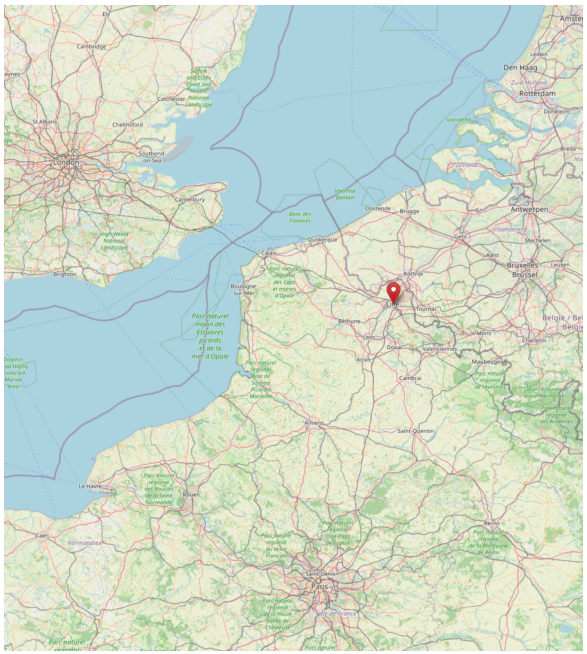
Journée des nouveaux entrants du Pôle Théorie

Karim Hasnaoui

Laboratoire de physique des deux infinis Irène Joliot-Curie

High-Performance Computing Engineer

Origins



- Born and grew up in Lille/Rijsel area
- World citizen but officialy  &  citizen
- Mother tongues : French, Ch'ti and Algerian Arabic

Scientific background and career

2000-2005 : University

- Université de Lille Lille University : BSc of Physics
- Lyon University : Master's degree in theoretical physics

2005-2008 : PhD Thesis

- GANIL GANIL : PhD thesis in theoretical nuclear physics

2008-2013 : Postdoctoral Fellowship

- 2008-2010 : Tohoku University (Japan)
- 2011-2013 : Florida State University (USA)

2013-2016 : Industry

- 2013-2015 : NUVIA Nuvia - Millennium
- 2015-2016 : SCALIAN Alyotech France

2016-Now : CNRS

- 2016-2018 : ICP Orsay
- 2018-2025 : cnrs IDRIS & Maison de la Simulation

Hobbies : Hockey & Judo

Roller in line hockey

- I play since 1992
- Part of my High school education
- I played as semi-professional (1999-2020)
- Federal coach degree
- I'm still having fun and helping young generation ☺

Judo

- I started in 1988, stopped in 1993... but I started again in 2022
- Head of Dojo @ Bures sur Yvette
- Would you like to join us ?

Last 7 years at CNRS

Institut du développement et des ressources en informatique scientifique

- Helpdesk @ ADA, Turing and Jean Zay supercomputers
- Advanced support for parallelism and code optimization : short term ($\sim$ days - weeks) and mid term ($\sim$ weeks - month)
- Contrat de progrès GPU
- NVIDIA Hackathon GPU

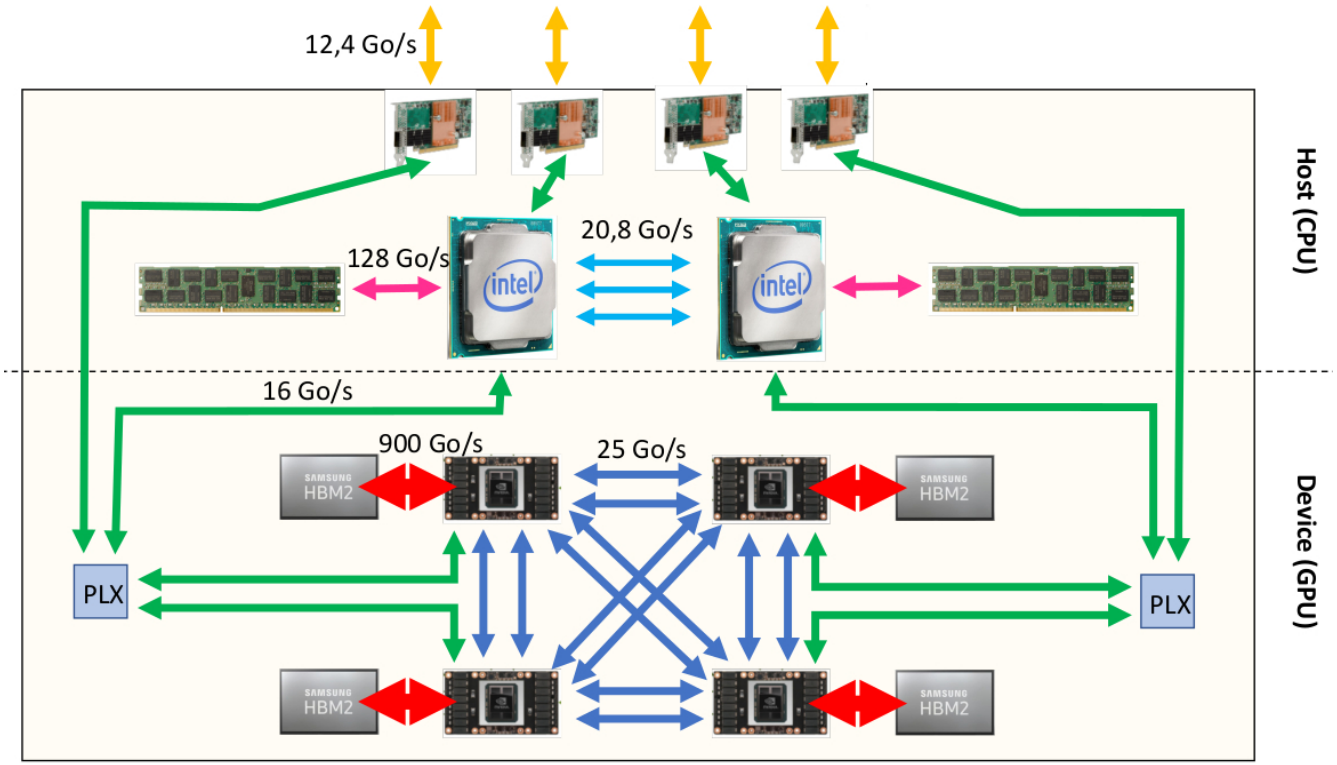
Maison de la Simulation

- Helpdesk @ Ruche supercomputer
- Advanced support for parallelism and code optimization : long term ($\sim$ month - years)
- Manager of the French PRACE Training Center

Main technologies used

- CPU Parallelization : MPI, OpenMP & ScaLAPACK
- GPU Parallelization : CUDA/HIP, OpenMP, OpenACC & MAGMA

Typical GPU node used by modern supercomputers



Jean Zay node for V100 GPU partition :

- 2 Intel Cascade Lake 6248 processors (20 cores at 2.5 GHz), namely 40 cores per node
- 192 GB of memory per node
- 4 Nvidia Tesla V100 SXM2 GPUs (32 GB)

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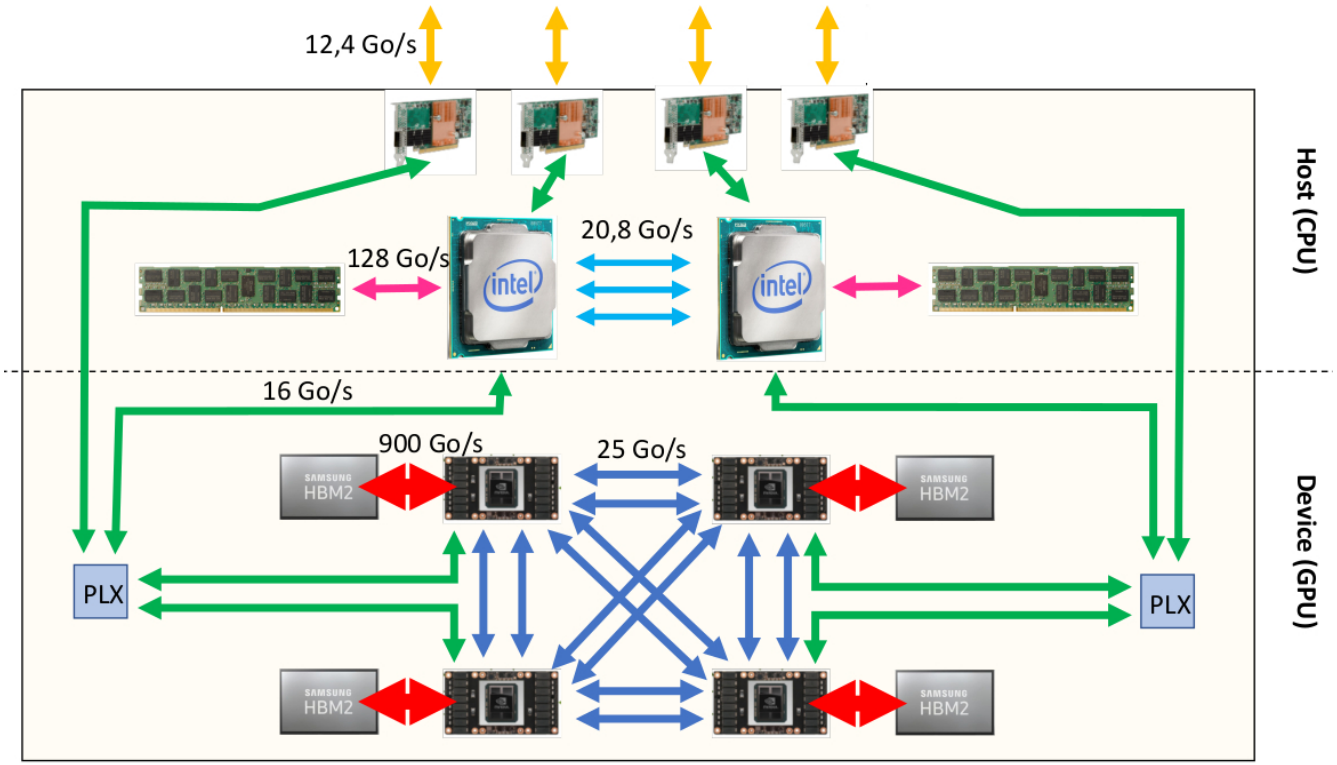

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GENCI criteria : Speedup 40CPU Vs 40CPU + 4 GPU ≥ 4

When is it advantageous to use GPUs ?

- GPU are efficients for massive and same independent calculation
- Examples where GPU are extremly efficient :
  - Graphical treatments
  - Linear algebra for dense vectors and matrices
  - Linear solvers for large grids
  - Fast Fourier Transform
  - Molecular dynamics
  - AI (machine and deep learning)
  - Lattice QCD

Possible APIs for GPU

API*	Advantages	Disadvantages
CUDA/HIP	- Low level perfomance - Portability	- Require to write GPU kernels - Code factorisation lost
OpenACC	- Based on directives - Code factorisation kept	- Good performance only with NVHPC - Not fully implemented in GCC - Not fully implemented in LLVM
OpenMP target	- Based on directives - Code factorisation kept	- Good performance only with CRAY - Not fully implemented in GCC - Not fully implemented in LLVM
Kokkos	- Key abstractions - Code factorisation kept - Multiple backends - Performance portability - Multiple backends	- Modern C++ - Not available in Fortran

* *Application Programming Interface*

Main goal @ IJCLab

- Assist researchers in developing, deploying and using simulation codes
- Support in optimization and parallelization (CPU/GPU)
- Deploy codes on local and/or national supercomputers
- Maintainability (porting codes to standards, regression tests, etc...)
- Track codes on GitLab
- Documentation
- User support
- Support in distributing open-source codes

Thank you very much... let's have fun ! ! !