$^{13}C(p,\gamma)\ ^{14}N$ as source reaction for interrogation and $^{10}B(p,\alpha)\ ^{7}Be$ reaction

"Hypotheses are nets only he who casts will catch" Novalis

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USNDP, Nov. 10, 10:45-12:45

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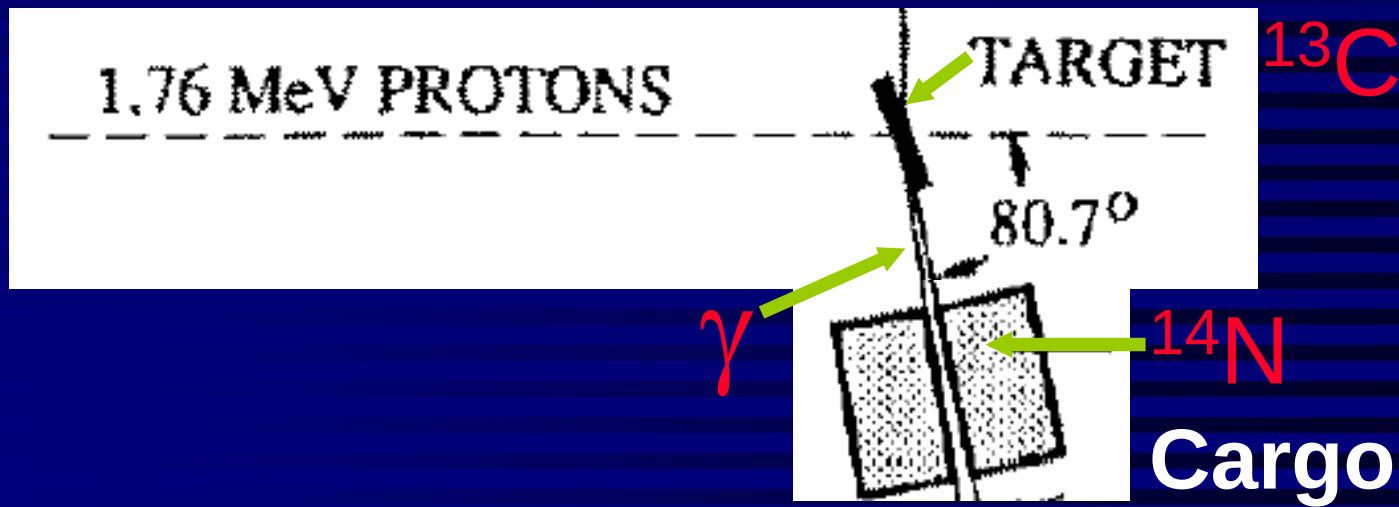
$p\ {}^{13}C \rightarrow \gamma_0\ {}^{14}N$

Storage ring



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

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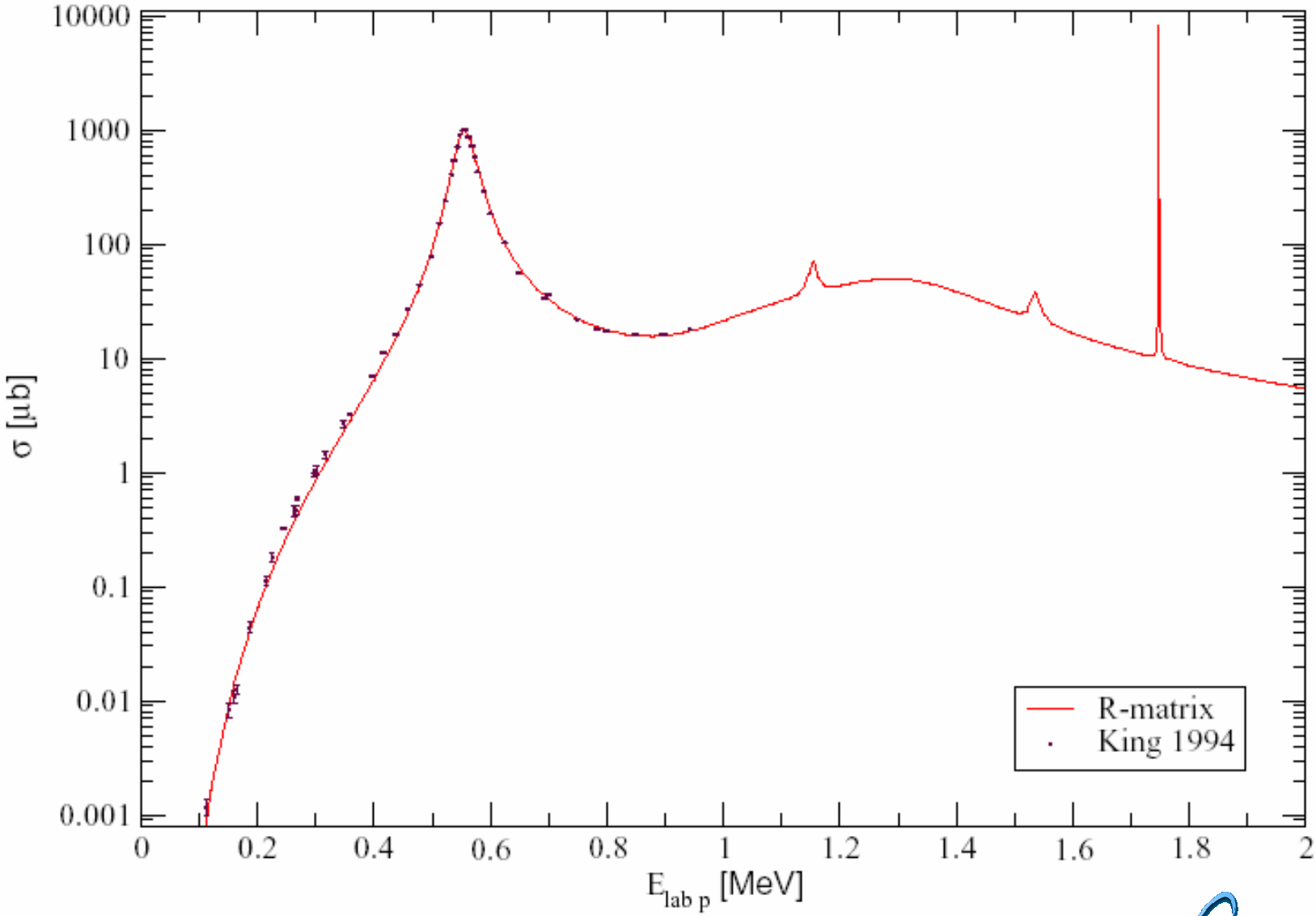
$^{13}C\ (p,\gamma_0)$ Cross Section



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Summary: $^{13}C(p,\gamma_0)\ ^{14}N$

- 3 data sets used for R-matrix fit to 4 known resonances (background) and generation of $E_p = 1.76$ MeV resonance
- ENDF cross-section files with angular dist. for $p\ ^{13}C \rightarrow \gamma_0\ ^{14}N$, $0.01 < E_p < 2$ MeV

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R-matrix fit for $^{10}B(p,\alpha_0)\ ^{7}Be$

- Most comprehensive
- Data included:
  ^{10}B (p,p) & ^{10}B (p,α)
- Cross-sections:
  - Total (plotted)
  - Differential (plotted)

- 1845 data points
- 10 references
- ~25 parameter fit
- χ^2 / d.o.f. = 2.2
- Up to E_p = 3 MeV

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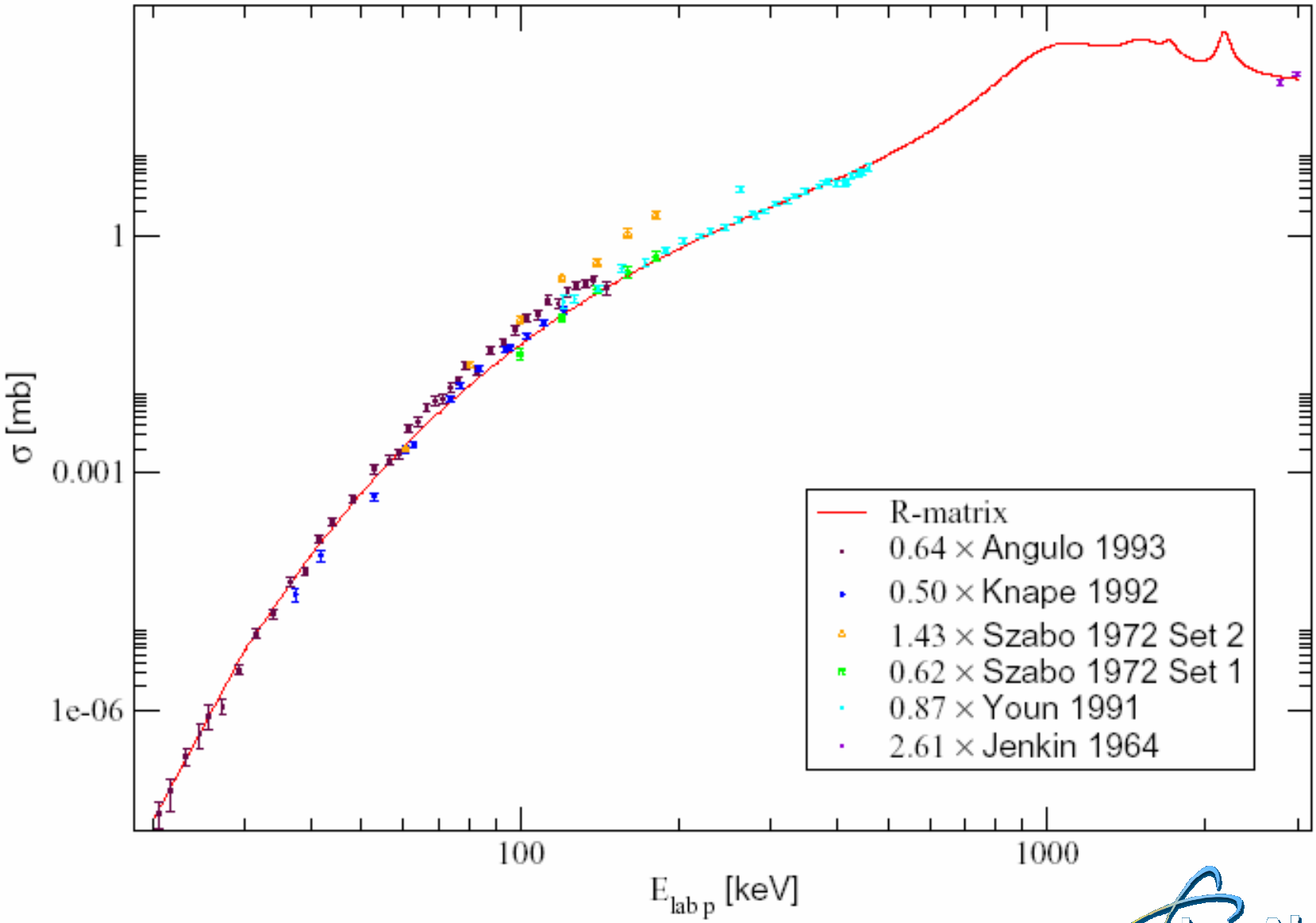
^{10}B (p,α_0) Cross Section



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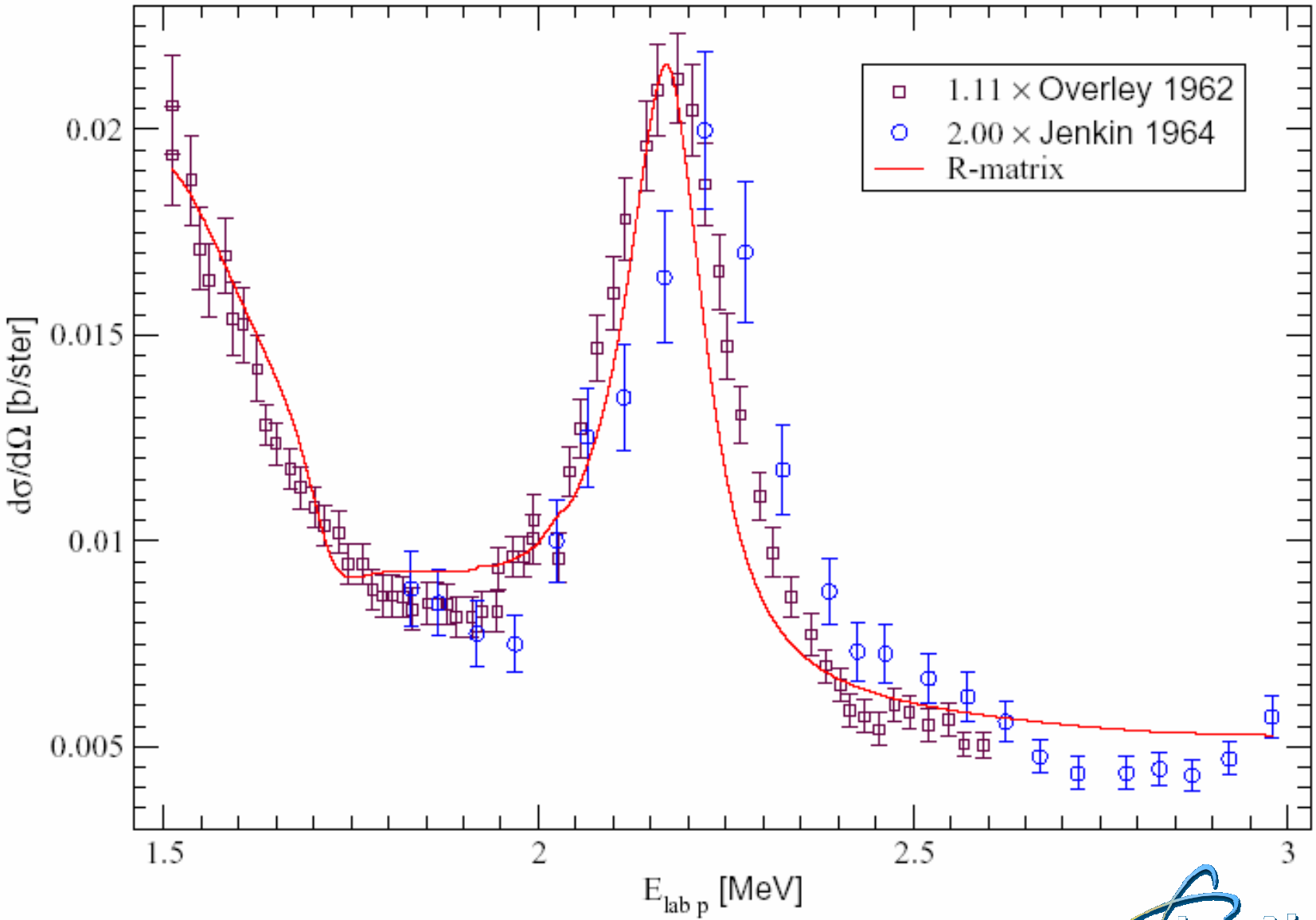
$^{10}B\ (p,\alpha_0)$ Differential Cross Section at 90^{o}_{lab}



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Benefits of R-matrix

- Predict isospin related reactions
- Fill in data (e.g. ^{10}B (p,α_0) by elastic)
- Low-energy region (e.g. resonance @ E_p = 10 keV; influence of elastic)
  $\Rightarrow$ S-factors in astrophysics may need multichannel R-matrix fit

Summary: $^{10}B(p,\alpha_0)\ ^{7}Be$

- F
  - Evaluated cross sections and angular dependence in ENDF format for 2 reactions $^{10}B\ p \rightarrow {}^{10}B\ p\ ,\ {}^{7}Be\ \alpha$
  - Temperature dependent reaction rates in NDI format for reaction $^{10}B\ (p,\alpha_0)\ ^{7}Be$
- b
  - $^{16}O(n,\alpha_0)\ ^{13}C$ needs to be re-evaluated: New data are 30% lower than old data

END

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