

Multi-scattering processes and spectral properties of low-energy QCD

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quark and meson spectral functions from a { direct real-time, Lorentz invariant, RG-self-consistent } computation

01 O(4) Yukawa theory

Quarks coupled to O(4) mesonic field $\phi = (\sigma, \vec{\pi})$, symmetry explicitly broken

$$S_{\text{QM}}[\bar{q}, q, \phi] = \int_x \left\{ \bar{q} (i\partial + h_\phi \phi_a \tau_a) q + \frac{1}{2} (\partial_\mu \phi_a)^2 + \frac{m_\phi^2}{2} \phi_a \phi^a - c_\sigma \sigma \right\}$$

02 Spectral functions

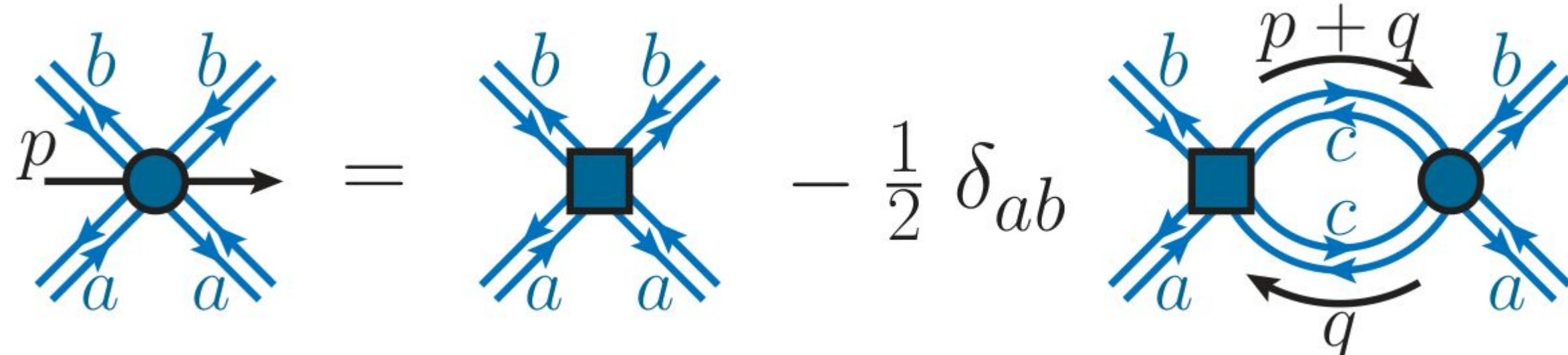
Källén-Lehmann representation encodes propagator in the complex plane

$$G(p) = \int_0^\infty \frac{d\lambda}{\pi} \frac{\lambda \rho(\lambda)}{\lambda^2 + p^2}$$

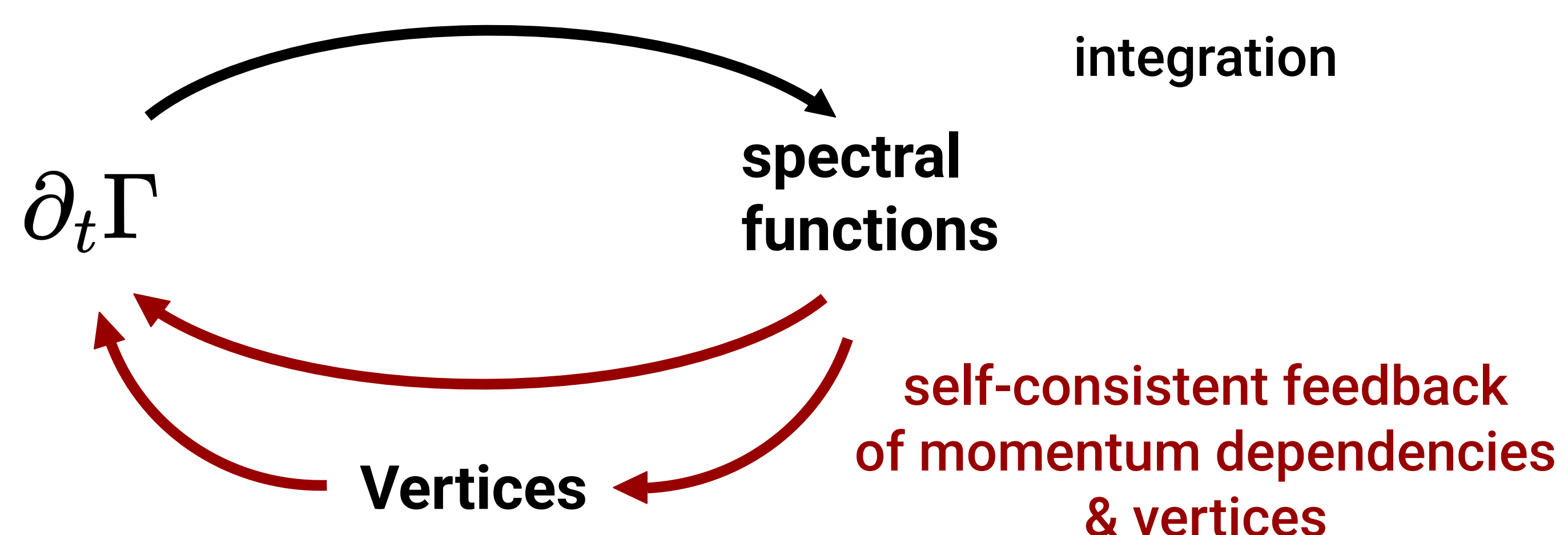
Computation directly in real time
No analytic continuation necessary

03 4-Pion scatterings from the BSE

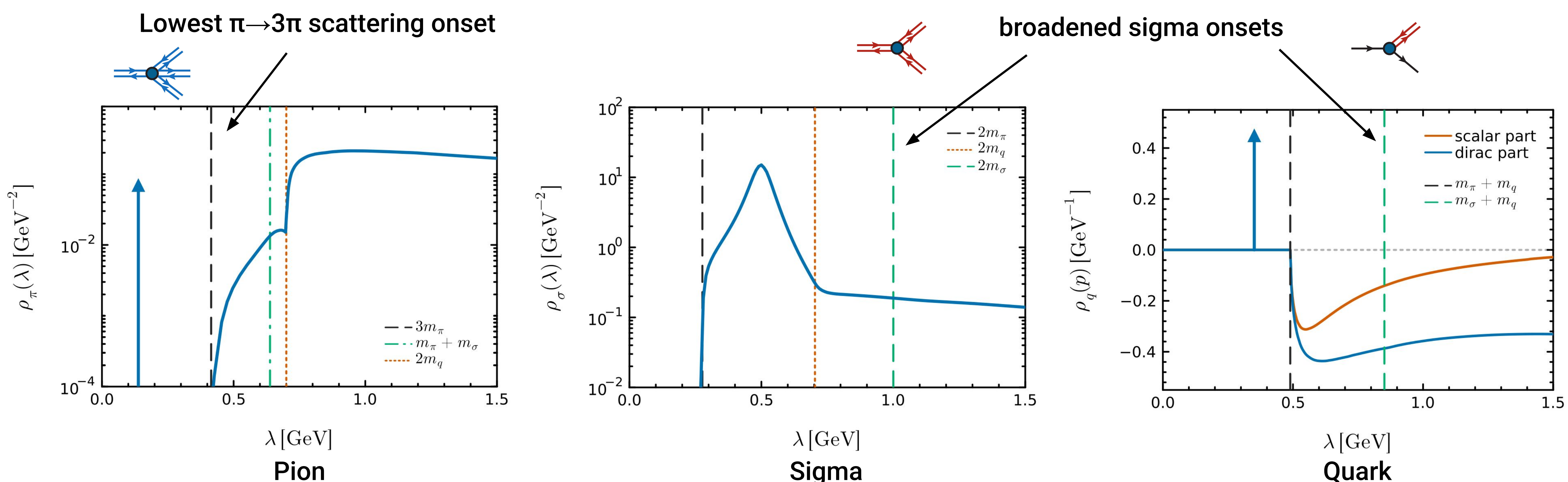
Resolution of $\pi \rightarrow 3\pi$ scattering requires momentum dependent four-pion vertex



04 Workflow



05 Results: Qualitatively new behaviour due to feedback of momentum dependence



06 Outlook

- Extension to arbitrary models with arbitrary external parameters
- Applications in high-energy physics, condensed matter, quantum gravity, etc.
- Near criticality, self-consistent inclusion of momentum dependence becomes crucial

