Friction forces are deliberately neglected in the theory presented in this paper. This causes a problem for applying this theory to the experimental situation displayed in Figure 1. The problem is most easily described when discussing only a stack of two spheres. When gravity overcomes the stability boundary, i.e. alpha becomes sufficiently small, the upper sphere will slide downhill, and the magnetization vector of the upper sphere will orient to the magnetic field of the lower one, as indicated in the lower right part of Figure 4.

In the experiment friction is finite. In the vertical position the normal force is infinitely larger the horizontal force, which according to Coulombs friction law would initially lead to a rolling motion of the upper sphere for *any* finite friction coefficient. For that motion the magnetization vector of the upper sphere is not parallel to the magnetic field of the lower one, as it would be in the frictionless case. In consequence, the magnetic energy is increased compared to the sliding particle at the same position. This means that the rolling particle is more stable than the sliding one.

While the stability boundary for the sliding case with N = 2 spheres is 4 (see eq. 4.7), it turns out to be 3 for the rolling case, and this number is independent of the friction coefficient. Such a 33%-effect should be measurable. Whether this discrepancy becomes smaller or larger for particle numbers N>2 remains to be investigated.

(Comments by Ingo Rehberg on the paper
“Stability of Vertical Magnetic Chains”
by Johannes Schönke and Eliot Fried)