Quantum Computing for High Energy Physics: state of the art and challenges

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Quantum computers presents the opportunity for a transformative shift in computing across the sciences and beyond. While theoretically holding the potential to achieve a "quantum advantage," on a number of algorithms, care is required when analysing their performance on realistic use cases. At the same time the swift advancement of hardware devices with various qubit implementations allows for the execution of small-scale yet representative applications on quantum computers. Keeping this in mind, the high-energy physics community has started a series of investigations to understand the potential of quantum algorithms, and quantum machine learning in particular, across many challenging computational problems. From the point of view of theoretical physics applications, this involves exploring simulation models that are extremely difficult or even impossible to tackle with classical methods. In the case of experimental high energy physics it addresses the massive data challenges posed by new experiments, such as the Large Hadron Collider upgrade. This work has generated a community driven roadmap paper outlining the current status of quantum computing for high-energy physics. Its focus and main benchmark applications in both the theoretical and experimental physics domains are the subject of this talk.