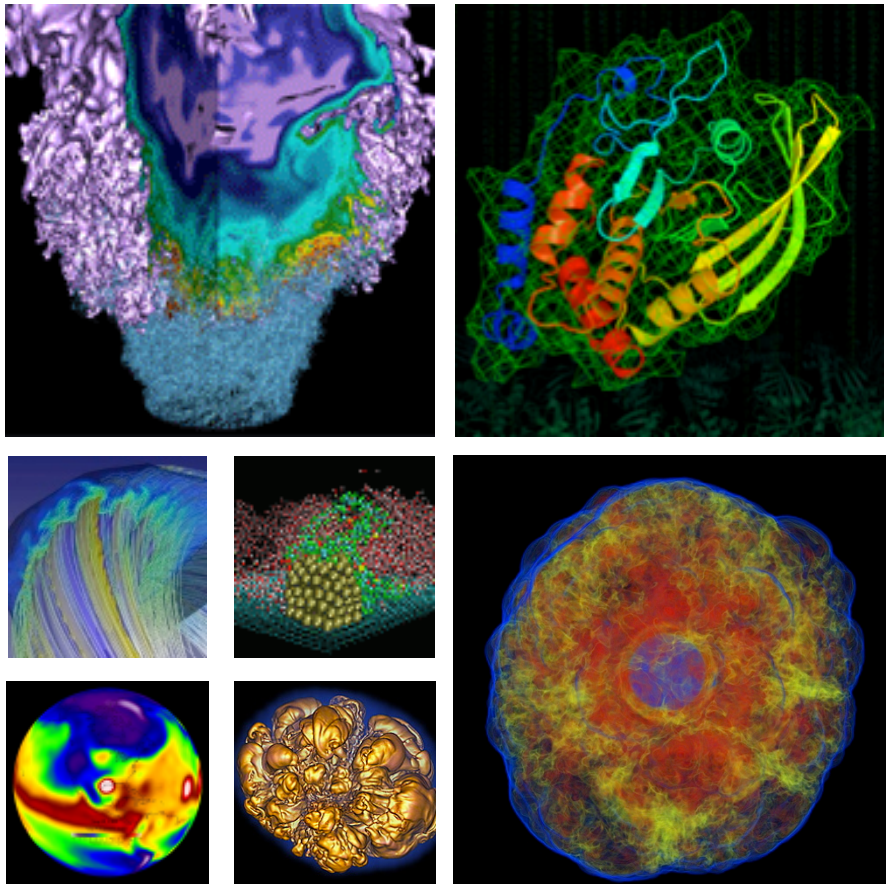
# Using the Burst Buffer on Cori

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# Full documentation

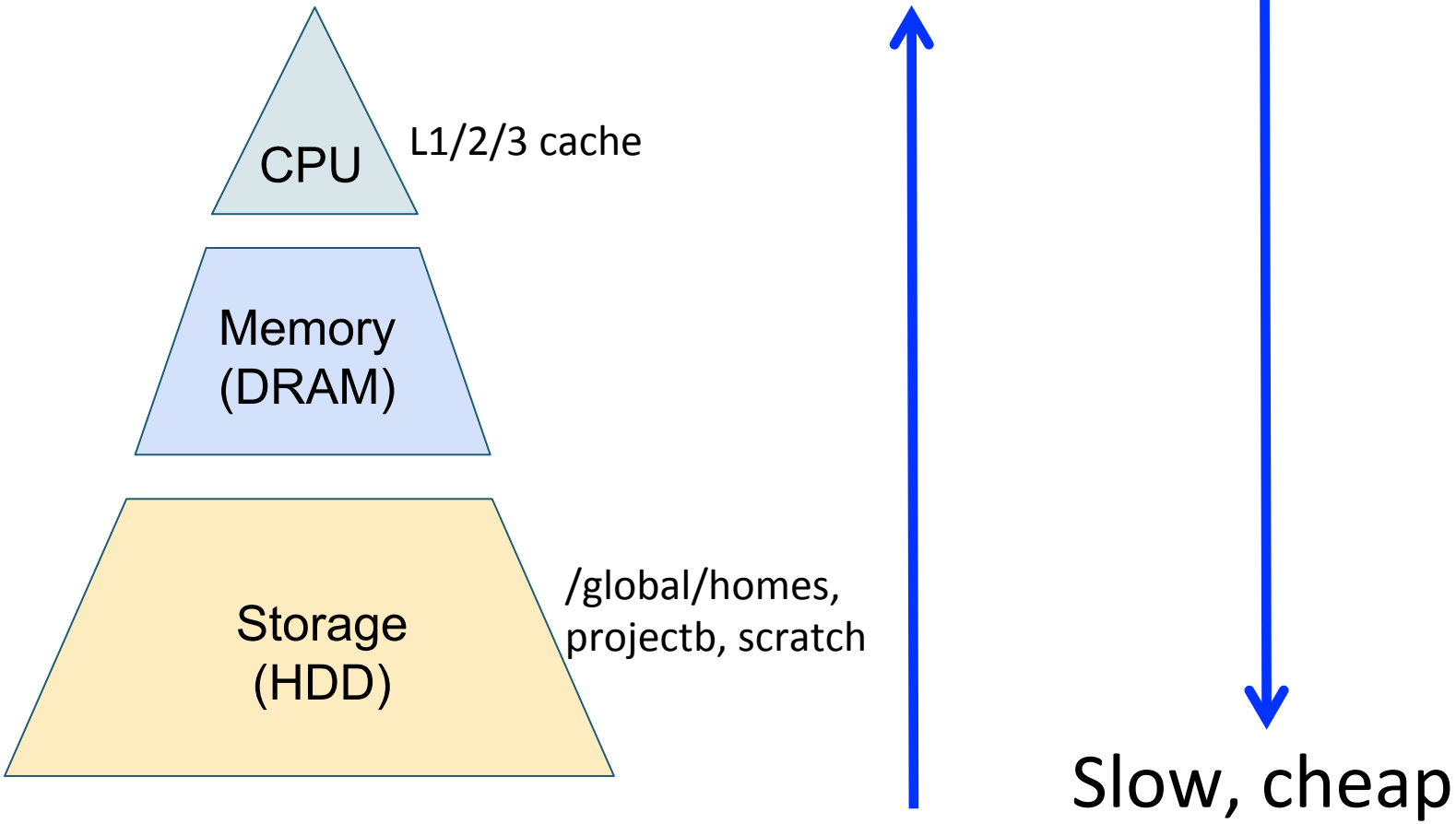
- **On the NERSC website, at**
  - https://www.nersc.gov/users/computational-systems/cori/burst-buffer/

# What is a Burst buffer?

- **Unlike Genepool, Cori batch nodes have no local disk**
- **Global filesystems can be slow for some workloads**
  - Applications with large I/O requirements
  - Random-access I/O, instead of streaming
  - Problem magnifies with scale
    - Many jobs reading same reference DBs etc
- **Burst buffer is fast disk you can use in batch, on Cori**
  - Physically part of Cori, close to the compute nodes
  - Much faster (SSDs instead of spinning disks)
  - Smaller volume (10's − 100's GB, not TB)
  - User-configurable properties
    - Lifetime, performance

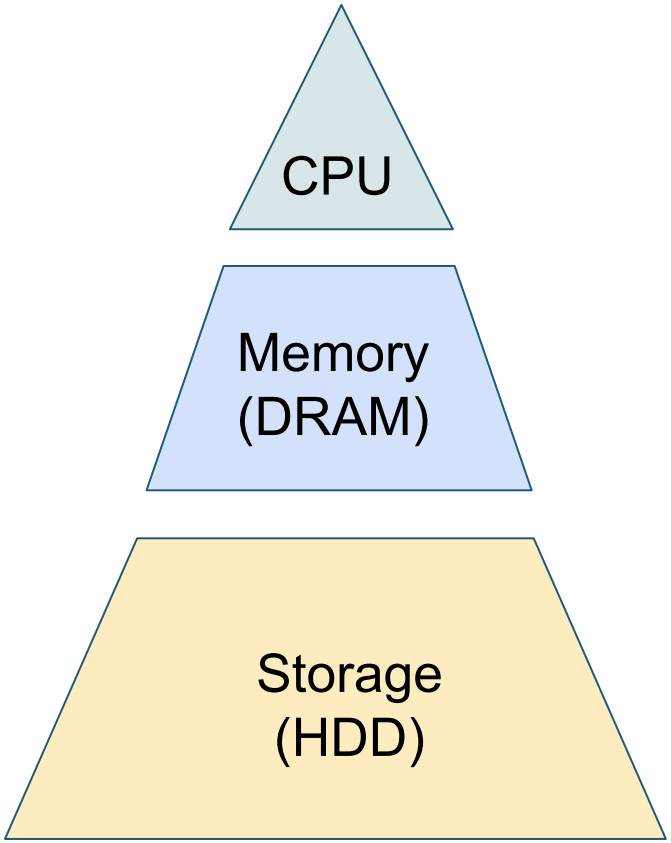
# HPC memory hierarchy

## Past

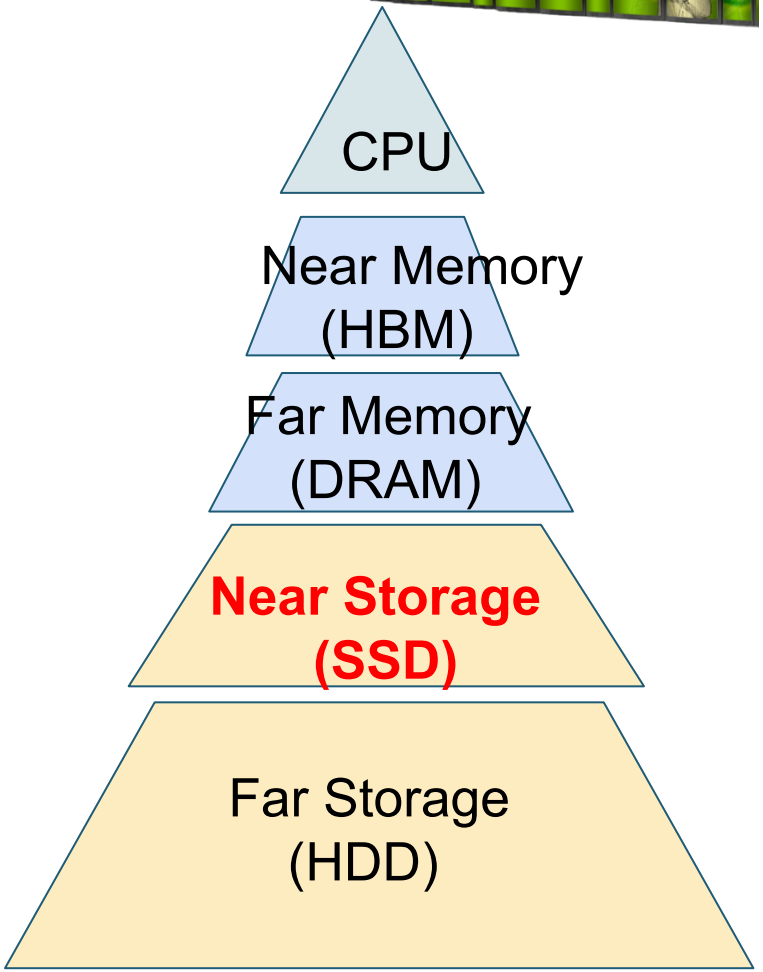


# HPC memory hierarchy

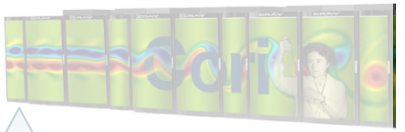
## Past



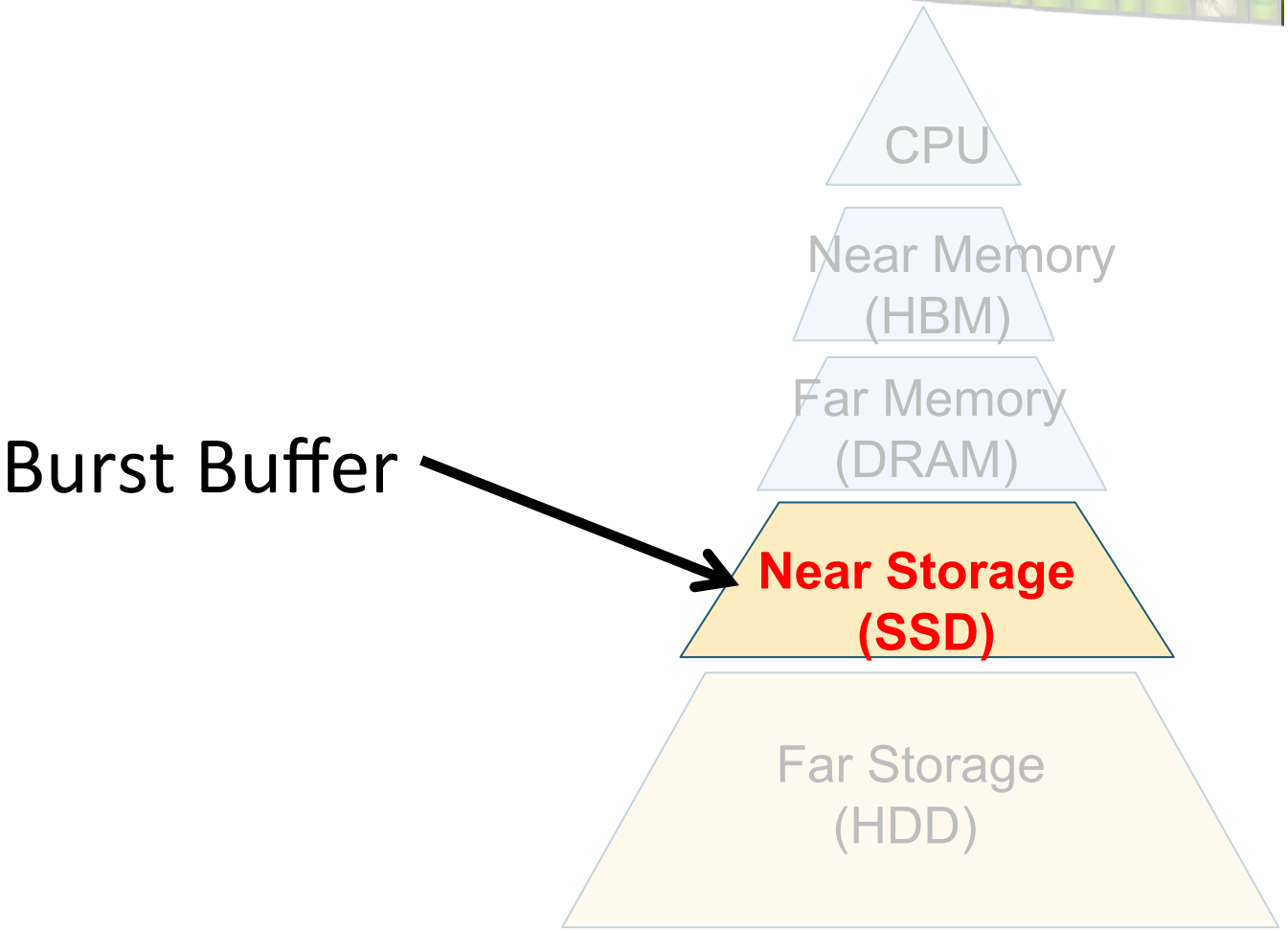

## Present



# HPC memory hierarchy



Present




Burst Buffer

# Accessing the Burst buffer

- **Cori only, not available on Edison or Genepool**
  - ~1.8 PB available, spread over 288 nodes
  - Accessible to both Haswell and KNL partitions
  - Batch nodes only, not available on login nodes
- **Create/delete Burst buffer reservations**
  - Use **#DW** or **#BB** directives in your batch jobs
    - At top of script, just below any #SBATCH directives
  - Granularity: 'pool' size fixed, but can ask for any capacity you want
    - 80 GB default granularity
    - 20 GB – for really intense I/O, add 'pool=sm_pool' to commands
- **View existing reservations**
  - 'scontrol show burst | grep $USER'

# Burst buffer characteristics

- **Per-job reservation– scratch space**
  - Lasts as long as the batch job it's created for
  - Only visible to that batch job
  - Used for:
    - staging files in/out of job
    - fast scratch space
    - Checkpoints
- **Persistent reservation – sharing data**
  - Can be shared among jobs
  - Lifetime controlled by person who creates it
  - Used for
    - staging files in/out of jobs
    - sharing data (reference files)
    - coupling job workflows
  - **Not for long-term storage of data!**
    - No guarantees, instance may disappear at any time

# Using Burst buffer as scratch

```
#!/bin/bash
#SBATCH -p debug
#SBATCH -N 1
#SBATCH -C haswell
#SBATCH -t 00:15:00
#DW jobdw capacity=200GB access_mode=striped type=scratch
...
```

Currently, the only option

Required keywords

Size

**striped**: all jobs in multi-node job share the same space

**private**: each node in multi-node job gets its own space

# Using Burst buffer as scratch

'**#DW**' only gets you capacity
it's up to you to actually use it!

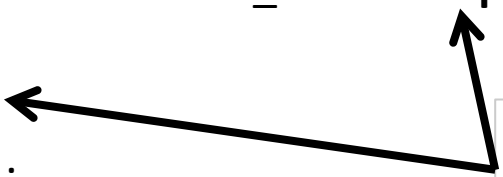
**$DW_*** environment variables
point to the space on disk

```
#!/bin/bash
#SBATCH -p debug
#SBATCH -N 1
#SBATCH -C haswell
#SBATCH -t 00:15:00
#DW jobdw capacity=200GB access_mode=striped type=scratch

cd $DW_JOB_STRIPED
cp $HOME/my-file.dat .

./do-something --with my-file.dat --output my-output.dat

cp my-output.dat $HOME/      # Save your output, or lose it!
```



$DW_JOB_PRIVATE
if mode=private

# Staging data to the Burst buffer

- Staging in/out happens before/after the job runs
  - #DW directives at top of script, not inline
- Not counted against your batch-job time
- Can't use environment variables – why not?

```
#!/bin/bash
#SBATCH -p debug
#SBATCH -N 1
#SBATCH -C haswell
#SBATCH -t 00:15:00
#DW jobdw capacity=20GB access_mode=striped type=scratch

#DW stage_in source=/global/cscratch1/sd/username/path/to/filename
destination=$DW_JOB_STRIPED/filename type=file

#DW stage_out source=$DW_JOB_STRIPED/dirname destination=/
global/cscratch1/sd/username/path/to/dirname type=directory
```

Full path, no environment variables!

Stage in/out files or directories

# Staging data to the Burst buffer

- Staging in/out happens before/after the job runs
  - #DW directives at top of script, not inline
- Not counted against your batch-job time
- Can't use environment variables
  - Your job hasn't 'logged in' yet!

```
#!/bin/bash
#SBATCH -p debug
#SBATCH -N 1
#SBATCH -C haswell
#SBATCH -t 00:15:00
#DW jobdw capacity=20GB access_mode=striped type=scratch

#DW stage_in source=/global/cscratch1/sd/username/path/to/filename
destination=$DW_JOB_STRIPED/filename type=file

#DW stage_out source=$DW_JOB_STRIPED/dirname destination=/
global/cscratch1/sd/username/path/to/dirname type=directory
```

Full path, no environment variables!

Stage in/out files or directories

# Persistent Burst buffer reservations

- **Use #BB directives to create/delete, #DW to use it**
  - Create batch jobs to create/delete the reservation
  - No lifetime guarantees, always back up valuable data!
  - **#BB create_persistent name=TW_BB** capacity=80GB access=striped type=scratch
    - Create my persistent reservation
    - **$DW_PERSISTENT_STRIPED_TW_BB** points to directory
  - **#DW persistentdw** name=TW_BB
    - Use it in subsequent batch jobs
  - **#BB destroy_persistent** name=TW_BB
    - It's your responsibility to destroy the reservation yourself

# Burst buffer and interactive sessions

- **Want an interactive session for debugging, with Burst buffer? You can do that!**
  - Create a file with the same #DW or #BB directives you'd put in a batch script
  - Use the **--bbf** flag to salloc to create the burstbuffer allocation
    - > salloc --qos=interactive −C haswell −t 01:00:00 **--bbf="mybbf.conf"**
  - N.B. the quotes around the filename are obligatory!
  - Can create temporary reservations, for lifetime of interactive session, or create/use/delete persistent reservations

# Best practices

- **Experiment, to see if using the Burst buffer helps your application**
  - Not everything will benefit, try it and see
  - Don't forget to try the data-staging in/out too!
- **Prefer per-job scratch to persistent reservations**
  - Easier to manage
- **Choose unique names for persistent reservations**
  - Make them meaningful
- **Clean up persistent reservations when done**
  - Build it into your workflow

# Environment variables

- **Only one DW_* environment variable will be set at a time**
  - DW_JOB_STRIPED,
    DW_JOB_PRIVATE,
    or DW_PERSISTENT_STRIPED_*
  - But which? Don't want to keep changing your batch scripts just because you changed Burst buffer reservation!

```
v=`env | egrep ^DW_`
variable=`echo $v | awk −F= '{ print $1 }'`
value=`echo $v | awk −F= '{ print $2 }'`
echo "I found a variable called $variable with value $value"
```

# Exercises!

1. **Create a config file to specify a 40 GB persistent reservation**
   1. Use salloc to get an interactive session and create this reservation
   2. Copy some files to the burst buffer directory
   3. Terminate your interactive batch session

2. **Use the scontrol command to list information about the persistent reservation you created**

3. **Create a batch job to list files on the persistent reservation**
   1. Submit it, wait until it runs

4. **Create a config file to destroy the persistent reservation, 'execute' it with salloc**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