periments been found to lie in the range 3–4. The frictional term acts only when the relative velocity $|\mathbf{v}_s - \mathbf{v}_n|$ exceeds $\mathbf{v}_c$.

The boundary condition applied to the normal fluid in obtaining (12) required that the tangential component of the normal fluid velocity vanish at the slit walls. Since the superfluid component is considered to possess no viscosity no similar boundary condition applies and one must resort to other arguments to determine the superfluid velocity profile. A sufficient condition for this profile to be determined is that there exist an arbitrarily small force, a function of $|\mathbf{v}_s - \mathbf{v}_n|$, acting between the superfluid and the normal fluid. The form of the force is immaterial. Then from (1), assuming a nonvanishing force and neglecting as before the terms on the left, we have

$$\mathbf{F}_{sn}(\mathbf{v}_s - \mathbf{v}_n) = \rho_s s \nabla T - (\rho_s/\rho)\nabla P. \tag{16}$$

Equation (16) may then be solved for $\mathbf{v}_s - \mathbf{v}_n$ in the form

$$\mathbf{v}_s - \mathbf{v}_n = f(T, P). \tag{17}$$

We now average across the slit, making use of the earlier assumptions (justified in Section II, B) that T and P undergo negligible variation across the slit.

$$\overline{\mathbf{v}_s - \mathbf{v}_n} = \frac{1}{d}\int_{-d/2}^{d/2} (\mathbf{v}_s - \mathbf{v}_n)\, dx = \frac{1}{d}\int_{-d/2}^{d/2} f(T, P)\, dx = f(T, P). \tag{18}$$

Therefore we conclude that

$$\overline{\mathbf{v}_s - \mathbf{v}_n} = \mathbf{v}_s - \mathbf{v}_n . \tag{19}$$

The normal fluid velocity profile is given (from (12) using $\mathbf{q} = \beta^{-1}\mathbf{v}_n$) by

$$\mathbf{v}_n = \frac{3}{2}\bar{\mathbf{v}}_n\left(1 - \frac{4x^2}{d^2}\right) \tag{20}$$

and hence from (3) the superfluid velocity profile is

$$\mathbf{v}_s = \bar{\mathbf{v}}_n\left[\frac{3}{2}\left(1 - \frac{4x^2}{d^2}\right) - \frac{\rho}{\rho_s}\right] \tag{21}$$

and the superfluid velocity at the slit walls is

$$(\mathbf{v}_s)_{\text{wall}} = -(\rho/\rho_s)\bar{\mathbf{v}}_n . \tag{22}$$

The superfluid flow is rotational, the curl of the velocity being given by

$$\nabla \times \mathbf{v}_s = (12x/d^2)\bar{\mathbf{v}}_n\mathbf{e}_y . \tag{23}$$

The circulation vector is along the y axis and the circulation is a maximum at the slit walls.

At low velocities it is not clear whether a frictional force exists between the