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Multi- and many-core computing for Physics applications

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More and more often, processor manufacturers adopt the multi-core design approach as a way to further improve performances in spite of the fact that current micro-electronic technologies put a practical upper limit on clock frequency at approximately 3 GHz. A multi-core processor is a single chip integrating two or more independent CPUs. The number of cores within one chip is quickly growing: processors with 100 or more cores are expected in the near future. The many-core approach allows processors to scale according to Moore's law, but it bears a great impact on application design, further moving the challenge of sustaining performance from hardware to algorithms and software.
In this lecture we focus on architecture and programming aspects of recent developed many- and multi-core processors, analyzing the impact of their use on physics applications (mostly in theoretical physics but considering also experimental physics applications). We take into account multi-core processors based on "traditional" core-architecture such as the Sandybridge, as well as many-core systems based on GP-GPUs and on the most recent Intel Xeon-Phi. We also analyze programming strategies to exploit high performance computing using as test-bed real case physics applications.

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