

# **CRYOGENICS FOR PARTICLE ACCELERATORS**

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Cryogenics, the science of low temperature and liquefied gases, has become a key ancillary technology to particle accelerators, enabling their sustained development and containing their capital and operating costs. We first describe the role of cryogenics in achieving high performance in accelerators, evidently for cooling superconducting devices, but also for limiting beam instabilities and maintaining ultra-high vacuum in the beam pipes. We then present essentials in cryogenic engineering – properties of fluids, design principles of cryogenic equipment, refrigeration and liquefaction techniques – with particular application to particle accelerators.