A=8 reactions, charged particle reactions (mainly)

Philip Page

Los Alamos National Laboratory

CSEWG, Nov. 3, 8:30-12:30

Los Alamos

Contents

- ^{8}Be nuclear data evaluation
- ^{8}Be resonances

Los Alamos

Applications

- ✓ **Thermonuclear weapons:** ^{7}Li (p,α), ^{7}Li (p,n), ^{7}Li (p,d), ^{7}Be (n,α), ^{7}Be (n,p), ^{7}Be (n,d), ^{6}Li (d,α), ^{6}Li (d,p), ^{6}Li (d,n)

No data ■ Limited data

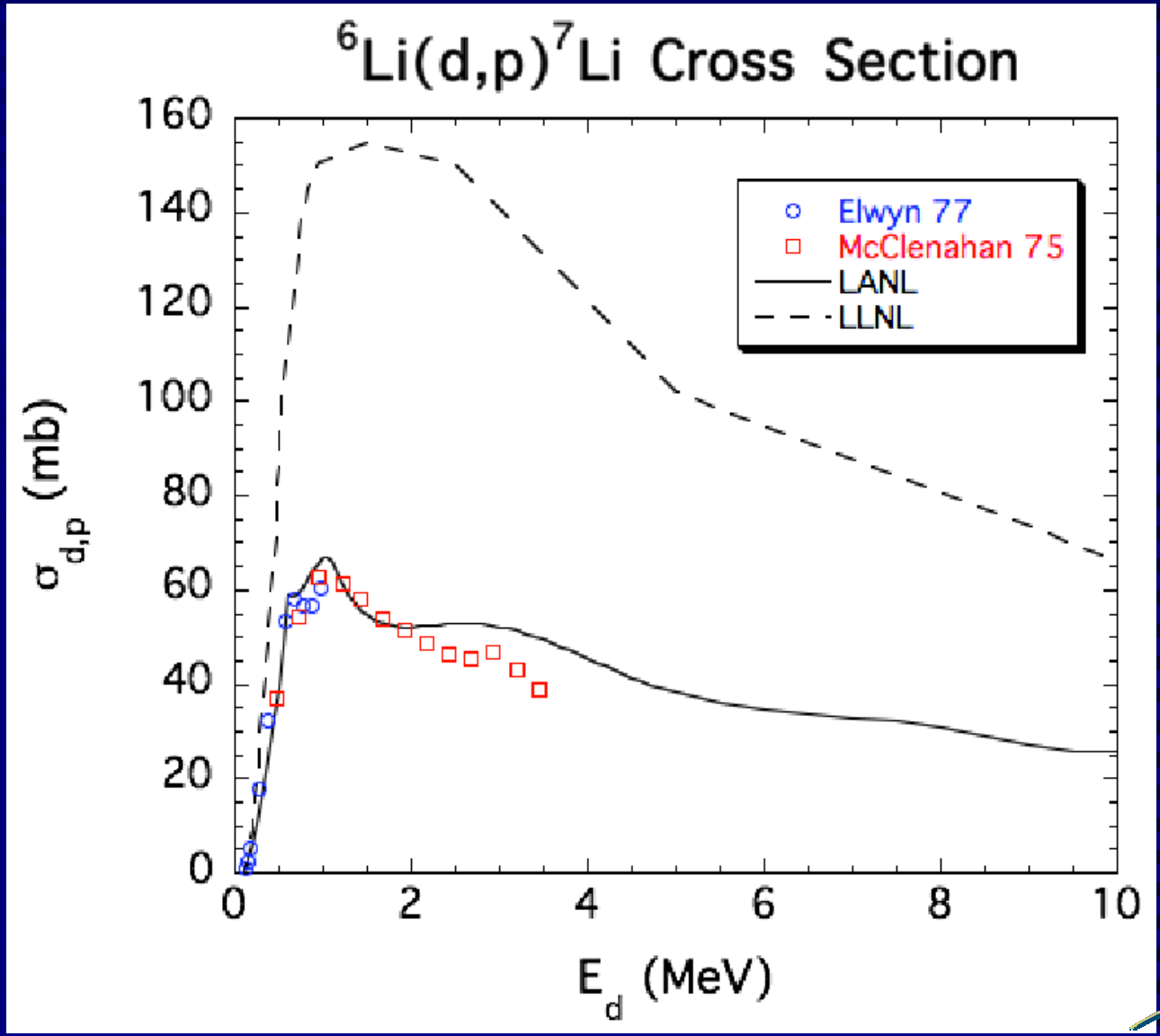
- ✓ **Nucleosynthesis**: Out of 12 most important reactions ^{7}Li (p,α), ^{7}Be (n,p)

Smith, Kawano, Malaney 1993

Los Alamos

Comparison: LANL - LLNL

Thanks to D. McNabb & J. McAnish



Los Alamos

R-matrix fit to experimental data

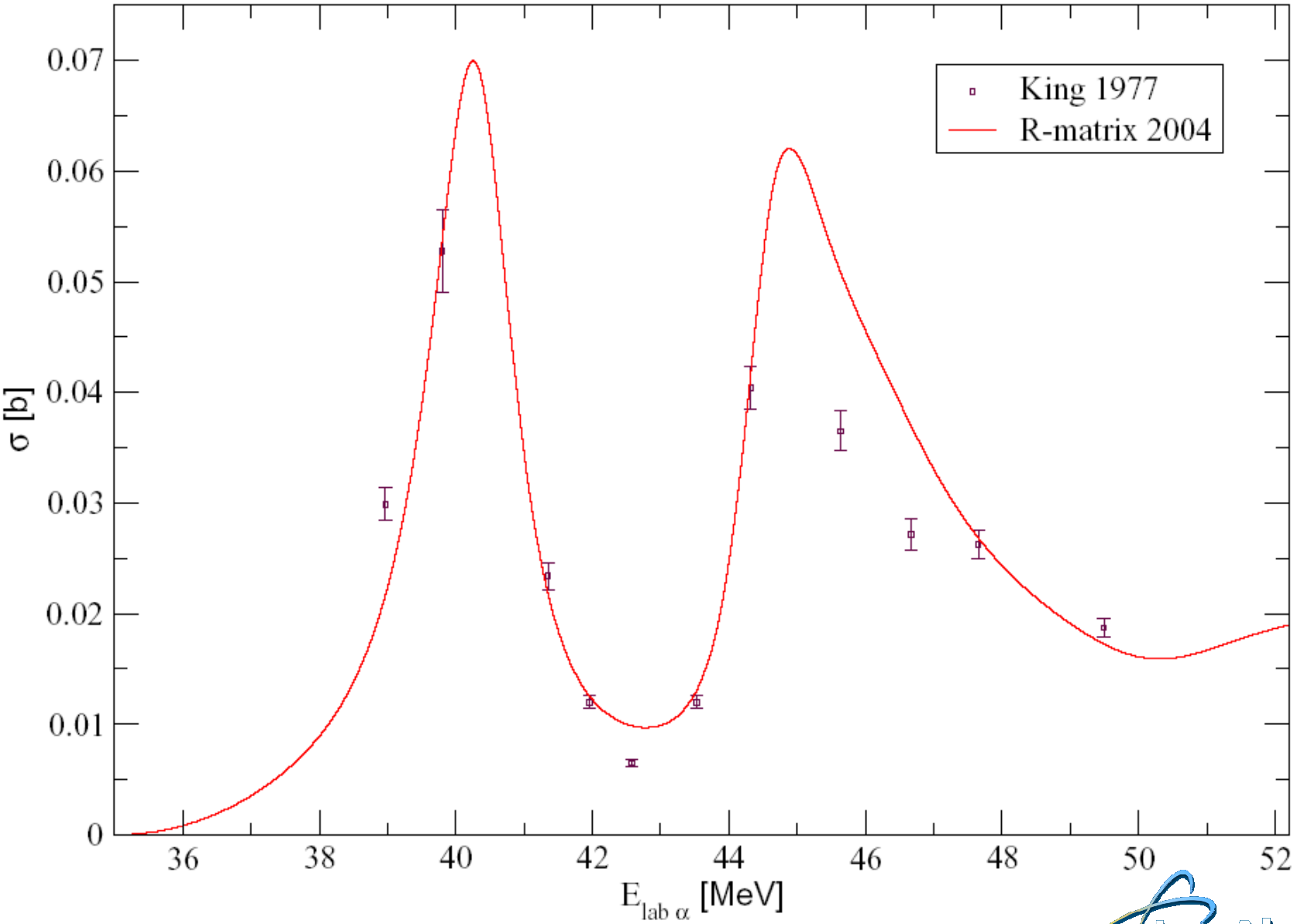
Thanks to G.M. Hale

- Most comprehensive
- ^{4}He α, ^{7}Li p, ^{7}Be n, ^{6}Li d $\rightarrow$ ^{4}He α, ^{7}Li p, ^{7}Be n, ^{6}Li d
- Cross-sections:
  - Total (plotted)
  - Differential
- Polarization Data

- 4700 data points
- 69 references
- 141 parameter fit
- χ^2 / d.o.f. = 7.9

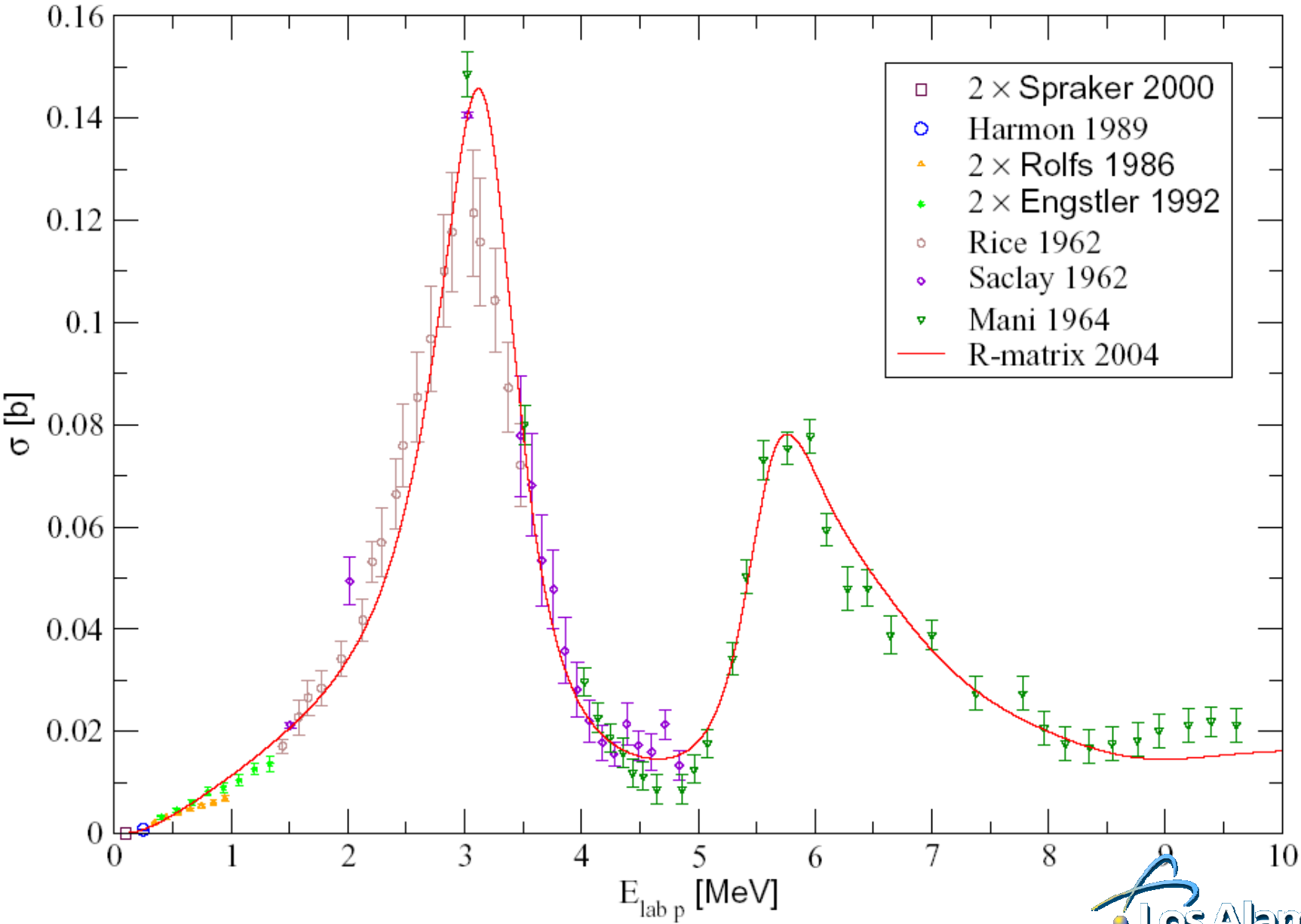
Los Alamos

^{4}He (α,p) Cross Section



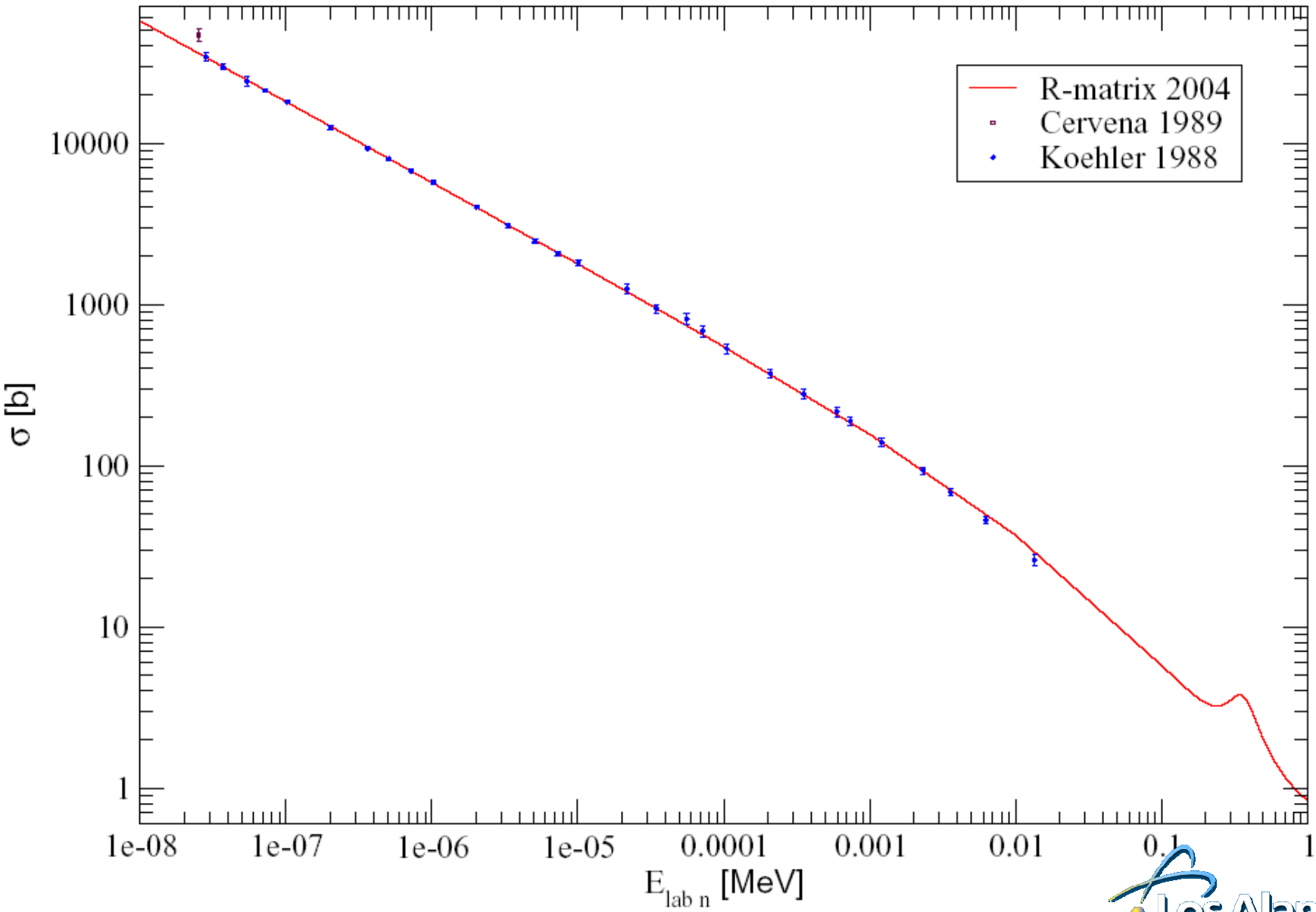
Los Alamos

^{7}Li (p,α) Cross Section



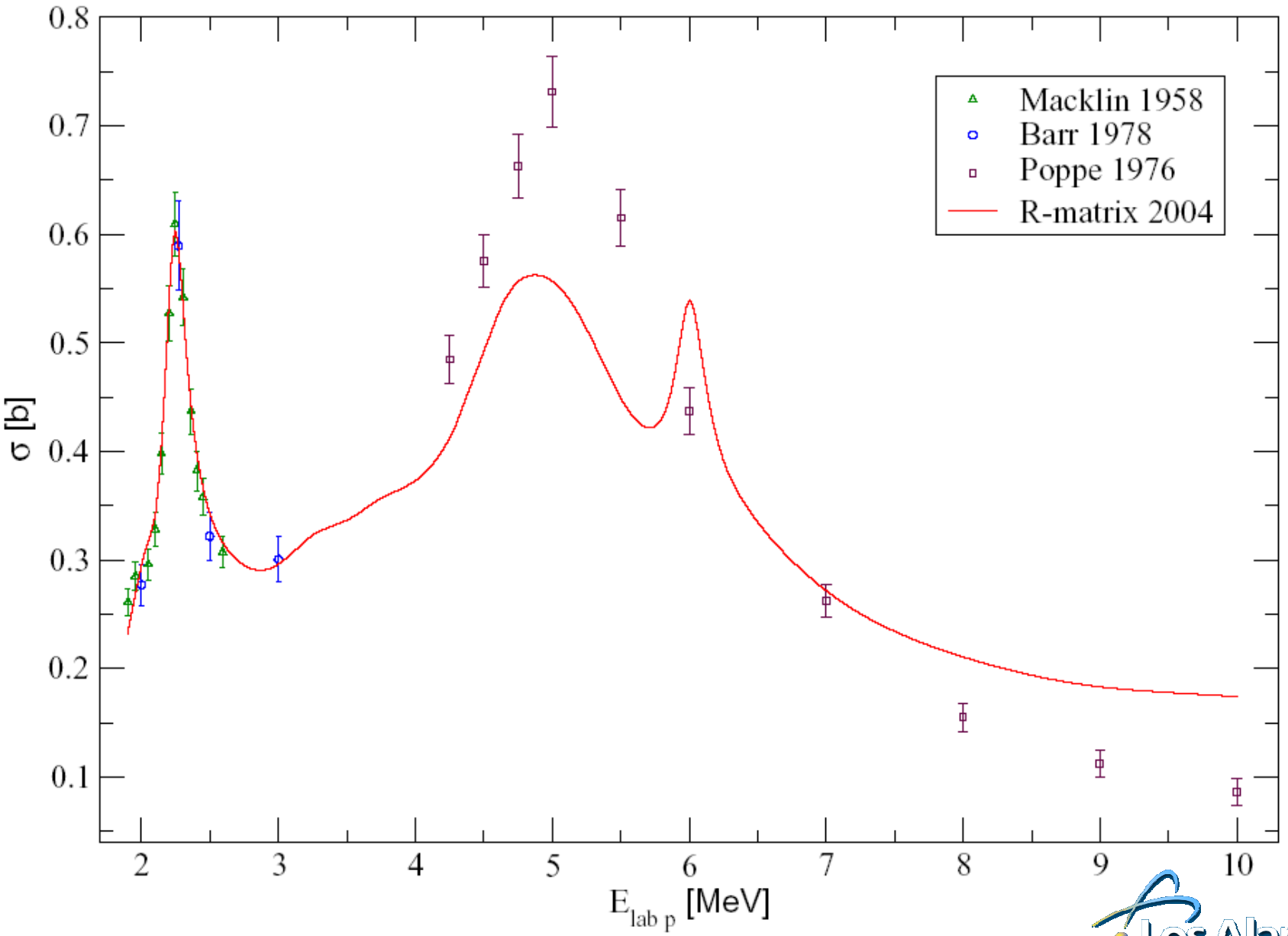
Los Alamos

^{7}Be (n,p) Cross Section



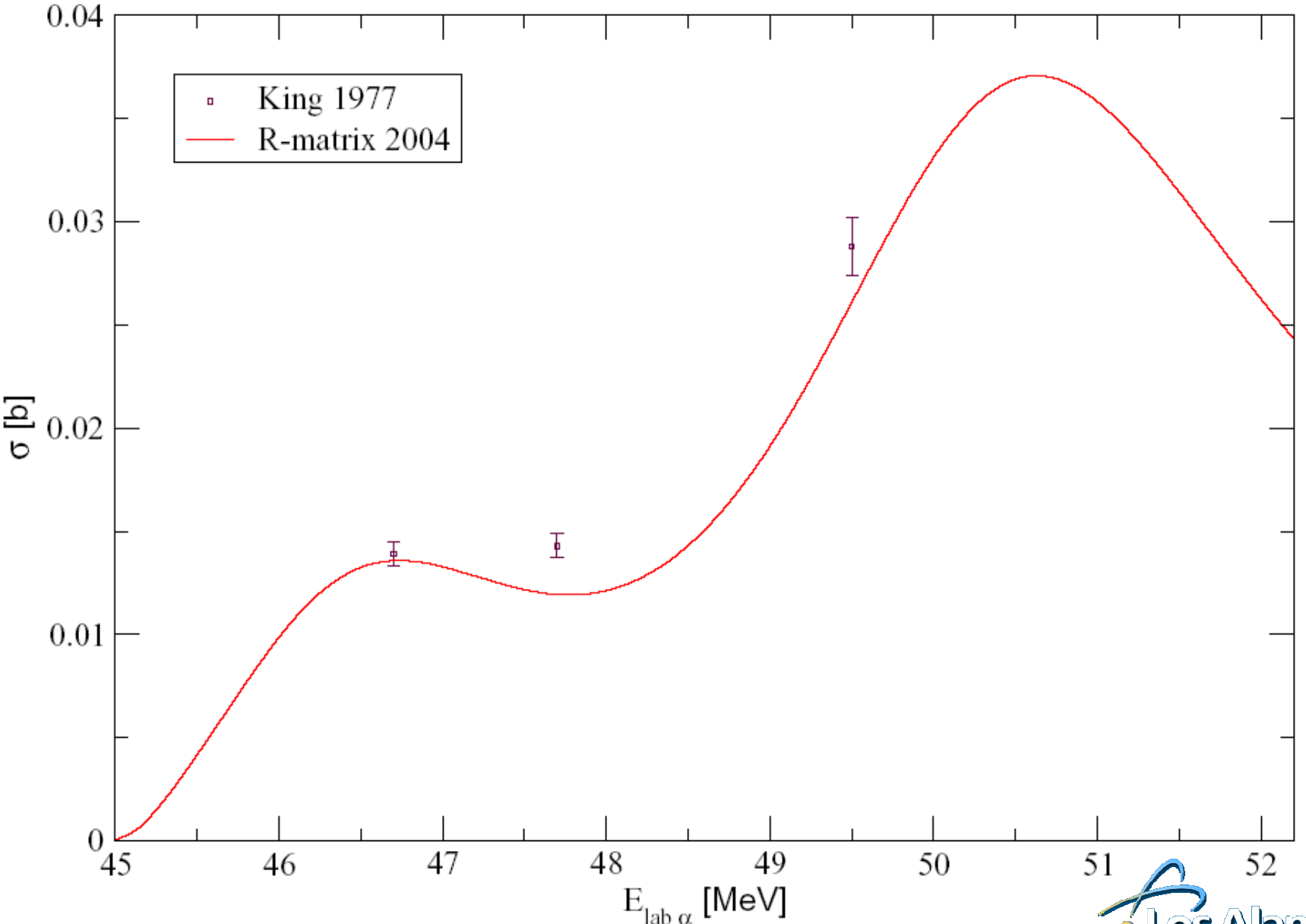
Los Alamos

^{7}Li (p,n) Cross Section

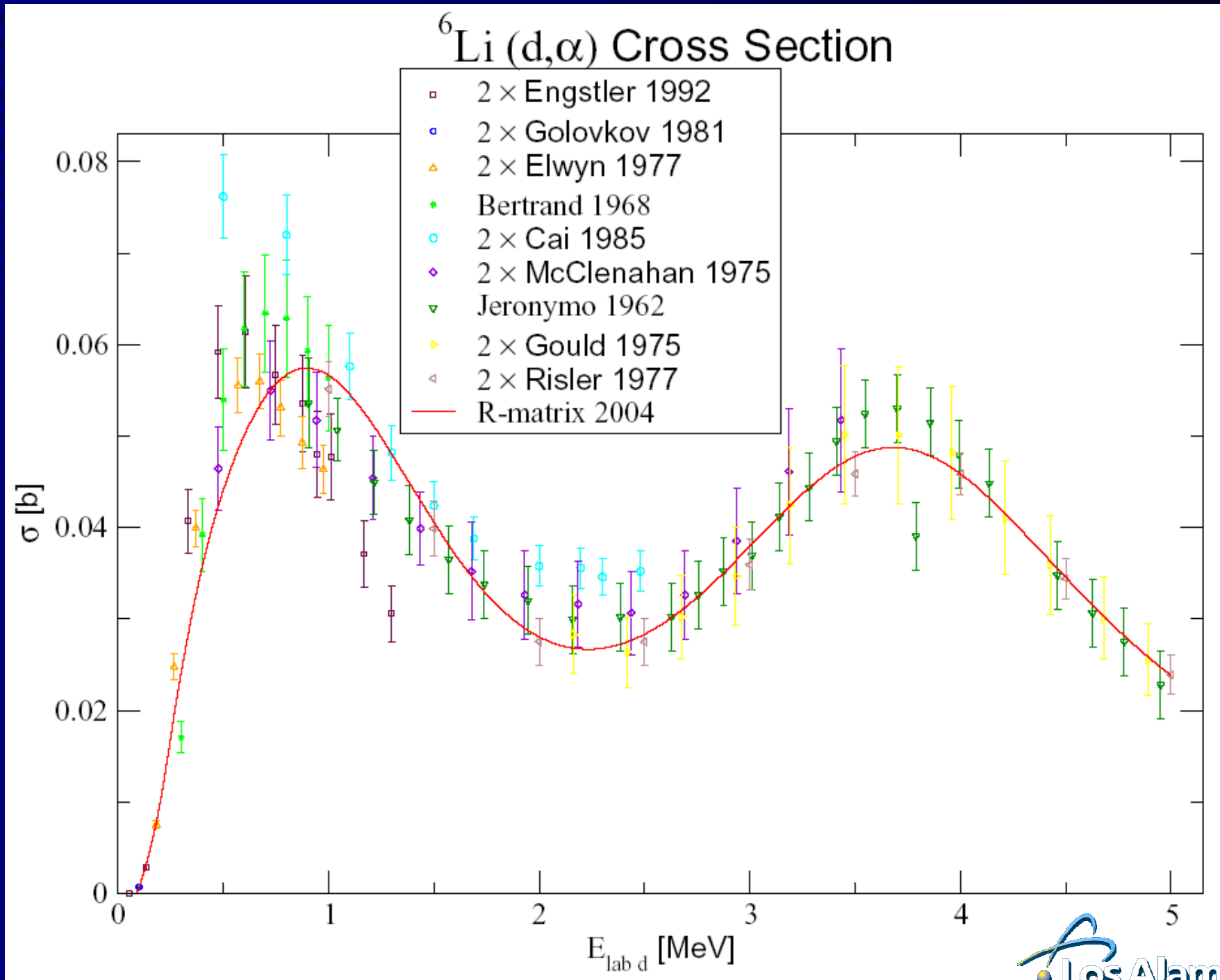


Los Alamos

^{4}He (α,d) Cross Section

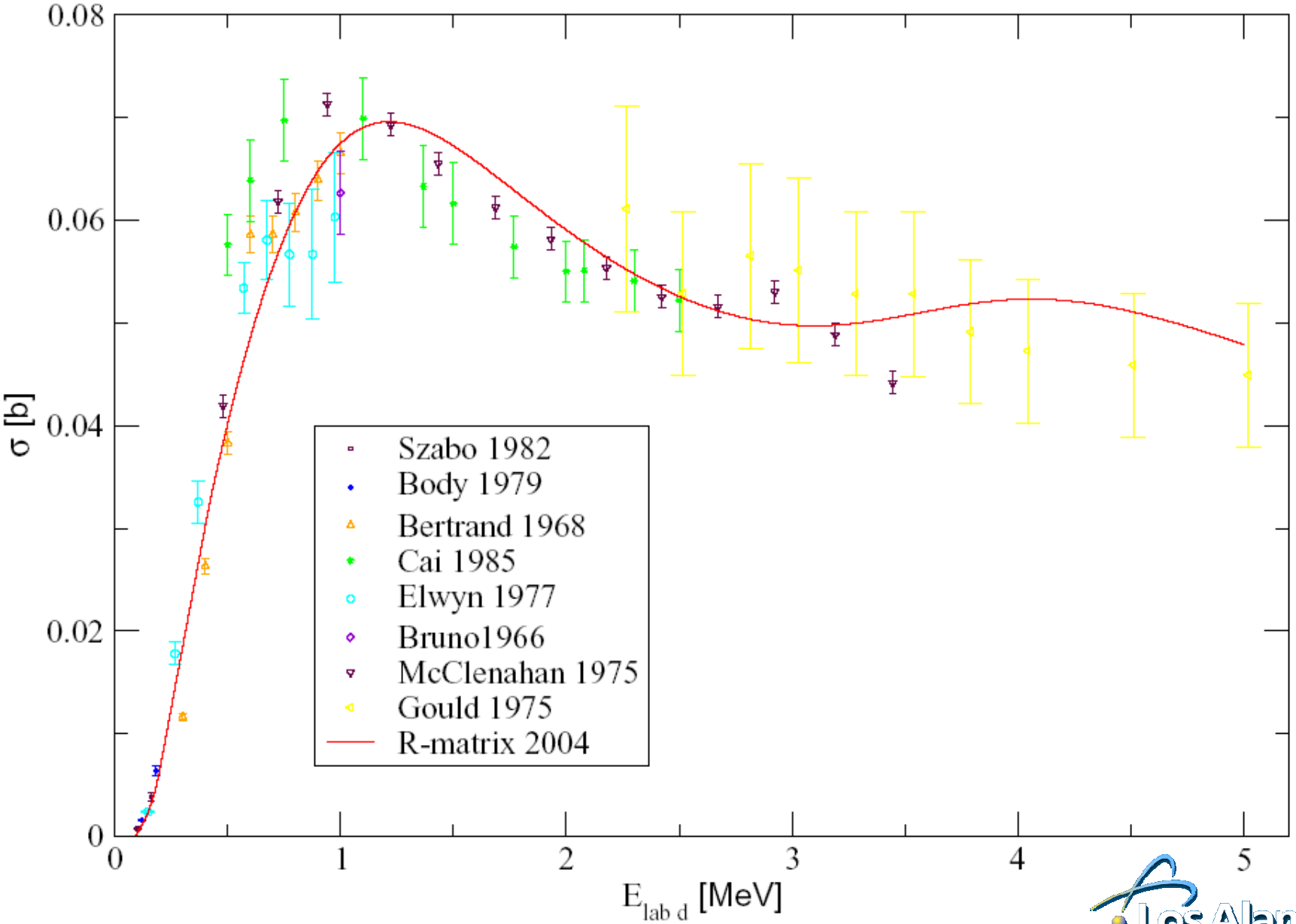


Los Alamos


^{6}Li (d,α) Cross Section
2 × Engstler 1992
2 × Golovkov 1981
2 × Elwyn 1977
Bertrand 1968
2 × Cai 1985
2 × McClenahan 1975
Jeronymo 1962
2 × Gould 1975
2 × Risler 1977
R-matrix 2004
σ [b]
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
E$_{lab\ d}$ [MeV]

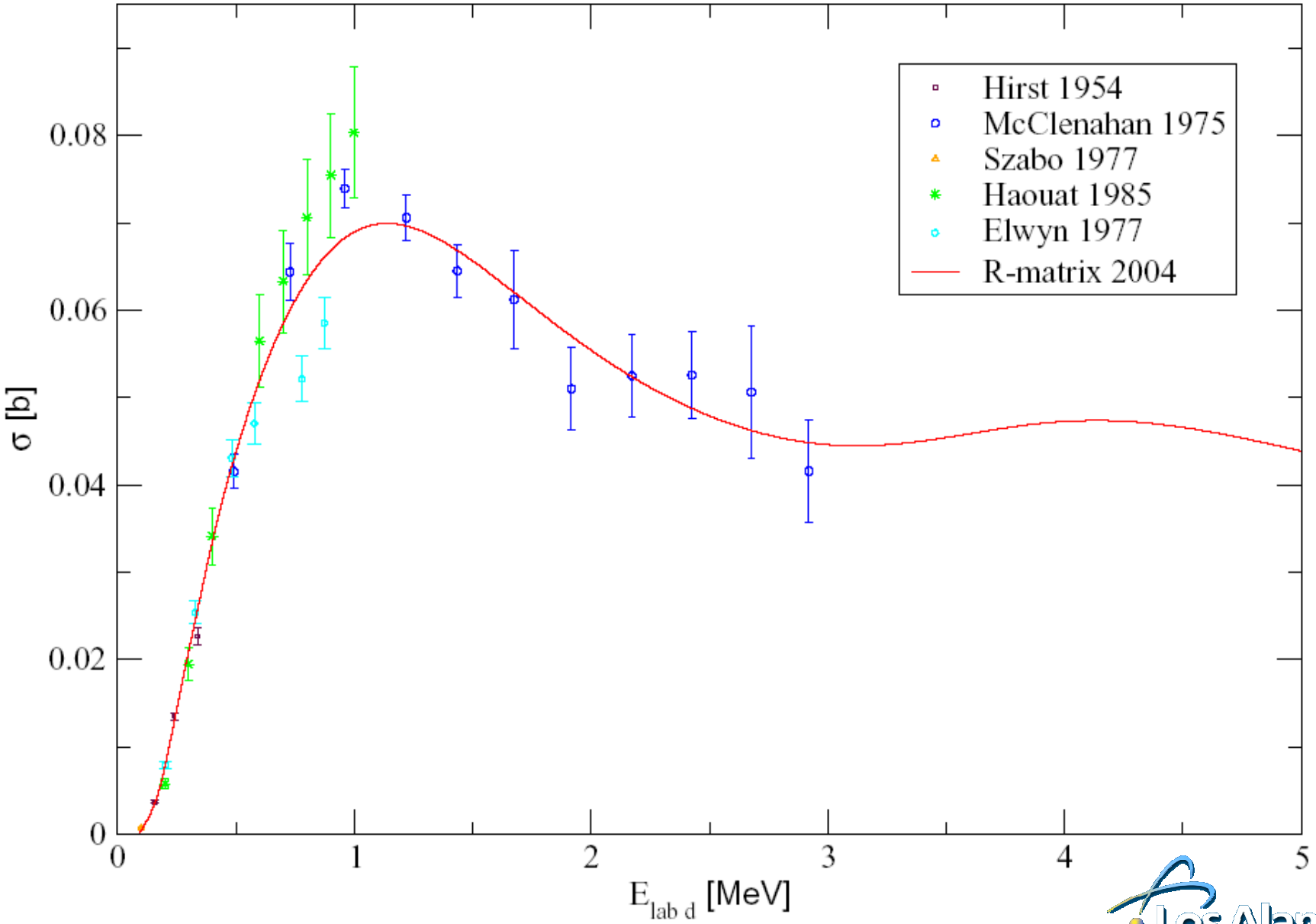
Los Alamos

^{6}Li (d,p) Cross Section

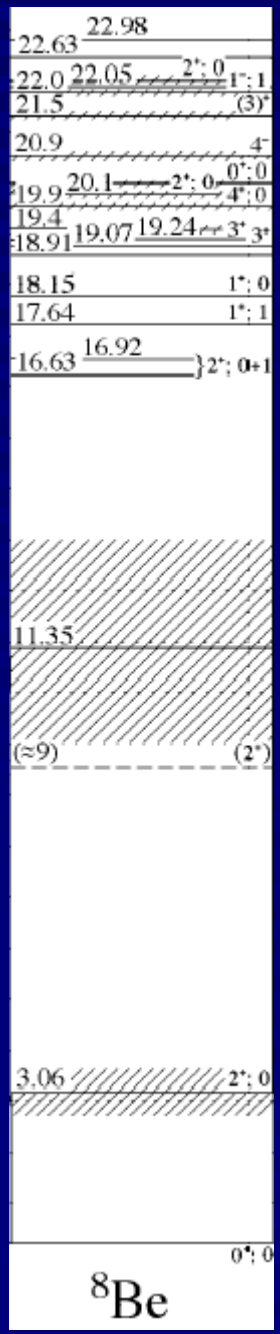


Los Alamos

^{6}Li (d,n) Cross Section



Los Alamos



4⁺0

2⁺0

2⁺0

0⁺0

⁶Li d

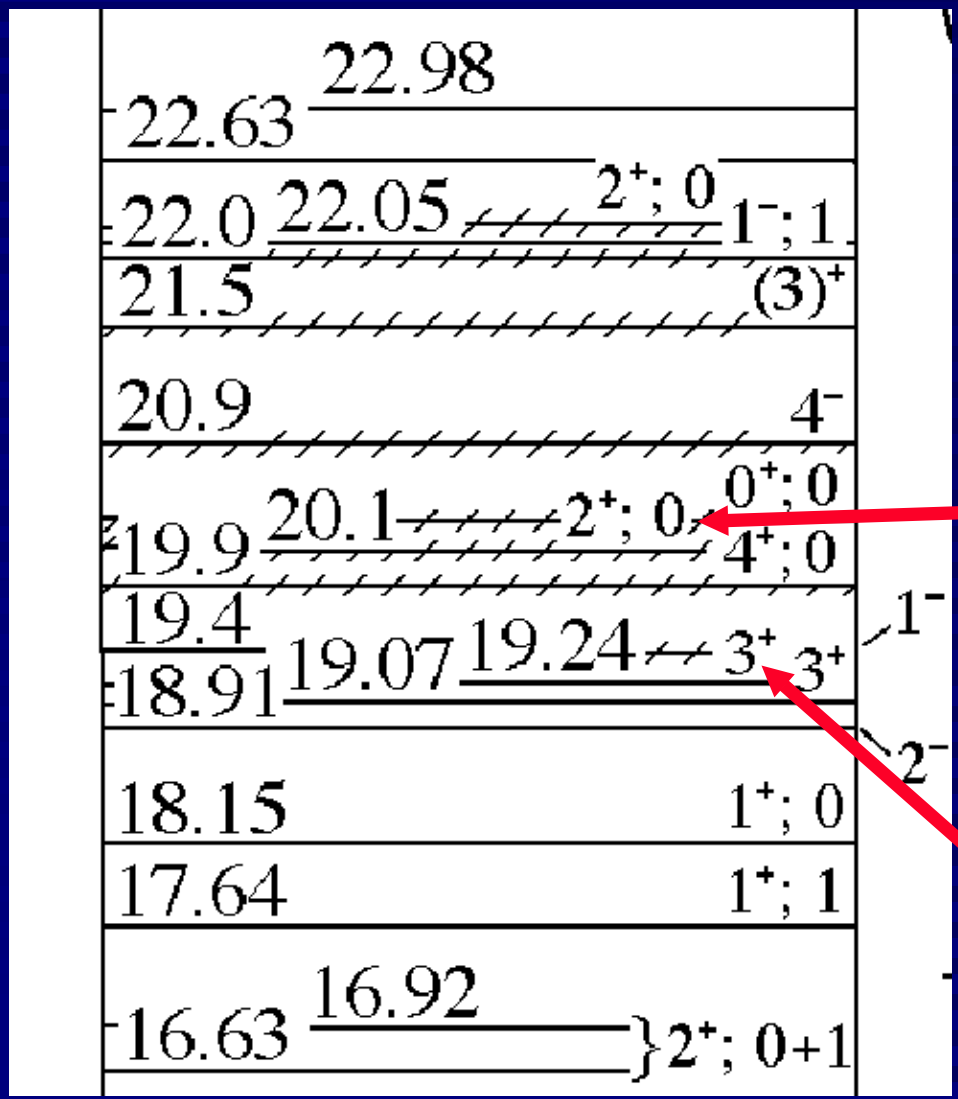
⁷Be n

⁷Li p

αα

- ⁸Be resonances

Los Alamos



$J^\pi T$	Energy (MeV)	
	2003	Experiment
0^+0	0.07	0
	19.32	20.2
2^+0	2.80	3.06 ± 0.03
	15.37	≈ 9
	17.51	16.922 ± 0.003
	20.02	20.1
	22.11	22.2
4^+0	11.56	11.35 ± 0.15
	17.52	19.86 ± 50
2^-0	18.60	18.91
3^+0	19.23	19.24
3^+1	19.04	19.07
1^+0	18.15	18.150 ± 0.004
1^+1	17.75	17.640 ± 0.001
1^-1	20.74	19.40

Conclusions

- Fitted > 4700 experimental data on ^{4}He (α,α), ^{4}He (α,p), ^{4}He (α,d), ^{7}Li (p,α), ^{7}Li (p,p), ^{7}Li (p,n), ^{7}Be (n,p), ^{6}Li (d,α), ^{6}Li (d,p), ^{6}Li (d,n), ^{6}Li (d,d) with 19 resonances [141 parameters] up to E_X = 25-26 MeV
- ENDF cross-section files with angular distributions for 12 reactions ^{7}Li p, ^{7}Be n, ^{6}Li d $\rightarrow$ ^{4}He α, ^{7}Li p, ^{7}Be n, ^{6}Li d

END

Los Alamos