Answers

1 Circular orbit $qvB=mv^2/R$ implies $1/R(m) = 0.3\ B(T)/p(GeV)$ or $R = p/(0.3 \times B)$

a) $R = 7000\ GeV/(0.3 \times 12\ T) = 1{,}944.4\ m$

This tight radius would indicate circumference of 12.217 km. The LHC circumference is 26 km and the difference is due to the FODO (focusing-drift-defocusing-drift) optical structure of the accelerator plus the space needed for quadrupole magnets, RF cavities and final-focus optical structures

b) $B = p/(0.3 \times R)$ implies a scale factor of 13/7, i.e , $B = 12\ T \times 13/7 = 22.286\ T$

c) minimum radius $R = 50000\ GeV/(0.3 \times 20\ T) = 8.333\ km$

assuming the same scaling factor between minimum and actual radius as for LHC

k = actual radius/minimal radius =

$k = 26000\ m/(2\times\pi)\times 1944\ m = 2.13$

we would get a total length of the tunnel = $2\times\pi\times 8.333\ km\times 2.13 = 111.5\ km$

2. Light year in km: $ly = 9.461 \times 10^{12}\ km$

Distance to Alpha Centauri: $d = 4\ ly = 3.784 \times 10^{13}\ km$