DecaySelector

A Web Tool for Multi-Body Decay Topologies in the Isobar Model

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Rising Complexity in Multibody Decays ($n > 3$)

In the helicity formalism, a general decay amplitude for a multi-body decay can be written as

$$\mathcal{A}^{\lambda_0}_{\lambda_1,\lambda_2,\dots} = \sum_{\text{chains}} A_c^{\text{aligned}}(\lambda_0, \lambda_1, \lambda_2, \dots) \quad ,$$

where $A_c^{\text{aligned}}(\lambda_0, \lambda_1, \lambda_2, \dots)$ denotes the aligned chain amplitude and λ are the initial and final-state helicities [1].
The number of chains is calculated as

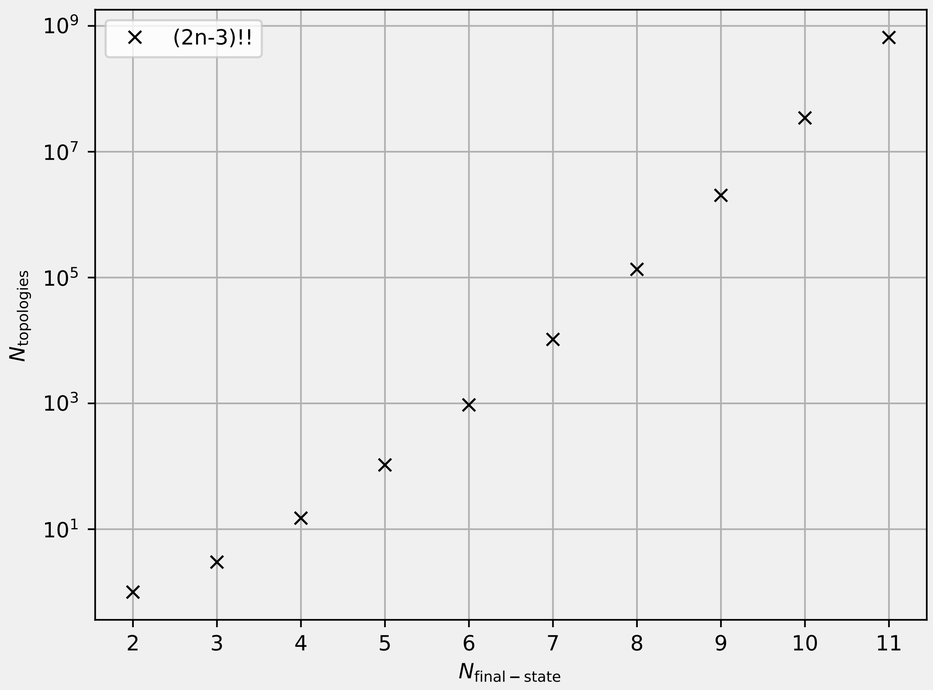
$$N_{\text{chains}} = N_{\text{topologies}} \cdot \prod_{\text{nodes}} N_{\text{Resonances}} \quad .$$

From this formula, one sees that:

- The total number of amplitude chains grows with the number of intermediate resonances.
- Each resonance can participate in multiple topologies, further increasing the combinatorial complexity.
- Due to combinatorics $N_{\text{topologies}} = (2 \cdot N_{\text{final-state}} - 3)!!$ grows quickly as a function of final-state particles.

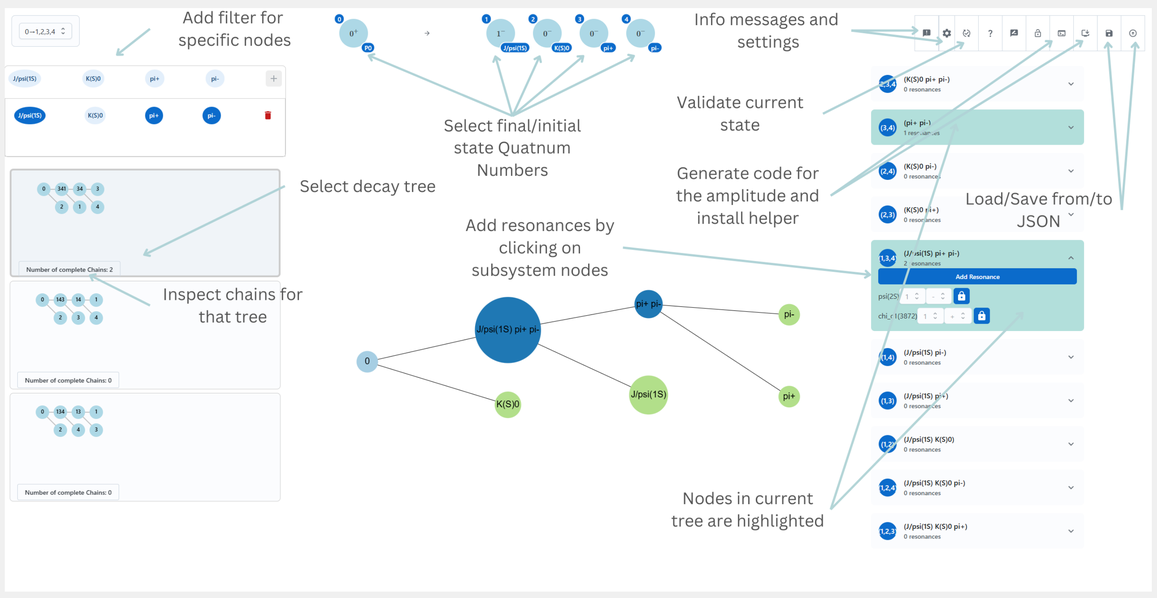
DecaySelector helps manage this complexity by allowing users to:

- Visually inspect automatically generated decay topologies.
- Manage complexity with filtering, sorting and automatic filling of chains.
- Generate and view chains by adding resonances.
- Export validated decay setups for amplitude analysis.



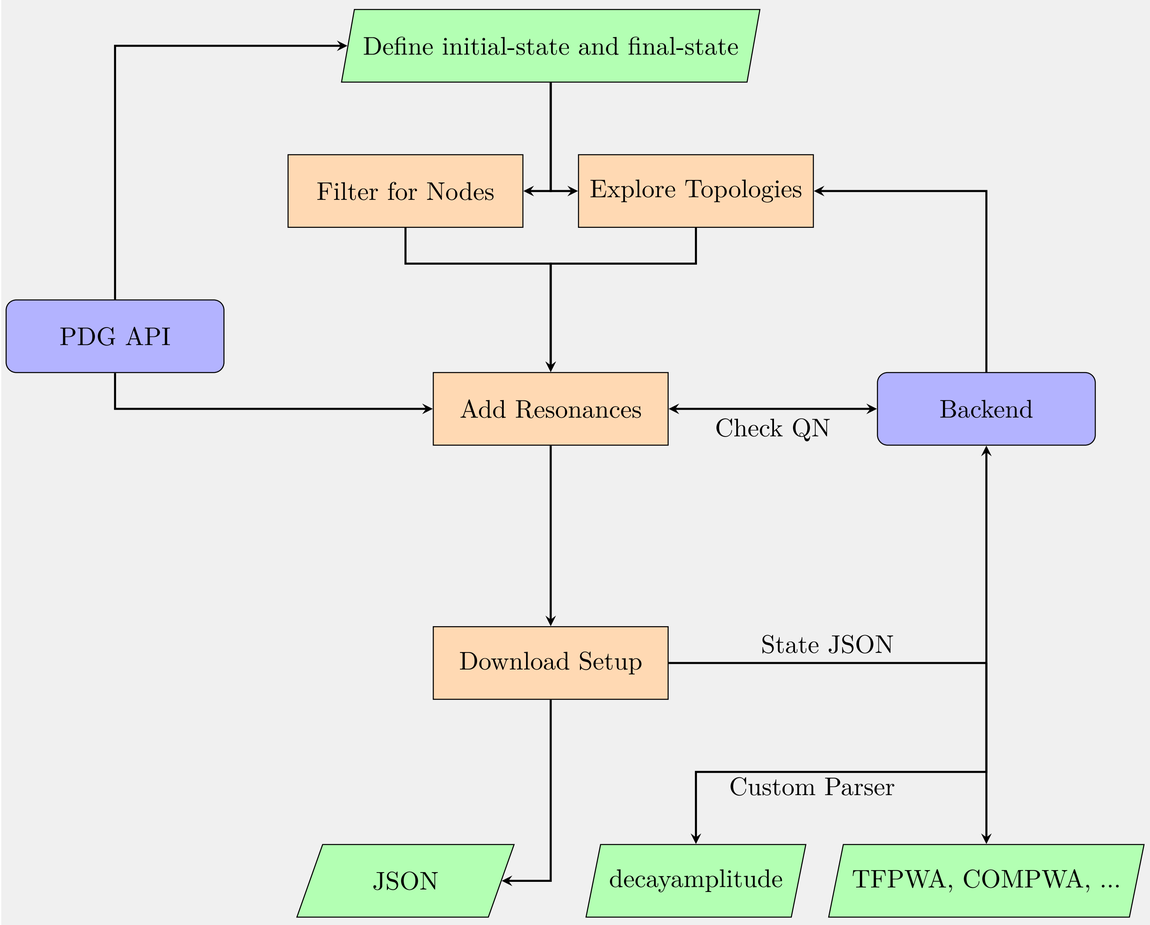
[1] Kai Habermann and Mikhail Mikhasenko. Wigner rotations for cascade reactions. *Phys. Rev. D*, 111:056015, Mar 2025.

Sneak Peek



https://kaihabermann.github.io/DecaySelector/

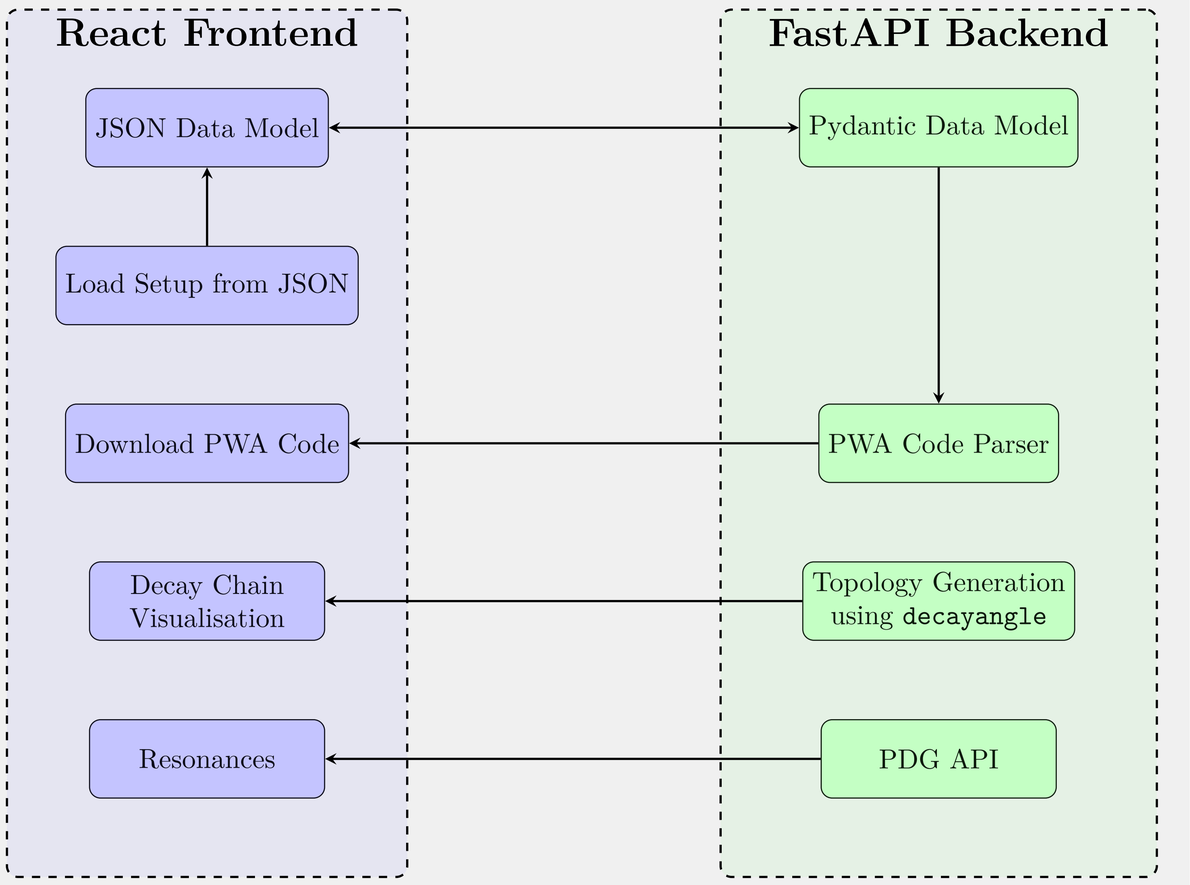
Workflow



Integration with Amplitude Frameworks

- Current support: `decayamplitude` framework.
- JSON dumps can be parsed to generate running amplitude code.
- Future: support for more amplitude analysis frameworks.
- **Help needed:** If you develop amplitude analysis frameworks please get into contact, so we may be able to build a parser together!

Architecture



Outlook

- Extend support to additional PWA frameworks.
- Smart resonance suggestion system.

Live Demo

Try out the Prototype!

Add your own parser!