European Research Council
Established by the European Commission

GETTING STARTED
Idefix

PART 1: ON YOUR LAPTOP → this presentation

PART 2: ON BIGFOOT (GPU) → Geoffroy's presentation

https://idefix.readthedocs.io/en/v2.0/quickstart.html

IPAG

Requirements

- cmake ≥ 3.16 (+ ccmake)
- c++17 compatible compiler
  (GCC > 8 or Xcode command line tools for MacOS)
- external MPI library
  (OpenMPI, IntelMPI)
- git and git-lfs
- GitHub account

Download and install IDEFIX

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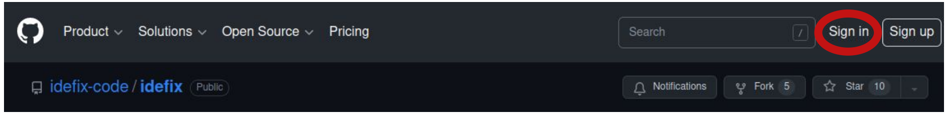

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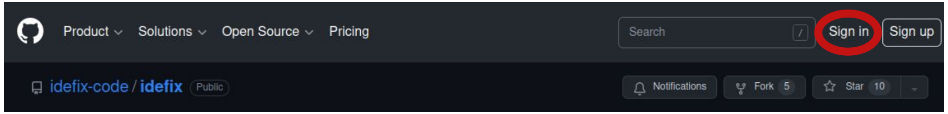

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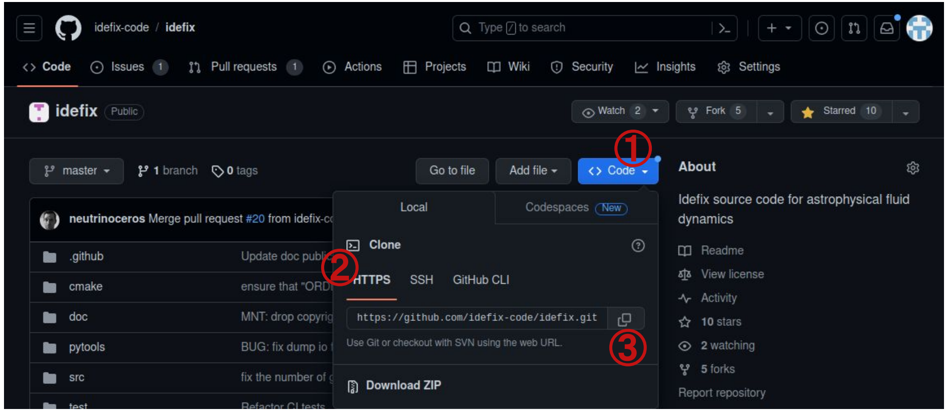

neutrinoceros Merge pull request #20 from idefix-c

Update doc publi

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Idefix source code for astrophysical fluid dynamics

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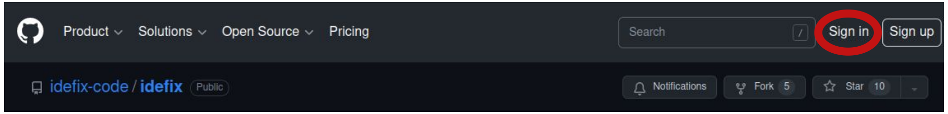

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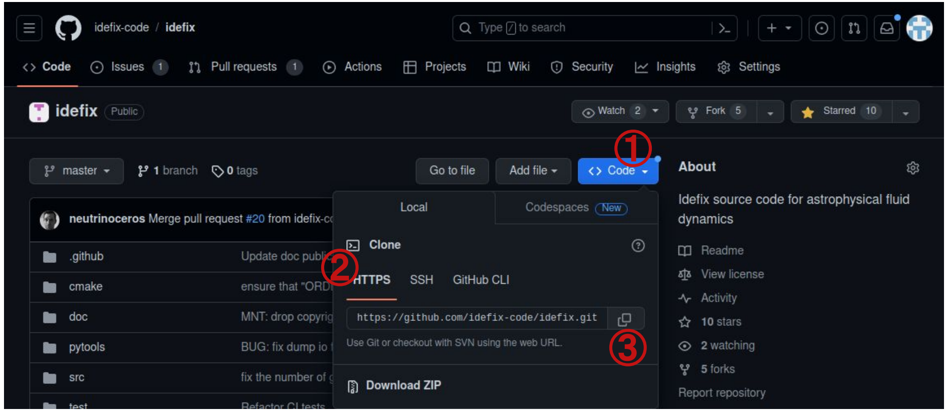

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<u>see Clément’s tutorial (git), thursday p.m</u>

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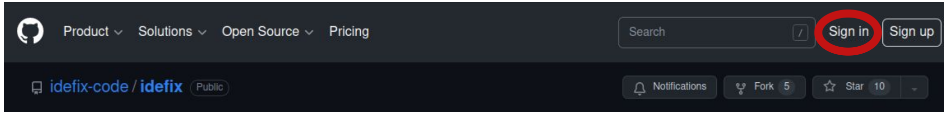

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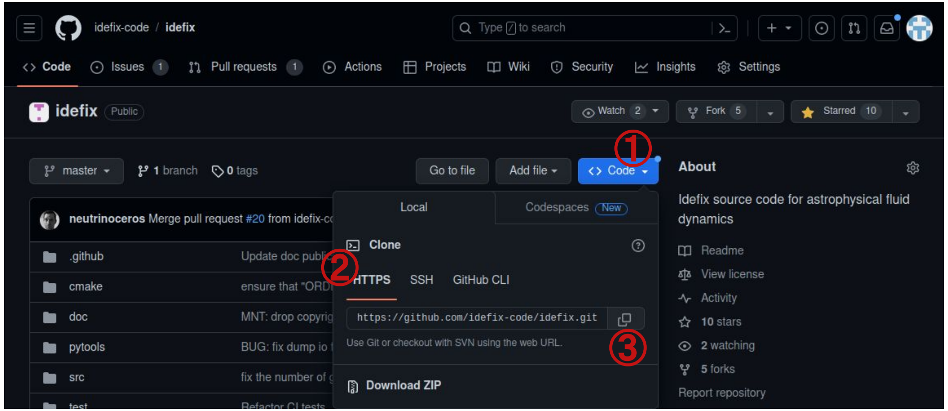

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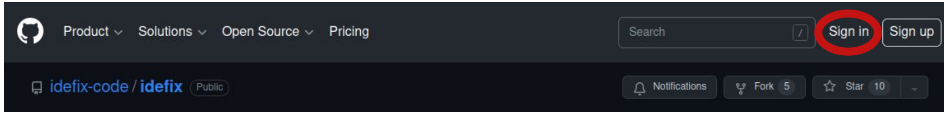

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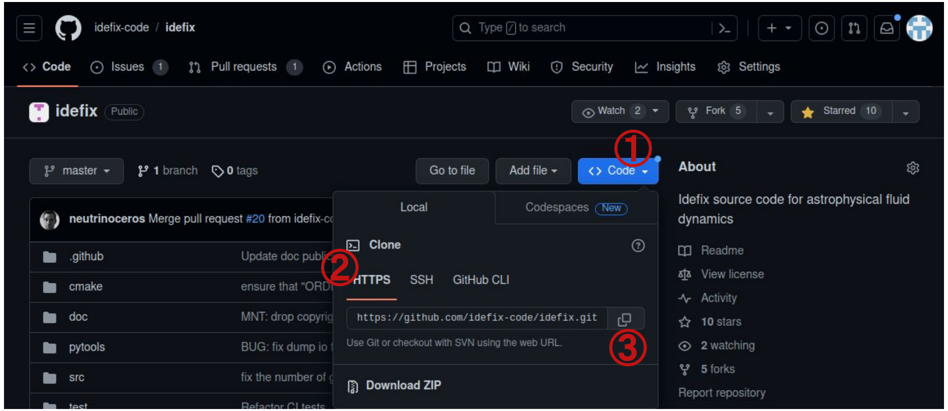

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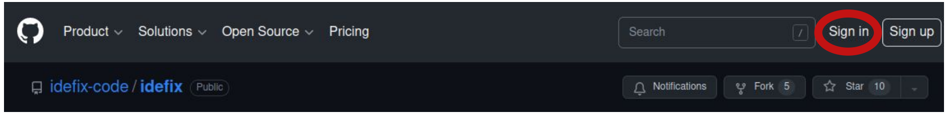

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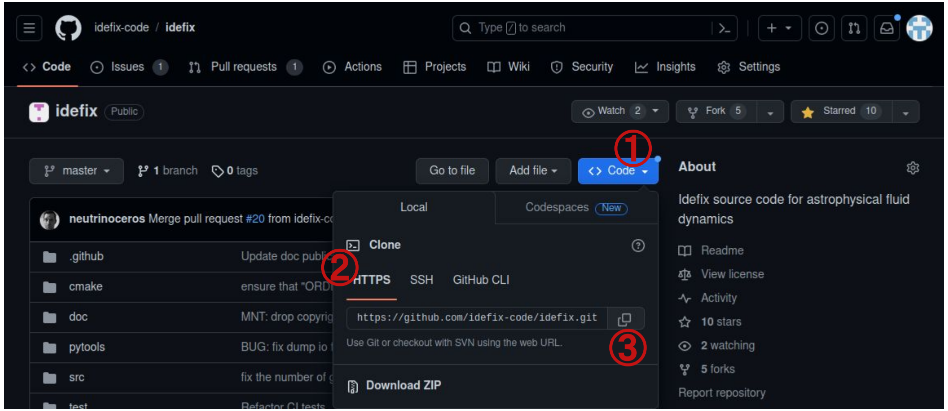

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You can add this line to your .profile or .bashrc

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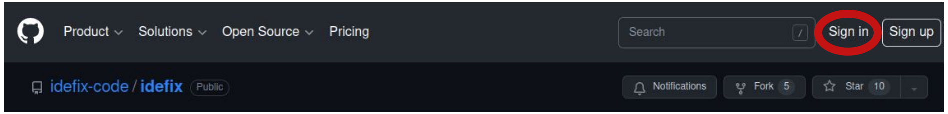

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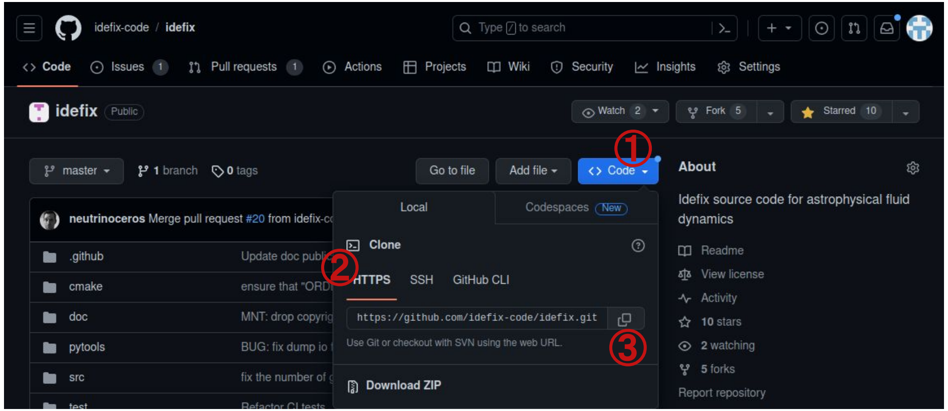

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6. Validation for testing relies on large reference files

```
git lfs install; git lfs pull
```

Get access to all the tutorials idefix-days

1. Go to https://github.com/idefix-code/idefix-days
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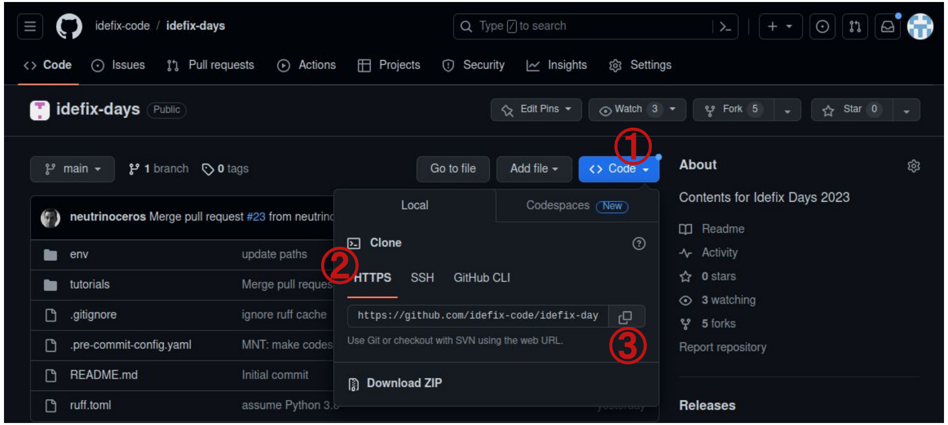

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cd idefix-days/tutorials/getting_started
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Configure, compile and run test problems

Problem 1: OrszagTang

Well-known test problem for MHD codes

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ERROR - SERIAL

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<u>see Jonah’s tutorial (Usage), this afternoon</u>

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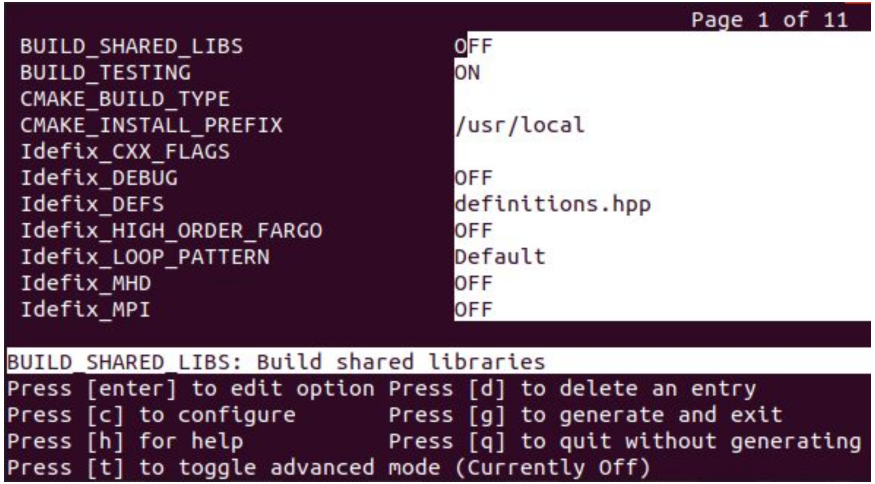

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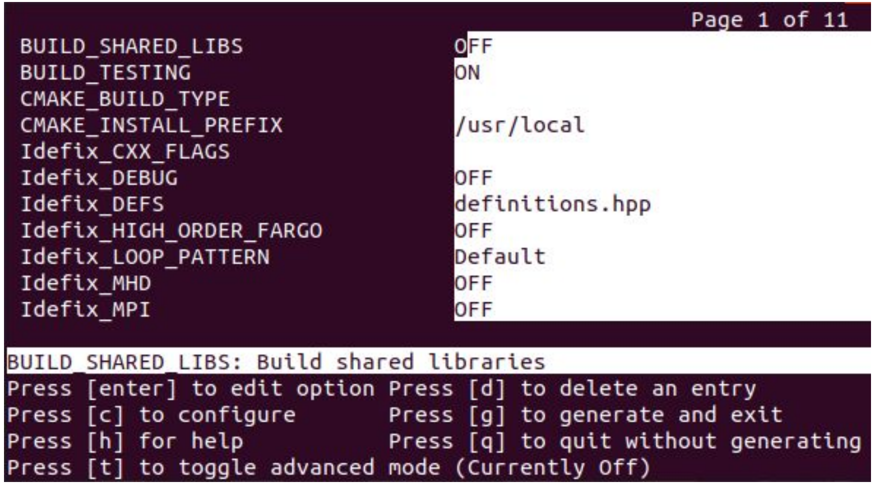

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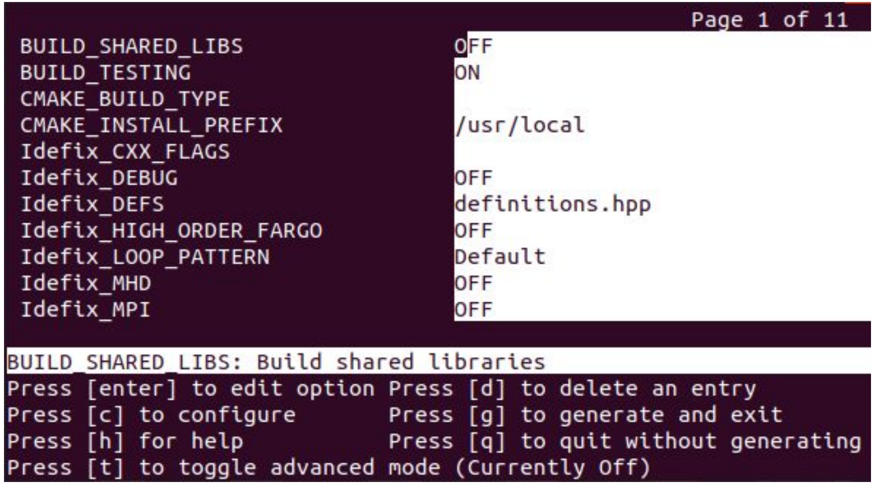

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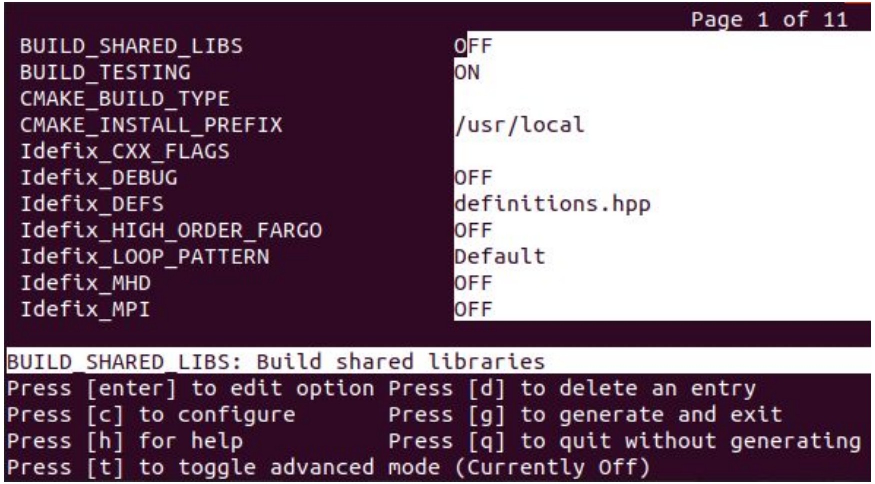

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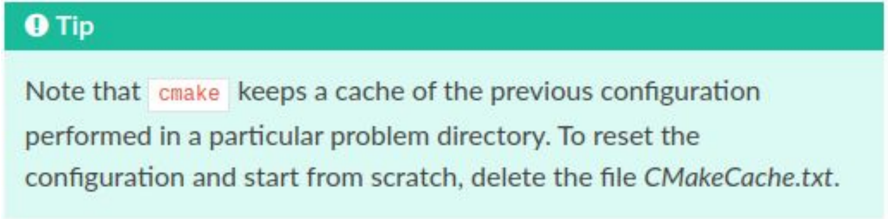

Tip

Note that `cmake` keeps a cache of the previous configuration performed in a particular problem directory. To reset the configuration and start from scratch, delete the file *CMakeCache.txt*.

Idefix - GETTING STARTED

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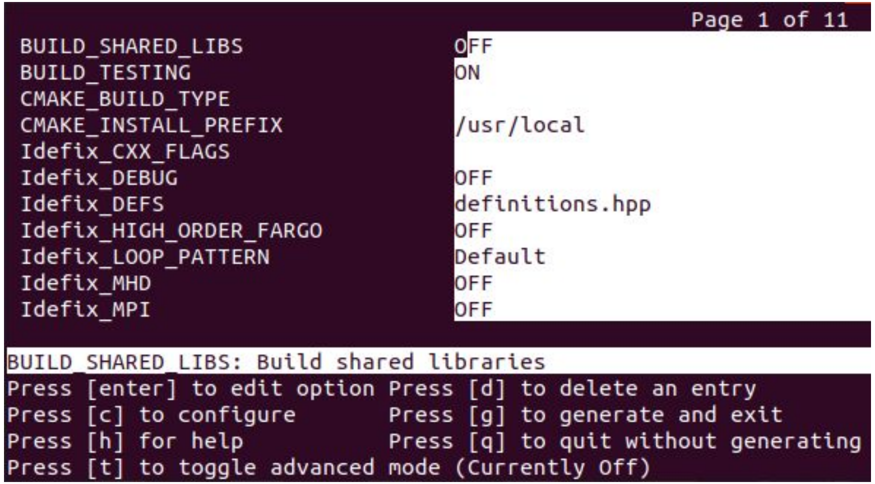

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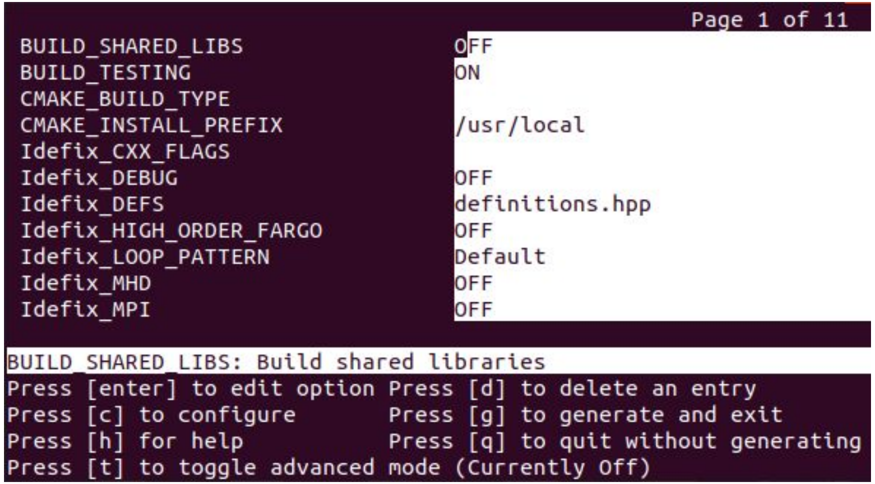

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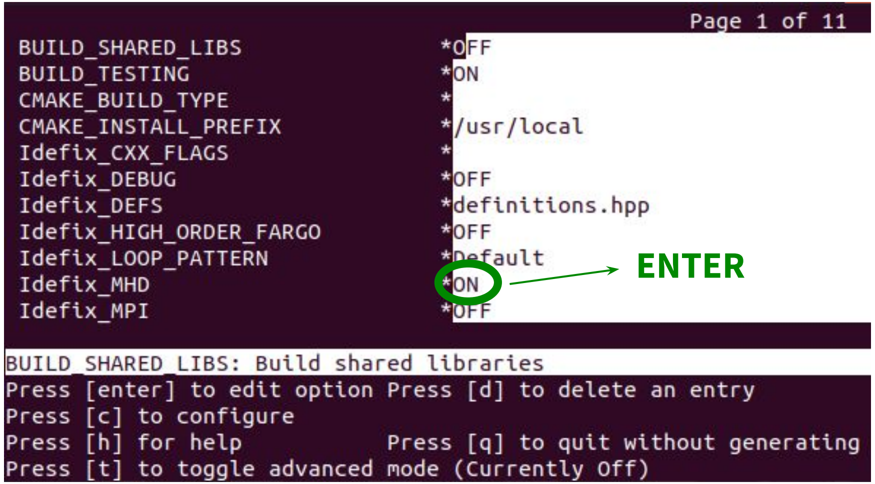

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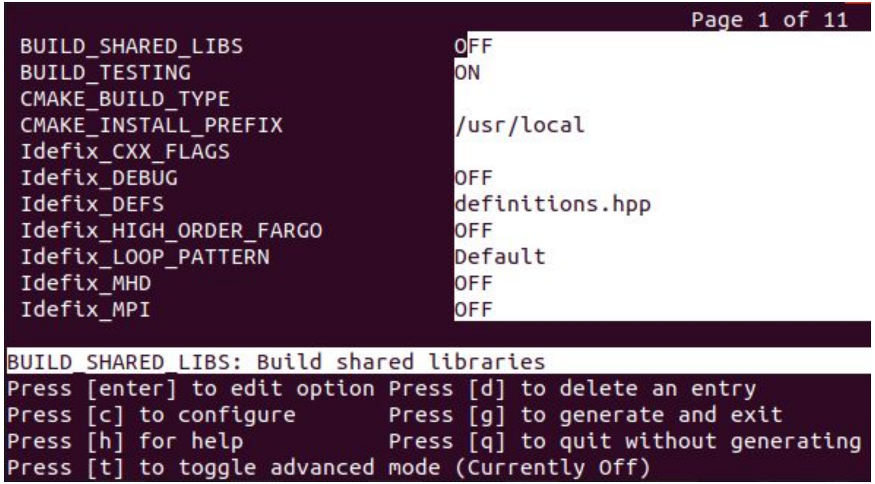

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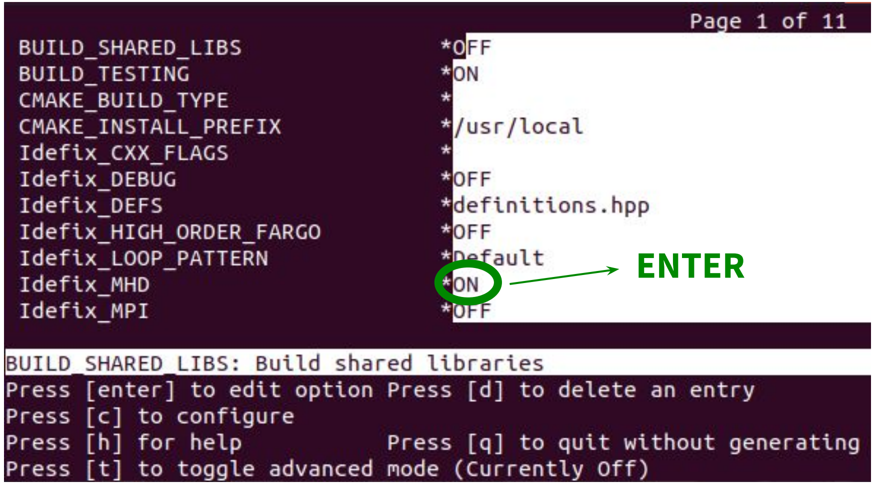

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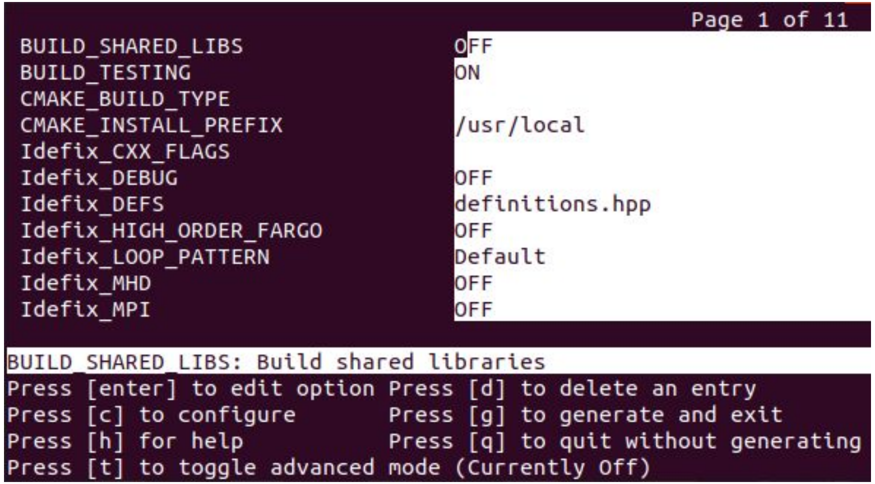

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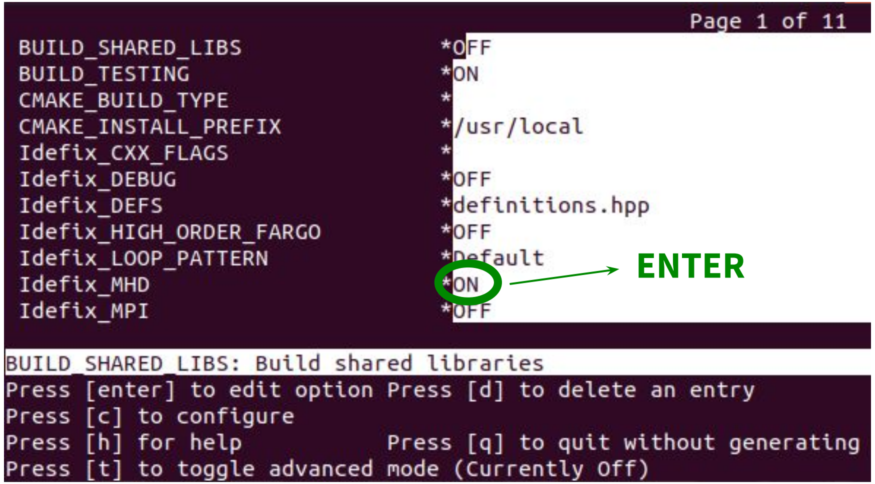

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3. Run

   `./idefix`

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PARALLEL - MPI library

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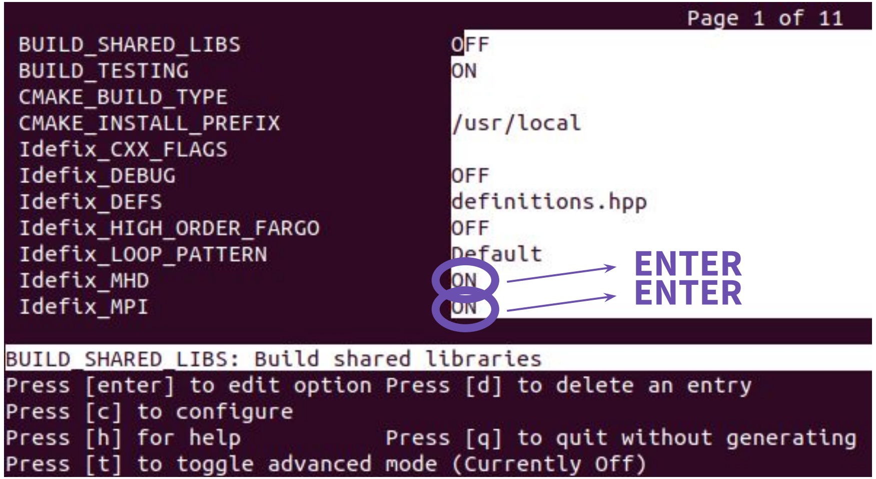
1. Configure :

   `ccmake $IDEFIX_DIR`



```
                                                     Page 1 of 11
 BUILD_SHARED_LIBS                OFF
 BUILD_TESTING                    ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX             /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                     OFF
 Idefix_DEFS                      definitions.hpp
 Idefix_HIGH_ORDER_FARGO          OFF
 Idefix_LOOP_PATTERN              Default
 Idefix_MHD                       ON
 Idefix_MPI                       ON

BUILD_SHARED_LIBS: Build shared libraries
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

ENTER
ENTER

   Press [c], then [c] to configure and [g] to generate

2. Compile

   `make -j 8`

3. Run

   `mpirun -np 2 ./idefix`

Idefix - GETTING STARTED

Configure, compile and run test problems

Problem 1: OrszagTang

Well-known test problem for MHD codes

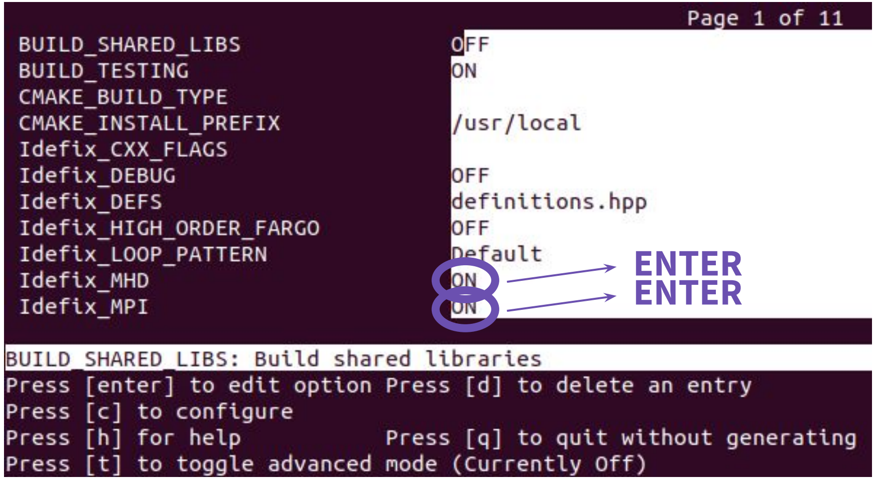
`cd OrszagTang`

PARALLEL - MPI library

`rm CMakeCache.txt`

1. Configure :

   `ccmake $IDEFIX_DIR`



```
                                                   Page 1 of 11
 BUILD_SHARED_LIBS                OFF
 BUILD_TESTING                    ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX             /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                     OFF
 Idefix_DEFS                      definitions.hpp
 Idefix_HIGH_ORDER_FARGO          OFF
 Idefix_LOOP_PATTERN              Default
 Idefix_MHD                       ON
 Idefix_MPI                       ON

BUILD_SHARED_LIBS: Build shared libraries
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

ENTER
ENTER

Press [c], then [c] to configure and [g] to generate

2. Compile

   `make -j 8`

3. Run

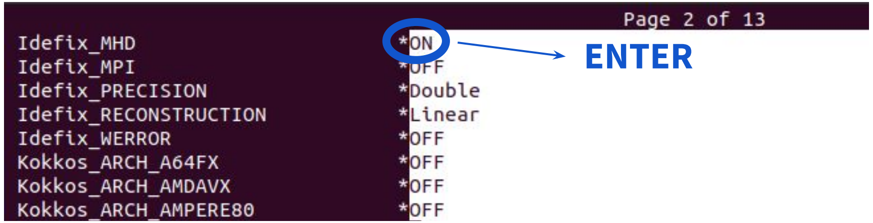
   `mpirun -np 2 ./idefix`

PARALLEL - openmp

`rm CMakeCache.txt`

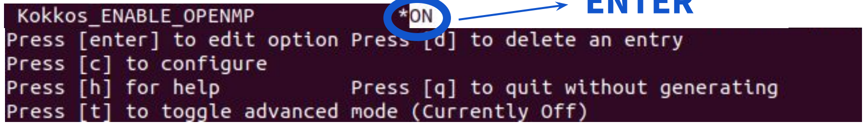
1. Configure :

   `ccmake $IDEFIX_DIR`



```
                                                  Page 2 of 13
 Idefix_MHD                       *ON
 Idefix_MPI                       *OFF
 Idefix_PRECISION                 *Double
 Idefix_RECONSTRUCTION            *Linear
 Idefix_WERROR                    *OFF
 Kokkos_ARCH_A64FX                *OFF
 Kokkos_ARCH_AMDAVX               *OFF
 Kokkos_ARCH_AMPERE80             *OFF
```

ENTER



```
 Kokkos_ENABLE_OPENMP             *ON
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

ENTER

Press [c], then [c] to configure and [g] to generate

2. Compile

   `make -j 8`

   `export OMP_NUM_THREADS=2`

3. Run

   `./idefix`

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

```
cd PlanetMigration2D
```

will be used in my tutorial (visualization/nonos), tomorrow afternoon

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

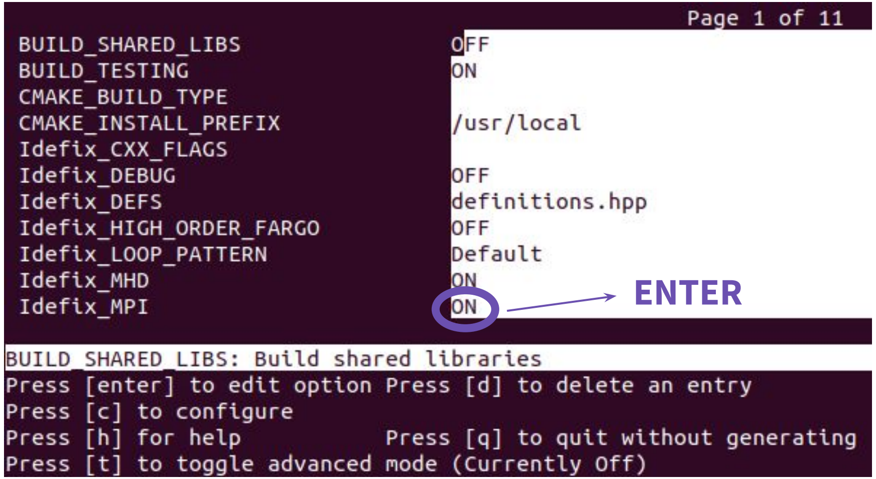
```
cd PlanetMigration2D
```

PARALLEL - MPI library

```
rm CMakeCache.txt
```

1. Configure :

```
ccmake $IDEFIX_DIR
```



```
                                                   Page 1 of 11
 BUILD_SHARED_LIBS                OFF
 BUILD_TESTING                    ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX             /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                     OFF
 Idefix_DEFS                      definitions.hpp
 Idefix_HIGH_ORDER_FARGO          OFF
 Idefix_LOOP_PATTERN              Default
 Idefix_MHD                       ON
 Idefix_MPI                       ON

BUILD_SHARED_LIBS: Build shared libraries
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

Press [c], then [c] to configure and [g] to generate

2. Compile

```
make -j 8
```

3. Run

```
mpirun -np 2 ./idefix
```

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

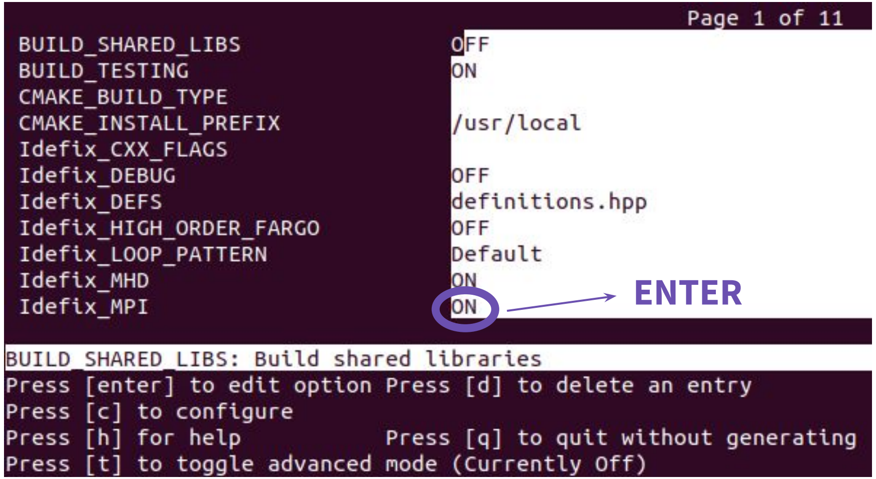
`cd PlanetMigration2D`

PARALLEL - MPI library

`rm CMakeCache.txt`

1. Configure :

   `ccmake $IDEFIX_DIR`



```
                                                        Page 1 of 11
 BUILD_SHARED_LIBS                 OFF
 BUILD_TESTING                     ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX              /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                      OFF
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 Idefix_LOOP_PATTERN               Default
 Idefix_MHD                        ON
 Idefix_MPI                        ON

BUILD_SHARED_LIBS: Build shared libraries
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

ENTER

Press [c], then [c] to configure and [g] to generate

2. Compile

   `make -j 8`

3. Run

   `mpirun -np 2 ./idefix`

“Automatic domain decomposition requires nx1, nx2 and nx3 to be powers of 2. Alternatively, set a manual decomposition with -dec”

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

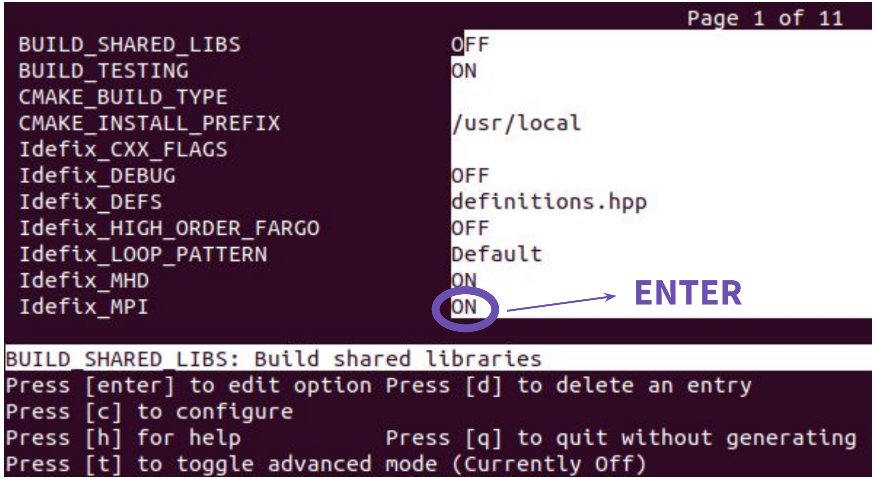
`cd PlanetMigration2D`

PARALLEL - MPI library

`rm CMakeCache.txt`

1. Configure :

   `ccmake $IDEFIX_DIR`



```
                                                            Page 1 of 11
 BUILD_SHARED_LIBS                OFF
 BUILD_TESTING                    ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX             /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                     OFF
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 Idefix_HIGH_ORDER_FARGO          OFF
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Press [enter] to edit option Press [d] to delete an entry
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   Press [c], then [c] to configure and [g] to generate

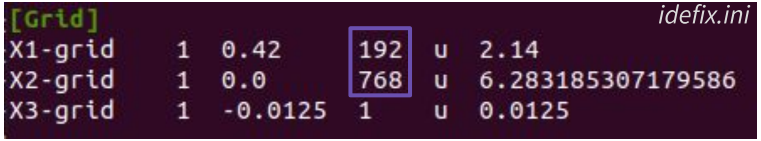
2. Compile

   `make -j 8`

3. Run

   `mpirun -np 2 ./idefix`

"Automatic domain decomposition requires nx1, nx2 and nx3 to be powers of 2. Alternatively, set a manual decomposition with -dec"



```
[Grid]                                                     idefix.ini
X1-grid    1   0.42       192   u   2.14
X2-grid    1   0.0        768   u   6.283185307179586
X3-grid    1   -0.0125    1     u   0.0125
```

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

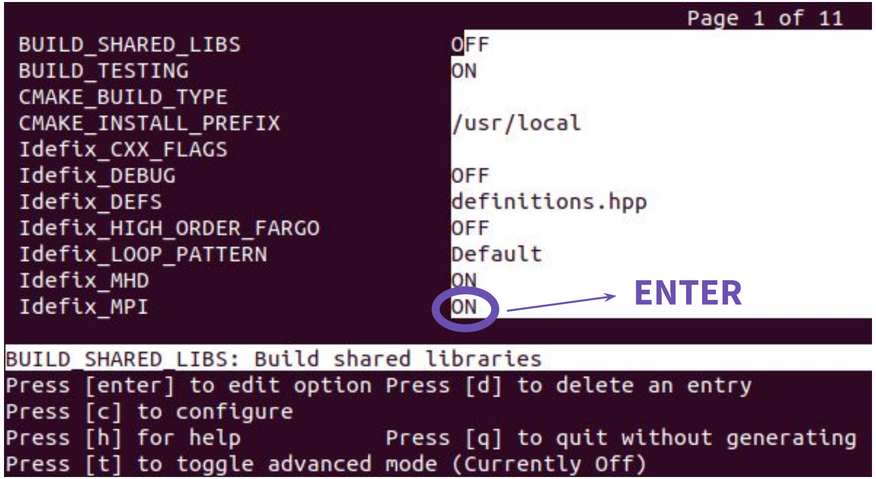
```
cd PlanetMigration2D
```

PARALLEL - MPI library

```
rm CMakeCache.txt
```

1. Configure :

```
ccmake $IDEFIX_DIR
```



```
                                                  Page 1 of 11
 BUILD_SHARED_LIBS                OFF
 BUILD_TESTING                    ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX             /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                     OFF
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 Idefix_HIGH_ORDER_FARGO          OFF
 Idefix_LOOP_PATTERN              Default
 Idefix_MHD                       ON
 Idefix_MPI                       ON

BUILD_SHARED_LIBS: Build shared libraries
Press [enter] to edit option Press [d] to delete an entry
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

Press [c], then [c] to configure and [g] to generate

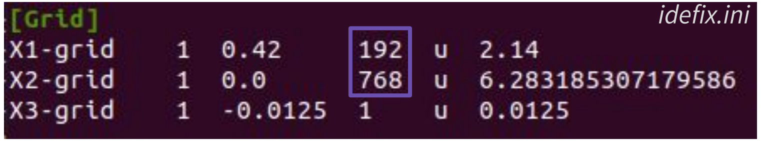
2. Compile

```
make -j 8
```

3. Run

```
mpirun -np 2 ./idefix
```

"Automatic domain decomposition requires nx1, nx2 and nx3 to be powers of 2. Alternatively, set a manual decomposition with -dec"



```
[Grid]                                                idefix.ini
X1-grid    1   0.42      192   u   2.14
X2-grid    1   0.0       768   u   6.283185307179586
X3-grid    1   -0.0125   1     u   0.0125
```

-dec n1 n2 n3 : **domain decomposition**

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

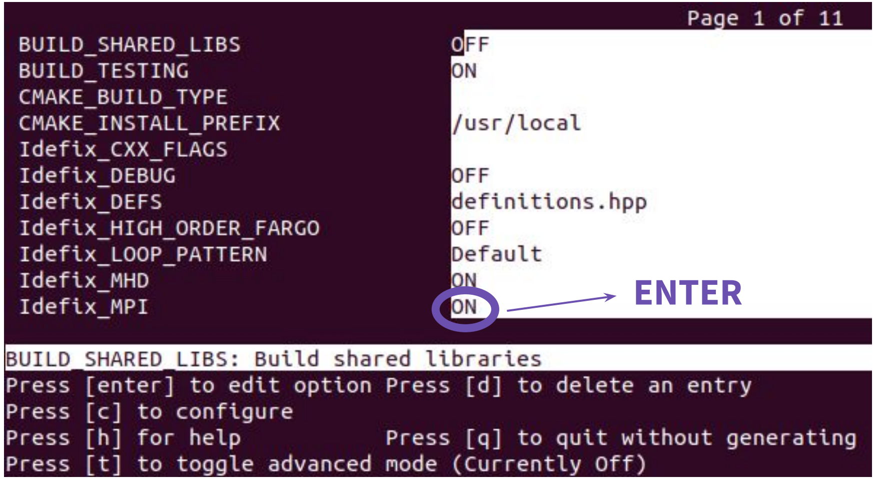
```
cd PlanetMigration2D
```

PARALLEL - MPI library

```
rm CMakeCache.txt
```

1. Configure :

```
ccmake $IDEFIX_DIR
```



```
                                                         Page 1 of 11
 BUILD_SHARED_LIBS                 OFF
 BUILD_TESTING                     ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX              /usr/local
 Idefix_CXX_FLAGS
 Idefix_DEBUG                      OFF
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 Idefix_HIGH_ORDER_FARGO           OFF
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 Idefix_MHD                        ON
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BUILD_SHARED_LIBS: Build shared libraries
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Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

Press [c], then [c] to configure and [g] to generate

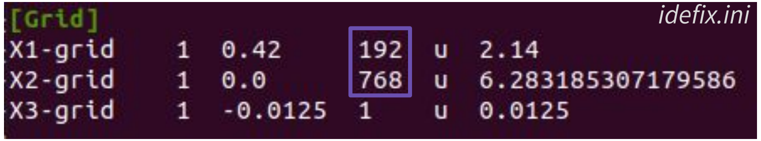
2. Compile

```
make -j 8
```

3. Run

```
mpirun -np 2 ./idefix
```

“Automatic domain decomposition requires nx1, nx2 and nx3 to be powers of 2. Alternatively, set a manual decomposition with -dec”

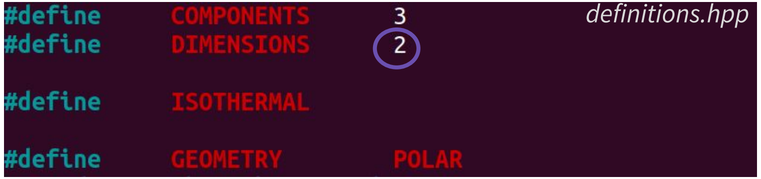


idefix.ini

```
[Grid]
X1-grid     1   0.42      192   u   2.14
X2-grid     1   0.0       768   u   6.283185307179586
X3-grid     1   -0.0125   1     u   0.0125
```

-dec n1 n2 n3 : **domain decomposition**

→ should be equal to DIMENSIONS



definitions.hpp

```
#define      COMPONENTS       3
#define      DIMENSIONS       2

#define      ISOTHERMAL

#define      GEOMETRY             POLAR
```

see Jonah’s tutorial (Usage), this afternoon

Configure, compile and run test problems

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

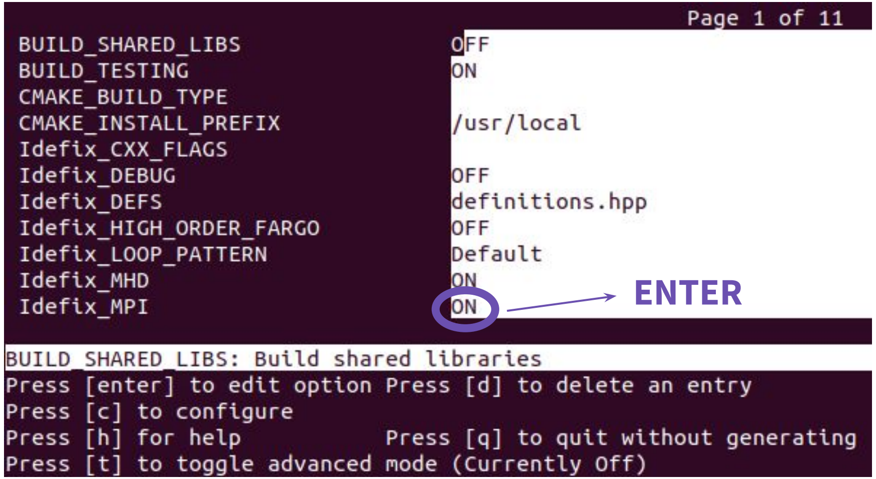
```
cd PlanetMigration2D
```

PARALLEL - MPI library

```
rm CMakeCache.txt
```

1. Configure :

```
ccmake $IDEFIX_DIR
```



```
                                                         Page 1 of 11
 BUILD_SHARED_LIBS               OFF
 BUILD_TESTING                   ON
 CMAKE_BUILD_TYPE
 CMAKE_INSTALL_PREFIX            /usr/local
 Idefix_CXX_FLAGS
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Press [h] for help           Press [q] to quit without generating
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```

Press [c], then [c] to configure and [g] to generate

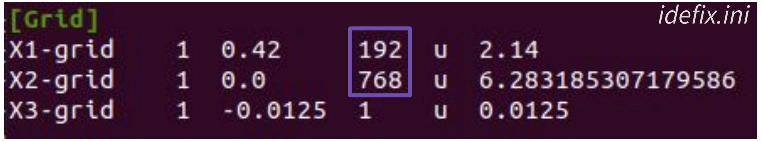
2. Compile

```
make -j 8
```

3. Run

```
mpirun -np 2 ./idefix -dec 2 1
```

"Automatic domain decomposition requires nx1, nx2 and nx3 to be powers of 2. Alternatively, set a manual decomposition with -dec"

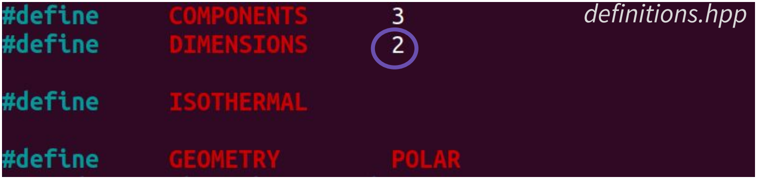


idefix.ini

```
[Grid]
X1-grid    1   0.42      192   u   2.14
X2-grid    1   0.0       768   u   6.283185307179586
X3-grid    1   -0.0125   1     u   0.0125
```

-dec n1 n2 n3 : **domain decomposition**

→ should be equal to DIMENSIONS



definitions.hpp

```
#define      COMPONENTS      3
#define      DIMENSIONS      2

#define      ISOTHERMAL

#define      GEOMETRY        POLAR
```

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

```
cd PlanetMigration2D
```

Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

```
cd PlanetMigration2D
```

Most of the tests in the test/ directory can be validated against:

- analytical solution (standard test)
- pre-computed solutions (non-regression tests).

Test problem Planet/Disk interaction

```
cd PlanetMigration2D
```

Test and validation

Problem 2: PlanetMigration2D

Most of the tests in the test/ directory can be validated against:

- analytical solution (standard test)
- pre-computed solutions (non-regression tests).

RULE: All the tests **HAVE TO** pass to merge a pull-request.
It is therefore a good practice to run locally the tests before creating a pull-request!

Example: If Clément implements a new module to simulate Lagrangian particles (***see his talk tomorrow morning***), all the pre-existing tests in IDEFIX have to pass in order for his module to be merged!

Test and validation

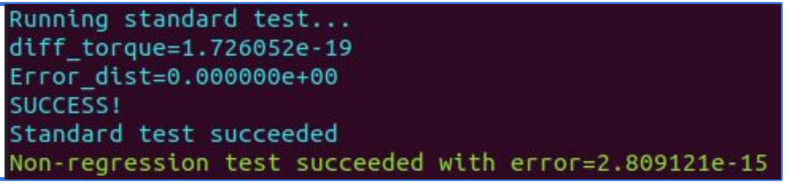
Problem 2: PlanetMigration2D

Test problem Planet/Disk interaction

```
cd PlanetMigration2D
```

Most of the tests in the test/ directory can be validated against:

- analytical solution (standard test)
- pre-computed solutions (non-regression tests).



```
Running standard test...
diff_torque=1.726052e-19
Error_dist=0.000000e+00
SUCCESS!
Standard test succeeded
Non-regression test succeeded with error=2.809121e-15
```

RULE: All the tests **HAVE TO** pass to merge a pull-request.
It is therefore a good practice to run locally the tests before creating a pull-request!

Example: If Clément implements a new module to simulate Lagrangian particles (***see his talk tomorrow morning***), all the pre-existing tests in IDEFIX have to pass in order for his module to be merged!

1. `./testme.py -all` Full validation of a test (**configure**/**compile**/**run**/**test** various combination of algorithms)
2. `./testme.py` Partial validation of a test (**run**/**test** various input files)
3. `./testme.py -check` Validation of a test that has already been run

GETTING STARTED

Idefix

PART 1: ON YOUR LAPTOP → this presentation

PART 2: ON BIGFOOT (GPU) → Geoffroy’s presentation

https://idefix.readthedocs.io/en/v2.0/quickstart.html