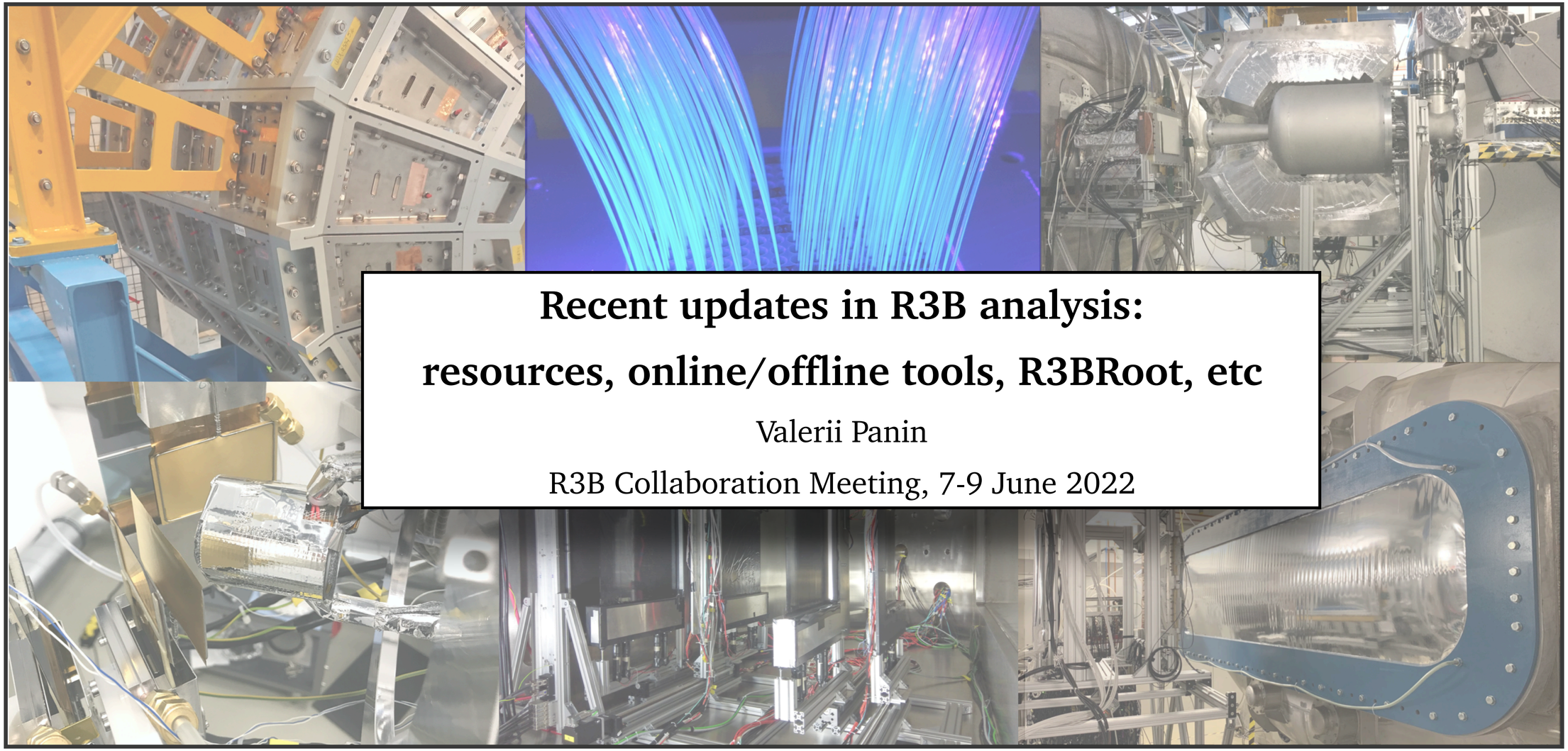
FAIR — Facility for Antiproton and Ion Research in Europe

R3B

GSI Helmholtzzentrum für Schwerionenforschung GmbH

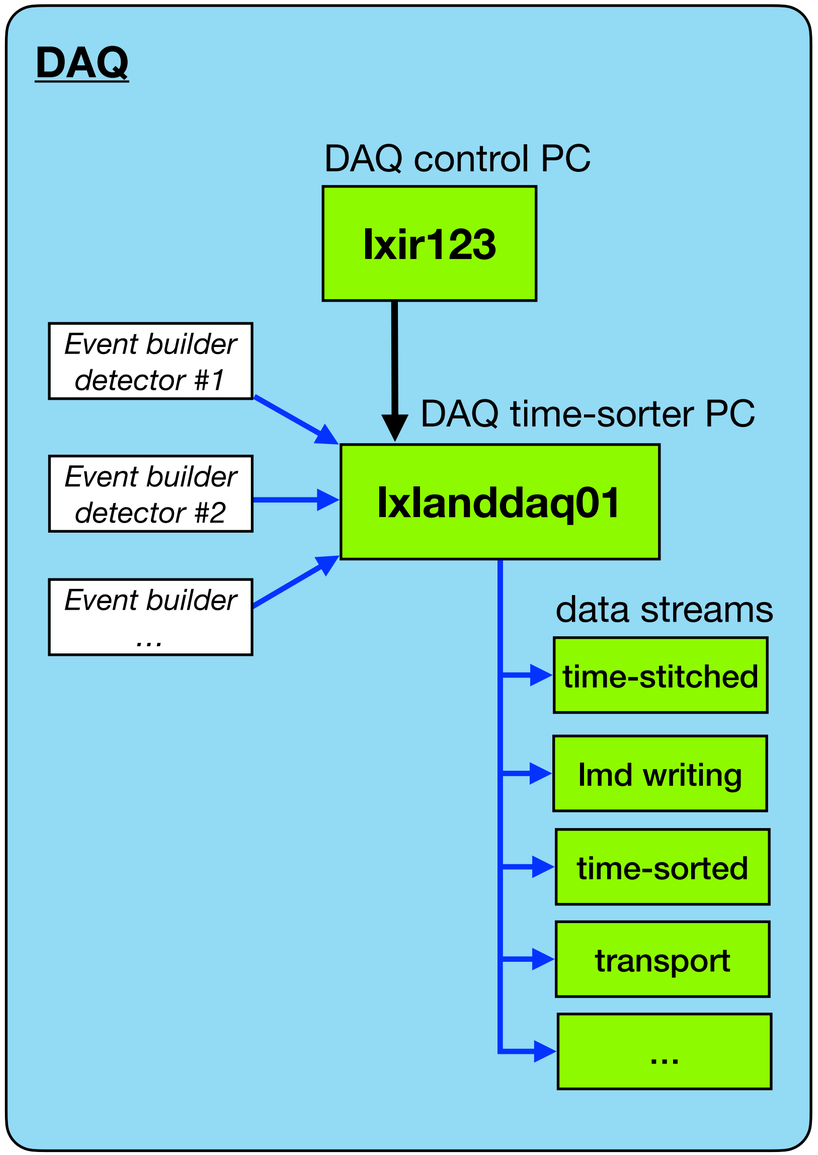


# Recent updates in R3B analysis: resources, online/offline tools, R3BRoot, etc

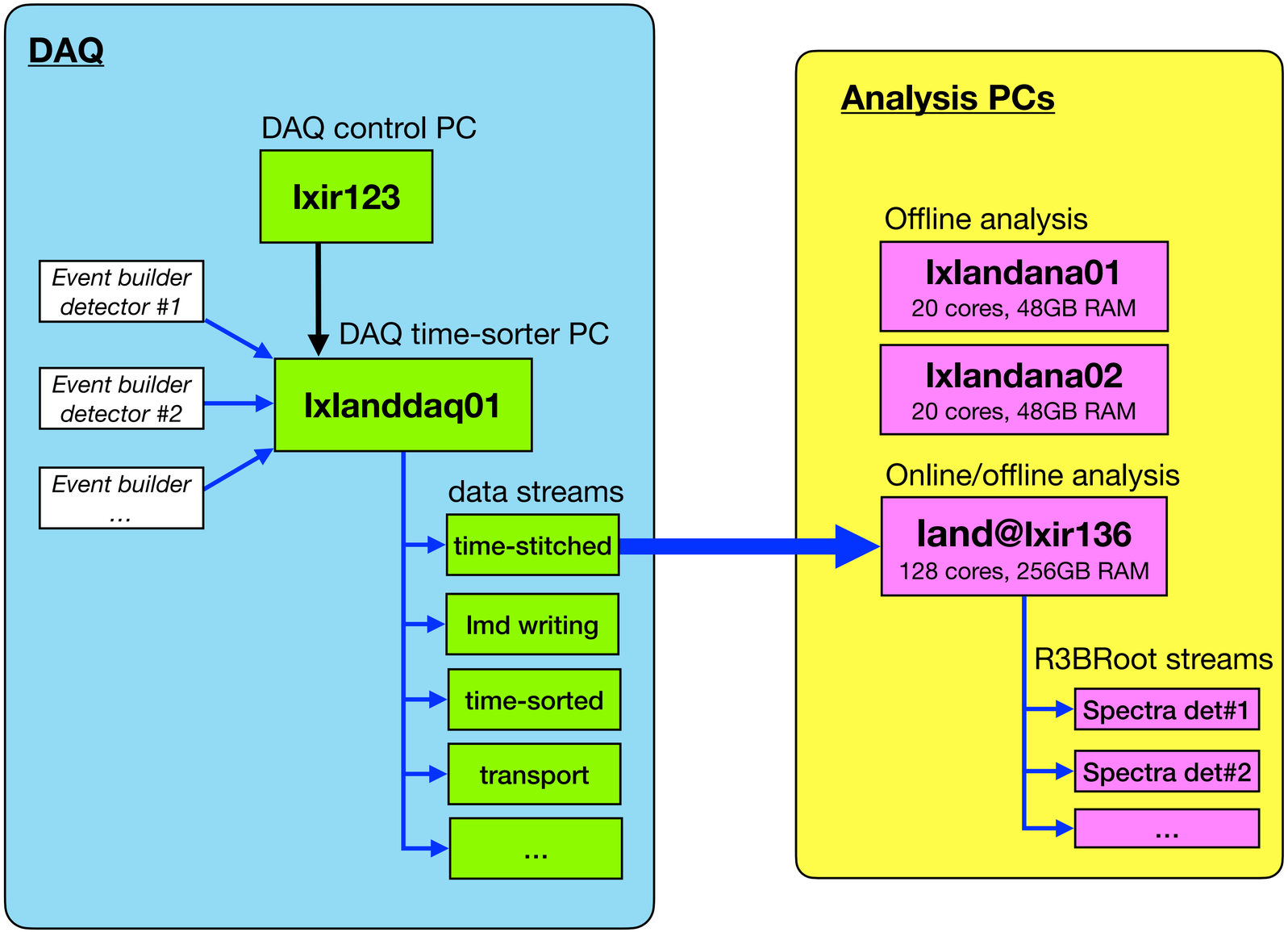
Valerii Panin

R3B Collaboration Meeting, 7-9 June 2022

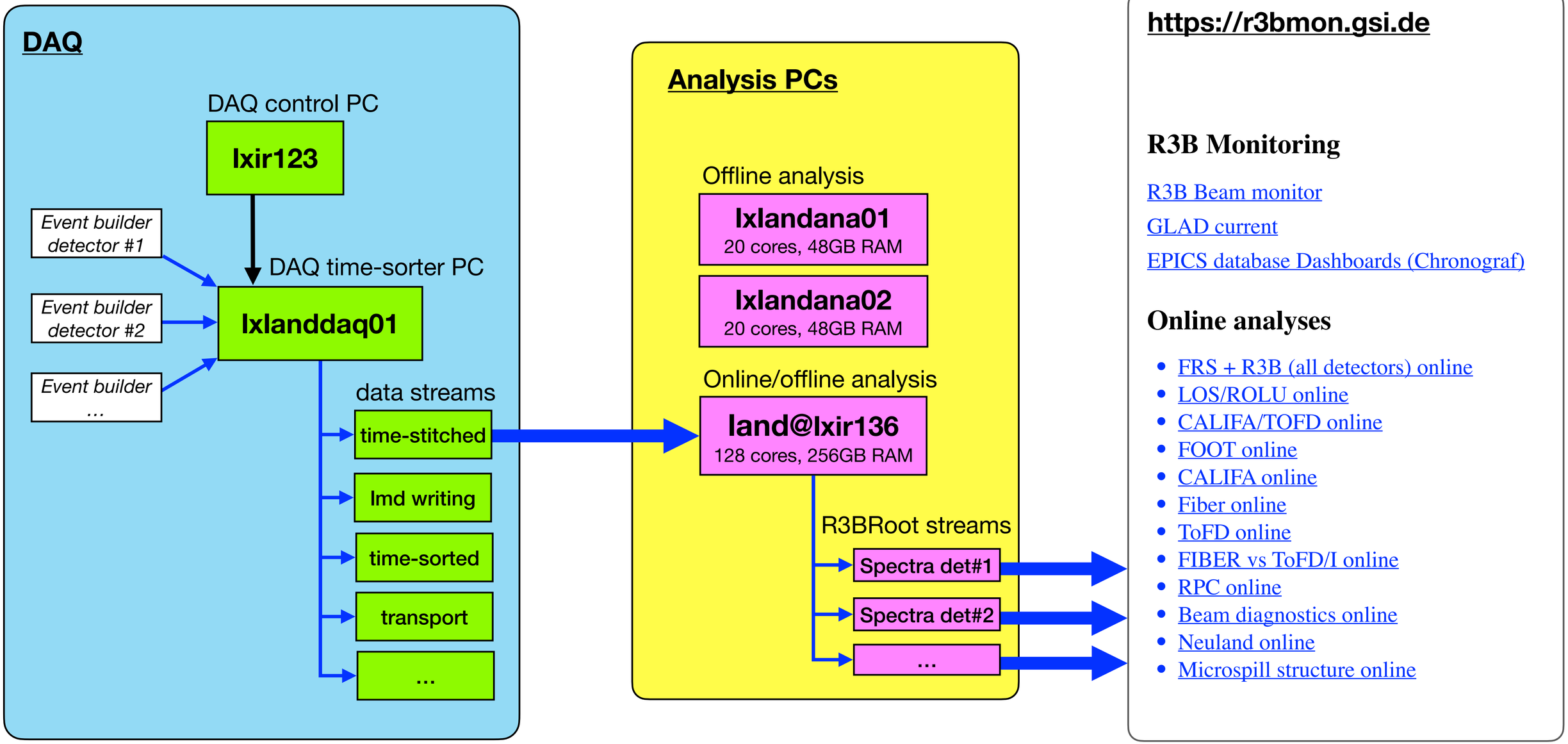
# Data streams for online analysis



# Data streams for online analysis

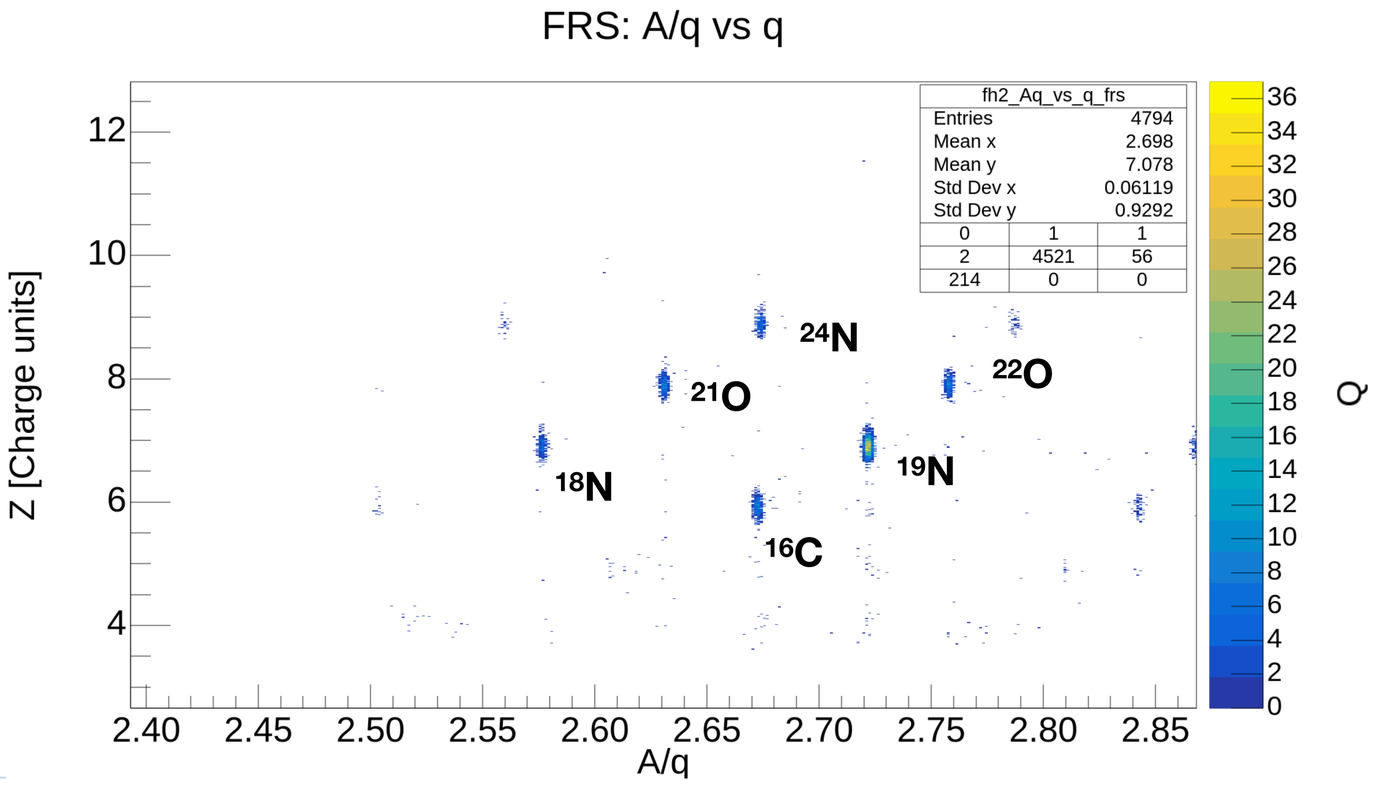


# Data streams for online analysis

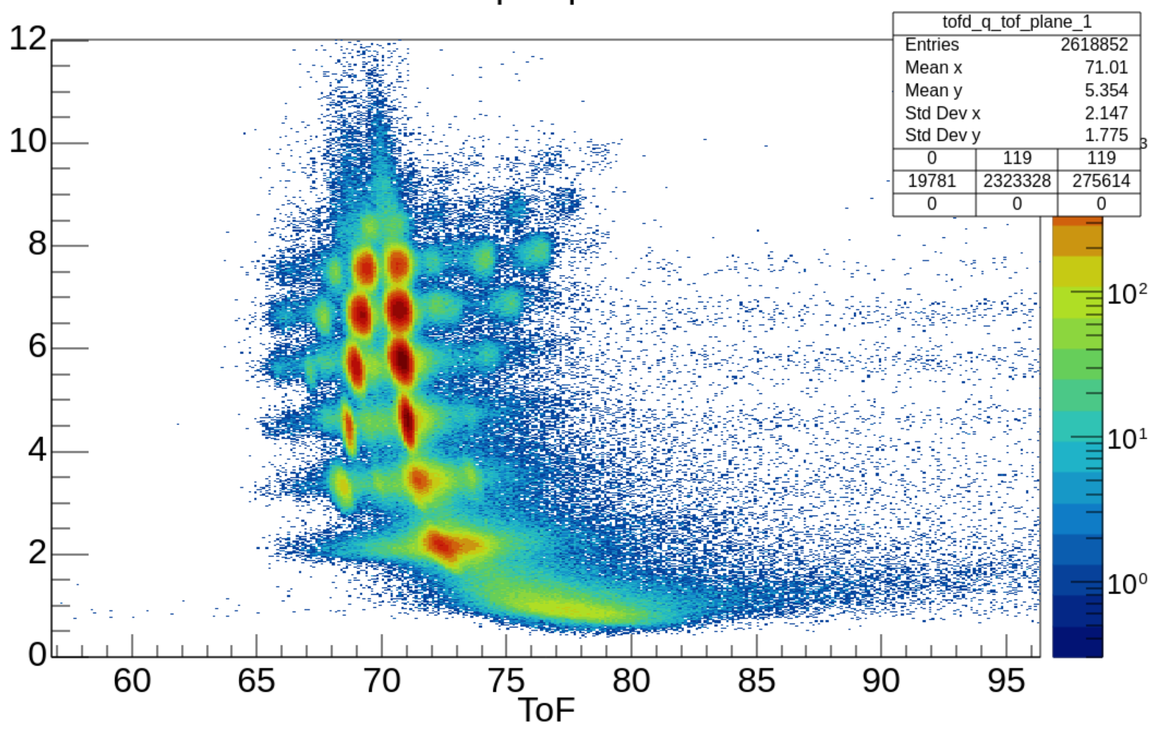


# Example of online spectra from s509

## Incoming beam PID (S2-LOS)




## Outgoing beam PID (TOFD)

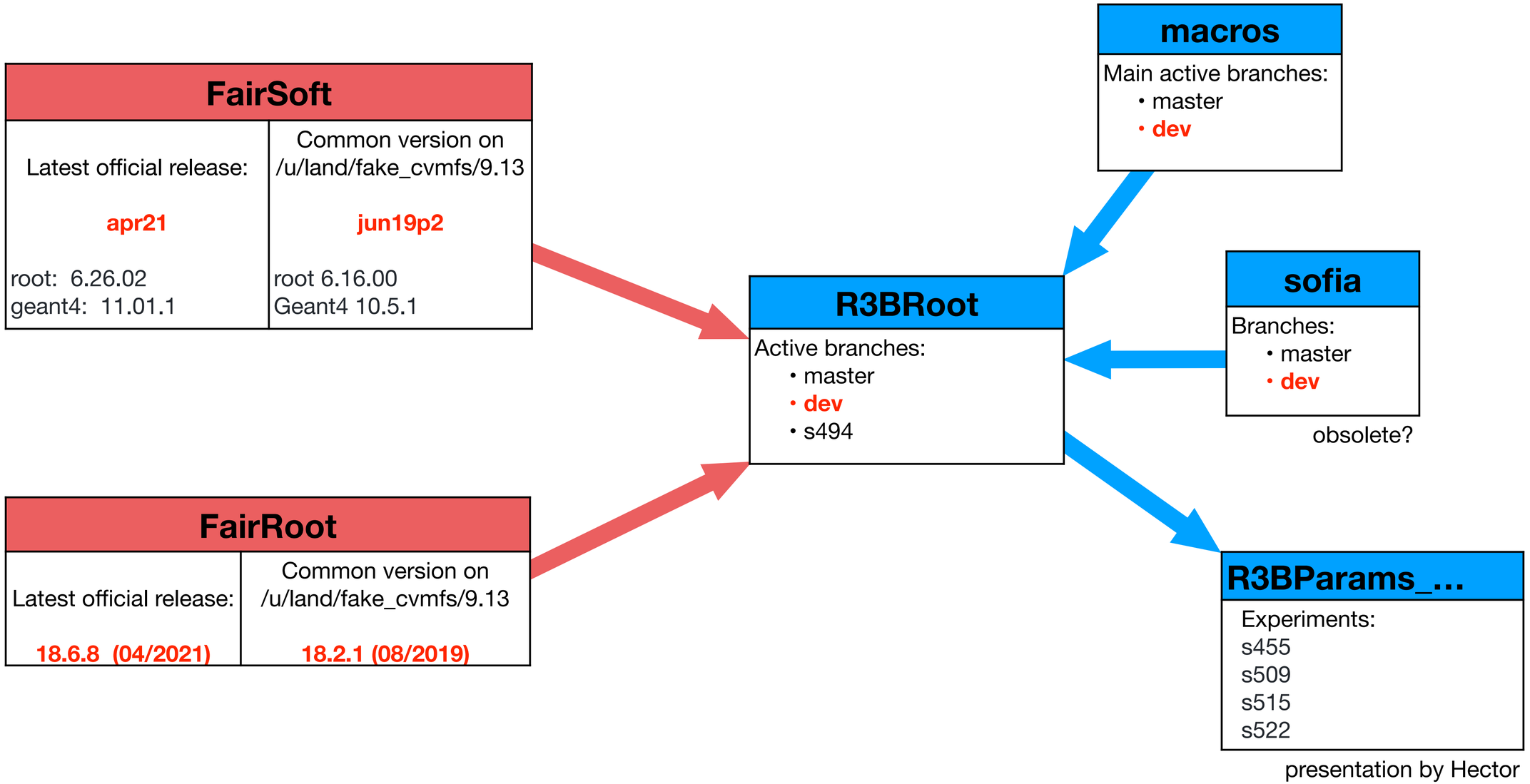



https://elog.gsi.de/land/s509/175

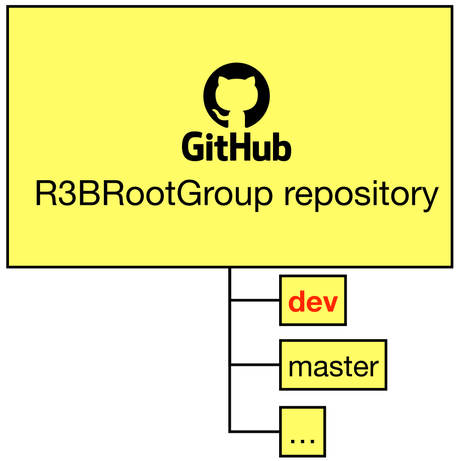
# Screenshot of the display in Messhuette (5th June)

## FairRoot Group at GSI

## R3BRoot Group

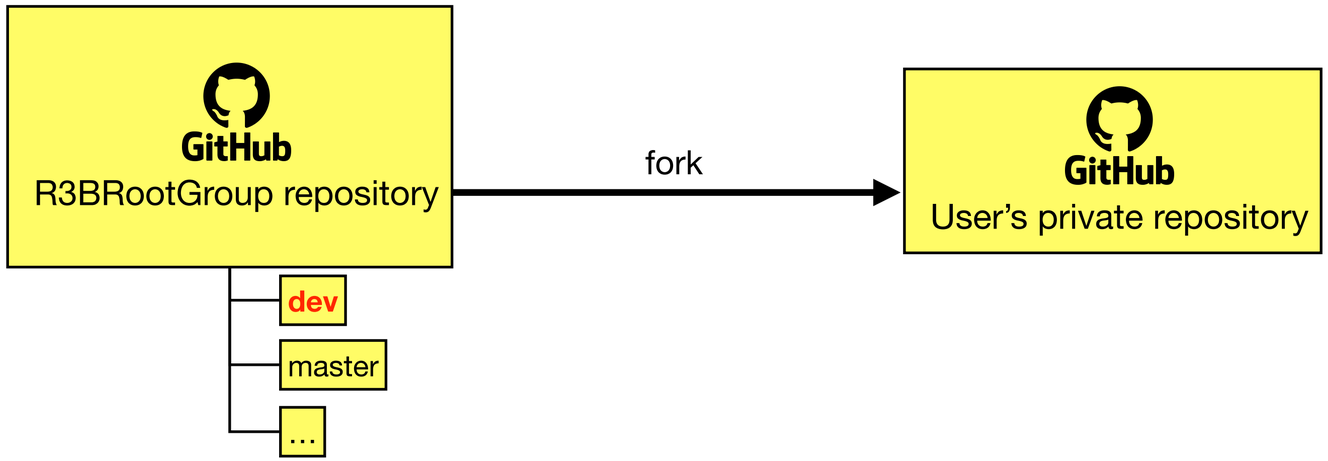


# Our standard git workflow ( adapted from Anar Manafov's manual )



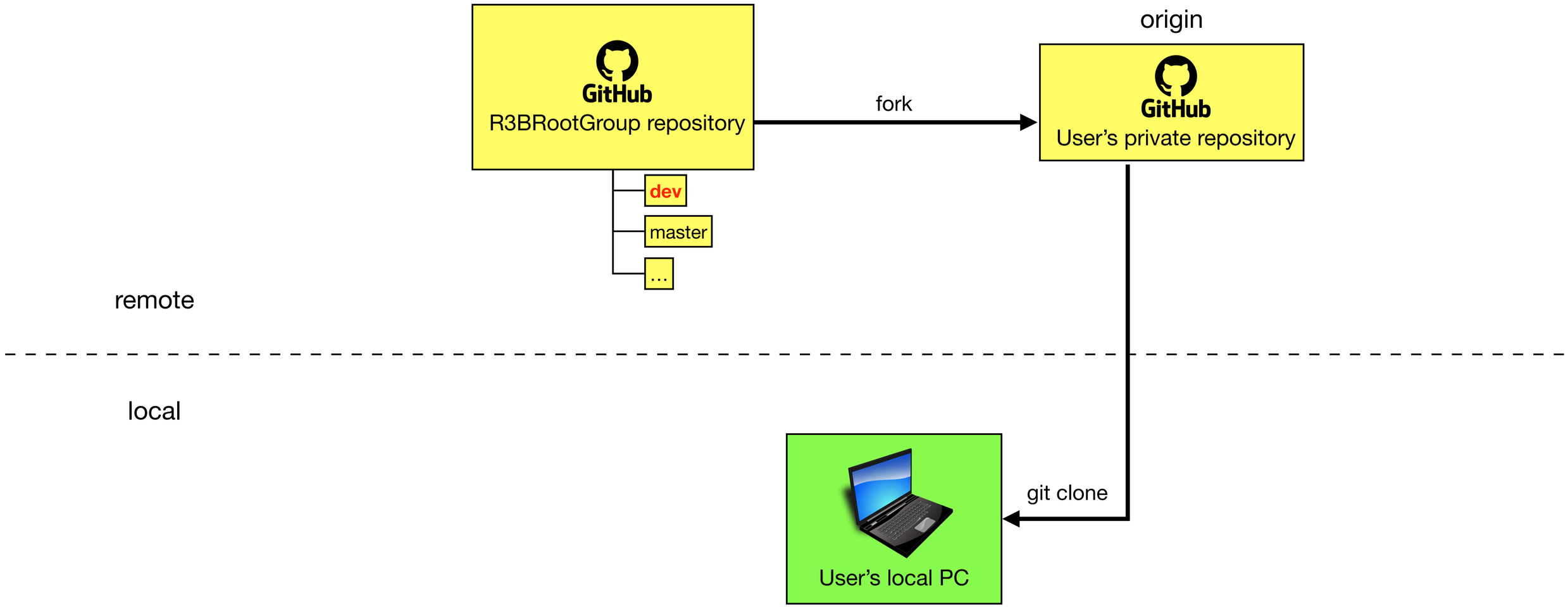

remote

# Our standard git workflow ( adapted from Anar Manafov's manual )

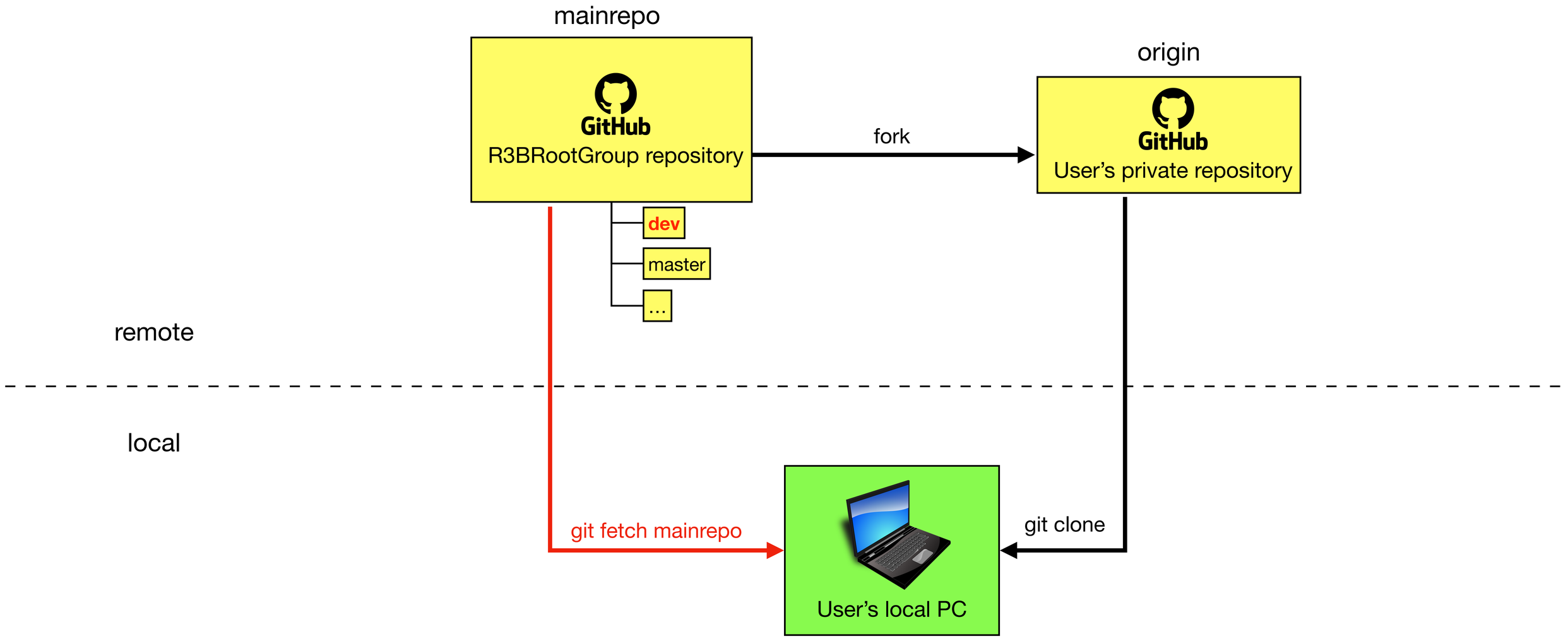



remote

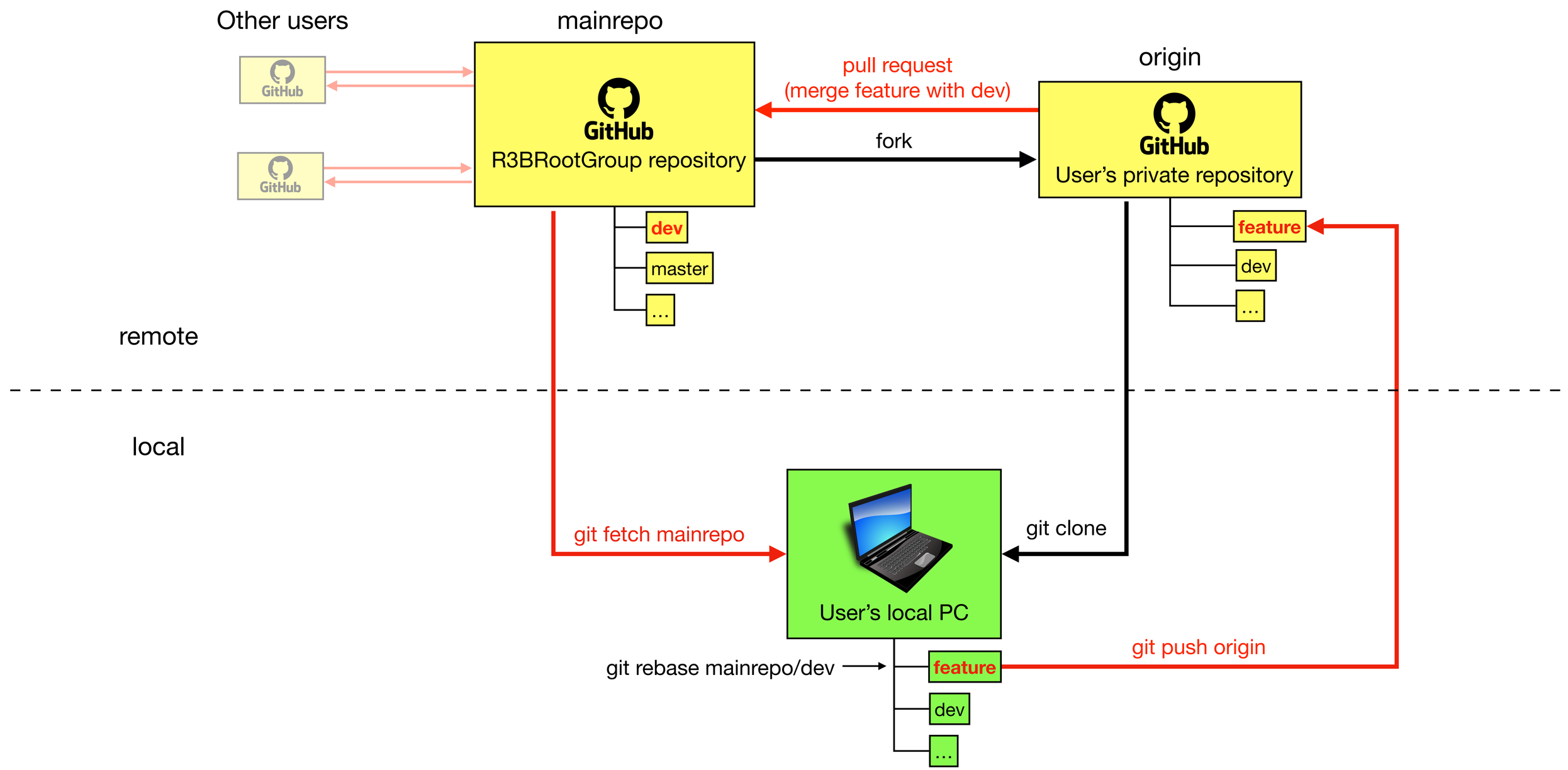
# Our standard git workflow ( adapted from Anar Manafov's manual )



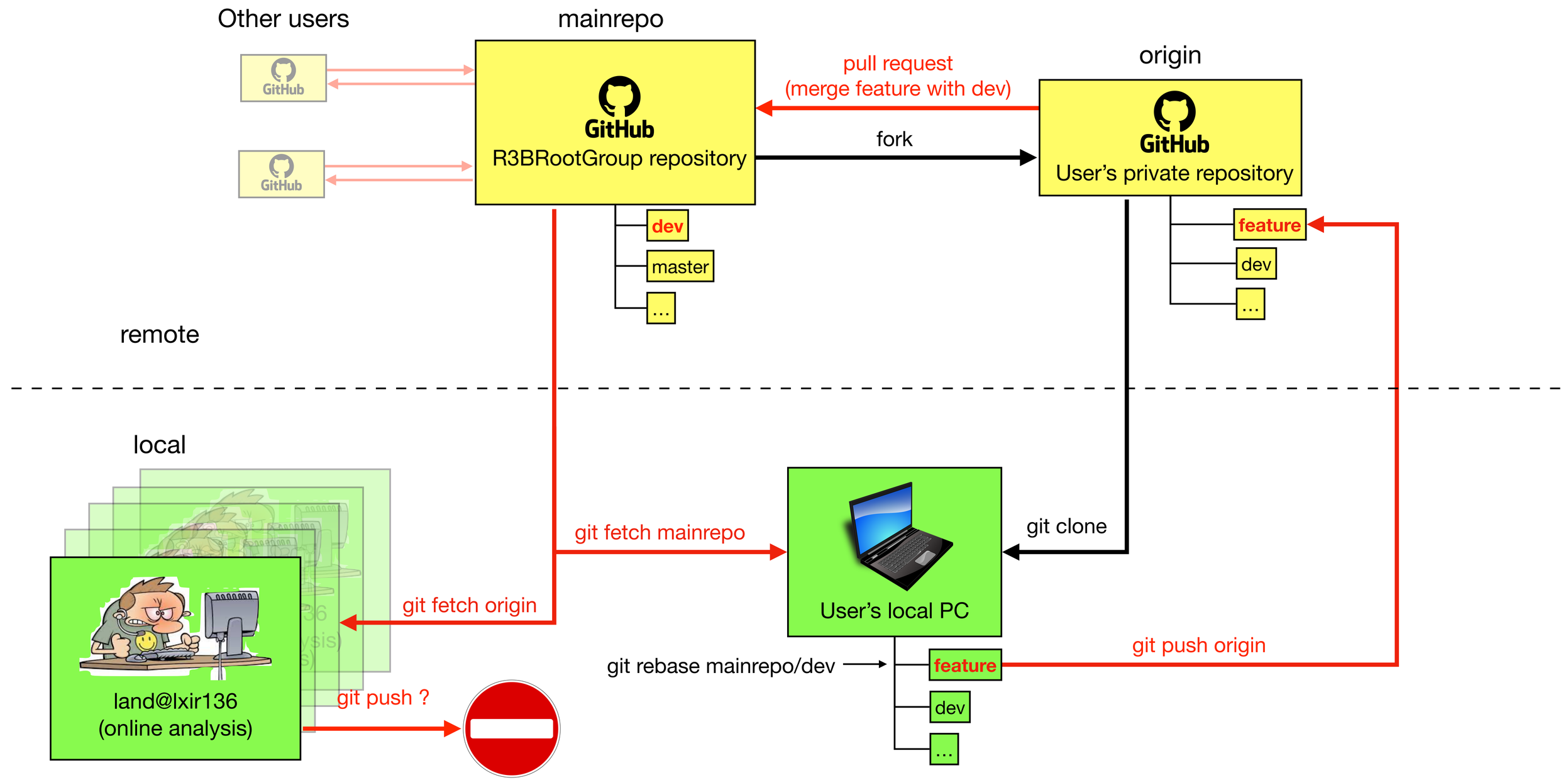
# Our standard git workflow ( adapted from Anar Manafov's manual )



# Our standard git workflow ( adapted from Anar Manafov's manual )

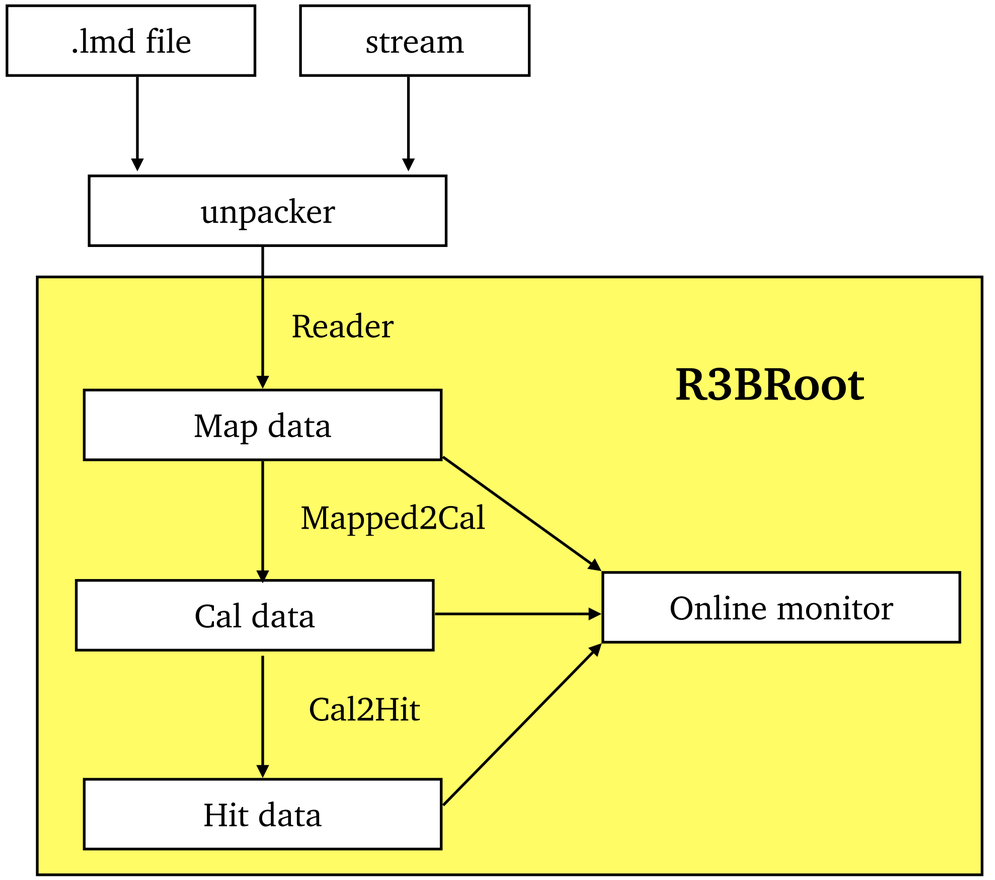


# Our standard git workflow ( adapted from Anar Manafov's manual )



# Current status of particular detectors in R3Broot

R3B data flow for online/offline analysis




From R3BWiki (based on dev branch of R3BRoot in GitHub)

| Detector | Reader | Mapped2Cal | Cal2Hit | Online |
|---|---|---|---|---|
| SCI-FRS | YES | YES | YES | YES |
| R3B-Music | YES | YES | YES | YES |
| Twin-Music for light ions | YES | YES | YES | YES |
| MWPCs | YES | YES | YES | YES |
| ROLU | YES | YES | YES | YES |
| LOS | YES | YES | YES | YES |
| PSPX | YES | YES | YES | YES |
| AMS | YES | YES | YES | YES |
| FOOT | YES | YES | Needs update | Needs update |
| ALPIDE | Needs update | YES | YES | YES |
| CALIFA | YES | YES | YES | Needs update |
| Twin-Music | YES | YES | YES | YES |
| Fibers | YES | YES | YES | YES |
| ToFD | YES | YES | YES | YES |
| ToFI | YES | YES | YES | YES |
| NeuLAND | YES | YES | YES | YES |
| RPC | YES | YES | YES | YES |
| HYDRA | NO | YES (sim data) | YES (sim data) | NO |

R3BRoot source directory structure
dev branch on 11/06/2021

```
.
├── actar
├── analysis
├── atima
├── califa
├── cmake
├── compilehelper
├── config
├── containers
├── dch
├── epics
├── evtvis
├── fi0
├── fi10
├── fi11
├── fi12
├── fi13
├── fi1a
├── fi1b
├── fi2a
├── fi2b
├── fi3a
├── fi3b
├── fi4
├── fi5
├── fi6
├── fi7
├── fi8
├── fi9
├── fiber
├── field
├── gconfig
├── geometry
├── gfi
├── input
├── land
├── los
├── lumon
├── macros
├── mfi
├── mtof
├── music
├── neuland
├── passive
├── pdc
├── psp
├── r3bbase
├── r3bdata
├── r3bgen
├── r3bsource
├── rolu
├── sci2
├── sci8
├── sfi
├── sfib
├── sofia
├── startrack
├── strawtubes
├── tcal
├── timestitcher
├── tof
├── tracker
├── tracker_rene
├── tracking
└── xball
```

R3BRoot source directory structure
current dev

```
.
├── actar
├── alpide
├── analysis
├── atima
├── califa
├── cmake
├── compilehelper
├── config
├── containers
├── dch
├── epics
├── evtvis
├── fiber
├── field
├── gconfig
├── geometry
├── gfi
├── input
├── land
├── los
├── lumon
├── macros
├── mfi
├── mtof
├── music
├── musli
├── mwpc
├── neuland
├── passive
├── pdc
├── psp
├── r3bbase
├── r3bdata
├── r3bgen
├── r3bsource
├── rolu
├── rpc
├── sci2
├── sci8
├── sfib
├── ssd
├── startrack
├── strawtubes
├── tcal
├── template
├── timestitcher
├── tof
├── tofd
├── tofi
├── tracker_rene
├── tracking
├── twim
└── xball
```

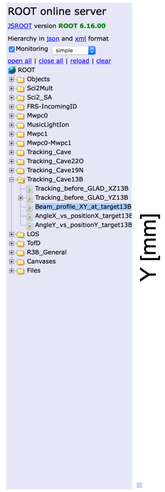
R3BRoot source directory structure
dev branch on 11/06/2021

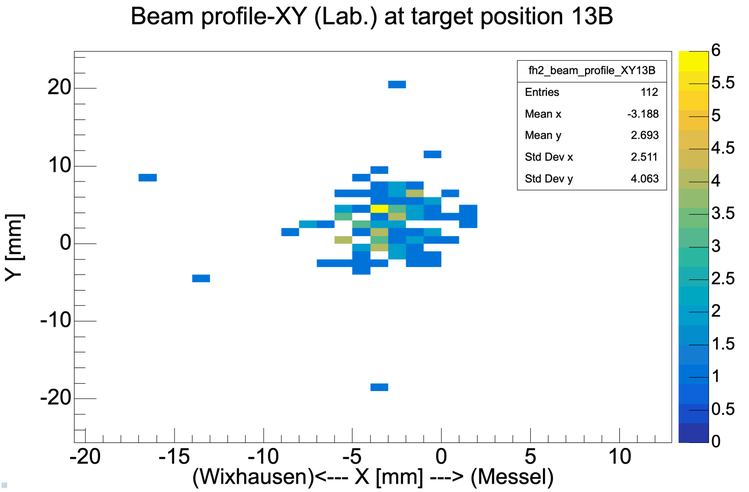
- actar
- analysis
  - CMakeLists.txt
  - R3BAnaLinkDef.h
  - R3BAnalysisIncomingFrs.cxx
  - R3BAnalysisIncomingFrs.h
- atima
- califa
- cmake
- compilehelper
- config
- containers
- dch
- epics
- evtvis
- fi0
- fi10
- fi11
- fi12
- fi13
- fi1a
- fi1b
- fi2a
- fi2b
- fi3a
- fi3b
- fi4
- fi5
- fi6
- fi7
- fi8
- fi9
- fiber
- field
- gconfig
- geometry
- gfi
- input
- land
- los
- lumon
- macros
- mfi
- mtof
- music
- neuland
- passive
- pdc
- psp
- r3bbase
- r3bdata
- r3bgen
- r3bsource
- rolu
- sci2
- sci8
- sfi
- sfib
- sofia
- startrack
- strawtubes
- tcal
- timestitcher
- tof
- tracker
- tracker_rene
- tracking
- xball

R3BRoot source directory structure
current dev

- actar
- alpide
- analysis
  - AnaLinkDef.h
  - CMakeLists.txt
  - offline
    - R3BAnalysisIncomingFrs.cxx
    - R3BAnalysisIncomingFrs.h
    - R3BAnalysisIncomingID.cxx
    - R3BAnalysisIncomingID.h
    - R3BGlobalAnalysis.cxx
    - R3BGlobalAnalysis.h
    - R3BGlobalAnalysisS454.cxx
    - R3BGlobalAnalysisS454.h
    - R3BIncomingBeta.cxx
    - R3BIncomingBeta.h
    - R3BTrackS454.cxx
    - R3BTrackS454.h
    - R3BTrackerTestS454.cxx
    - R3BTrackerTestS454.h
  - online
    - R3BCalifavsFootOnlineSpectra.cxx
    - R3BCalifavsFootOnlineSpectra.h
    - R3BCalifavsTofDOnlineSpectra.cxx
    - R3BCalifavsTofDOnlineSpectra.h
    - R3BFibervsTofDOnlineSpectra.cxx
    - R3BFibervsTofDOnlineSpectra.h
    - R3BGeneralOnlineSpectra.cxx
    - R3BGeneralOnlineSpectra.h
    - R3BIncomingIDOnlineSpectra.cxx
    - R3BIncomingIDOnlineSpectra.h
    - R3BIncomingTrackingOnlineSpectra.cxx
    - R3BIncomingTrackingOnlineSpectra.h
    - R3BOnlineSpectra.cxx
    - R3BOnlineSpectra.h
    - R3BOnlineSpectraBMON_S494.cxx
    - R3BOnlineSpectraBMON_S494.h
    - R3BOnlineSpectraDec2019.cxx
    - R3BOnlineSpectraDec2019.h
    - R3BOnlineSpectraFiber23.cxx
    - R3BOnlineSpectraFiber23.h
    - R3BOnlineSpectraFibvsToFDS494.cxx
    - R3BOnlineSpectraFibvsToFDS494.h
    - R3BOnlineSpectraLosVsSci2.cxx
    - R3BOnlineSpectraLosVsSci2.h
    - R3BOnlineSpectraPdc.cxx
    - R3BOnlineSpectraPdc.h
    - R3BOnlineSpectraSfib.cxx
    - R3BOnlineSpectraSfib.h
    - R3BOnlineSpectraToFD_S494.cxx
    - R3BOnlineSpectraToFD_S494.h
    - R3BOnlineSpectraToFI_S494.cxx
    - R3BOnlineSpectraToFI_S494.h
    - R3BOnlineSpillAnalysis.cxx
    - R3BOnlineSpillAnalysis.h
    - R3BTwimvsFootOnlineSpectra.cxx
    - R3BTwimvsFootOnlineSpectra.h
  - pars
    - R3BAnalysisContFact.cxx
    - R3BAnalysisContFact.h
    - R3BIncomingIDPar.cxx
    - R3BIncomingIDPar.h
- atima
- califa
- cmake
- compilehelper
- config
- containers
- dch
- epics
- evtvis
- fiber
- field
- gconfig
- geometry
- gfi
- input
- land
- los
- lumon
- macros
- mfi
- mtof
- music
- musli
- mwpc
- neuland
- passive
- pdc
- psp
- r3bbase
- r3bdata
- r3bgen
- r3bsource
- rolu
- rpc
- sci2
- sci8
- sfib
- ssd
- startrack
- strawtubes
- tcal
- template
- timestitcher
- tof
- tofd
- tofi
- tracker_rene
- tracking
- twim
- xball

- Collection of online and offline tasks in the analysis directory
  - Previously scattered in various directories
- Improved incoming FRS ID reconstruction and calib tasks
  - Online spectra for gated isotopes




Example from steering macro:

```
auto TrackingonlineB13 =
    new R3BIncomingTrackingOnlineSpectra("13B",4.5,5.5,2.5,2.7);
run->AddTask(TrackingonlineB13);
```

## R3BRoot source directory structure
## dev branch on 11/06/2021

```
actar
analysis
atima
califa
cmake
compilehelper
config
containers
dch
epics
evtvis
fi0
fi10
fi11
fi12
fi13
fi1a
fi1b
fi2a
fi2b
fi3a
fi3b
fi4
fi5
fi6
fi7
fi8
fi9
fiber
field
gconfig
geometry
gfi
input
land
los
lumon
macros
mfi
mtof
music
neuland
passive
pdc
psp
r3bbase
r3bdata
r3bgen
r3bsource
rolu
sci2
sci8
sfi
sfib
sofia
startrack
strawtubes
tcal
timestitcher
tof
tracker
tracker_rene
tracking
xball
```

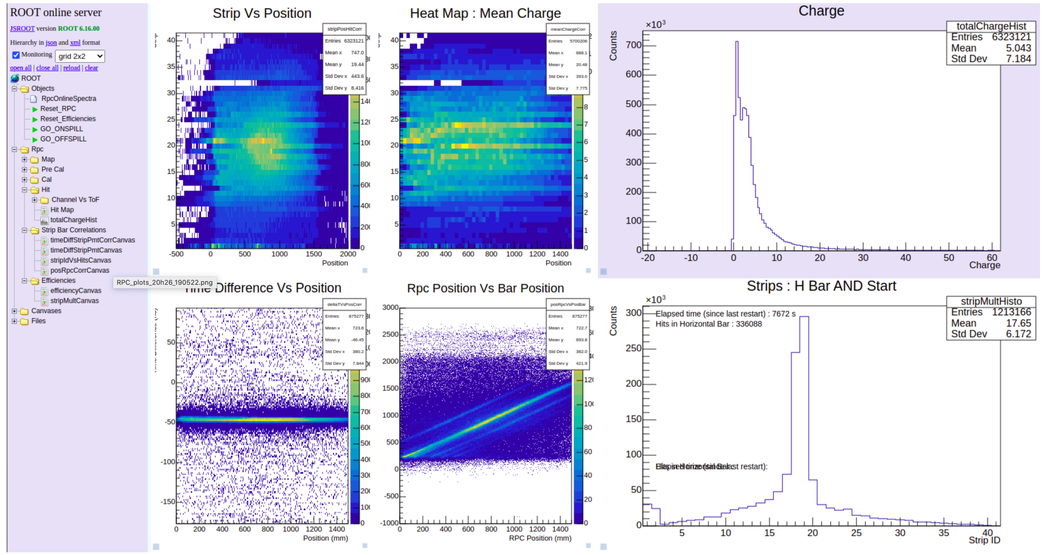
## R3BRoot source directory structure
## current dev

```
actar
alpide
  AlpideLinkDef.h
  CMakeLists.txt
  README.md
  calibration
    R3BAlpideCal2Hit.cxx
    R3BAlpideCal2Hit.h
    R3BAlpideMapped2Cal.cxx
    R3BAlpideMapped2Cal.h
  online
    R3BAlpideOnlineSpectra.cxx
    R3BAlpideOnlineSpectra.h
  pars
    R3BAlpideCluster.cxx
    R3BAlpideCluster.h
    R3BAlpideContFact.cxx
    R3BAlpideContFact.h
    R3BAlpideMappingPar.cxx
    R3BAlpideMappingPar.h
    R3BAlpideNoisyPixels.cxx
    R3BAlpideNoisyPixels.h
  sim
    R3BAlpide.cxx
    R3BAlpide.h
analysis
atima
califa
cmake
compilehelper
config
containers
dch
epics
evtvis
fiber
field
gconfig
geometry
gfi
input
land
los
lumon
macros
mfi
mtof
music
musli
mwpc
neuland
passive
pdc
psp
r3bbase
r3bdata
r3bgen
r3bsource
rolu
rpc
  CMakeLists.txt
  README.md
  RpcLinkDef.h
  calibration
    LUT.txt
    R3BRpcCal2Hit.cxx
    R3BRpcCal2Hit.h
    R3BRpcCal2HitPar.cxx
    R3BRpcCal2HitPar.h
    R3BRpcMapped2PreCal.cxx
    R3BRpcMapped2PreCal.h
    R3BRpcMapped2PreCalPar.cxx
    R3BRpcMapped2PreCalPar.h
    R3BRpcPreCal2Cal.cxx
    R3BRpcPreCal2Cal.h
    R3BRpcPreCal2CalPar.cxx
    R3BRpcPreCal2CalPar.h
  online
    R3BRpcOnlineSpectra.cxx
    R3BRpcOnlineSpectra.h
  pars
    R3BRpcContFact.cxx
    R3BRpcContFact.h
    R3BRpcHitPar.cxx
    R3BRpcHitPar.h
    R3BRpcPars4Sim.cxx
    R3BRpcPars4Sim.h
    R3BRpcTotCalPar.cxx
    R3BRpcTotCalPar.h
  sim
    R3BRpc.cxx
    R3BRpc.h
    R3BRpcDigitizer.cxx
    R3BRpcDigitizer.h
sci2
sci8
sfib
ssd
startrack
strawtubes
tcal
template
timestitcher
tof
tofd
tofi
tracker_rene
tracking
twim
xball
```

- Added ALPIDE code
  - Reconstruction tasks
  - Parameter containers, etc.

- New directory for RPC detector
  - Calibration/reconstruction tasks
  - Parameter containers, digitizers  etc.

## Example of RPC online spectra



R3BRoot source directory structure
dev branch on 11/06/2021

```
actar
analysis
atima
califa
cmake
compilehelper
config
containers
dch
epics
evtvis
fi0
fi10
fi11
fi12
fi13
fi1a
fi1b
fi2a
fi2b
fi3a
fi3b
fi4
fi5
fi6
fi7
fi8
fi9
fiber
field
gconfig
geometry
gfi
input
land
los
lumon
macros
mfi
mtof
music
neuland
passive
pdc
psp
r3bbase
r3bdata
r3bgen
r3bsource
rolu
sci2
sci8
sfi
sfib
sofia
startrack
strawtubes
tcal
timestitcher
tof
tracker
tracker_rene
tracking
xball
```

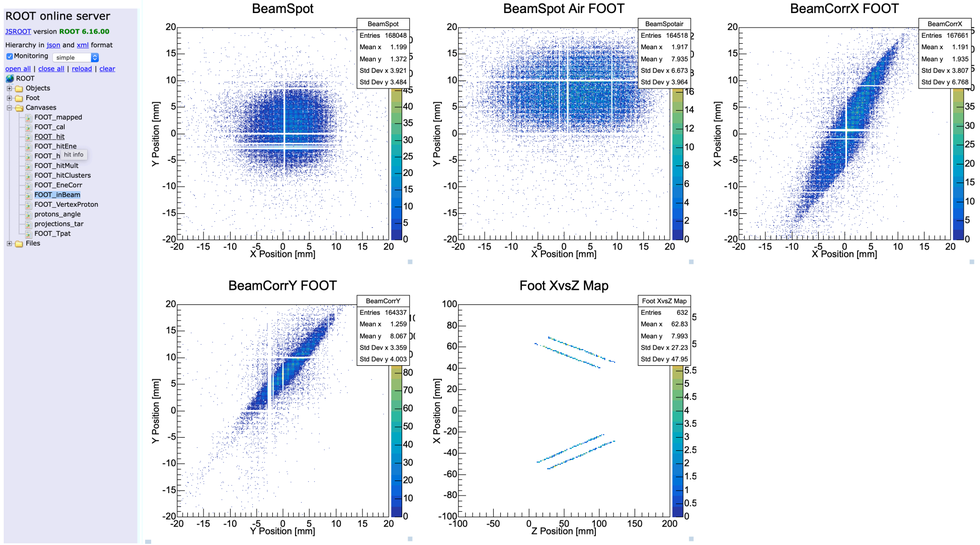
R3BRoot source directory structure
current dev

```
actar
alpide
analysis
atima
califa
cmake
compilehelper
config
containers
dch
epics
evtvis
fiber
field
gconfig
geometry
gfi
input
land
los
lumon
macros
mfi
mtof
music
musli
mwpc
neuland
passive
pdc
psp
r3bbase
r3bdata
r3bgen
r3bsource
rolu
rpc
sci2
sci8
sfib
ssd
startrack
strawtubes
tcal
template
timestitcher
tof
tofd
tofi
tracker_rene
tracking
twim
xball
```

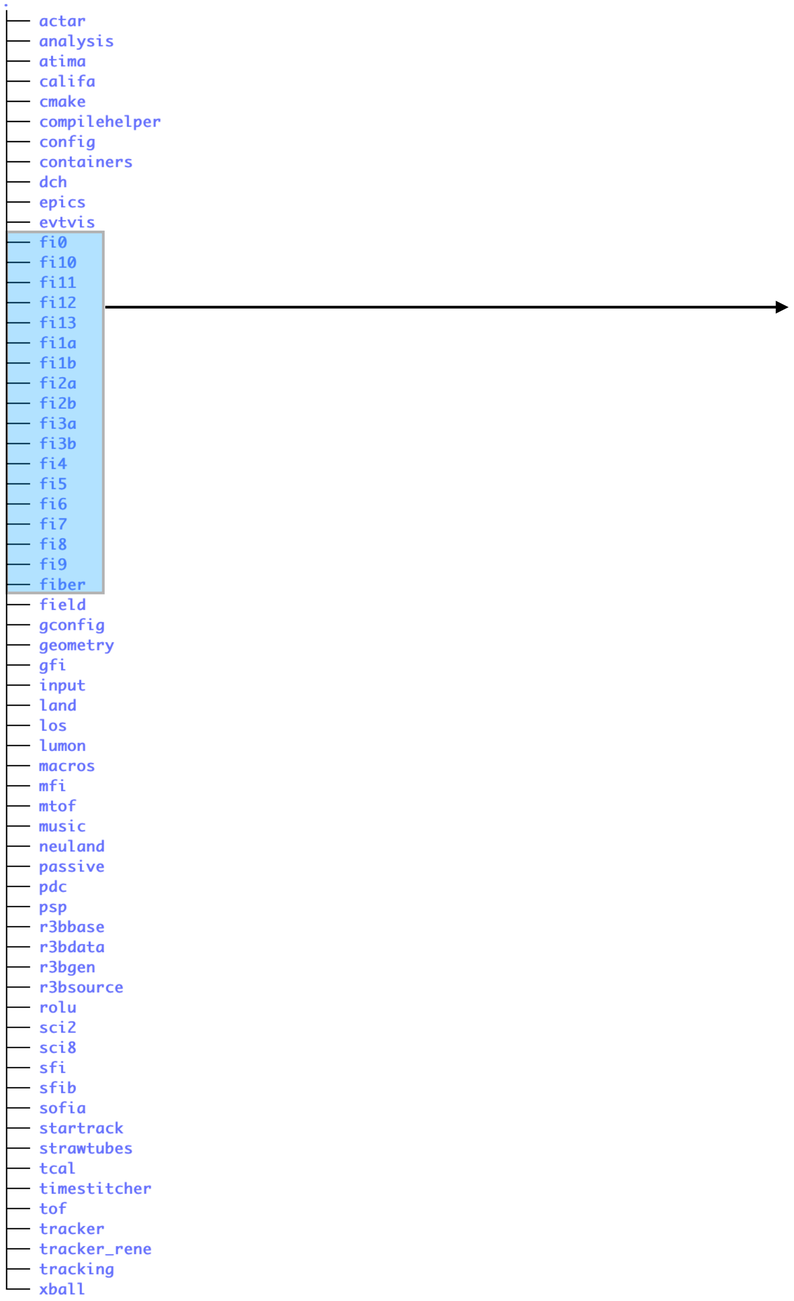
```
CMakeLists.txt
README.md
SsdLinkDef.h
calibration
    R3BAmsMapped2StripCal.cxx
    R3BAmsMapped2StripCal.h
    R3BAmsMapped2StripCalPar.cxx
    R3BAmsMapped2StripCalPar.h
    R3BAmsStripCal2Hit.cxx
    R3BAmsStripCal2Hit.h
    R3BFootMapped2StripCal.cxx
    R3BFootMapped2StripCal.h
    R3BFootStripCal2Hit.cxx
    R3BFootStripCal2Hit.h
digi
    R3BTarget2pDigiPar.cxx
    R3BTarget2pDigiPar.h
    R3BTarget2pDigitizer.cxx
    R3BTarget2pDigitizer.h
    R3BTargetDigiPar.cxx
    R3BTargetDigiPar.h
    R3BTargetDigitizer.cxx
    R3BTargetDigitizer.h
    R3BTra2pDigiPar.cxx
    R3BTra2pDigiPar.h
    R3BTra2pDigitizer.cxx
    R3BTra2pDigitizer.h
    R3BTraDigiPar.cxx
    R3BTraDigiPar.h
    R3BTraDigitizer.cxx
    R3BTraDigitizer.h
    R3BTraFraDigiPar.cxx
    R3BTraFraDigiPar.h
    R3BTraFraDigitizer.cxx
    R3BTraFraDigitizer.h
online
    R3BAmsCalifaCorrelatedOnlineSpectra.cxx
    R3BAmsCalifaCorrelatedOnlineSpectra.h
    R3BAmsOnlineSpectra.cxx
    R3BAmsOnlineSpectra.h
    R3BFootOnlineSpectra.cxx
    R3BFootOnlineSpectra.h
pars
    R3BAmsMappingPar.cxx
    R3BAmsMappingPar.h
    R3BAmsStripCalPar.cxx
    R3BAmsStripCalPar.h
    R3BFootCalPar.cxx
    R3BFootCalPar.h
    R3BFootMappingPar.cxx
    R3BFootMappingPar.h
    R3BGeoTra.cxx
    R3BGeoTra.h
    R3BGeoTraPar.cxx
    R3BGeoTraPar.h
    R3BSsdContFact.cxx
    R3BSsdContFact.h
sim
    R3BTra.cxx
    R3BTra.h
    R3BTraHitFinder.cxx
    R3BTraHitFinder.h
    R3BTra_Si_Lampshade.cxx
```

- SOFIA detectors are now part of R3BRoot (MUSIC, MUSLI, MWPCs)
  - no need (?) to install separately sofia directory
- All code for silicon-strip detectors (AMS, FOOT, L3T) is moved to ssd directory
  - Parameters, calibrations, digitizers, etc.
  - Added essential classes for FOOT

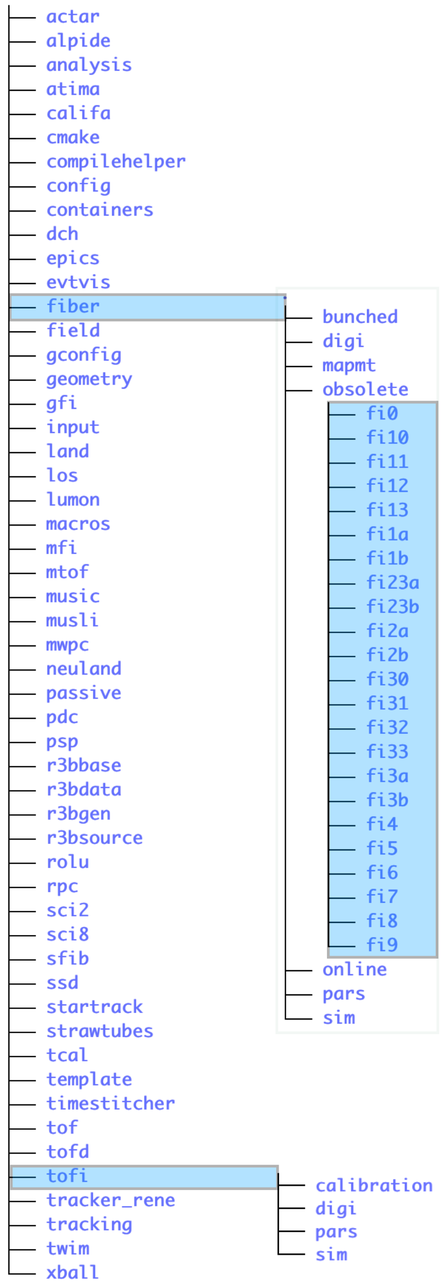
Example of FOOT online spectra



R3BRoot source directory structure
dev branch on 11/06/2021




R3BRoot source directory structure
current dev




- Single directory for all fiber detectors
- Added MAPMT fiber classes rom s494 branch
- Generic classes for different fiber types (Bunched and MAPMT)
  - Unified readers and parameters
  - Parameterized mapping instead of hard-coded one
  - Unified tasks for each type:
    - Map2Cal, Cal2Hit, online etc.
  - “Obsolete” code for inherited fiber classes is preserved

- Added TOFI detector from s494 branch:
  - Data, params, reconstructions, digitizers etc.

Example from steering macro:

```
auto fiber31reader =new R3BFiberReader(“Fi31”,….. );
auto map2calFi31 = new R3BFiberMAPMTMapped2Cal("Fi31");
```

# Other updates in R3BRoot (summary from git log since 11/06/2021)

- Updated data, parameters and reconstructions in CALIFA, NeuLAND, LOS, AnalysisIncomigID, ROLU, PSPs, TWIM, ROLU, TOFD
- Update readers for UCESB and TRLOII( data struct. to read scaler info), S2, NeuLAND (added structure with 26 planes), AMS, FOOT
- Added R3BDataPropagator class to propagate data levels between root files
- Updated EventHeader and R3BEventHeaderPropagator class and info. Reading of run IDs as function of timestamps
- Added readout of WR timestamps for PSPs, R3B-MUSIC, FOOT
- Updated R3BFileSource and Added randomization procedure for CALIFA Hit Level
- Added TCut to select the incoming projectiles at Cave-C
- Added event generator based on INCL input
- Updated GLAD field map class to read filed data from root file (new field maps)
- Added R3BTimeStitch class to calculate ToF between different electronics
- Modifying cmake files and compilation to incorporate all changes

# Thank you everyone!