Structure of the Hadronic Current

Decay Rate of $\tau \to$hadrons can be broken down into contrib's from Final States with Specific J^P

1. Spectral Functions Formalism:

$$\frac{d\Gamma}{ds} = \frac{{G_F}^2}{(2\pi)^2(2m_\tau)^3}({m_\tau}^2 - s)^2 \times$$
$$|V_{ud}|^2 \left\{({m_\tau}^2 + 2s)[v_1(s) + a_1(s)] + {m_\tau}^2 a_0(s)\right\}$$

v_1	$J^P = 1^-$	$2\pi_{(\rho(770),\,\rho(1450)\ldots)}, 4\pi, 6\pi$
a_0, a_1	$J^P = 0^-, 1^+$	$\pi, 3\pi_{(a_1(1260)\ldots)}, 5\pi$

- CVC $\Rightarrow \sigma^{I=1}(e^+e^- \to X^0) = \frac{4\pi\alpha^2}{s} v_1(\tau \to \nu_\tau X^-)$ for Final States with Even #'s of π's

2. Structure Functions Formalism:

$$\frac{d\Gamma}{dPS^{(4)}} = \frac{{G_F}^2}{(4m_\tau)}|V_{ud}|^2 \sum_{\mu\nu} L_{\mu\nu} H^{\mu\nu}$$
$$= \frac{{G_F}^2}{(4m_\tau)}|V_{ud}|^2 \sum_{X}^{16-\text{terms}} L_X H_X$$

- Leptonic: $L_X = L_X(P_\tau, \gamma_{VA}, s, \alpha, \beta, \gamma, \cos\theta^*)$
- Hadronic: $H_X = H_X(s, s_1, s_2)$ $(\tau^\pm \to 3\pi^\pm \nu_\tau)$ separate terms for S,V,A & Interferences