"The (^{3}He,p) reaction to study *np* pairing in ^{56}Ni"

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- Introduction
- Pairing vibrations in ^{56}Ni
- The experiment
- Stable-beam runs
- Results for ^{40}Ca
- Summary and conclusions

HRIBF Workshop on Transfer Reactions
June 21-22 2002, ORNL

Motivation

☆ **N=Z nuclei, unique systems to study *np* correlations.**

☆ **Role of isoscalar (T=0) and isovector (T=1) pairing**

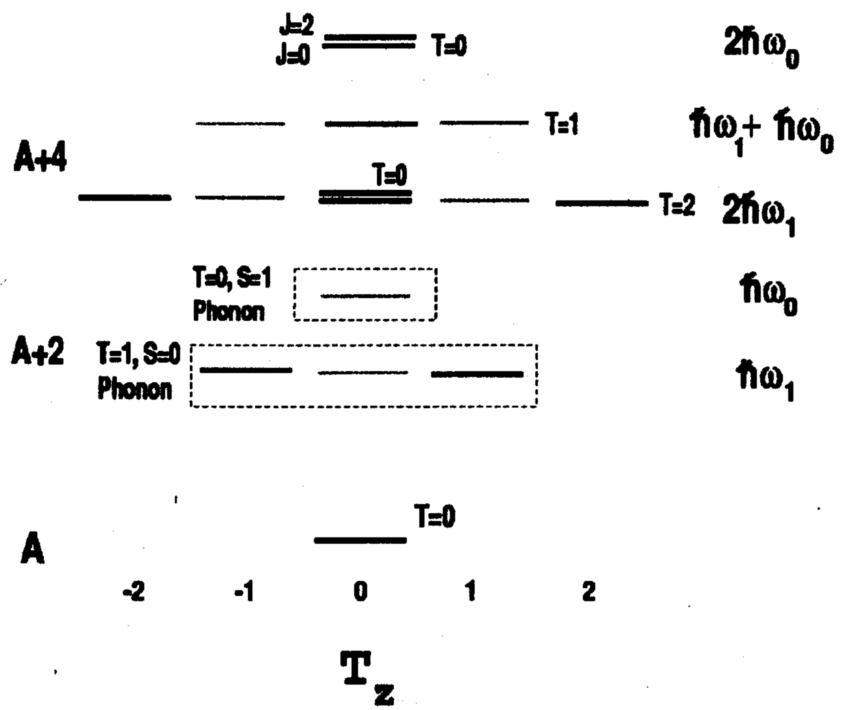
Large spatial overlap of *n* and *p*

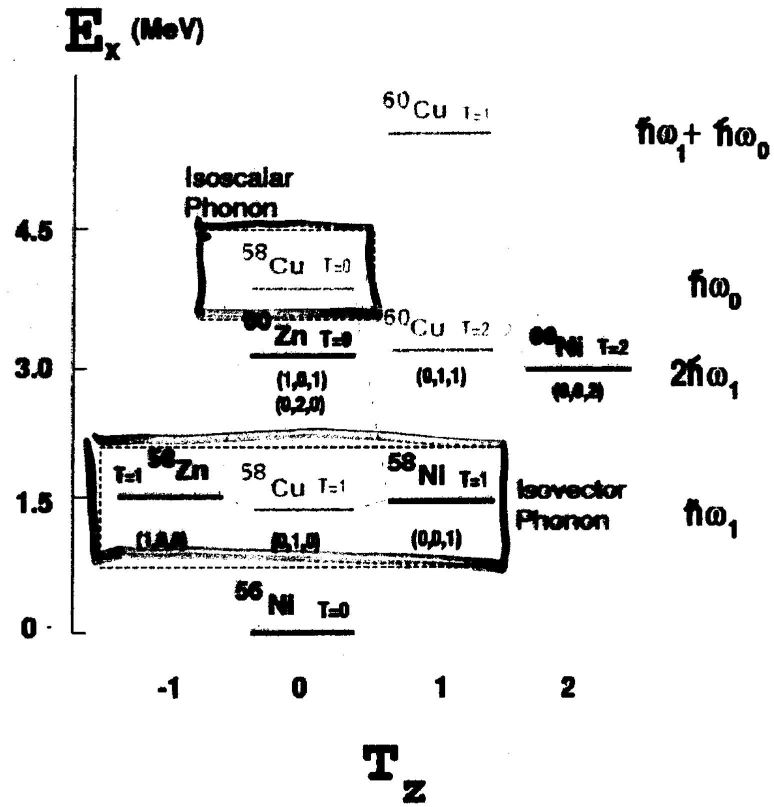
Pairing vibrations (normal system)
Pairing rotations (superfluid system)

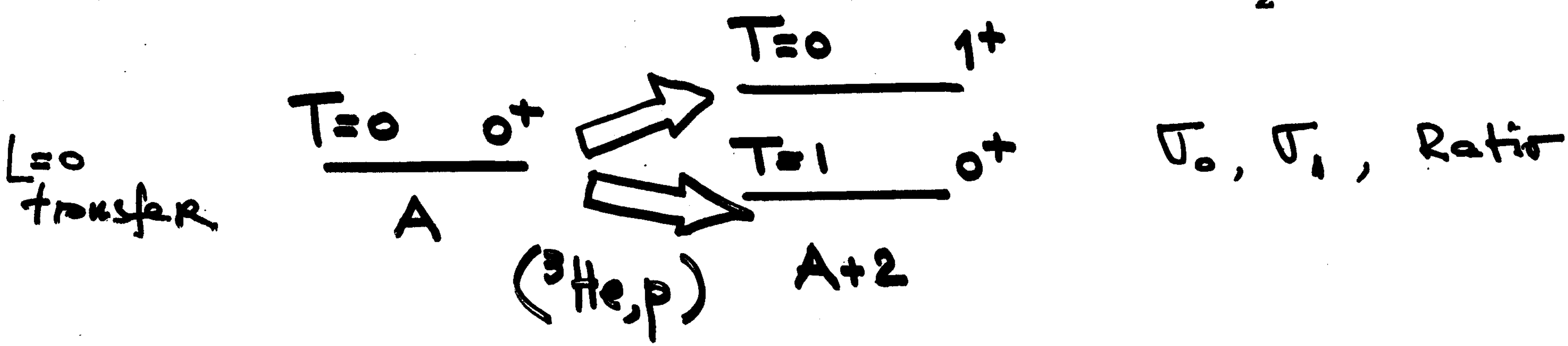
☆ **Does isoscalar pairing give rise to collective modes?**

As you move out *nn* and *pp* pairs are favored

☆ **Two-nucleon transfer reactions provide an excellent tool to test the correlations in the wave-functions**


J=2
J=0
T=0
2ħω0
T=1
ħω1+ ħω0
A+4
T=0
T=2
2ħω1
T=0, S=1
Phonon
ħω0
A+2
T=1, S=0
Phonon
ħω1
T=0
A
-2
-1
0
1
2
Tz


Ex (MeV)
60Cu T=1
ħω1+ ħω0
Isoscalar
Phonon
58Cu T=0
ħω0
60Zn T=0
(1,0,1)
(0,2,0)
60Cu T=2
(0,1,1)
60Ni T=2
(0,0,2)
2ħω1
T=1 58Zn
58Cu T=1
58Ni T=1
(0,1,0)
(0,0,1)
Isovector
Phonon
ħω1
56Ni T=0
4.5
3.0
1.5
0
-1
0
1
2
Tz


L=0
transfer
T=0
0+
A
(3He,p)
T=0
1+
T=1
0+
A+2
σ0, σ1, Ratio

1.E.1:
2.B

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~~LEVELS OF ^{42}Sc~~ FROM $^{40}Ca(^3He, p)^{42}Sc$ AND $^{40}Ca(^3He, p\gamma)^{42}Sc$

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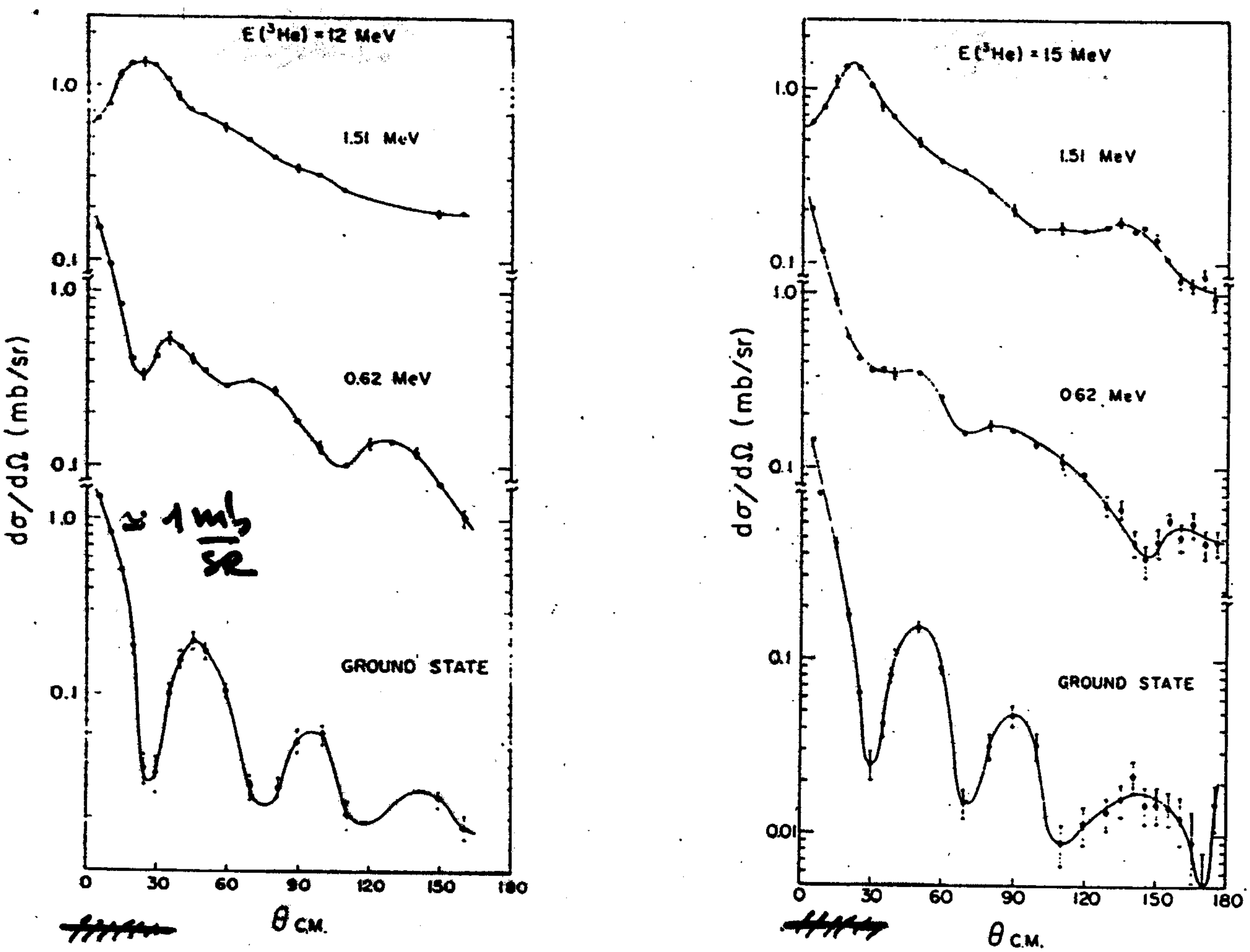

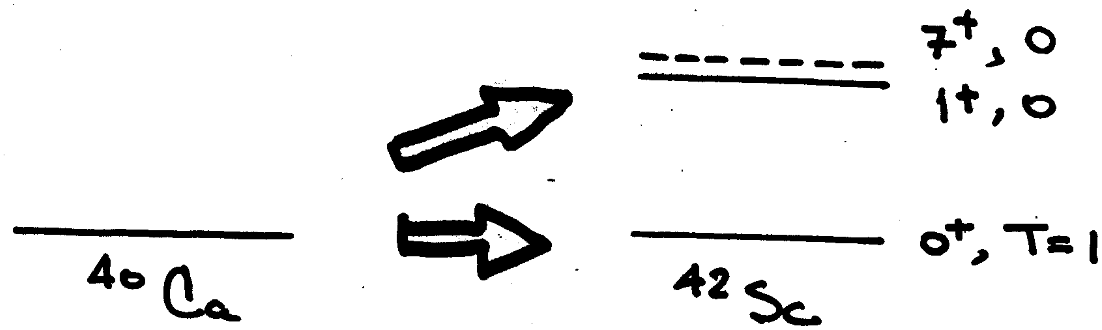

Study of the $^{56}Ni(d,p)^{57}Ni$ Reaction and the Astrophysical $^{56}Ni(p,\gamma)^{57}Cu$ Reaction Rate

K. E. Rehm,[1] F. Borasi,[1] C. L. Jiang,[1] D. Ackermann,[1] I. Ahmad,[1] B. A. Brown,[2] F. Brumwell,[1] C. N. Davids,[1] P. Decrock,[1] S. M. Fischer,[1] J. Görres,[3] J. Greene,[1] G. Hackmann,[1] B. Harss,[1] D. Henderson,[1] W. Henning,[1] R. V. F. Janssens,[1] G. McMichael,[1] V. Nanal,[1] D. Nisius,[1] J. Nolen,[1] R. C. Pardo,[1] M. Paul,[4] P. Reiter,[1] J. P. Schiffer,[1] D. Seweryniak,[1] R. E. Segel,[5] M. Wiescher,[3] and A. H. Wuosmaa[1]

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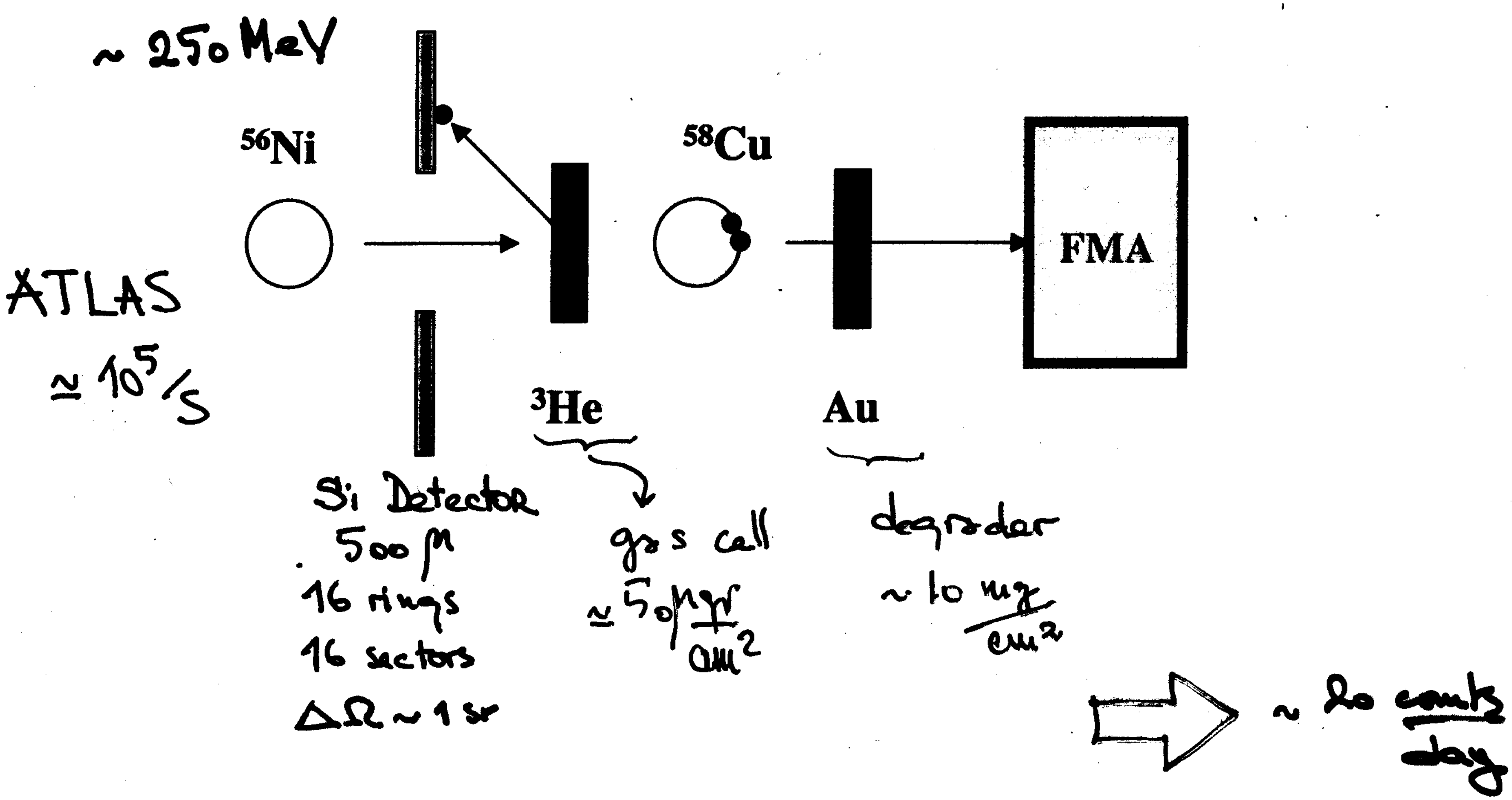
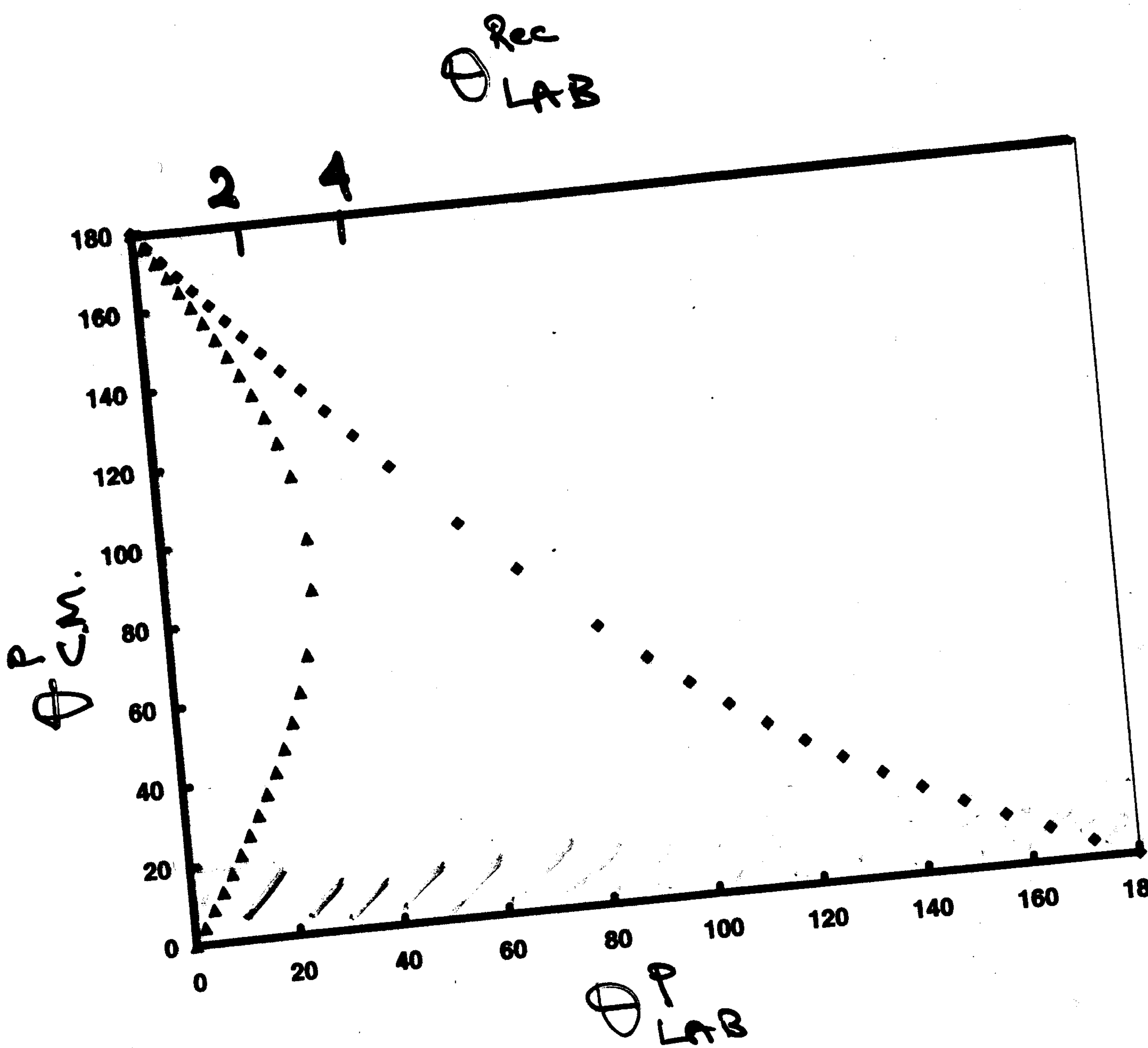
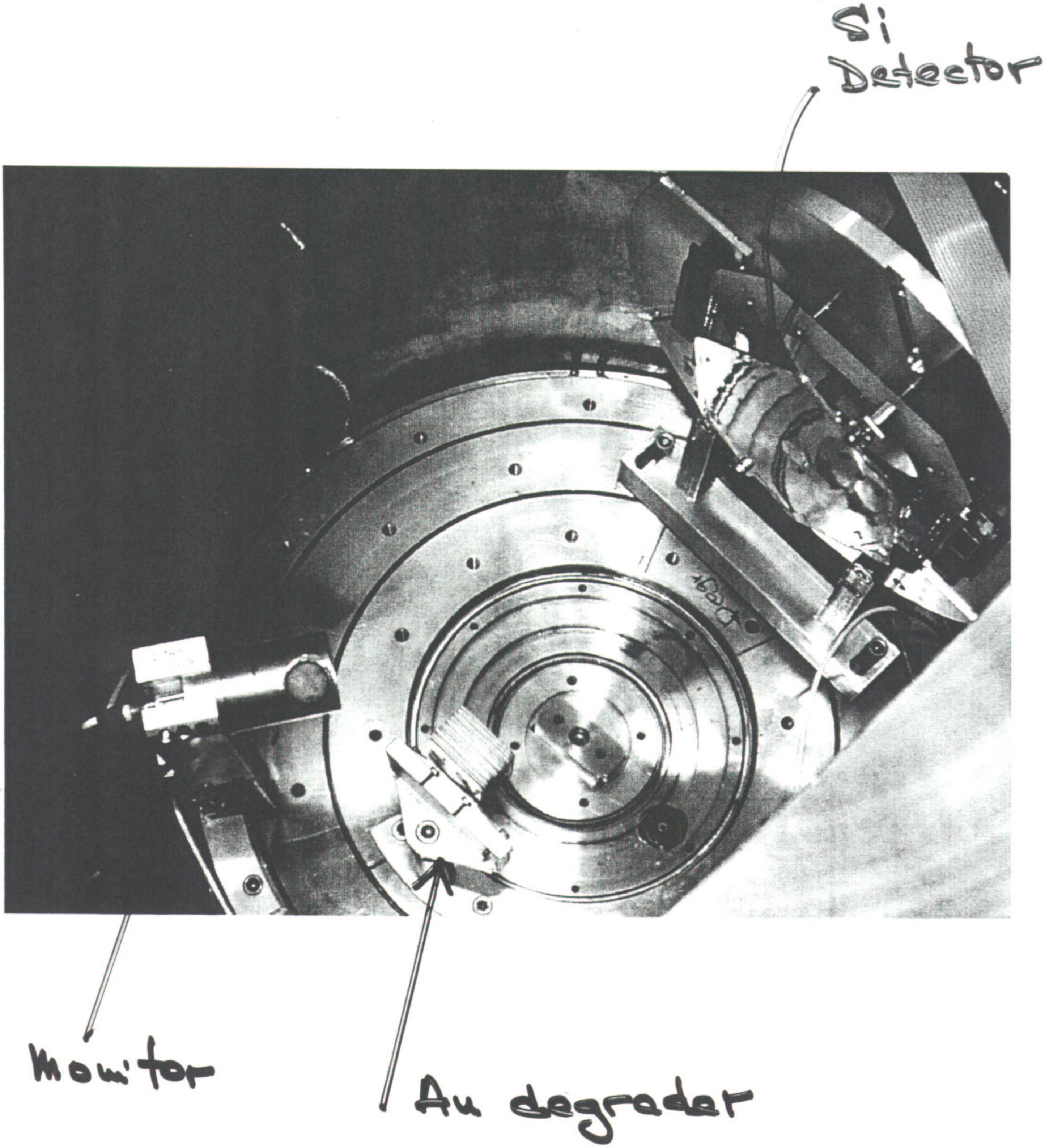
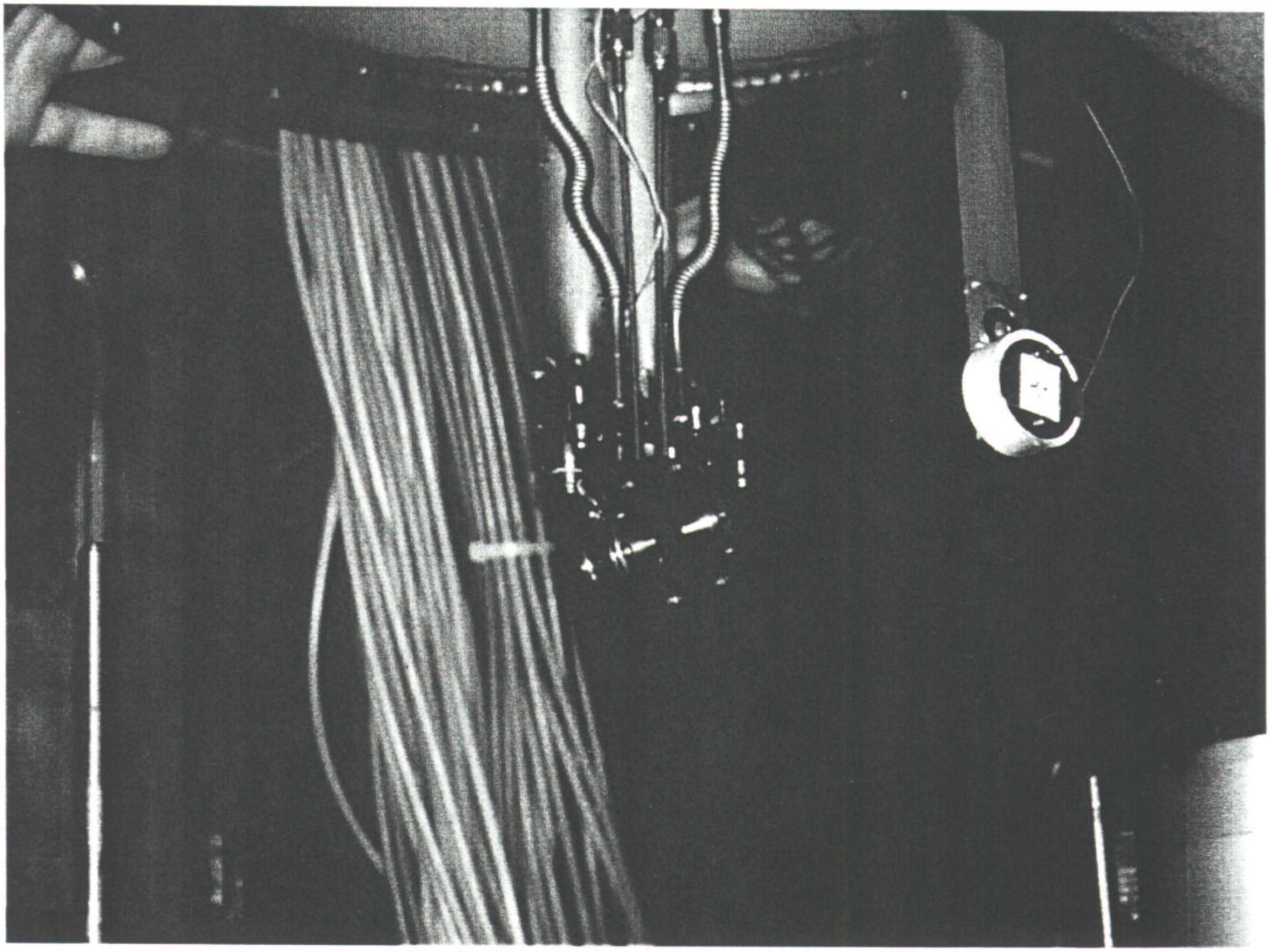


$^{40}Ca(^{3}He, p)^{42}Sc$ @ 220 MeV




Si
Detector
Monitor
Au degrader

^{3}He Cell

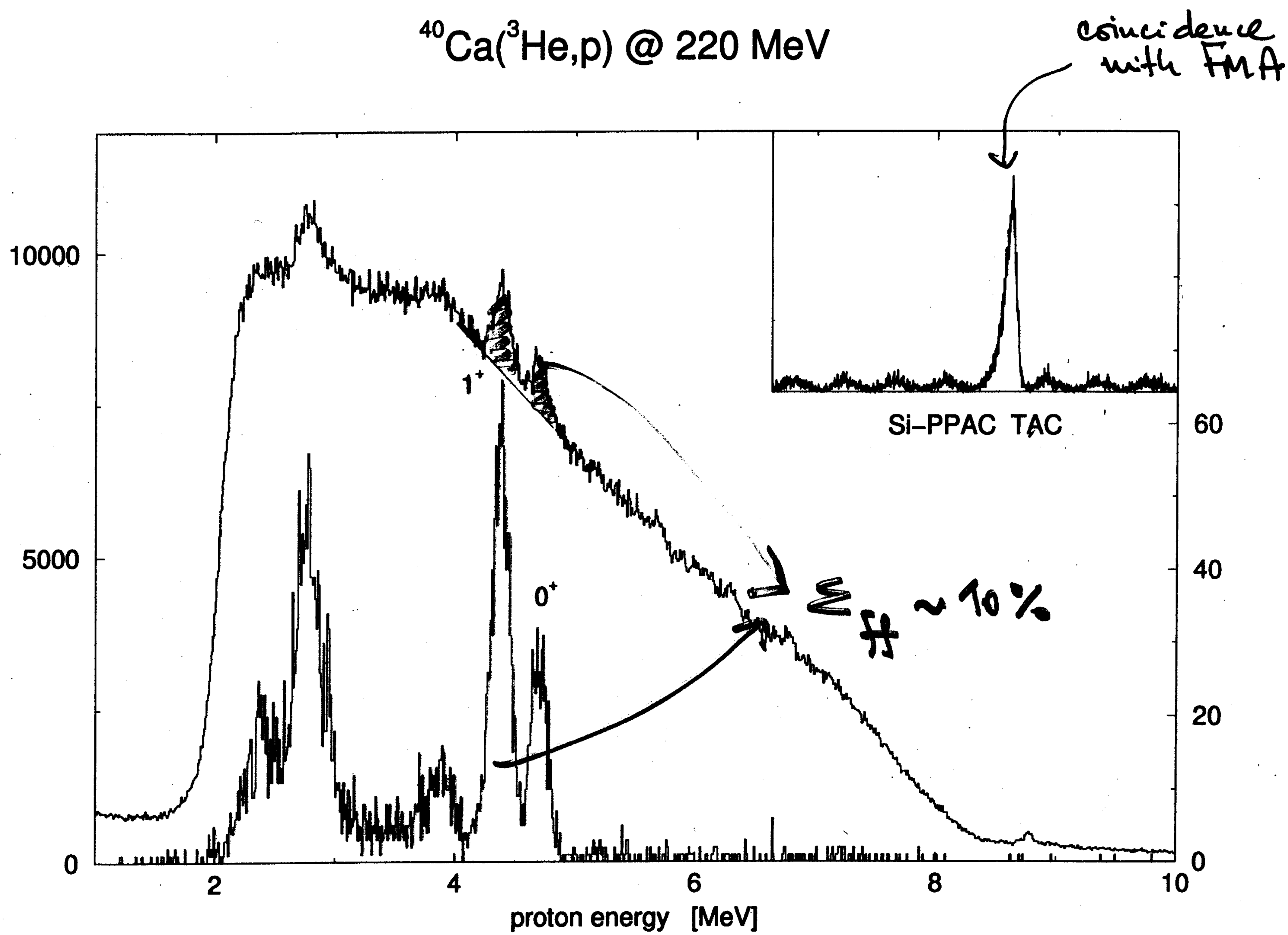


Ti windows ~ 1.5 mg/cm^2

~ 740 mbar ~ −177 °C

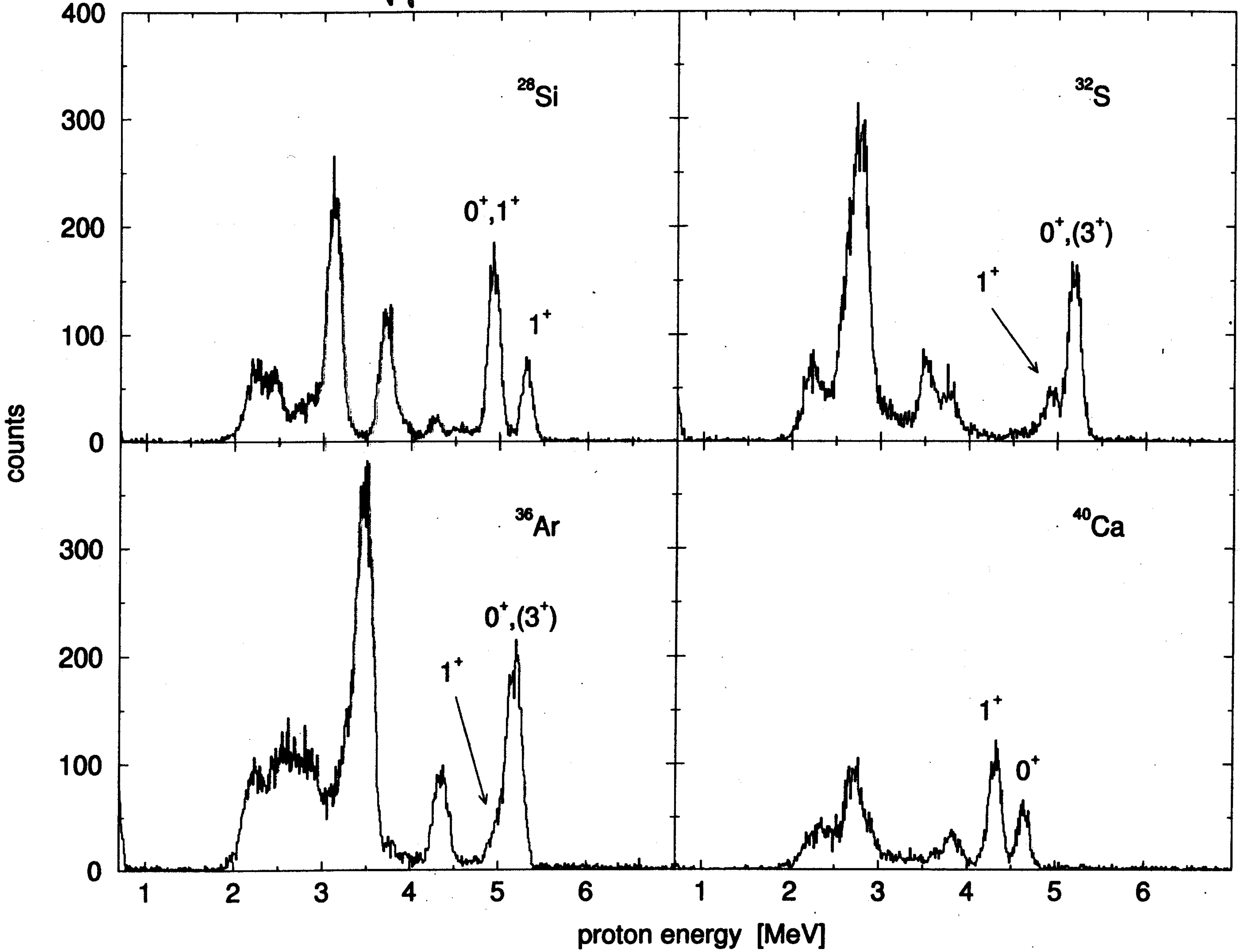
Δx ~ 1.5 mm

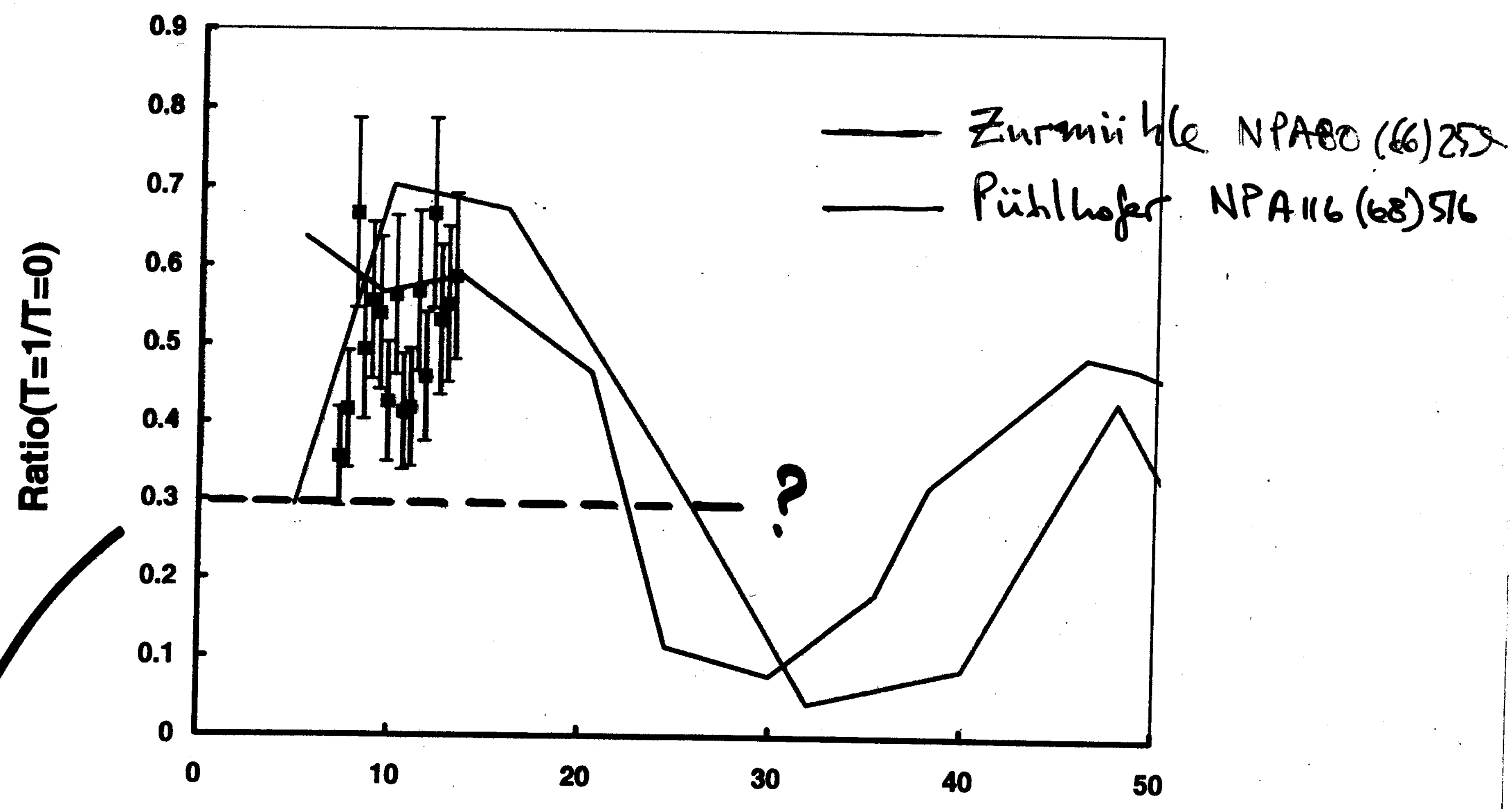
⇨ ~ 50 μg/cm^2



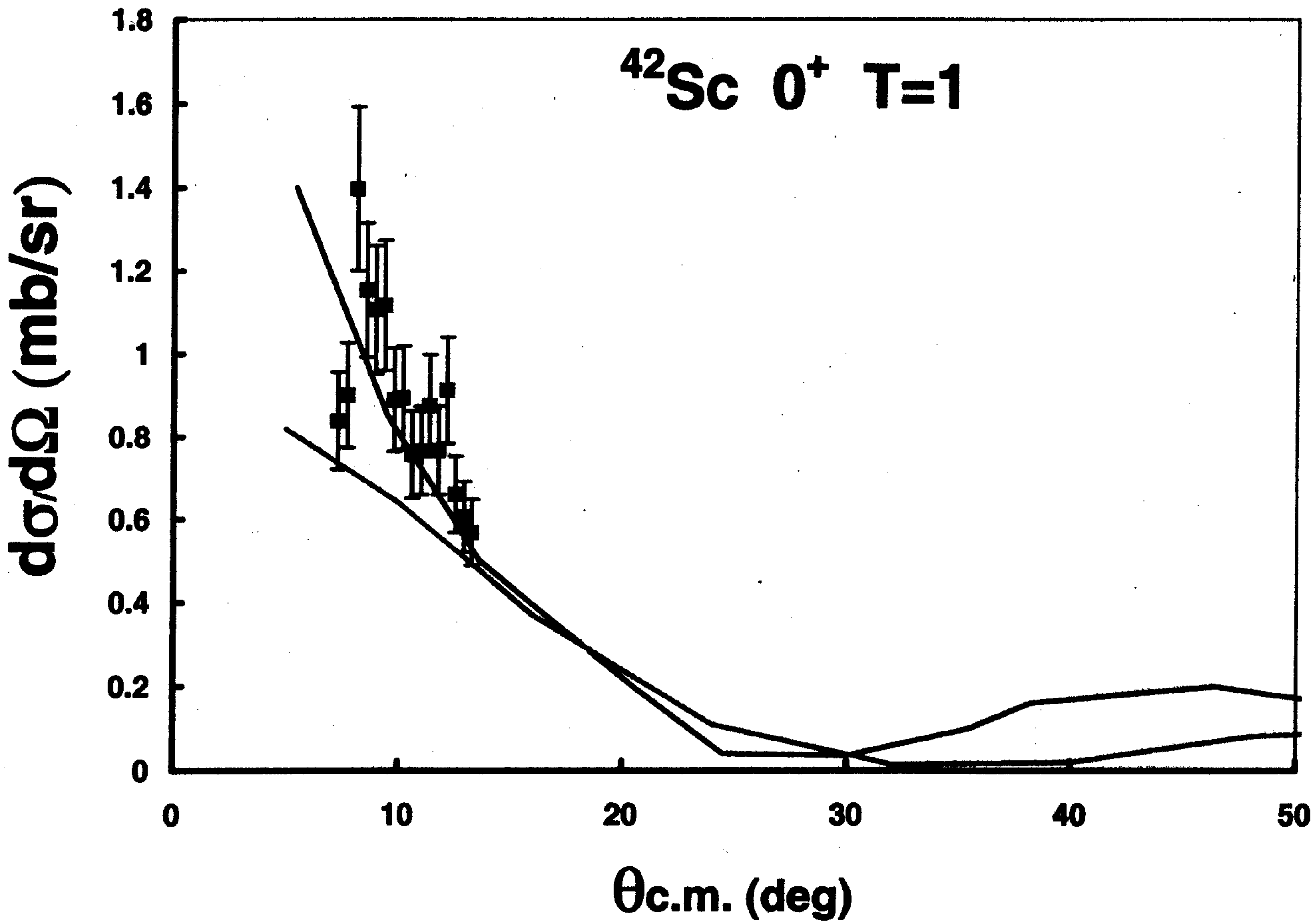
$^{40}Ca(^{3}He,p)$ @ 220 MeV
10000
5000
0
2
4
6
8
10
0
20
40
60
proton energy [MeV]
1^{+}
0^{+}
Si–PPAC TAC

$E_{beam} \sim 5 \frac{MeV}{A}$ ~ 20 part pA ~ 1 day

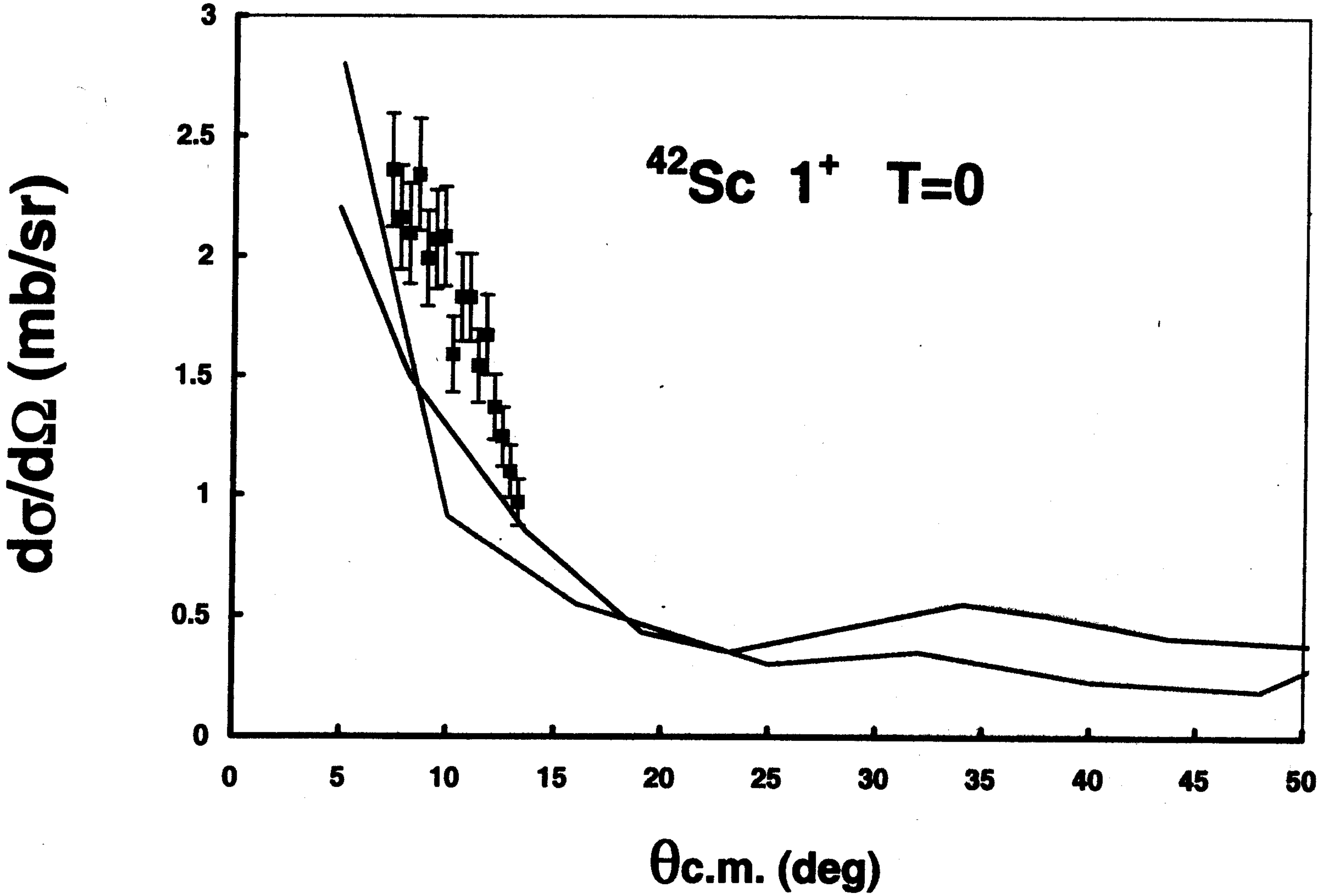




$$\left.\frac{d\sigma_1}{d\sigma_0}\right)_{DWBA} \sim \frac{1}{3}$$



^{42}Sc 0$^+$ T=1
dσ/dΩ (mb/sr)
θc.m. (deg)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
10
20
30
40
50



dσ/dΩ (mb/sr)
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
30
35
40
45
50
θc.m. (deg)
42Sc 1+ T=0

☆ Looking ahead