"Double the grid" refinement for NLS

example: $np = 8$

$$\text{regrid up} \longrightarrow$$

$$\longleftarrow \text{regrid down}$$
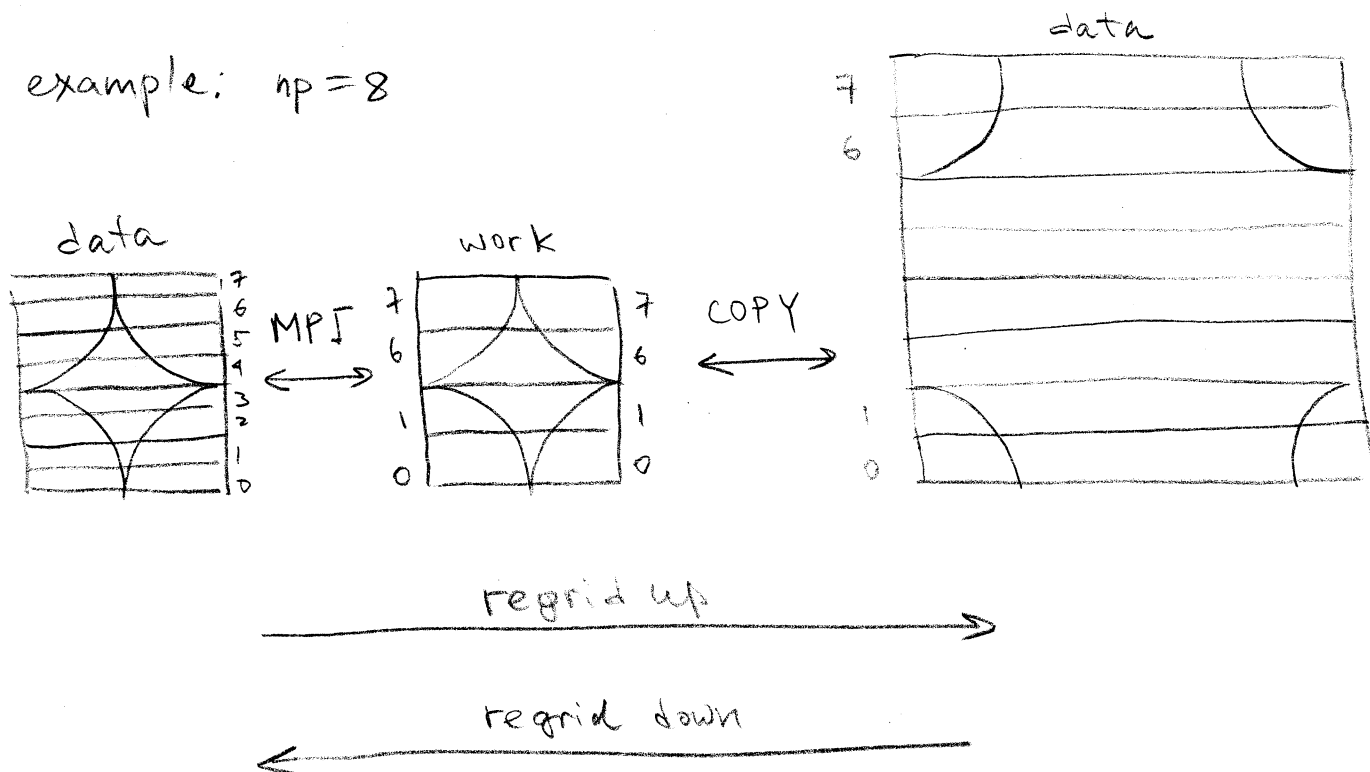
MPI communications $(np \geqslant 4)$

coarse grid   fine grid
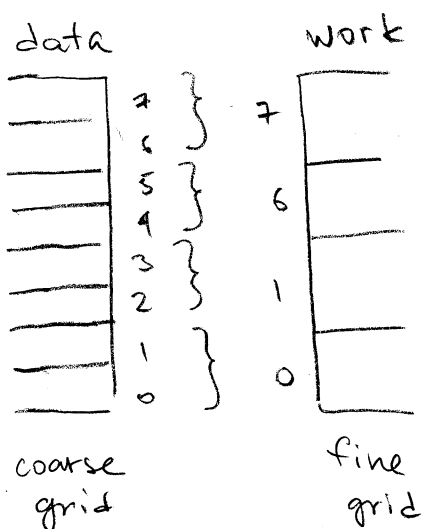
$myid < \dfrac{np}{2}$:

$$id\_fine1 = 2\,myid$$
$$id\_fine2 = 2\,myid + 1$$
$$id\_coarse = floor\left(\dfrac{myid}{2}\right)$$
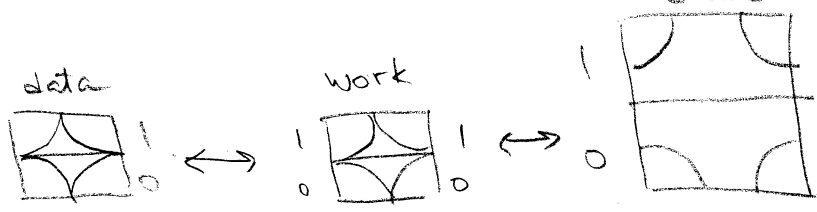
$myid \geqslant \dfrac{np}{2}$:

$$id\_fine1 = 2\,myid - np$$
$$id\_fine2 = 2\,myid - np + 1$$
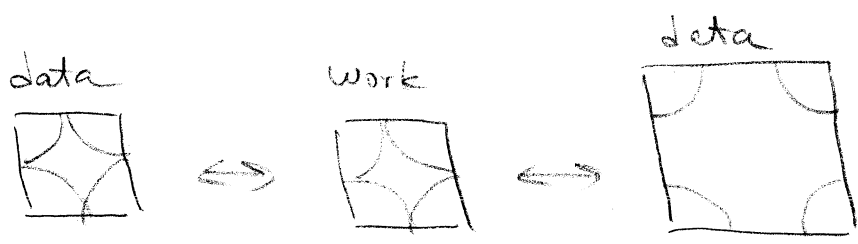$$id\_coarse = myid + floor\left(\dfrac{np - myid}{2}\right)$$

- data on even processes $\Longleftrightarrow$ 1st half of work
- data on odd processes $\Longleftrightarrow$ 2nd half of work

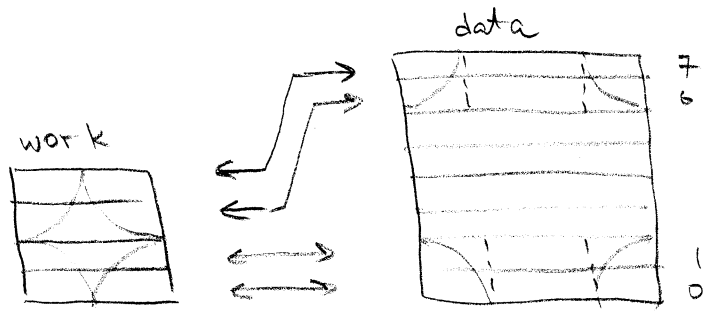MPI communications for np=1 and np=2 are replaced by copying

np = 2:

hp = 1:

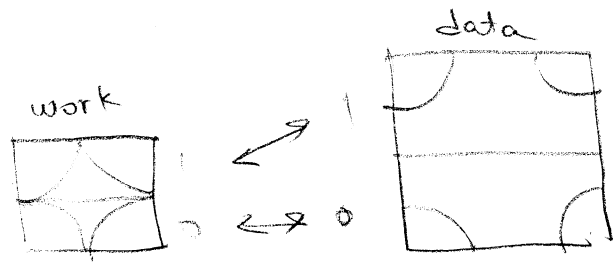## Array extension

hp ≥ 4:

first and last quarter of processes exchange all rows

hp = 2:

process 0 exchanges all rows of work with 1st half of data
process 1 exchanges all rows of work with 2nd half of data

hp = 1:

process 0 exchanges 1st half of work with 1st quarter of data
and 2nd half of work with last quarter of data