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DI RIPRESA E RESILIENZA



CASCADE CALL SPOKE2 - PUB3

Library for Quantum X-Dynamics (LIQUXD)



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








Library for Quantum X-Dynamics

- Creation of a library to simulate Quantum Field Theories on a lattice
- QXD: Quantum Chromo/Electro Dynamics

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Isospin symmetric			
 connected light 633.7(2.1)(4.2)	 connected strange 53.393(89)(68)	 connected charm 14.6(0)(1)	 disconnected -13.36(1.18)(1.36)
QED isospin-breaking: valence		Strong isospin-breaking	
 connected -1.23(40)(31)	 disconnected -0.55(15)(10)	 connected 6.60(63)(53)	 disconnected -4.67(54)(69)
QED isospin-breaking: sea		Etc.	
 connected 0.37(21)(24)	 disconnected -0.040(33)(21)	bottom; higher order; perturbative 0.11(4)	
QED isospin-breaking: mixed		Finite-size effects	
 connected -0.0093(86)(95)	 disconnected 0.011(24)(14)	isospin-symmetric 18.7(2.5) isospin-breaking 0.0(0.1)	

$$\begin{aligned}
 & + [m_d - m_{ud}^0] \partial_t \left[\text{diagram with } \otimes \text{ and } \oplus \text{ vertices} \right] - e_d e_s e^2 \partial_t \left[\text{diagram with wavy and straight lines} \right] - e_d^2 e^2 \partial_t \left[\text{diagram with star and wavy lines} \right] \\
 & + e_d e^2 \sum_f e_f \partial_t \left[\text{diagram with wavy and blue loop} \right] - [m_d^{cr} - m_0^{cr}] \partial_t \left[\text{diagram with red dot} \right] + [m_s^{cr} - m_0^{cr}] \partial_t \left[\text{diagram with red dot} \right] \\
 & + e_s e^2 \sum_f e_f \partial_t \left[\text{diagram with wavy and blue loop} \right] - e_s^2 e^2 \partial_t \left[\text{diagram with wavy and star lines} \right] + [m_s - m_s^0] \partial_t \left[\text{diagram with } \otimes \text{ and } \oplus \text{ vertices} \right]
 \end{aligned}$$

Heterogeneous diagrams, needs automatic & efficient implementation in heterogeneous HPC

CPU & GPU for performances portability

- Lately both CPU and GPU are used in Lattice computations
- Optimal data layout of CPU & GPU are incompatible
- Different parallelizations: OpenMP vs. Cuda
- Different theories/measures needs multiple implementations

An optimal simultaneous use of CPU and GPU is the target of the project.

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- Lately both CPU and GPU are used in Lattice computations
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An optimal simultaneous use of CPU and GPU is the target of the project.
By starting from components that are already available individually:

- Modern C++, CUDA, MPI, OpenMP
- Generic programming (metaprogramming)
- Abstraction of the data layout

We aim at building a complete and documented library

The Project

Duration: 15 Months

- Staff: C.Tarantino, PA 25% ; V.Lubicz, PO 25% (60 k€)
- Recruiting: 2 years of “Contratto di Ricerca” (2 x 50 k€)
- Hardware: 3 x Servers with 2 x GPU to prototyping (60 k€)
- Indirect costs (24 k€)

Subject to adjustment (Assegno? Ammortamento?)