$p + {}^{13}C \rightarrow \gamma$ source reaction for interrogation & photonuclear work

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USNDP, Nov. 4, 8:30-10:30

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Contents

- Interrogation concept
- Experimental data on $p\ ^{13}C \rightarrow \gamma_0\ ^{14}N$

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Application: Interrogation

- **Explosives containing ^{14}N detection system:** Inspection of cargo mainly at airports, but also other ports

- **Nuclear resonance absorption**: Bombard ^{14}N with mono-energetic γ beam where cross-section very high

  Morgado et al., 1994; Vartsky et al., 1989; Biesiot and Smith, 1981

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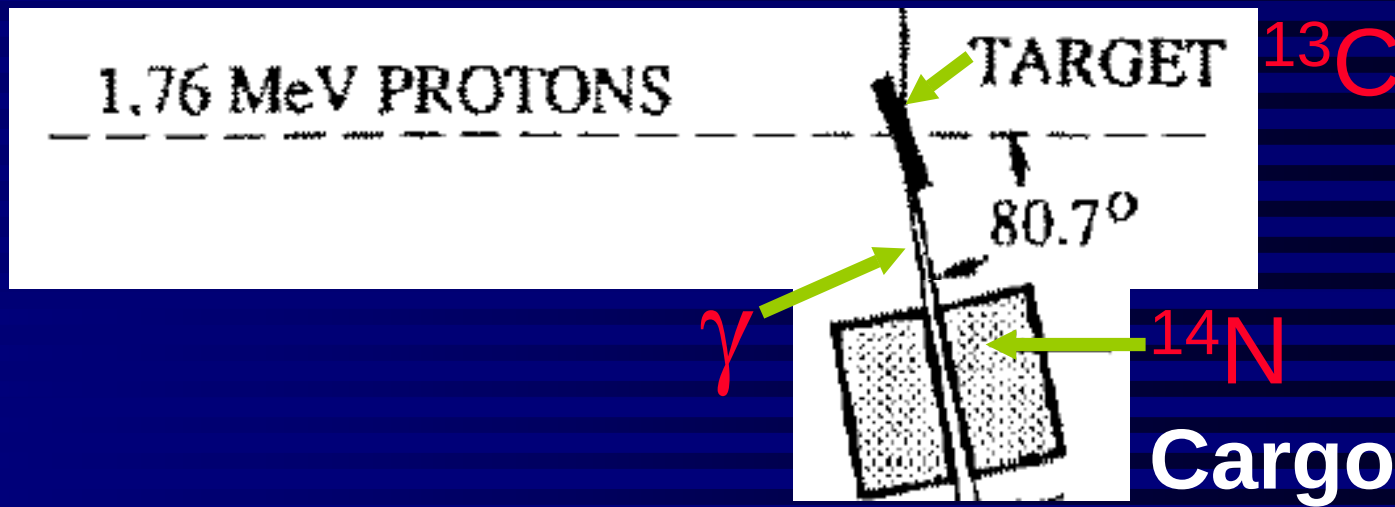
$p\ ^{13}C \rightarrow \gamma_0\ ^{14}N \rightarrow p\ ^{13}C$

Storage ring



Mono-energetic γ beam $\Leftarrow$
Mono-energetic p beam

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Source reaction p $^{13}C \rightarrow \gamma_0$ ^{14}N

- Mono-energetic p at lab. energy 1.75 MeV
- Very pure ^{13}C target
- 9.17 MeV γ. Very narrow 2^+ resonance
- High flux p $\Rightarrow$ Rapid cargo inspection
- Background: $E_p < 1.75$ MeV

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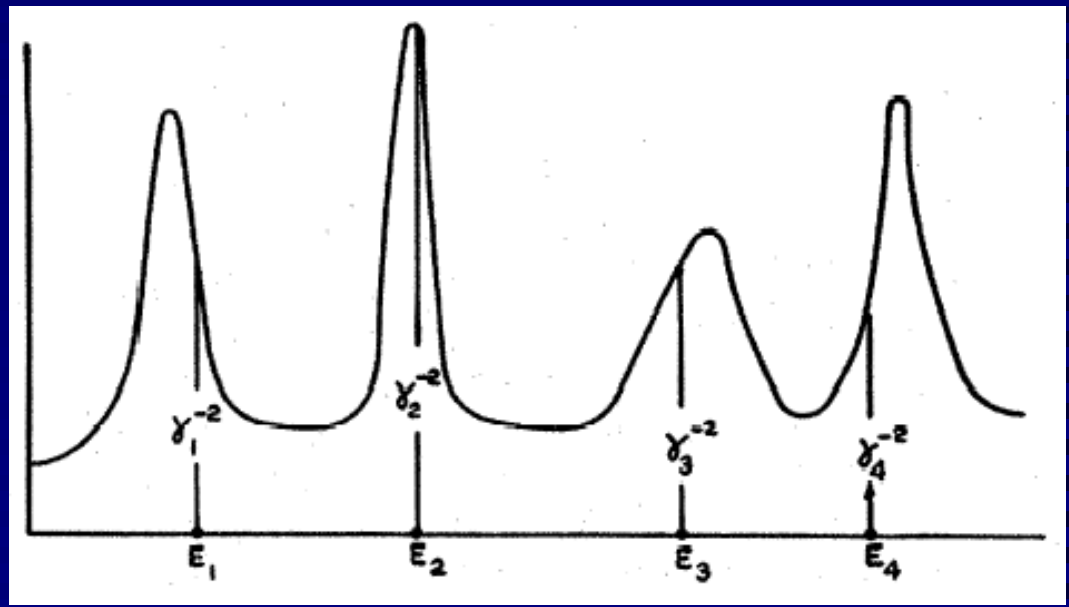
Experimental data on $p\ {}^{13}C \rightarrow \gamma_0\ {}^{14}N$ for R-matrix fit including 9.17 MeV resonance



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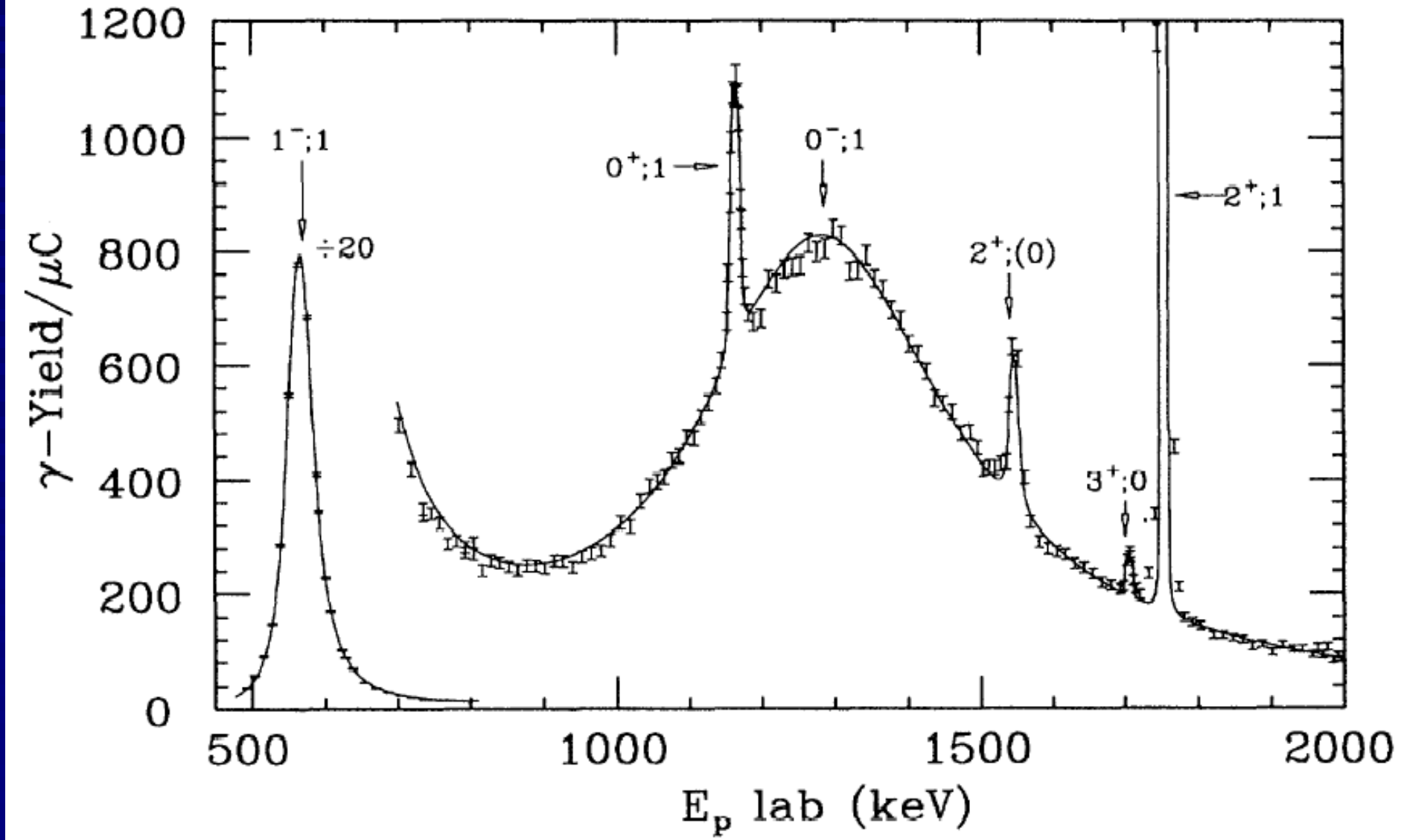

Six resonances

Zeps et al., 1995

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E_p^{lab} (keV)[a]	$\Gamma_{\mathrm{c.m.}}$ (keV)[a]	$J^\pi;T$	$^{14}\mathrm{N}^*$ (MeV)[a]
551 ± 1	30 ± 1	$1^-;1$	8.062
1156 ± 2 [1150 ± 2]	4.0 ± 0.3 [7 ± 1]	$0^+;1$	8.624 [8.618]
1347 ± 7 [1340 ± 50]	440 ± 8 [~ 460]	$0^-;1$	8.802 [8.79]
1523 ± 2	8 ± 2	$2^+;0$	8.980
1700.5 ± 1	< 1	$3^+;0$	9.1287
1747.6 ± 0.9	135 ± 8	$2^+;1$	9.1724

Ajzenberg-Selove

Cross-sections @ 9.17 MeV resonance:

Seagrave, 1952

Fowler, Lauritsen, Lauritsen, 1948

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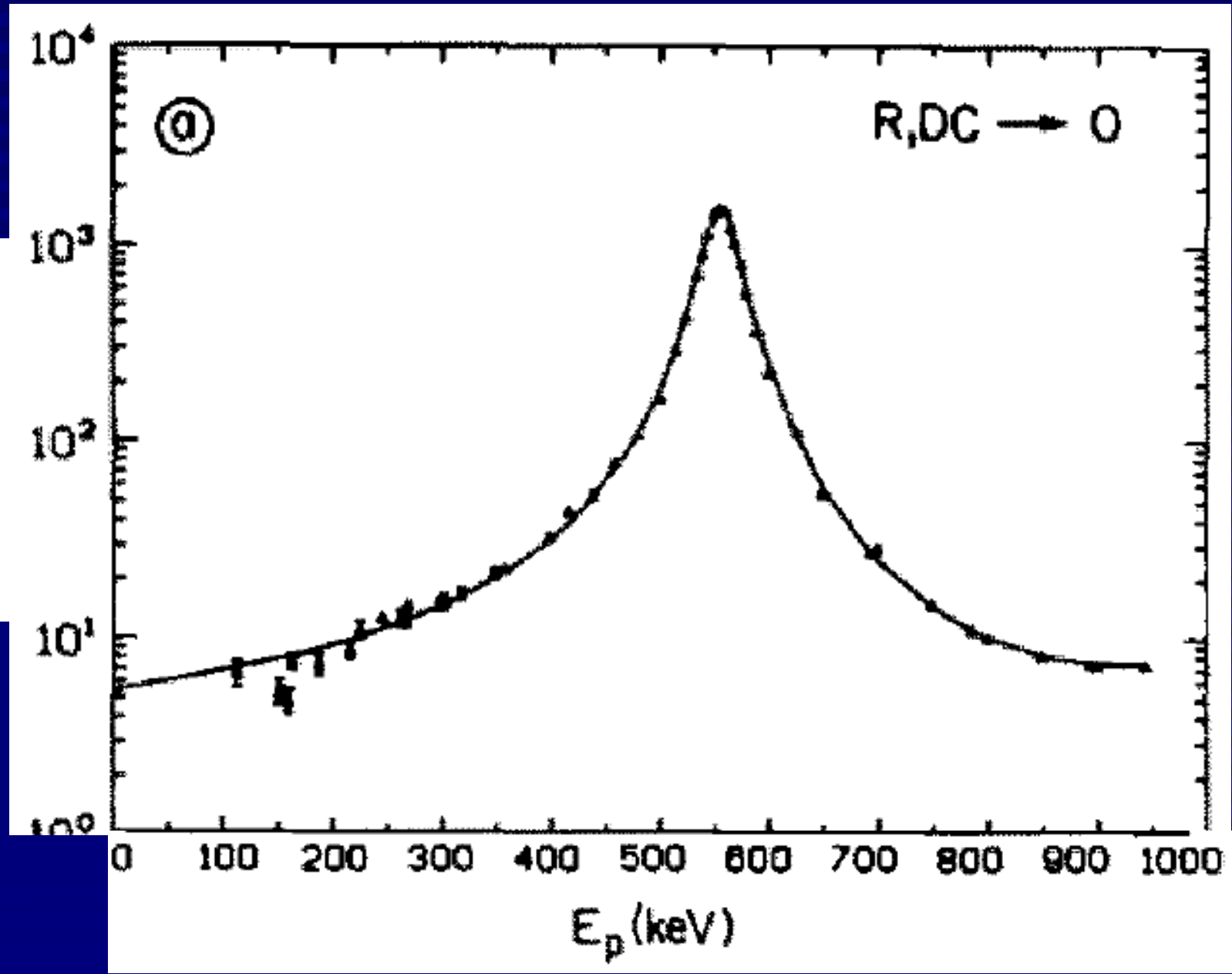

King et al., 1994

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Conclusions & Outlook

- Modern experimental data available for R-matrix fit to known resonances
- **Goal:** ENDF cross-section files with angular dist. for $p\ ^{13}C \rightarrow \gamma_0\ ^{14}N$, $E_p < 1.8$ MeV
- Two month project for Homeland Security

END

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