Beyond `MPI_Send`: What I learned implementing MPI for halo exchange

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Slides: git.io/fAV4t

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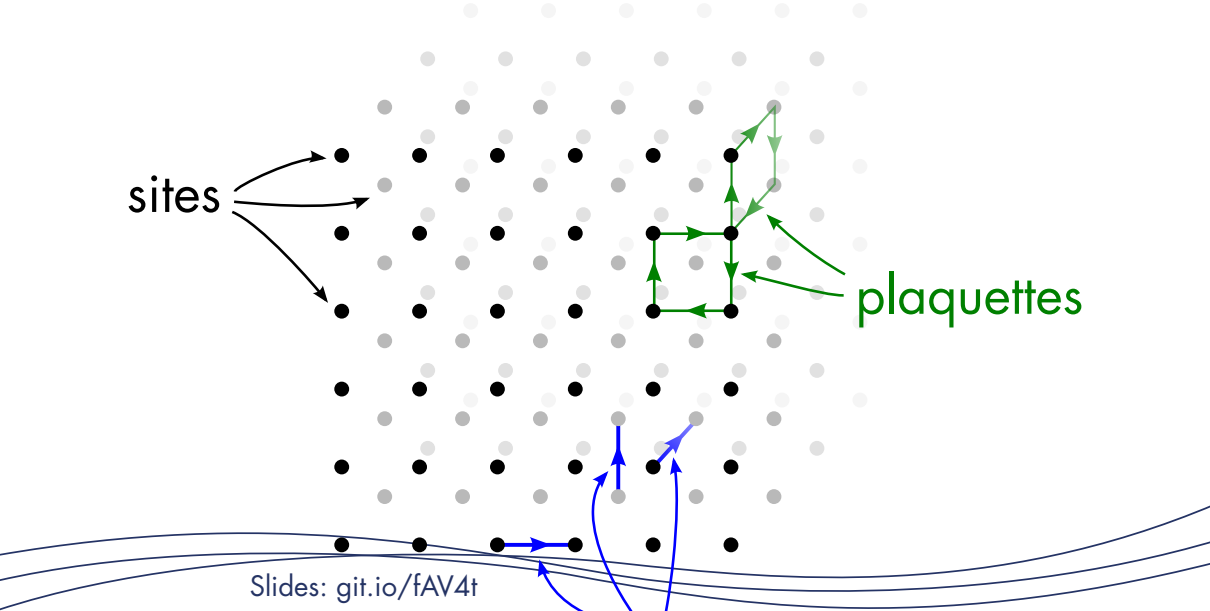
- Three-dimensional problem; 1-3 additional d.o.f.s

3D lattice



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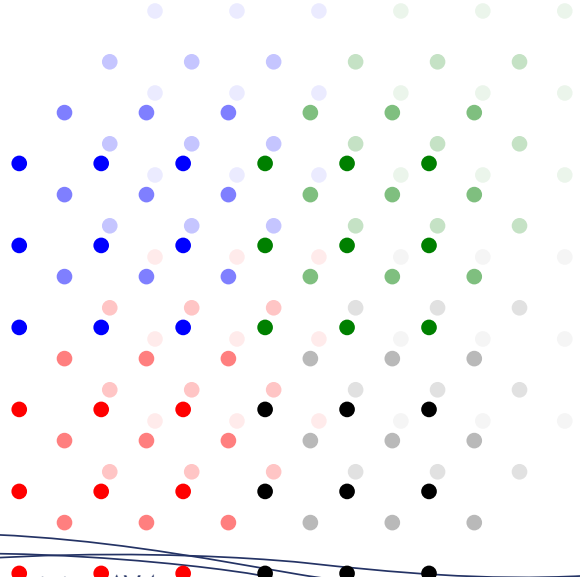
Partitioning a 3D lattice



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- Collectives, e.g. `MPI_Reduce`

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- In-place reductions

```
call MPI_AllReduce(MPI_In_Place, vel2, 1, MPI_Real, &
                   MPI_Sum, comm)
```

TIL #2: Subarray types

```
subroutine init_single_halo_type_4(direction, position, size4, &
                                   datatype, typetarget)
  integer, intent(in) :: direction, position, size4
  type(MPI_Datatype), intent(in) :: datatype
  type(MPI_Datatype), intent(out) :: typetarget
  integer, dimension(4) :: sizes, subsizes, starts

  sizes = (/ ksizex_l + 2, ksizey_l + 2, ksizet_l + 2, size4 /)
  subsizes = (/ ksizex_l, ksizey_l, ksizet_l, size4 /)
  subsizes(direction+1) = 1
  starts = (/ 1, 1, 1, 0 /)
  starts(direction+1) = position

  call MPI_Type_Create_Subarray(4, sizes, subsizes, starts, &
                  MPI_Order_Fortran, datatype, typetarget)
  call MPI_Type_Commit(typetarget)
  return
end subroutine init_single_halo_type_4
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call MPI_File_Open(comm, 'con', MPI_Mode_Rdonly, &
                   MPI_Info_Null, mpi_fh)
call MPI_File_Set_View(mpi_fh, 0_8, MPI_Real, mpiio_type, &
                       "native", MPI_Info_Null)
call MPI_File_Read_All(mpi_fh, theta, &
                       3 * ksizex_l * ksizey_l * ksizet_l, &
                       MPI_Real, status)
call MPI_File_Close(mpi_fh)
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  - Gives index of processes in both directions

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- Also need `MPI_Wait`/`MPI_WaitAll`
- Collectives planned for MPI 3.2, e.g. `MPI_AllReduce_Init`

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- Include the type for MPI-IO here

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- Reading input parameters: do on rank 0 and broadcast

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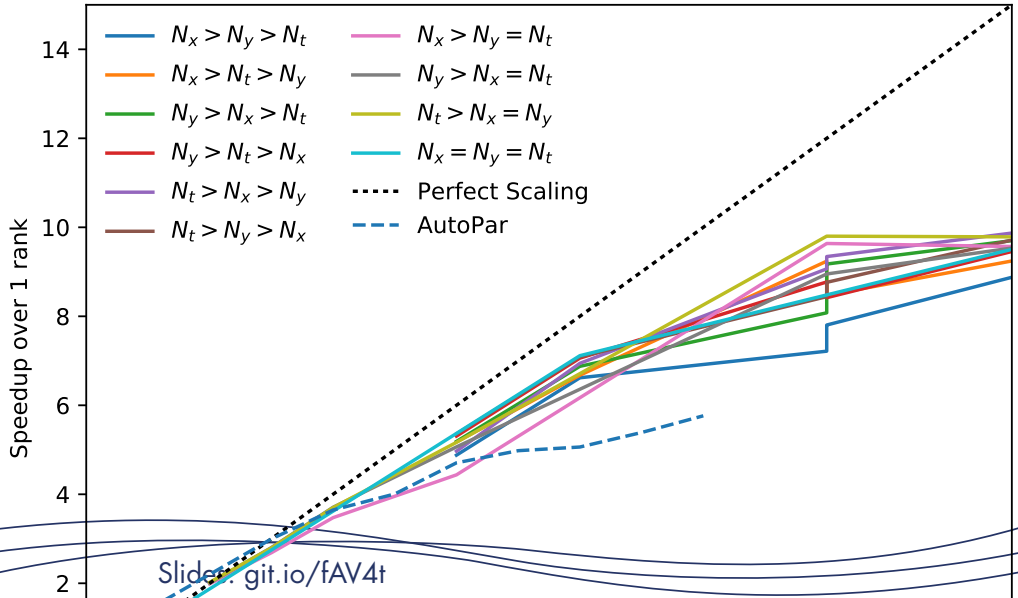

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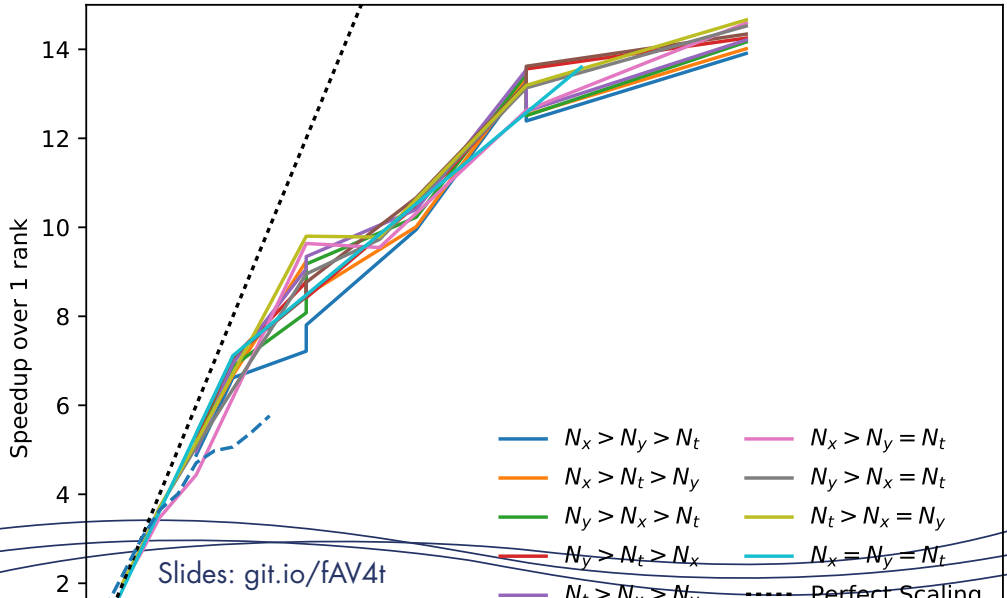
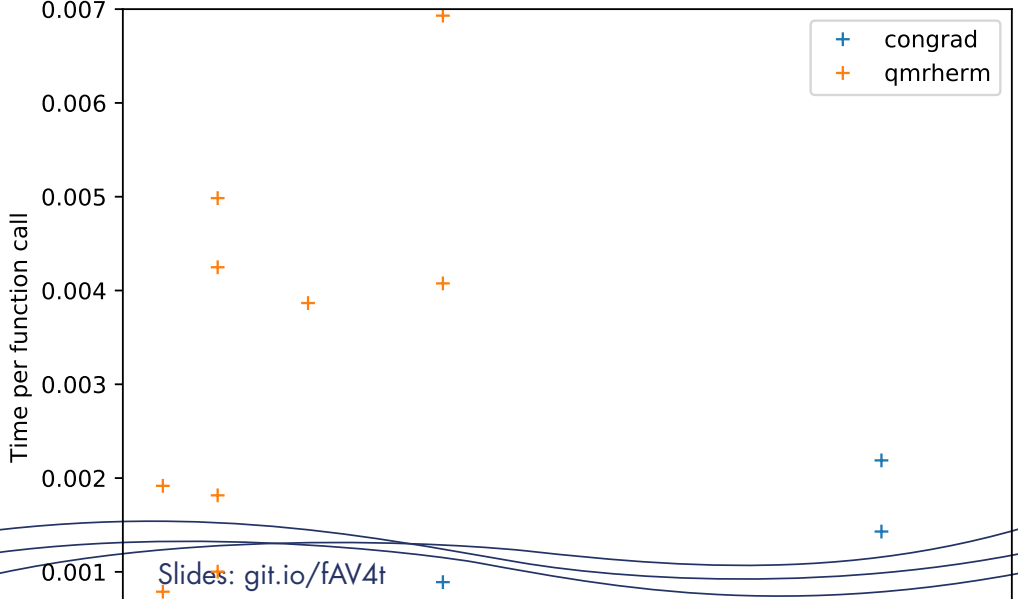


Weak and strong scaling of a single operation



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