Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

Realization of a Super-Tonks-Girardeau gas with strong attractive interactions RUSSELL HART, ELMAR HALLER, MATTIAS GUSTAVSSON, MANFRED MARK, JOHANN DANZL, GUIDO PUPILLO, HANNS-CHRISTOPH NÄGERL, University of Innsbruck — We realize a 1D quantum gas with strong attractive interactions. For this, we load a Bose-Einstein condensate of Cs atoms into an array of "tube-like" 1D traps generated by a 2D optical lattice and exploit the tunability of the interaction strength near a Feshbach resonance. When the 3D scattering length is increased towards and beyond the length scale set by the tight transversal confinement, we observe a confinement-induced resonance (CIR) that allows us to tune the effective 1D-interaction parameter g_{1D} to large positive and negative values. By tuning to large positive values of g_{1D}, we first observe the transition from a 1D mean field system to a Tonks-Girardeau (TG) gas as evidenced by a change of the breathing mode frequency ω_B along the weakly confining direction from $\sqrt{3}$ to 2 in units of the (bare) dipole oscillation frequency ω_D. When the CIR is crossed to enter the strong attractive interaction regime, ω_B increases beyond 2 (in units of ω_D), giving evidence of the regime of hard-rod interactions known as the super-Tonks-Girardeau (sTG) regime[1]. We find, in contrast to the TG regime, that the release energy strongly depends on g_{1D}, and that the sTG gas is surprisingly stable despite the fact that the interaction is strongly attractive.
[1] G. Astrakharchik et al., Phys. Rev. Lett. **95**, 190407 (2005).

Russell Hart
University of Innsbruck

Date submitted: 23 Jan 2009 Electronic form version 1.4