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Cryogenic infrastructures challenges for quantum computing

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Quantum computing has recently gained interest from industry, opening new fields of applications. Air Liquide Advanced Technologies, thanks to its experiences on low temperature systems and on Helium Refrigeration and Liquefaction systems for Physics and Industry, is actively developing solutions to address the many emerging challenges associated with Quantum Data Centers.
Recently, the challenges of scaling up various quantum computing technologies have been highlighted through the roadmaps of several major players. One key area of development is the need for increased cryogenic cooling power, which could be provided by helium refrigerators similar to those used to cool particle accelerator equipment or physics experiments.
This presentation will address the adaptation of solutions developed by Air Liquide Advanced Technologies over several years for industrial and scientific helium cryogenics applications. It will focus on the upcoming needs of quantum computing, particularly in terms of energy efficiency, distribution, reliability, and operability leading to proposals of new cryogenic architectures.
These works are also part of collaborations that we will present with French academic partners who utilize these cryogenic technologies for their own needs and who, furthermore, possess experience and expertise in very low-temperature cryogenics.
By exploring these aspects, the presentation aims to contribute to the ongoing discourse surrounding the future of quantum computing and its integration into large-scale data centers, offering insights into the intricate challenges and innovative solutions within this burgeoning field.

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