FMS on the lattice

The structure of asymptotic states in weak physics (Part II)

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In collaboration with Patrick Jenny, Axel Maas and Georg Wieland

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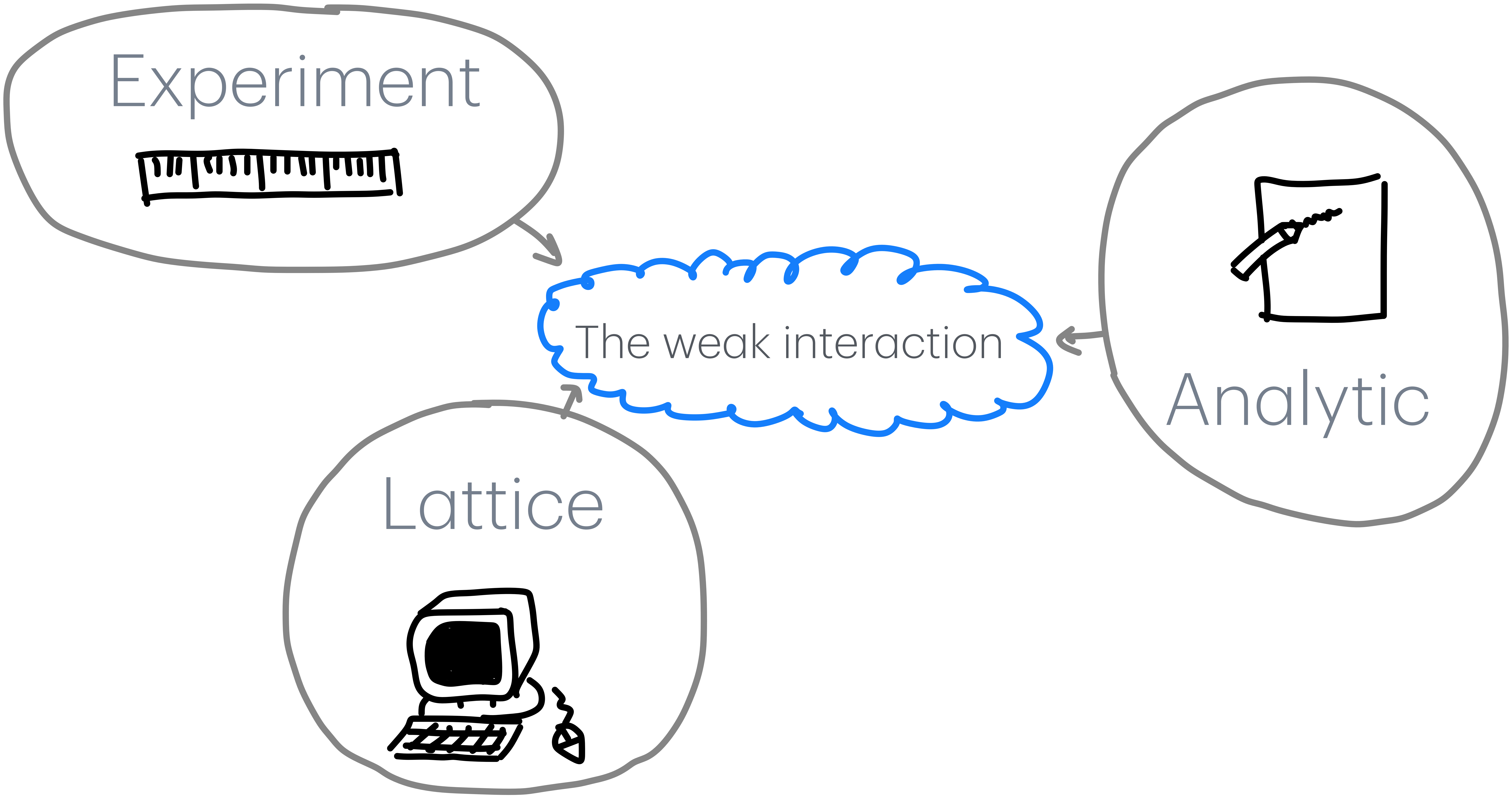
Royal Swedish Academy of Sciences

Matching perspectives



Matching perspectives

You just heard

- PDFs
- Particle masses

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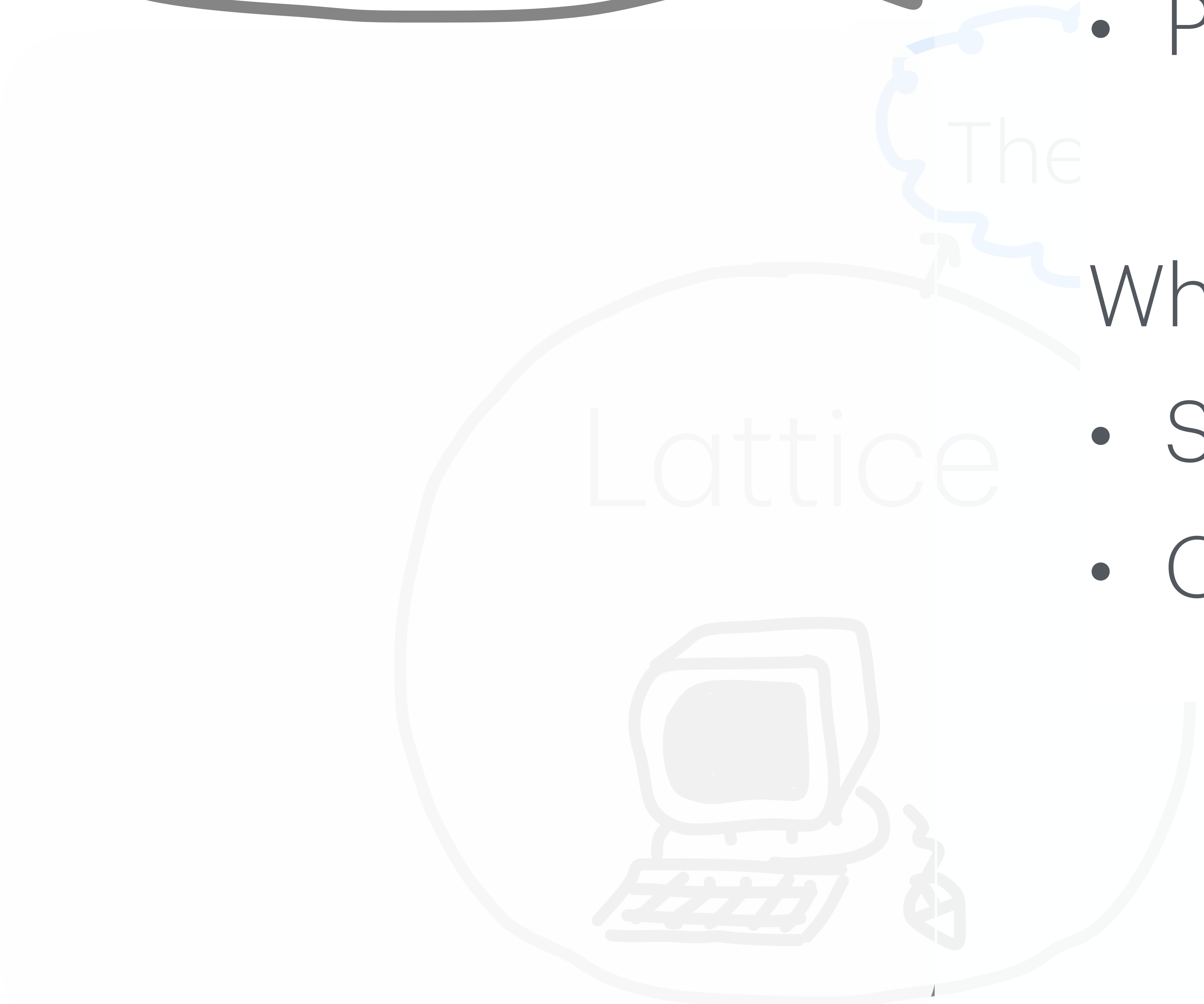

You just heard

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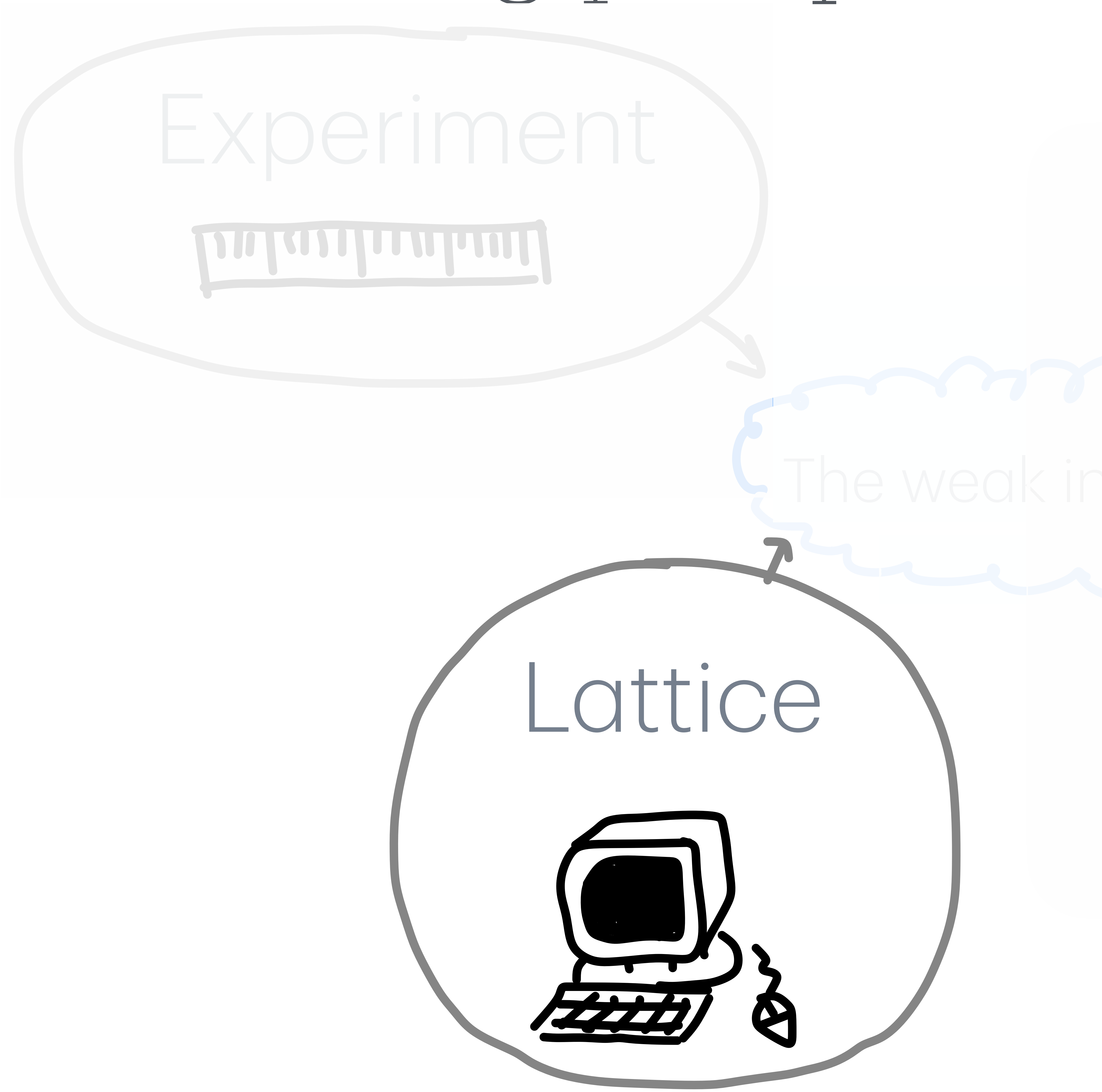
What else

- Spectral densities
- Cross-sections

Matching perspectives



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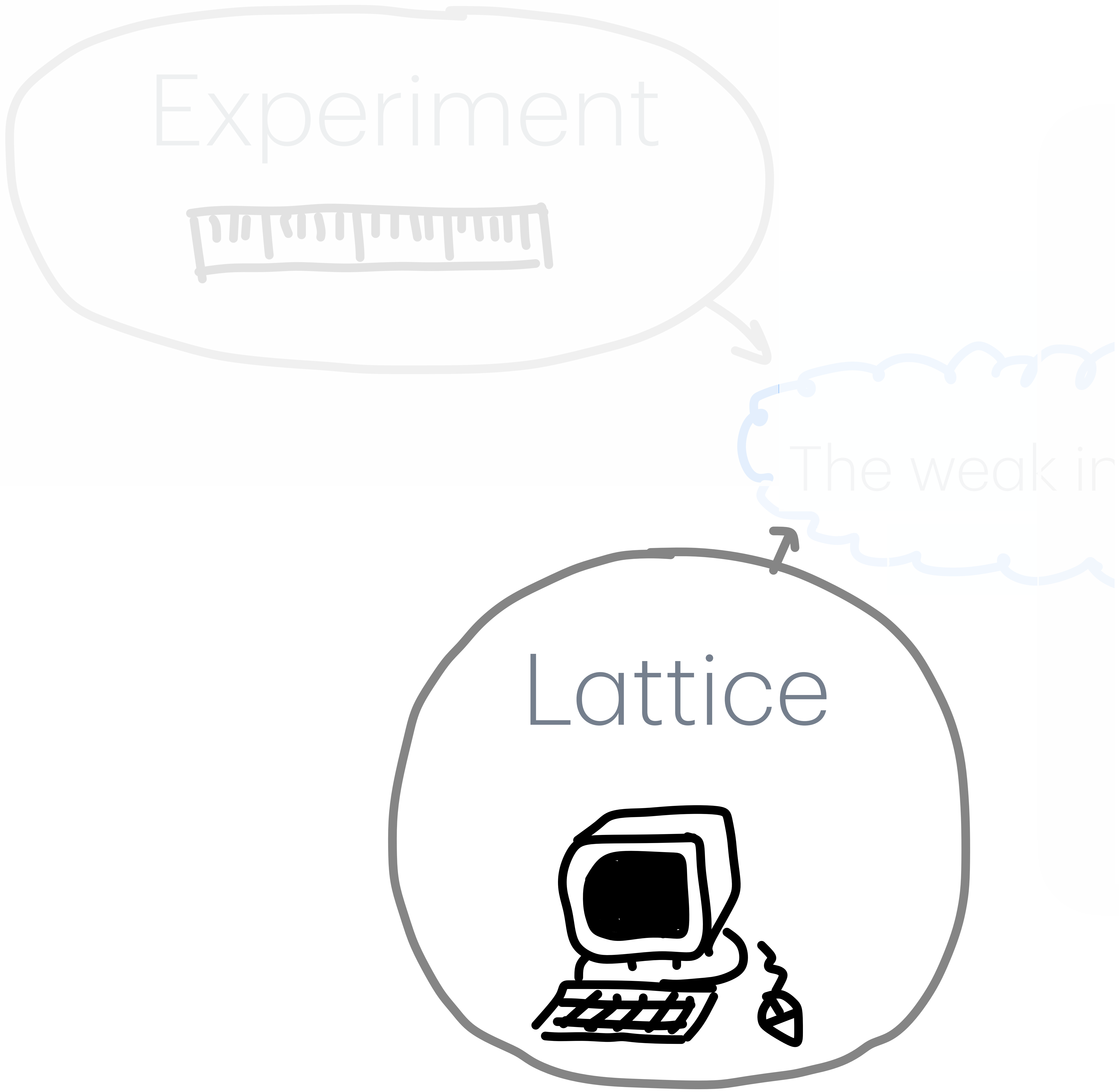

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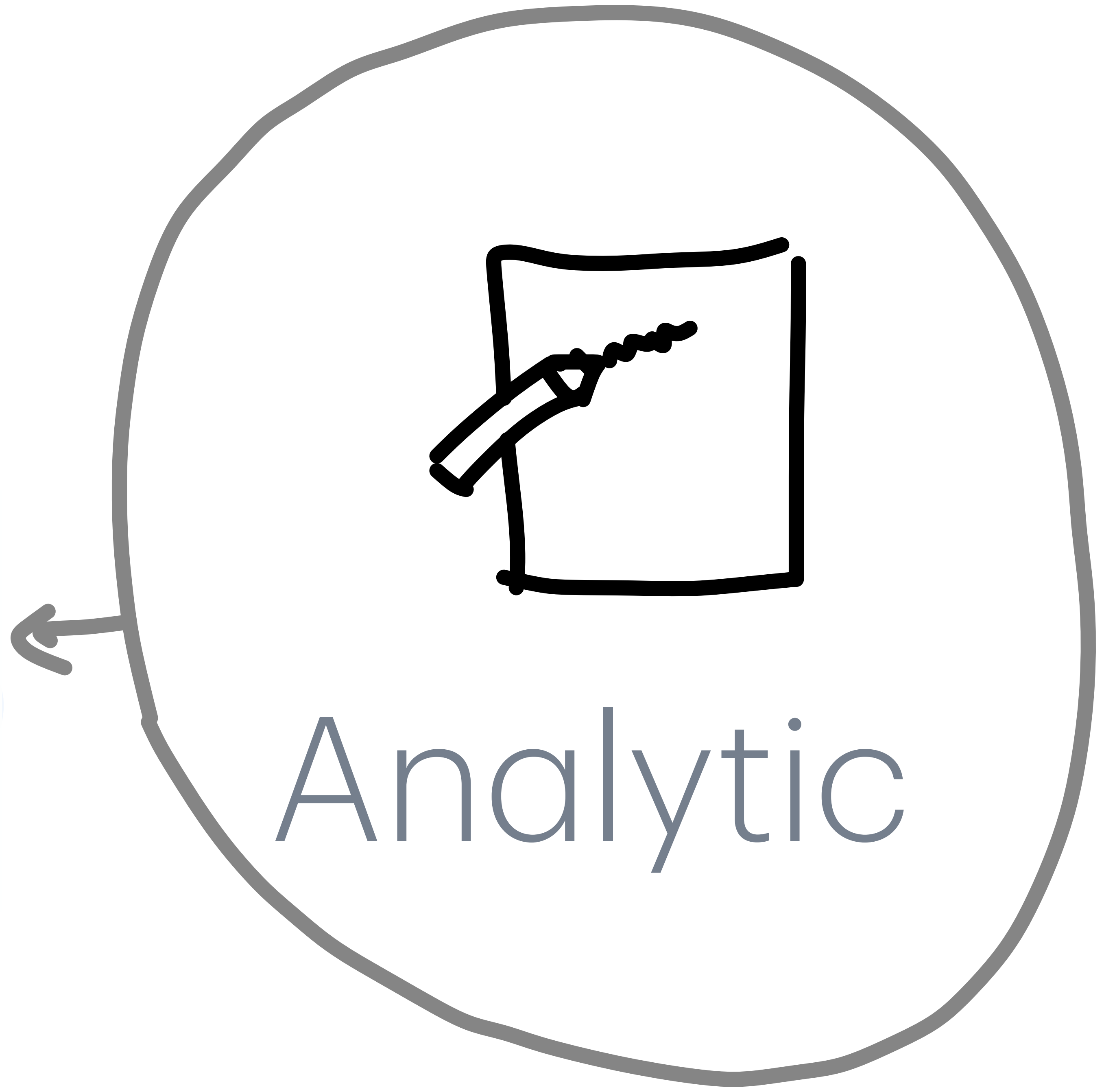
Last talk: Are these composites actually the **asymptotic states?**

Matching perspectives

What changes **analytically**?

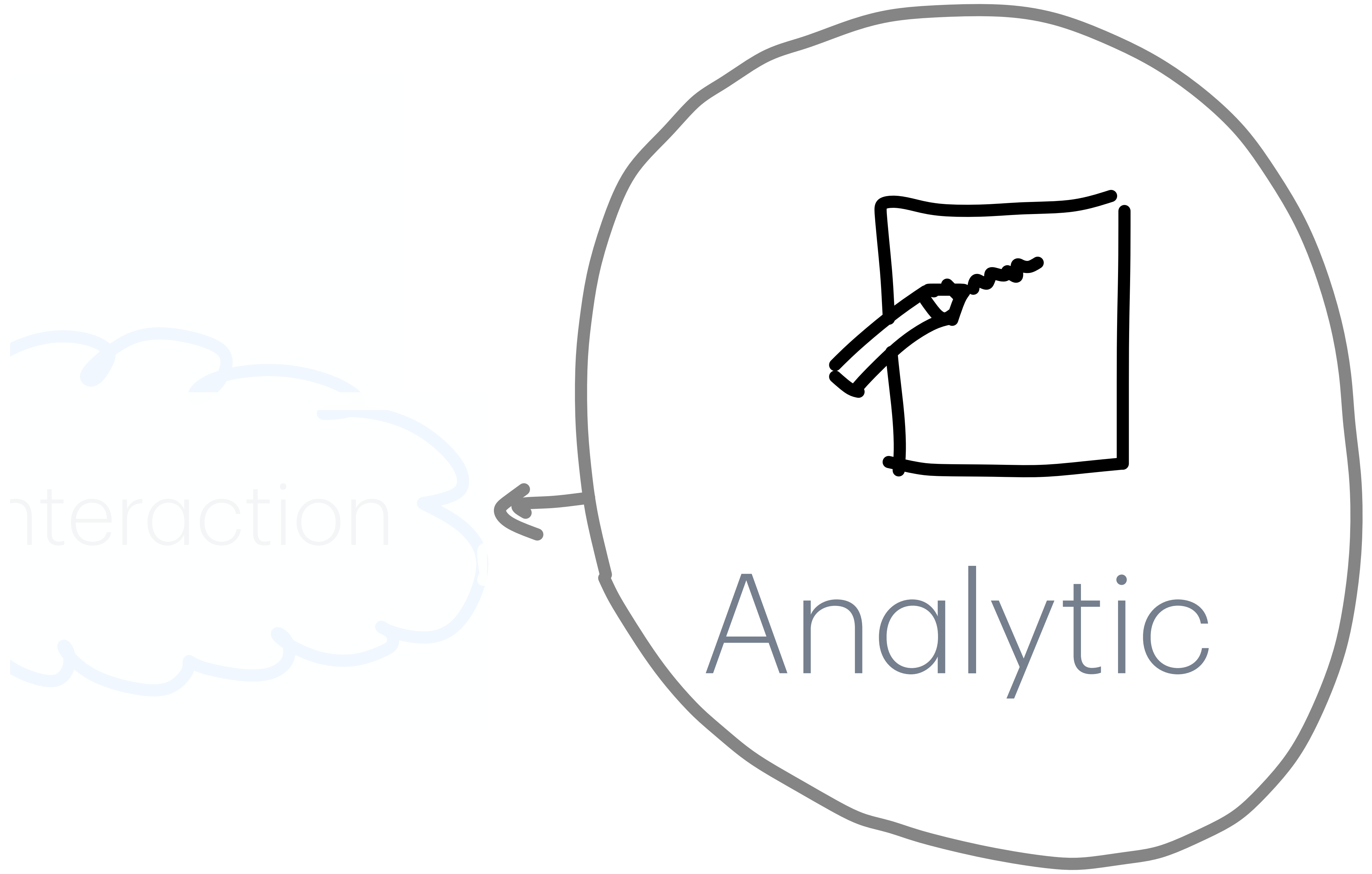
- Replace gauge-variant operators with gauge-invariant operators



Matching perspectives

What changes **analytically**?

- Replace gauge-variant operators with gauge-invariant operators
- Due to the FMS mechanism, the results remain the same up to small higher-order corrections



Complexity of asymptotic states in the weak sector

Analytic approach

1) Write down an asymptotic state: It has to be gauge invariant

[A. Maas, Prog. Part. Nucl. Phys., 2019, 1712.04721] and references therein

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$$\langle(\varphi^\dagger\varphi)(x)(\varphi^\dagger\varphi)(y)\rangle_c = 4v^2\langle h^\dagger(x)h(y)\rangle_c + \mathcal{O}(v)$$

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↓ Additional effects

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Example for perturbative approach

Spectral densities of complex composite asymptotic states

Compute spectral density from decomposition

$$\langle h(p)h(-p)\rangle = \int_0^\infty \mathrm{d}m^2 \, \frac{\rho(m^2)}{p^2 - m^2}$$

[Maas, Sondenheimer, Phys. Rev. D, 2020]

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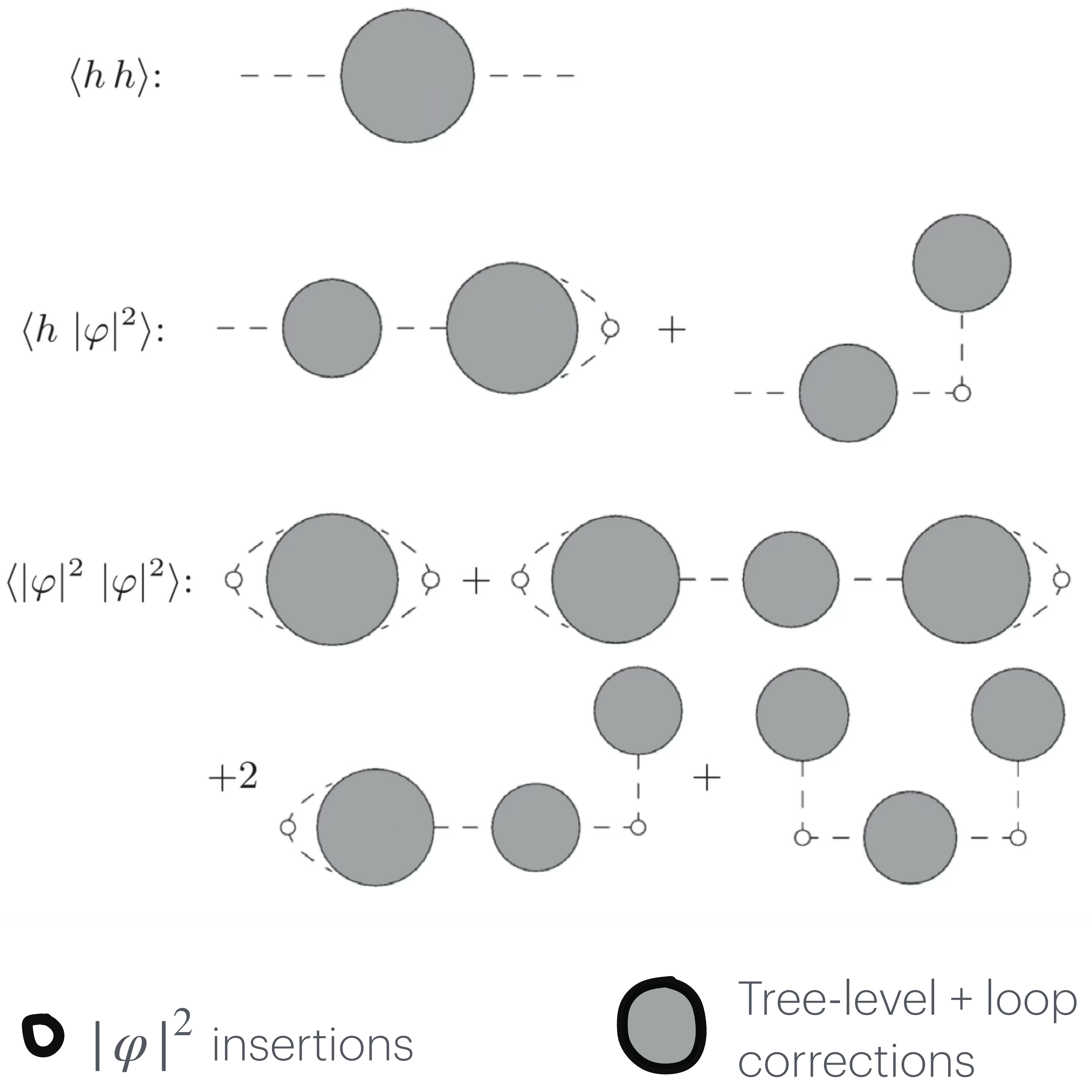

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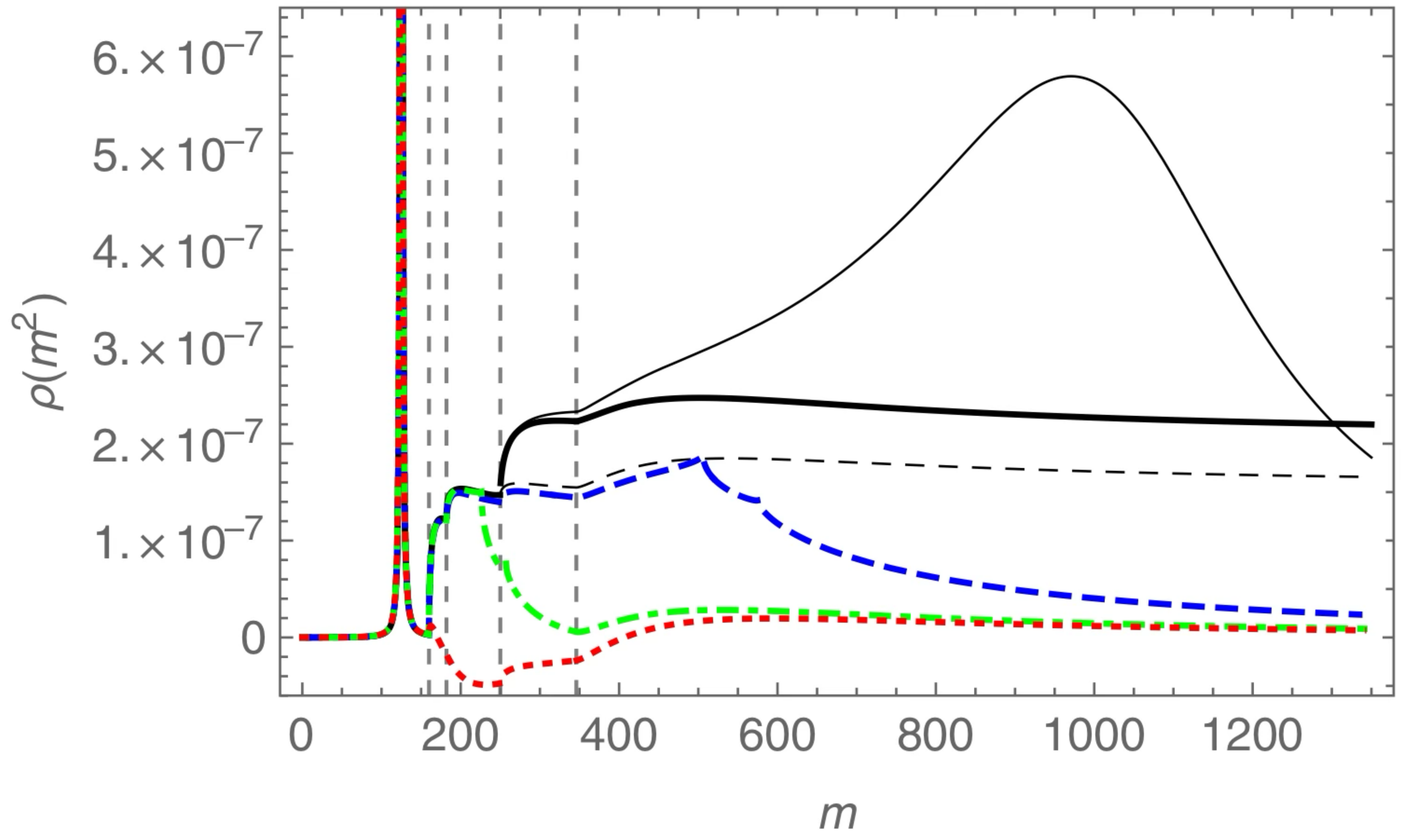
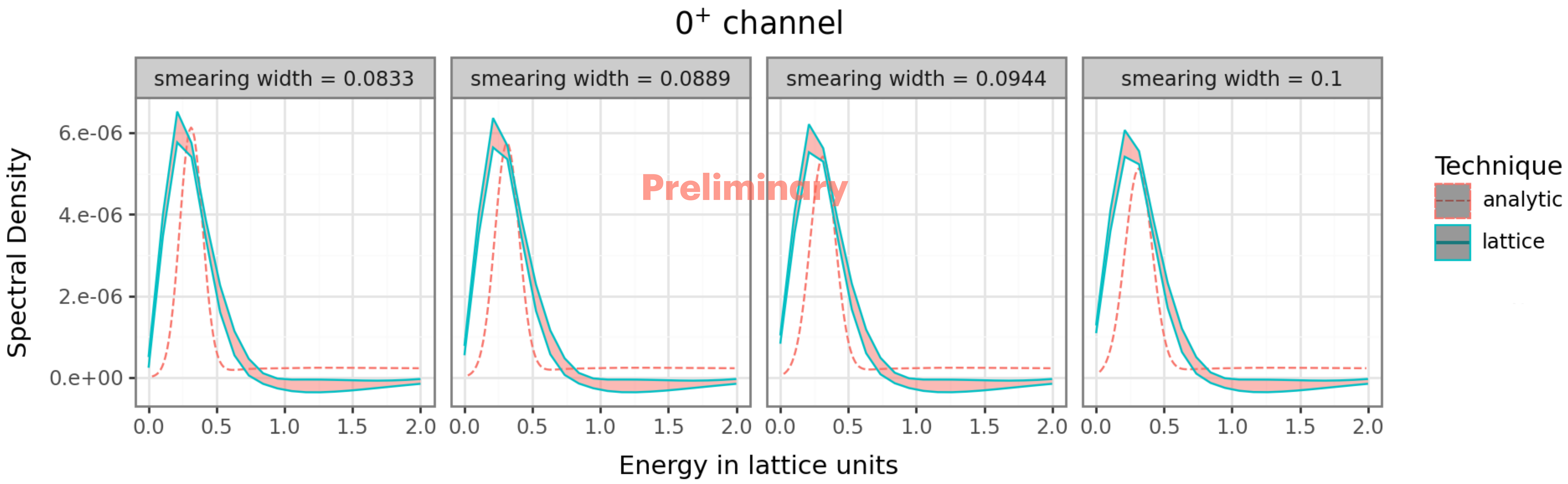


Gauge parameter dependent fundamental spectral densities and gauge-invariant bound state spectral density

Example for perturbative approach

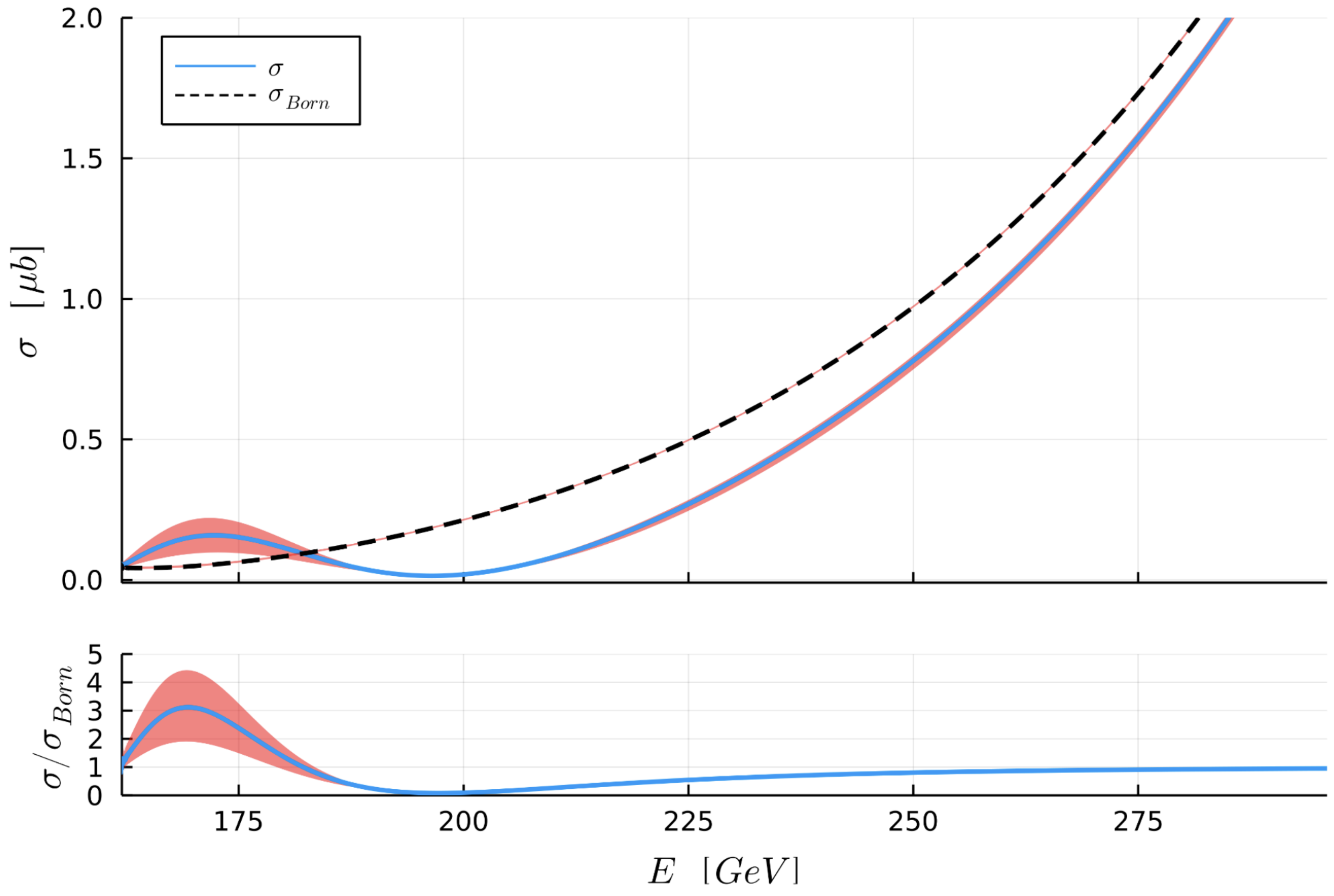
Spectral densities of complex composite asymptotic states

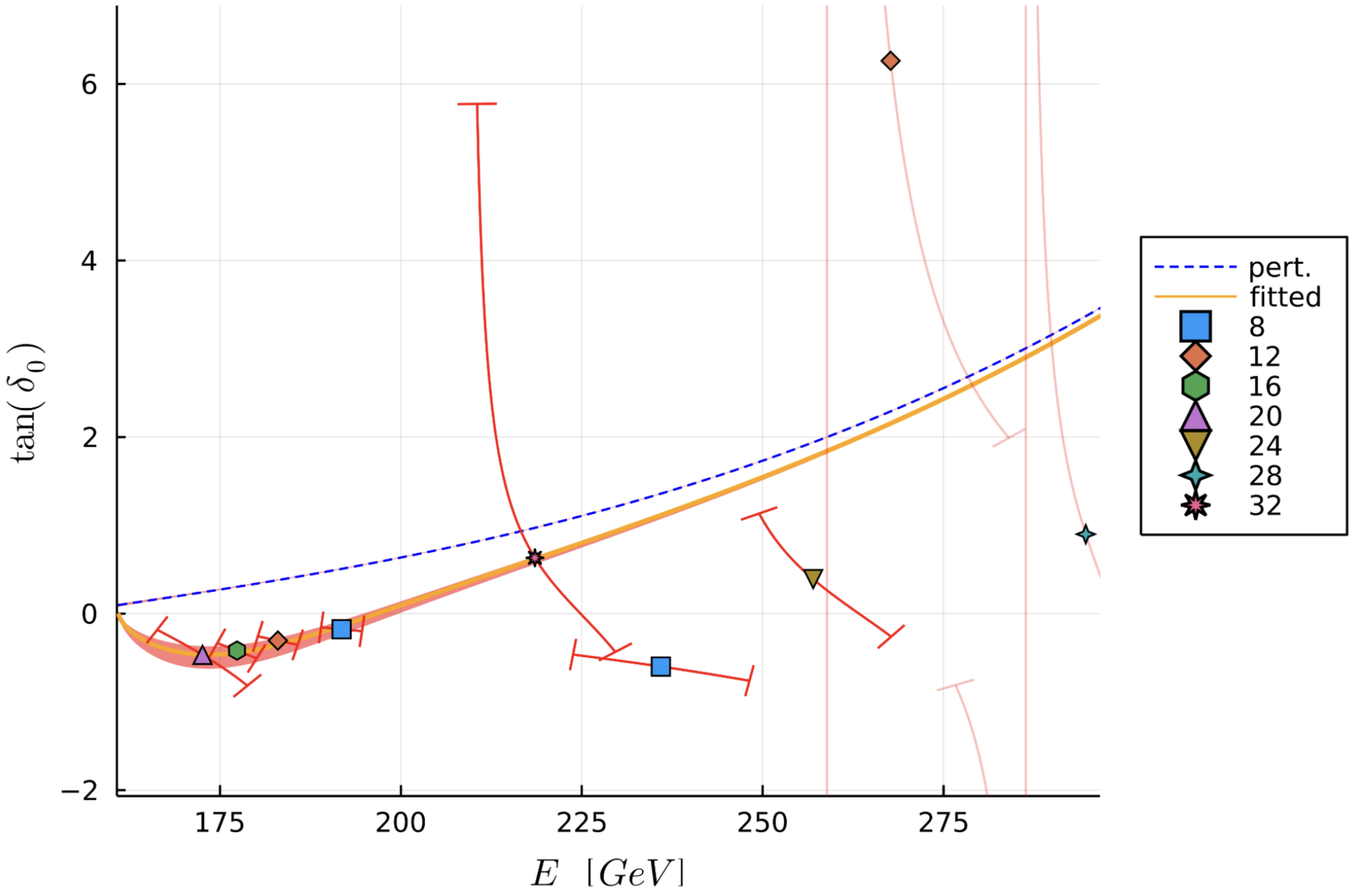
The lattice requires a smearing/convolution of the spectral density so we apply the same to the analytic result



Another example: Cross sections

Analytic differences have been predicted for vector boson scattering (VBS) for elementary vs. composite asymptotic states





Expected deviations @ O(100 GeV)

[Jenny, Maas, Riederer, Phys. Rev. D, 2022, 2204.02756]

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Thank you for your attention!