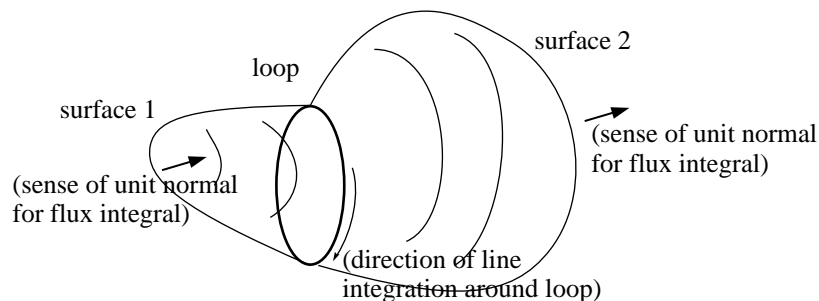# Apparent oversight in the flux rule

Griffiths, *Electrodynamics*, **fourth edition, problem 7.9**

Here's the loop. (The unit normals are drawn in accord with the right hand rule described by Griffiths on the top of page 298.) Does Φ_B refer to the flux through surface 1 ($\Phi_{B,1}$) or the flux through surface 2 ($\Phi_{B,2}$)?

Surface 1 plus surface 2 combined to make a *closed* surface, which I'll call surface T (for "total"). If you calculate the (outward) flux of $\vec{B}$ through surface T, you'll find zero — this is Gauss's law of magnetism:

$$\Phi_{B,T} = 0.$$

But when finding the outward flux, we use an outward unit normal everywhere. This is the same as the unit normal adopted above for surface 2 but the negative of the unit normal adopted above for surface 1. Thus

$$\Phi_{B,T} = -\Phi_{B,1} + \Phi_{B,2}.$$

Our two results combine to tell us that

$$\Phi_{B,1} = \Phi_{B,2}.$$

It doesn't care which surface we use for the flux rule.