Multistage rectilinear 6D muon cooling channel with alternating tilted solenoids

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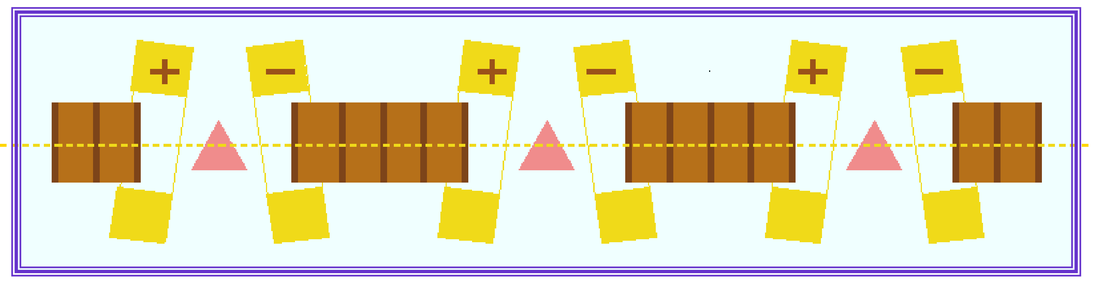
Abstract Alternate solenoid 4D cooling channel is considered. It is shown that it can be transformed to a rectilinear 6D cooling channel by small alternating tilt of the solenoids

Introduction

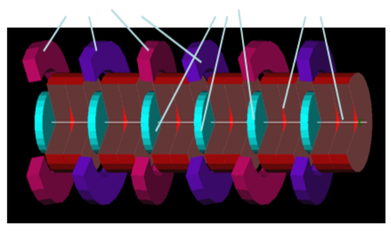
Alternating solenoid channel is recognized now as a suitable facility for 4D muon cooling. It has several regions of stability which traditionally are referred to FOFO, RFOFO, and Half-Flip versions of the channel. A possibility to transform any of them to 6D cooling channel by alternating tilt of the solenoids is a concern of this work.

Transformation of 4D to 6D cooling channel

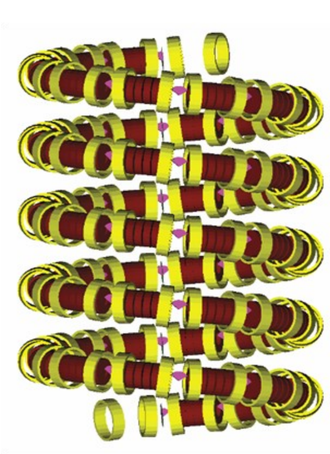


The transformation is achieved by alternating inclination of solenoids at small angle (typically 10-40 mrad) in horizontal plane. It gives rise to transverse periodic orbit and dispersion which can be used for emittance exchange with help of wedge absorbers. Such a channel has about the same performance as other known 6D cooling channels with a comparable field being simpler in construction.

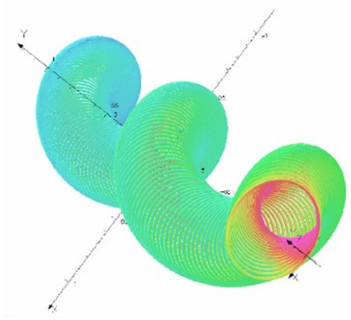
Helical FOFO Snake



"Guggenheim"



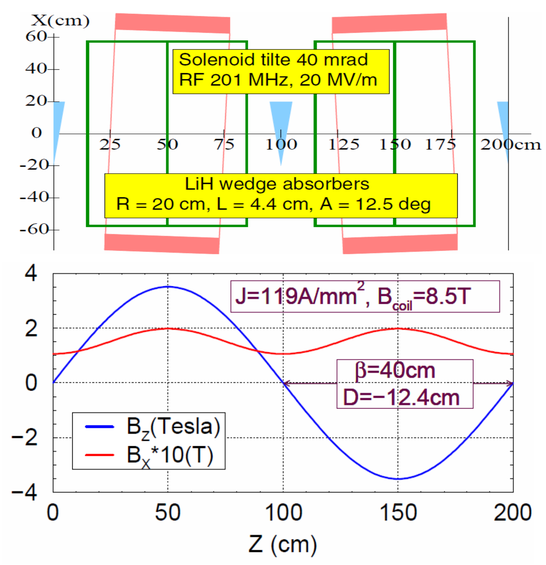
Helical Cooling Channel

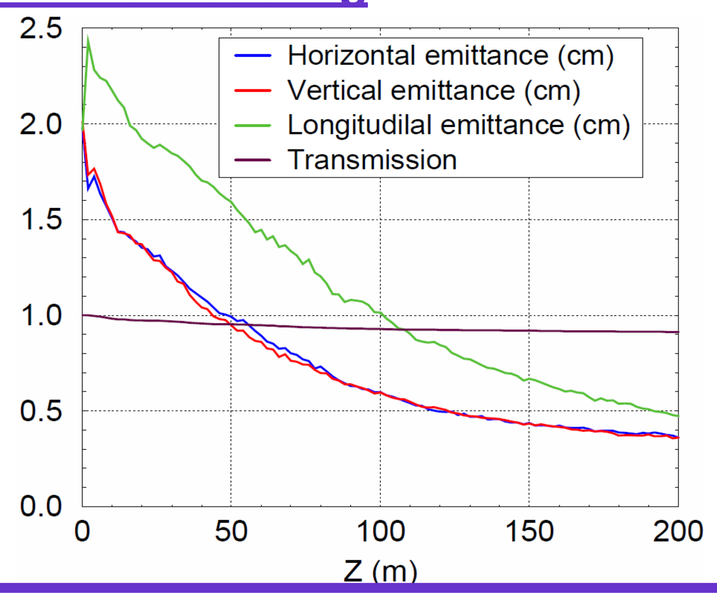


Cooling simulation

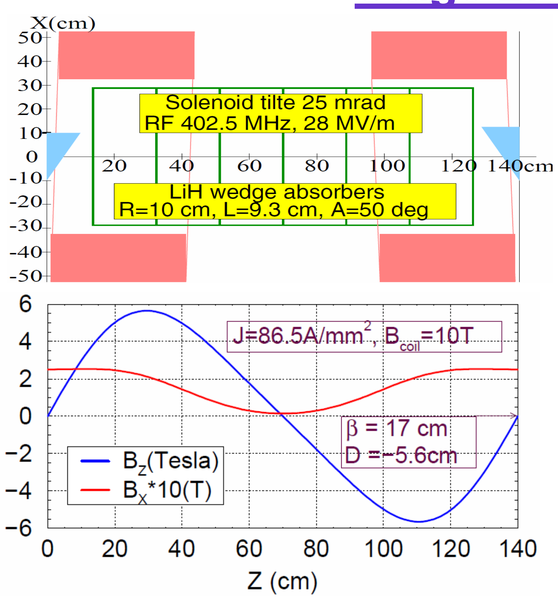
Results of simulation are presented in the right-hand column. Three versions of the cooling channel are considered being adapted for different beam acceptances. They can be combined into a series by adding of appropriate matching section (not considered)

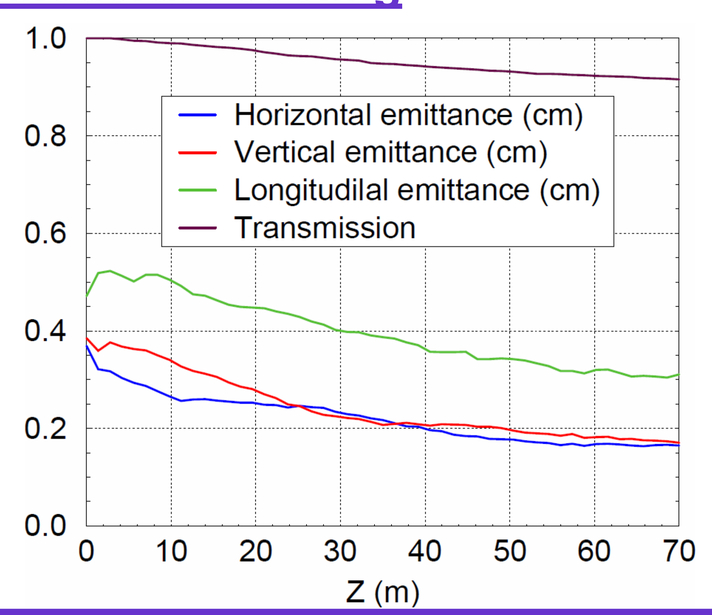
Stage 1: Low cooling



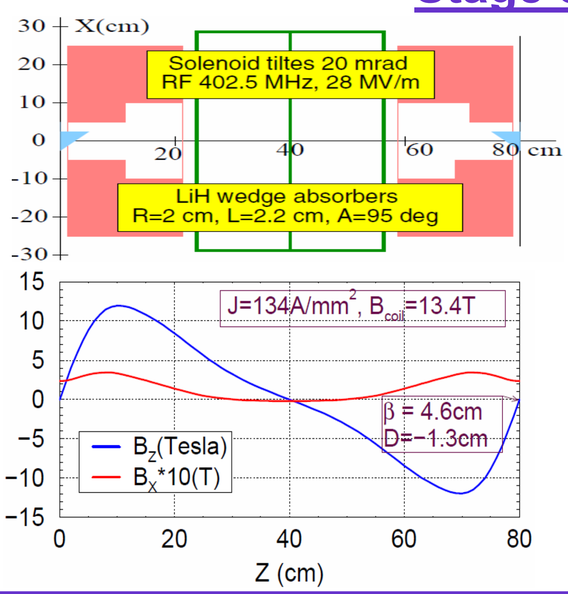


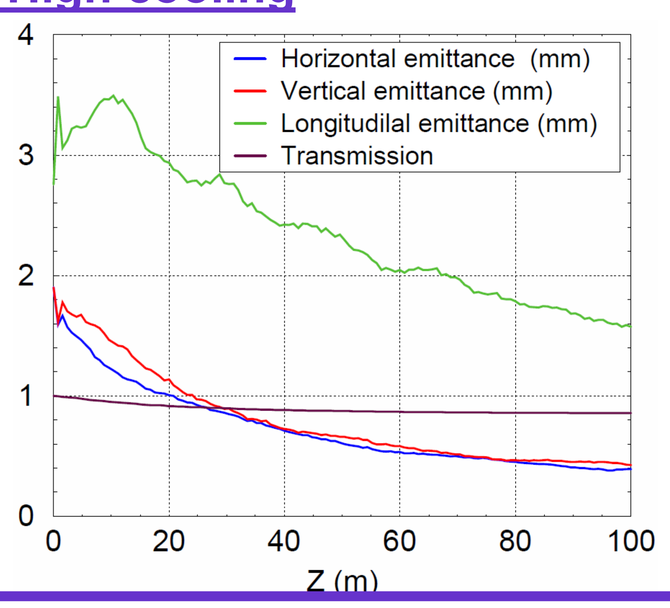
Stage 2: Moderate cooling



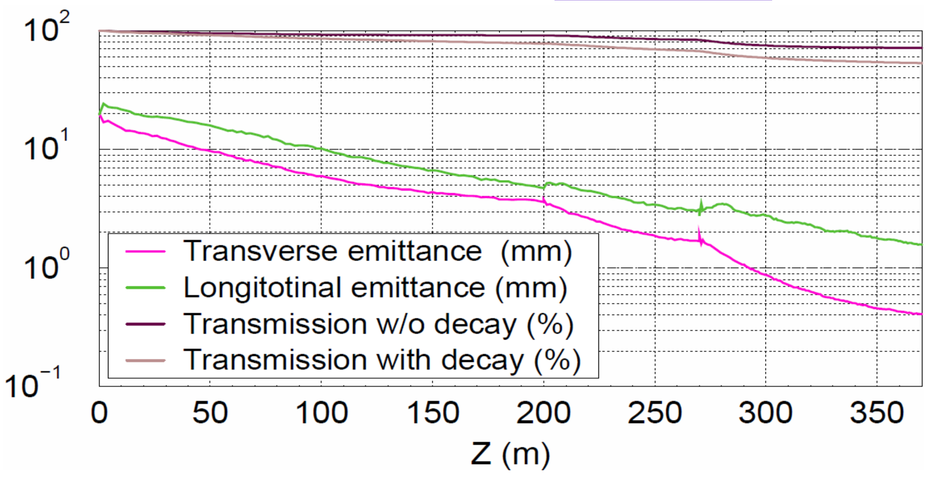


Stage 3: High cooling





Summary



72% transmission w/o decay
53% transmission with decay

1.6 mm long. emittance

0.41 mm trans. emittance

Conclusion Transverse emittance 0.4 mm and longitudinal emittance about 1.6 mm can be obtained with alternating tilted solenoids cooling channel at current density up to 134 A/mm^2 and coil field strength up to 13.4 T.