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LHC machine upgrades

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The plans for increasing the integrated luminosity of the LHC beyond its nominal parameters are well under way. The first upgrade is based on improvement of the collimation system, probably the most limiting factor at present. This will allow to reach and to pass the nominal $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. Other improvements in the injector chain (Linac4, PSB at 2 GeV, SPS upgrade) and in the LHC ring (a new cryo-plant for cooling of SC RF cavities, removal of radiation limitation in electronic equipment, etc.) should be able to bring us around $1.7\text{-}2 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. Then, in the longer term a major upgrade involving :

- a new Inner Triplets and insertion magnets (possibly based on High Field Nb3Sn technology)
- a revision of the matching region and of the corrector system
- Crab Cavities to allow full exploitation of the low beta* of the new triplet
- new cryoplants dedicated to the cooling of the new magnets and cavities in the two high luminosity IRs.

The implementation of this new scheme accompanied by other possible improvements under consideration (shorter bunches, etc.) should allow a peak luminosity of $\sim 5 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ and improved luminosity lifetime by "luminosity leveling". Finally, the very preliminary outcome of first discussions and studies on a LHC energy upgrade to around 28-33 TeV cm will be presented.

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