

# Parallel Materials Modelling Packages

## General Instructions for Exercises

### 1 Introduction

This handout contains basic instructions for how to login in to ARCHER and submit jobs to the batch system. ARCHER is the UK's National HPC Service, and consists of a 72,000 core Cray XC30 system. For more detailed instructions, please refer to the ARCHER website:

<http://www.archer.ac.uk/documentation/>

### 2 Connecting to ARCHER via SSH

Each course participant has a numbered guest account (from `guest01` to `guest40`). You should have picked up a paper slip with your username and log in details. Please ensure you use the correct account for the duration of the course. To log in to ARCHER you should use the following details:

Server: `login.archer.ac.uk`

Username: `guestXX`

Password: *As per printed slip*

For example, using the OpenSSH client run:

```
ssh guestXX@login.archer.ac.uk
```

You should see a welcome message, and obtain a command prompt on the ARCHER front-end similar to the following:

```
=====
login.archer.ac.uk
-----
```

```
This is a private computing facility. Access to this system is limited to those
who have been granted access by the operating service provider on behalf of the
issuing authority and use is restricted to the purposes for which access was
granted. All access and usage are governed by the terms and conditions of access
agreed to by all registered users and are thus subject to the provisions of the
Computer Misuse Act, 1990 under which unauthorised use is a criminal offence.
```

```
If you are not authorised to use this account then you must logout immediately.
-----
```

For assistance please contact the service helpdesk at: `support@archer.ac.uk`

```
=====
guest02@eslogin005:~>
```

If you have any difficulty connecting please ask the course staff.

## 3 Running a job

### 3.1 Filesystems

ARCHER uses the PBS batch processing system to schedule user jobs on the back-end nodes of the system. Please do not run compute-intensive tasks on the front-end nodes as these are shared by all users of the system.

ARCHER has two main file-systems, `/home/` and `/work/`. Upon login, you will be placed in your home directory on the `/home/` file system. This is intended for storage of files, code etc. It is not accessible to the back-end nodes where your jobs will run. `/work/` is a large, high-performance parallel file system, connected to the back-end nodes, and you should use this as a location to run your jobs from, store and access job input and output files.

To access your directory on `/work/` enter:

```
guest02@eslogin006:~> cd /work/y14/y14/guest02
guest02@eslogin006:/work/y14/y14/guest02>
```

Please note that data stored in the guest accounts will be erased shortly after the course ends. It is your responsibility to make copies of any data you wish to keep in another location before the course ends.

### 3.2 Batch system

To run a job using the batch system, you must create a batch script containing the commands you wish to execute. An example script is below, please make a copy of it in your own directory:

```
guest02@eslogin006:/work/y14/y14/guest02> cat run.pbs
#!/bin/bash --login

#PBS -N test_job
#PBS -l select=1
#PBS -l walltime=0:5:0
#PBS -A y14

cd $PBS_O_WORKDIR

module load castep

aprun -n 24 $CASTEP_EXE --version
```

The `#PBS` directives give the system information about your job, in this case that the job should be called `test_job`, that it should use 1 ARCHER node, and will run for up to 5 minutes. All jobs run during the course should use the `y14` project account.

Below this are a list of commands. The `cd` line ensures that the job runs correctly on the `/work/` filesystem. A module is then loaded to give access to the CASTEP software, and finally we launch the CASTEP executable in parallel using 24 MPI processes. ARCHER has 24 processor cores per node, so when running your jobs make sure that the number of processors (`-n 24`) is less than 24 times the number of nodes (`-l select=1`).

Once the script has been created, we submit the job using:

```

guest02@eslogin006:/work/y14/y14/guest02> qsub -q Rxxxxxx run.pbs
230228.sdb
guest02@eslogin006:/work/y14/y14/guest02> qstat -u guest02

```

sdb:

Job ID	Username	Queue	Jobname	SessID	NDS	TSK	Req'd Memory	Req'd Time	Elap S	Time
230228.sdb	guest02	standard	test_job	--	1	24	--	00:05	Q	--

The `qsub` command submits the script, and returns a unique job ID. The `qstat` command can be used to monitor the status of the job. `Q` corresponds to a job which is waiting in the queue, `R` to a job which is running, and `E` to a job which is in the process of exiting. Once the job has completed it does not appear in the list.

The `-q Rxxxxxx` argument refers to `q` unique Reservation ID which has been set up to give exclusive access to a set of 40 nodes for the duration of the course. This should reduce queue waiting times. Please be aware this is shared by all participants so avoid running many jobs at one time, or using many nodes at once. The following reservation IDs should be used:

- Wednesday 23rd April 13.00-18.00: R195838
- Thursday 24th April 13.00-18.00: R195850
- Friday 25th April 13.00-17.00: R195854

The standard output and error files produced by the job will be located in the current directory, and are numbered by the Job ID, alongside any additional files produced by the code:

```

guest02@eslogin006:/work/y14/y14/guest02> ls -ltr
total 8
-rw-r--r-- 1 guest02 y14 164 Apr 21 10:40 run.pbs
-rw----- 1 guest02 y14 0 Apr 21 10:52 test_job.e230228
-rw----- 1 guest02 y14 1523 Apr 21 10:52 test_job.o230228

```

In this case the standard output contains the version information from the CASTEP executable, as specified in the batch script, along with some information about the job. The standard error file is empty:

```
guest02@eslogin006:/work/y14/y14/guest02> cat test_job.o230228
```

```
-----  
*** guest02 Job: 230228.sdb started: 21/04/14 10:52:17 host: mom4 ***  
*** guest02 Job: 230228.sdb started: 21/04/14 10:52:17 host: mom4 ***  
*** guest02 Job: 230228.sdb started: 21/04/14 10:52:17 host: mom4 ***  
*** guest02 Job: 230228.sdb started: 21/04/14 10:52:17 host: mom4 ***  
-----
```

```
CASTEP version: 7.02
```

```
Compiled for linux_x86_64_ifort13-XT on Tue, 25 Feb 2014 15:09:13 +0000  
from code version 84e5d449383f+ Sat, 22 Feb 2014 18:56:31 +0000  
Compiler: Intel Fortran 13.1.3.192; Optimisation: fast  
MATHLIBS: Intel MKL(11.0.5) (LAPACK version 3.4.1)  
FFT Lib : fftw3 version commercial-fftw-3.3-sse2-avx  
Application 7970722 resources: utime ~1s, stime ~1s, Rss ~3812, inblocks ~45735, outblo  
-----
```

```
Resources requested: ncpus=24,place=free,walltime=00:05:00
```

```
Resources allocated: cpupercent=0,cput=00:00:01,mem=0kb,ncpus=24,vmem=0kb,walltime=00:0
```

```
*** guest02 Job: 230228.sdb ended: 21/04/14 10:52:20 queue: standard ***  
*** guest02 Job: 230228.sdb ended: 21/04/14 10:52:20 queue: standard ***  
*** guest02 Job: 230228.sdb ended: 21/04/14 10:52:20 queue: standard ***  
*** guest02 Job: 230228.sdb ended: 21/04/14 10:52:20 queue: standard ***  
-----
```

**Congratulations, you have now run a simple job on ARCHER. Please proceed with the rest of the exercises. You will need to modify your batch script as necessary.**