

# Homework #2

- Estimate the energy stored in the LHC beams using the accelerator parameters given in <http://pdg.lbl.gov/2018/reviews/rpp2018-rev-hep-collider-params.pdf>
  - How heavy should be a high-speed train that travels with 200 km/h to have the same energy?
  - How much water could be boiled at room temperature with the same energy?
- Discuss what could happen to a hamster that stands (without movement) in front of the beamline of the LHC for 10 seconds. 😊
- One of the main challenges for linear colliders is to reach sufficient accelerating gradient,  $g \equiv \Delta E/L$  (energy increase per meter). There are currently two on-going design efforts for such a linear collider: ILC and CLIC. ILC has a target gradient of  $g_{\text{ILC}} = 31.5 \text{ MeV/m}$  while CLIC has  $g_{\text{CLIC}} = 100 \text{ MeV/m}$ . Assume that the cavity fill factor is 70% and that the final focusing and beam collimation requires a 3 km long section before the collision point. Calculate the required machine length for ILC and CLIC to reach 1 TeV collision energy.
- Estimate how much power would be needed to operate the accelerating cavities at ILC and CLIC if they are built using traditional or superconducting cavities.