# CAS on Future Colliders

***Case Studies on FCC-ee***

**TASK:**
Design a e+/e- collider with a beam energy of 45 - 180 GeV,
an overall length of 100km and that can provide in parallel
a luminosity of L=10^34 cm^-2 s^-1 to two experiments.

Literature:

Wolski: CAS, CERN-2014-009
Wille: "The Physics of Particle Accelerators"
Teng: Fermilab, TM-1269-0102-000, "Minimising the Emittamnce in Designing the Lattice of an Electron Storage Ring"
Holzer: CAS, CERN-2014-009, "Lattice Design"

**Items to discuss:**

***1.) Linear collider or Circular machine ?***
motivate your opinion

***2.) Luminosity:***
Establish the luminosity formula in its basic form and determine the limitations

***3.) Determine the limit of the stored beam current***
if the overall synchrotron radiation power should not overpass 50MW.
Determine the optimum number of bunches for $E_{beam}$ = 180 GeV.

***4.) Lower Energy:***
How does the situation change if the machine is supposed to run on the Z resonance ($E_{beam}$ = 45 GeV)

***5.) Determine in both cases the rf system.***

***6.) Choose an adequate arc structure:***
here a wide range of options is possible, each leading to some different emittances, these options should be discussed and the decision motivated

**** 7.) Give a first idea about the equilibrium emittance that can be expected***
(-- horizontal & vertical --)

*** 8.) Luminosity:***
Given a free space of s= +/- 2m, determine the required beta-function at the IP in x and y, to obtain the required luminosity.
(Hint: assume equal aperture requiremenets in x & y at the first mini beta quadrupole).

***9.) Dipole Design:***
(field, length, critical energy)

**** 10.) Quadrupole design considerations:***
gradient, length
(how do you optimize, to limit the synchrotron rad. energy below the dipole radiation … assume 5 sigma beam size, → magnet length /aperture need / critical energy)

******* 11.) design an injection system, including the pre-accelerator & injection mode***
*(lifetime is determined via beam strahlung & radiative bhabha,*
*to about 15 minutes !!)*