



Contribution ID: 113

Type: **Poster Presentation**

## Gradient flow scale setting with tree-level improvement

*Tuesday, August 9, 2022 7:00 PM (1 hour)*

Lattice scales defined using gradient flow are typically very precise, while also easy to calculate. However, different definitions of flows and operators can differ, suggesting possible systematic effects. Using the set of RBC-UKQCD 2+1 flavor domain wall fermion and Iwasaki gauge action ensembles, we explore differences between  $\sqrt{t_0}$  and  $w_0$  gradient flow scales, compare the impact of different operators to define the energy density, and study the effect of using tree-level improvement for the gradient flow. We find that tree level improvement, traditionally used in step-scaling studies, significantly reduces cut-off effects of the  $t_0$  scale. Our findings should be generally applicable to any gauge action.

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**Session Classification:** Poster

**Track Classification:** Standard Model Parameters