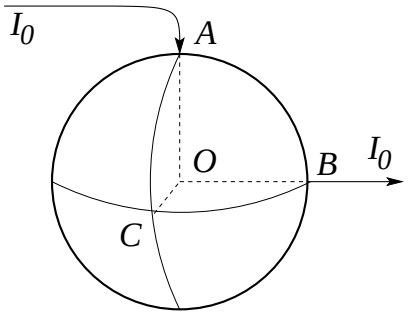
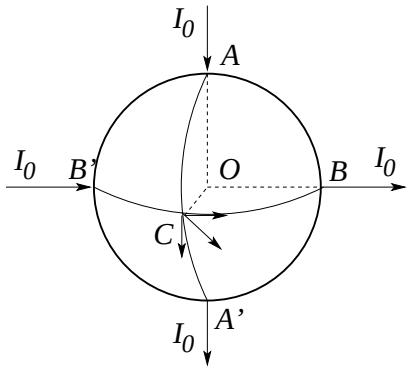
Current on a sphere

Thin-walled uniform conducting sphere (radius R) is attached to a current source I_0 by thin wires, at points A and B, as shown. In what direction charges move at point C ($OC \perp OA, OC \perp OB$)? Make two marks near point C, separated by distance $R/1000$, such that line connecting them is perpendicular to the motion of the charges at C. What fraction of the total current flows between the marks?



Answer of problem **Current on a sphere**

Consider a symmetrized problem, as shown in the figure. At point C the current will be twice that of the original configuration.



Now the pair of wires $B'-B$ create horizontal current at point C, and the pair $A-A'$ - vertical. The resulting direction will be downward at 45°.

The density of the $B'B$ horizontal current at the equator is $j_0 = I_0/2\pi R$, and similarly for the vertical AA' pair. The result for the AB pair of wires will be $j = \sqrt{2}j_0/2 = j_0/\sqrt{2}$ and the fraction of the current that flows between two marks is

$$\boxed{I = \frac{R}{1000}\frac{I_0}{2\pi R\sqrt{2}} = \frac{I_0}{2000\pi\sqrt{2}}}$$