

## Quantum Espresso 7.4 with GPU support

### ウェブページ

<https://www.quantum-espresso.org/>  
<https://gitlab.com/QEF/q-e>

### バージョン

7.4

### ビルド環境

- NVIDIA HPC SDK 24.9 (nompri version)
- Open MPI 4.1.6 (CUDA-aware)

### ビルドに必要なファイル

- q-e-qe-7.4.tar.gz (gitlab よりダウンロード)
- (以下の手順内でもダウンロードしている)

### ビルド手順

```
#!/bin/sh

QE_VERSION=7.4
BASEDIR=/home/users/${USER}/Software/QE/${QE_VERSION}
TARBALL=${BASEDIR}/q-e-qe-${QE_VERSION}.tar.gz

GIPAW_ID="3bbf5a931fc195503c3f01565ac43cac8c05db44"

WORKDIR=/gwork/users/${USER}

INSTDIR=/apl/qe/7.4-gpu
PARALLEL=24

# -----
umask 0022

module -s purge
module -s load nvhpc/24.9-nompri
module -s load openmpi/4.1.6/nv24
## gui; not necessary while building
#module -s load itcl/3.4.4
#module -s load itk/3.4.2
#module -s load iwidgets/4.1.1

export LANG=C
export LC_ALL=C
ulimit -s unlimited

if [ ! -d ${WORKDIR} ]; then
  mkdir -p ${WORKDIR}
fi

cd ${WORKDIR}
if [ -d q-e-qe-${QE_VERSION} ]; then
  mv q-e-qe-${QE_VERSION} qe-erase
  rm -rf qe-erase &
fi
tar xzf ${TARBALL}

QE_WORKDIR=${WORKDIR}/q-e-qe-${QE_VERSION}

# QE
```

```

cd ${QE_WORKDIR}
sed -i -e "s/wget -O/wget --trust-server-names -O/" \
    -e "s/curl -o/curl -L -o/" test-suite/check_pseudo.sh
sed -i -e "s/[ ^]* qe-gipaw/${GIPAW_ID} qe-gipaw/" \
    external/submodule_commit_hash_records

mkdir build && cd build
cmake .. \
-DMAKE_INSTALL_PREFIX=${INSTDIR} \
-DMAKE_Fortran_COMPILER=mpif90 \
-DMAKE_C_COMPILER=mpicc \
-DMAKE_CXX_COMPILER=mpicxx \
-DMAKE_PREFIX_PATH="${CMAKE_PREFIX_PATH}" \
-DESPRESSO_PSEUDO=${INSTDIR}/pseudo \
-DQE_ENABLE_CUDA=ON \
-DNVFORTRAN_CUDA_CC=80 \
-DNVFORTRAN_CUDA_VERSION=12.6 \
-DQE_ENABLE_OPENACC=ON \
-DQE_ENABLE_OPENMP=ON \
-DQE_ENABLE_MPI=ON \
-DQE_ENABLE_MPI_GPU_AWARE=ON \
-DQE_ENABLE_SCALAPACK=OFF \
-DQE_ENABLE_ELPA=OFF \
-DQE_ENABLE_LIBXC=OFF \
-DQE_ENABLE_HDF5=OFF \
-DQE_ENABLE_PLUGINS="pw2qmcpack;gipaw" \
-DQE_ENABLE_FOX=ON \
-DQE_WANNIER90_INTERNAL=ON \
-DQE_MBD_INTERNAL=ON \
-DQE_DEVICE_LIB_INTERNAL=ON \
-DQE_ENABLE_ENVIRON=OFF \
-DQE_ENABLE_OSCDFT=OFF

make -j${PARALLEL}
make install
ln -s ${INSTDIR}/bin ${QE_WORKDIR}/bin
cp -r ${QE_WORKDIR}/pseudo ${INSTDIR}/pseudo
mv ${QE_WORKDIR}/pseudo ${QE_WORKDIR}/pseudo.org
ln -s ${INSTDIR}/pseudo ${QE_WORKDIR}/pseudo
make test # to run "system--pw-pseudo" test for pseudo files

```

実際のテストは別途以下のスクリプトで実施

## テスト

GPU 搭載ノードにて以下のスクリプトで実行

```

#!/bin/sh
#PBS -l select=1:ncpus=32:mpiprocs=4:ompthreads=3:ngpus=2
#PBS -l walltime=24:00:00

QE_VERSION=7.4
BUILDDIR=/gwork/users/${USER}/q-e-qe-${QE_VERSION}/build

cd $PBS_O_WORKDIR

# -----
umask 0022

module -s purge
module -s load nvhpc/24.9-nompi
module -s load openmpi/4.1.6/nv24

export LANG=C
export LC_ALL=C
ulimit -s unlimited

```

```
export MPIF90=mpif90
export MPIFC=mpif90
export MPIF77=mpif90
export MPICC=mpicc
export MPICXX=mpicxx

cd ${BUILDDIR}
make test
```

## テスト結果

テスト結果は /apl/qe/7.4-gpu/testlog 以下にコピーしてあります。

- test\_qe\_lax-r9-t2 => 並列数不足
- test\_qe\_lapack\_zdotc => 数値エラー(Expected (1.0000000308637980,6.48839729724212839E-003) got (0.000000000000000,0.000000000000000))
- system--pw\_lda+U--lda+U+V-user\_ns => 終わらないため強制終了
- system--pw\_lda+U--lda+U+V\_force\_stress\_ortho => (同上)
- system--pw\_lda+U--lda+U\_force\_stress\_ortho => (同上)
- system--pw\_lda+U-correctness => 一部テスト動作せず
- system--pw\_scf-correctness => 数値エラー
- system--pw\_twochem--nscf\_twochem => GPU 未対応
- system--pw\_twochem--relax\_twochem => (同上)
- system--pw\_twochem--scf\_twochem => (同上)
- system--pw\_twochem--vc-relax\_twochem => (同上)
- system--pw\_uspp-correctness => 一部テスト動作せず
- system--cp\_h2o-correctness => 数値エラー

## メモ

- d3q はビルドに失敗したため外している
- ELPA, HDF, libxc, Environ は未検証