Preliminaries

My presentation yesterday was deliberately a bit provocative

As indicated on the slides I just expressed a personal opinion (bold, perhaps wrong?)
By no means I intended to be disrespectful and I apologize if this was perceived so
As stressed yesterday, we probably won't be here without Ji's seminal papers!

The point is that there is a fundamental disagreement that needs to be resolved

The arguments from both sides (correct me if I'm wrong)

Ji's approach $T^{\mu\nu} = \bar{T}^{\mu\nu} + \hat{T}^{\mu\nu}$

traceless	$\bar{T}^{\mu\nu} = T^{\mu\nu} - \frac{1}{4} g^{\mu\nu} T^{\alpha}{}_{\alpha}$	(1,1) rep
pure trace	$\hat{T}^{\mu\nu} = \frac{1}{4} g^{\mu\nu} T^{\alpha}{}_{\alpha}$	(0,0) rep

Argument 1: Lorentz tensors of different reps do not mix under renormalization

Argument 2: Trace anomaly originates from $T^{\alpha}{}_{\alpha}$ which transforms as a (0,0) rep

Conclusion: Only pure trace part differs from classical form

Metz et al. approach

Argument: $T^{\mu\nu}$ is conserved and is therefore protected under renormalization

Conclusion: $T^{\mu\nu}$ conserves its classical form under renormalization

Corollary: Both traceless and pure trace parts differ from classical form

$$\bar{T}^{\mu\nu} = T^{\mu\nu} - \frac{1}{4} g^{\mu\nu} T^{\alpha}{}_{\alpha}$$
$$\hat{T}^{\mu\nu} = \frac{1}{4} g^{\mu\nu} T^{\alpha}{}_{\alpha}$$

What goes wrong?

Are we on the same page?

One has to be very careful because renormalization, quark-gluon separation and trace operation do not commute!

⚠ Notations may be deceiving…

$$\tfrac{1}{2}(\vec{E}^2+\vec{B}^2)_R \overset{\text{Ji}}{=} \bar{T}^{00}_{gR} \overset{\text{MPR}}{=} T^{00}_{gR}$$

$$\bar{T}^{\mu\nu}_{gR} \overset{?}{\equiv} \left[T^{\mu\nu}_R - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}T^{\alpha\beta}_R\right]_g \qquad \text{RTS}$$

$$\overset{?}{\equiv} \left[(T^{\mu\nu}_R)_g - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}(T^{\alpha\beta}_R)_g\right] \qquad \text{RST (Metz et al.)}$$

$$\overset{?}{\equiv} \left[T^{\mu\nu}_g - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}T^{\alpha\beta}_g\right]_R \qquad \text{STR}$$

$$\overset{?}{\equiv} \left[(T^{\mu\nu}_g)_R - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}(T^{\alpha\beta}_g)_R\right] \qquad \text{SRT}$$

$$\overset{?}{\equiv} \left[\left(T^{\mu\nu} - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}T^{\alpha\beta}\right)_R\right]_g \qquad \text{TRS (Ji?)}$$

$$\overset{?}{\equiv} \left[\left(T^{\mu\nu} - \frac{1}{4}\,g^{\mu\nu}g_{\alpha\beta}T^{\alpha\beta}\right)_g\right]_R \qquad \text{TSR}$$