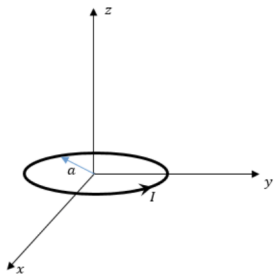
Problem 1. RHIC (5 Points)

Professor Kang works at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory in Long Island, New York. Relativistic particles undergoing cyclotron motion have cyclotron radius $R = \gamma mv/qB$ where $\gamma = 1/\sqrt{1 - v^2/c^2}$. If RHIC has a circumference of 3834 meters and an internal magnetic field of 3.45 T, and gold nuclei with mass 3.27×10^{-25} kg and charge $79e$ are traveling near to the speed of light, what is γ for the gold ions? Note: $e = 1.602 \times 10^{-19}$ C.

Problem 2. Current Loop (10 points)

Consider the current loop with radius a and current I in the xy-plane as pictured at right. What is the magnetic field at a point with height h on the z-axis? Hint 1: Pythagorean theorem. Hint 2: The Biot-Savart Law is:



$$d\vec{B}(\vec{r}(\ell)) = \frac{\mu_0}{4\pi} \frac{I(\ell)\, d\vec{\ell} \times \vec{r}(\ell)}{\|\vec{r}(\ell)\|^3}$$

which can be integrated along a path ℓ.