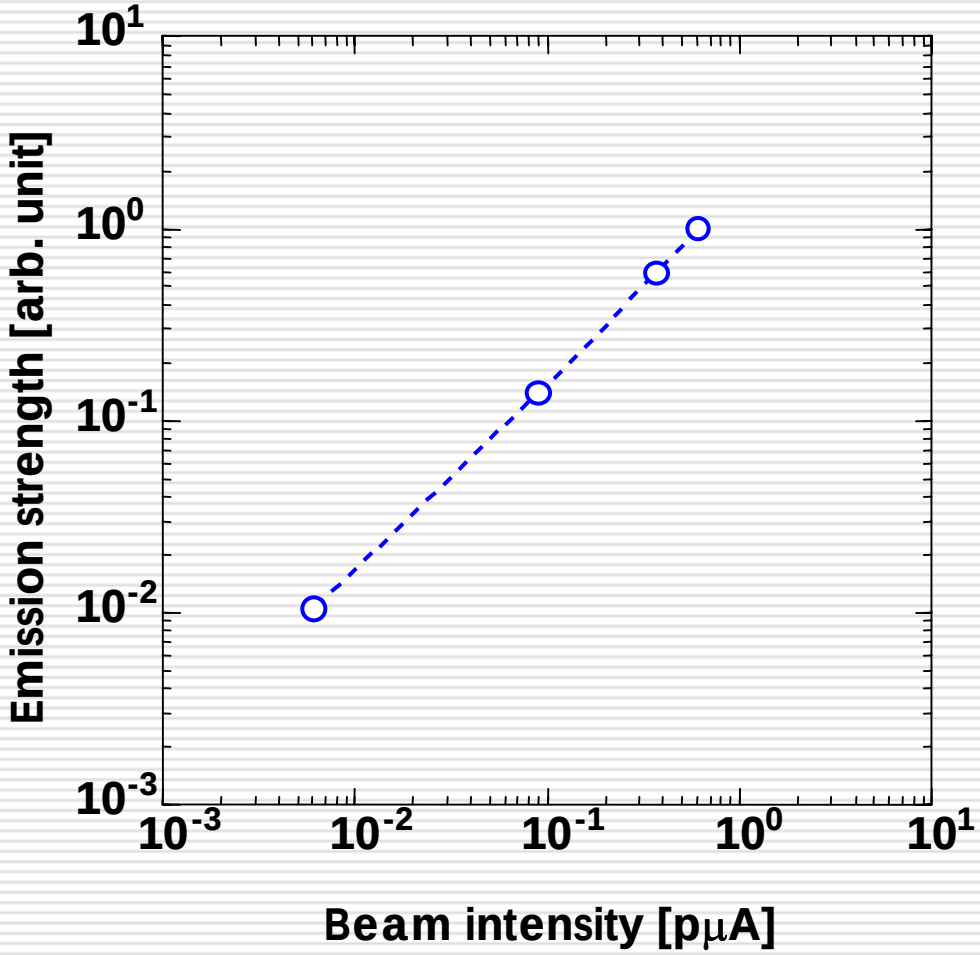




Application as intensity monitor



Scintillation / Elastic ratio



Summary

1. GARISによる最近の超重元素探索の現状を紹介した。

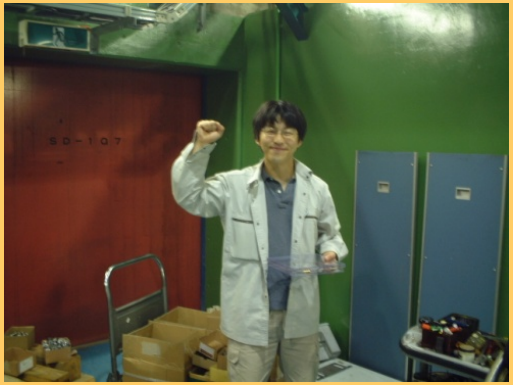
2. GARIS実験における照射モニターを紹介した。
   - Phase probe
   - CCD camera

3. GARIS実験におけるビーム強度モニターを紹介した。
   - PIN-diode
   - Gas scintillation measurement

Collaborators

K. Morita (RIKEN)

K. Morimoto (RIKEN)



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