鏡映核のモーメントで探る fシェルの核構造

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松多健策

重イオン衝突で偏極不安定核ビーム生成
ー＞　ディグレーダーで減速　ー＞　結晶植込停止

RNB技術
β-NMR ＞ ^{36,37}Pの磁気モーメント

⟶ スピンの決定、魔法数２０？

＋　スピン操作技術 ——— ^{13}B の整列相関項

⟶ 誘導テンソル項

RCNPでの今後の展開

Sdシェルのモーメント ⟶ f7/2シェル 鏡映核対

核物性研究

ENコース

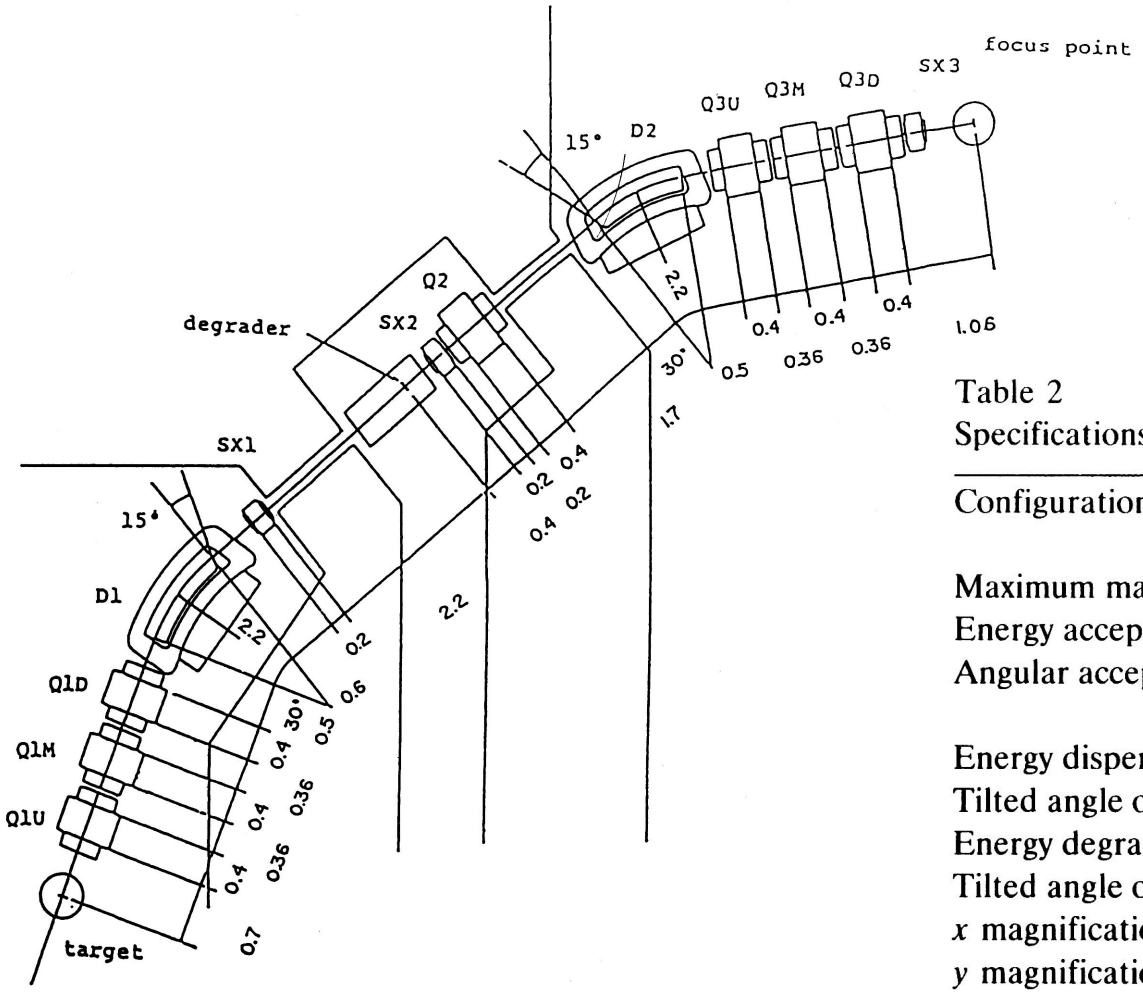
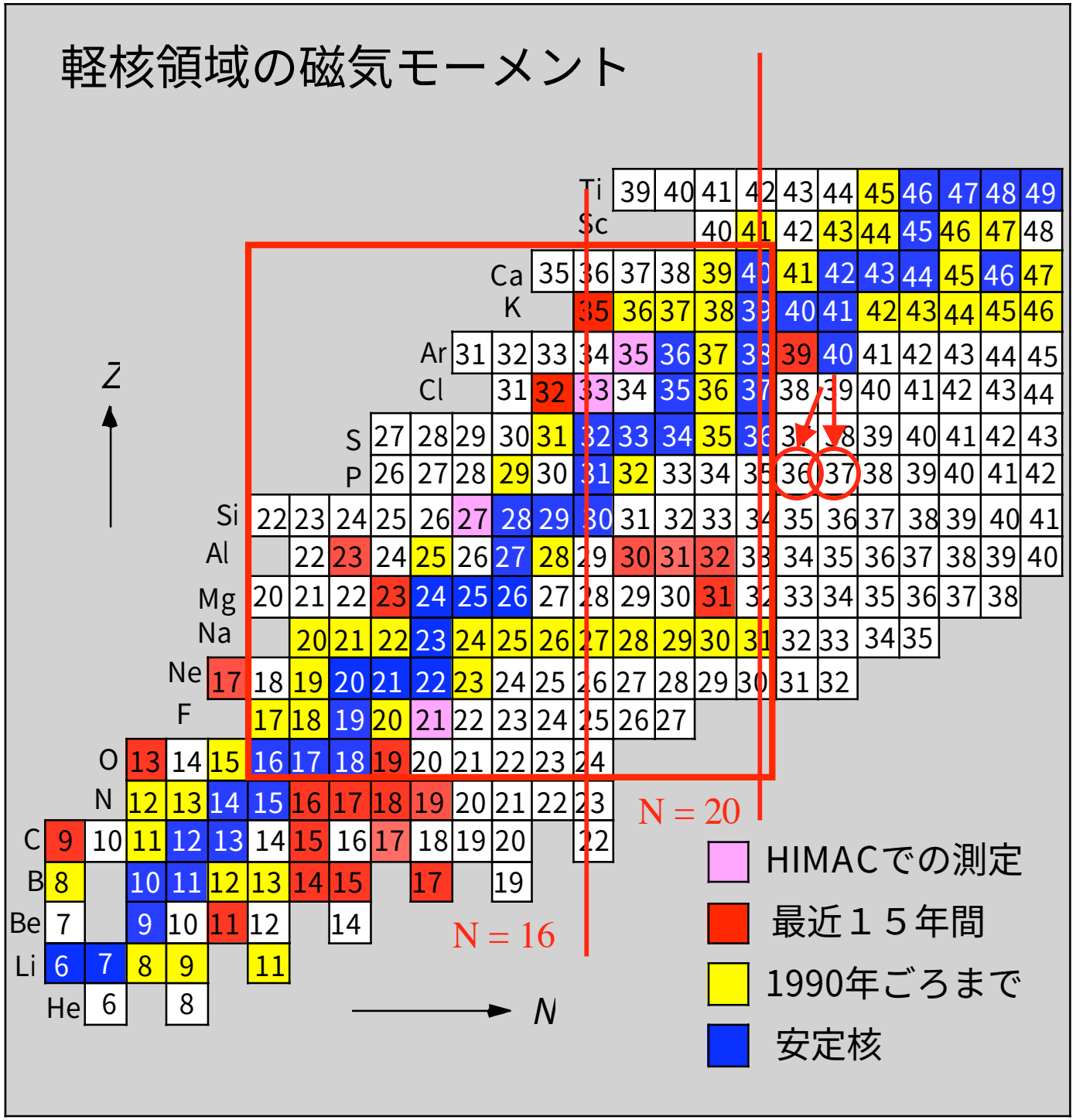


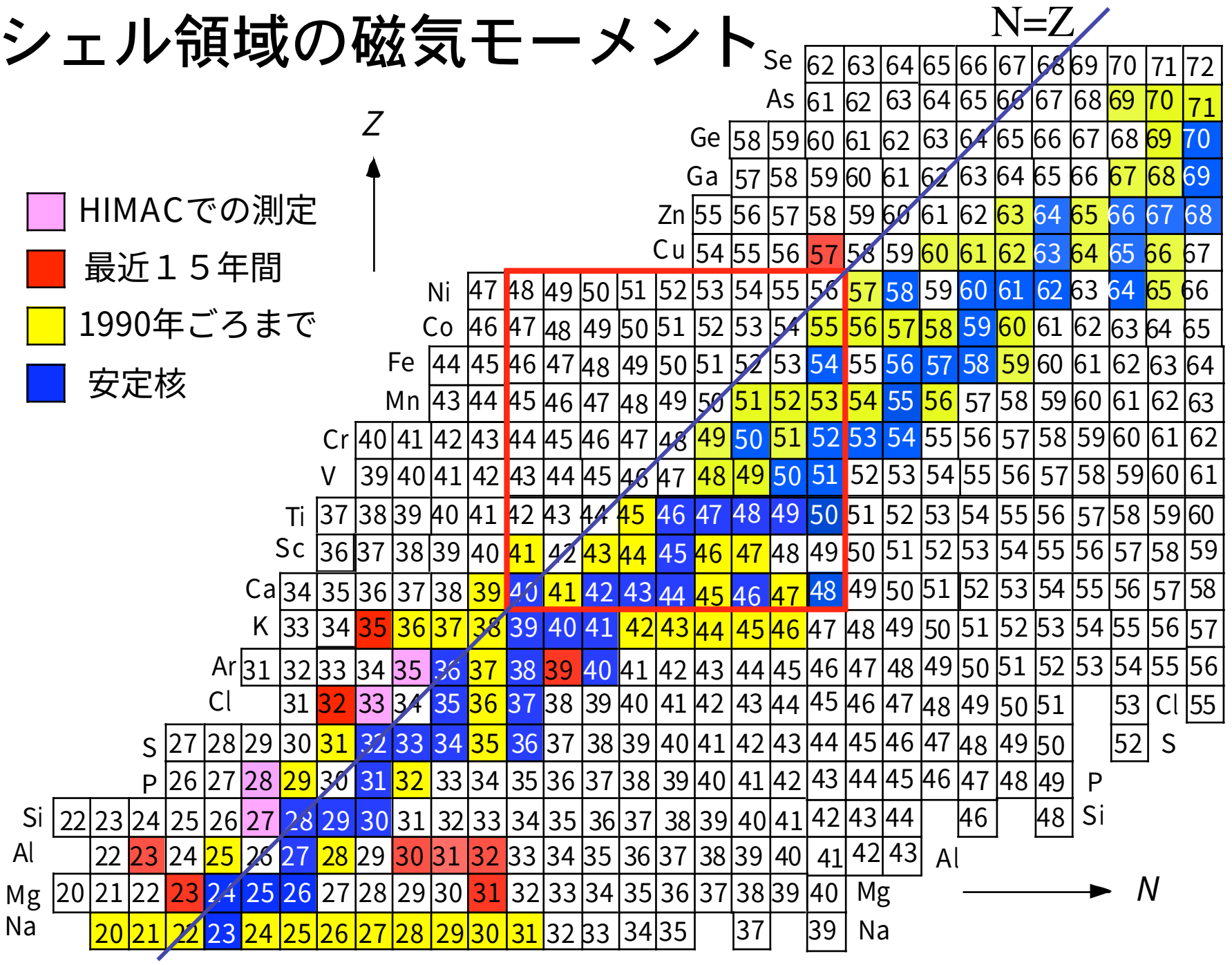
Table 2
Specifications of the RCNP secondary-beam line

Configuration	QQQDSX(F1) SXQDQQQSX(F2)
Maximum magnetic rigidity	3.2 T m
Energy acceptance	$\Delta E/E = \pm 8\%$
Angular acceptance	$\Delta\theta = \pm 20$ mrad
	$\Delta\phi = \pm 14$ mrad
Energy dispersion at F1	0.866 m
Tilted angle of F1 focal line	90°
Energy degrader	uniformly thick
Tilted angle of F2 focal line	86.6°
x magnification	2.0 (variable)
y magnification	1.4 (variable)
A dispersion	6.51 mm/%
	($d_0/R = 0.5$, variable)
Z dispersion	−3.91 mm/%
	($d_0/R = 0.5$, variable)
$A/\Delta A$ ($x_0 = \pm 0.5$ mm)	326 ($d_0/R = 0.5$,
	without energy straggling)
$Z/\Delta Z$ ($x_0 = \pm 0.5$ mm)	195 ($d_0/R = 0.5$,
	without energy straggling)
Path length of the central orbit	14.774 m

下田、森信

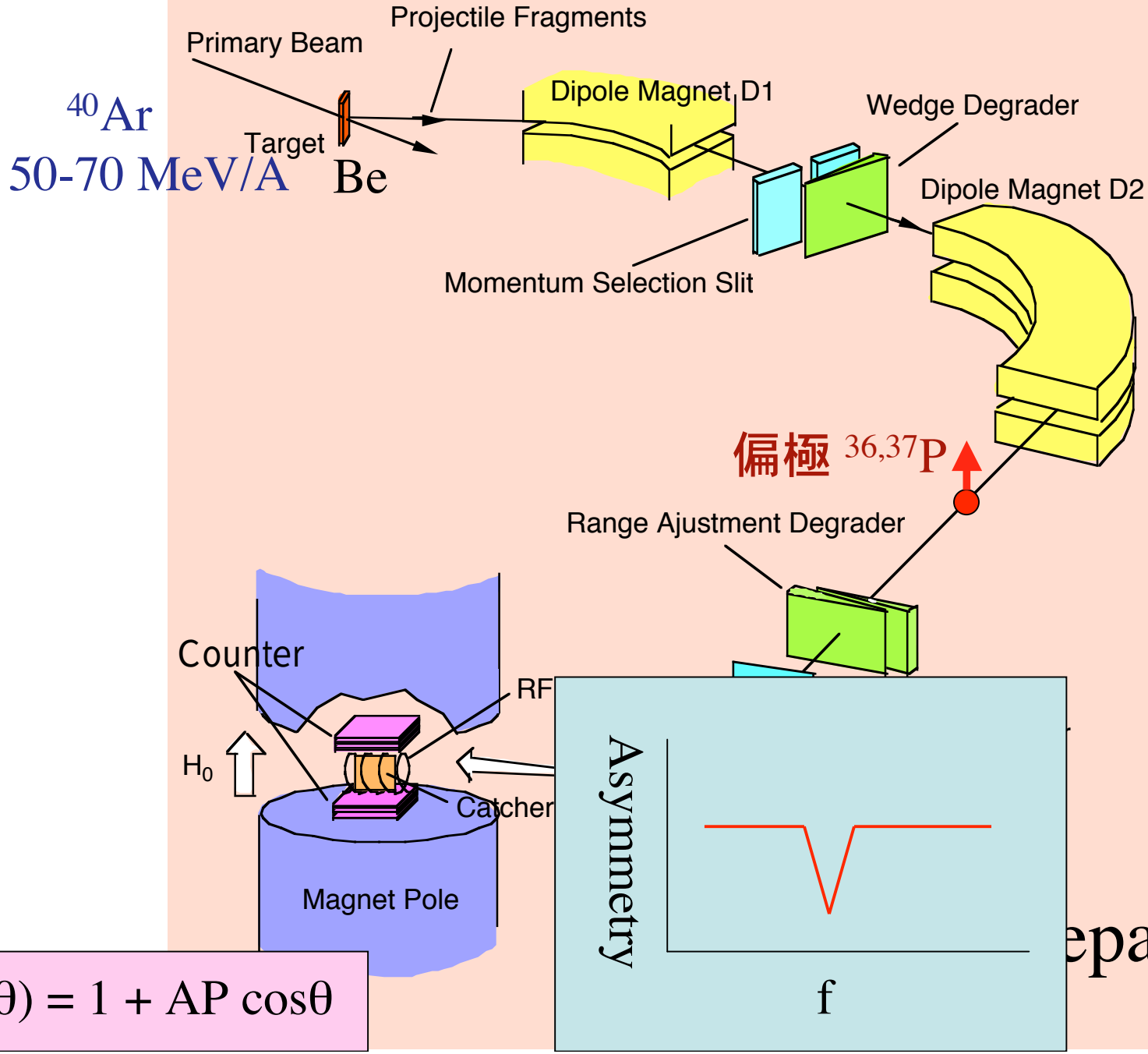

軽核領域の磁気モーメント
Z
N
N = 20
N = 16
HIMACでの測定
最近１５年間
1990年ごろまで
安定核

fシェル領域の磁気モーメント



RCNP, ENコース

Fragment Separator



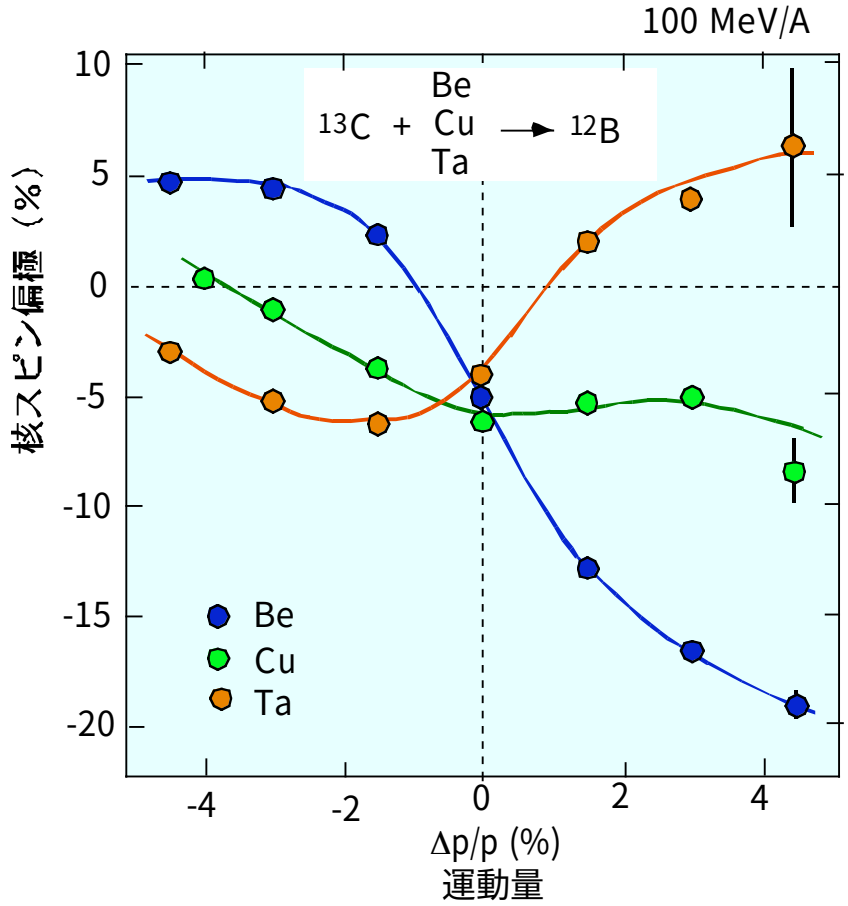
^{40}Ar

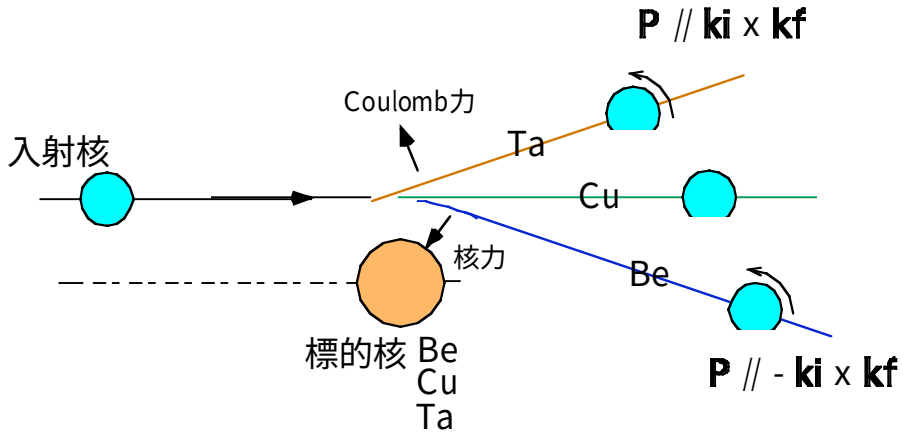
50-70 MeV/A

eparator

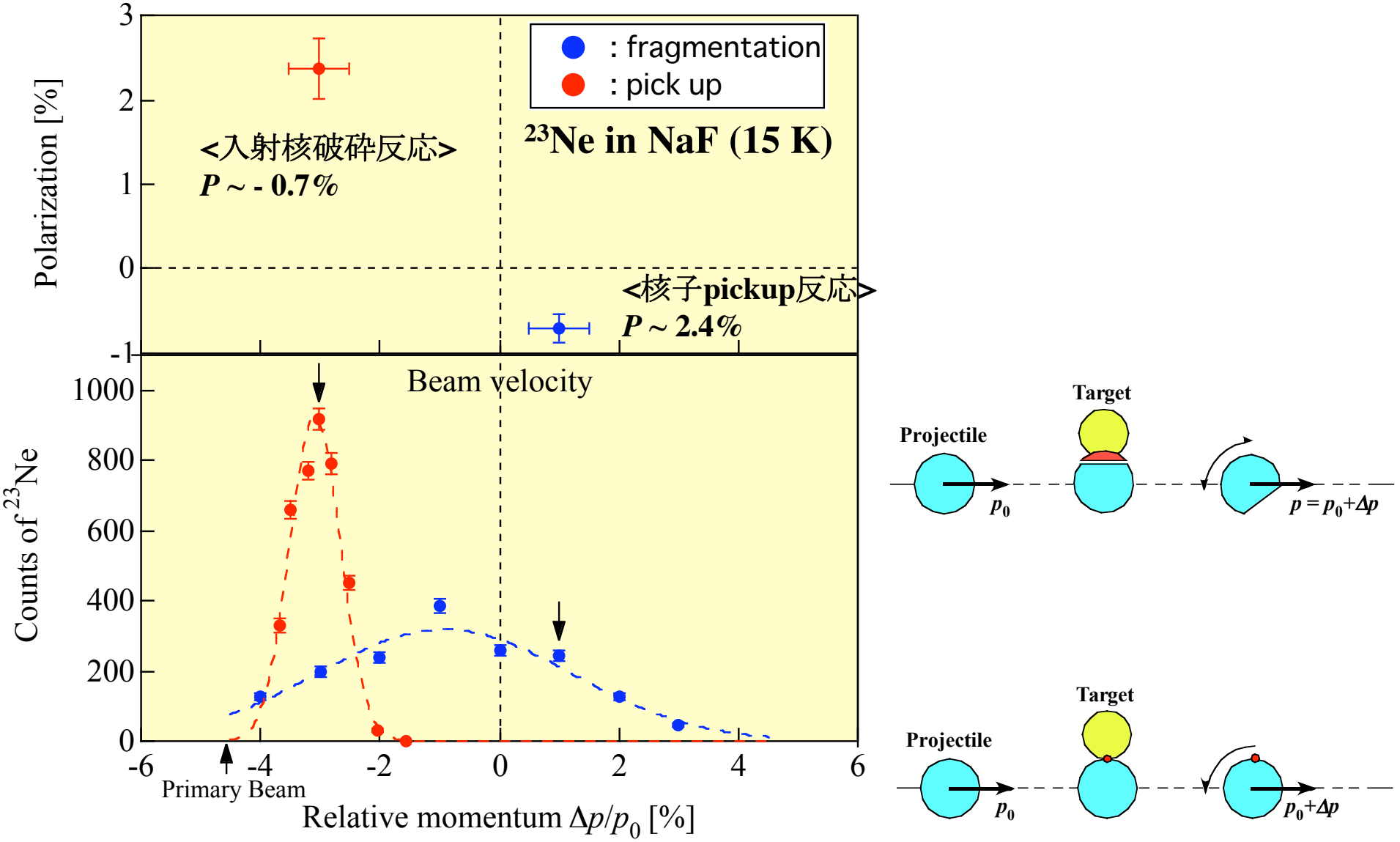
$$W(\theta) = 1 + AP\cos\theta$$

高エネルギー入射核破砕過程での偏極機構





Polarization and Yield of ^{23}Ne



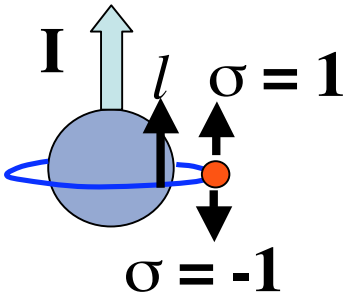
f7/2シェル 鏡映核対

Q	μ	$T_{1/2}$		?		$T_{1/2}$	μ	Q
	2.00(5)*	0.20 s	^{57}Cu	—	^{57}Ni$_{3/2^-}$	36 h	-0.7975(14)	新潟大
		0.19 s	^{55}Ni	—	^{55}Co$_{7/2^-}$	18 h	+4.822(3)	
		0.26 s	^{53}Co	—	^{53}Fe$_{7/2^-}$	8.5 m	オンライン 低温核整列	
		0.25 s	^{51}Fe	—	^{51}Mn$_{5/2^-}$	46 m	+3.5683(13)	420(70)
		0.38 s	^{49}Mn	—	^{49}Cr$_{5/2^-}$	42 m	0.476(3)	
		0.46 s	^{47}Cr	—	^{47}V$_{3/2^-}$	33 m	オンライン 低温核整列	
		0.4 s	^{45}V	—	^{45}Ti$_{7/2^-}$	3.1 h	0.095(2)	15(15)
		0.50 s	^{43}Ti	—	^{43}Sc$_{7/2^-}$	3.9 h	+4.62(4)	-260(60)
156(3)	5.4305(36)	0.60 s	^{41}Sc	—	^{41}Ca$_{7/2^-}$	10^5 y	-1.594781(9)	-80(8)

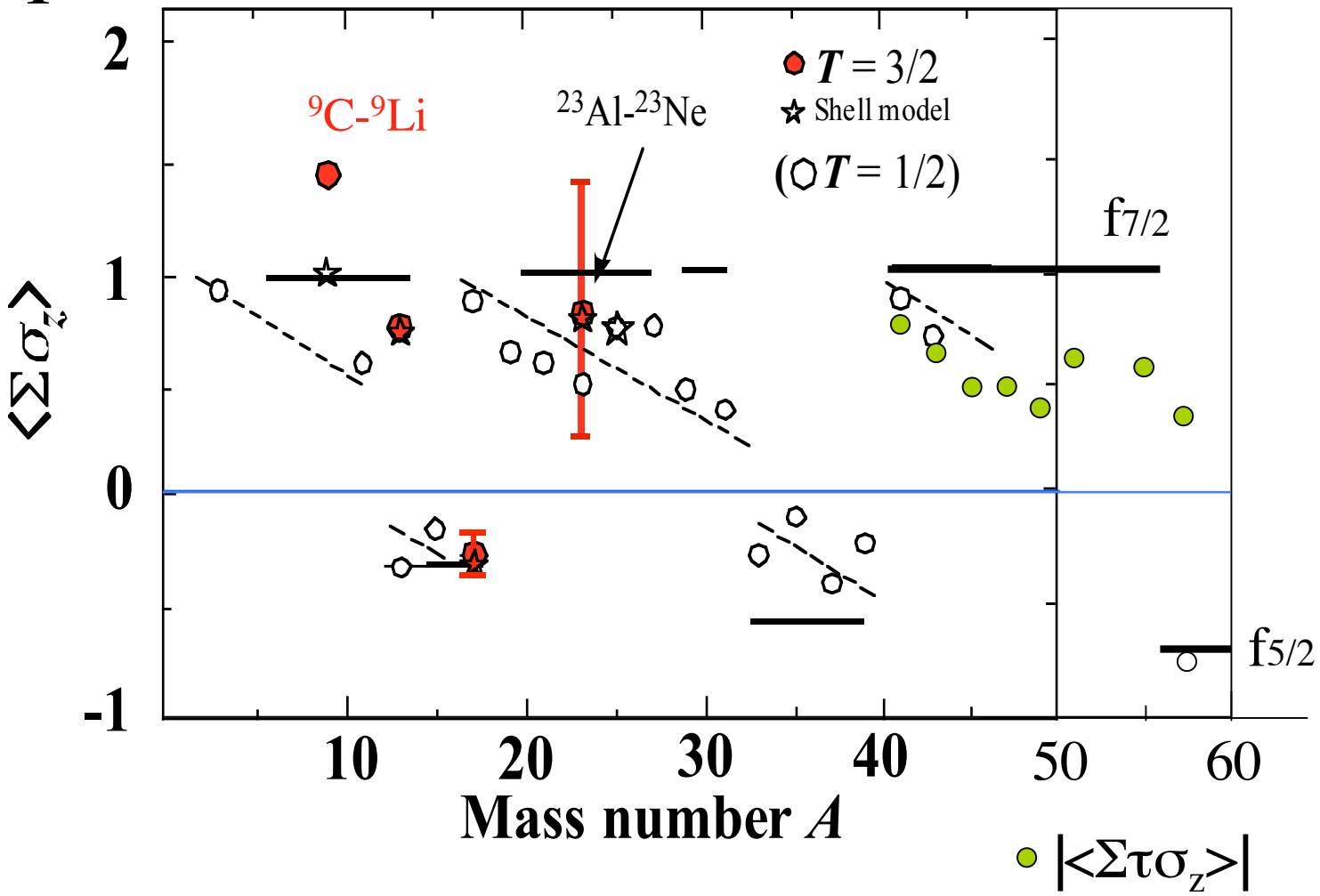
RCNPに期待

β-NMR

スピン期待値（含f シェル）

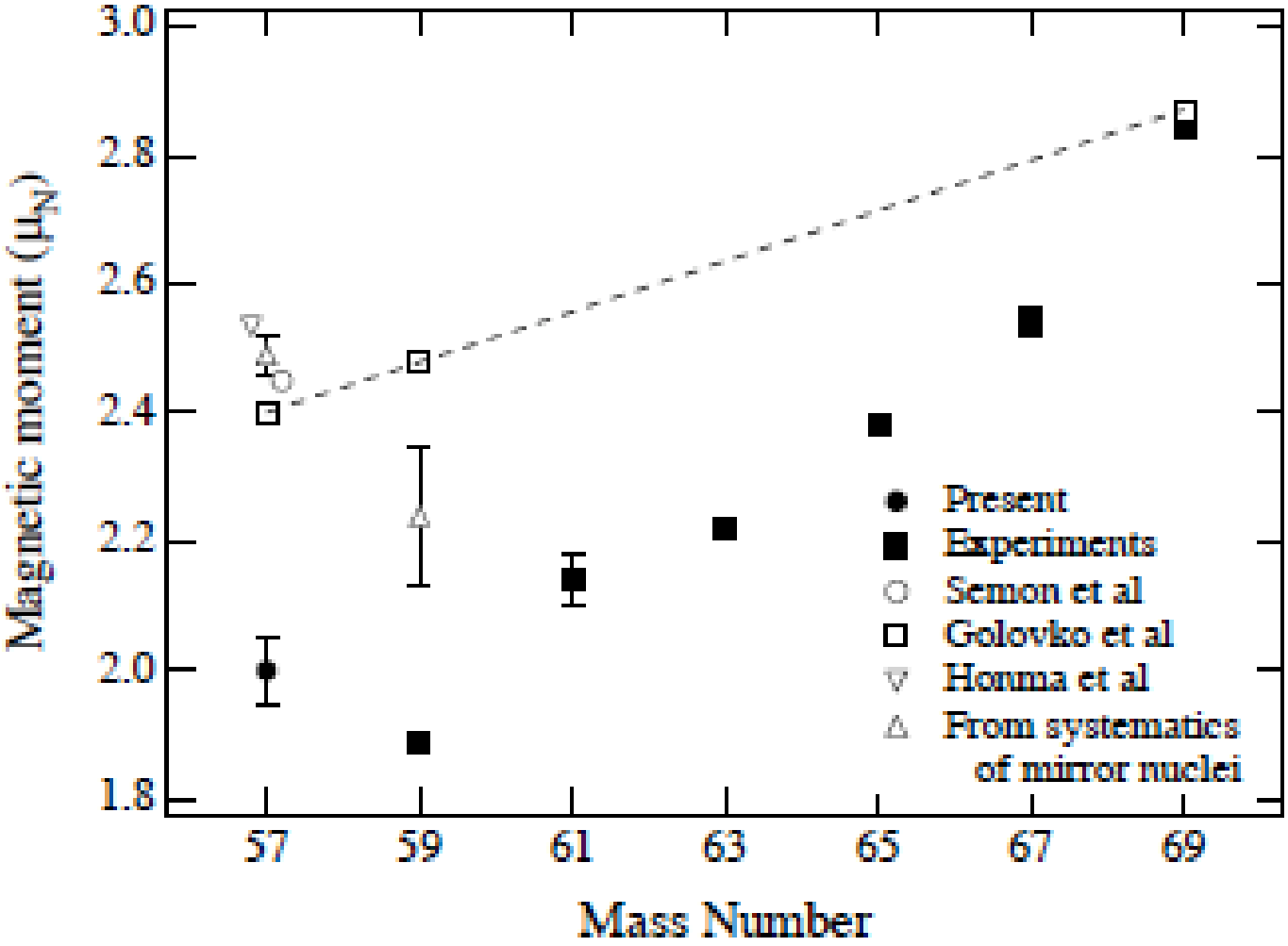


σ = 2S



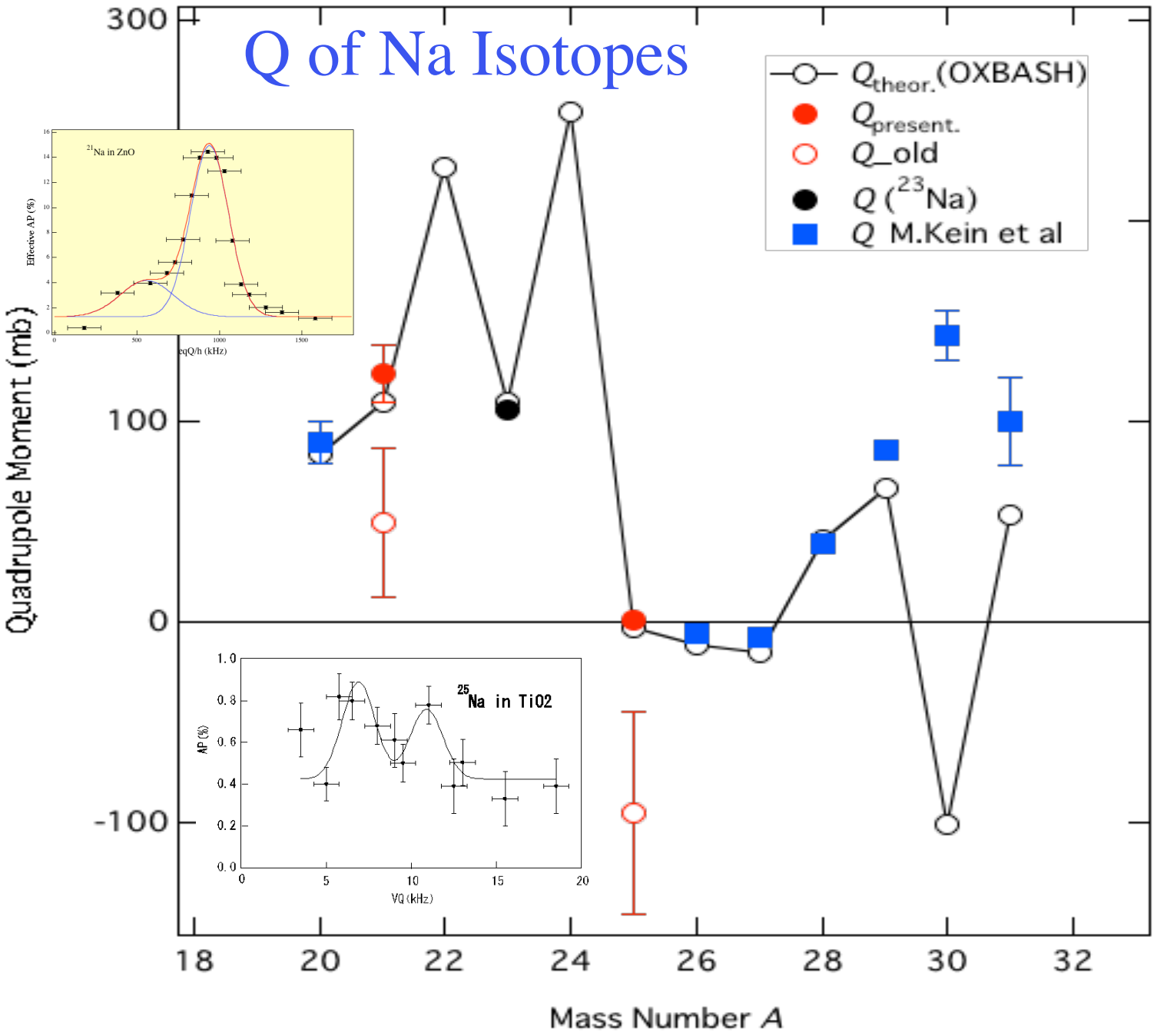
$$\mu(T_z=+T)+\mu(T_z=-T)$$
$$=I+(\mu_p+\mu_n-1/2)\langle\Sigma\sigma_z\rangle$$

Magnetic Moments of Cu Isotopes

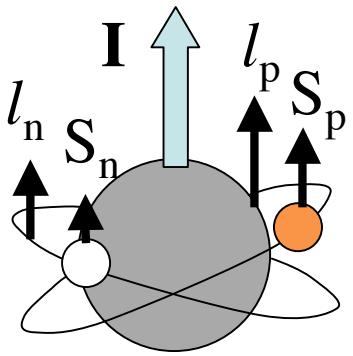


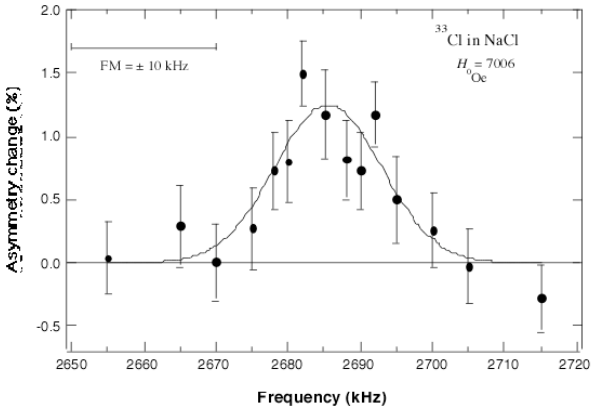
K. Minamisono, P. Mantica

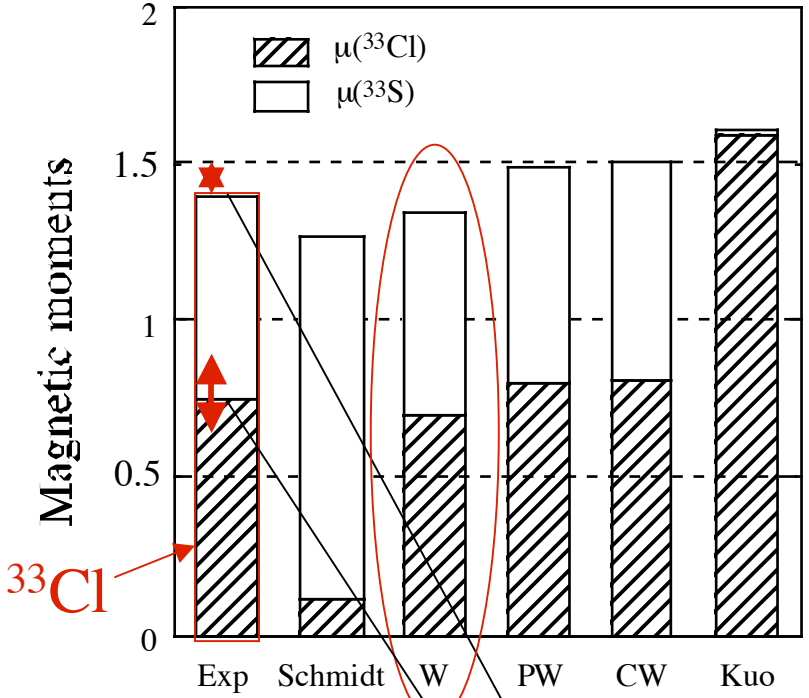
Q of Na Isotopes

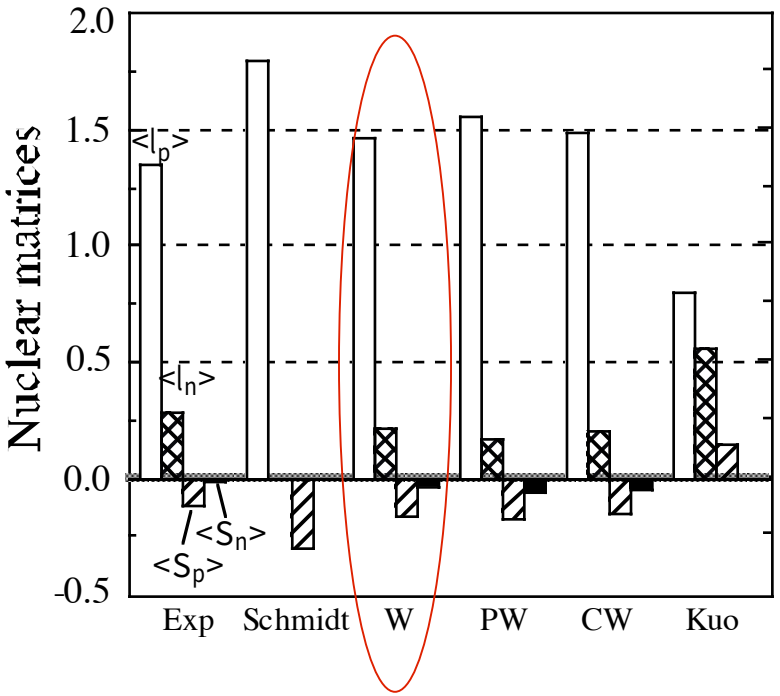


Discussion on ^{33}Cl









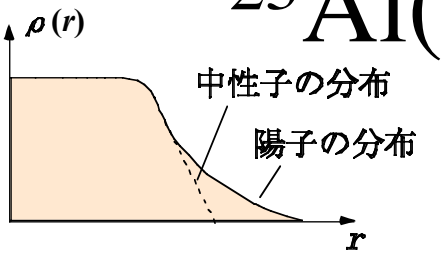
<S> = 1/2<σ>

<τ$_3 l$>, <τ$_3$S>

ft

$$\mu(T_z=+T)+\mu(T_z=-T) = I+(\mu_p+\mu_n-1/2)\langle\Sigma\sigma_z\rangle$$

$$\langle\tau\sigma\rangle = \frac{I}{I+1}\frac{1}{C_A}\sqrt{\frac{B}{ft}-1}$$



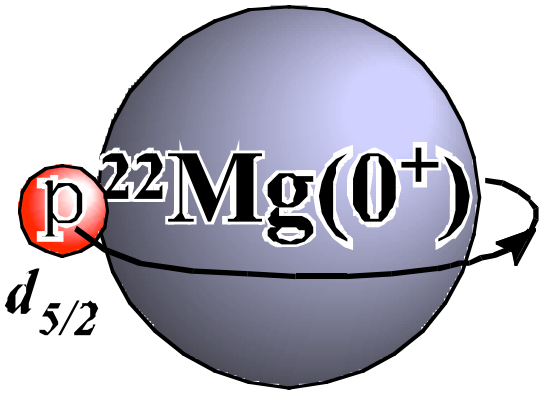
^{23}Al(I^{π}= ? , $T_{1/2}$ = 0.47s)

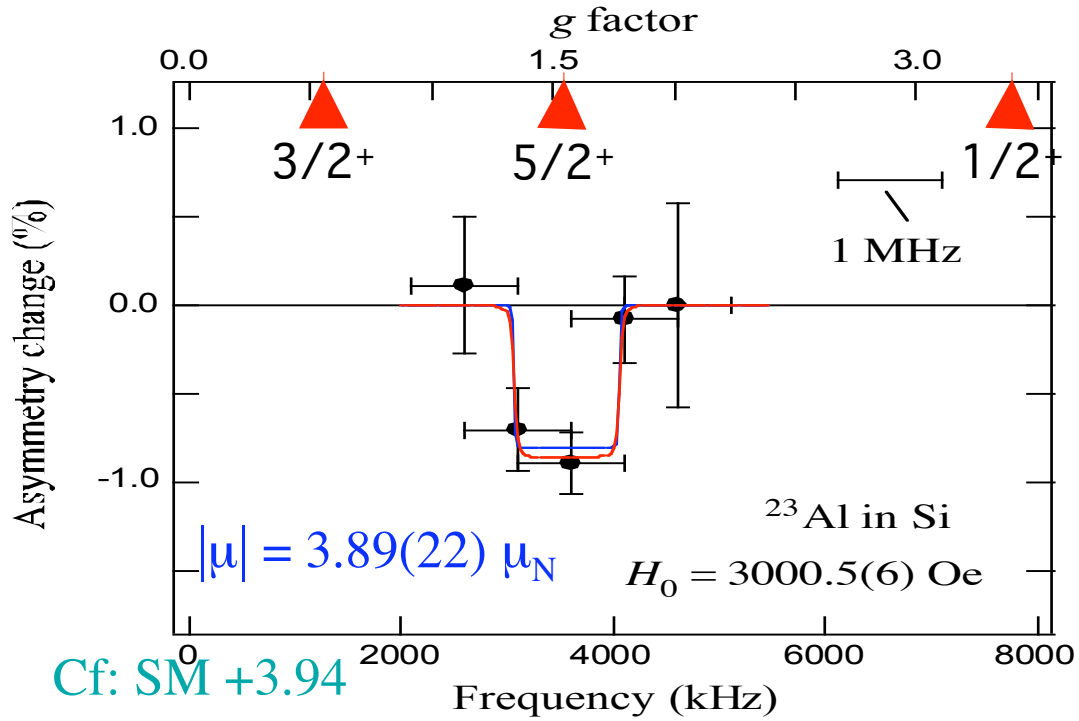
Proton halo?

^{22}Mg (0+) × $d_{5/2}$

$s_{1/2}$?

Large Radius





$|\mu| = 3.89(22)\ \mu_N$

Cf: SM +3.94

$g = \mu/I$

Shell Model

1.58 $(5/2^{+})$

3.40 $(1/2^{+})$

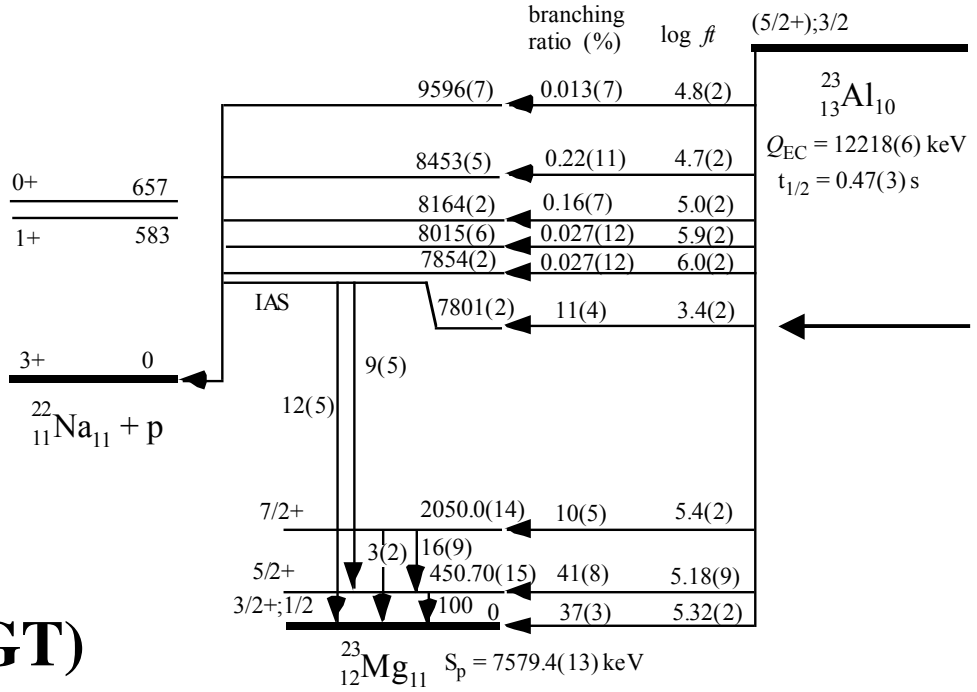
陽子、中性子の角運動量期待値

$$I = \left\langle l_z^p \right\rangle + \left\langle s_z^p \right\rangle + \left\langle l_z^n \right\rangle + \left\langle s_z^n \right\rangle$$

IASへの遷移 log *ft* = 3.4(2)

$\mu(^{23}\mathrm{Al})=3.89(22)\ \mu_N$

$\mu(^{23}\mathrm{Ne})=-1.0817(9)\ \mu_N$



$C/ft_{1/2} = B(F)+B(GT)$

$$-1.4(2) \leq \langle l_z(\mathrm{p}) \rangle \leq 1.2(2)$$

$$-0.07(15) \leq \langle s_z(\mathrm{p}) \rangle \leq 0.20(15)$$

$$0.9(2) \leq \langle l_z(\mathrm{n}) \rangle \leq 3.5(2)$$

$$0.20(15) \leq \langle s_z(\mathrm{n}) \rangle \leq 0.48(15)$$

Shell-model

$$\langle l_z(\mathrm{p}) \rangle = 0.194$$

$$\langle s_z(\mathrm{p}) \rangle = 0.025$$

$$\langle l_z(\mathrm{n}) \rangle = 1.898$$

$$\langle s_z(\mathrm{n}) \rangle = 0.388$$

まとめ

RCNPでの重イオン利用研究展開

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スピン期待値、軌道角運動量

$$I = \left\langle l_z^p \right\rangle + \left\langle s_z^p \right\rangle + \left\langle l_z^n \right\rangle + \left\langle s_z^n \right\rangle$$

核物性研究