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## Optimizing the filling factor in high energy colliders

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The energy of a collider is proportional to the field of the dipoles and to the length of the arcs available to dipoles. A way to increase energy without increasing the field or making a longer tunnel is to have a larger filling factor (fraction of the arcs covered by dipoles), ie to reduce the space dedicated to quadrupoles, correctors, interconnections ... In this paper we discuss three possible paths to increase the filling factor, namely (i) having longer spacing between quadrupoles, (ii) using a 60 degrees phase advance optics rather than 90 degrees , and (iii) spreading the quadrupole gradient in the dipoles, i.e. going for a combined function magnet. The case of both the HE-LHC and the FCC lattices are considered.

### Funding Agency

### Footnotes

### I have read and accept the Privacy Policy Statement

Yes

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