Kalbach-Mann and interpolation

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LLNL-PRES-??????

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Credit

- Caleb Mattoon
  - Suppose to give this talk
- Gerry Hedstrom
  - Most of the ideas are his
  - He is the one pushing this subject
    - This is good

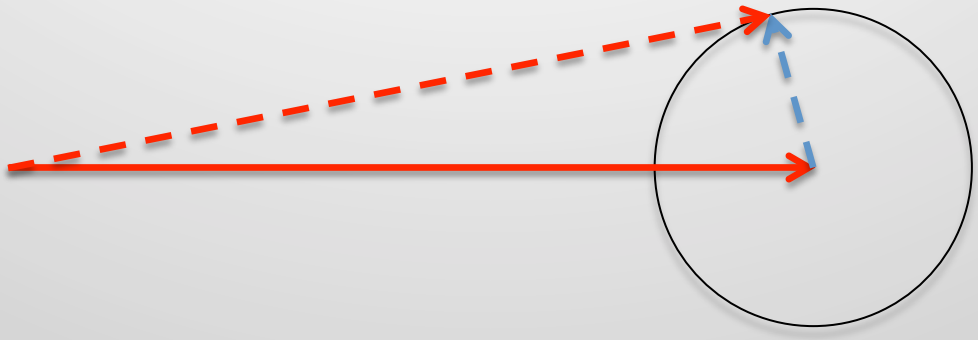
Outline

- Outgoing particle interpolation overview

- Kalbach/Mann

Outgoing particle interpolation

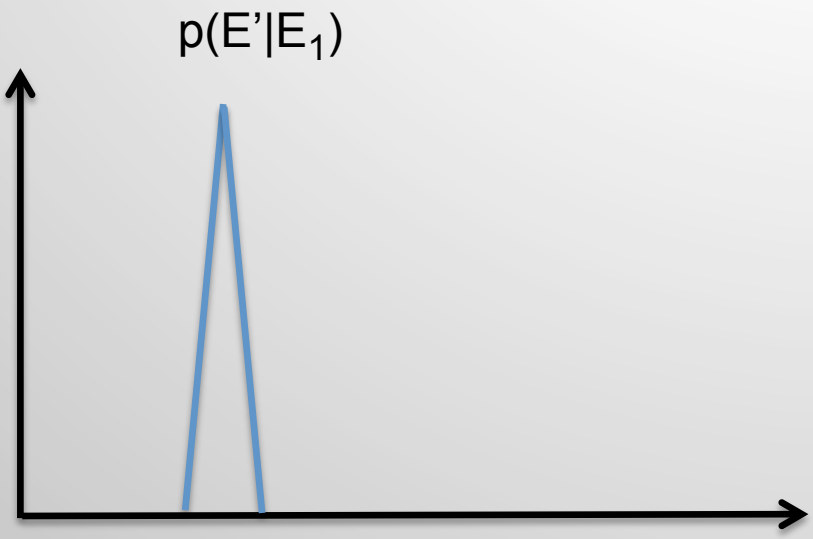
- E = projectile energy, E' is product energy, μ is product angle (can be lab or COM)

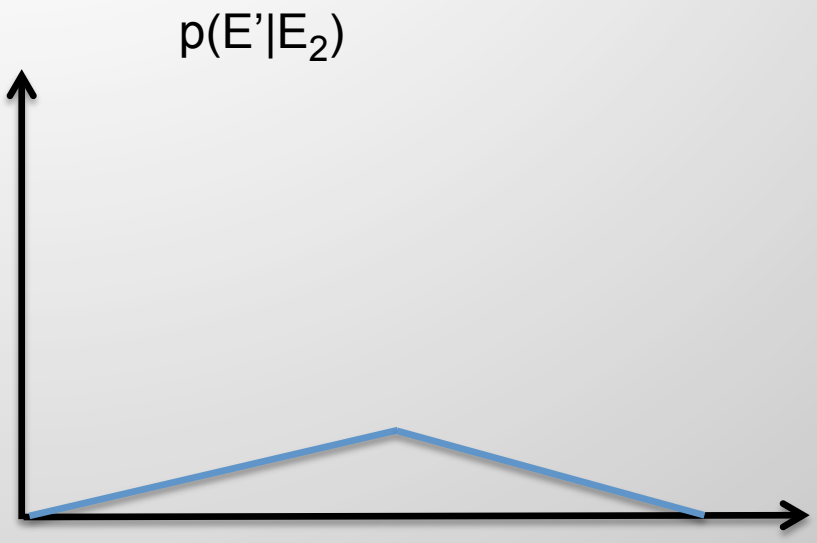


E' and μ range depends on E. To make physical distributions, interpolation of P(μ,E'|E) must handle range depends.

- If μ ranges from -1 to 1, there is no issue with it
- Will only consider E' in the rest of the talk

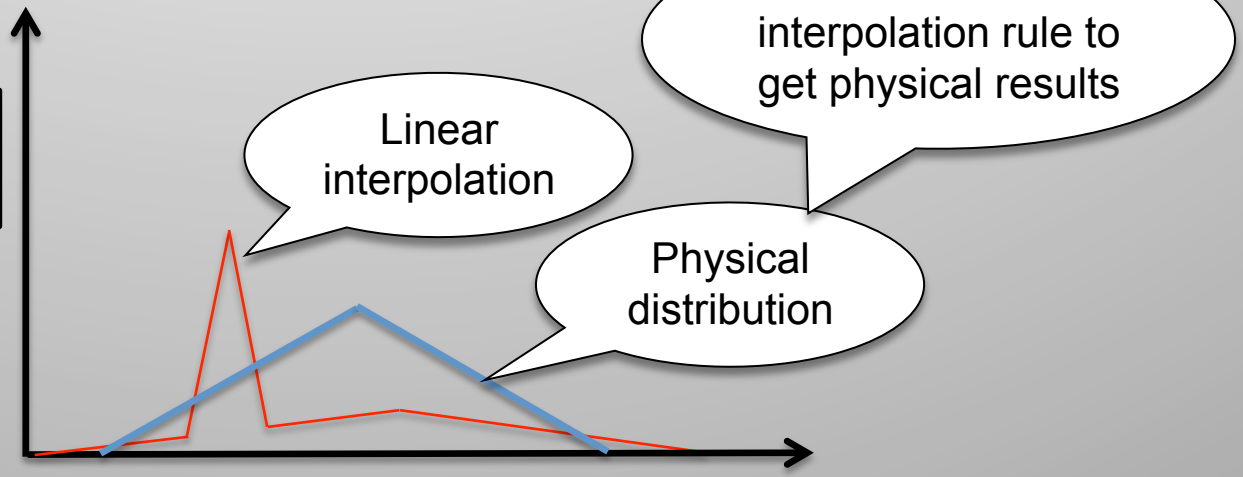
Interpolating along E





$E_1 < E < E_2$

In example: E is midway between E_1 and E_2



Interpolations for P(E'|E)

- Traditional interpolations
  - lin,lin
  - lin,log
  - log,lin
  - log,log
  - flat
  - etc.
- interpolation qualifiers – additional rules
  - None – should never be used for P(E'|E)
  - Unit base – scale E' and P by inverse to preserve norm
  - Corresponding energies – Gerry would like to change this

ENDF/B-VII.1 P(E'|E) interpolation survey

distribution		qualifier	count
uncorrelated energy	P(E'|E) x f(μ|E)	none	853
		unitBase	83
		correspondingPoints	39
energyAngular	P(μ,E'|E)	unitBase	953
		correspondingPoints	35
KalbachMann		none	298
Skipped			84

Kalbach/Mann doc and example

[MAT, 6, MT/ 0.0, 0.0, LANG, LEP, NR, NE/ E_{int}]TAB2
[MAT, 6, MT/ 0.0, E_1, ND, NA, NW, NEP/
E'_1, $b_0(E_1, E'_1)$, $b_1(E_1, E'_1)$, -------- $b_{NA}(E_1, E'_1)$,
E'_2, $b_0(E_1, E'_2)$, $b_1(E_1, E'_2)$, -------- $b_{NA}(E_1, E'_2)$,
---
E'_{NEP}, $b_0(E_1, E'_{NEP})$, $b_1(E_1, E'_{NEP})$, ---- $b_{NA}(E_1, E'_{NEP})$]LIST
<repeat the LIST structure for all the NE incident energies>

Lang = 2, Kalbach/Mann

Law = 1

```
5.011000+3 1.091470+1          0          2          2          0 528 6 91
1.000000+0 1.000000+0          0          1          1          2 528 6 91
         2          2          0          0          0          0 528 6 91
1.002700+7 1.000000+0 2.000000+7 1.000000+0                       528 6 91
0.000000+0 0.000000+0          2          1          1         15 528 6 91
        15          2          0          0          0          0 528 6 91
```

'lin,lin' interpolation in E

Data for each E is list of (E', f, r) or (E', f, r, a). No way to specify different E interpolation for f and r.

Interpolation of f(E'|E) vs r(E',E)

- f(E'|E) is a distribution so remapping of E' must be compensated by an inverse scale to f.

$$\frac{E'' - E''_{\min}}{E''_{\max} - E''_{\min}} = \frac{E' - E'_{\min}}{E'_{\max} - E'_{\min}}$$

$$f(E'') = \frac{E'_{\max} - E'_{\min}}{E''_{\max} - E''_{\min}} f(E')$$

- r(E',E) is not a distribution so only map domain

$$\frac{E'' - E''_{\min}}{E''_{\max} - E''_{\min}} = \frac{E' - E'_{\min}}{E'_{\max} - E'_{\min}}$$

$$r(E'') = r(E')$$

Kalbach/Mann interpolation

qualifier	f(E',E)	r(E)
None	Not allowed	Not allowed
Unit base	unit base Scale E' domain and f	common domain Only scale E'
Corresponding energies	Corresponding energies Break E' into corresponding energy sub-domains. Perform unit base within each sub-domain	Corresponding domain Only scale E' within each sub-domain.

How do we communicate these to ENDF community?

Current GND stores f and r in separate containers.