# $N_f = 2$ Wilson twisted mass fermions: Exploring the phase structure and parameter space with the tree-level Symanzik improved gauge action

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This is one of four contributions to dynamical Wilson twisted mass fermions which are summarized in ref. [1]. In this talk we are specifically discussing simulations of $N_f = 2$ dynamical Wilson twisted mass fermions using the tree-level Symanzik improved (tlSym) gauge action. We first discuss the phase structure of $N_f = 2$ dynamical Wilson (twisted mass) fermions, in particular the dependence of phase structure on the choice of the gauge action. We then present our results from exploring the parameter space in $\beta, \mu$ and $\kappa$. We have determined $\kappa_c$, i.e. maximal twist, in a range of lattice spacings $0.13\,\text{fm} \lesssim a \lesssim 0.09\,\text{fm}$ and in that range we seem to be able to reach pion masses of about $m_\pi \simeq 350\,\text{MeV}$, for lattice spacings $a \lesssim 0.09$ fm even $m_\pi \lesssim 300\,\text{MeV}$.

**References**

[1] F. Farchioni *et al.*, *Dynamical twisted mass fermions*, PoS(LAT2005)072.

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