Double Ratio Method

- Excited state dependent only on sum $\tau_e + \tau_m$.

$$C_3^{\mu\nu}(\tau_e, \tau_m; \mathbf{p}_e, \mathbf{p}_m) = R^{\mu\nu}(\tau_e - \tau_m; \mathbf{p}, \mathbf{q}) \frac{Z_\pi(\mathbf{p})}{2E_\pi(\mathbf{p})} e^{-E_\pi(\mathbf{p})(\tau_e+\tau_m)/2},$$

- Construct ratio

$$\mathcal{R} = \frac{C_3^{\mu\nu}(\tau_e - 1, \tau_m + 1; \mathbf{p}_e, \mathbf{p}_m)}{C_3^{\mu\nu}(\tau_e, \tau_m; \mathbf{p}_e, \mathbf{p}_m)} = \frac{R^{\mu\nu}(\tau_e - \tau_m - 2; \mathbf{p}, \mathbf{q})}{R^{\mu\nu}(\tau_e - \tau_m; \mathbf{p}, \mathbf{q})} \Big[1 + \ldots\Big]$$

- No need for 2-point data!
- No renormalization required.