$^{11}C(p,\gamma)^{12}N$ @ DRAGON (preliminary)

Weiping Liu

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China Institute of Atomic Energy
Beijing, P. R. China

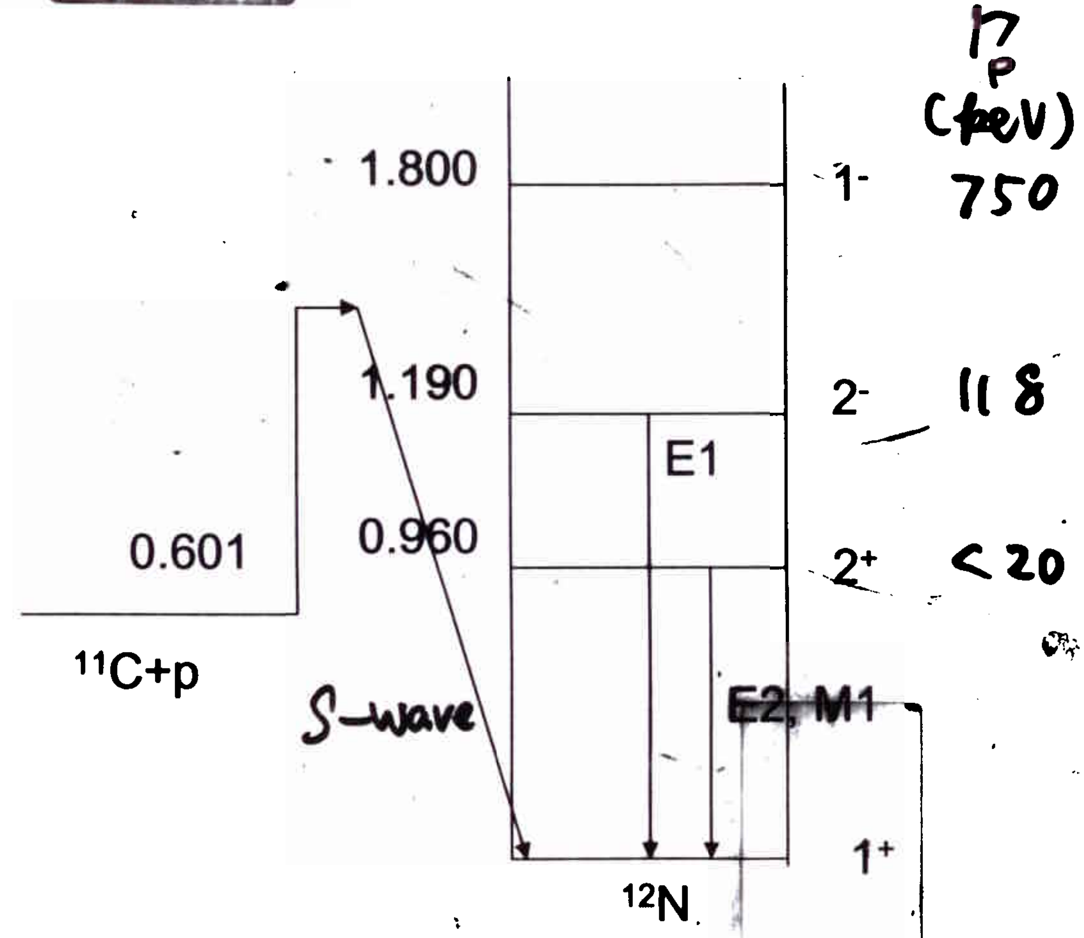
Some technical details

- g-coin enhance the S/N ratio and distinguish components among DC and resonance
- Use IC if possible to further enhance the recoil identification and to increase the beam suppression power (e.g. 1 μm Mylar window(1.3 MeV) + 20 torr * 10 cm IC(2.7 MeV) backed by silicon strip detector(1 MeV), for 5 MeV ^{12}N.)

Astro Physics case

- Part of hot pp chain G. J. Mathews Ap. J 287(1984)969
- Massive zero-metal stars, high temperature, high density
- Compete with β-decay, bypass triple α-reaction. A.E. Campagne Ann. Rev. Nucl. Part. Sci 42(1992)39.
- ^{11}B synthesis in novae. M. Arnould. Astron Astrophys. 42(1975)55.

Level scheme



F. Ajzenberg-Selove, NPA 506 (1990) 1.

Current status –experimental

- Coulomb, GANIL, RIKEN
- ANC, TAMU, CIAE X. Tang PRC 67 (2003) 015804
  W. Liu NPA (Submitted)
- Direct, Leuven (proposed) Leuven PAC application

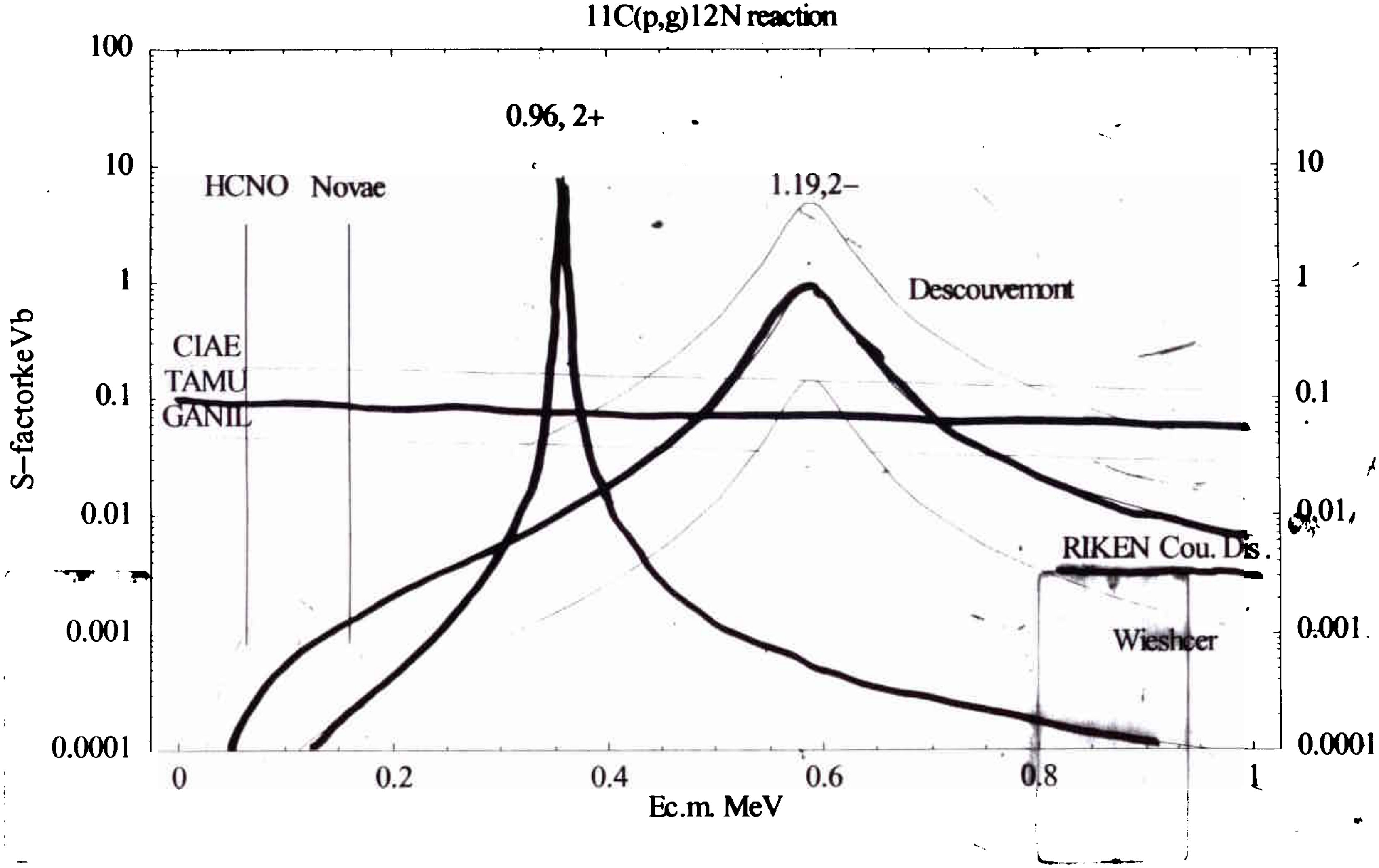
A. Lefebvre NPA 592 (1995) 69
T. Motobayashi (private comm.)

Problem

Γ_γ P. Descouvemont NPA646(1999)261.

- Resonance peak, width disagreement
  - Theory 2, 140, 68 meV M. Wiescher APJ343(1989)352
  - Experiment 6, 13 meV GANIL, RIKEN
- ANC for DC component, disagreement
  - S(0) CIAE 168(44) eVb W. Liu $^{11}C(d,n)^{12}N$
  - S-factor TAMU 93(13) eVb X. Tang $^{11}C(^{14}N,^{13}C)^{12}N$
- NO direct measurement yet (only proposed in Leuven)
  - Theory 149 eVb N.K. Timofeyuk NPA713(2003)217.

The details of S-factor uncertainty



Where do we have ^{11}C?

why Dragon?

- LBL, 60-130 MeV, 10^7 pps.
- Leuven, 6.2-10 MeV, 10^7 pps
- GANIL?
- Beijing, 40-60 MeV, 10^4 pps CIAE
- CERN?
- Dragon, 10^8-10^9 pps? 0.5–1.5 MeV/u

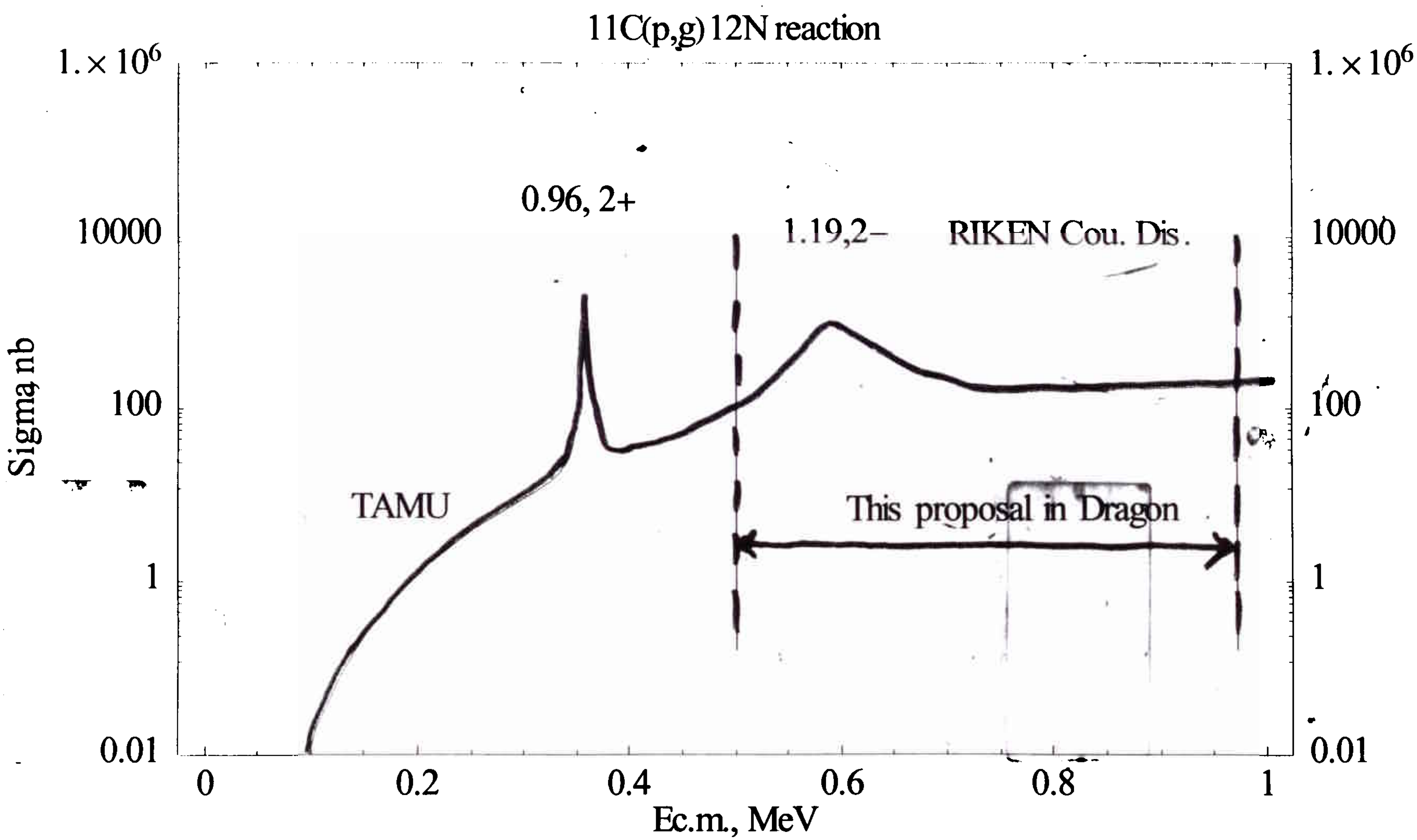
Comparison

Location	Dragon	Leuven ARES
Intensity, pps	10^8-10^9	10^6
Target thickness, atom/cm^2	10^{18} H_2 windowless	10^{18} CH_2
g coincidence	Yes	No

Advantage in Dragon

- High beam intensity · 10^8–10^9 pps expected.
- Gas target   Windowless → low energy background free
- Gamma coincidence
- Large acceptances   20 mradian
- Not other lab have above at same time!

Feasibility: proposed energy range

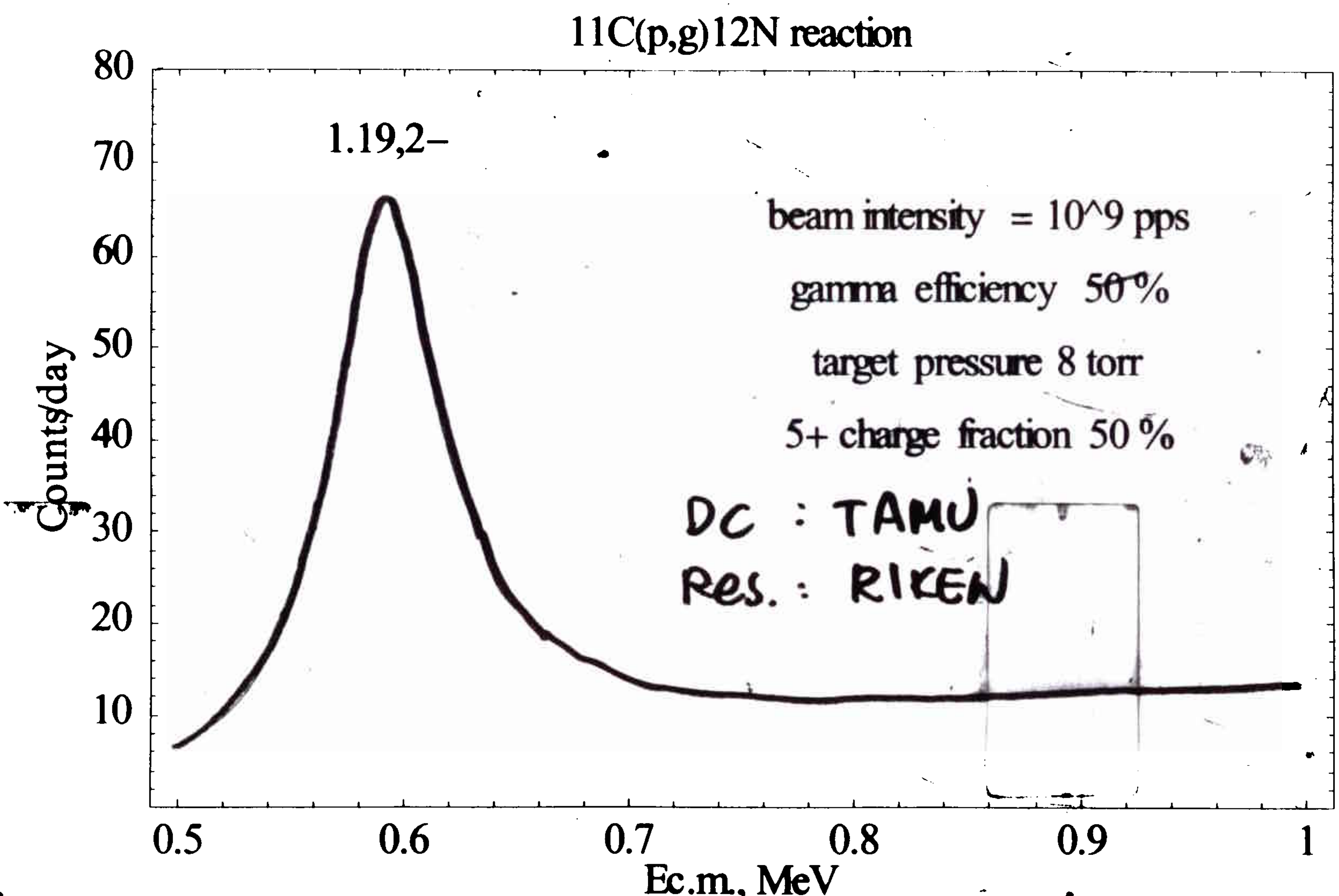


Detailed calculation

DC + Res.

Ecm	S-factor	sigma	daycount
MeV	KeVb	nb	events
		TAMU	RIKEN
0.5	0.155232	97.3776	6.54749
0.55	0.391841	325.267	21.8704
0.6	0.875961	924.787	62.1809
0.65	0.25374	330.108	22.1959
0.7	0.132692	207.35	13.9418
0.75	0.0974239	179.046	12.0387
0.8	0.0819744	174.095	11.7058
0.85	0.0733316	177.325	11.923
0.9	0.0676537	183.931	12.3672
0.95	0.0634867	191.962	12.9071
1.	0.0601816	200.483	13.4801
Ec.m.(MeV)	S-factor keVb	σ (nb)	Counts/day

Feasibility: counting rates



"True" data May be larger or smaller by factor of 2!

Feasibility

- 10^8-10^9 pps ^{11}C
- 10^{18} atom/cm^2 gas target ~8 torr
- 25 % overall efficiency (gamma+dragon)
  50% 5+ 50%
- 100-1000 nb cross section
- 6-60 events/day ± 100%
- ~~40~~ shift for an excitation function from 0.5 to 1.0 MeV (200 keV step in 2⁻ peak, 0.5-0.7 MeV 500 keV step in DC) 0.7-1.0 MeV
- 10-30 % uncertainty

PAC issues

- Man power: Current Dragon collaboration + CIAE
- Time: 2004-2005
- Financial: TRIUMF + CIAE / MOST ?