



Figure 3. Slenderness ratio R versus density mismatch $\Delta\rho$ at the limit of stability; the maximum value on the x -axis, $\Delta\rho = 0.07 \text{ g cm}^{-3}$, corresponds to a Bond number $B = 0.108$. The bridge is stable below the curve; the solid line is a fit to the data with $\sigma = 16 \pm 1 \text{ erg cm}^{-2}$.

stress below Y only elastic behaviour is observed. Above Y one observes an onset of plastic flow, and the material is referred to as a Bingham fluid. In smectic A liquid crystals this behaviour arises from the domain structure of an unaligned sample, i.e. randomly oriented regions of characteristic length \sim a few μm , with each region having parallel smectic layers. To examine the effects of this highly non-Newtonian behaviour on bridge stability, we first formed a cylindrical smectic A column of slenderness ratio $R = 3.88$ (figure 4) at room temperature, approximately 23°C . This is well in excess of the Rayleigh limit of π for Newtonian liquids [1, 2], and it was observed to remain unchanged in shape for well over 50 h. A column of $R = 4.2$ was similarly stabilized. It is clear that the smectic A phase behaves differently from the nematic phase. We next examined the stability of the cylindrical smectic A columns on changing the density of the bath. A cylindrical column of slenderness ratio $R = 3.88$ was initially drawn in a density-matched H_2O bath. D_2O was then titrated into the water bath in order to increase the (temperature-dependent) density mismatch $\Delta\rho$ up to $\Delta\rho = 0.037 \text{ g cm}^{-3}$. The temperature was then slowly increased. At lower temperatures there was no observable change in the column, indicating the absence of flow. However, when the temperature reached $T_{\text{NA}} - 1^\circ\text{C}$ (approximately 32.5°C), the smectic A cylinder began to deform (but did not collapse) with the density mismatch $\Delta\rho_{\text{deform}}$ at this temperature equal to 0.034 g cm^{-3} . If we make the excellent approximation that the surface tension of the smectic A–water interface is the same as nematic–water interface [22, 23], $\Delta\rho_{\text{deform}}$



Figure 4. Cylindrical smectic A bridge with $R = 3.88$ in pure H_2O bath.