A more general Lorentz cup that adds another lever on function behavior far from the rest length. Let us bring the Lorentz cup to a form with no length scales:

Now we can add a new parameter to control the nonlinearity of this function:

Define :

With this is just a parabola (linear case) and recovers the Lorentz cup. We have set so that and .

The gradient of this energy form:

Gradients of interaction variables:

Hessian of objects:

Gradient of the cup with :

We can also consider in which case the potential becomes repulsive at some distance from the central rest state:

The distance of the turnover is thus

Hessian of Interactions variables:

Mixed Hessian :

Energy and gradient far from rest length , specifically in the limit :

If :

If :

Modified potential:

Setting we get:

The gradient of this energy form:

Gradients of interaction variables: