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# Lumi-Hackathon Summary

## PEPS-Julia Team

Collaborators:

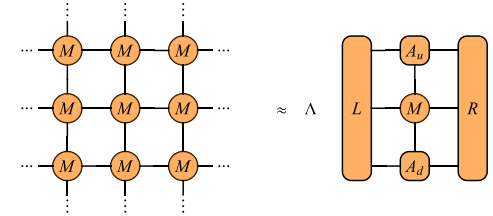
Xingyu Zhang

Victor Vanthilt

Bert Jorissen

Alfio Lazzaro

# Background information



- We study condensed matter physics using Tensor Networks.
- Doing so requires multiplying matrices, decomposing them, ...
- Many physical systems have relevant Symmetries
- Symmetries lead to **block diagonal structure**
- The goal is to get specialized GPU code as a backend to our algorithms

$$\begin{pmatrix}
 a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 0 & a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 0 & 0 & a & a & a & a & 0 & 0 & 0 & 0 & 0 & 0 \\
 0 & 0 & a & a & a & a & 0 & 0 & 0 & 0 & 0 & 0 \\
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 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a & a \\
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 \end{pmatrix}$$

# Goals for the week

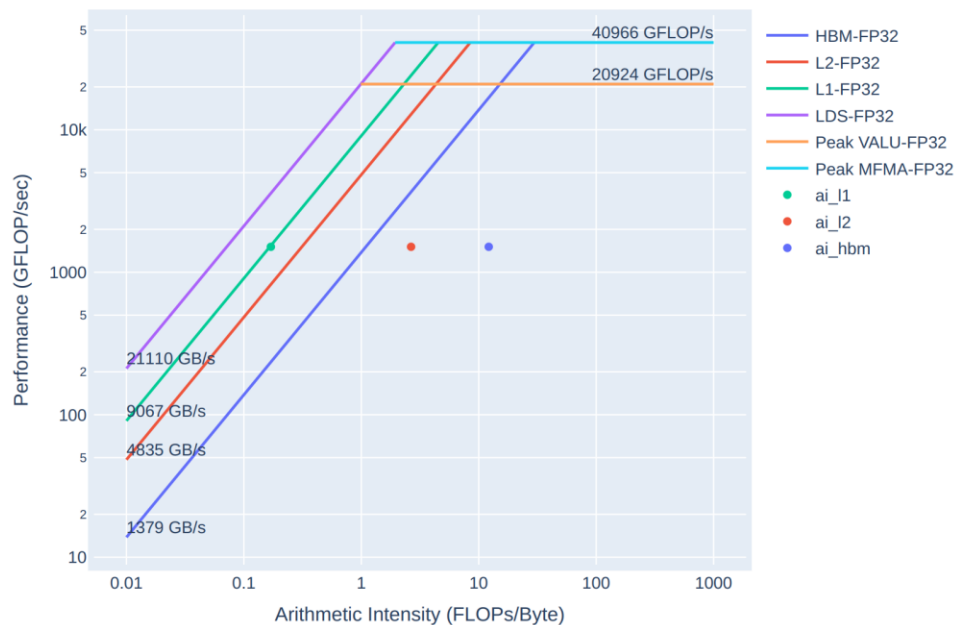


- How can we get Julia running on Lumi, using the HPE-provided compilers, rocblas, ...
- Get familiar with writing performant code with Julia on HPC systems.

# Compile Julia?

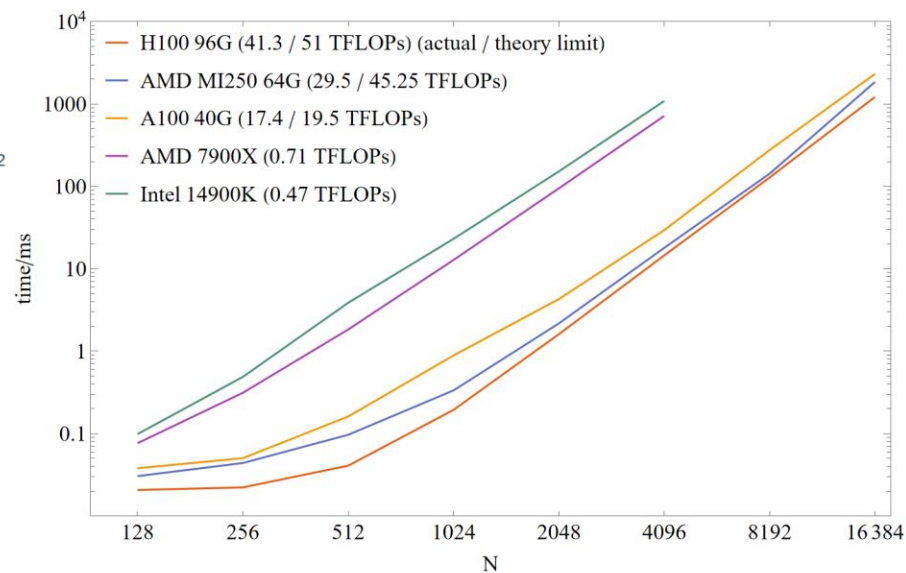
- Roofline profile for kernels

KernelAbstractions.jl



- Matrix multiplication

AMDGPU.jl

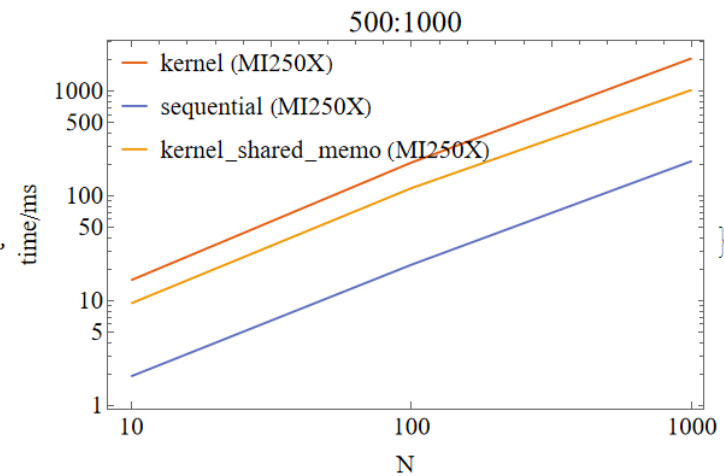
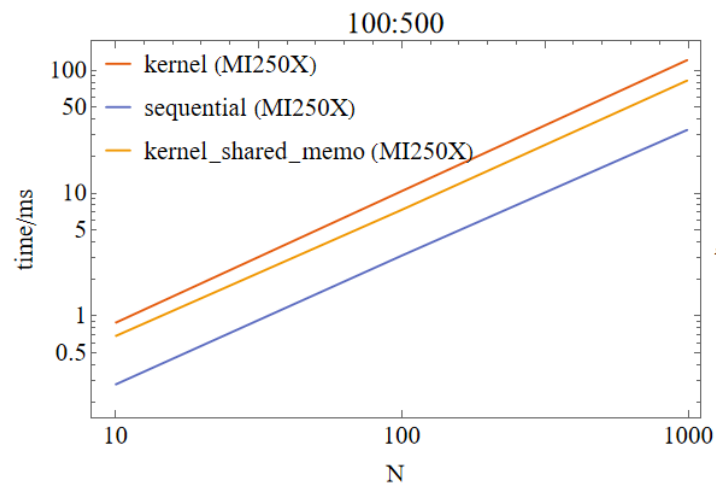
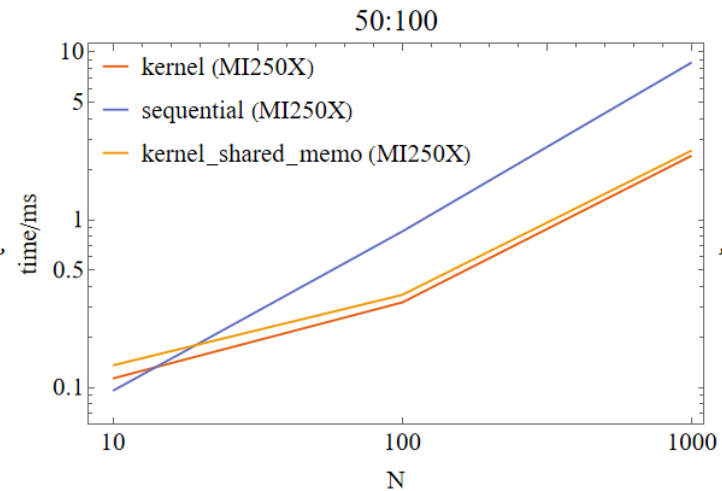
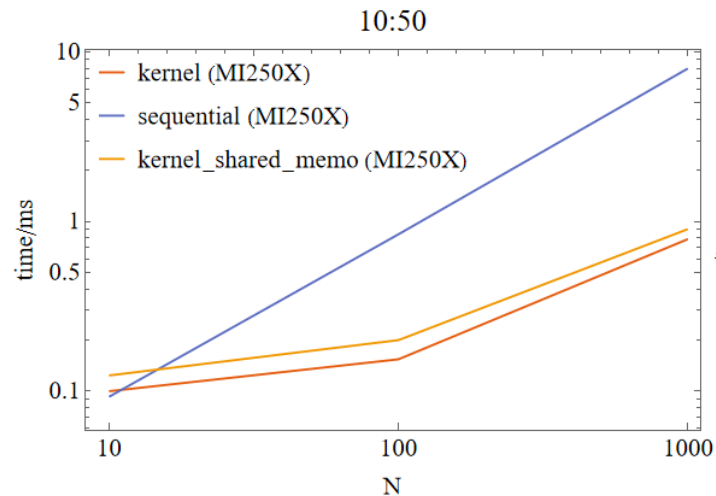


# Tools learned

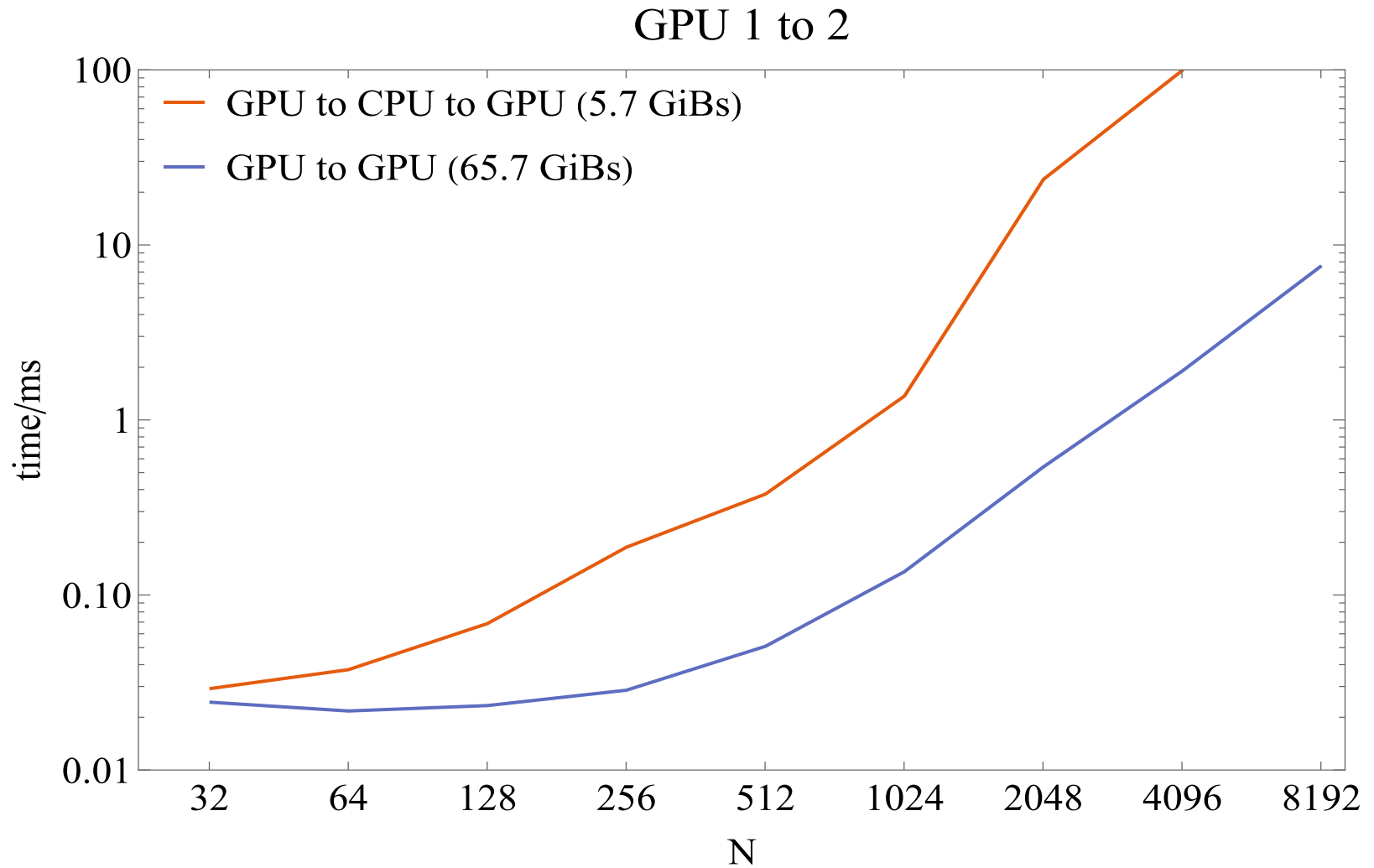
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- Profile GPU code with rocprof
- Use omniperf to get roofline
- Running batch (using srun)
- MPI coding using Julia handles
- Intranode GPU to GPU communication (without MPI)

# Benchmark: Kernel vs Sequential Blas



# Data transfer



# Work in progress

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- One process
  - Parallel sequential matrix multiplication
  - Cannon algorithm (GC errors)
- Multiple processes
  - MPI profiling using Score-P
  - Internode GPU to GPU using MPI(.jl)



# Future goal

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- Improve AMDGPU.jl memory management
- Integrate multi gpu/node code in the backend of our Tensor Network code. (Real Physics!)

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# Thank you for Listening!

Q&A