Given an observable $\mathcal{O}[\rho]$ we can have:

- $\mathcal{O}[\langle\rho\rangle]$ the observable is applied to the averaged density operator $\langle\rho\rangle$
- $\langle\mathcal{O}[\rho]\rangle$ the observable is computed pointwise in the phase space, then averaged

In the $t\bar{t}$ frame:

- θ is the emission angle between gluon and top-quark, E_g the gluon energy

$$\rho^{H}_{t\bar{t}g} = \rho^{H}_{t\bar{t}g}(\theta, E_g)$$

- Two additional spherical angles to describe the direction of the e^+e^- beam in the lab frame, that is then boosted to the $t\bar{t}$

$$\rho^{e^+e^-}_{t\bar{t}g} = \rho^{e^+e^-}_{t\bar{t}g}(\chi, \phi, \theta, E_g)$$

- In each case we average ρ over all the angles available

$$\langle \rho^{i}_{t\bar{t}g} \rangle = \langle \rho^{i}_{t\bar{t}g}(E_g) \rangle_{\Omega_i} \qquad \text{for } i = H,\, e^+e^-$$

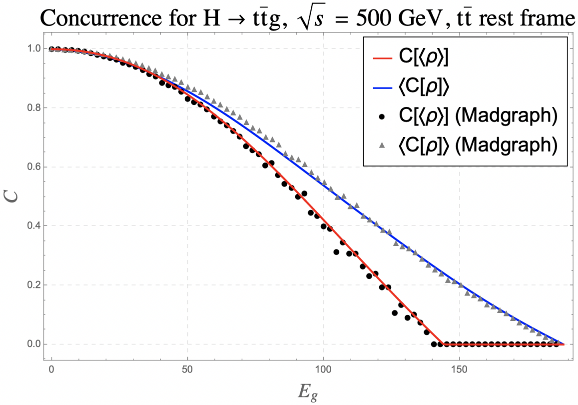
$$\rho = \frac{R}{\mathrm{tr}[R]} = \frac{R}{4A} \qquad\qquad A = \frac{1}{4}\,\mathrm{tr}[R]$$

$$\langle\rho\rangle = \frac{1}{\int \frac{\partial\sigma}{\partial E_g\,\partial\Omega}\;d\Omega} \int \rho \frac{\partial\sigma}{\partial E_g\,\partial\Omega}\;d\Omega$$

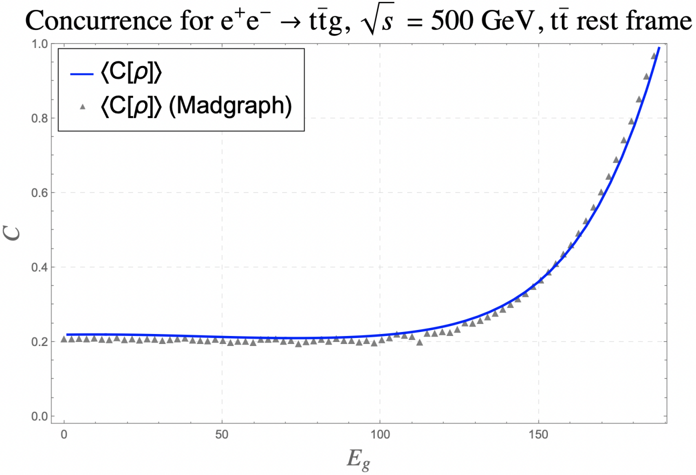
$$\frac{\partial\sigma}{\partial E_g\,\partial\Omega} \propto \mathrm{tr}[R] \propto A$$

$$\langle\rho\rangle = \frac{\int \rho\,A\;d\Omega}{\int A\;d\Omega} = \frac{\int R\;d\Omega}{\int \mathrm{tr}[R]\;d\Omega}$$

$H \to t\bar{t}g$


Concurrence for H → tt̄g, √s = 500 GeV, tt̄ rest frame
C[⟨ρ⟩]
⟨C[ρ]⟩
C[⟨ρ⟩] (Madgraph)
⟨C[ρ]⟩ (Madgraph)
1.0
0.8
0.6
0.4
0.2
0.0
C
0
50
100
150
E_g

$e^+e^- \to t\bar{t}g$


Concurrence for e⁺e⁻ → tt̄g, √s = 500 GeV, tt̄ rest frame
⟨C[ρ]⟩
⟨C[ρ]⟩ (Madgraph)
C
E_g
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150