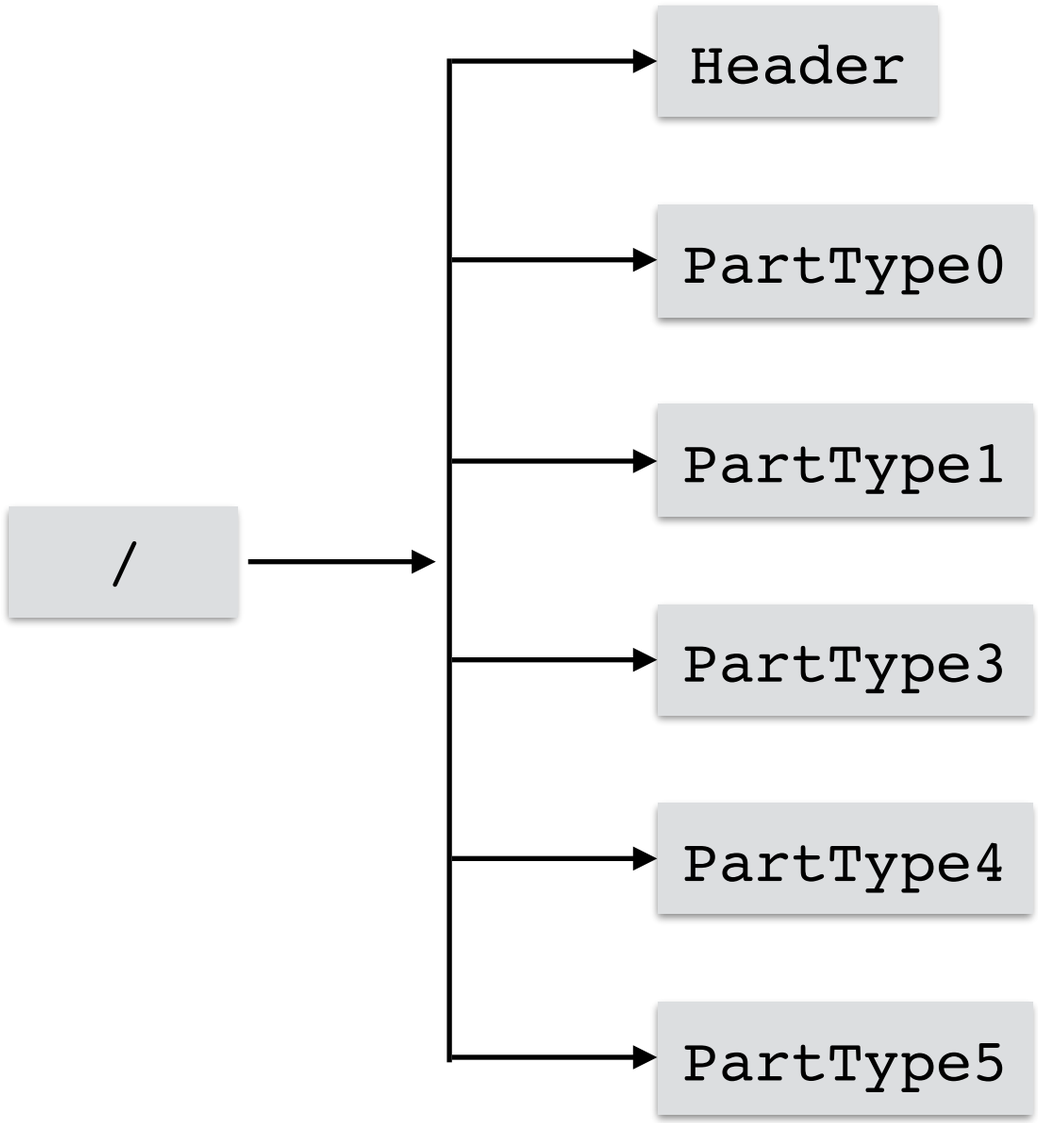
# Accessing the data

# Figuring out the file structure

```
$ h5dump -H snapdir_135.0.hdf5


GROUP "/" {
   GROUP "Header" {
      ATTRIBUTE "BoxSize" {
         DATATYPE  H5T_IEEE_F64LE
         DATASPACE  SCALAR
      }
      ATTRIBUTE "Composition_vector_length" {
         DATATYPE  H5T_STD_I32LE
         DATASPACE  SCALAR
      }
      ATTRIBUTE "Flag_Cooling" {
         DATATYPE  H5T_STD_I32LE
         DATASPACE  SCALAR
      }
```

(…)

# unix filesystem




Info. about the simulation

Gas “particles”

Dark matter

Tracers

Stars + Wind

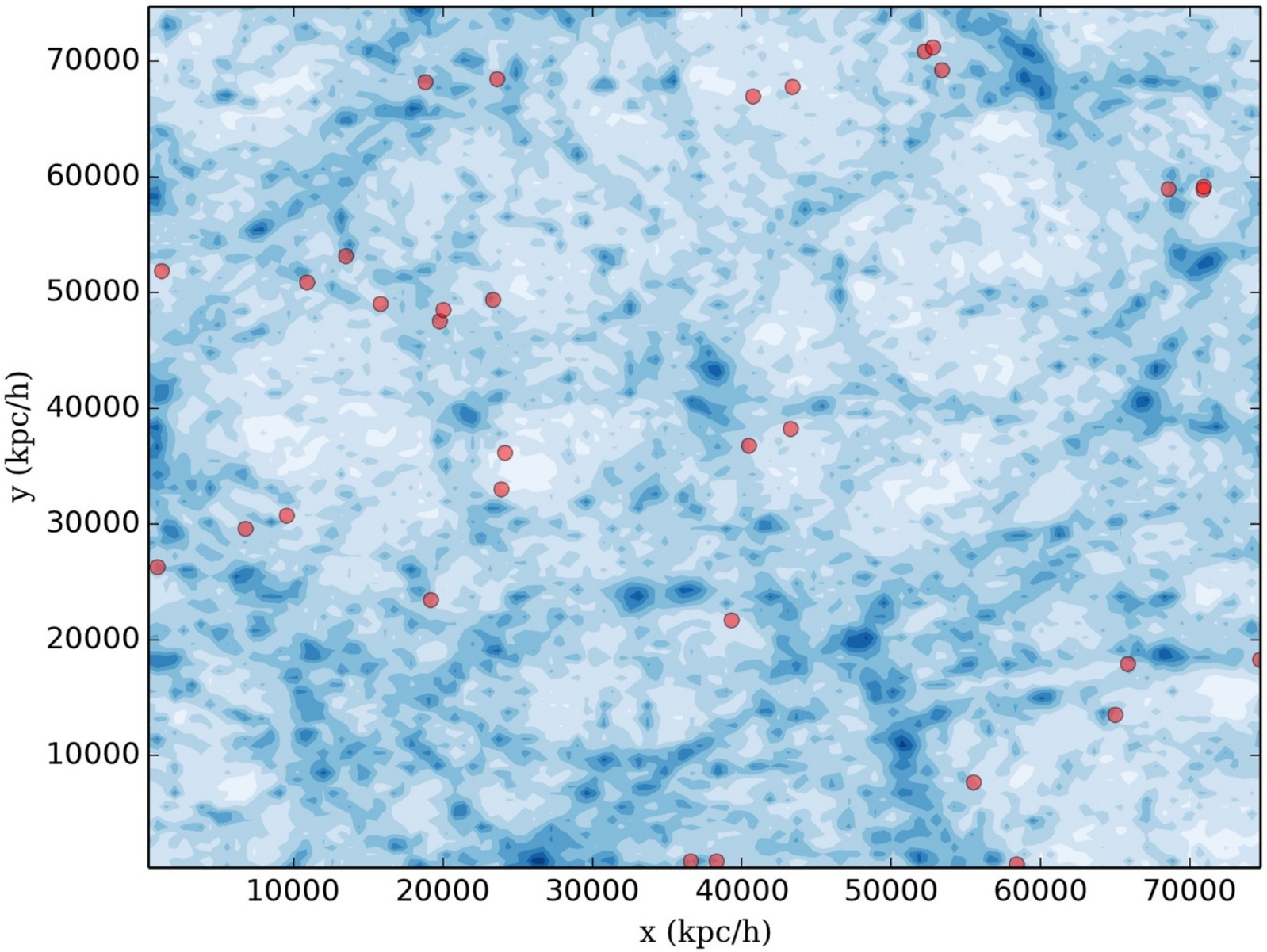
Black holes

```
$ h5dump -g "/Header" snap_135.0.hdf5


HDF5 "snap_135.0.hdf5" {
GROUP "/Header" {
   ATTRIBUTE "BoxSize" {
      DATATYPE  H5T_IEEE_F64LE
      DATASPACE  SCALAR
      DATA {
      (0): 75000
      }
   }
   ATTRIBUTE "Composition_vector_length" {
      DATATYPE  H5T_STD_I32LE
      DATASPACE  SCALAR
      DATA {
      (0): 0
      }
   }
   ATTRIBUTE "Flag_Cooling" {
      DATATYPE  H5T_STD_I32LE
      DATASPACE  SCALAR
      DATA {
      (0): 1
      }
   }

(…)
ATTRIBUTE "MassTable" {
      DATATYPE  H5T_IEEE_F64LE
      DATASPACE  SIMPLE { ( 6 ) / ( 6 ) }
      DATA {
      (0): 0, 0.0282174, 0, 0, 0, 0
      }
   }
ATTRIBUTE "NumFilesPerSnapshot" {
      DATATYPE  H5T_STD_I32LE
      DATASPACE  SCALAR
      DATA {
      (0): 32
      }
   }
   ATTRIBUTE "NumPart_ThisFile" {
      DATATYPE  H5T_STD_I32LE
      DATASPACE  SIMPLE { ( 6 ) / ( 6 ) }
      DATA {
      (0): 2782102, 2893619, 0, 3032547, 132085, 1107
      }
   }
(…)
```

Units?

Units?

# DM + BH

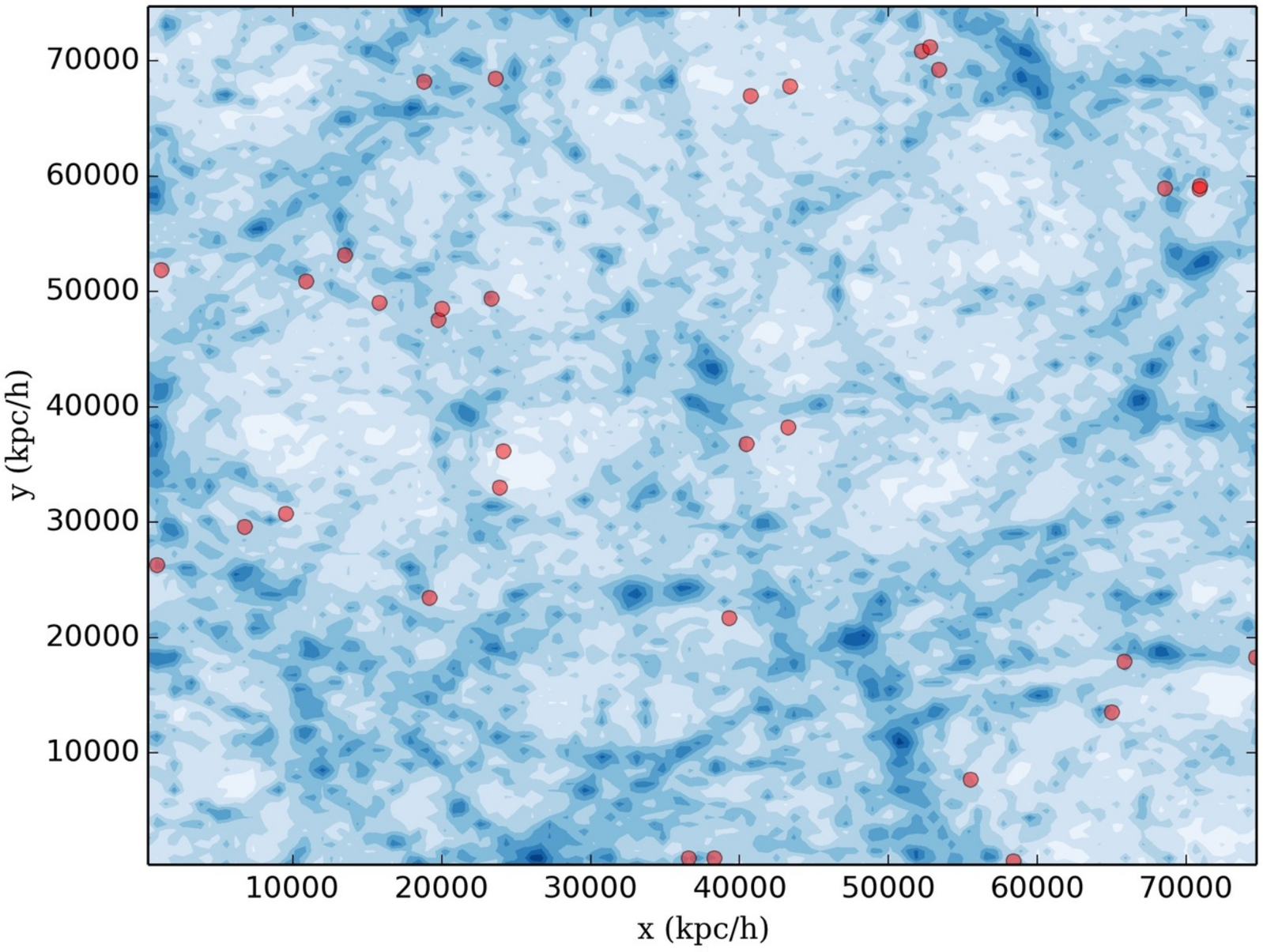

70000
60000
50000
40000
30000
20000
10000
y (kpc/h)
10000
20000
30000
40000
50000
60000
70000
x (kpc/h)

```
import numpy as np
import matplotlib.pyplot as plt
import readsnapHDF5 as rs

# Header
basedir = "/usr/users/ciro/training/astroph/snaps/Illustris/Illustris-3"
snapnum = 135
fname = basedir + "/snapdir_" + str(snapnum).zfill(3) + "/snap_" + \
str(snapnum).zfill(3)

header = rs.snapshot_header(fname)
print 'Box size = %f kpc' % (header.boxsize / header.hubble)
```

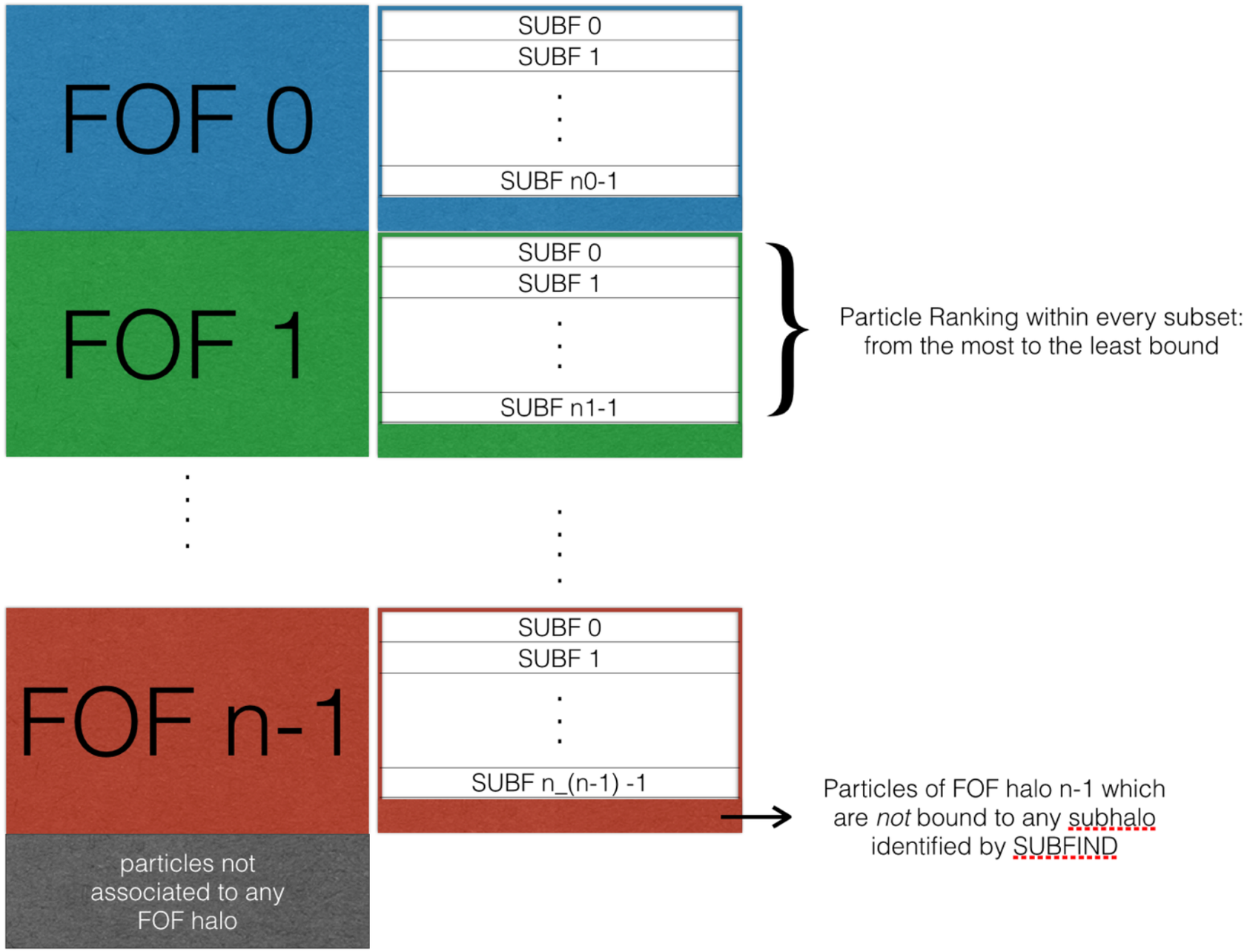
```
# Positions of all dark matter particles
pos1 = rs.read_block(fname, "POS ", parttype=1)
L = header.boxsize
nbins = 128

z, x, y = np.histogram2d(pos1[:, 0], pos1[:, 1], bins=nbins, range=[[0, L], [0, L]])
x = x[ 0 : nbins] + 0.5 * (x[1] - x[0])
y = y[ 0 : nbins] + 0.5 * (y[1] - y[0])
z = np.log(z)
```

```
# Plotting
cmap = plt.get_cmap('Blues')

plt.contourf (x, y, np.log(z), cmap=cmap)
plt.axis([x.min(), x.max(), y.min(), y.max()])
plt.show()
```

```
# Positions of black holes
pos5 = rs.read_block(fname, "POS ", parttype=5)
m5   = rs.read_block(fname, "MASS", parttype=5)

i = np.nonzero ((m5 > 1))[0]
pos5 = pos5[i]

plt.plot(pos5[:, 0], pos5[:, 1], 'or', alpha=0.5)
```


70000
60000
50000
40000
30000
20000
10000
y (kpc/h)
10000
20000
30000
40000
50000
60000
70000
x (kpc/h)

# Looking for one particular halo



# Homework

- Find the density profile of the main subhalo of the second most massive cluster in the box

- Fit an expression of the form

$$\rho(r) = \frac{\delta_c \rho_{\rm crit}}{r/r_s(1+r/r_s)^2}$$