

Mapping scRNAseq to 3D coordinate space

The aim is to spatially map single cell RNA-seq (scRNAseq) to a 3D spatial plane such that the cells are spatially arranged analogously to how they would be structured in-vivo.

This is done without prior knowledge of cell locations for the scRNAseq cells.

The training set would include all information from a Spatial Transcriptomic (ST) measurement, including gene expression per spatial coordinate overlayed on histology pixels.

ST data from the Allen Brain Institute is used from:

<https://github.com/almaan/spacex/>

This is purposed for the Competition from the Allen Brain Institute:

https://labshare.cshl.edu/shares/gillislab/resource/CellTypeMapping_2022/

Able to run on 16 vCPUs, 128 GB RAM with PyTorch 1.11 (with Intel® MKL-DNN/MKL)

```
In [1]: # !wget https://labshare.cshl.edu/shares/gillislab/resource/CellTypeMapping_
# !wget https://github.com/almaan/spacex/raw/master/data/Allen-1.h5ad.gz
# !wget https://github.com/almaan/spacex/raw/master/data/Allen-2.h5ad.gz
# !wget https://github.com/almaan/spacex/raw/master/data/Allen-3.h5ad.gz
# !wget https://github.com/almaan/spacex/raw/master/data/Allen-4.h5ad.gz

# !gunzip Allen-1.h5ad.gz
# !gunzip Allen-2.h5ad.gz
# !gunzip Allen-3.h5ad.gz
# !gunzip Allen-4.h5ad.gz
```

```
In [2]: import h5py
import torch
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import math
import torch.nn as nn
import gc
import scanpy as sc
from scipy import ndimage
import random
import torch.nn.functional as F
import torchvision.transforms.functional as TF
import leidenalg
import scanorama
import anndata as AnnData
import scvi
```

Global seed set to 0

```
In [3]: device = torch.device('cuda:0' if torch.cuda.is_available() else 'cpu')

seed_num = 1
np.random.seed(seed_num)
```

```
random.seed(seed_num)
torch.manual_seed(seed_num)
```

Out[3]: <torch._C.Generator at 0x7ff652965f70>

```
In [4]: window_size = 2
main_axis_size = 800

# Generate a uniform grid of M cells
def to_grid(M):
    grid = np.random.uniform(size=(M.shape[1],2))
    return grid

# Put gene expression as new "channels" on top of uniform grid
def to_kde_grid(M,grid,main_axis_size=main_axis_size,window_size=window_size):
    main_grid = np.zeros(((main_axis_size+4*window_size),(main_axis_size+4*w
    for i in range(M.shape[0]):
        x = np.round(main_axis_size*grid[:,0]).astype(np.int)+2*window_size
        y = np.round(main_axis_size*grid[:,1]).astype(np.int)+2*window_size
        main_grid[x,y,i] = main_grid[x,y,i]+M[i,:].reshape([M.shape[1],])
        main_grid[:, :, i] = ndimage.gaussian_filter(main_grid[:, :, i], window_
    return main_grid

# Get KNN gene expression "convolutions" from gene expression "channels"
def to_samples(kde_grid,grid,w_size=window_size,type_data="numpy",modality=""
    W,H,C = kde_grid.shape
    if modality=="ST":
        x = grid[:,0].astype(np.int)
        y = grid[:,1].astype(np.int)
    else:
        x = np.round(main_axis_size*grid[:,0]).astype(np.int)+2*window_size
        y = np.round(main_axis_size*grid[:,1]).astype(np.int)+2*window_size

    main_kde_conv = np.zeros((len(x),w_size*2*w_size*2*C))
    for i in range(len(x)):
        main_kde_conv[i,:] = (kde_grid[(x[i]-w_size):(x[i]+w_size),(y[i]-w_s
    if type_data == "tensor":
        main_kde_conv = torch.from_numpy(main_kde_conv).float().to(device)

    return main_kde_conv
```

```
In [5]: # Read in Allen Brain data
allen_1 = sc.read_h5ad("Allen-1.h5ad")
allen_2 = sc.read_h5ad("Allen-2.h5ad")
allen_3 = sc.read_h5ad("Allen-3.h5ad")
allen_4 = sc.read_h5ad("Allen-4.h5ad")
```

```
# Read in Competition data
import h5py
from scipy import sparse
with h5py.File('barseq2.hdf5') as f:
    dim = f['dim'][()]
    genes_old = [g.decode('utf-8') for g in f['dimnames/genes'][()]]
    cells = [c.decode('utf-8') for c in f['dimnames/cells'][()]]
    i = f['matrix/i'][()] - 1
    j = f['matrix/j'][()] - 1
    x = f['matrix/x'][()]
    M = sparse.csc_matrix((x, (i,j)), shape =dim )
    M = M.todense()
```

```
# Select similar genes shared between datasets
genes = [i for i in genes_old if i not in ['Tafal1', 'Tafal2', 'Ccn2']]
allen_1_select = allen_1[:, genes]
allen_2_select = allen_2[:, genes]
allen_3_select = allen_3[:, genes]
allen_4_select = allen_4[:, genes]

M = M[np.where(np.asarray([i in genes for i in genes_old]))[0],:]
```

```
In [7]: coord_list = [
    np.vstack((allen_1_select.obs["x"]*allen_1_select.uns["tissue_hires_sca
    np.vstack((allen_2_select.obs["x"]*allen_2_select.uns["tissue_hires_sca
    np.vstack((allen_3_select.obs["x"]*allen_3_select.uns["tissue_hires_sca
    np.vstack((allen_4_select.obs["x"]*allen_4_select.uns["tissue_hires_sca
]

pixel_list = [
    allen_1_select.uns["image_hires"],
    allen_2_select.uns["image_hires"],
    allen_3_select.uns["image_hires"],
    allen_4_select.uns["image_hires"]
]

main_pixel_list = [
    allen_1_select.uns["image_hires"],
    allen_2_select.uns["image_hires"],
    allen_3_select.uns["image_hires"],
    allen_4_select.uns["image_hires"]
]

gex_list = [
    allen_1_select.X,
    allen_2_select.X,
    allen_3_select.X,
    allen_4_select.X
]

for i in range(len(gex_list)):
    gex_list[i] = torch.from_numpy(gex_list[i]).float().to(device)
    pixel_list[i] = to_samples(pixel_list[i],coord_list[i],16,"numpy","ST")
    pixel_list[i] = torch.from_numpy(pixel_list[i]).float().to(device)
    print(pixel_list[i].shape)
    print(gex_list[i].shape)
```

torch.Size([2669, 3072])
 torch.Size([2669, 106])
 torch.Size([3571, 3072])
 torch.Size([3571, 106])
 torch.Size([2741, 3072])
 torch.Size([2741, 106])
 torch.Size([3354, 3072])
 torch.Size([3354, 106])

In []:

In []:

In [8]: # Prepare Allen brain dataset

```
allen_1_grid = np.vstack((allen_1_select.obs["x"]*allen_1_select.uns["tissue_hires_scalef"]*allen_1_select.obs["y"]*allen_1_select.uns["tissue_hires_scalef"]/2000)).T
allen_1_M = allen_1_select.X.T
print(allen_1_grid.shape)
print(allen_1_M.shape)

allen_1_kde_grid = to_kde_grid(allen_1_M,allen_1_grid,main_axis_size)
allen_1_kde_samples = to_samples(allen_1_kde_grid,allen_1_grid,window_size,"")
print(allen_1_kde_samples.shape)

allen_2_grid = np.vstack((allen_2_select.obs["x"]*allen_2_select.uns["tissue_hires_scalef"]*allen_2_select.obs["y"]*allen_2_select.uns["tissue_hires_scalef"]/2000)).T
allen_2_M = allen_2_select.X.T
print(allen_2_grid.shape)
print(allen_2_M.shape)

allen_2_kde_grid = to_kde_grid(allen_2_M,allen_2_grid,main_axis_size)
allen_2_kde_samples = to_samples(allen_2_kde_grid,allen_2_grid,window_size,"")
print(allen_2_kde_samples.shape)

allen_3_grid = np.vstack((allen_3_select.obs["x"]*allen_3_select.uns["tissue_hires_scalef"]*allen_3_select.obs["y"]*allen_3_select.uns["tissue_hires_scalef"]/2000)).T
allen_3_M = allen_3_select.X.T
print(allen_3_grid.shape)
print(allen_3_M.shape)

allen_3_kde_grid = to_kde_grid(allen_3_M,allen_3_grid,main_axis_size)
allen_3_kde_samples = to_samples(allen_3_kde_grid,allen_3_grid,window_size,"")
print(allen_3_kde_samples.shape)

allen_4_grid = np.vstack((allen_4_select.obs["x"]*allen_4_select.uns["tissue_hires_scalef"]*allen_4_select.obs["y"]*allen_4_select.uns["tissue_hires_scalef"]/2000)).T
allen_4_M = allen_4_select.X.T
print(allen_4_grid.shape)
print(allen_4_M.shape)

allen_4_kde_grid = to_kde_grid(allen_4_M,allen_4_grid,main_axis_size)
allen_4_kde_samples = to_samples(allen_4_kde_grid,allen_4_grid,window_size,"")
print(allen_4_kde_samples.shape)
```

```
(2669, 2)
(106, 2669)
(2669, 1696)
(3571, 2)
(106, 3571)
(3571, 1696)
(2741, 2)
(106, 2741)
(2741, 1696)
(3354, 2)
(106, 3354)
(3354, 1696)
```

```
In [9]: # Generate uniform grid
grid = to_grid(M)

# Generate gene expression channels
kde_grid = to_kde_grid(M,grid,main_axis_size)

# Generate KNN convolutions from gene expression channels
kde_samples = to_samples(kde_grid,grid,window_size,"numpy","scRNAseq")
```

```
In [10]: class VisualFormNet(nn.Module):

    def __init__(self):
        super(VisualFormNet, self).__init__()

        # beta is to learn gene expression
        # spatial signals from scRNAseq only
        self.summary_beta = nn.Linear(10,window_size*2*window_size*2*106,bias=False)

        # gex and pix are to learn transformation parameters that
        # assign based on image similarity to real histology
        self.summary_gex = nn.Linear(len(genes),100,bias=False)
        self.summary_pix = nn.Linear(32*32*3,100,bias=False)

        # output layer
        self.output_gex = nn.Linear(10,3)

        self.eye_beta = torch.eye(10,10).to(device)
        self.eye_pix = torch.eye(32*32*3).to(device)
        self.eye_gex = torch.eye(len(genes)).to(device)

        self.dropout_gex = nn.Dropout(0.6)

    def forward(self, x_list, gex_list, pix_list):

        # Use spatial gene expression to align single cells properly
        spatial_gex_list = []

        # Run
        for i in range(len(gex_list)):
            gex = gex_list[i]
            pix = pix_list[i]
            N,P = gex.shape
            s_pix_2_code = self.summary_pix(self.eye_pix)
            s_gene_2_code = self.dropout_gex(self.summary_gex(self.eye_gex))
            s_pix_2_gex = s_pix_2_code@s_gene_2_code.T
```

```

gex_pix1,gex_pix2 = pix@s_pix_2_gex,pix@s_pix_2_gex
spatial_gex_list += [[gex_pix1,gex_pix2,s_pix_2_gex]]


# Use spatial histology pixels to align single cells properly
ST_grid = [ ]


# Find a set of optimal signals that push cells around like Waddington
# via linear form model - see https://github.com/AskExplain/Interpre
x_grid = [ ]


# Run
for i in range(len(x_list)):
    x = x_list[i]

    ST_x = x.reshape([x.shape[0],window_size*2,window_size*2,106])·p
    ST_x = torch.mean(ST_x,(2,3)).reshape(ST_x.shape[:2])
    ST_grid += [[ST_x@s_pix_2_gex.T]]

    N,P = x.shape
    beta = self.summary_beta(self.eye_beta).T
    x1,x2 = self.output_gex(x@beta), self.output_gex(x@beta@(beta.T@
    x1,x2 = torch.subtract(x1,torch.mean(x1).to(device)),torch.subtr
    x1,x2 = torch.div(x1,torch.std(x1).to(device)),torch.div(x2,torc
    x1,x2 = torch.subtract(x1,torch.min(x1).to(device)),torch.subtra
    x1,x2 = torch.div(x1,torch.max(x1).to(device)),torch.div(x2,torc
    x_grid += [[x1,x2]]


return x_grid, ST_grid, spatial_gex_list

```

In [11]:

```

import torch.optim as optim

net = VisualFormNet()
net.to(device)

mseloss = nn.MSELoss()
optimizer = optim.Adam(net.parameters(), lr=1e-2, weight_decay = 0.5)

```

In [12]:

```

# GRID_list is a normalised list of coordinates from 0 to 1
GRID_list = [
    allen_1_grid,
    allen_2_grid,
    allen_3_grid,
    allen_4_grid
]

# Gene expression
M_list = [
    M,
    allen_1_M,
    allen_2_M,
    allen_3_M,
    allen_4_M
]

```

```

# Spatial gene expression convolutions from gene "channels"
x_list = [kde_samples,
          allen_1_kde_samples,
          allen_2_kde_samples,
          allen_3_kde_samples,
          allen_4_kde_samples
        ]

del allen_1_M, allen_2_M, allen_3_M, allen_4_M
gc.collect()

for i in range(len(x_list)):
    x_list[i] = torch.from_numpy(x_list[i]).float().to(device)

for i in range(len(GRID_list)):
    GRID_list[i-1] = torch.from_numpy(GRID_list[i-1]).float().to(device)

```

Loss functions

How accurate are cell distributions compared to training?

Whether the parameters for the new cell locations are actual signals?

Whether gene to pixel transformations are learned correctly?

Whether cell types are aligned with a reference?

Whether pixel image prediction is aligned with reality on a local predicted imaging spot level?

Whether pixel image prediction is aligned with reality on a global predicted imaging tissue level?

Whether the movement of cells around fits well with the idea of Waddington's marble analogy?

```

In [13]: plt.rcParams['figure.figsize'] = (8, 8)

import time
import gc

start = time.time()

for epoch in range(10): # loop over the dataset multiple times

    optimizer.zero_grad()
    grid_return_list, ST_list, spatial_gex_list = net(x_list, gex_list,pixel

# Initialise loss

    loss = torch.zeros(1).to(device)

    x1 = grid_return_list[0][0]

```

```

x2 = grid_return_list[0][1]
for i in range(1,len(grid_return_list)):

# Loss function questions how accurate are cell distributions compared to tr

    loss += mseloss(grid_return_list[i][0][:,:2],GRID_list[i-1])

    x1 = torch.vstack((x1,grid_return_list[i][0]))
    x2 = torch.vstack((x2,grid_return_list[i][1]))


# Loss function questions whether the parameters for the new cell locations

loss += mseloss(x1,x2)

# Loss function questions whether gene to pixel transformations are learned

for i in range(len(gex_list)):
    loss += mseloss(gex_list[i],spatial_gex_list[i][0])+mseloss(gex_list[i],spatial_gex_list[i][1])

# Loss function questions whether pixel image prediction is aligned with rea
# local predicted imaging spot level?

for i in range(len(pixel_list)):
    loss += mseloss(pixel_list[i],ST_list[i+1][0])



kde_grid_new = []
cell_grid_new = []
cell_prob_new = []
for i in range(len(grid_return_list)):
    kde_grid_new += [[to_kde_grid(M_list[i],(grid_return_list[i][0][:,:2]),x_list[i]) + 0.8*x_list[i] + 0.2*to_samples(kde_grid_new[i][0],(grid_return_list[i][0][:,:2]))],cell_grid_new.append((grid_return_list[i][0][:,:2])),cell_prob_new.append((grid_return_list[i][0][:,:2]))]

# Loss function questions whether pixel image prediction is aligned with rea
# global predicted imaging tissue level?

if i>0:

    main_histology = np.max((kde_grid_new[i][0]).reshape([(main_axis_size+4*window_size)*main_axis_size,main_axis_size]))
    main_histology = (main_histology-np.min(main_histology))/np.max(main_histology)

    loss += mseloss(torch.from_numpy(main_histology).float().to(device),main_histology)

if i == 0 and epoch%5==4:

    x = (to_kde_grid(M_list[i],(grid_return_list[i][0][:,[0,1]]).cpu(),y = (to_kde_grid(M_list[i],(grid_return_list[i][0][:,[0,2]]).cpu(),z = (to_kde_grid(M_list[i],(grid_return_list[i][0][:,[1,2]]).cpu(),image_x = np.max((x.reshape([(main_axis_size+4*window_size)*(main_axis_size+4*window_size),main_axis_size+4*window_size]))*(main_axis_size+4*window_size)+0.5*main_histology))


```

```

image_x = (image_x-np.min(image_x))/np.max(image_x-np.min(image_x))
image_y = np.max((y.reshape([(main_axis_size+4*window_size)*(main_axis_size+4*window_size),1]))/(main_axis_size+4*window_size)*((main_axis_size+4*window_size)*(main_axis_size+4*window_size)))
image_y = (image_y-np.min(image_y))/np.max(image_y-np.min(image_y))

image_z = np.max((z.reshape([(main_axis_size+4*window_size)*(main_axis_size+4*window_size),1]))/(main_axis_size+4*window_size)*((main_axis_size+4*window_size)*(main_axis_size+4*window_size)))
image_z = (image_z-np.min(image_z))/np.max(image_z-np.min(image_z))

print("In-Silico Histology Examples - X-axis")
plt.imshow(image_x)
plt.show()

print("In-Silico Histology Examples - Y-axis")
plt.imshow(image_y)
plt.show()

print("In-Silico Histology Examples - Z-axis")
plt.imshow(image_z)
plt.show()

else:

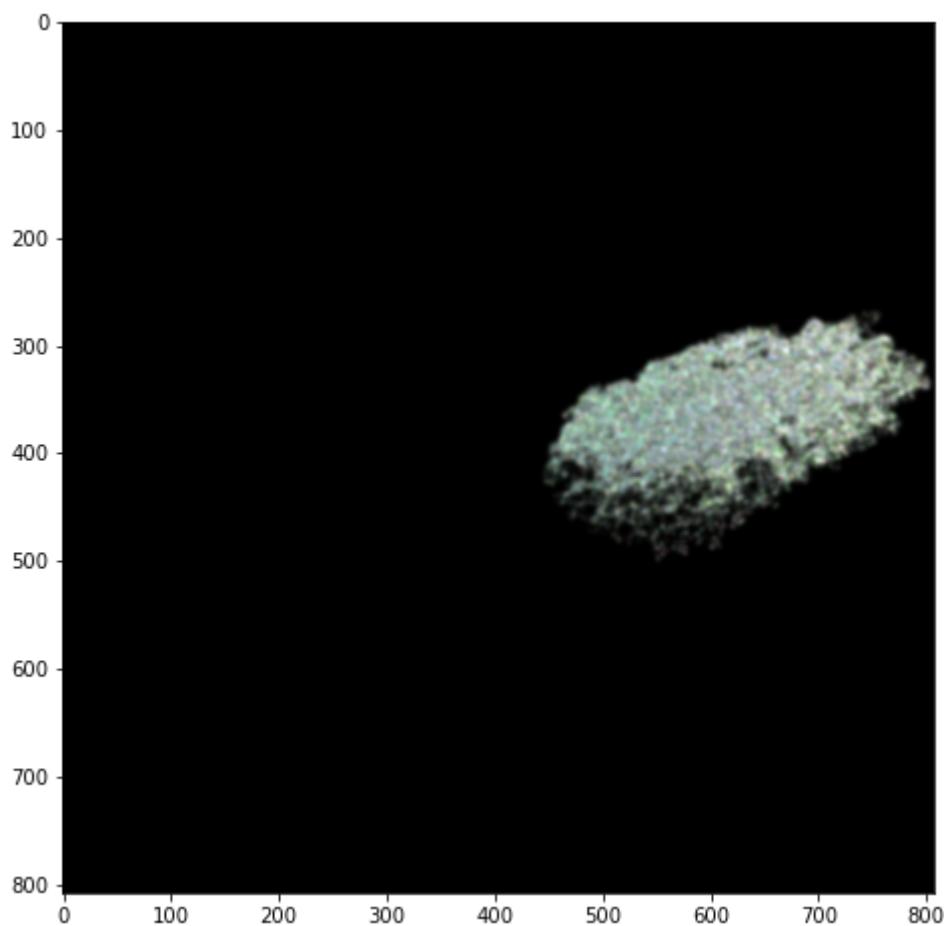
# Loss function questions whether the movement of cells around fits well with the new grid
loss += mseloss(x_list[i],to_samples(kde_grid_new[i][0],(grid_return_list[i].shape[0],grid_return_list[i].shape[1])))
loss.backward()
optimizer.step()

end = time.time()
if epoch%5==4:
    print([epoch,end - start,loss])

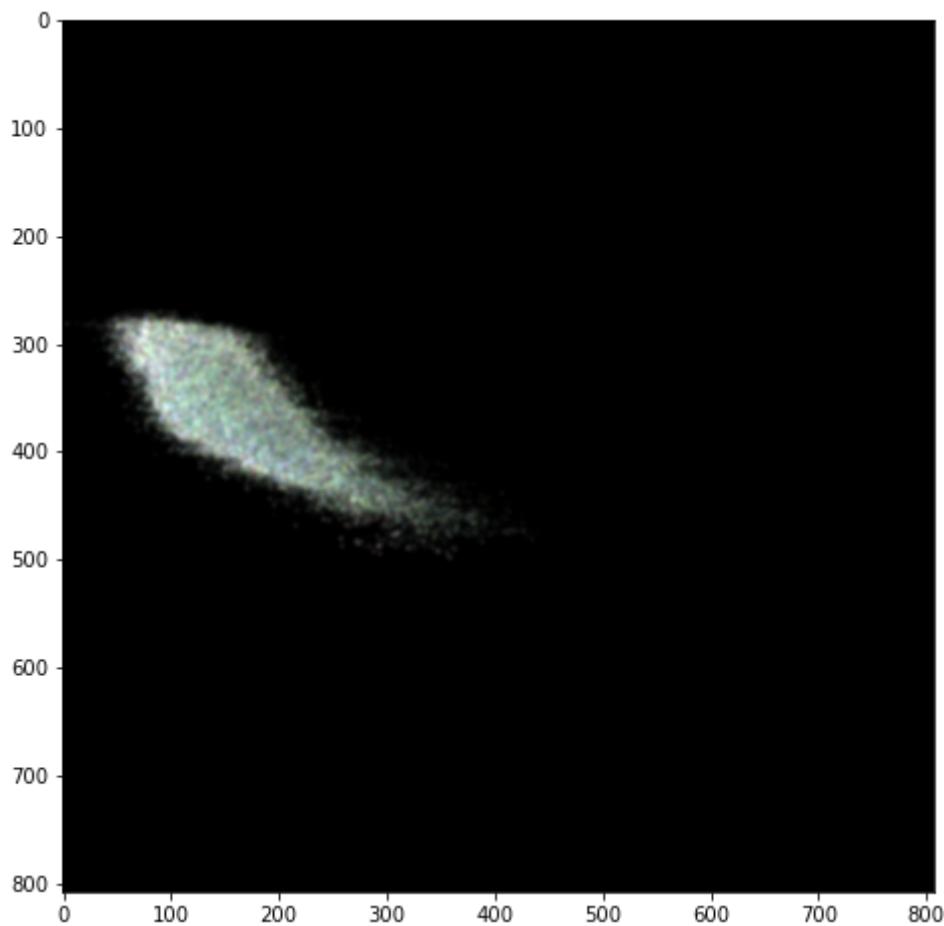
print('Finished Training')

```

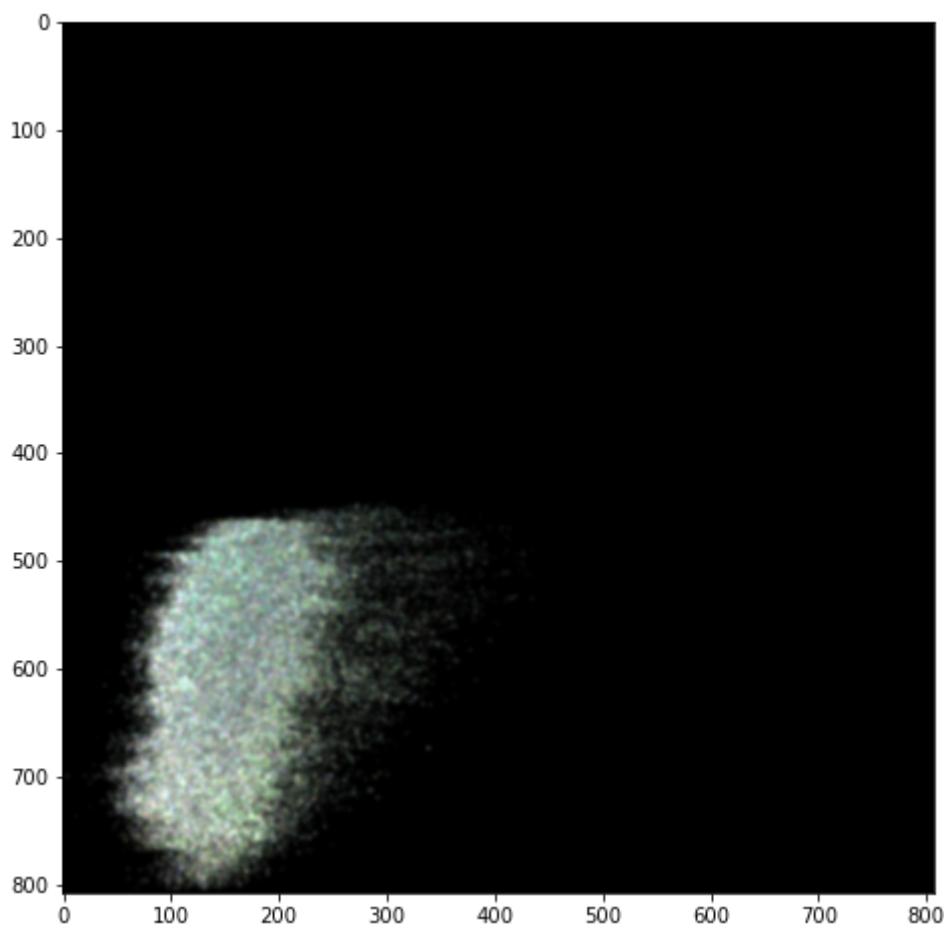
In-Silico Histology Examples - X-axis



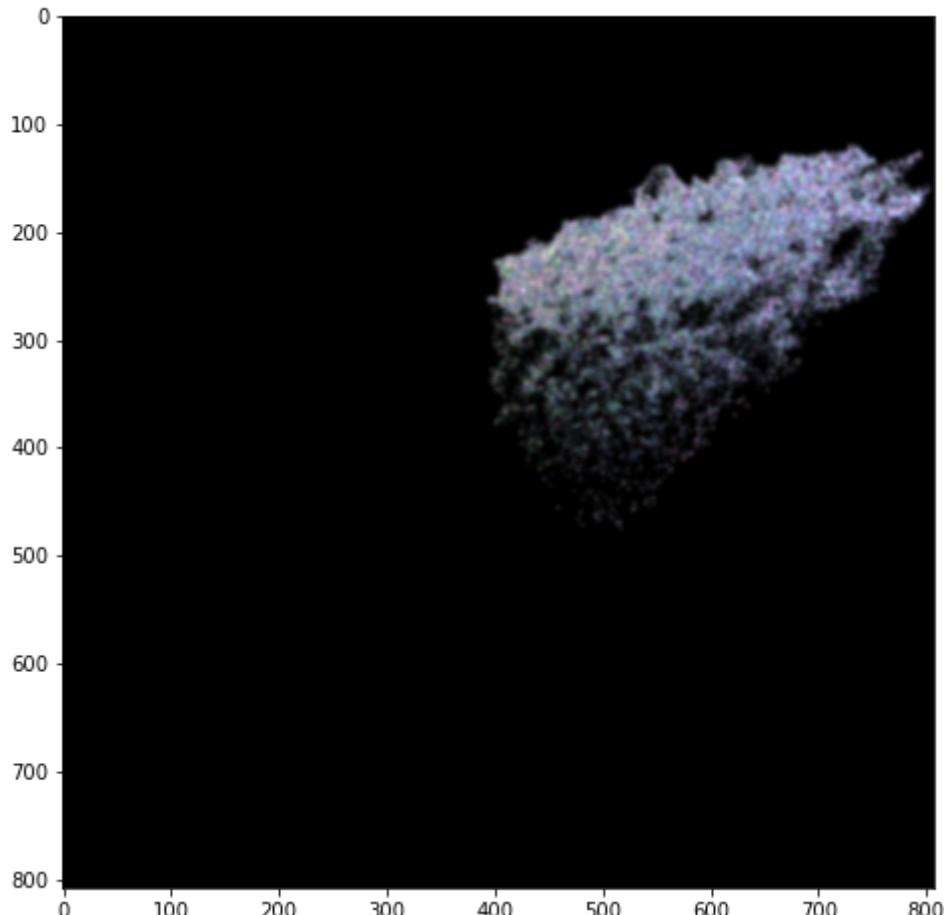
In-Silico Histology Examples - Y-axis



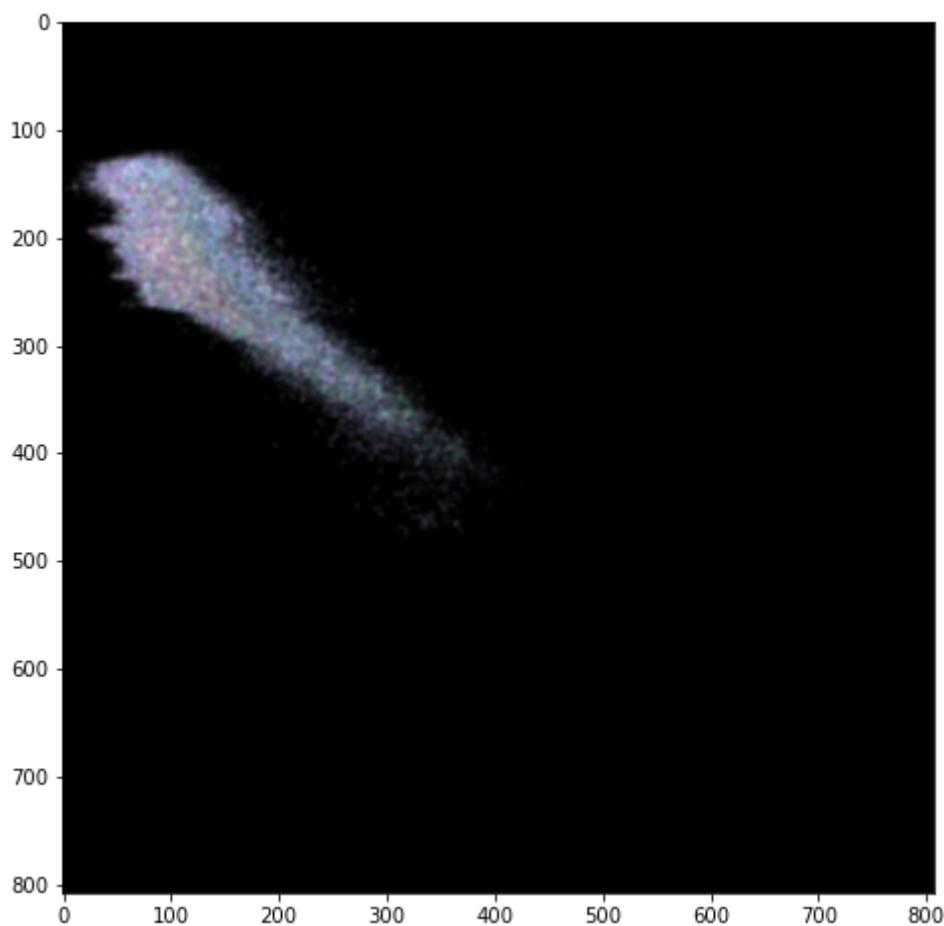
In-Silico Histology Examples - Z-axis



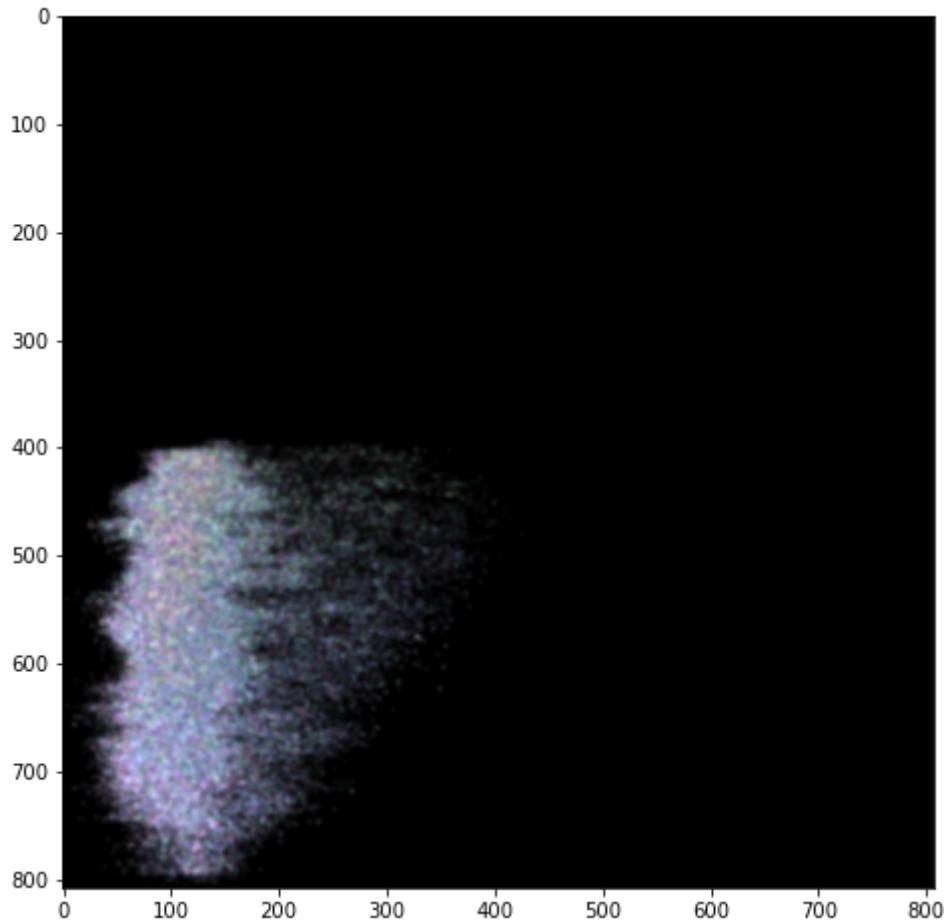
```
[4, 681.13592004776, tensor([54675000.], grad_fn=<AddBackward0>)]  
In-Silico Histology Examples - X-axis
```



```
In-Silico Histology Examples - Y-axis
```



In-Silico Histology Examples - Z-axis



```
[9, 1362.5275220870972, tensor([17450640.], grad_fn=<AddBackward0>)]  
Finished Training
```

```
In [14]: PATH1 = "/home/jupyter/lmform_analysis/base_cnn/state_dict_VisualForm.pt"  
PATH2 = "/home/jupyter/lmform_analysis/base_cnn/to_train_VisualForm.pt"
```

```

PATH3 = "/home/jupyter/lmform_analysis/base_cnn/all_VisualForm.pt"

torch.save(net.state_dict(), PATH1)
torch.save({
    'epoch': epoch,
    'model_state_dict': net.state_dict(),
    'optimizer_state_dict': optimizer.state_dict(),
    'loss': loss
}, PATH2)
torch.save(net, PATH3)

```

```

In [47]: grid_return_list, ST_list, spatial_gex_list = net(x_list,gex_list,pixel_list

for i in range(len(GRID_list)):
    grid_return_list[i+1][:,:2] = GRID_list[i]

main_axis_size = 300

kde_grid_new_x = []
kde_grid_new_y = []
kde_grid_new_z = []

for i in range(len(grid_return_list)):
    kde_grid_new_x += [[to_kde_grid(M_list[i],grid_return_list[i][0].cpu().d
    kde_grid_new_y += [[to_kde_grid(M_list[i],grid_return_list[i][0].cpu().d
    kde_grid_new_z += [[to_kde_grid(M_list[i],grid_return_list[i][0].cpu().d

```

```

In [48]: plt.rcParams['figure.figsize'] = (8, 8)

for i in range(5):

    x = kde_grid_new_x[i][0]
    y = kde_grid_new_y[i][0]
    z = kde_grid_new_z[i][0]

    image_x = np.max((x.reshape([(main_axis_size+4*window_size)*(main_axis_s
    image_x = (image_x-np.min(image_x))/np.max(image_x-np.min(image_x))

    image_y = np.max((y.reshape([(main_axis_size+4*window_size)*(main_axis_s
    image_y = (image_y-np.min(image_y))/np.max(image_y-np.min(image_y))

    image_z = np.max((z.reshape([(main_axis_size+4*window_size)*(main_axis_s
    image_z = (image_z-np.min(image_z))/np.max(image_z-np.min(image_z))

    if i == 0:
        print("In-Silico Histology Examples")

    if i > 0:
        print("Real Histology Examples")

    print("X-axis")
    plt.imshow(image_x)
    plt.show()

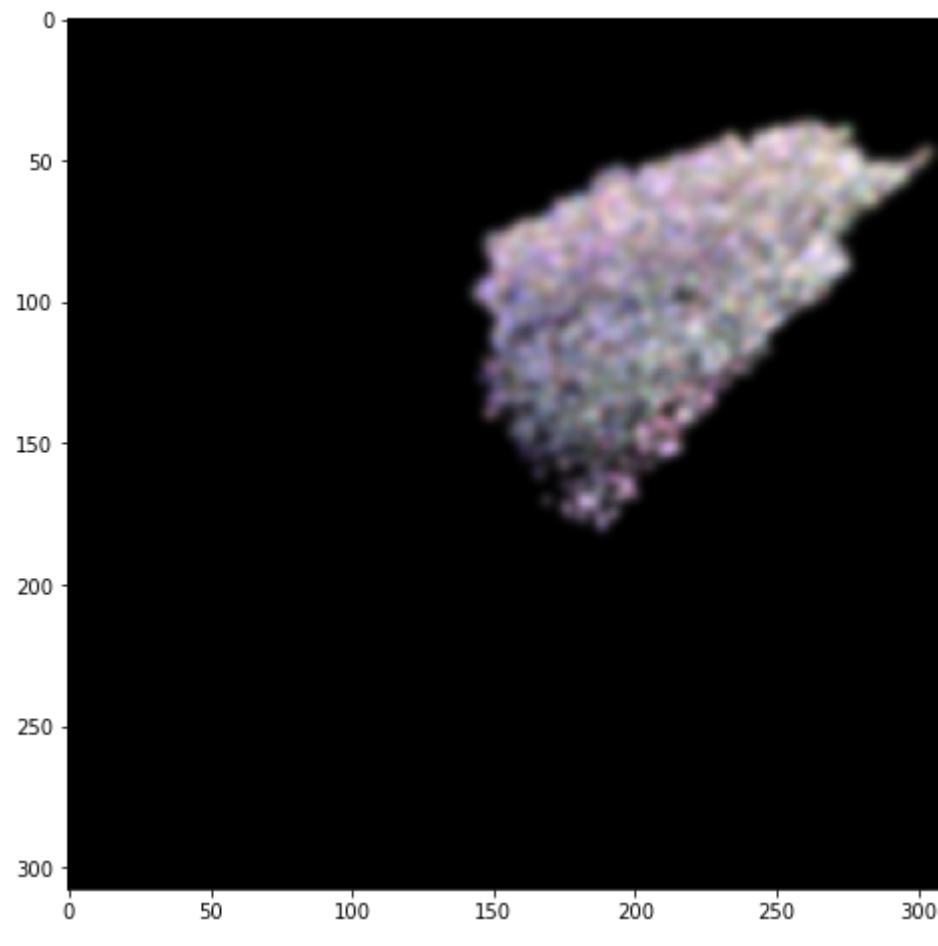
    print("Y-axis")
    plt.imshow(image_y)
    plt.show()

```

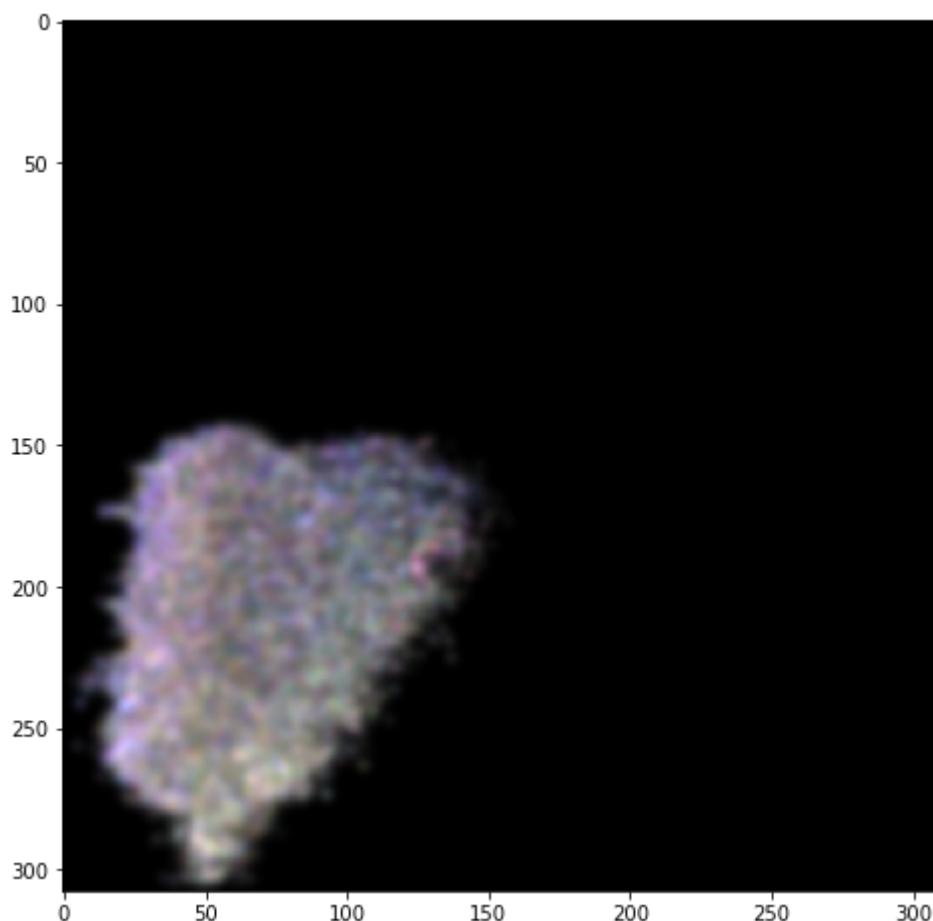
```
print("Z-axis")
plt.imshow(image_z)
plt.show()
```

In-Silico Histology Examples

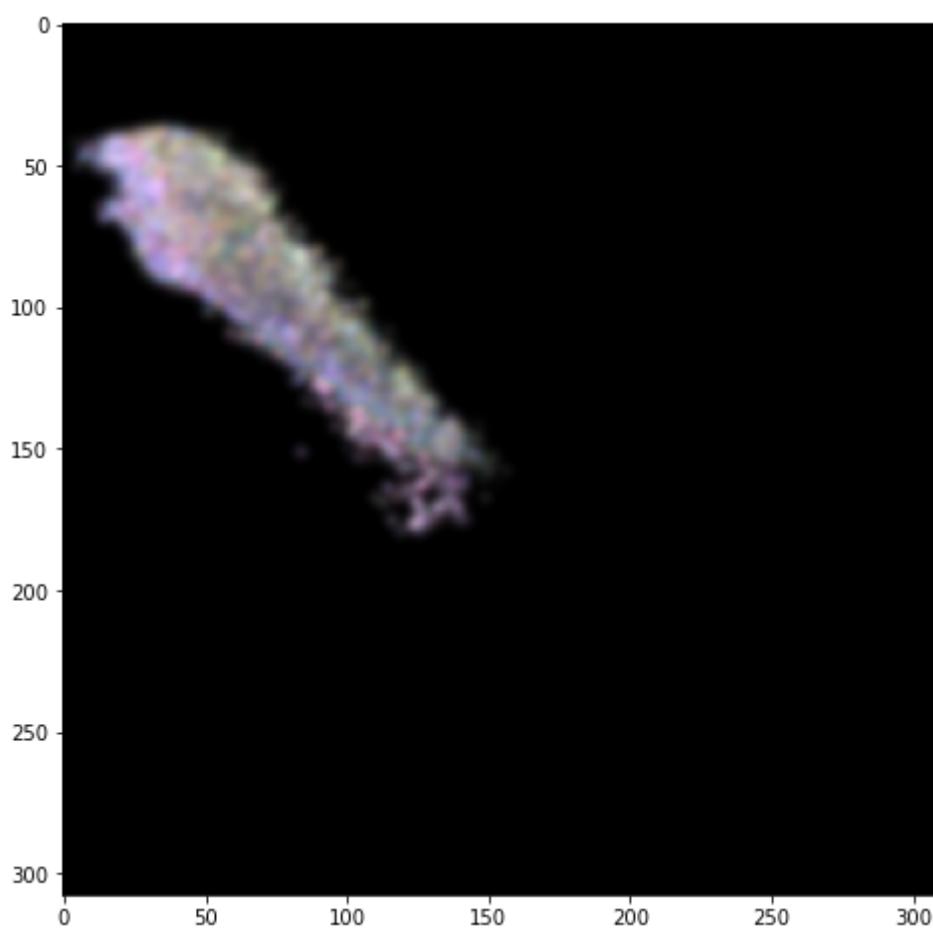
X-axis



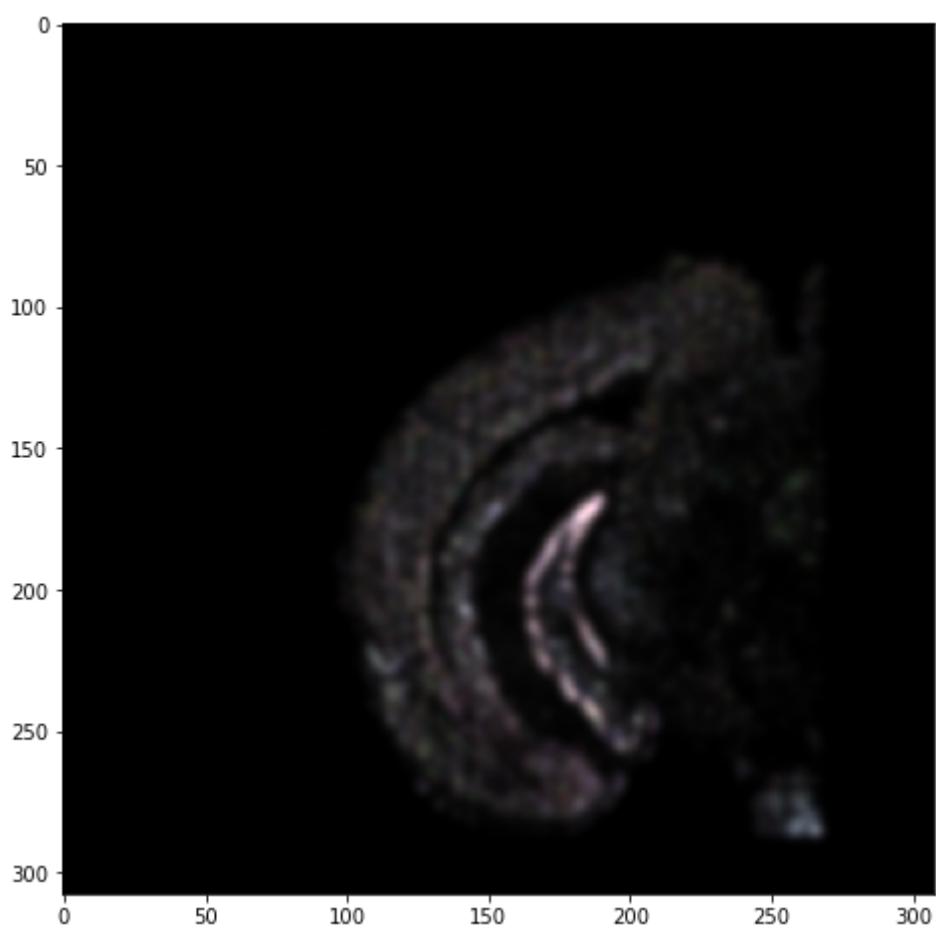
Y-axis



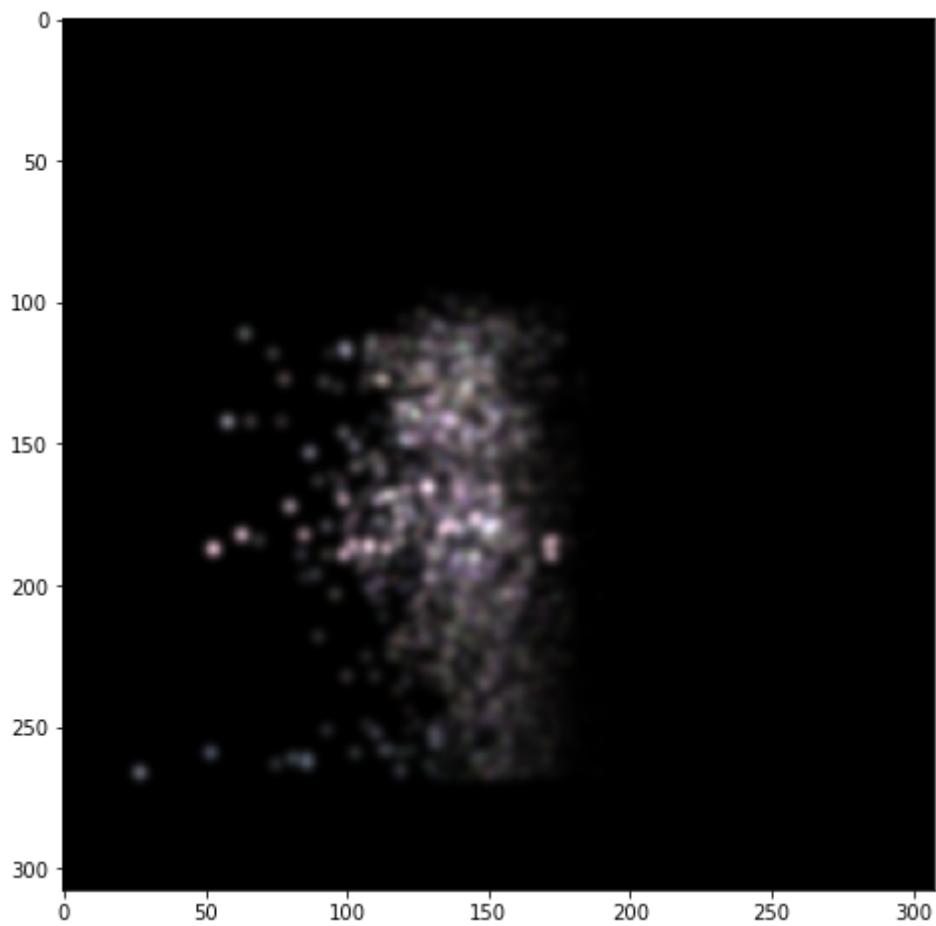
Z-axis



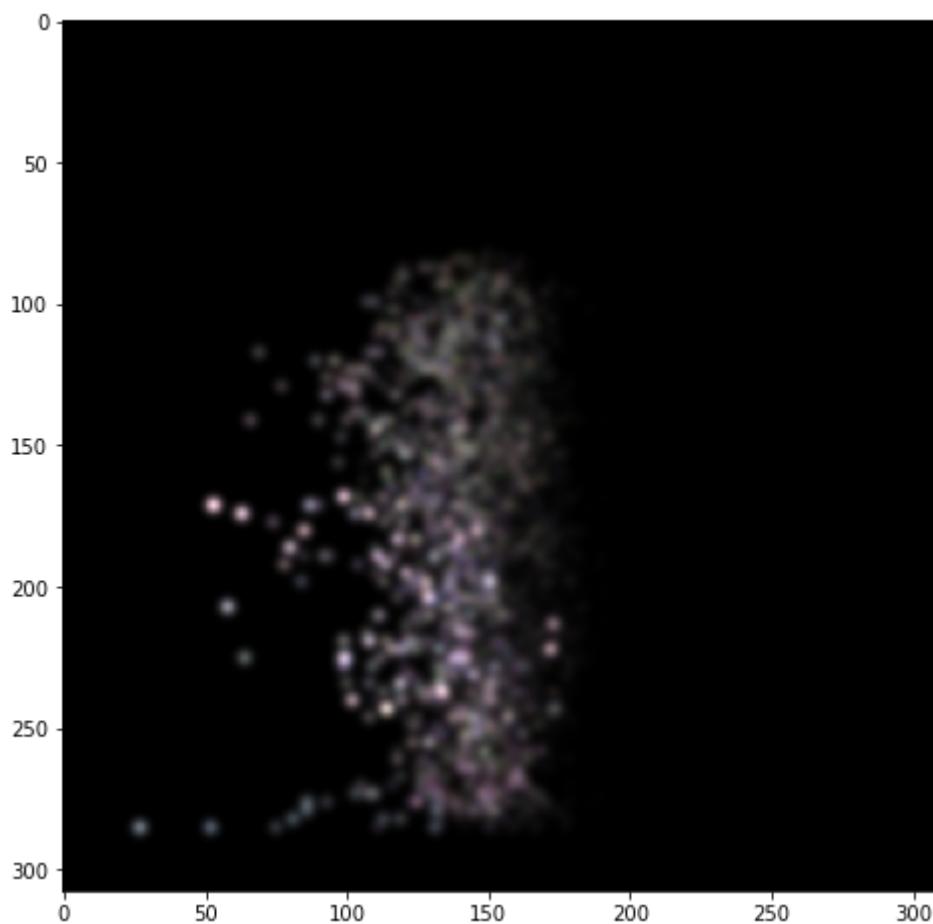
Real Histology Examples
X-axis



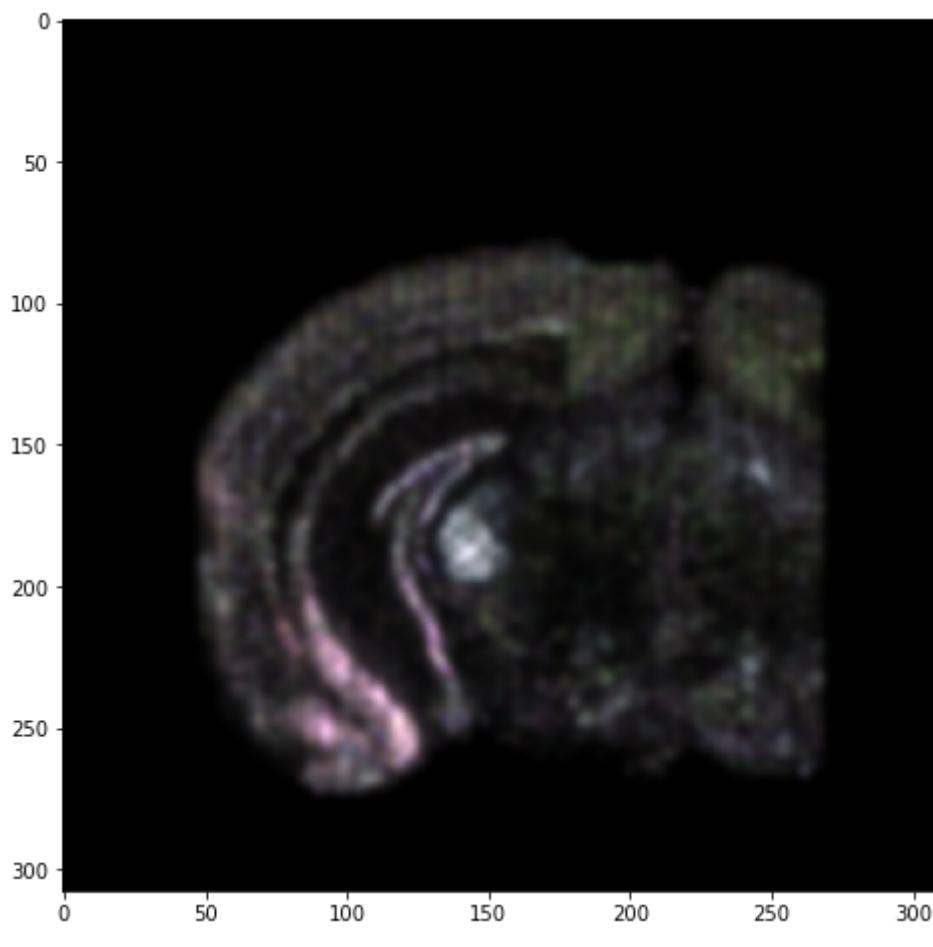
Y-axis



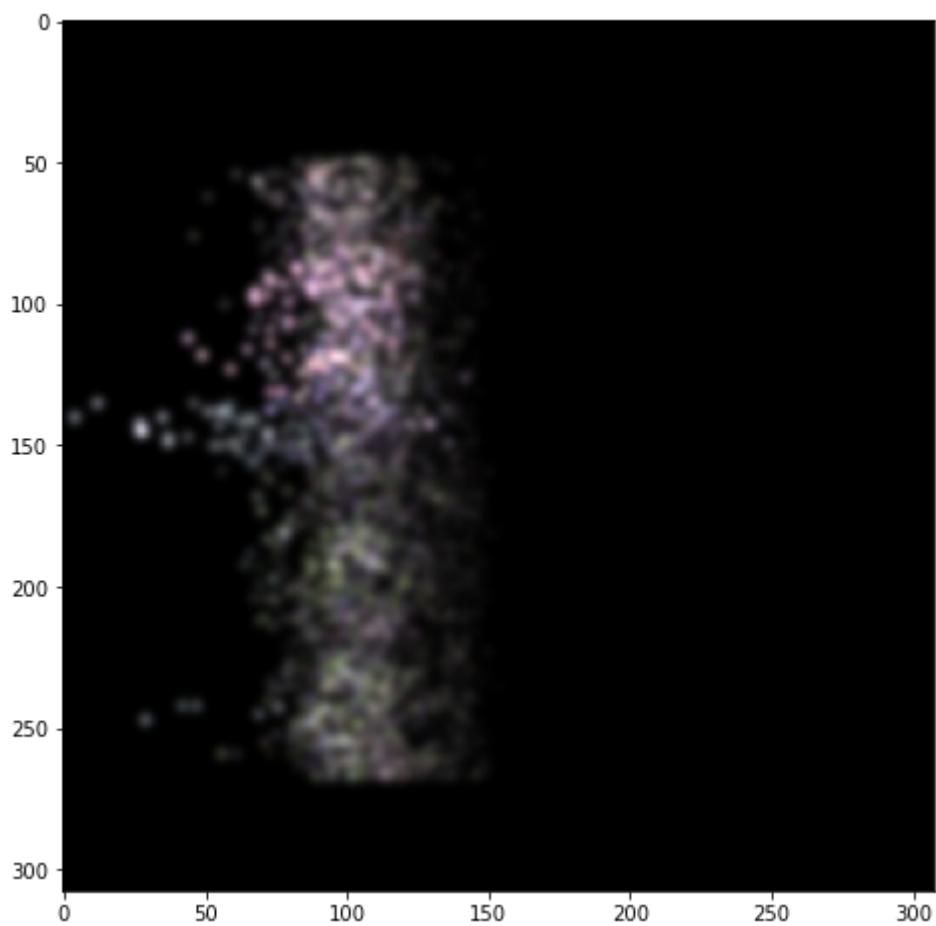
Z-axis



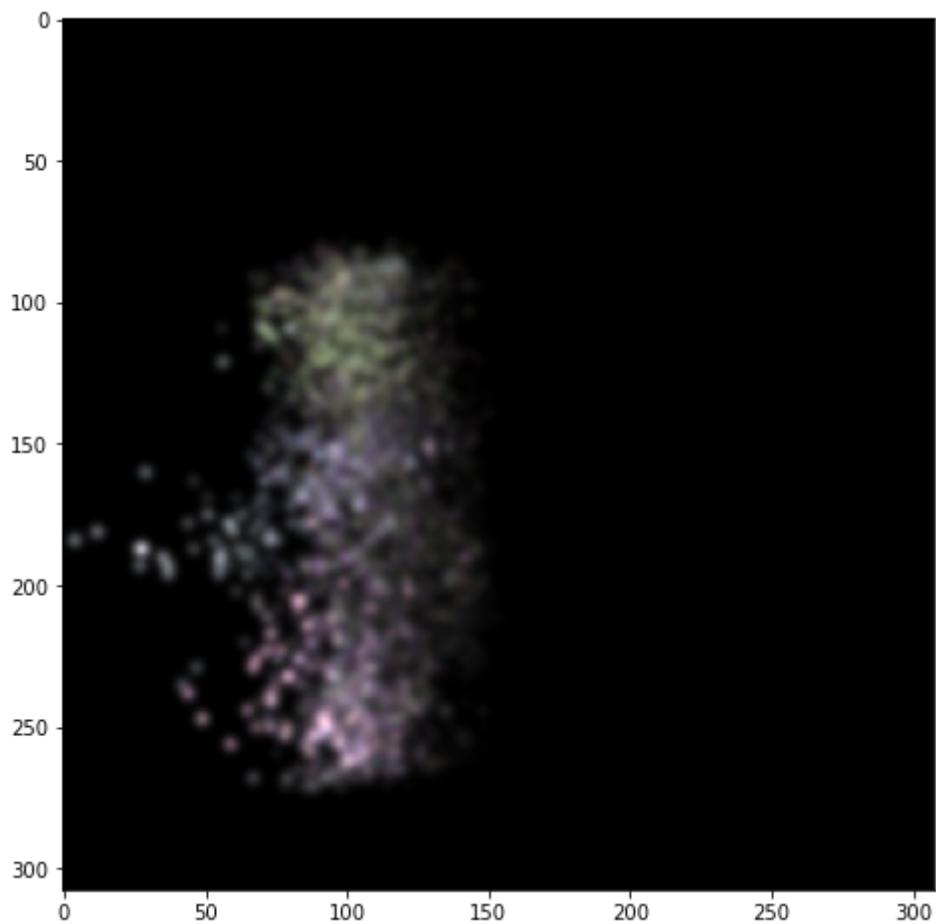
Real Histology Examples
X-axis



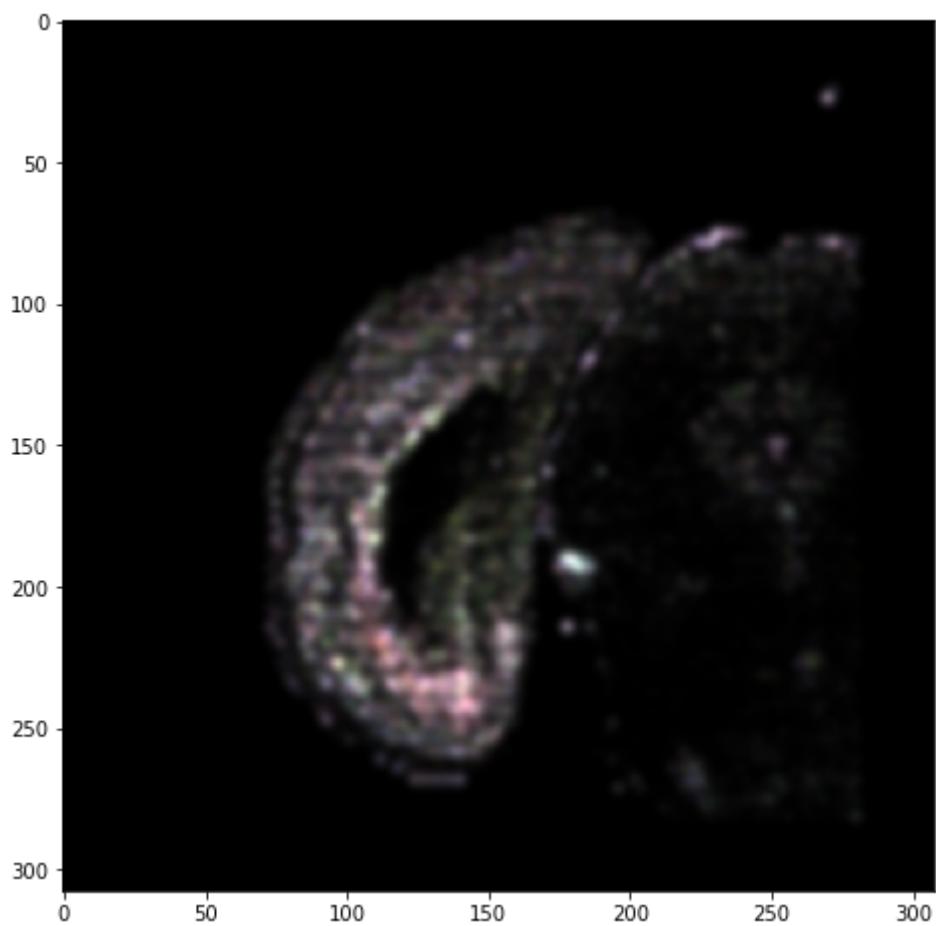
Y-axis



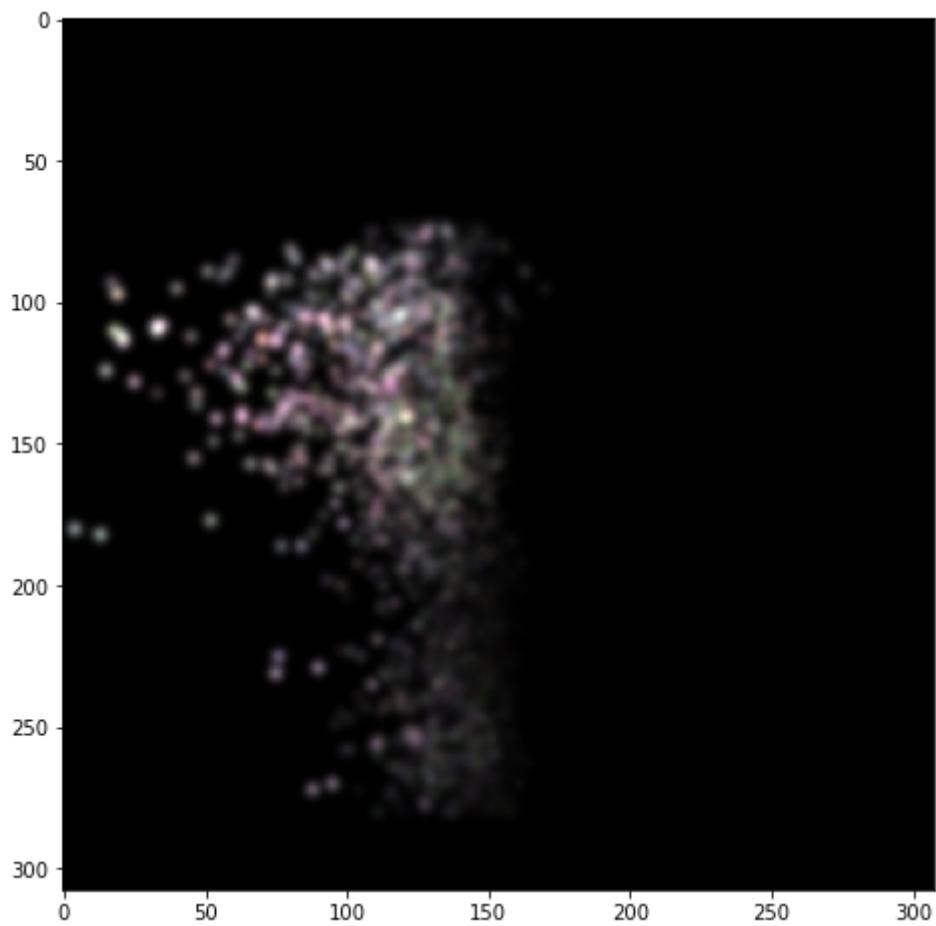
Z-axis



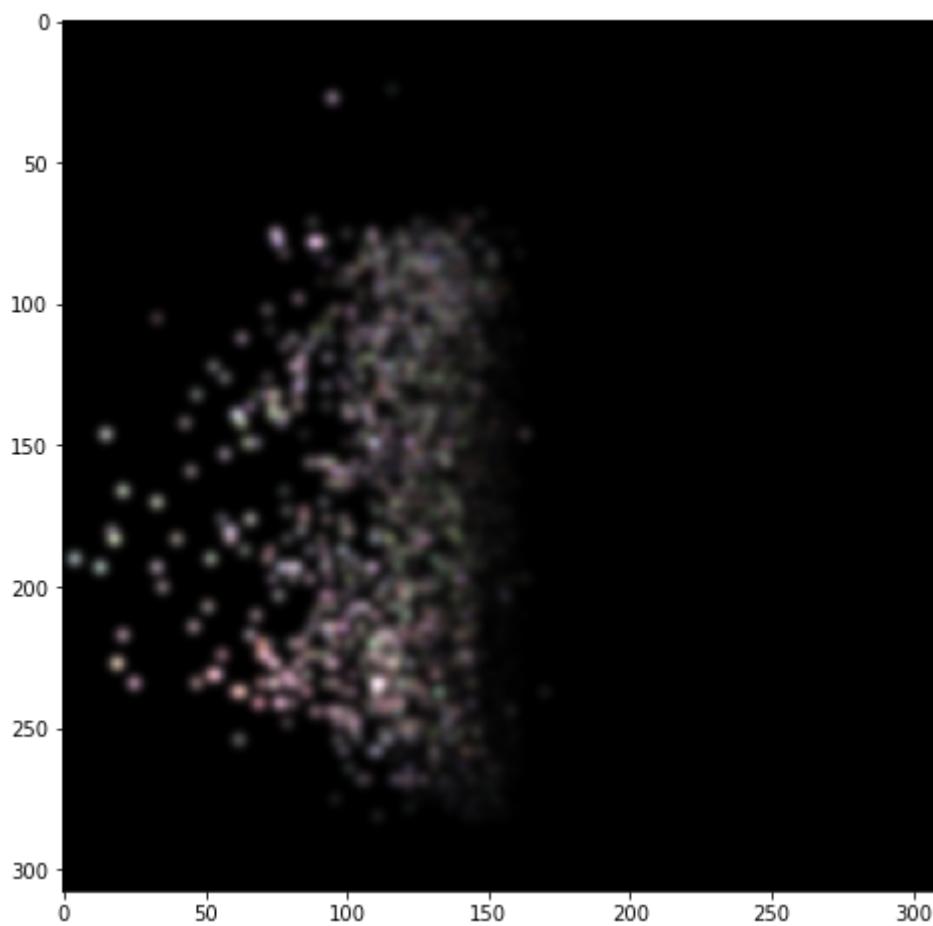
Real Histology Examples
X-axis



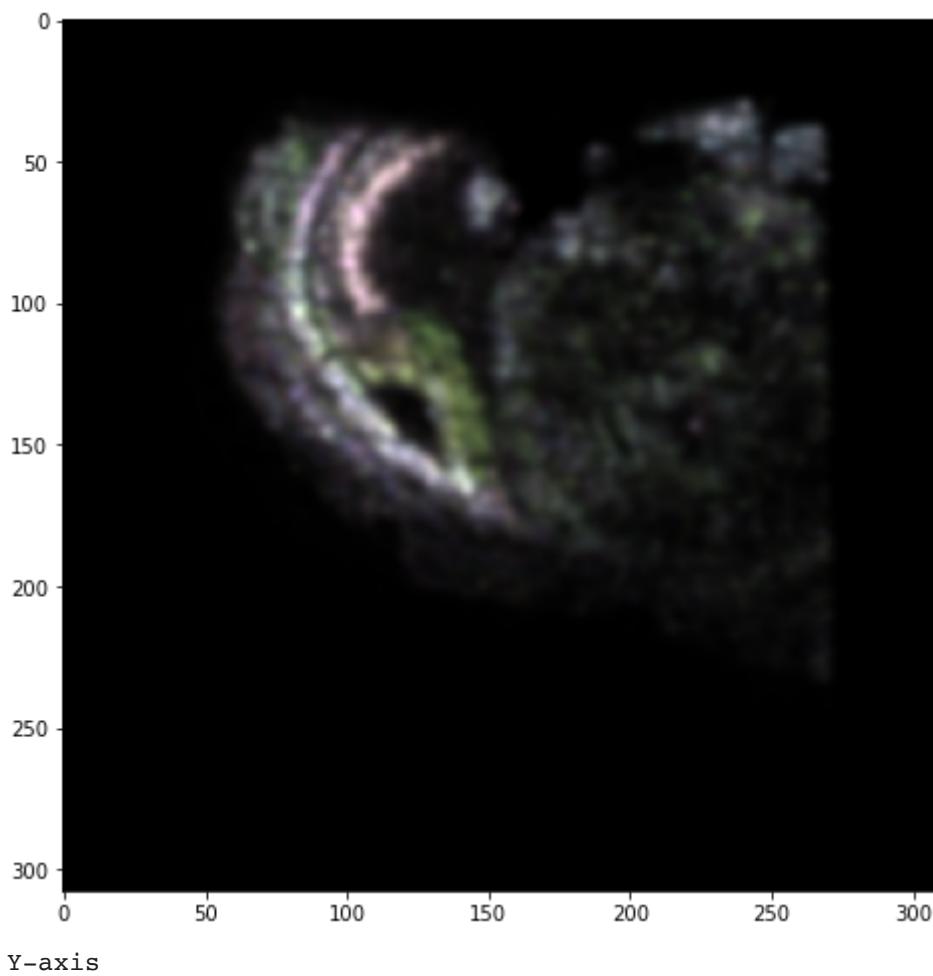
Y-axis



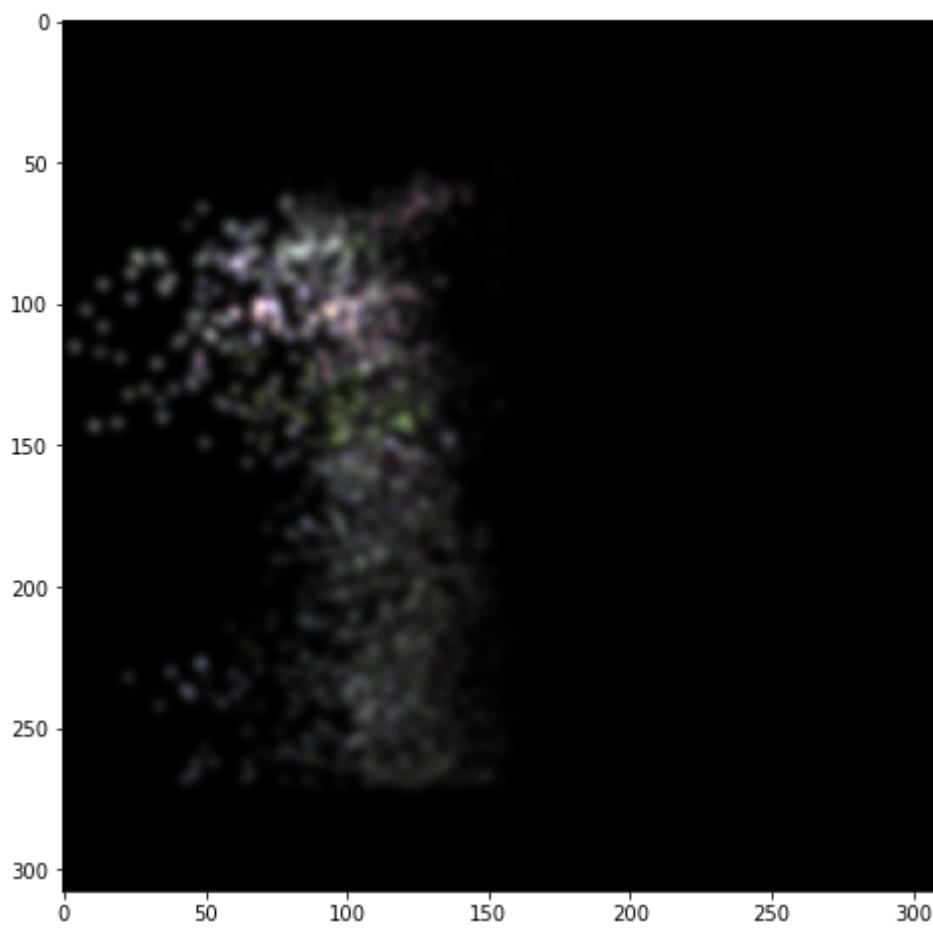
Z-axis



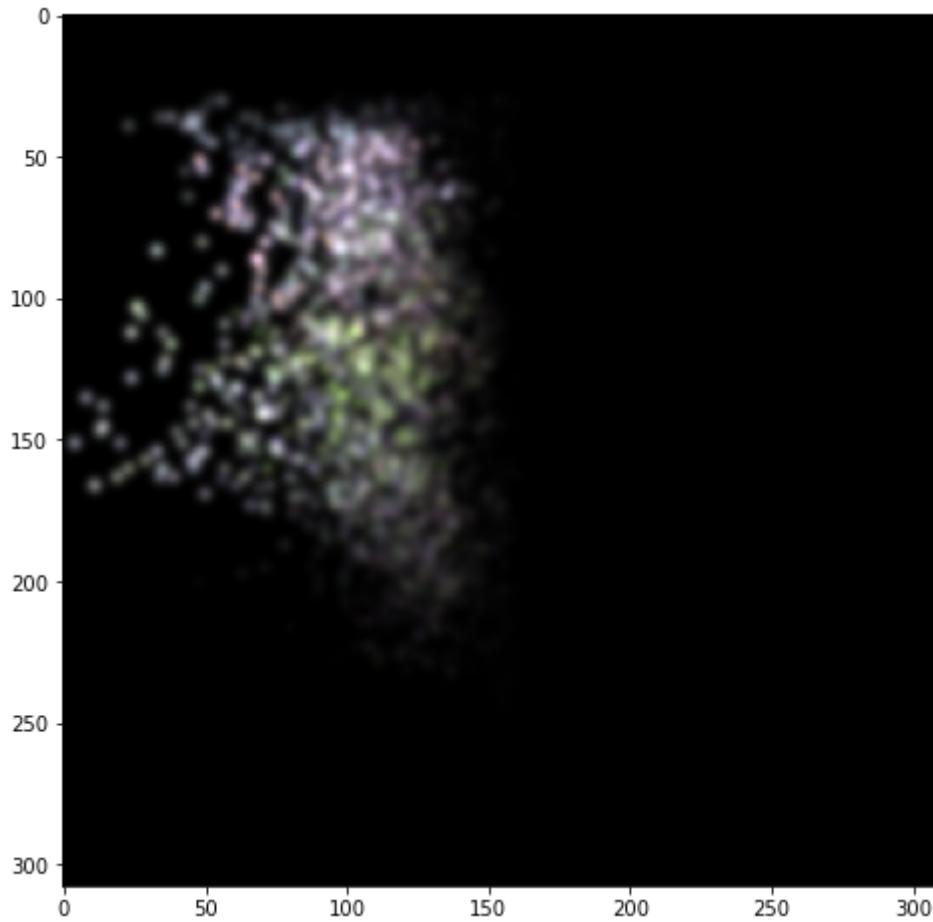
Real Histology Examples
X-axis



Y-axis



Z-axis



```
In [74]: print("Plotting in-silico ST data via loss function optimisation through lea  
for i in range(len(genes)):
```

```

plt.rcParams['figure.figsize'] = (10, 14)

fig, axs = plt.subplots(5,3,rasterized=True)

fig.suptitle("Real GEX      " + genes[i])

axs[0,1].set_title("Real GEX (Tissue 1) - X-Y-Z-axis      " + genes[i])

axs[0,0].imshow(kde_grid_new_x[1][0][:,:,i])
axs[0,1].imshow(kde_grid_new_y[1][0][:,:,i])
axs[0,2].imshow(kde_grid_new_z[1][0][:,:,i])

axs[1,1].set_title("Real GEX (Tissue 2) - X-Y-Z-axis      " + genes[i])

axs[1,0].imshow(kde_grid_new_x[2][0][:,:,i])
axs[1,1].imshow(kde_grid_new_y[2][0][:,:,i])
axs[1,2].imshow(kde_grid_new_z[2][0][:,:,i])

axs[2,1].set_title("Real GEX (Tissue 3) - X-Y-Z-axis      " + genes[i])

axs[2,0].imshow(kde_grid_new_x[3][0][:,:,i])
axs[2,1].imshow(kde_grid_new_y[3][0][:,:,i])
axs[2,2].imshow(kde_grid_new_z[3][0][:,:,i])

axs[3,1].set_title("Real GEX (Tissue 4) - X-Y-Z-axis      " + genes[i])

axs[3,0].imshow(kde_grid_new_x[4][0][:,:,i])
axs[3,1].imshow(kde_grid_new_y[4][0][:,:,i])
axs[3,2].imshow(kde_grid_new_z[4][0][:,:,i])

axs[0,0].axis('off')
axs[0,1].axis('off')
axs[0,2].axis('off')

axs[1,0].axis('off')
axs[1,1].axis('off')
axs[1,2].axis('off')

axs[2,0].axis('off')
axs[2,1].axis('off')
axs[2,2].axis('off')

axs[3,0].axis('off')
axs[3,1].axis('off')
axs[3,2].axis('off')

axs[4,1].set_title("In-Silico GEX - X-Y-Z-axis      " + genes[i])

axs[4,0].imshow(kde_grid_new_x[0][0][:,:,i])
axs[4,1].imshow(kde_grid_new_y[0][0][:,:,i])
axs[4,2].imshow(kde_grid_new_z[0][0][:,:,i])

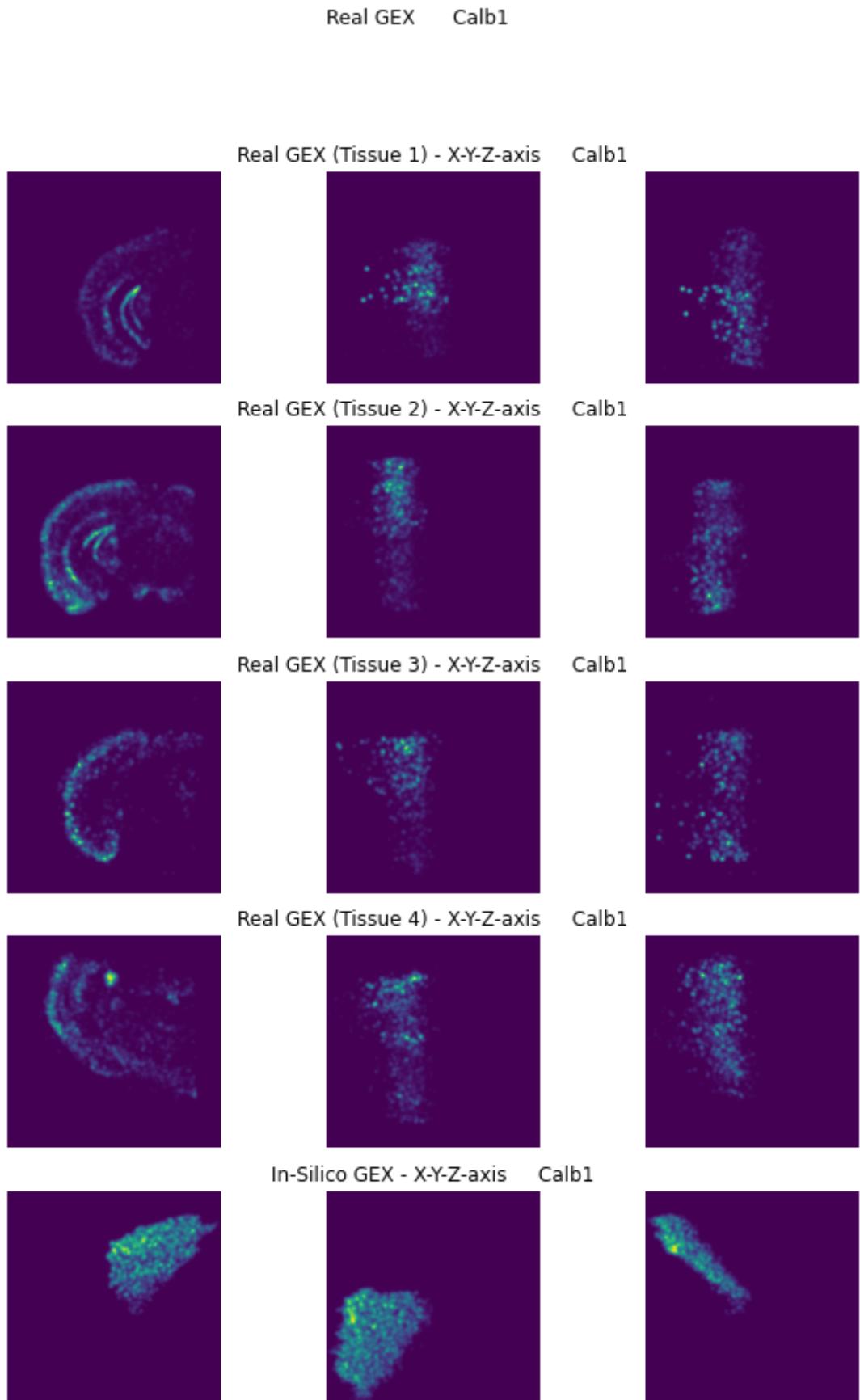
axs[4,0].axis('off')
axs[4,1].axis('off')
axs[4,2].axis('off')

fig.savefig("./scMaps/mouse___"+genes[i]+'.png')

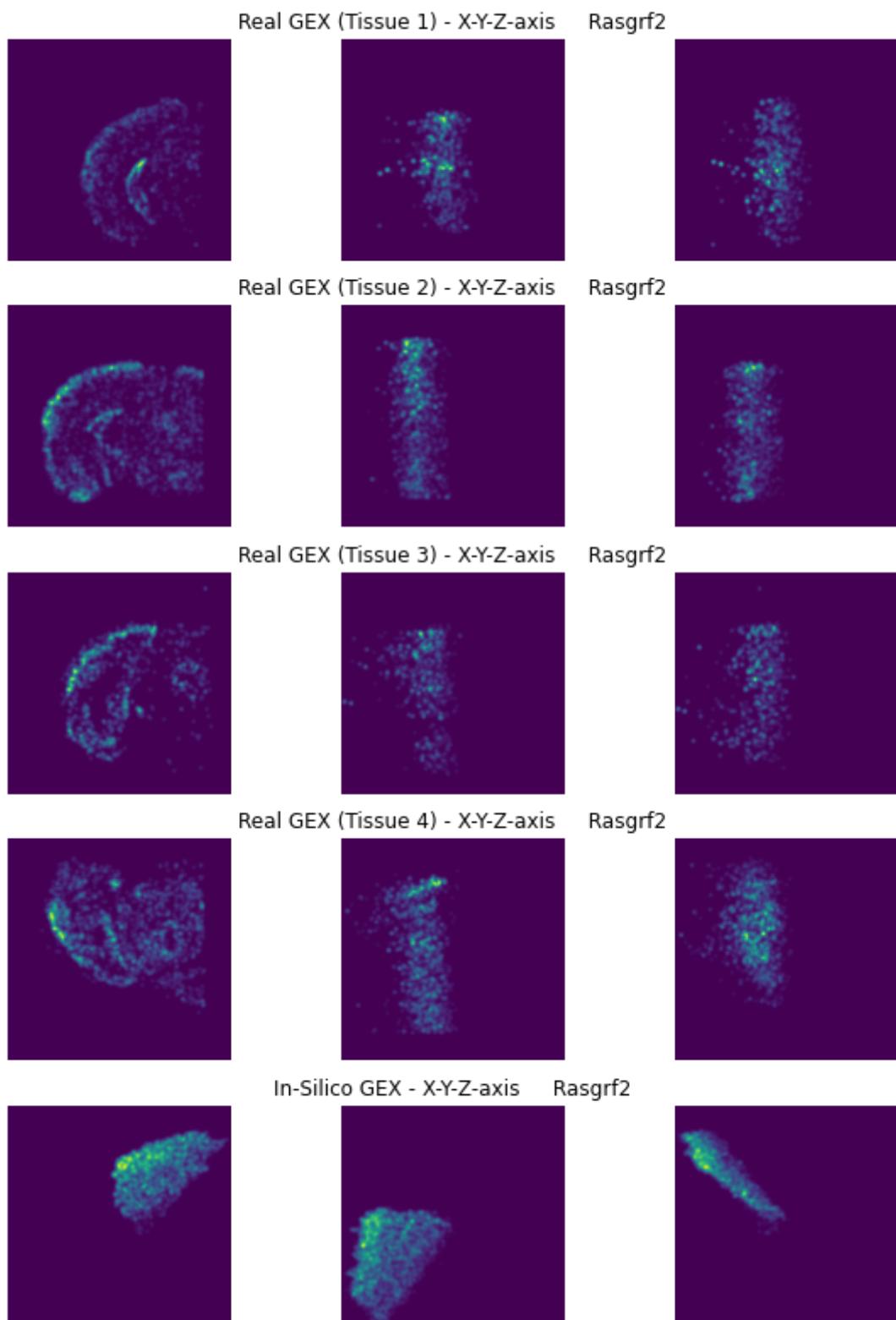
```

Plotting in-silico ST data via loss function optimisation through learning proper gene to pixel transformations and cell placement via KNN gene convolutions

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:8: RuntimeWarning: More than 20 figures have been opened. Figures created through the pyplot interface (`matplotlib.pyplot.figure`) are retained until explicitly closed and may consume too much memory. (To control this warning, see the rcParam `figure.max_open_warning`).
```

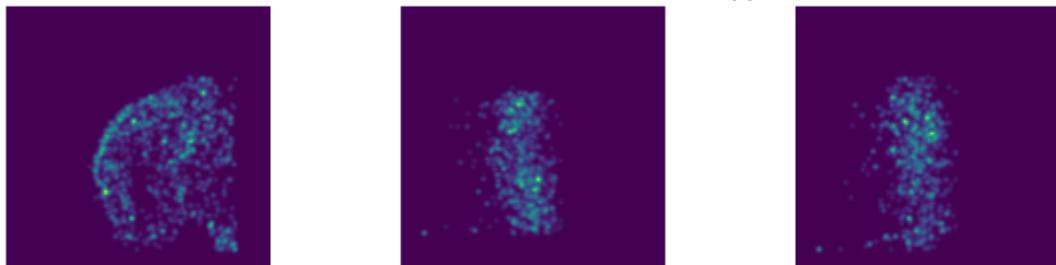


Real GEX Rasgrf2

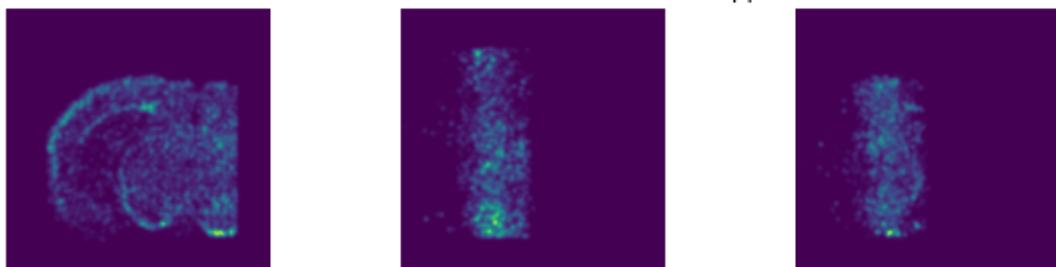


Real GEX Enpp2

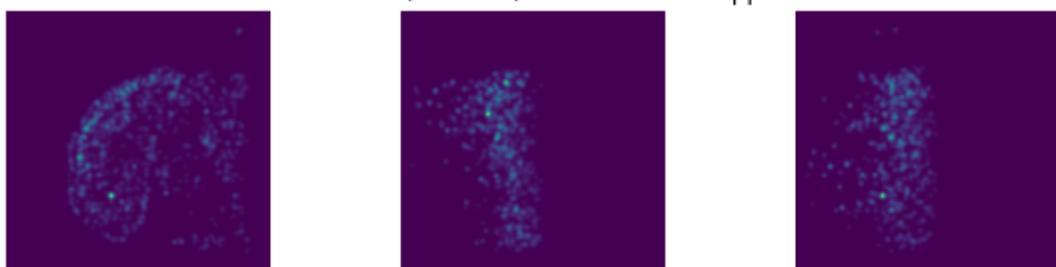
Real GEX (Tissue 1) - X-Y-Z-axis Enpp2



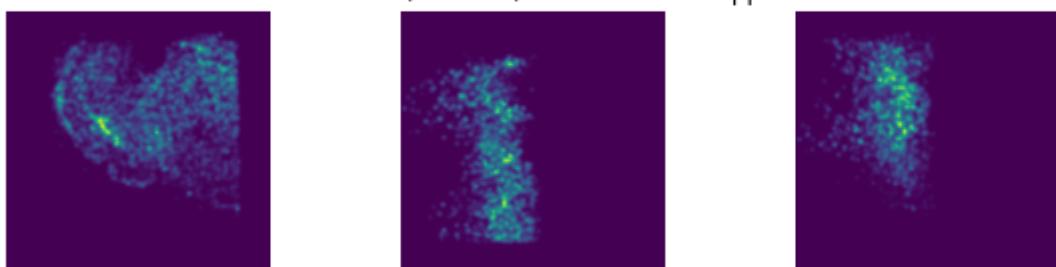
Real GEX (Tissue 2) - X-Y-Z-axis Enpp2



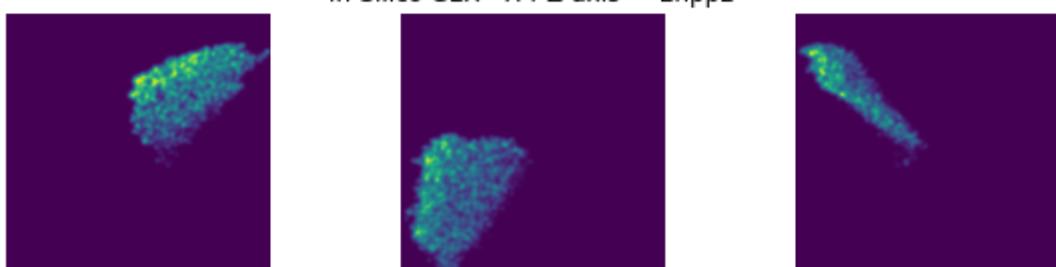
Real GEX (Tissue 3) - X-Y-Z-axis Enpp2



Real GEX (Tissue 4) - X-Y-Z-axis Enpp2

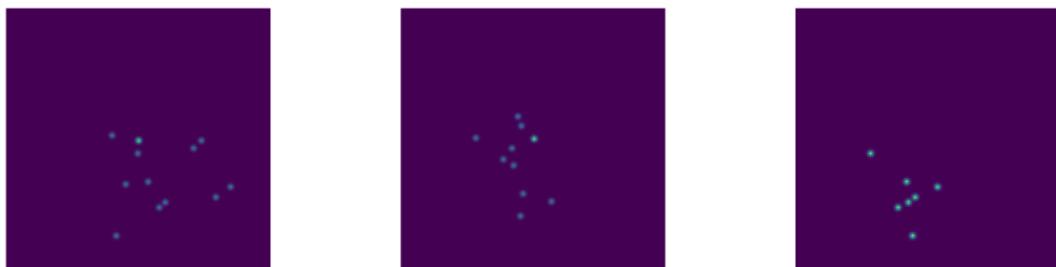


In-Silico GEX - X-Y-Z-axis Enpp2

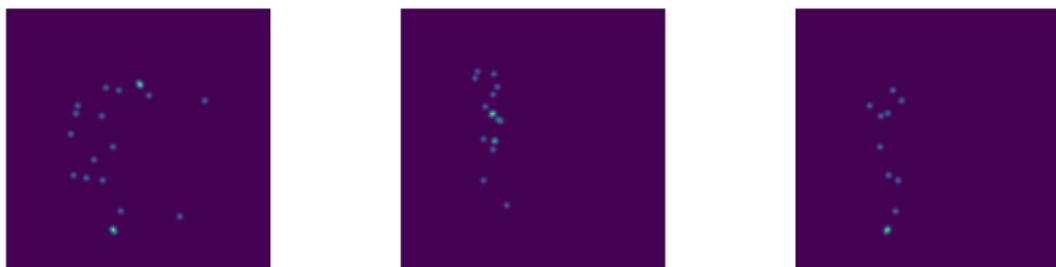


Real GEX Col19a1

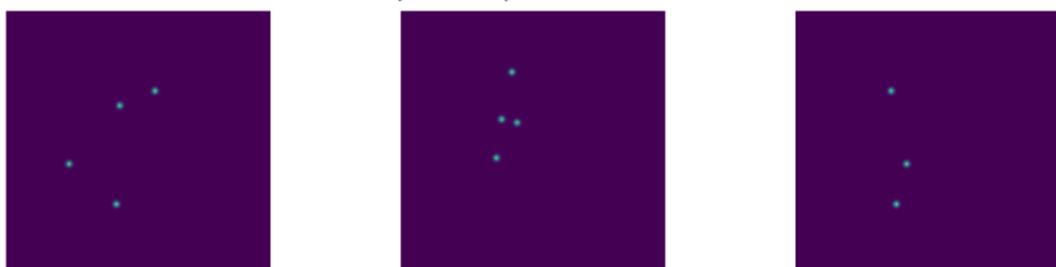
Real GEX (Tissue 1) - X-Y-Z-axis Col19a1



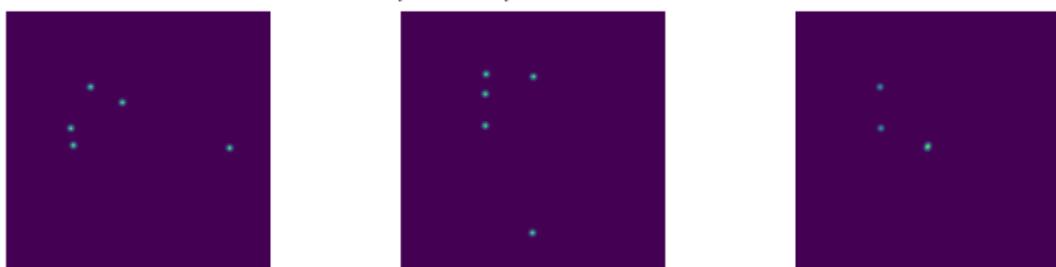
Real GEX (Tissue 2) - X-Y-Z-axis Col19a1



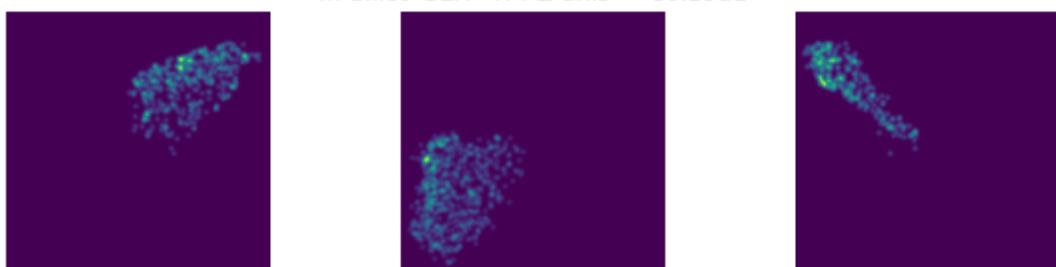
Real GEX (Tissue 3) - X-Y-Z-axis Col19a1



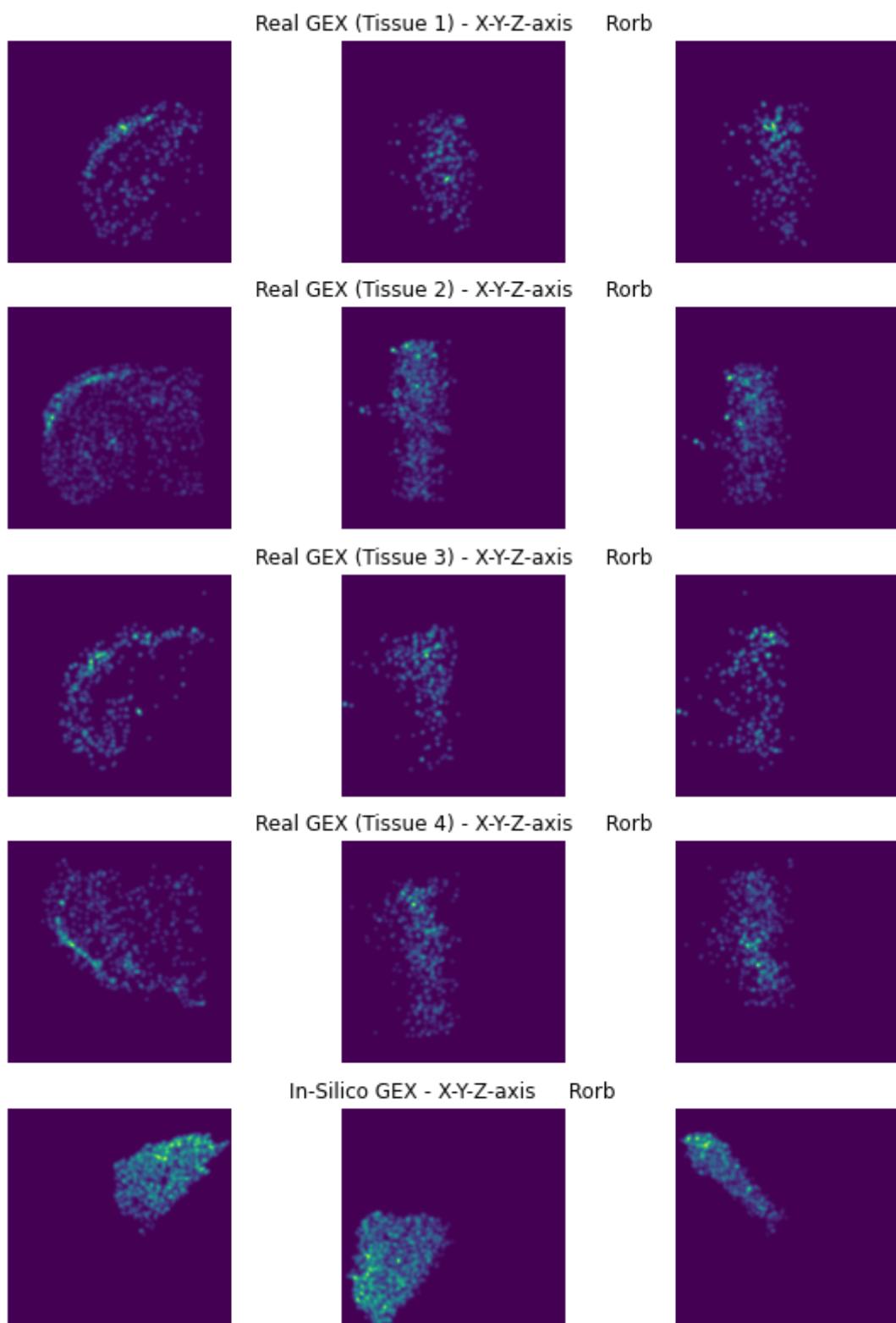
Real GEX (Tissue 4) - X-Y-Z-axis Col19a1



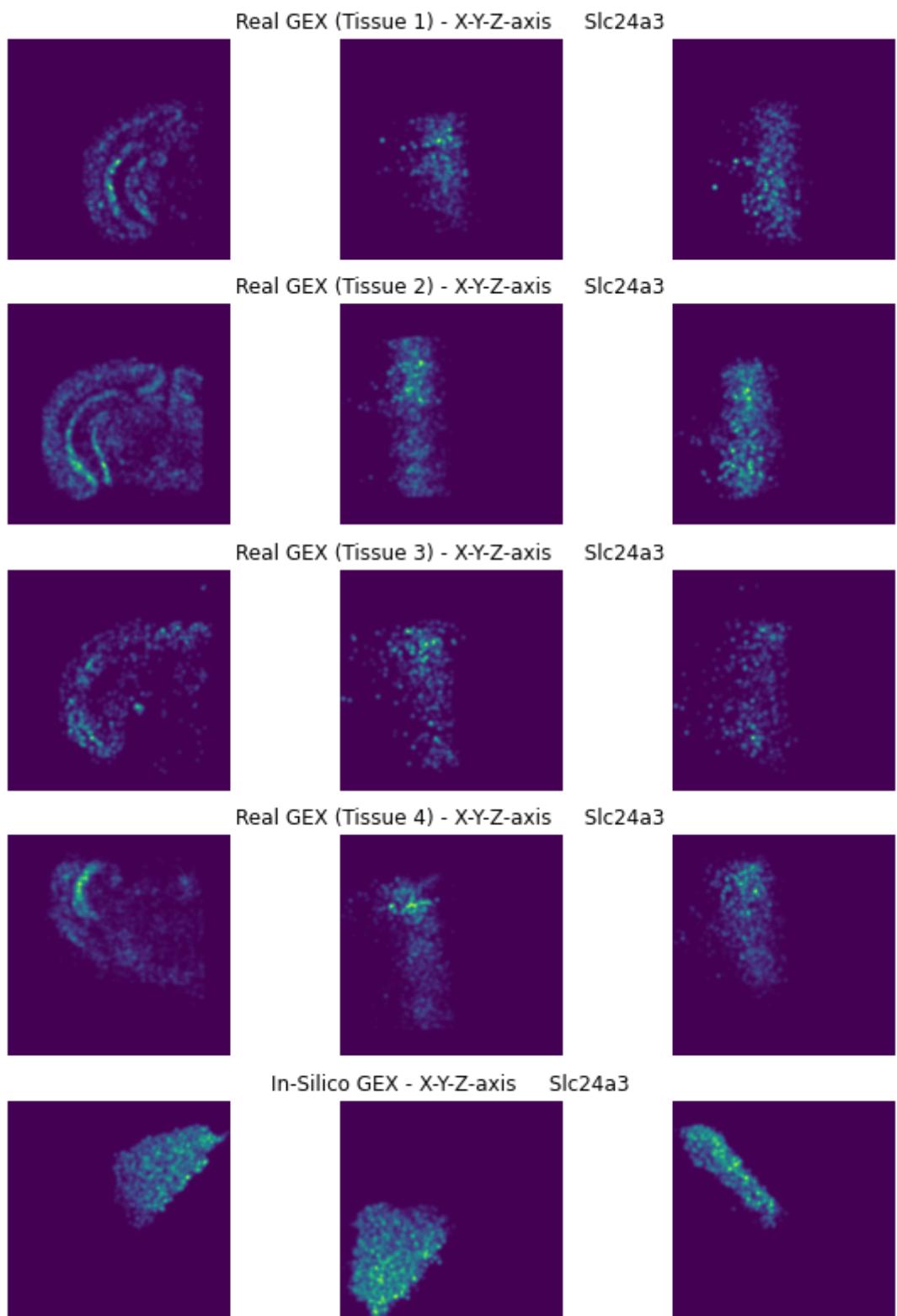
In-Silico GEX - X-Y-Z-axis Col19a1



Real GEX Rorb

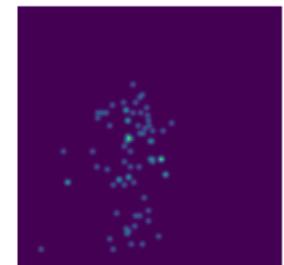
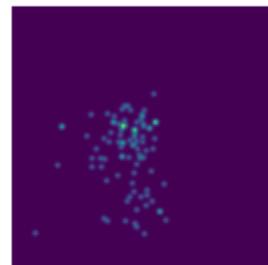
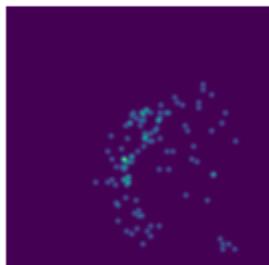


Real GEX Slc24a3

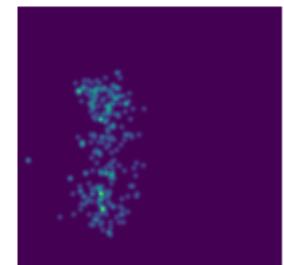
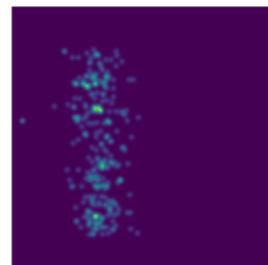
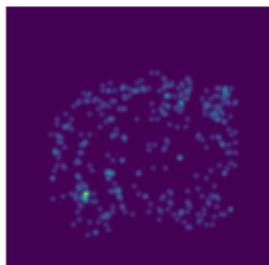


Real GEX Galntl6

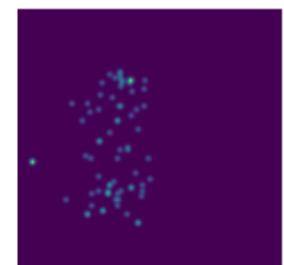
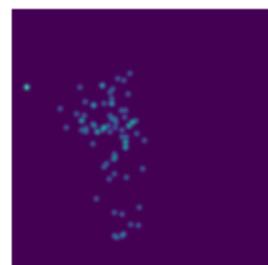
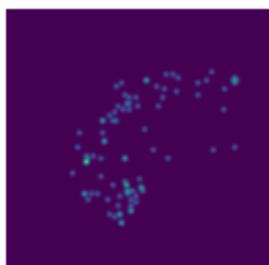
Real GEX (Tissue 1) - X-Y-Z-axis Galntl6



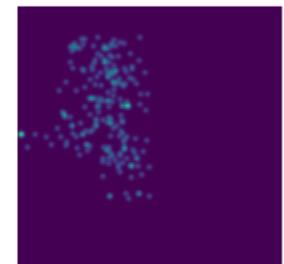
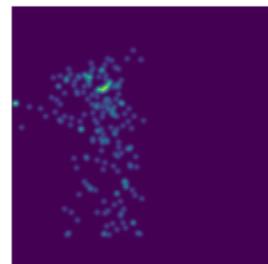
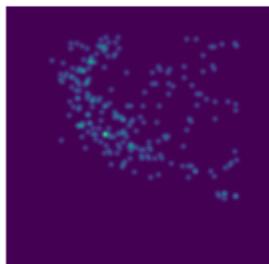
Real GEX (Tissue 2) - X-Y-Z-axis Galntl6



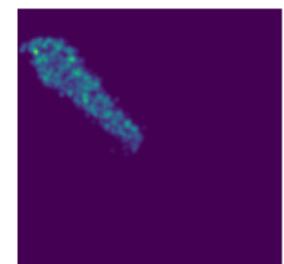
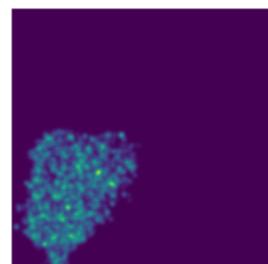
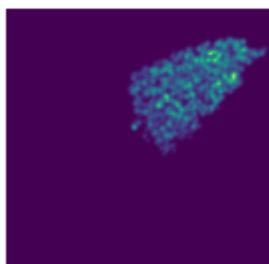
Real GEX (Tissue 3) - X-Y-Z-axis Galntl6



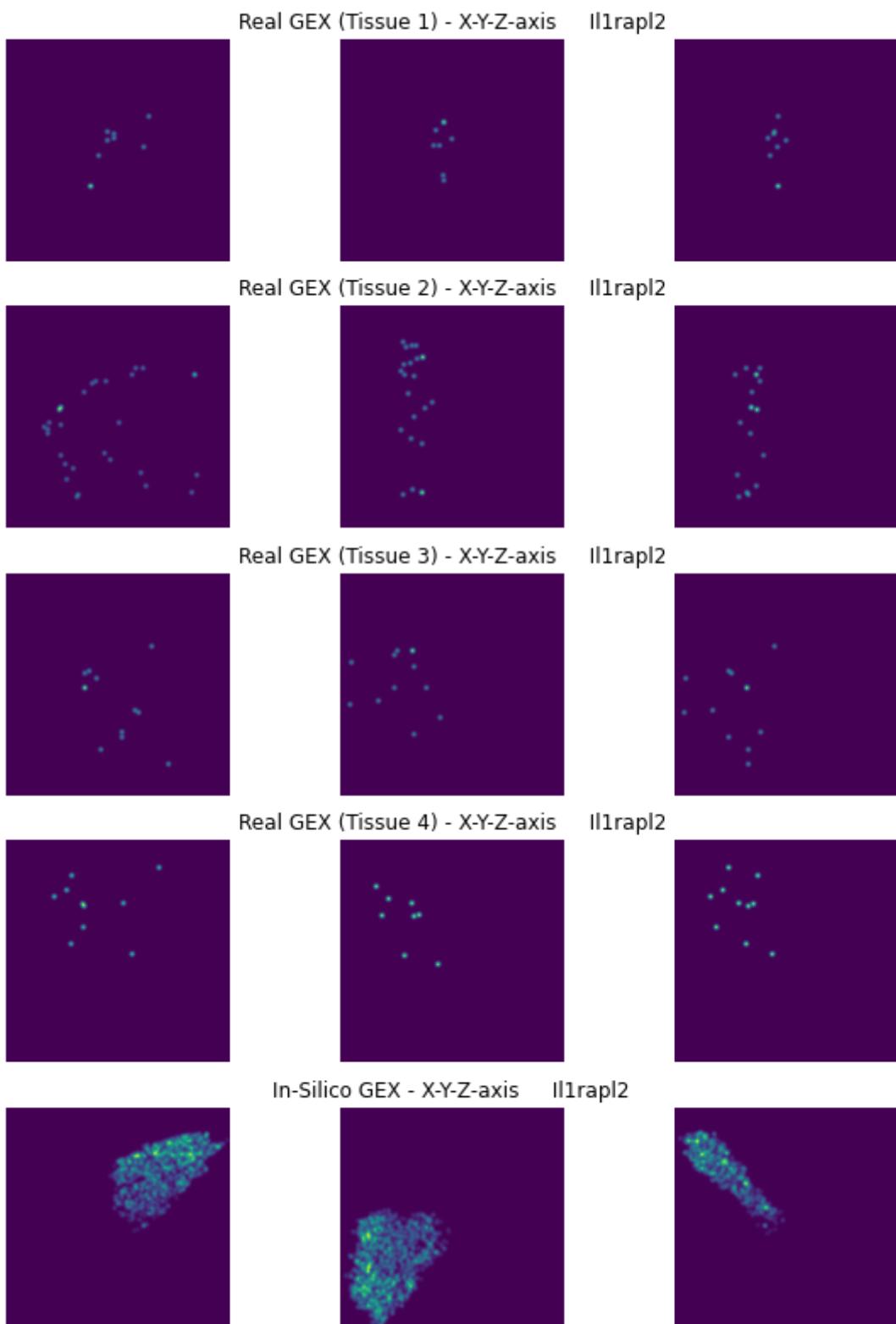
Real GEX (Tissue 4) - X-Y-Z-axis Galntl6



In-Silico GEX - X-Y-Z-axis Galntl6

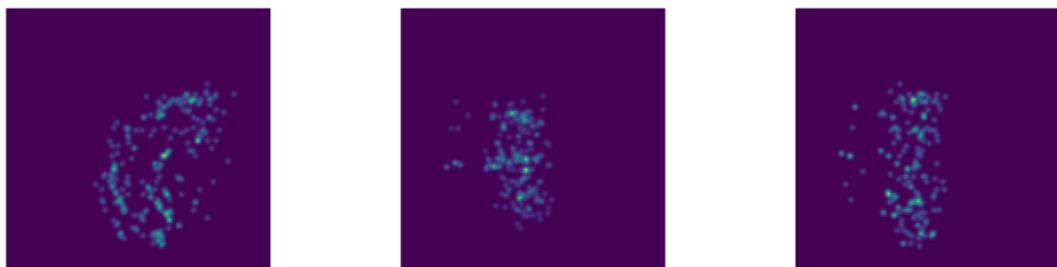


Real GEX II1rapl2

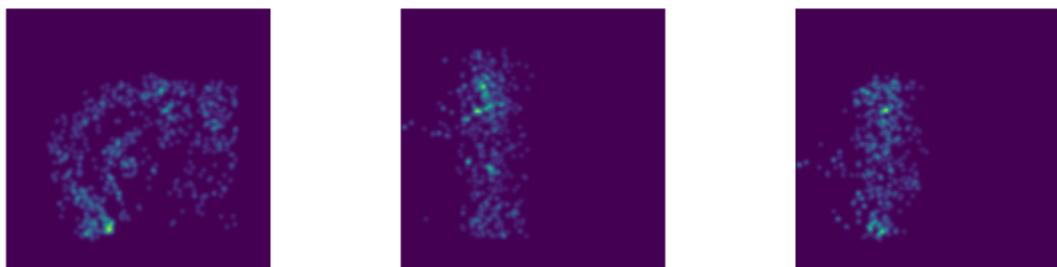


Real GEX Galnt14

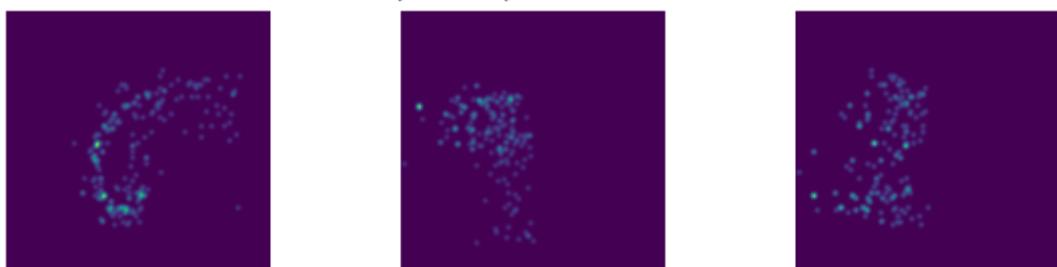
Real GEX (Tissue 1) - X-Y-Z-axis Galnt14



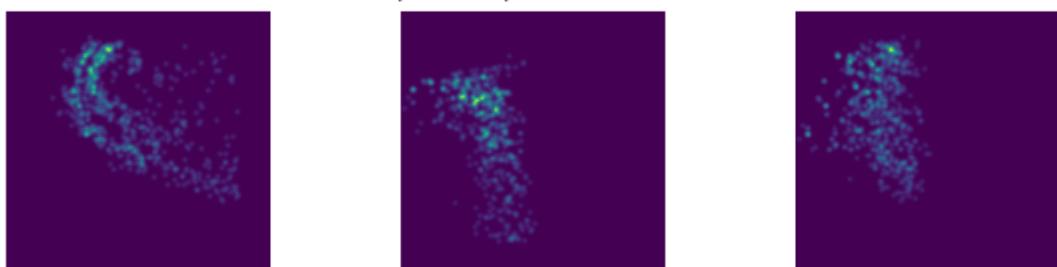
Real GEX (Tissue 2) - X-Y-Z-axis Galnt14



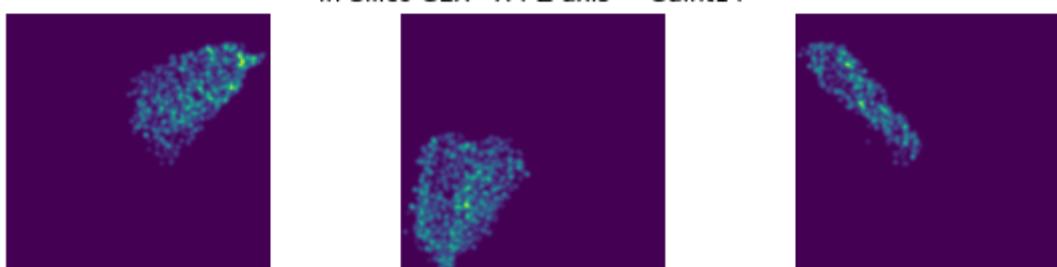
Real GEX (Tissue 3) - X-Y-Z-axis Galnt14



Real GEX (Tissue 4) - X-Y-Z-axis Galnt14

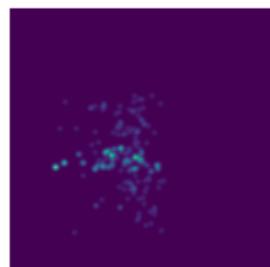
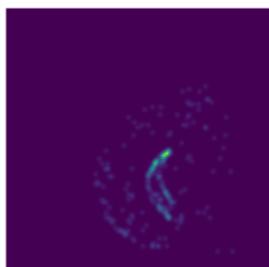


In-Silico GEX - X-Y-Z-axis Galnt14

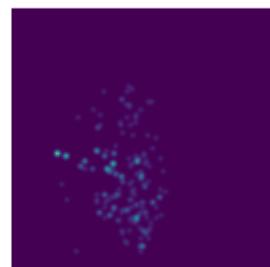


Real GEX Cdh9

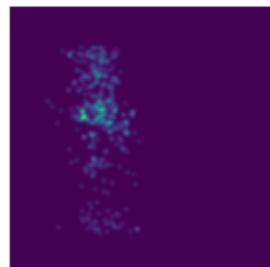
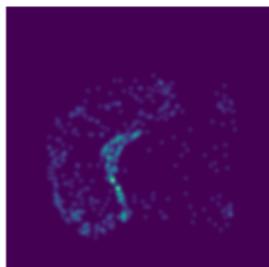
Real GEX (Tissue 1) - X-Y-Z-axis Cdh9



Cdh9



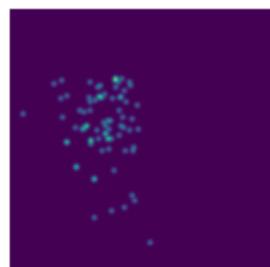
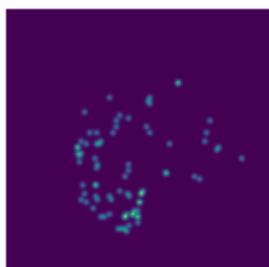
Real GEX (Tissue 2) - X-Y-Z-axis Cdh9



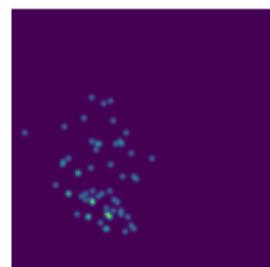
Cdh9



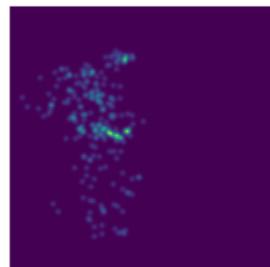
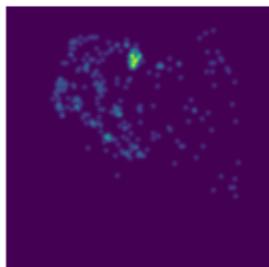
Real GEX (Tissue 3) - X-Y-Z-axis Cdh9



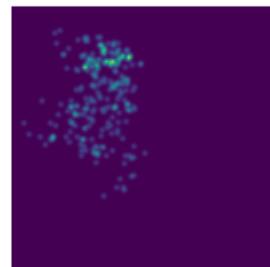
Cdh9



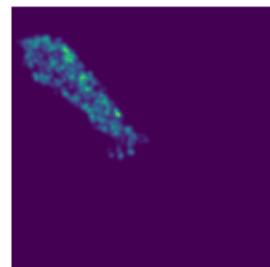
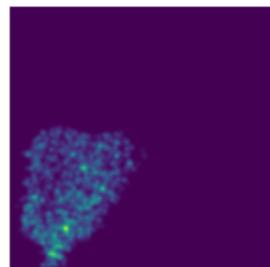
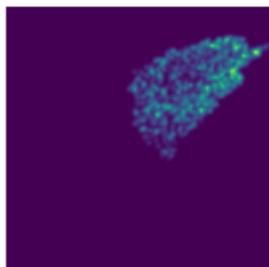
Real GEX (Tissue 4) - X-Y-Z-axis Cdh9



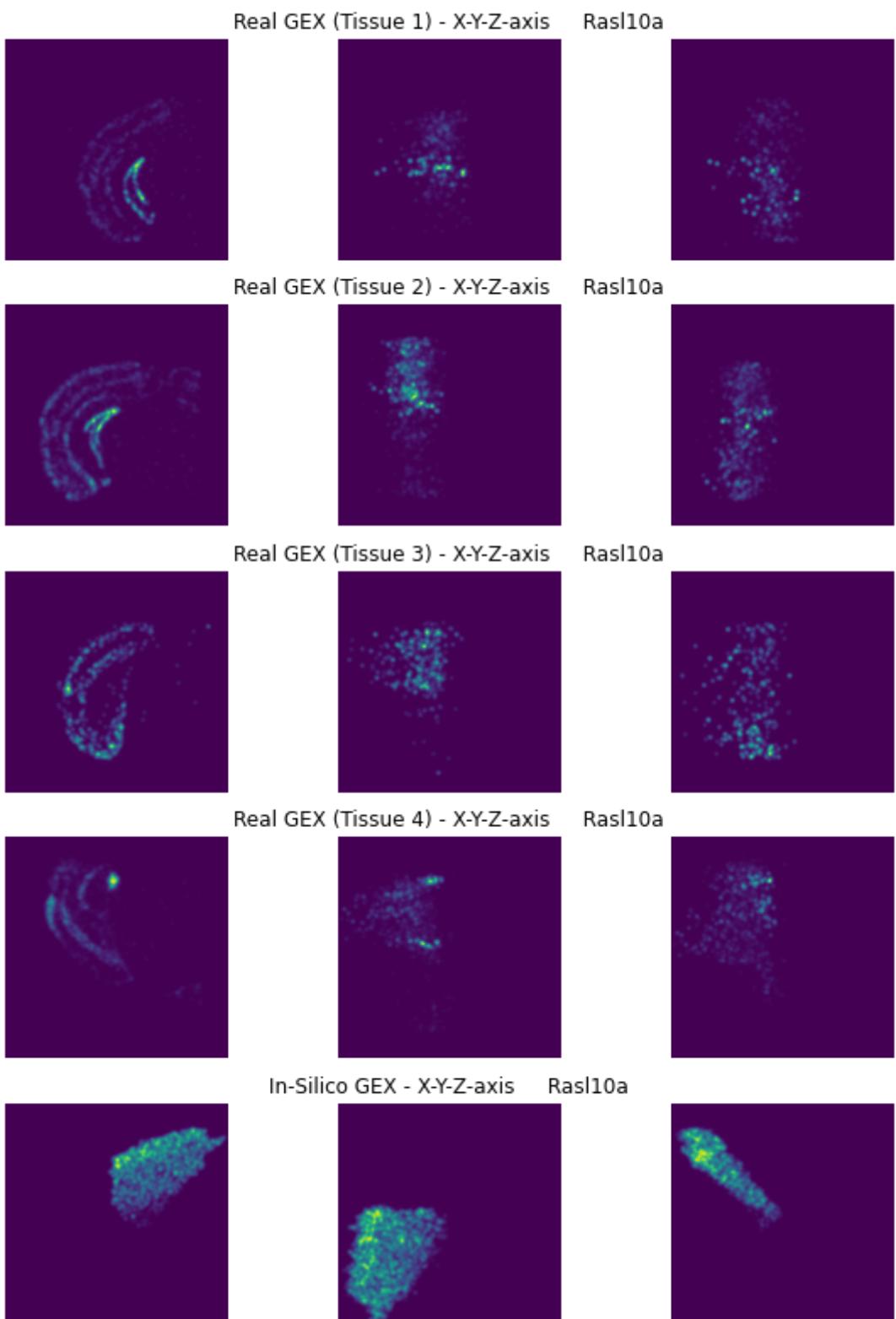
Cdh9



In-Silico GEX - X-Y-Z-axis Cdh9

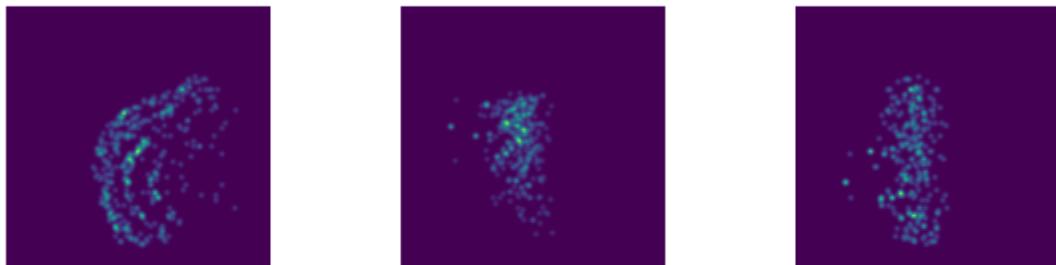


Real GEX Rasl10a

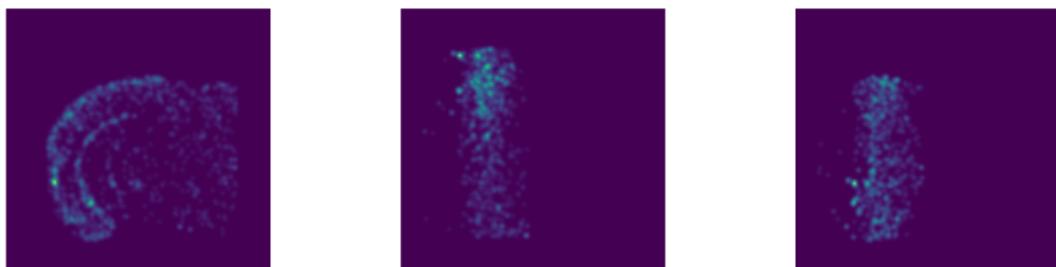


Real GEX Sorcs3

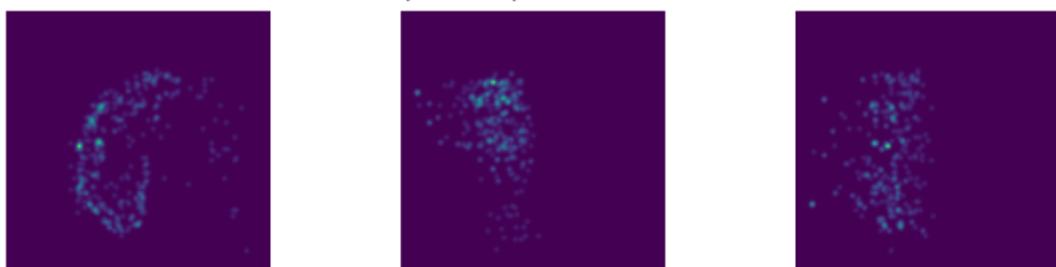
Real GEX (Tissue 1) - X-Y-Z-axis Sorcs3



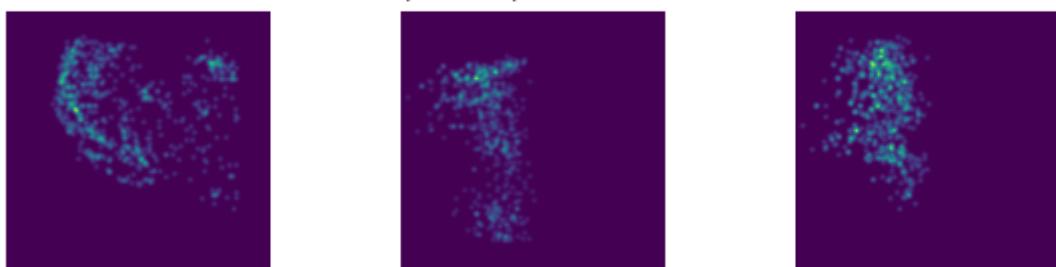
Real GEX (Tissue 2) - X-Y-Z-axis Sorcs3



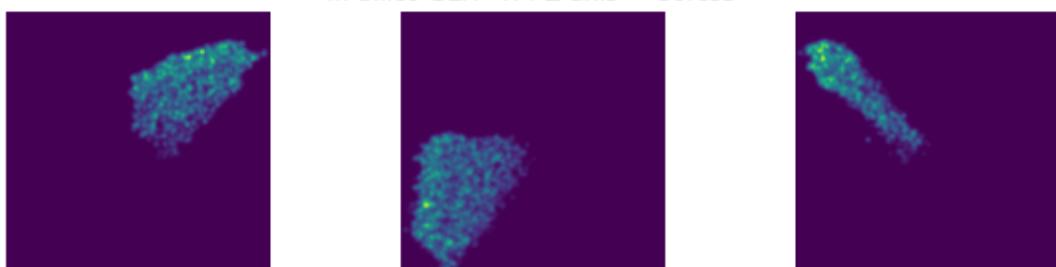
Real GEX (Tissue 3) - X-Y-Z-axis Sorcs3



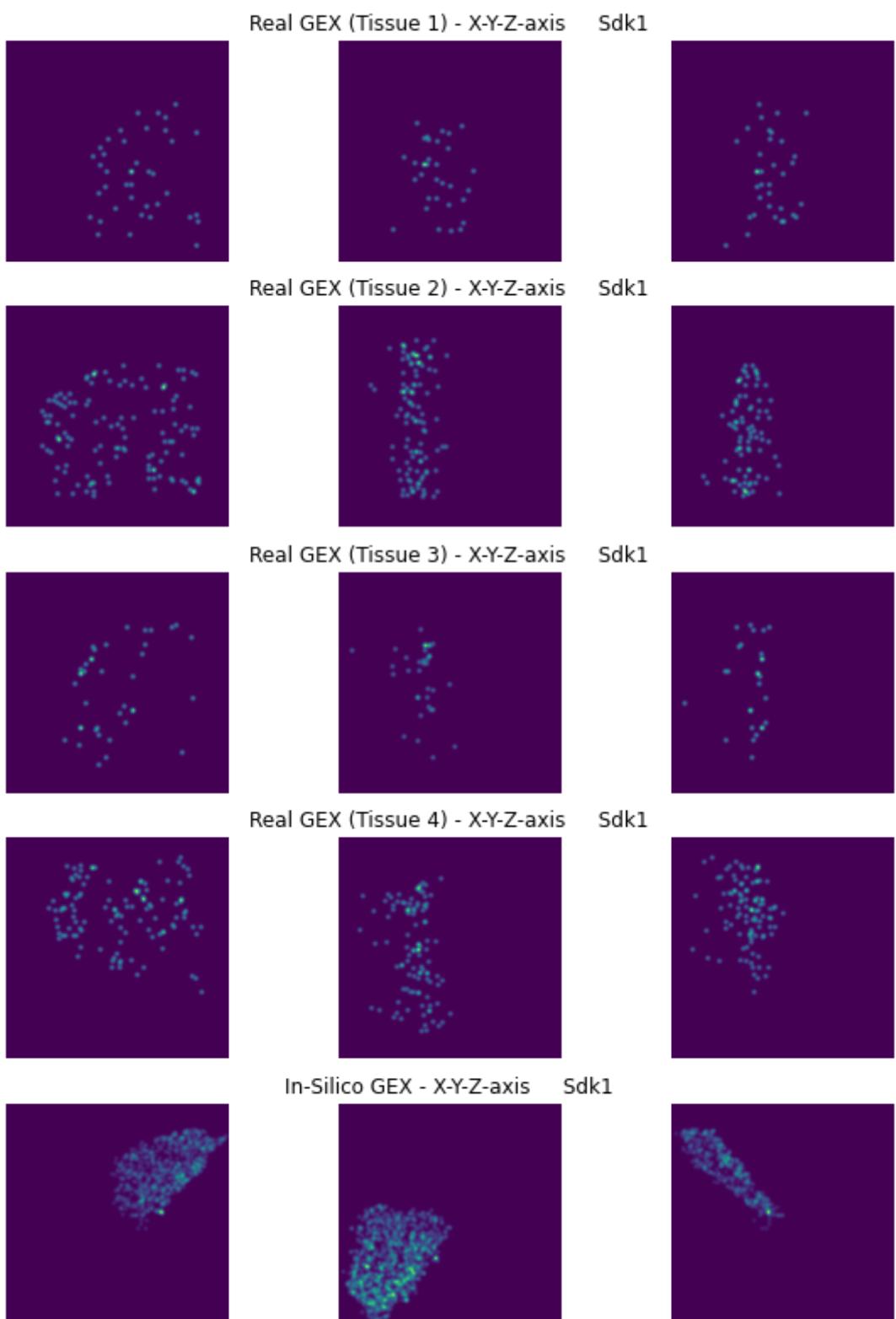
Real GEX (Tissue 4) - X-Y-Z-axis Sorcs3



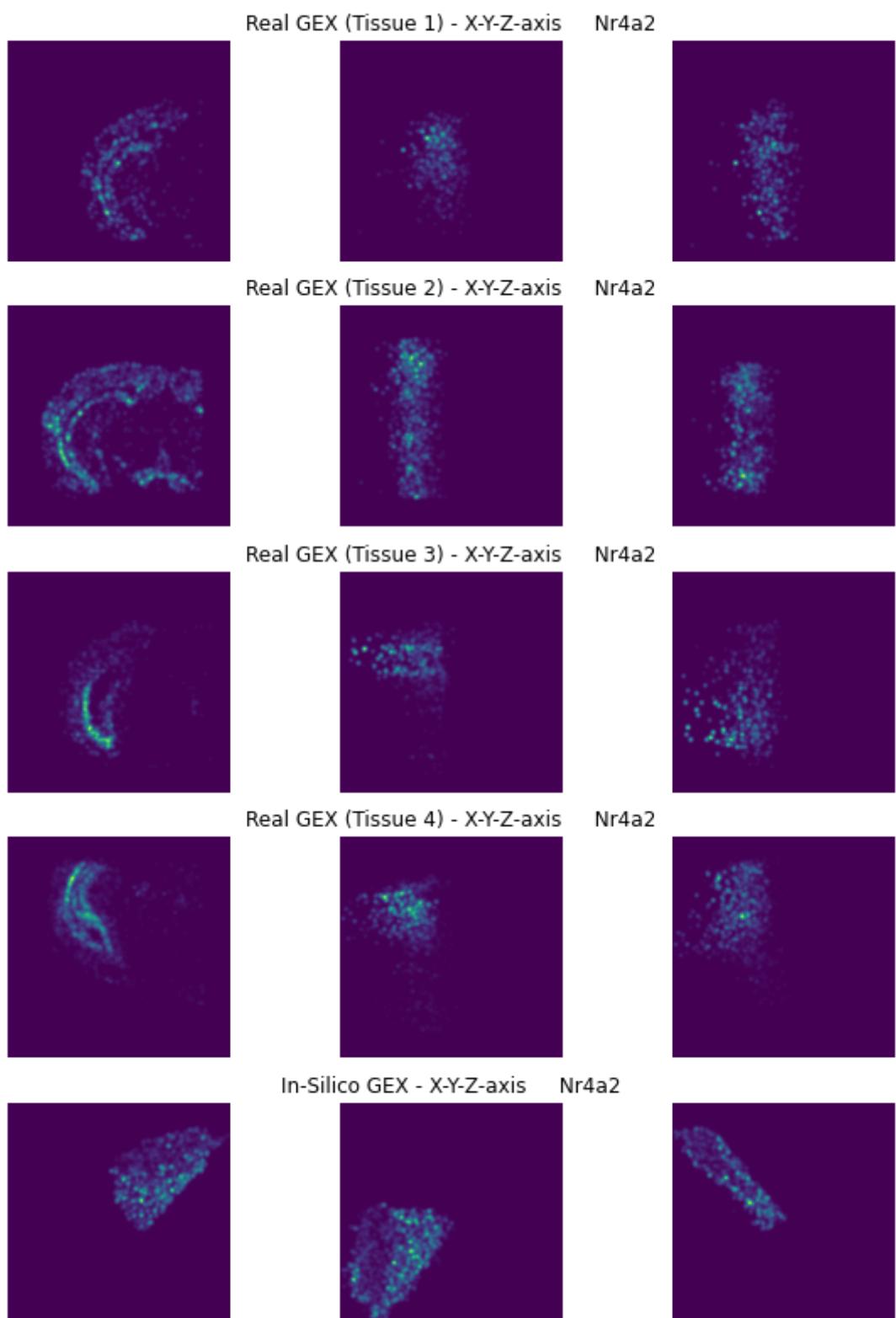
In-Silico GEX - X-Y-Z-axis Sorcs3



Real GEX Sdk1

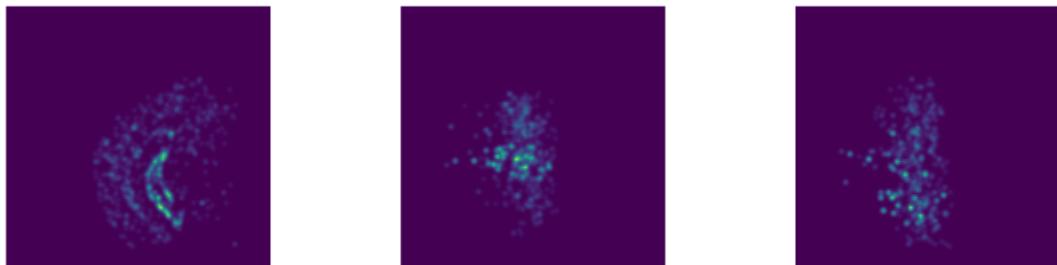


Real GEX Nr4a2

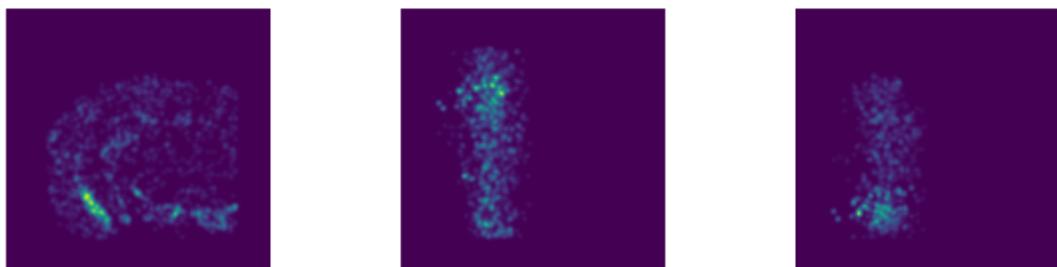


Real GEX Gfra1

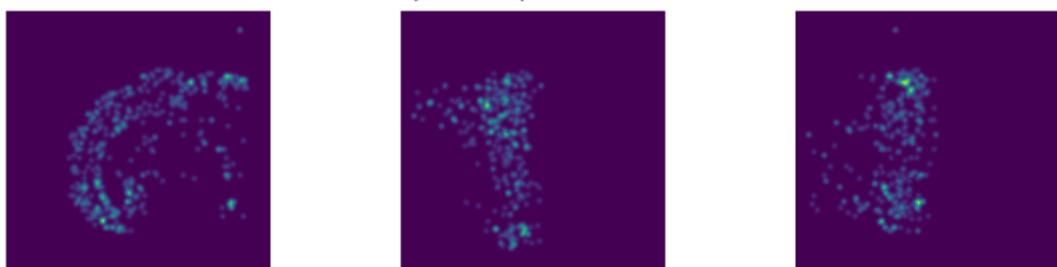
Real GEX (Tissue 1) - X-Y-Z-axis Gfra1



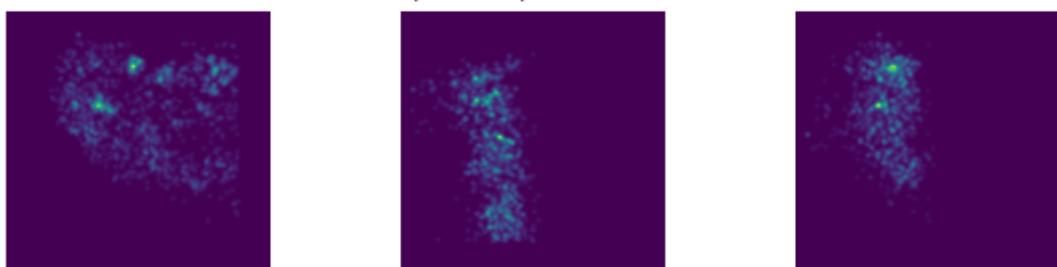
Real GEX (Tissue 2) - X-Y-Z-axis Gfra1



Real GEX (Tissue 3) - X-Y-Z-axis Gfra1



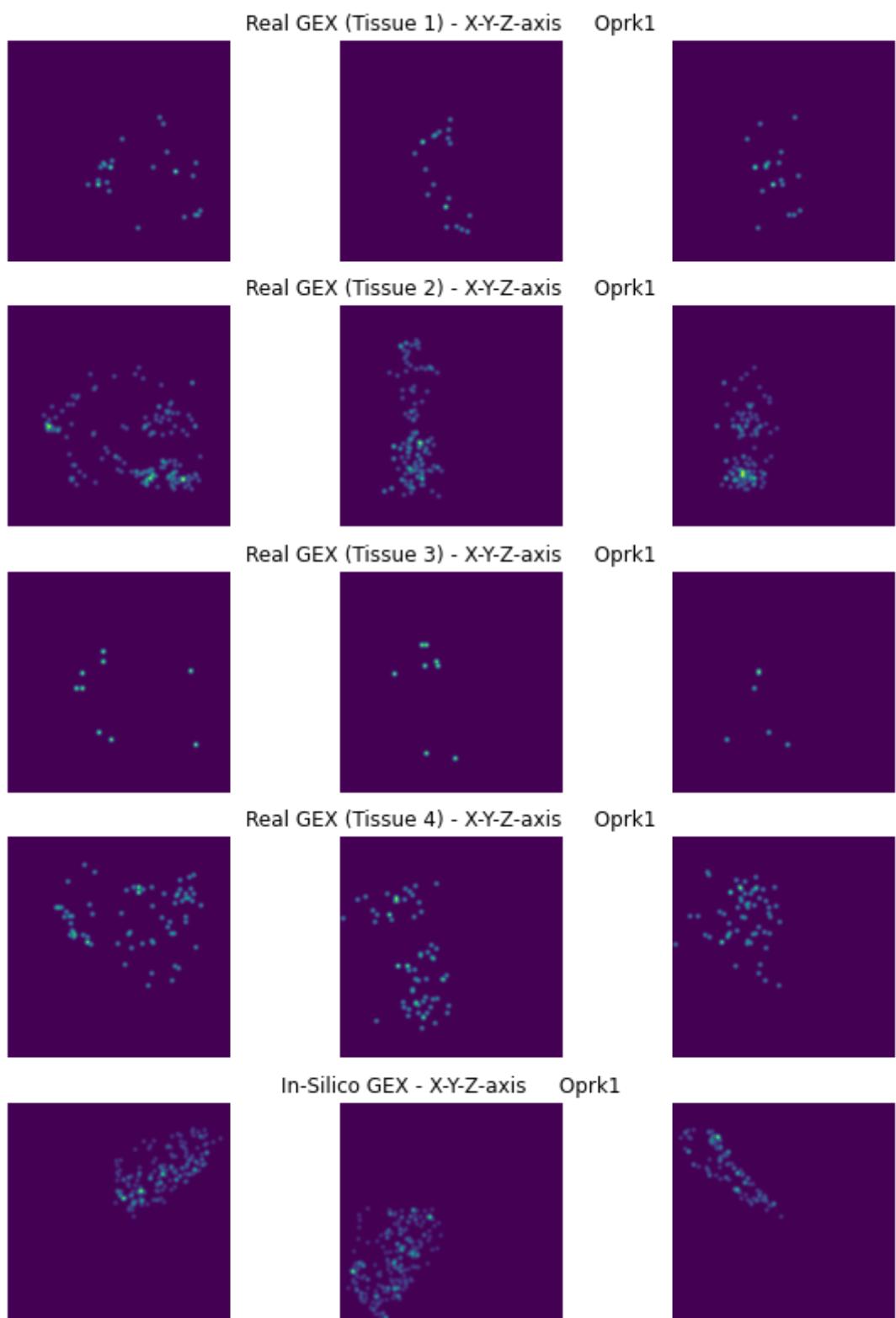
Real GEX (Tissue 4) - X-Y-Z-axis Gfra1



In-Silico GEX - X-Y-Z-axis Gfra1

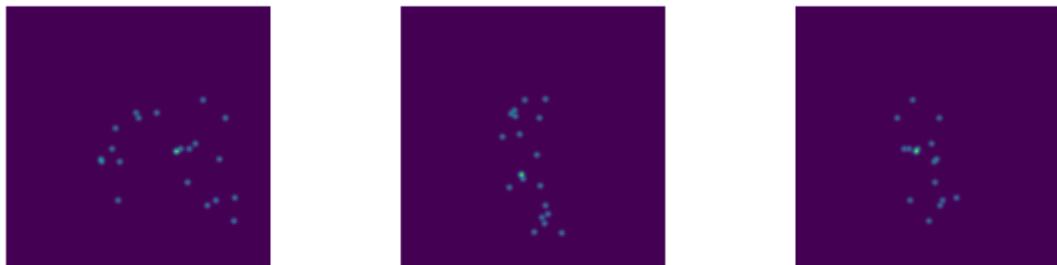


Real GEX Oprk1

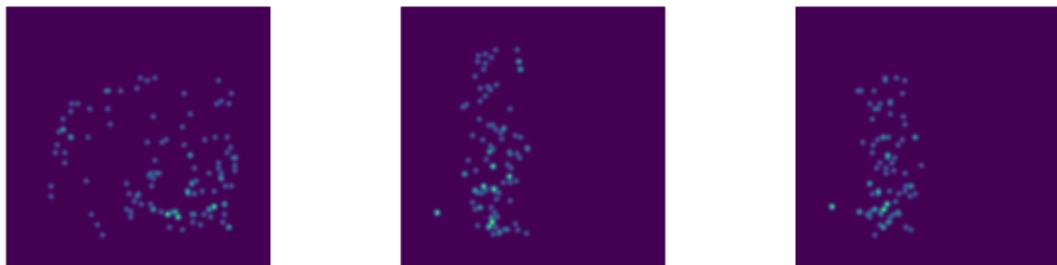


Real GEX Coll1a1

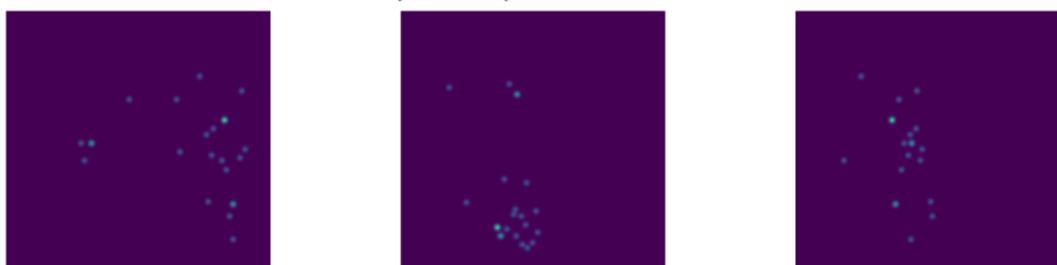
Real GEX (Tissue 1) - X-Y-Z-axis Coll1a1



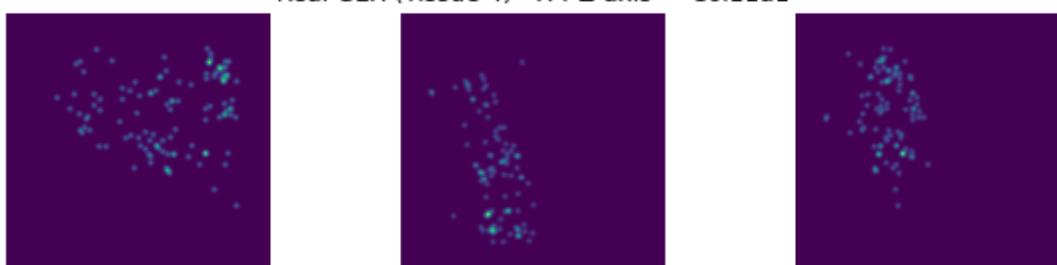
Real GEX (Tissue 2) - X-Y-Z-axis Coll1a1



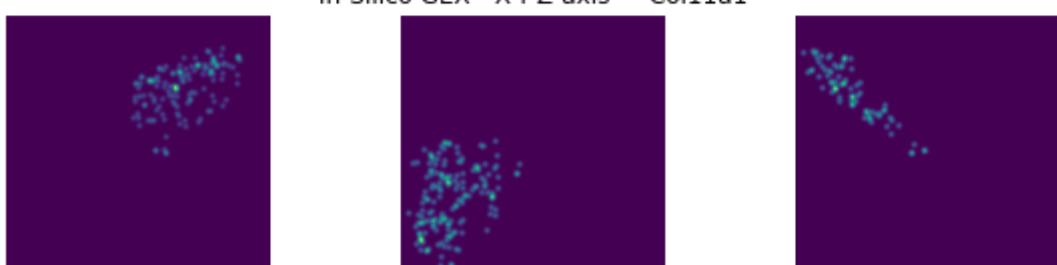
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Real GEX (Tissue 4) - X-Y-Z-axis Coll1a1

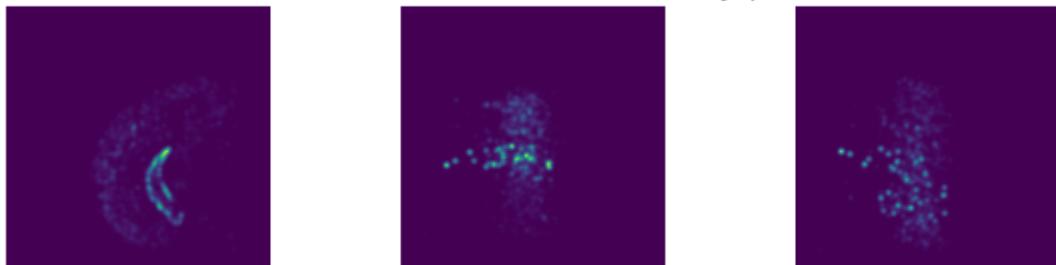


In-Silico GEX - X-Y-Z-axis Coll1a1

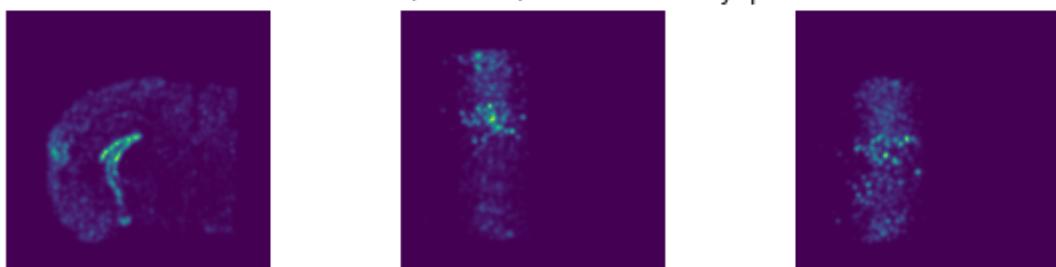


Real GEX Synpr

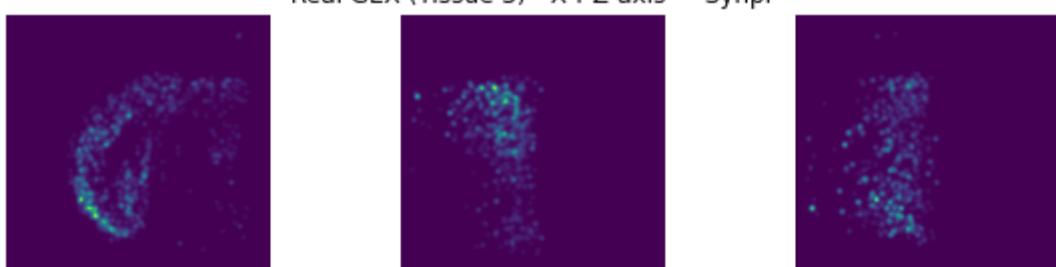
Real GEX (Tissue 1) - X-Y-Z-axis Synpr



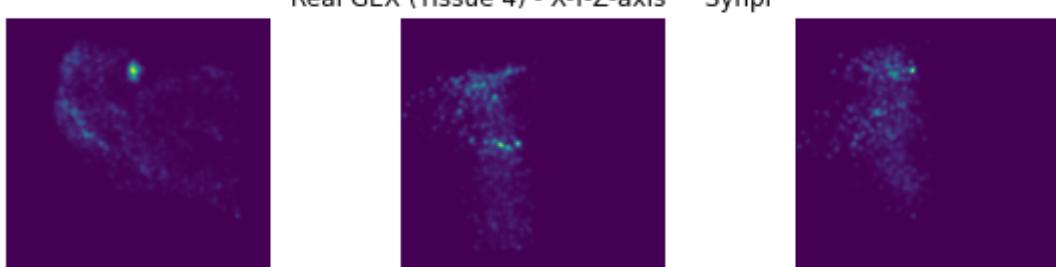
Real GEX (Tissue 2) - X-Y-Z-axis Synpr



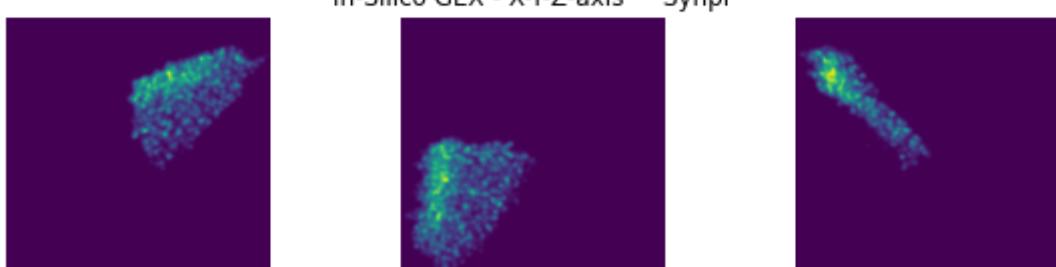
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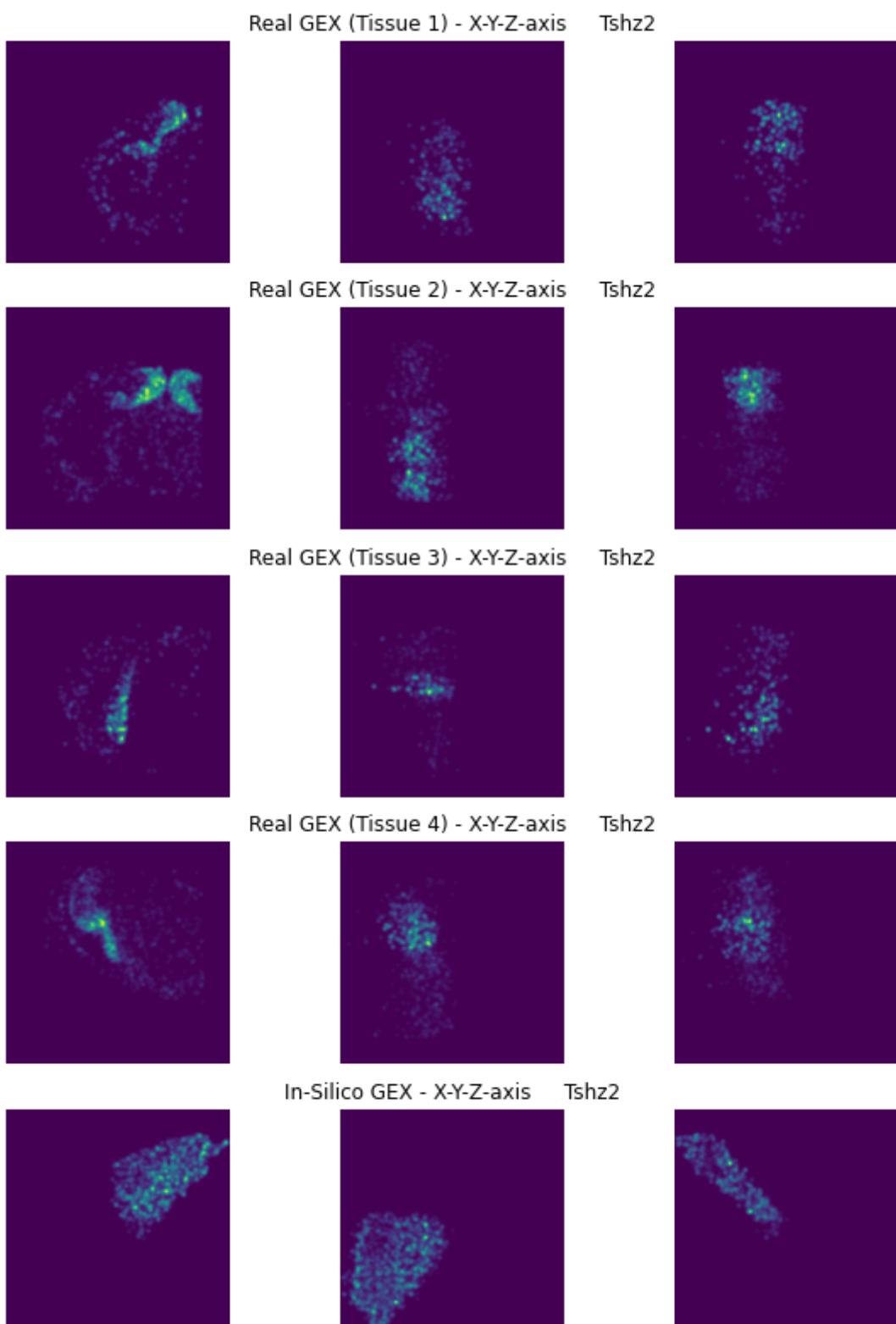
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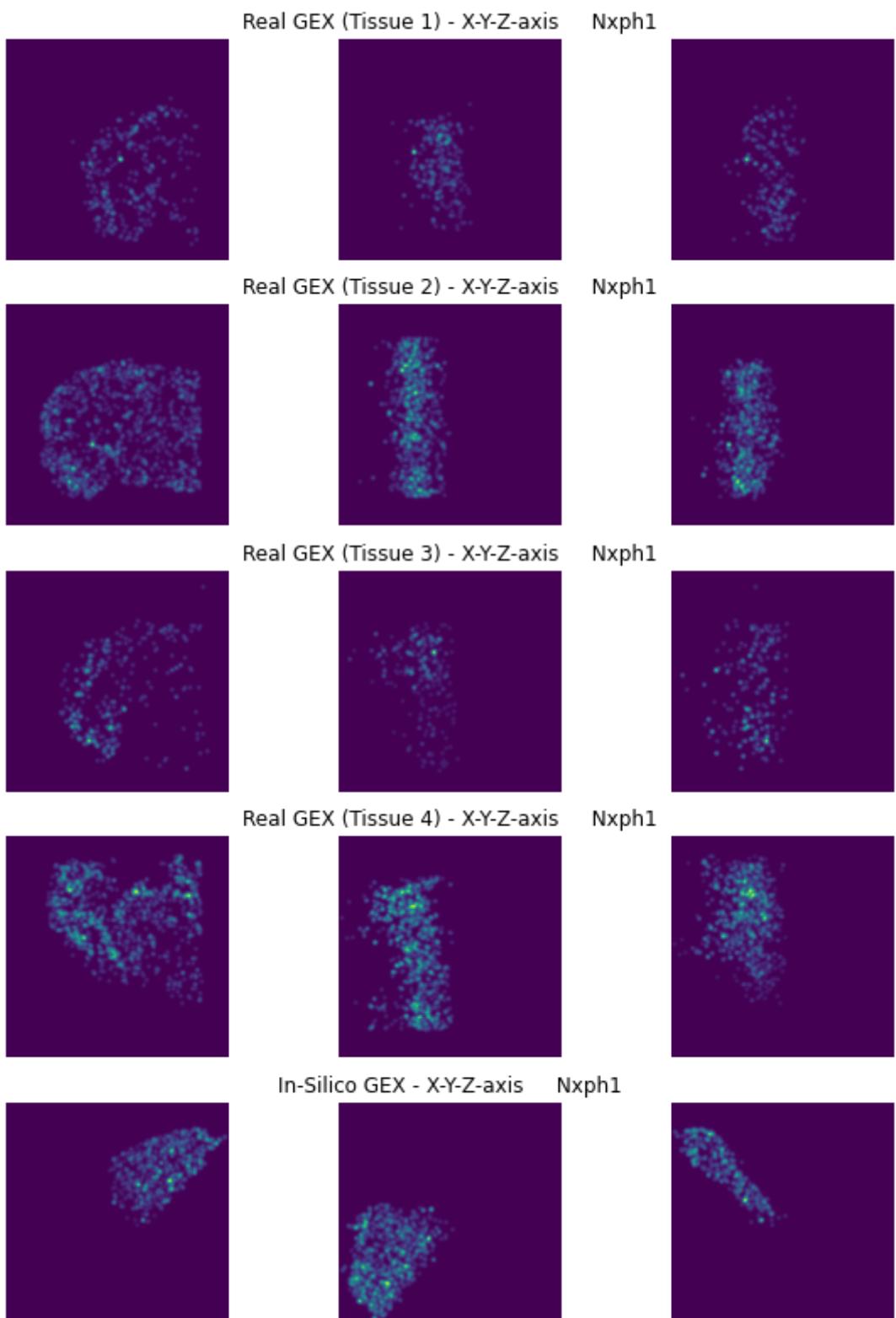
In-Silico GEX - X-Y-Z-axis Synpr



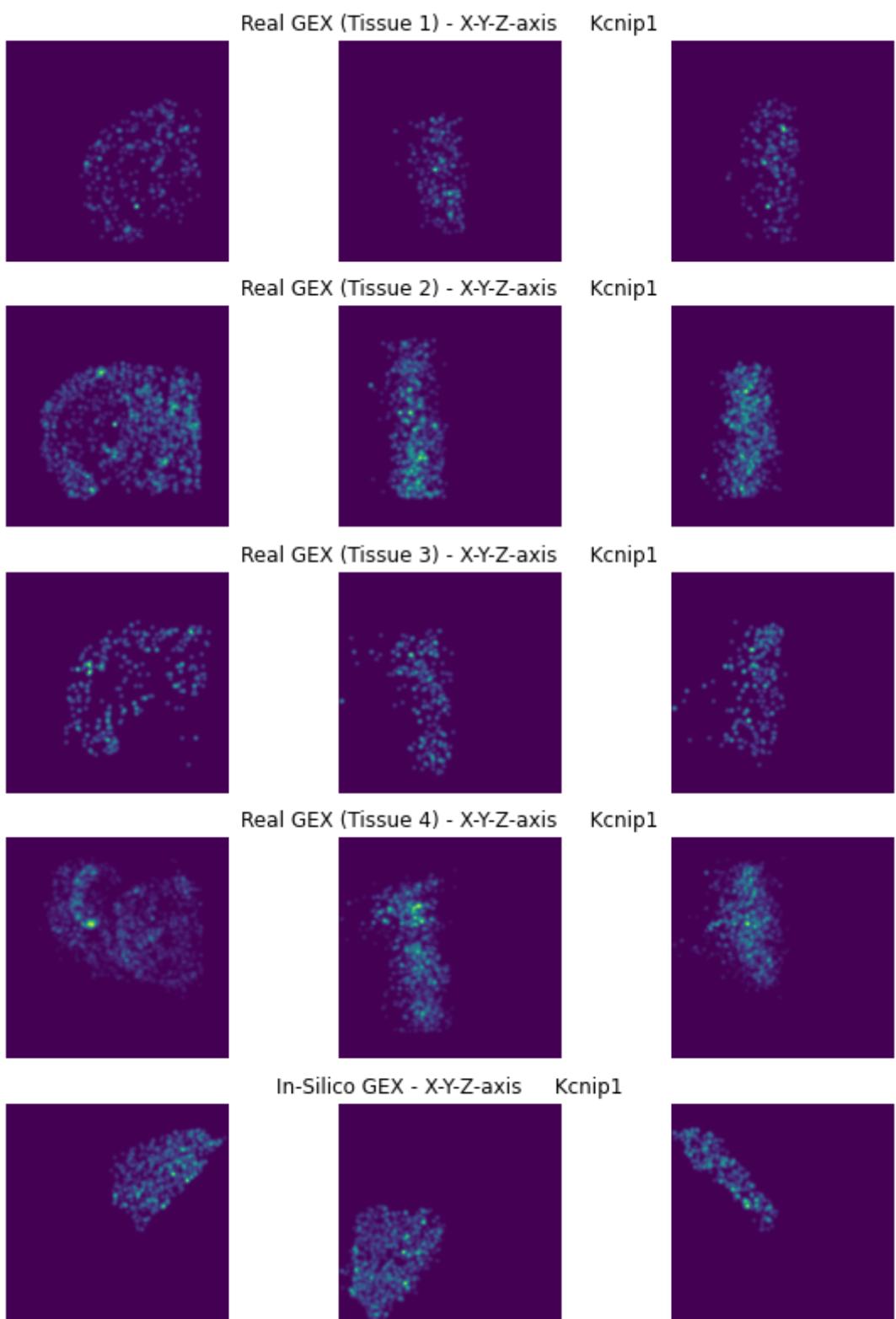
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Real GEX Nxph1

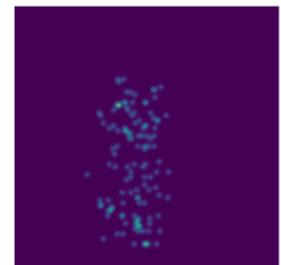
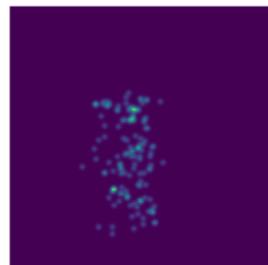
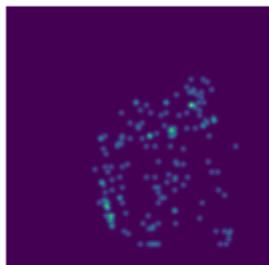


Real GEX Kcnip1

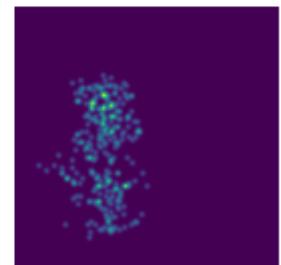
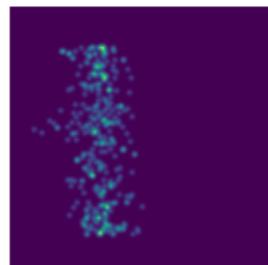
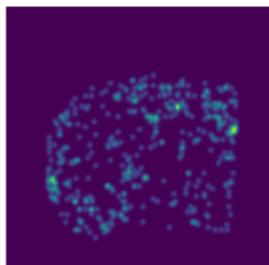


Real GEX Grik1

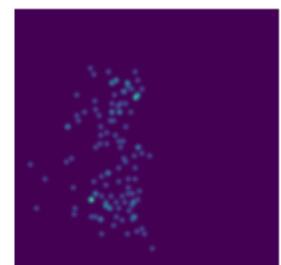
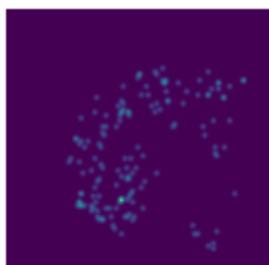
Real GEX (Tissue 1) - X-Y-Z-axis Grik1



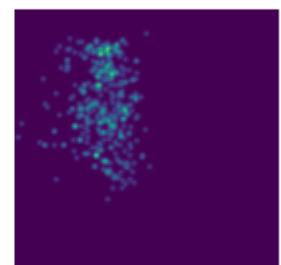
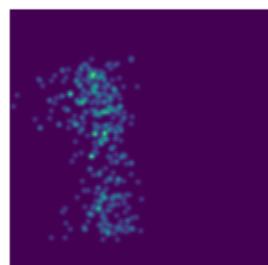
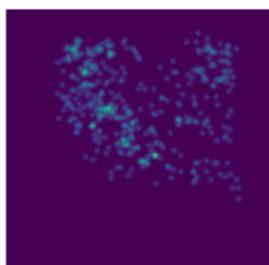
Real GEX (Tissue 2) - X-Y-Z-axis Grik1



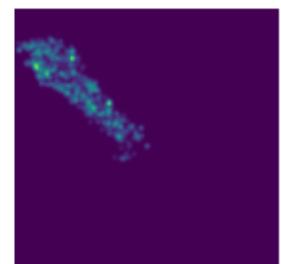
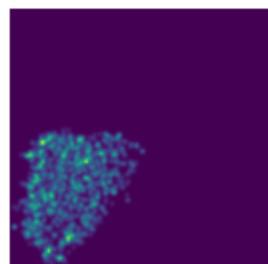
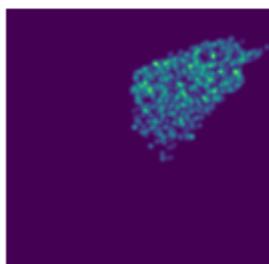
Real GEX (Tissue 3) - X-Y-Z-axis Grik1



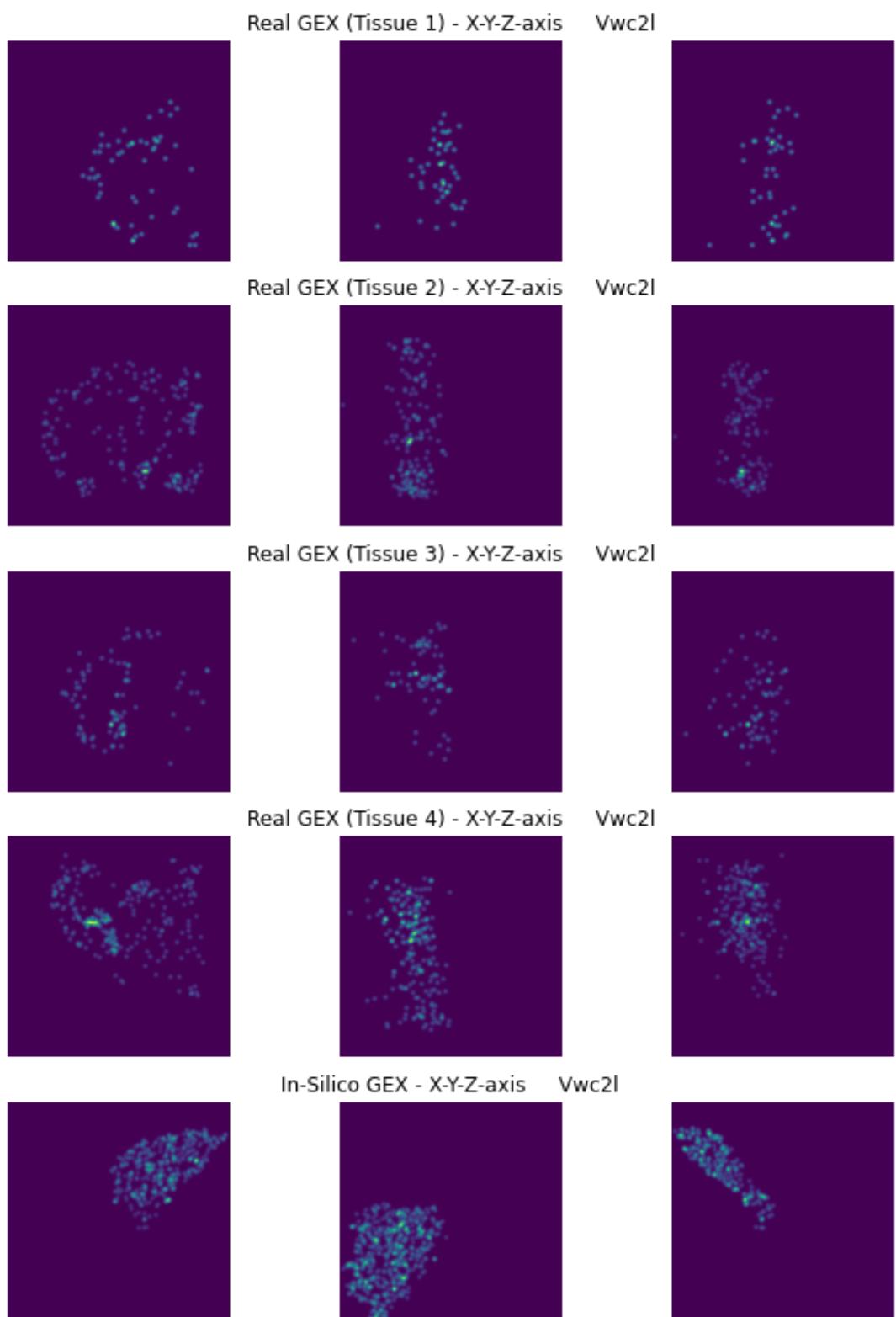
Real GEX (Tissue 4) - X-Y-Z-axis Grik1



In-Silico GEX - X-Y-Z-axis Grik1

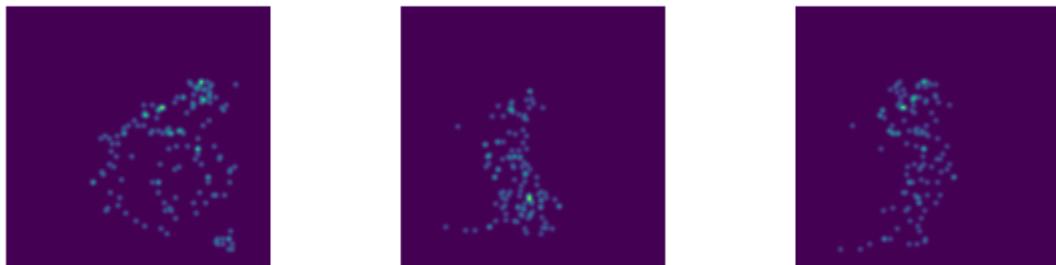


Real GEX Vwc2l

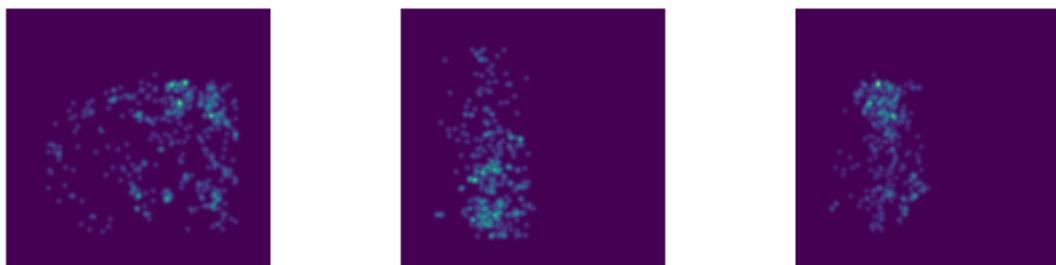


Real GEX Coro6

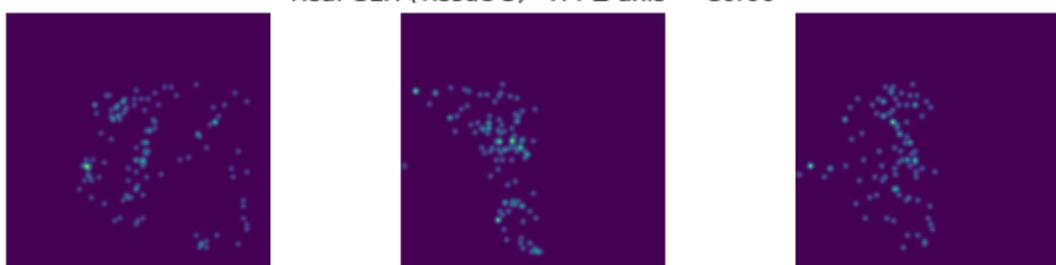
Real GEX (Tissue 1) - X-Y-Z-axis Coro6



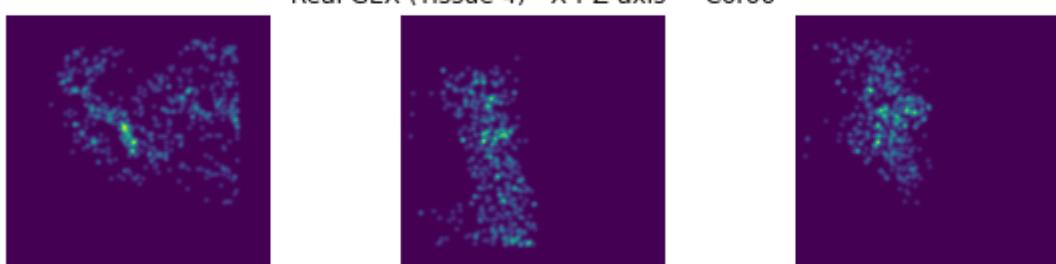
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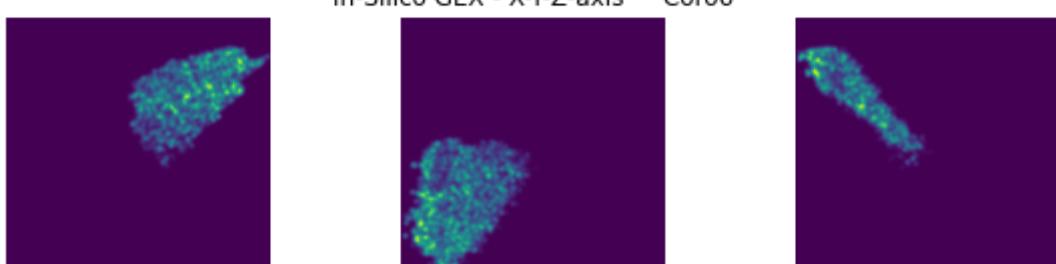
Real GEX (Tissue 3) - X-Y-Z-axis Coro6



Real GEX (Tissue 4) - X-Y-Z-axis Coro6

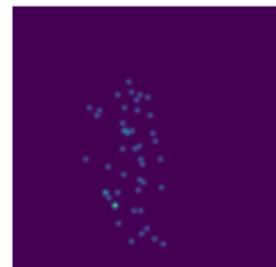
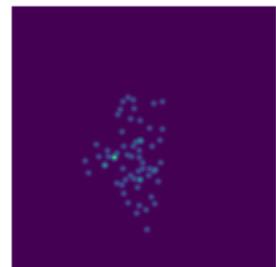
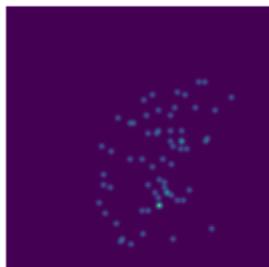


In-Silico GEX - X-Y-Z-axis Coro6

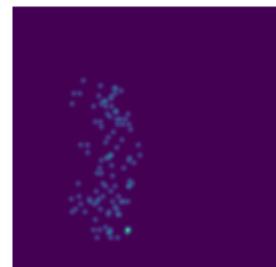
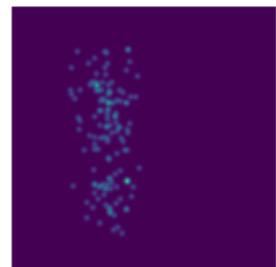
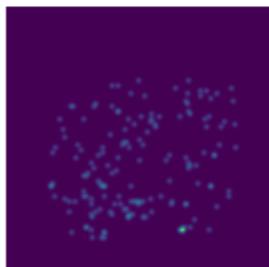


Real GEX Lpp

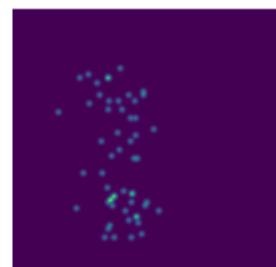
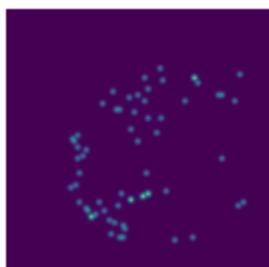
Real GEX (Tissue 1) - X-Y-Z-axis Lpp



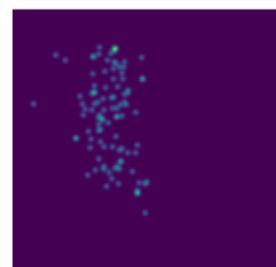
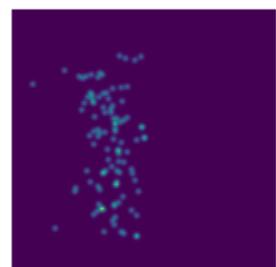
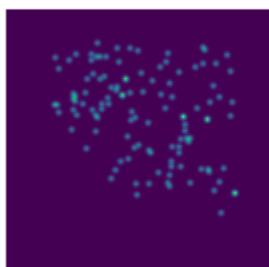
Real GEX (Tissue 2) - X-Y-Z-axis Lpp



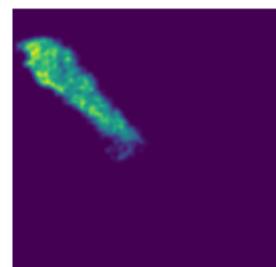
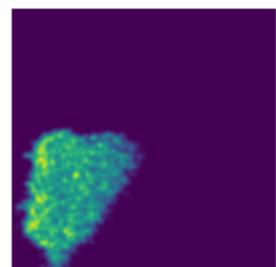
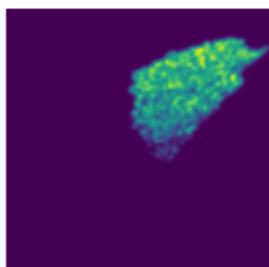
Real GEX (Tissue 3) - X-Y-Z-axis Lpp



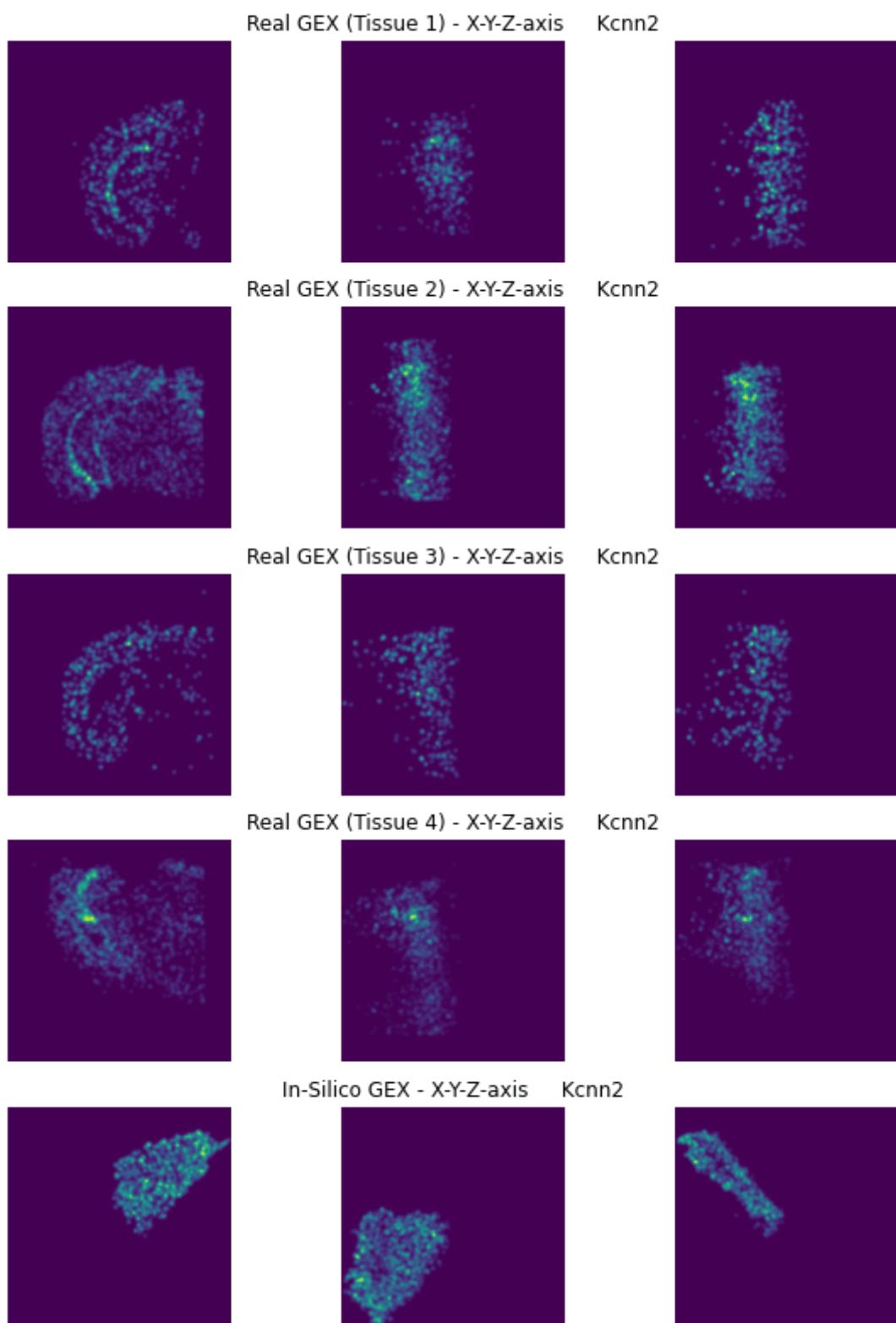
Real GEX (Tissue 4) - X-Y-Z-axis Lpp



In-Silico GEX - X-Y-Z-axis Lpp

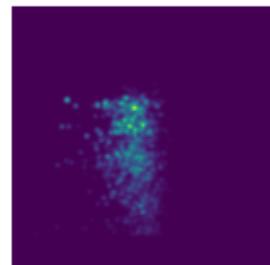
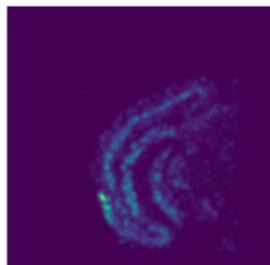


Real GEX Kcnn2

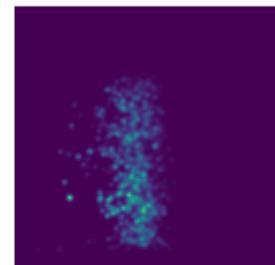


Real GEX Rab3c

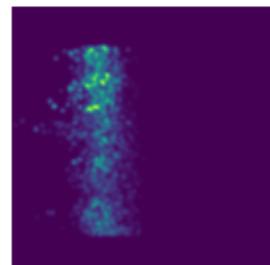
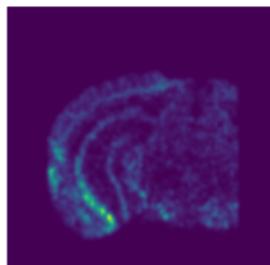
Real GEX (Tissue 1) - X-Y-Z-axis



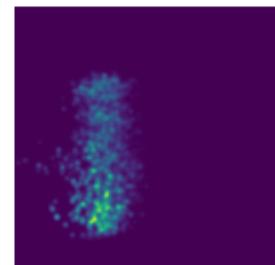
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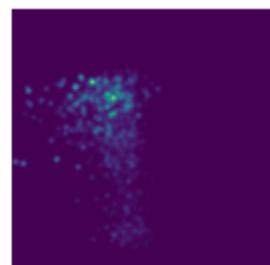
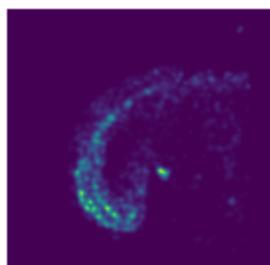
Real GEX (Tissue 2) - X-Y-Z-axis



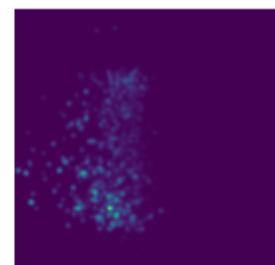
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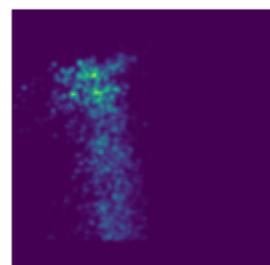
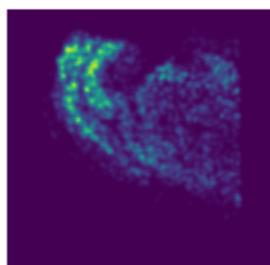
Real GEX (Tissue 3) - X-Y-Z-axis



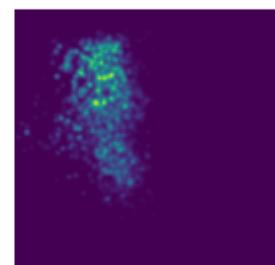
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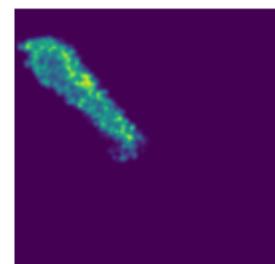
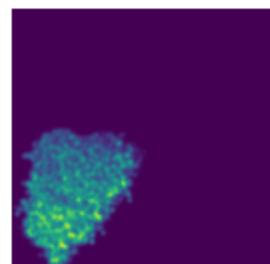
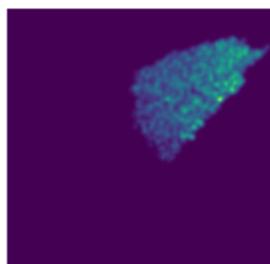
Real GEX (Tissue 4) - X-Y-Z-axis



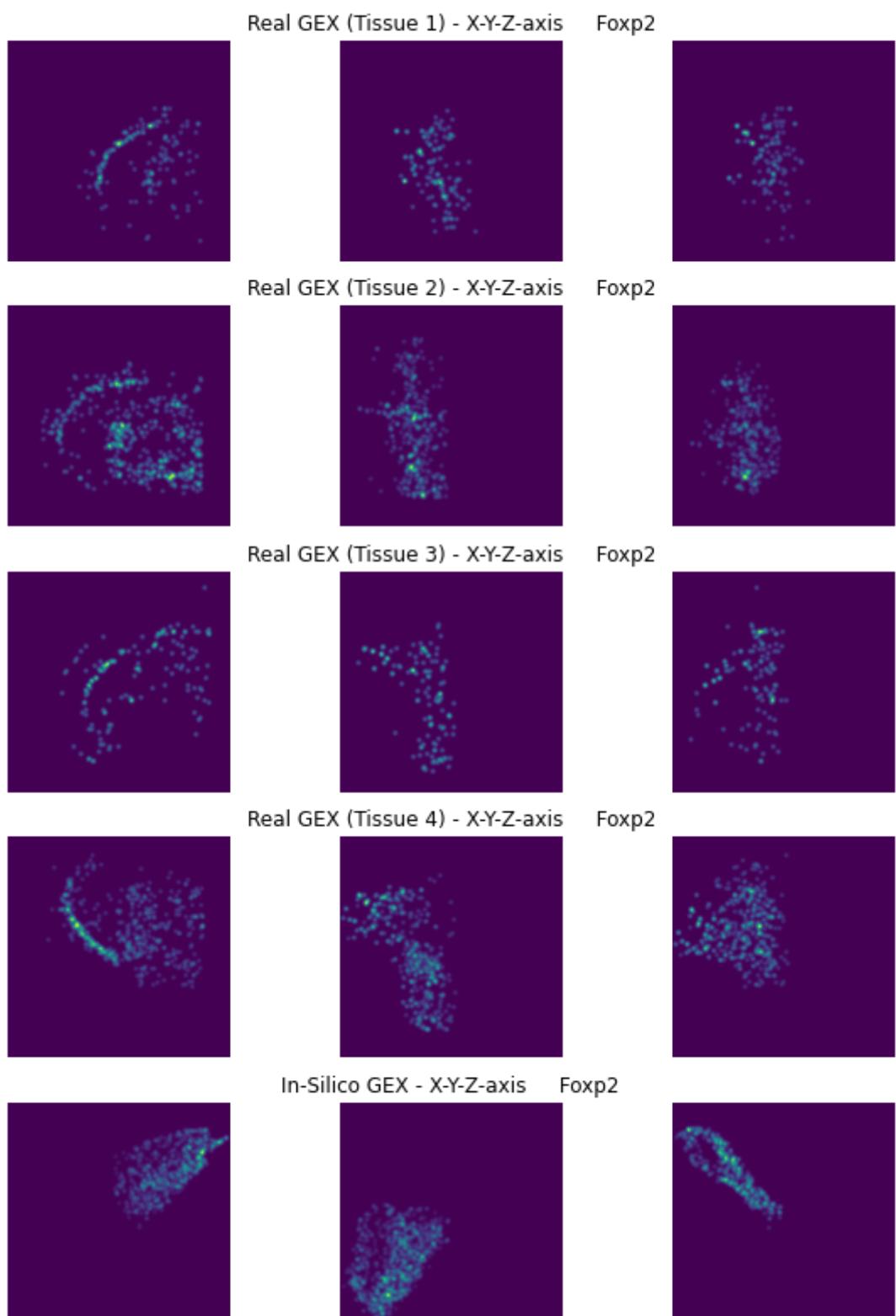
Rab3c



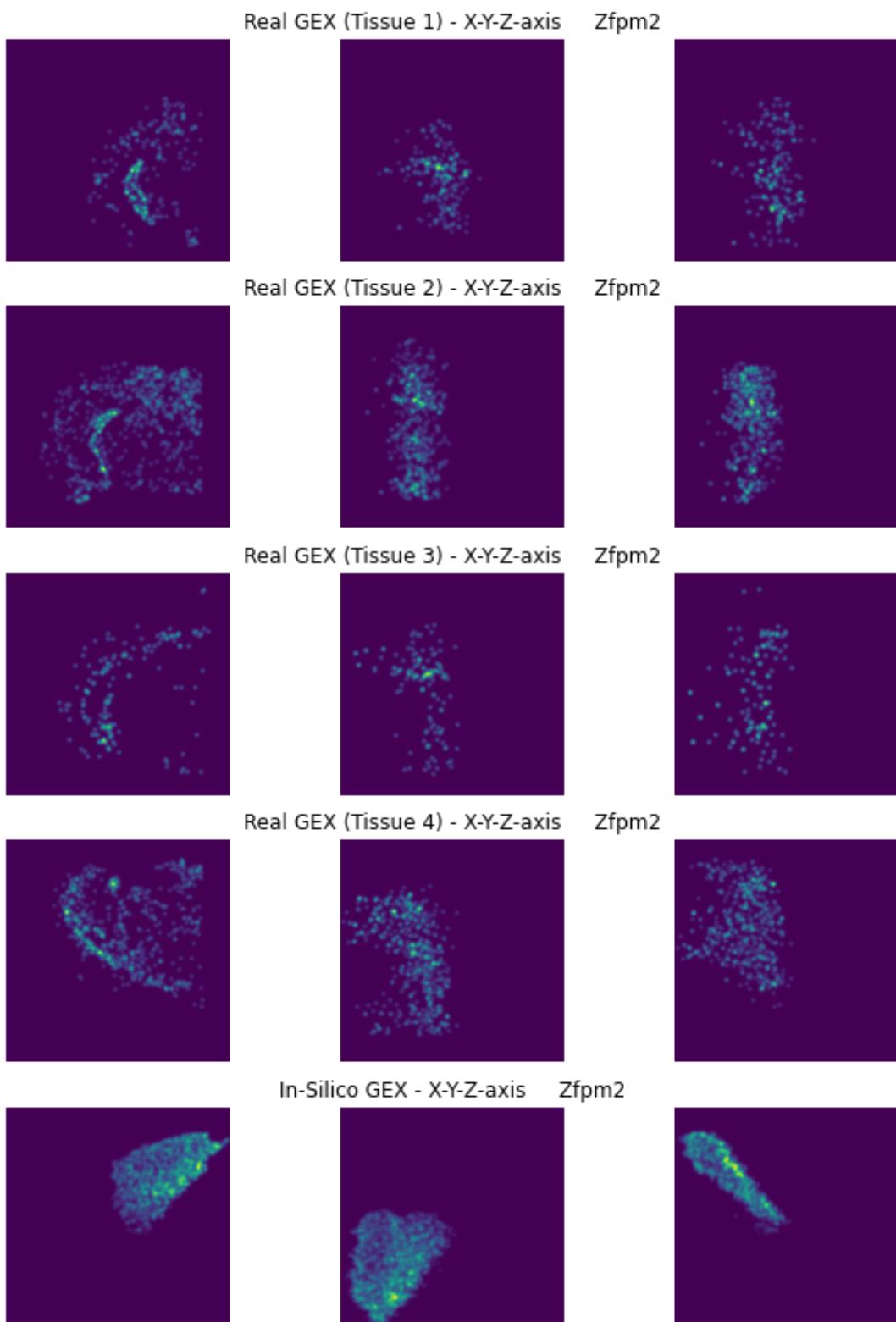
In-Silico GEX - X-Y-Z-axis Rab3c



Real GEX Foxp2

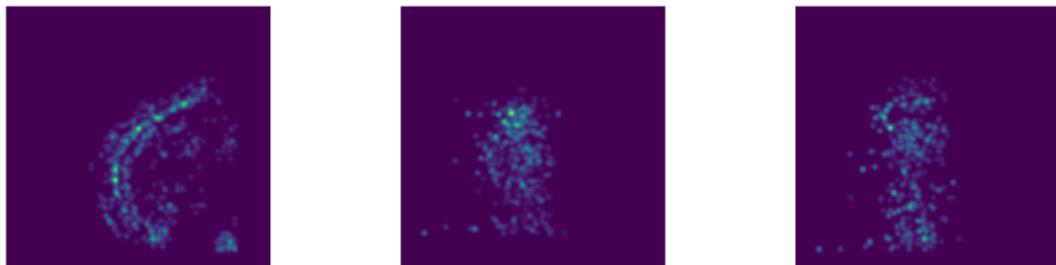


Real GEX Zfpm2

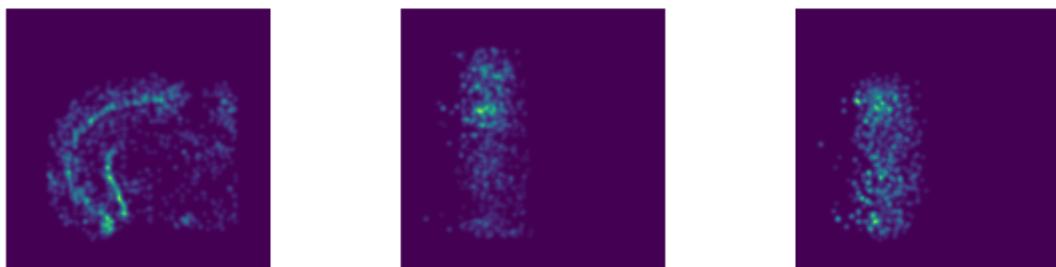


Real GEX Hs3st4

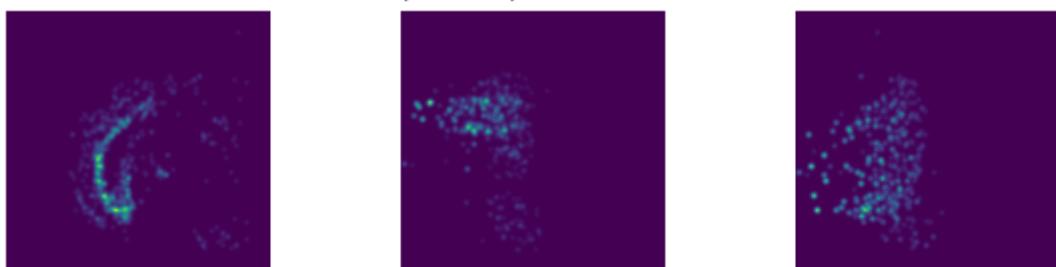
Real GEX (Tissue 1) - X-Y-Z-axis Hs3st4



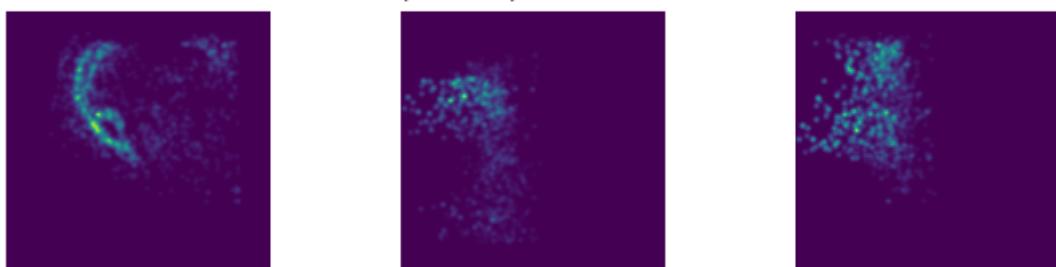
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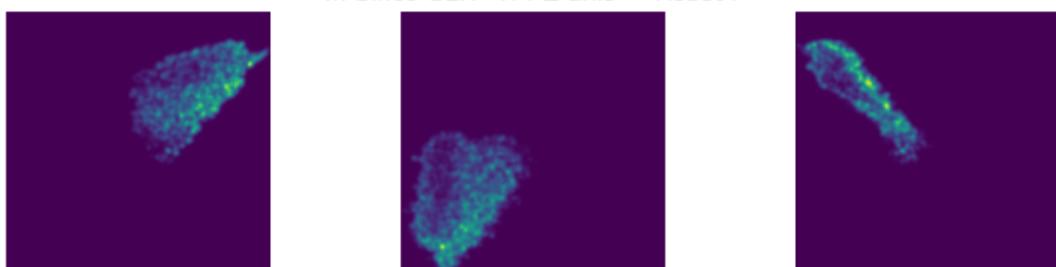
Real GEX (Tissue 3) - X-Y-Z-axis Hs3st4



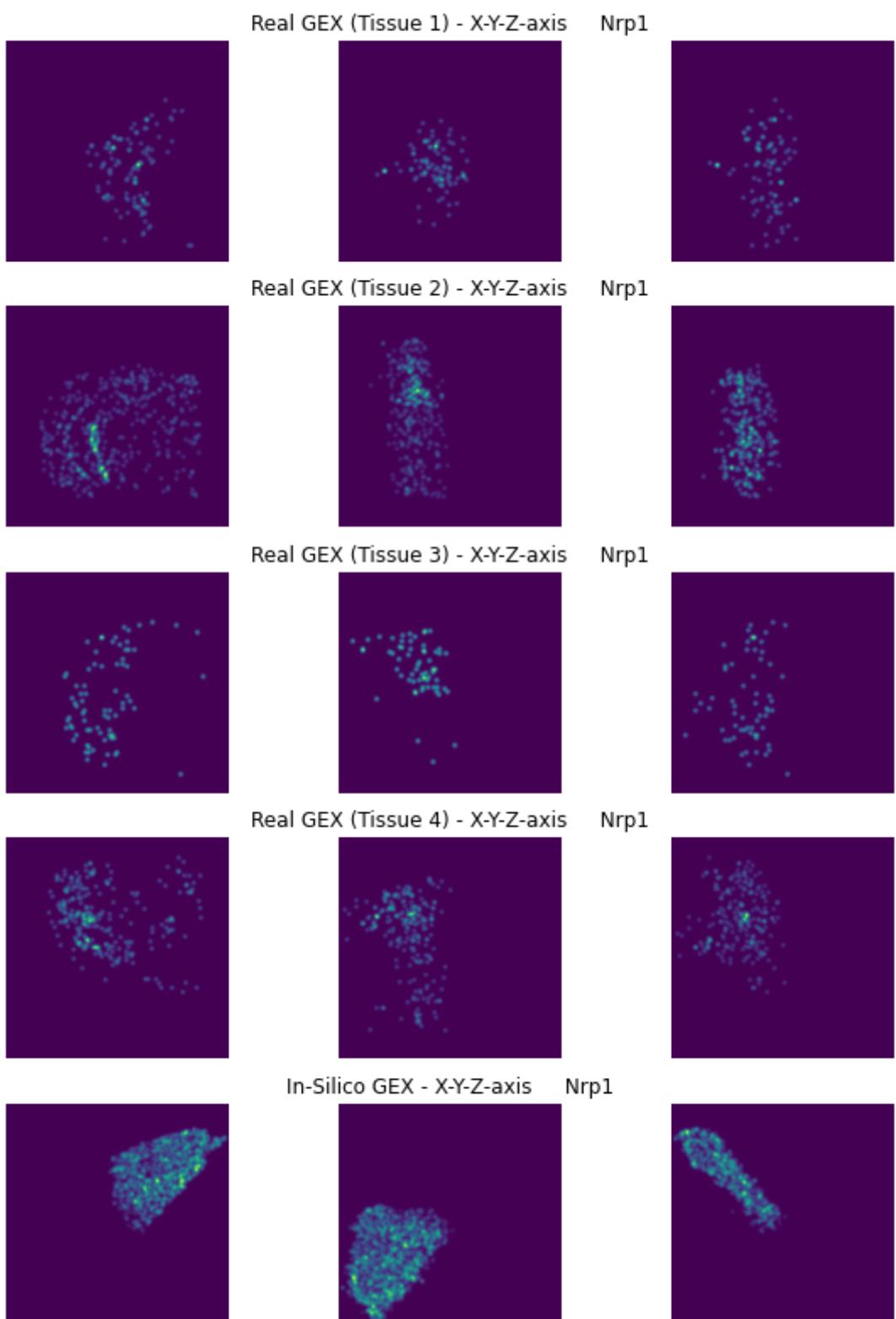
Real GEX (Tissue 4) - X-Y-Z-axis Hs3st4



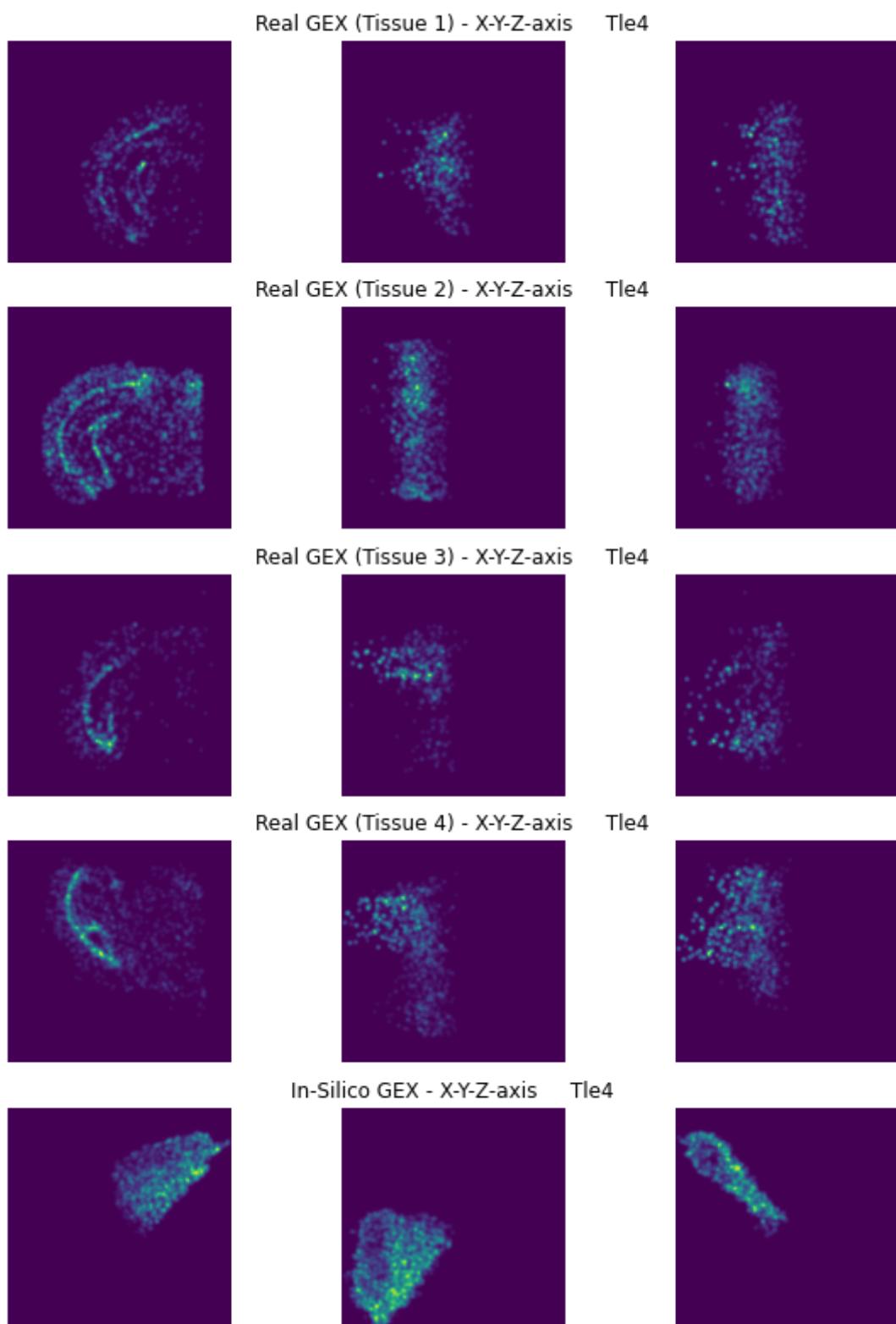
In-Silico GEX - X-Y-Z-axis Hs3st4



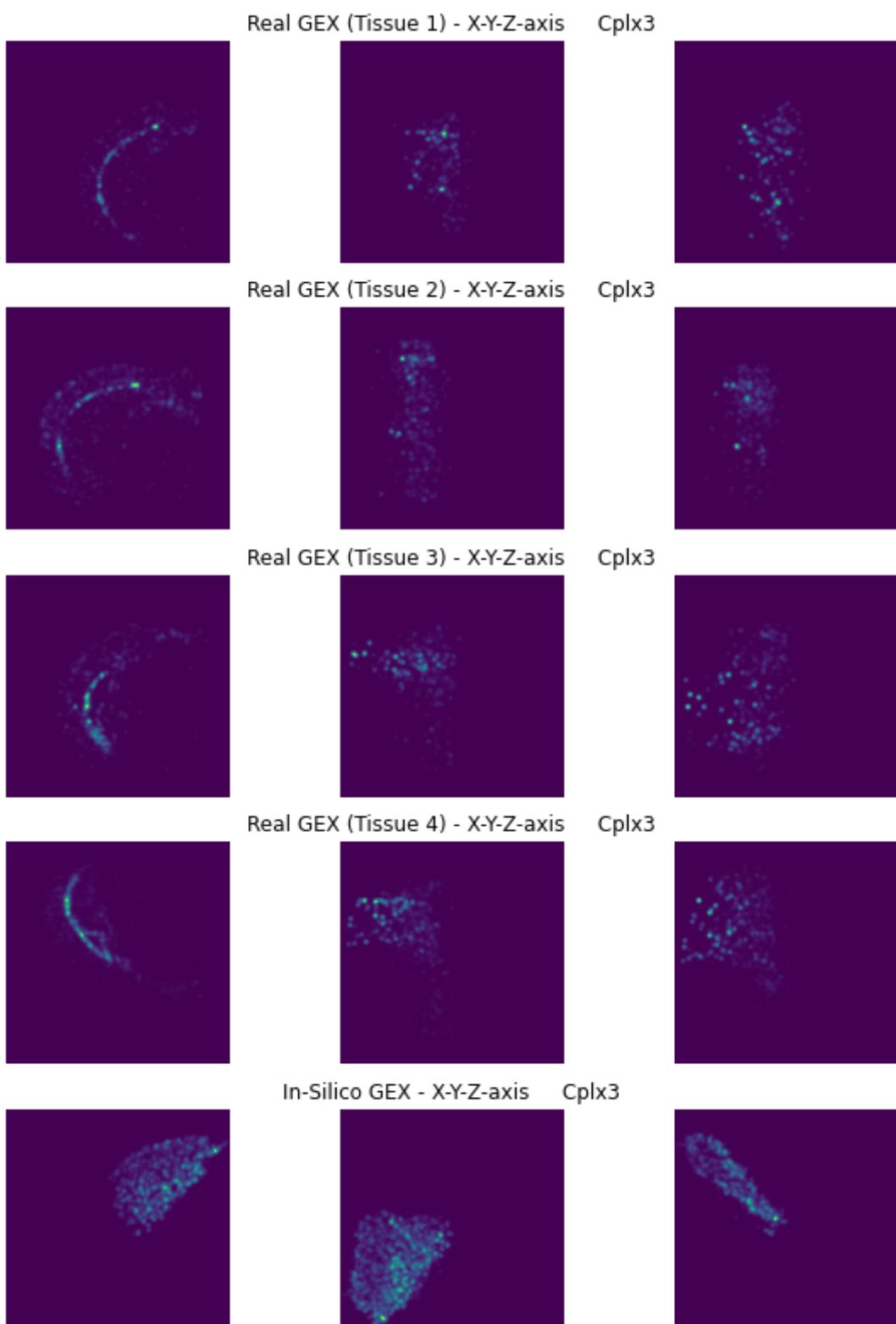
Real GEX Nrp1



Real GEX Tle4

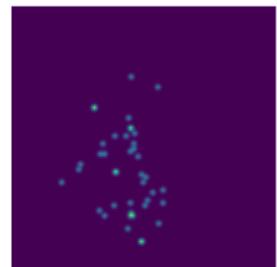
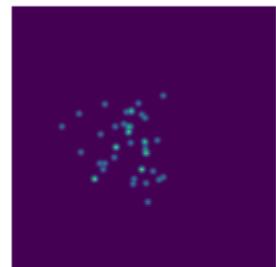
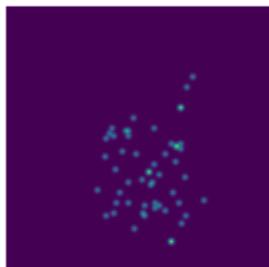


Real GEX Cplx3

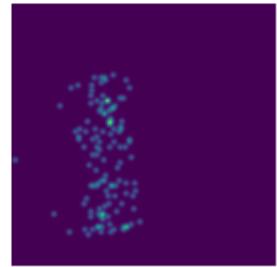
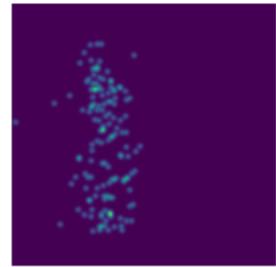
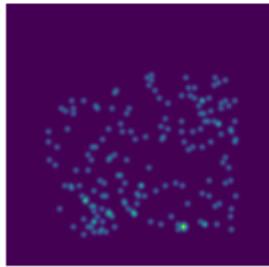


Real GEX Svil

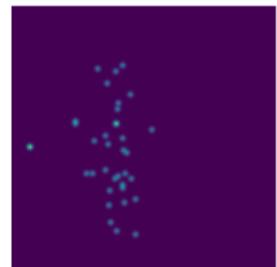
Real GEX (Tissue 1) - X-Y-Z-axis Svil



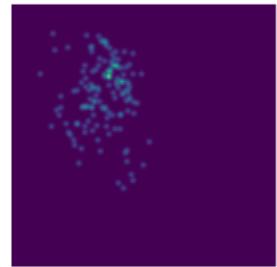
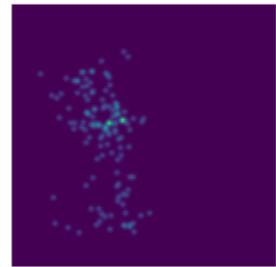
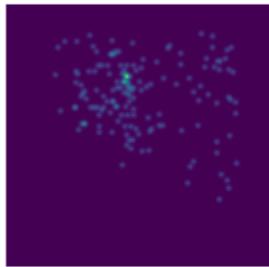
Real GEX (Tissue 2) - X-Y-Z-axis Svil



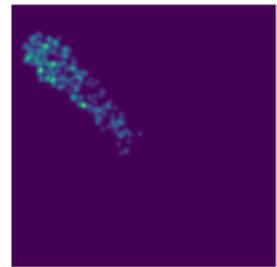
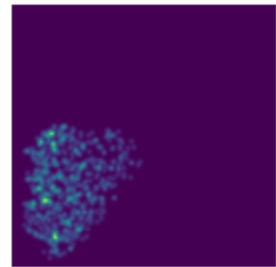
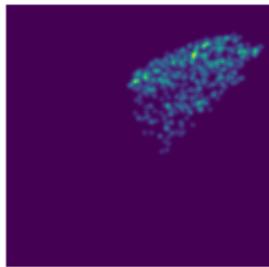
Real GEX (Tissue 3) - X-Y-Z-axis Svil



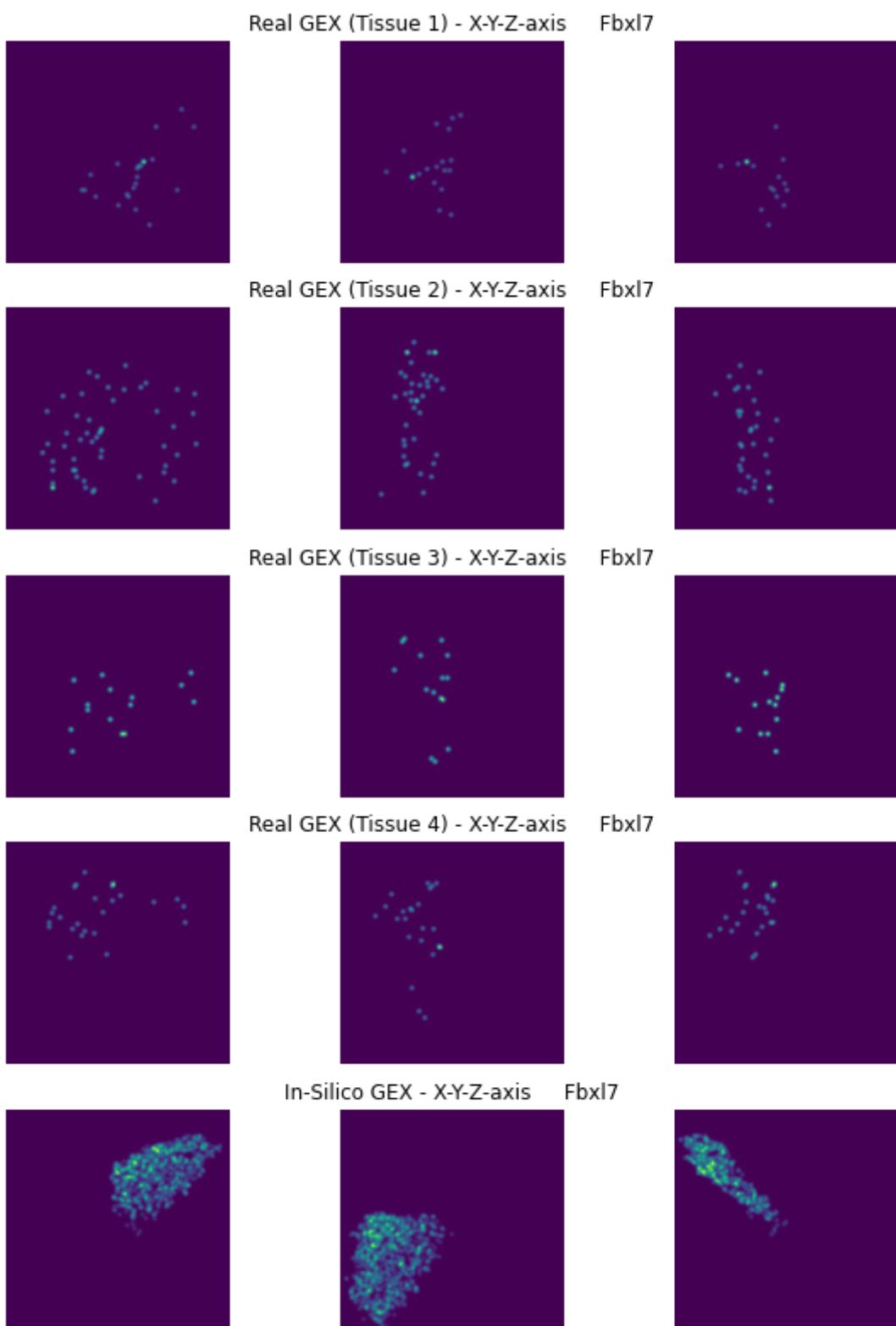
Real GEX (Tissue 4) - X-Y-Z-axis Svil



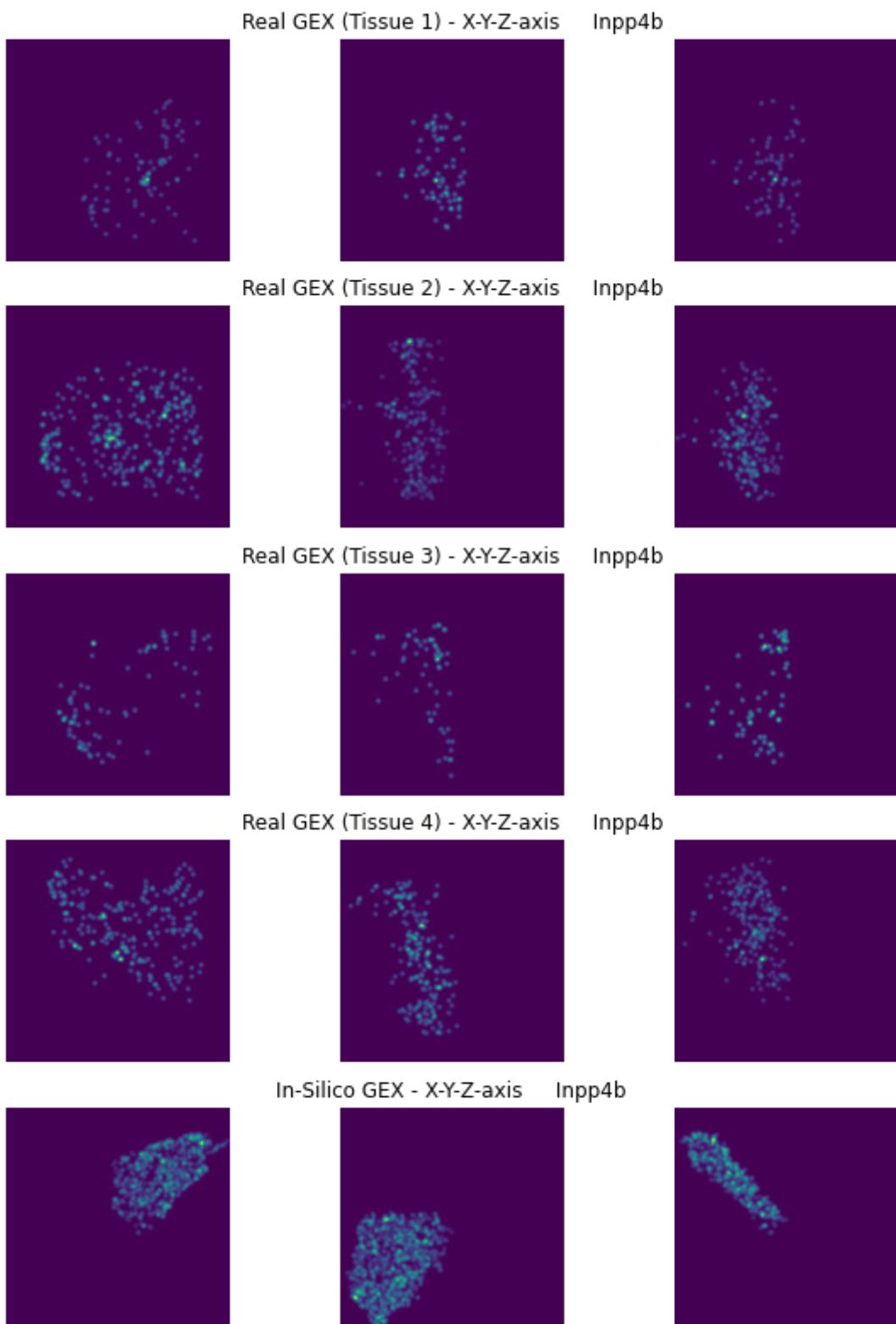
In-Silico GEX - X-Y-Z-axis Svil



Real GEX Fbxl7

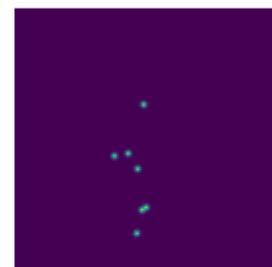
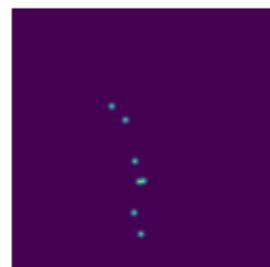
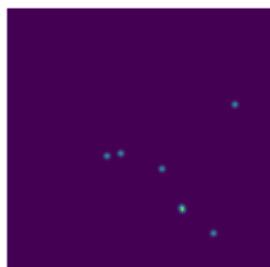


Real GEX Inpp4b

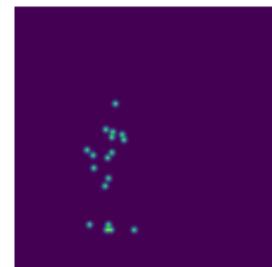
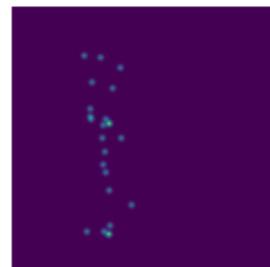
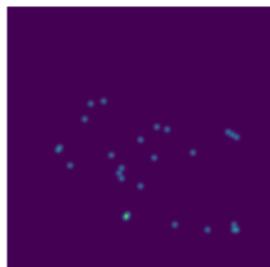


Real GEX Car3

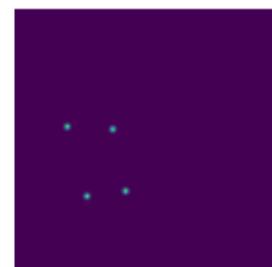
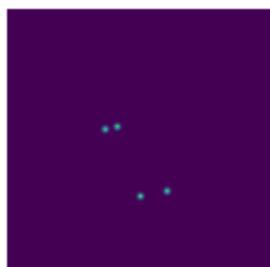
Real GEX (Tissue 1) - X-Y-Z-axis Car3



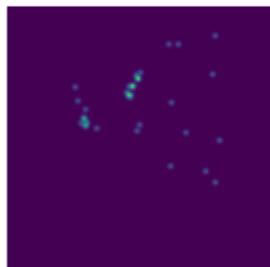
Real GEX (Tissue 2) - X-Y-Z-axis Car3



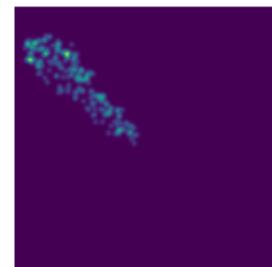
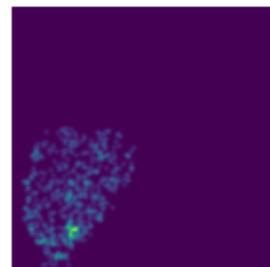
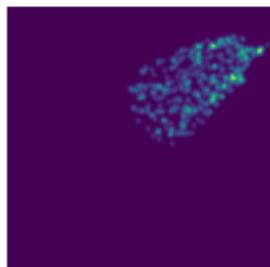
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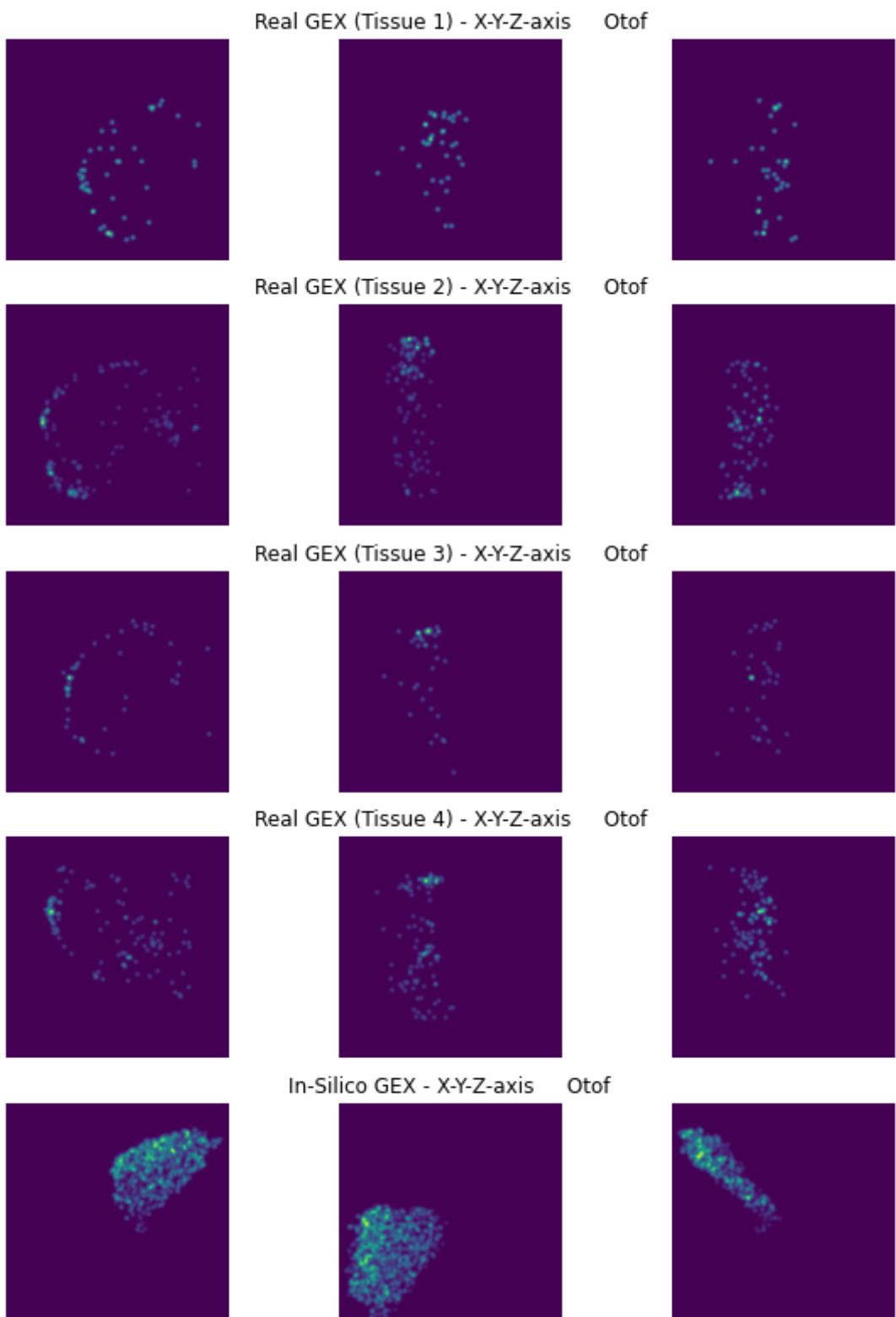
Real GEX (Tissue 4) - X-Y-Z-axis Car3



In-Silico GEX - X-Y-Z-axis Car3

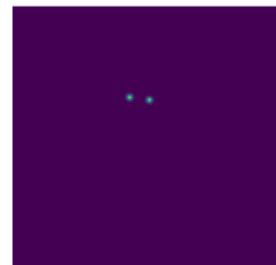
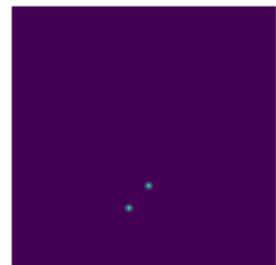


Real GEX Otof

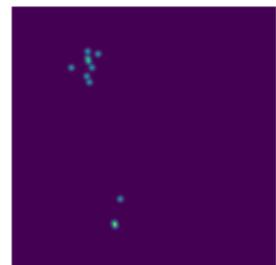
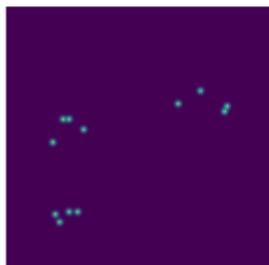


Real GEX Hgf

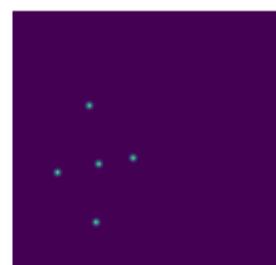
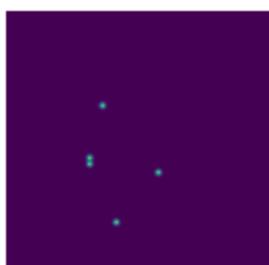
Real GEX (Tissue 1) - X-Y-Z-axis Hgf



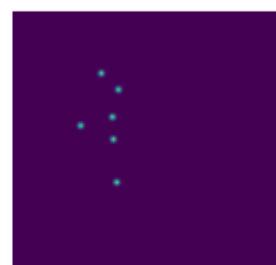
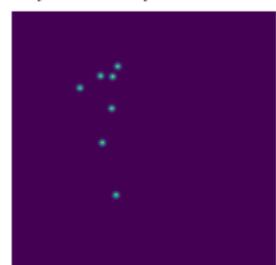
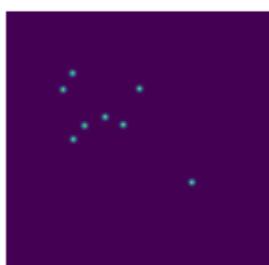
Real GEX (Tissue 2) - X-Y-Z-axis Hgf



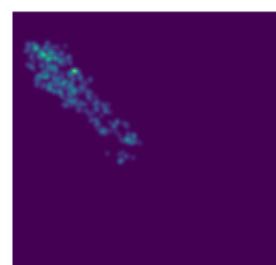
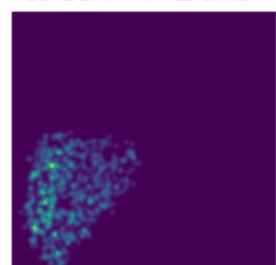
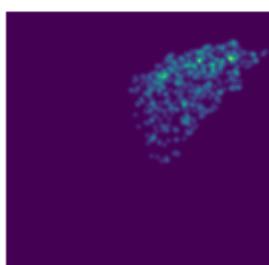
Real GEX (Tissue 3) - X-Y-Z-axis Hgf



Real GEX (Tissue 4) - X-Y-Z-axis Hgf

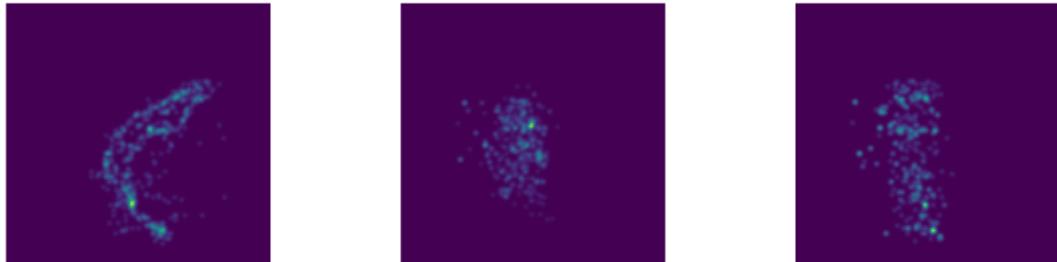


In-Silico GEX - X-Y-Z-axis Hgf

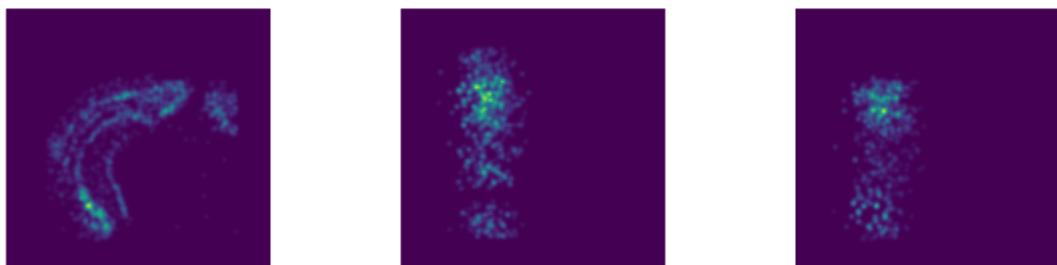


Real GEX Fezf2

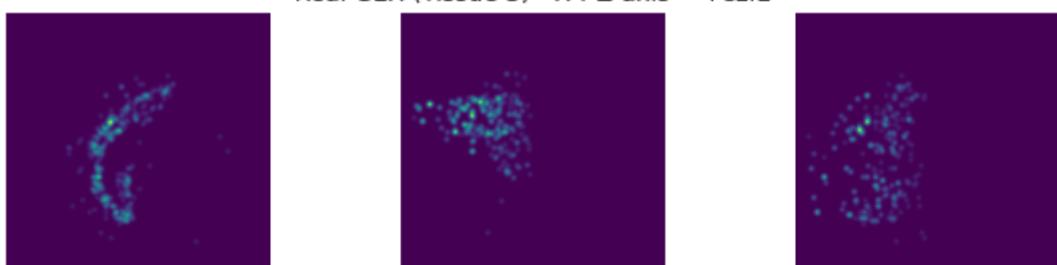
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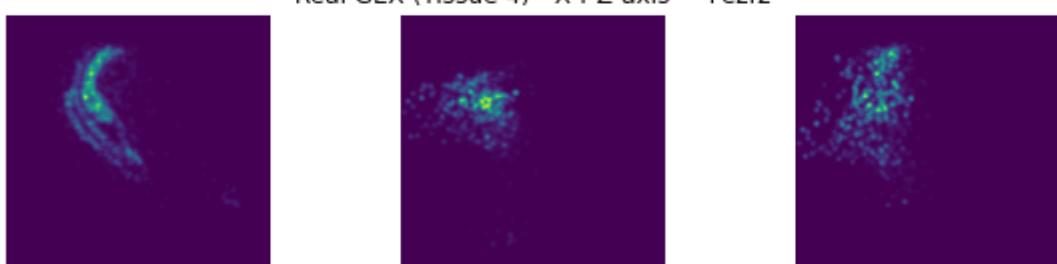
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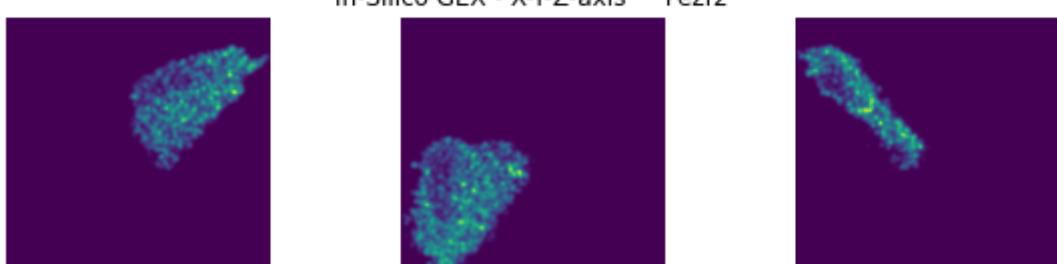
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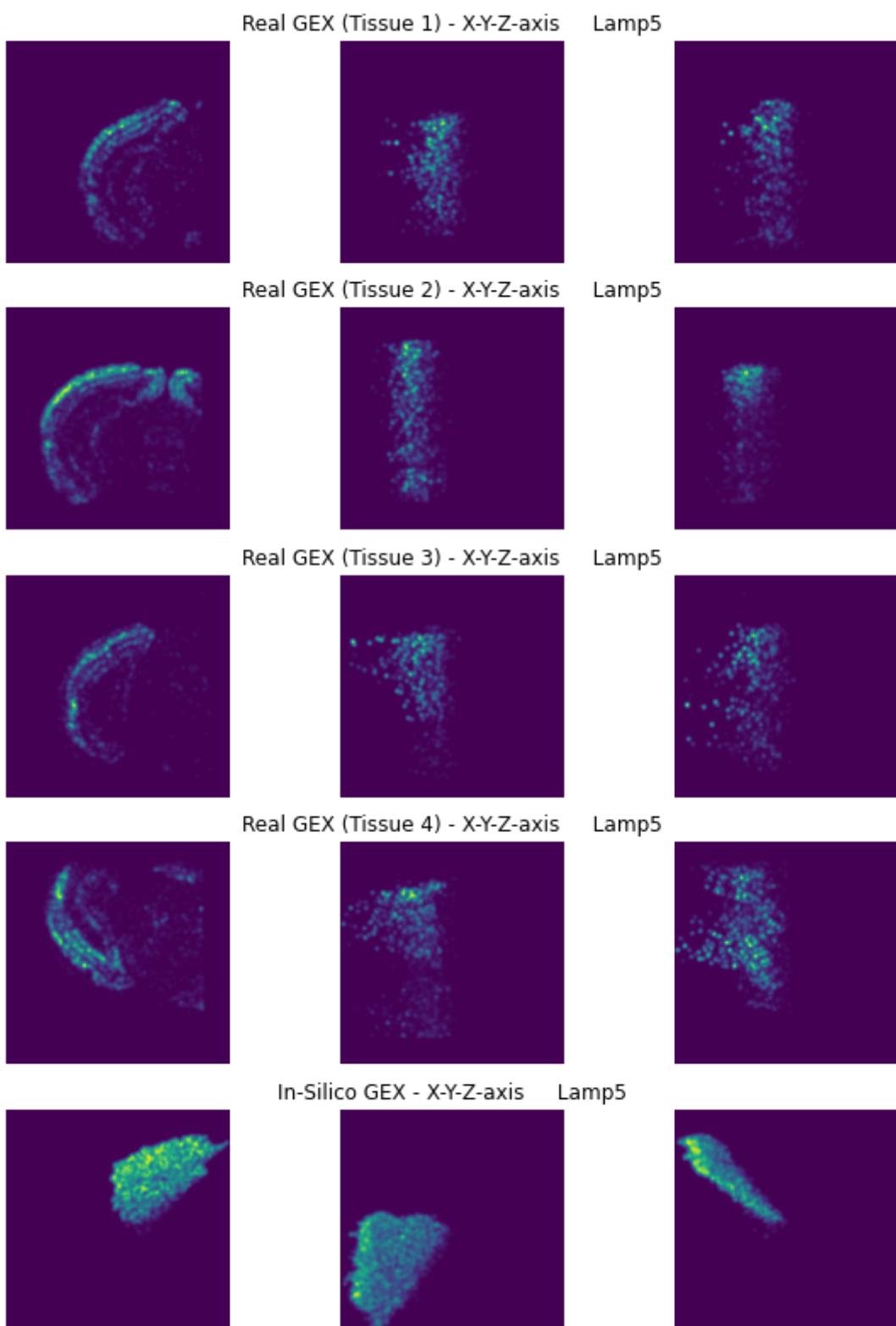
Real GEX (Tissue 4) - X-Y-Z-axis Fezf2



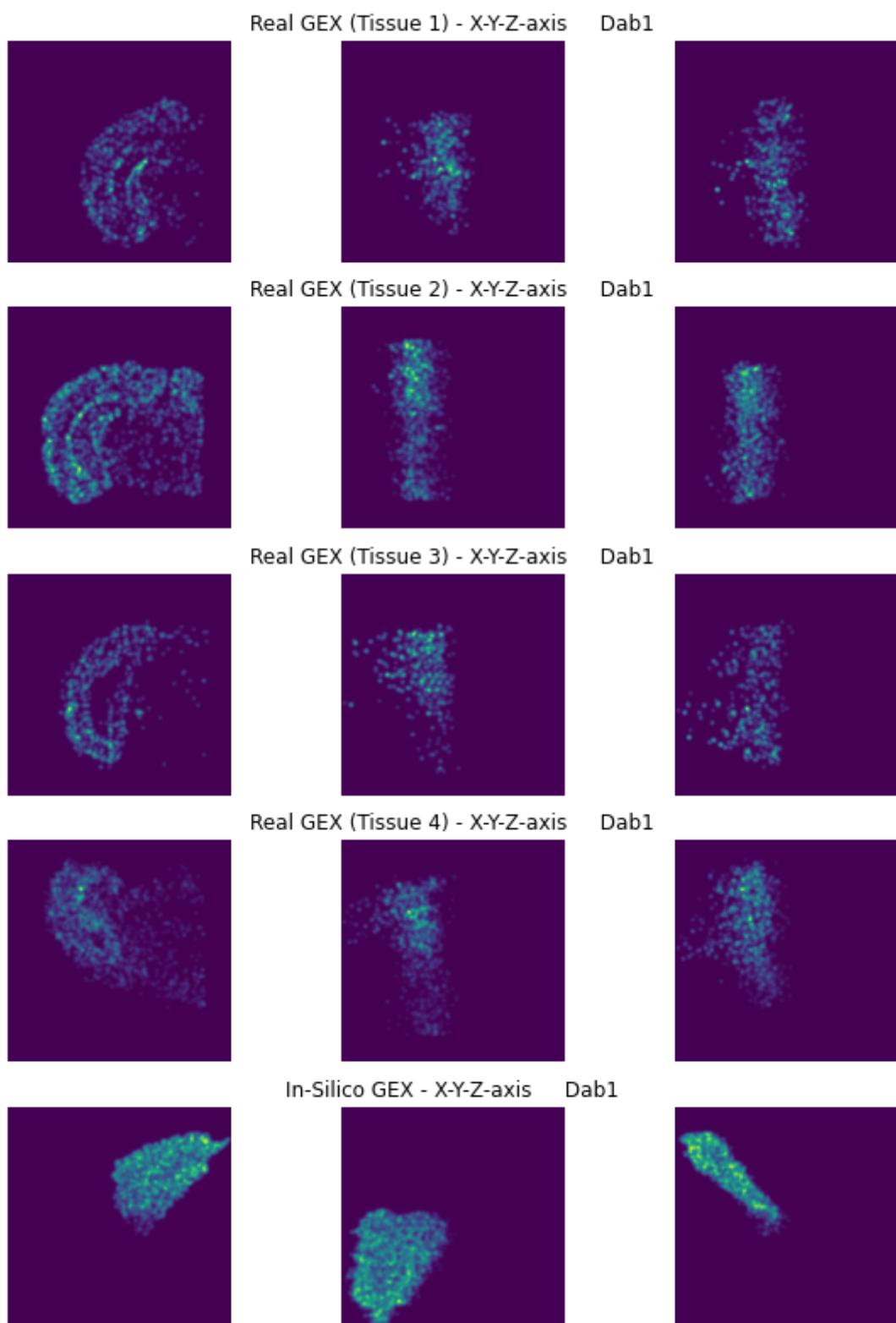
In-Silico GEX - X-Y-Z-axis Fezf2



Real GEX Lamp5

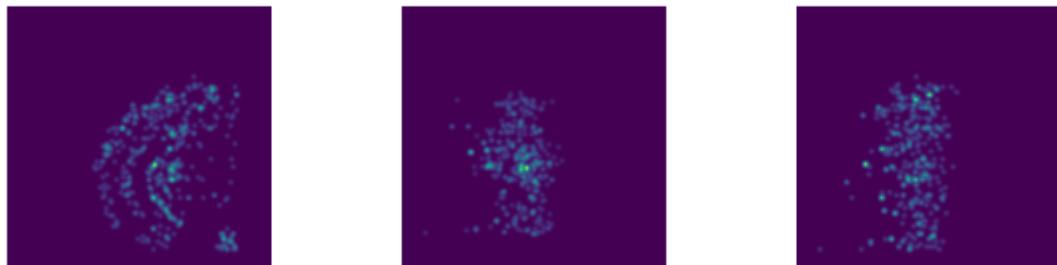


Real GEX Dab1

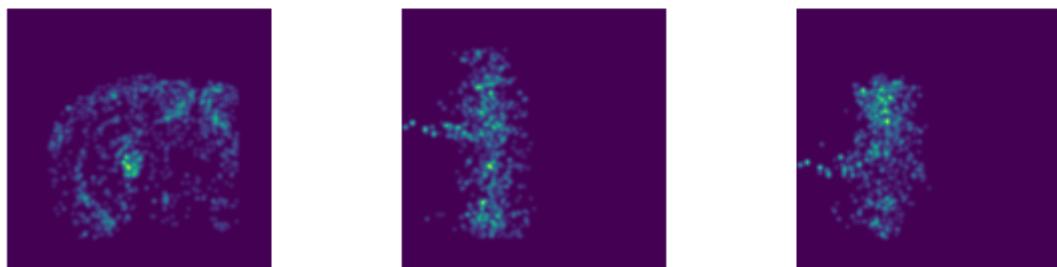


Real GEX Zmat4

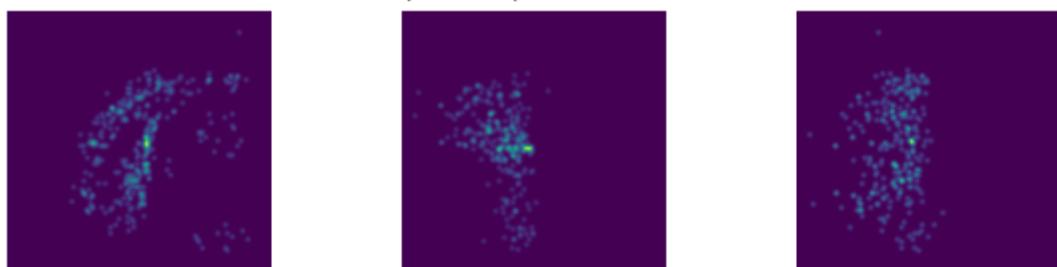
Real GEX (Tissue 1) - X-Y-Z-axis Zmat4



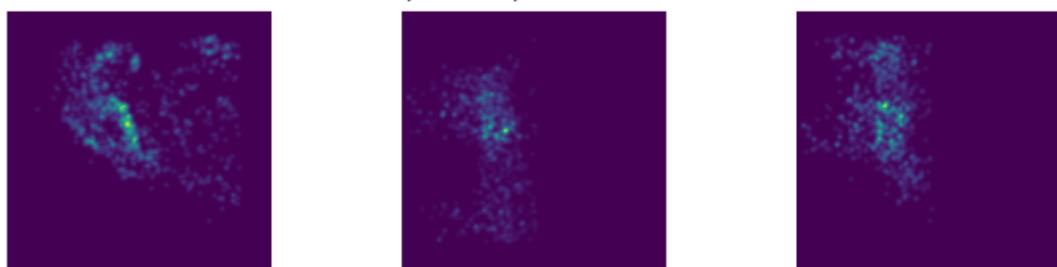
Real GEX (Tissue 2) - X-Y-Z-axis Zmat4



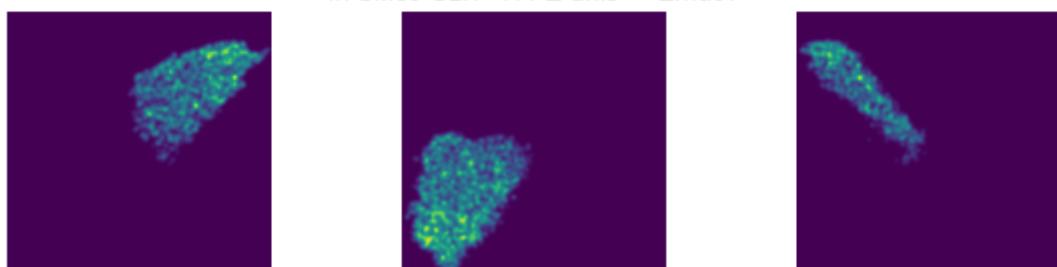
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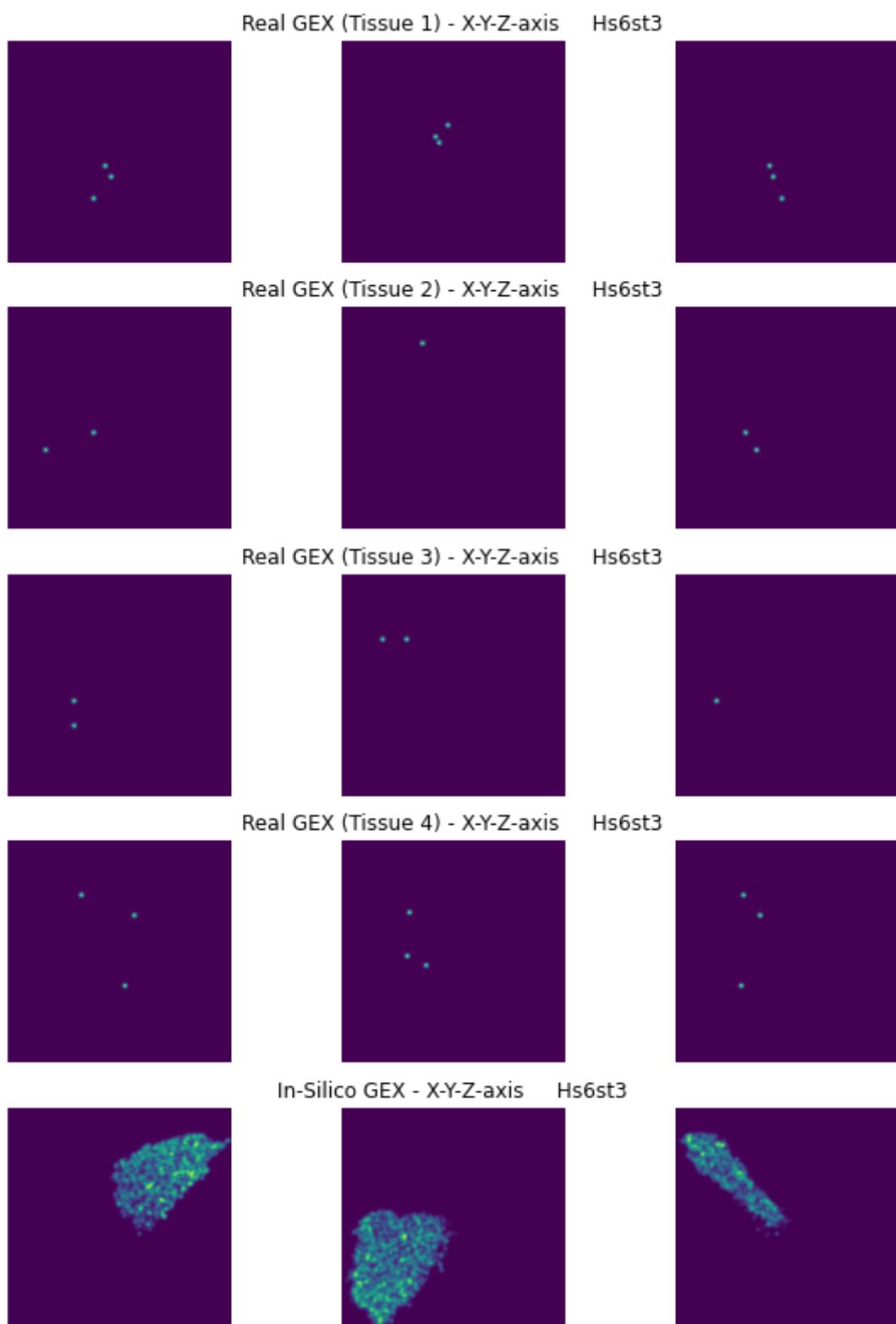
Real GEX (Tissue 4) - X-Y-Z-axis Zmat4



In-Silico GEX - X-Y-Z-axis Zmat4

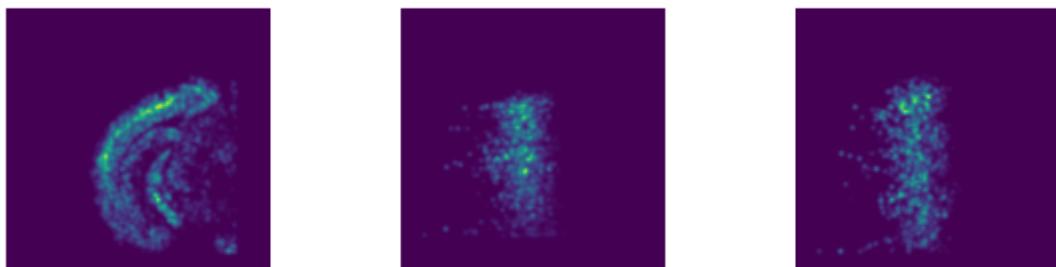


Real GEX Hs6st3

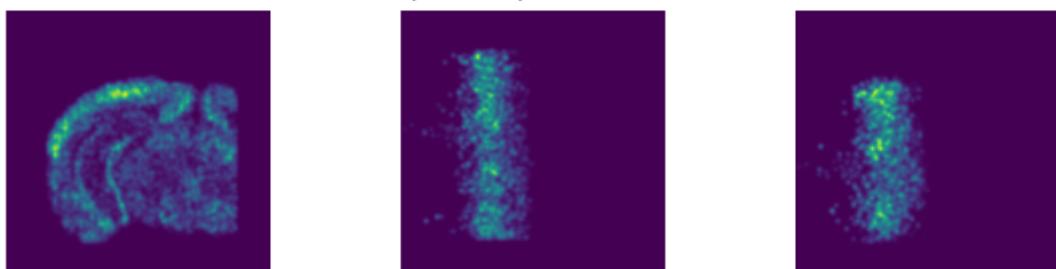


Real GEX Nrsn1

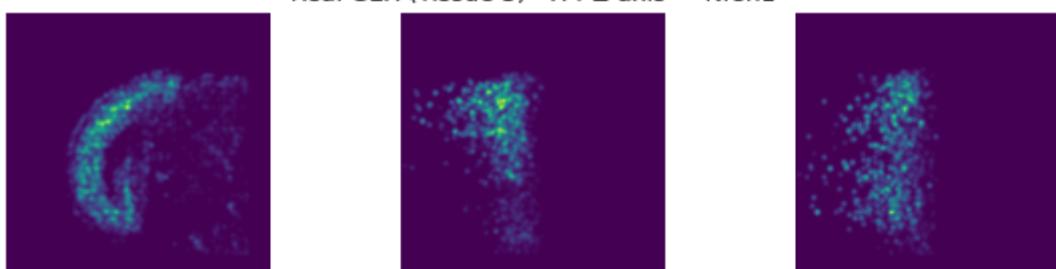
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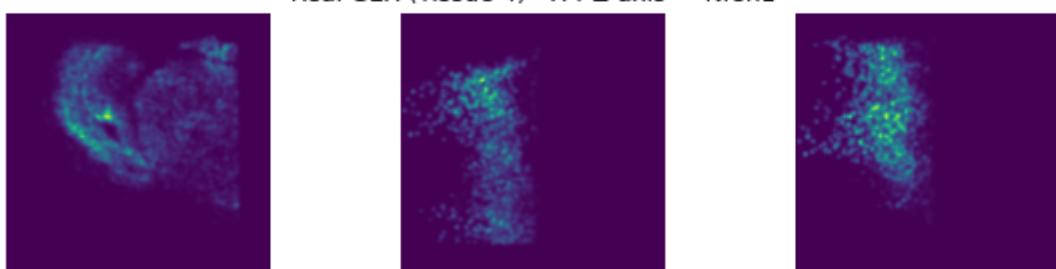
Real GEX (Tissue 2) - X-Y-Z-axis Nrsn1



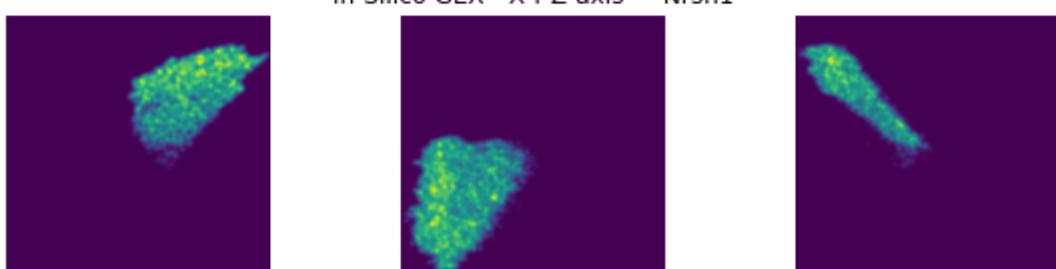
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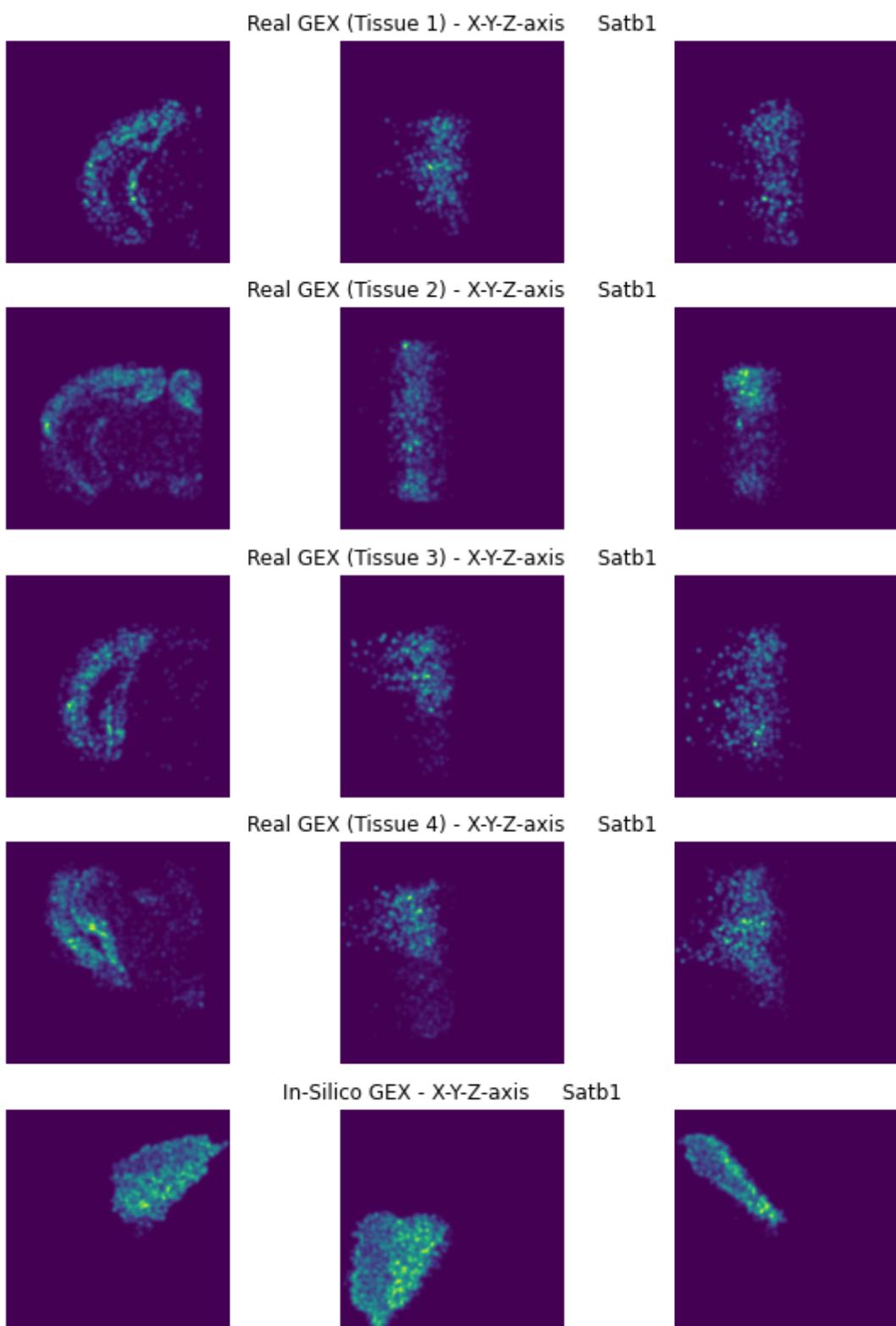
Real GEX (Tissue 4) - X-Y-Z-axis Nrsn1



In-Silico GEX - X-Y-Z-axis Nrsn1

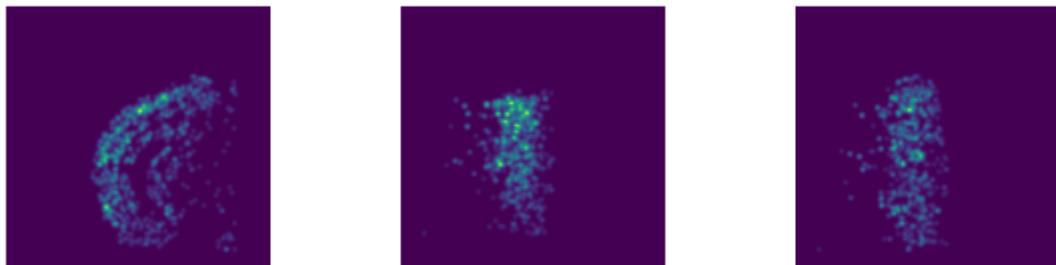


Real GEX Satb1

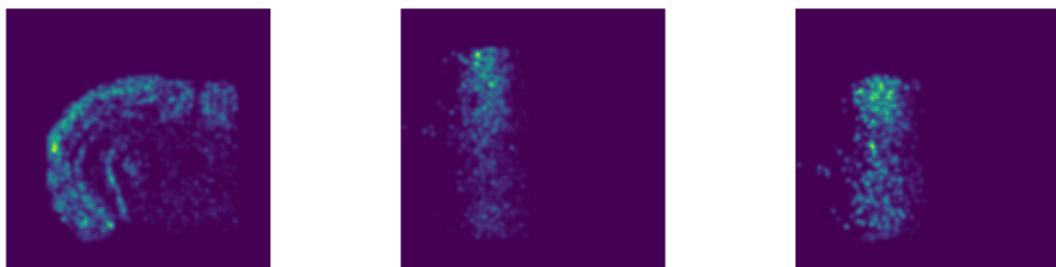


Real GEX Camk4

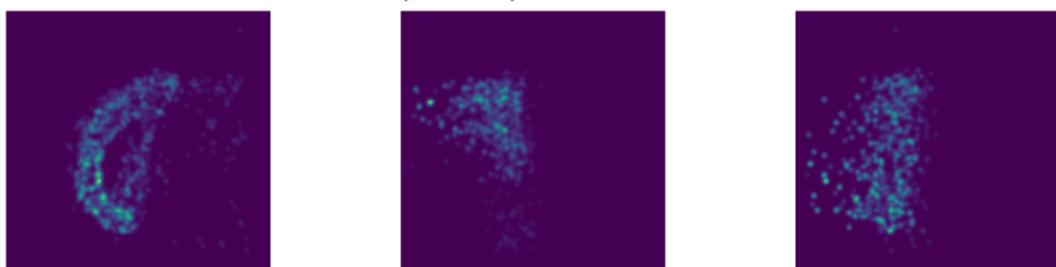
Real GEX (Tissue 1) - X-Y-Z-axis Camk4



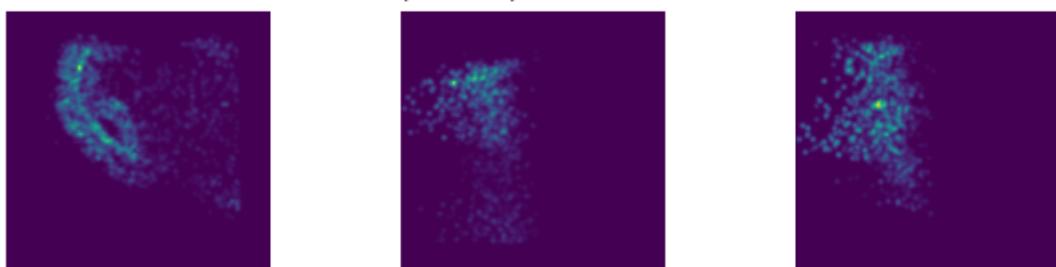
Real GEX (Tissue 2) - X-Y-Z-axis Camk4



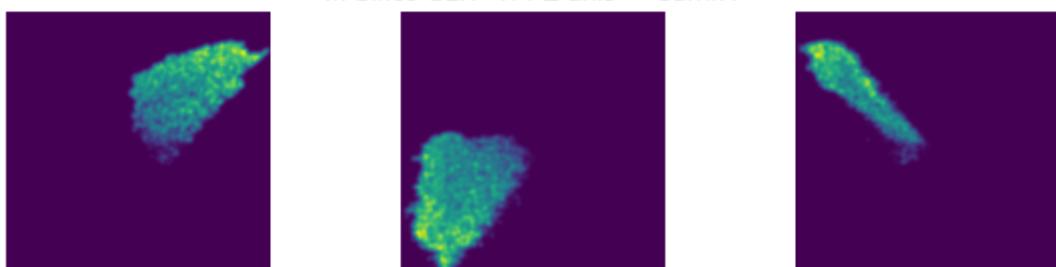
Real GEX (Tissue 3) - X-Y-Z-axis Camk4



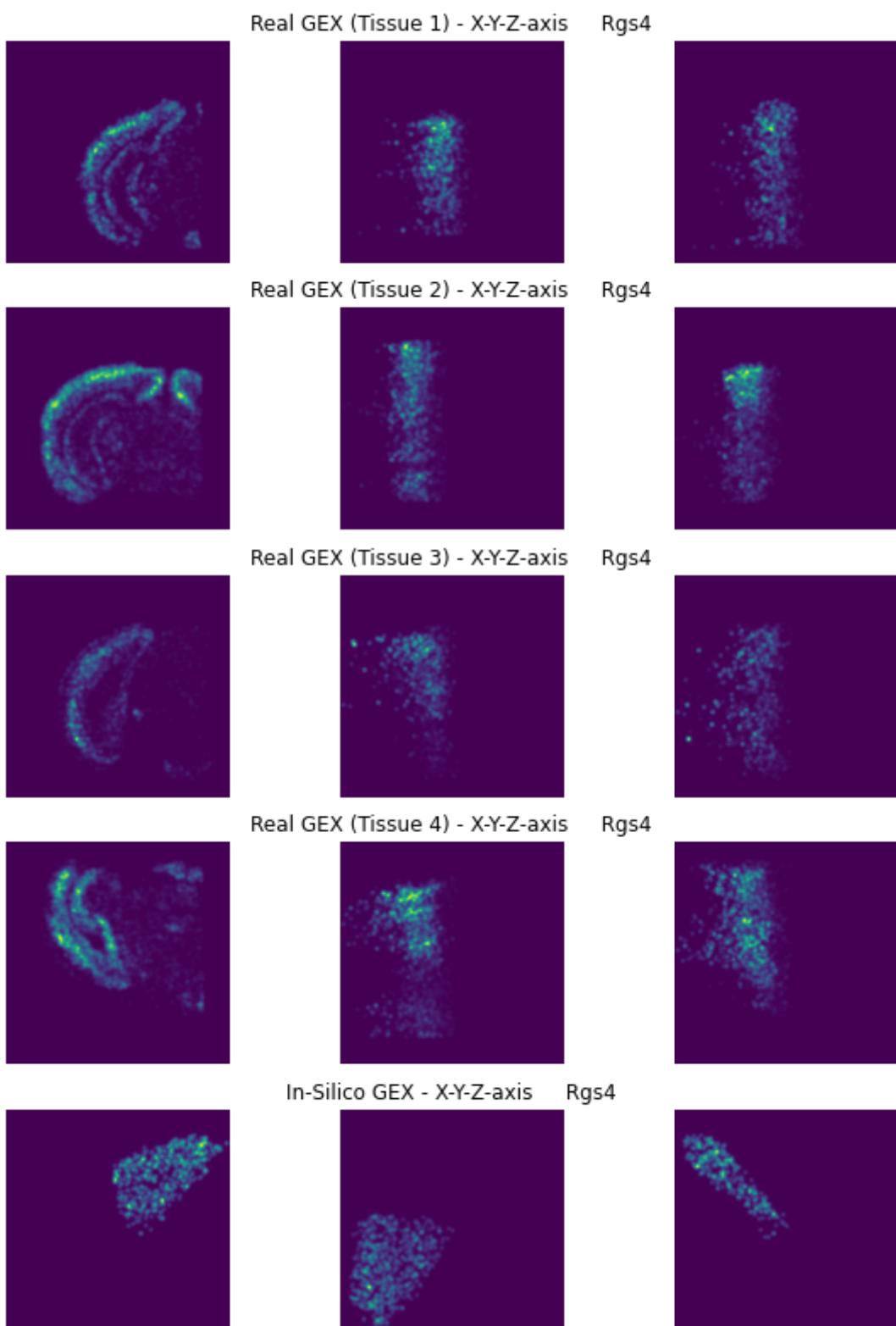
Real GEX (Tissue 4) - X-Y-Z-axis Camk4



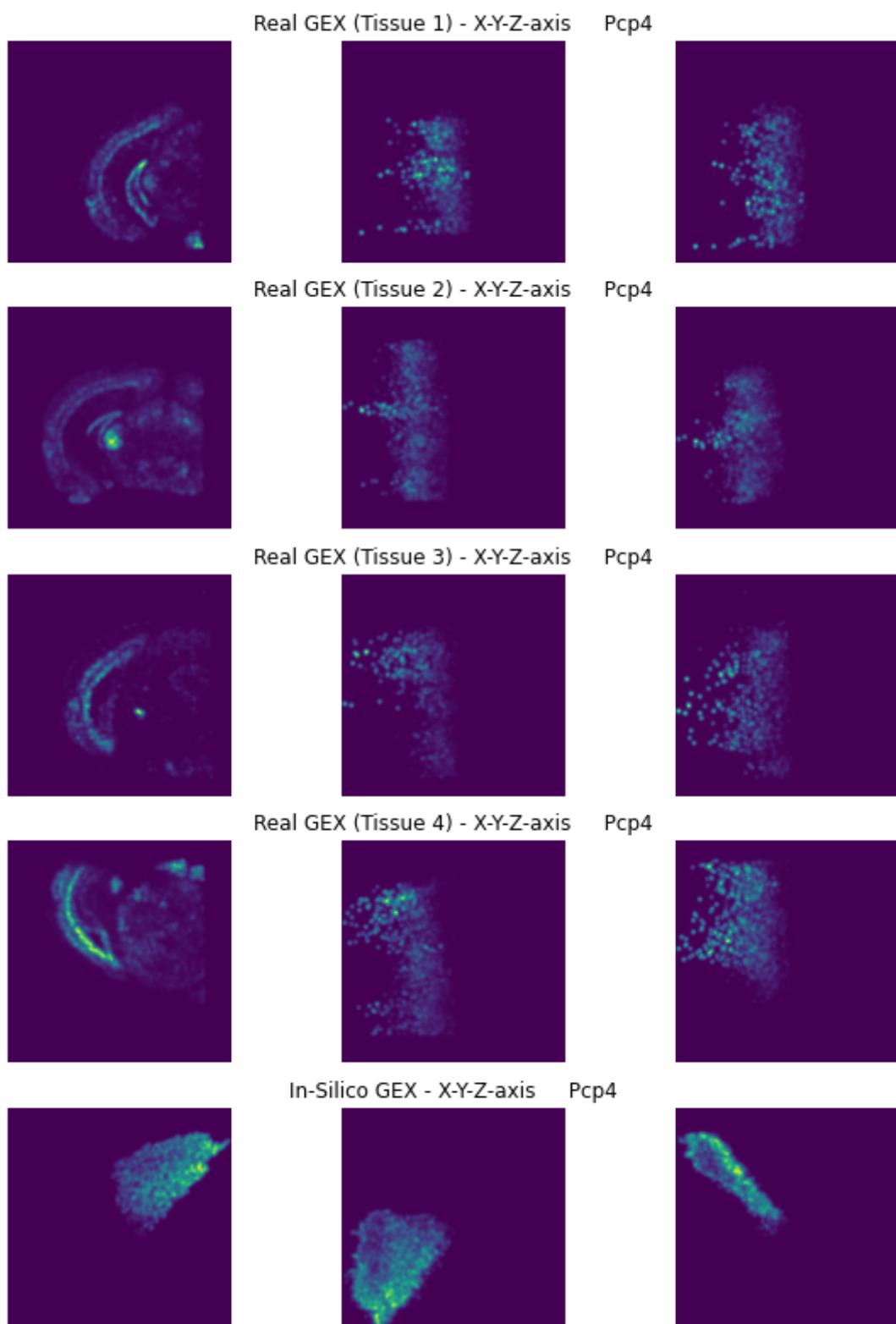
In-Silico GEX - X-Y-Z-axis Camk4



Real GEX Rgs4

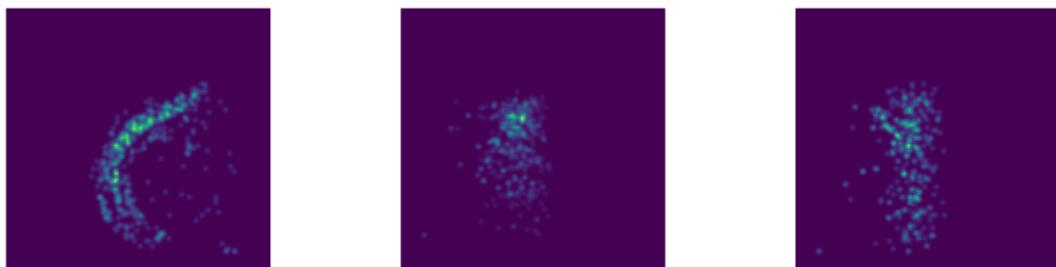


Real GEX Pcp4

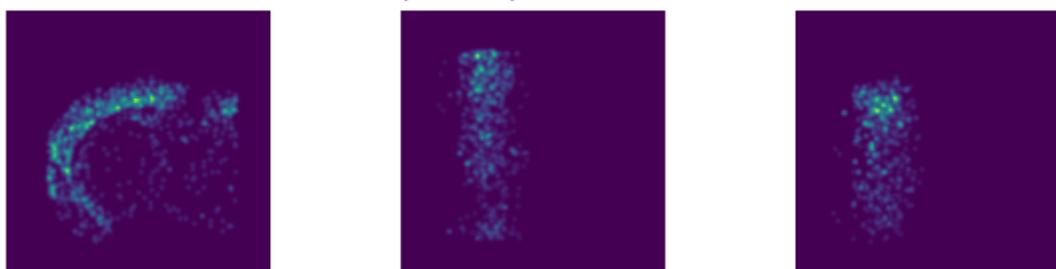


Real GEX Hs3st2

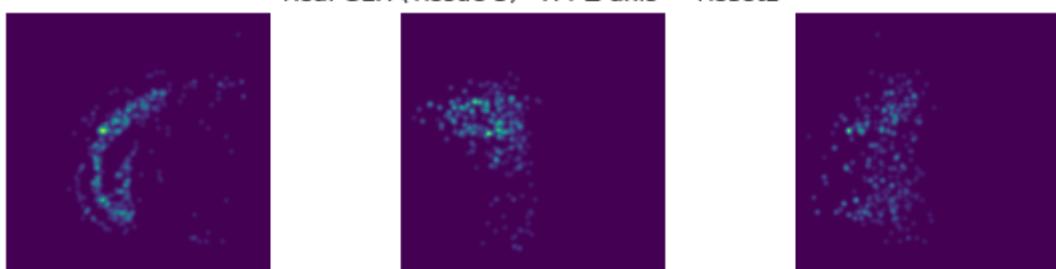
Real GEX (Tissue 1) - X-Y-Z-axis Hs3st2



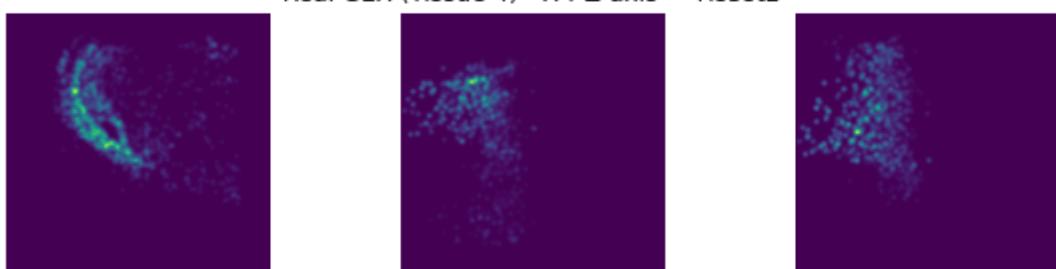
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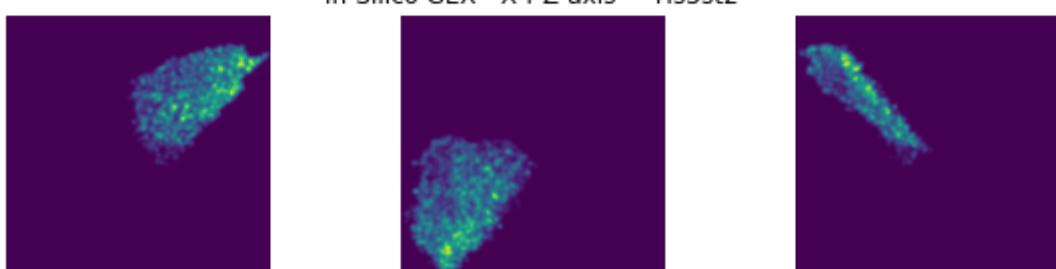
Real GEX (Tissue 3) - X-Y-Z-axis Hs3st2



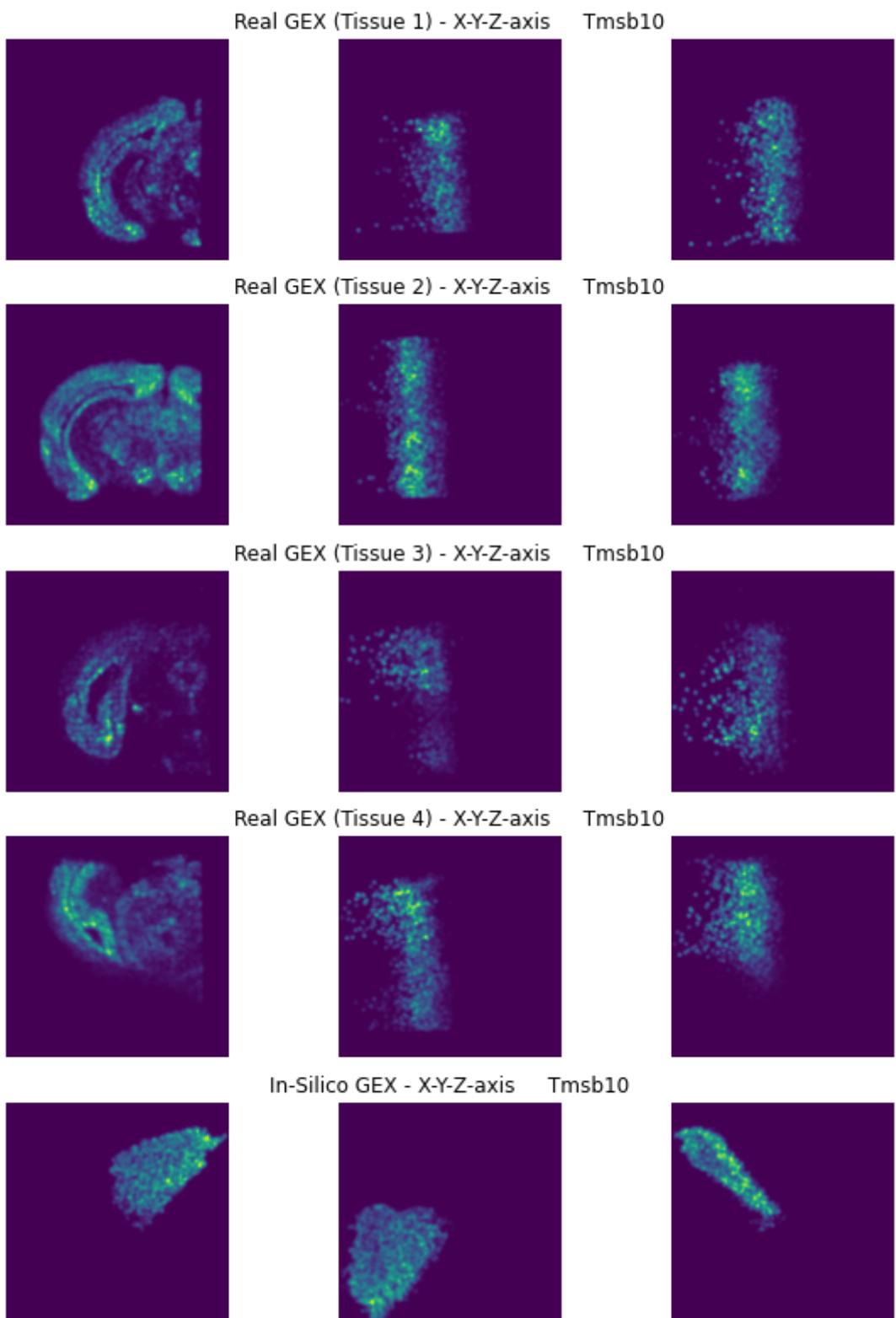
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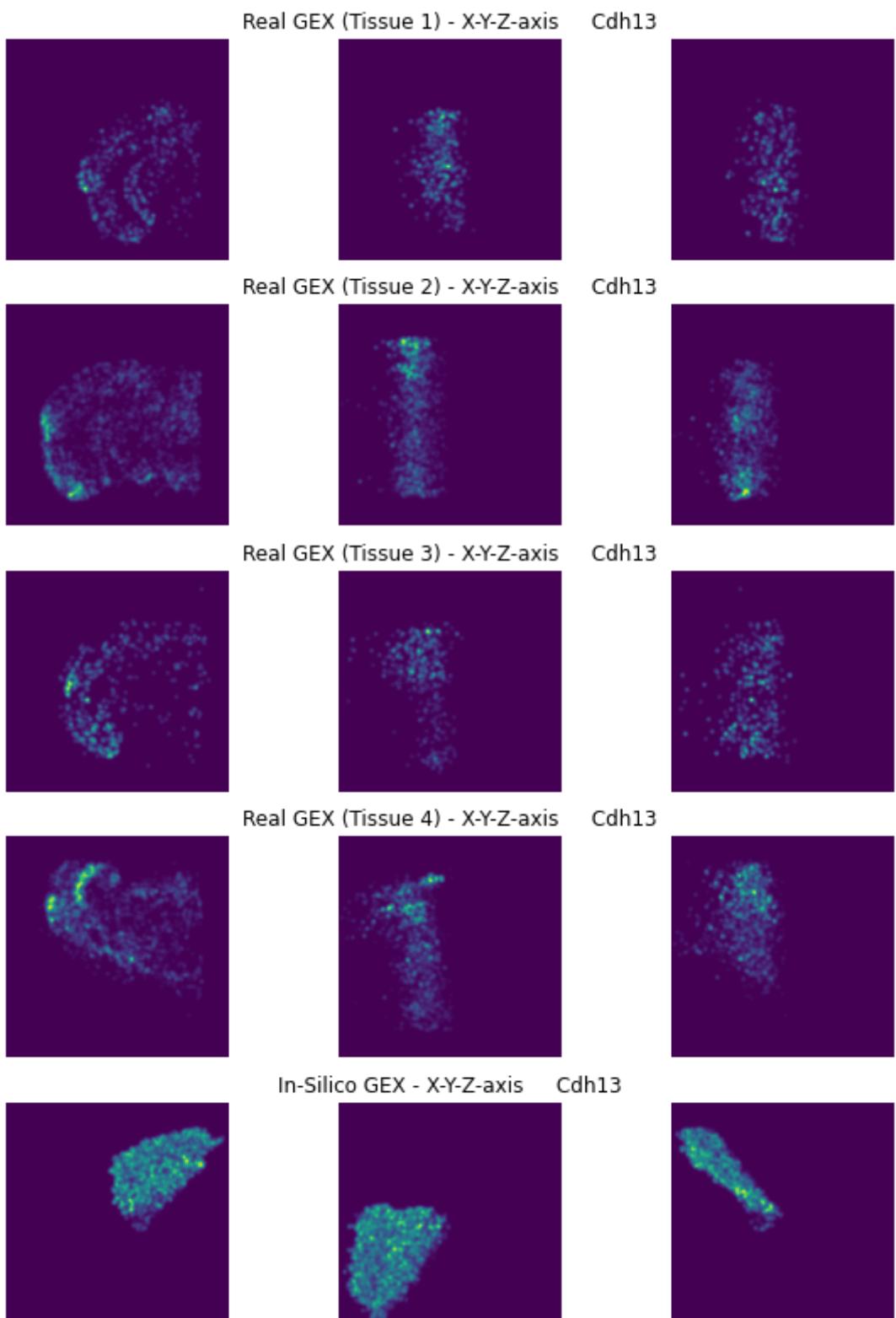
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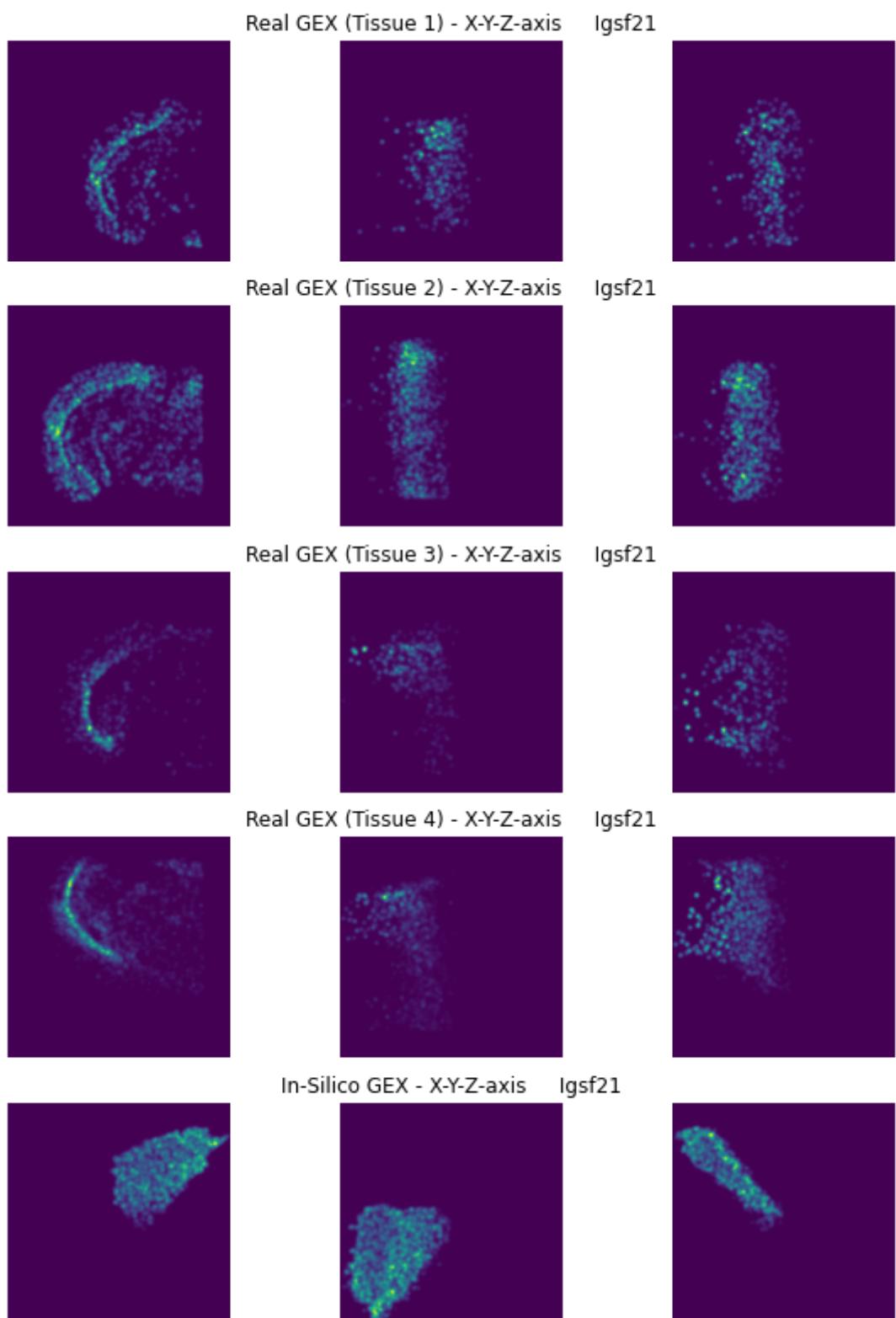
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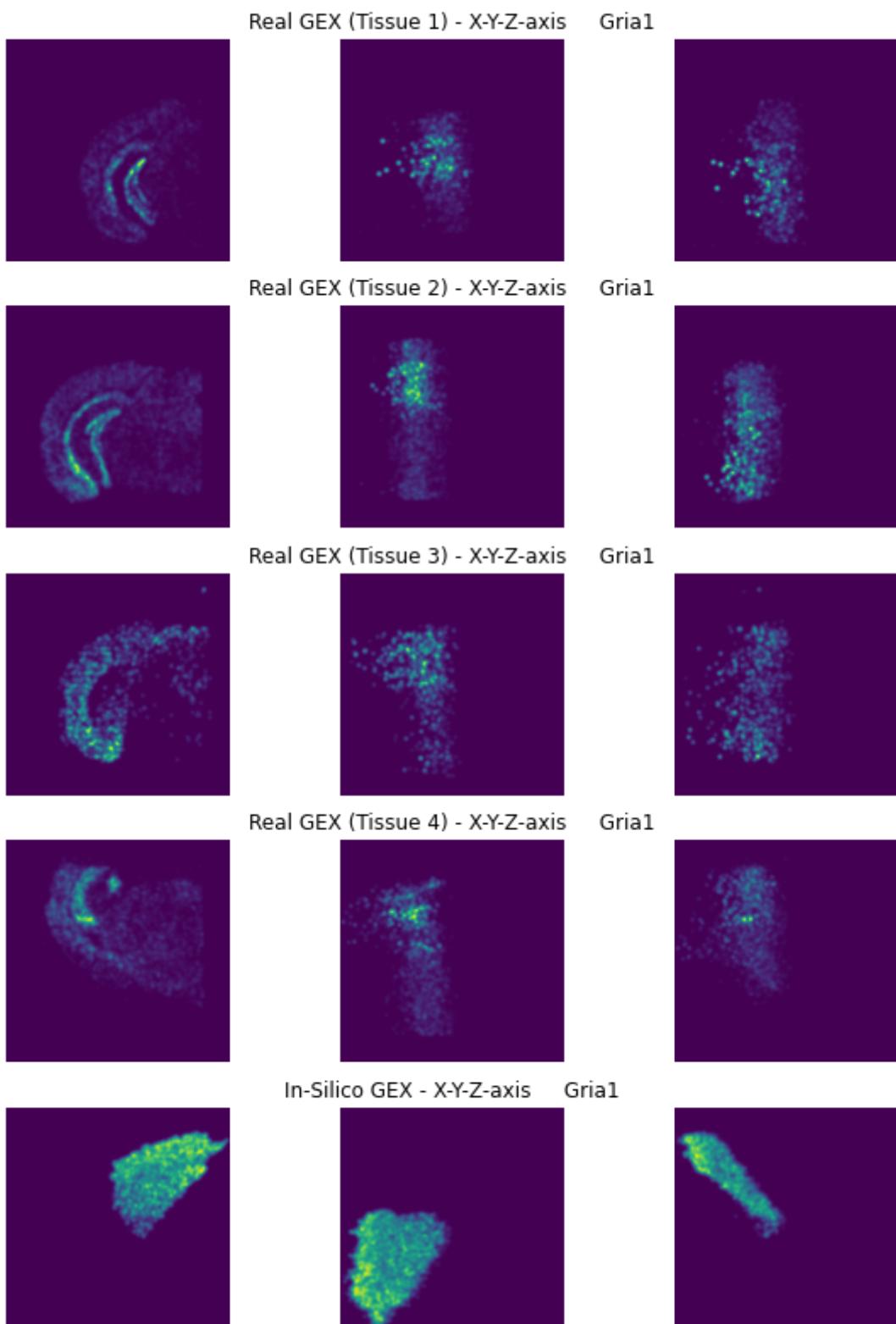
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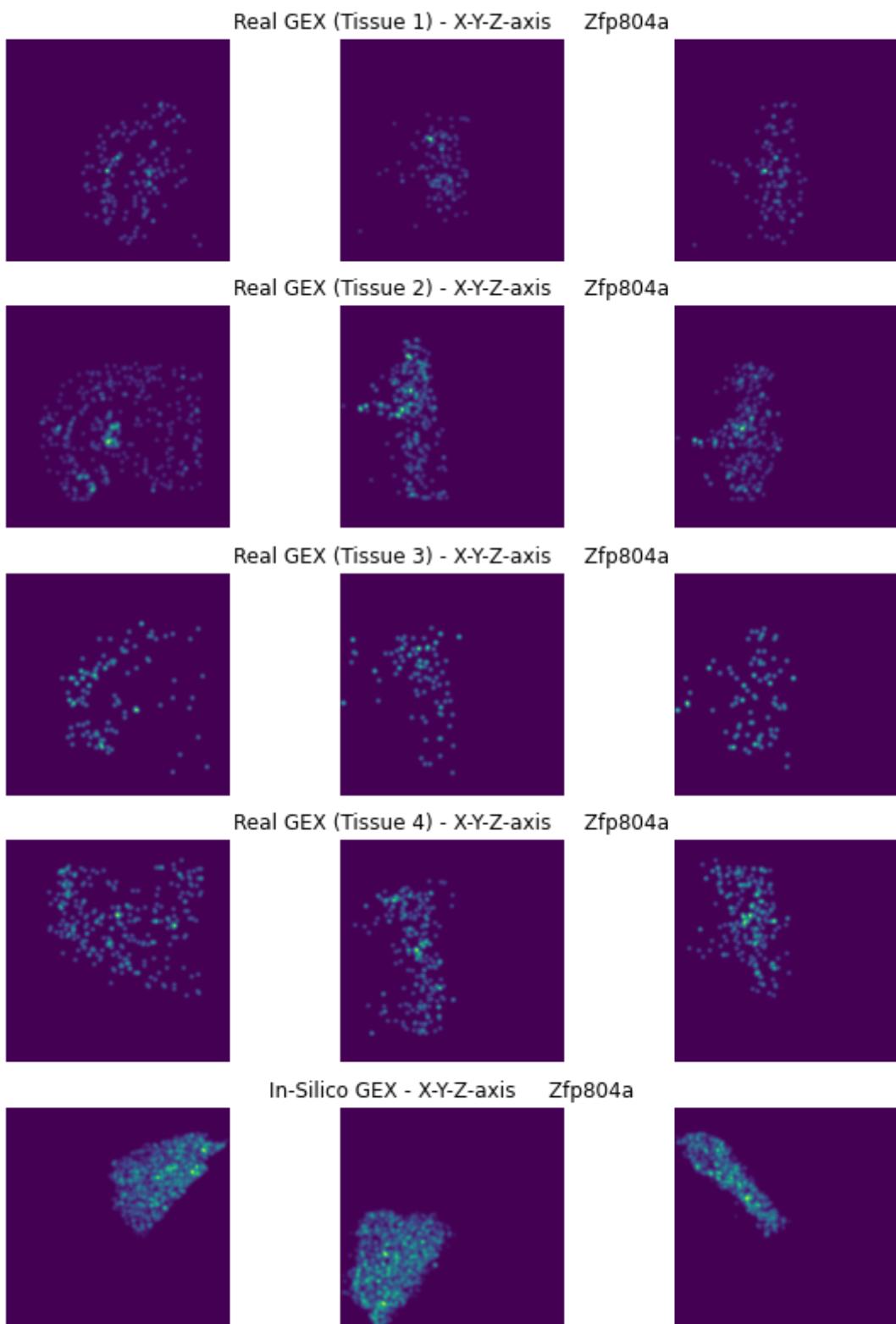
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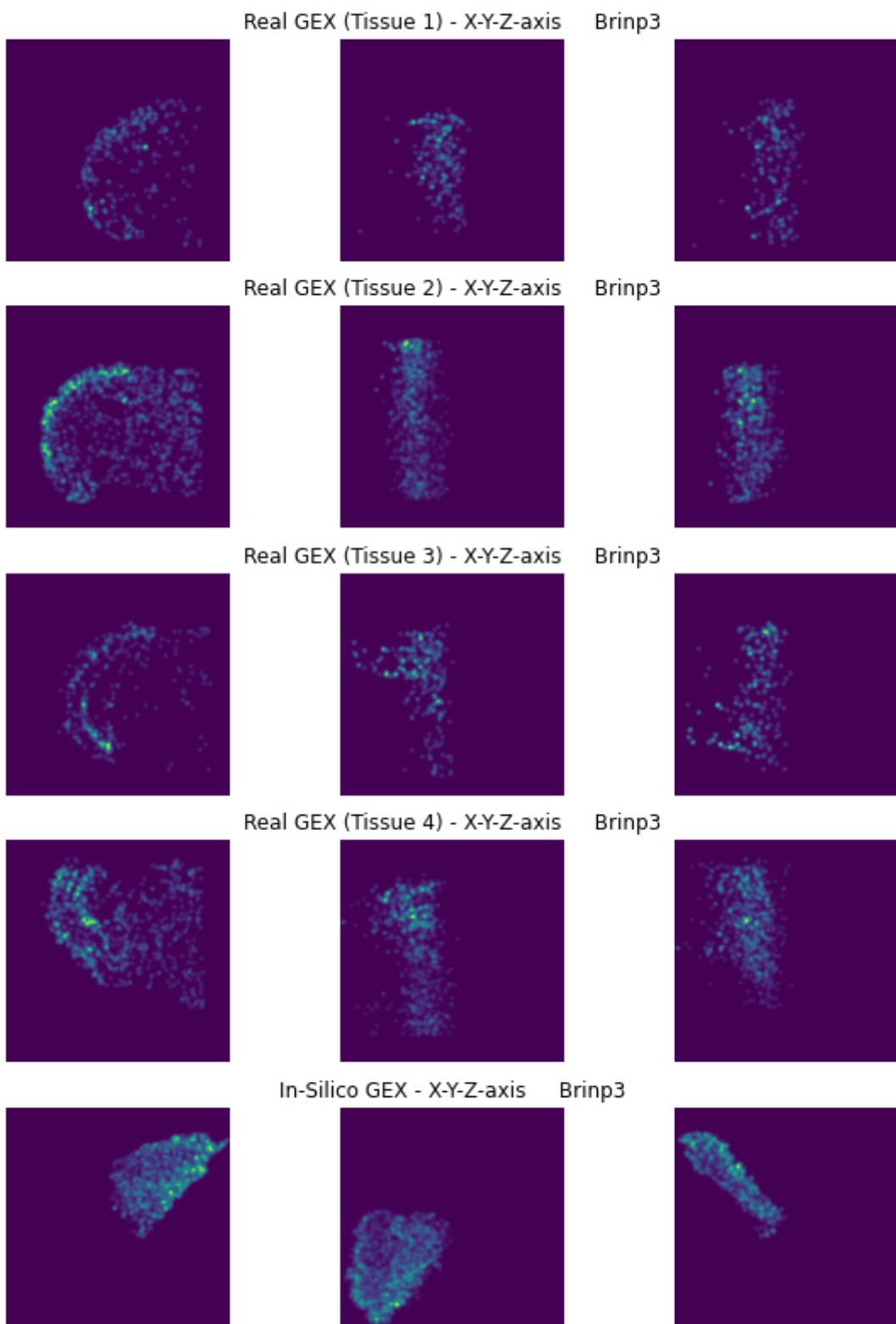
Real GEX Grial1



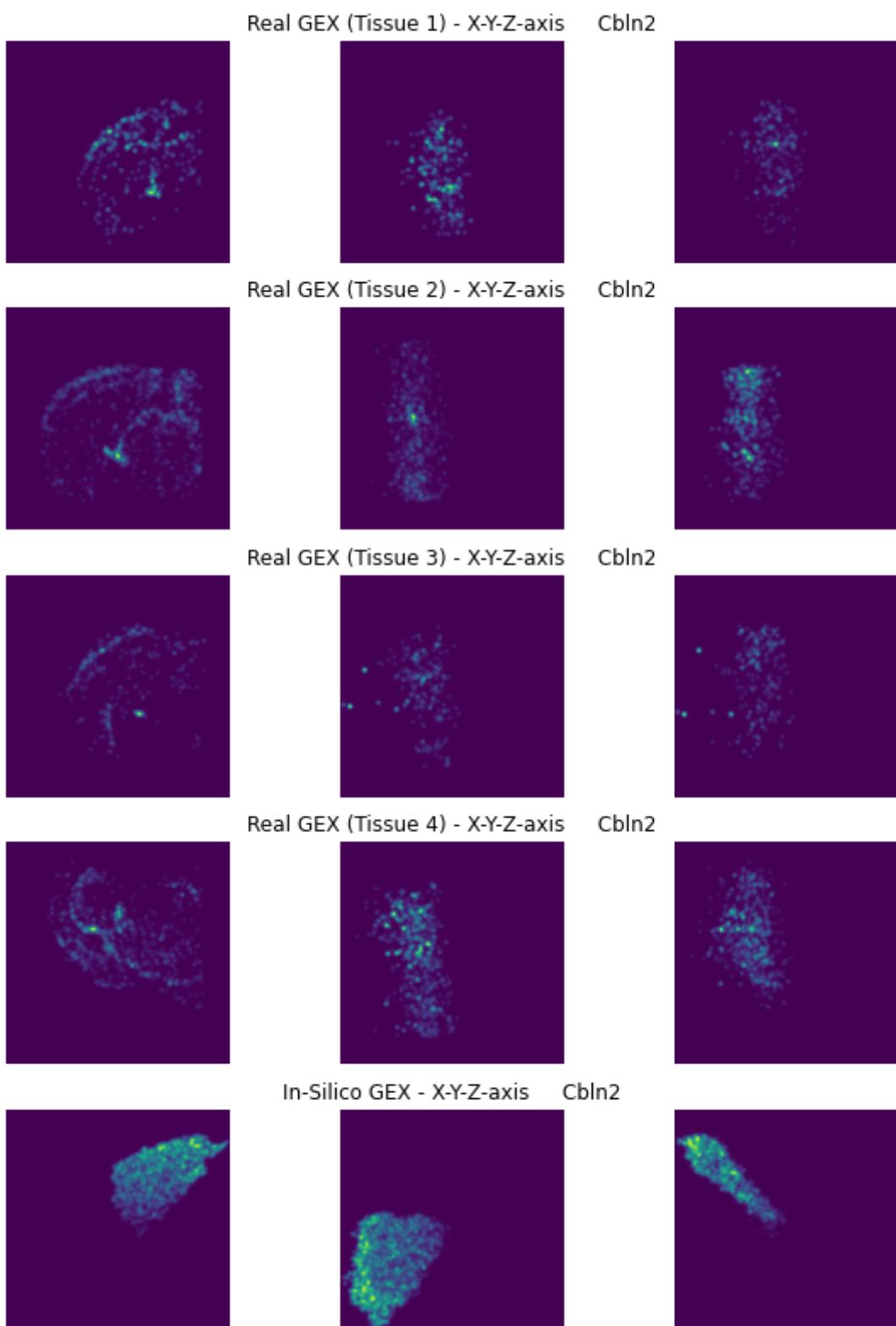
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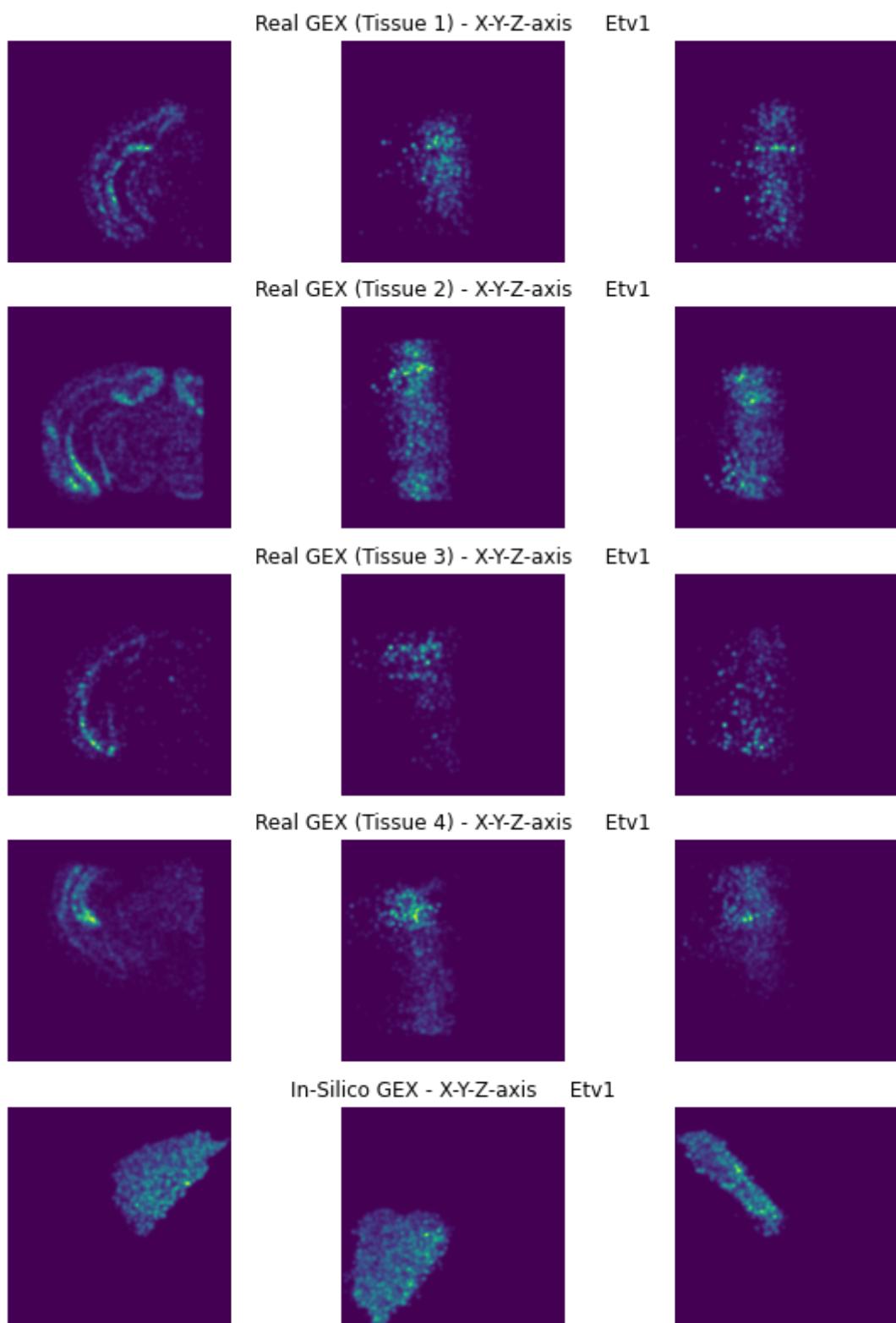
Real GEX Brinp3



Real GEX Cbln2

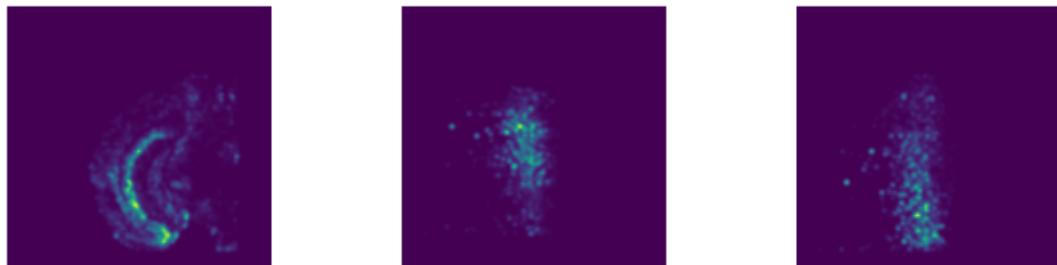


Real GEX Etv1

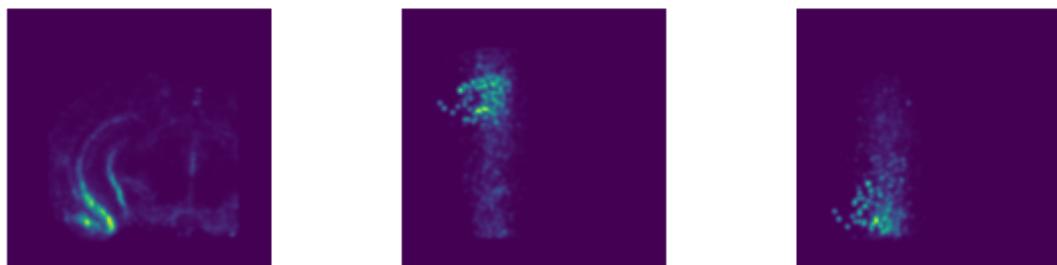


Real GEX Nnat

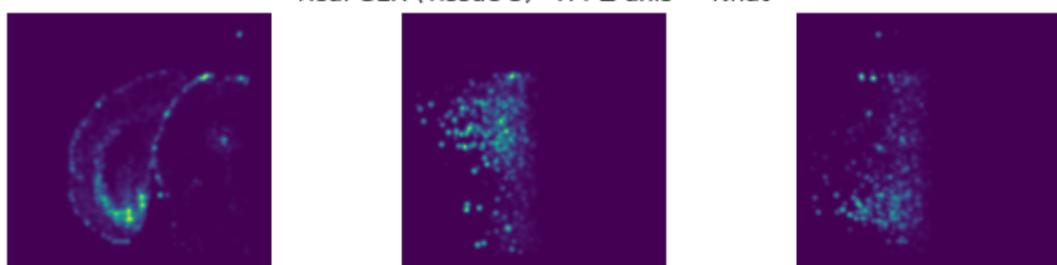
Real GEX (Tissue 1) - X-Y-Z-axis Nnat



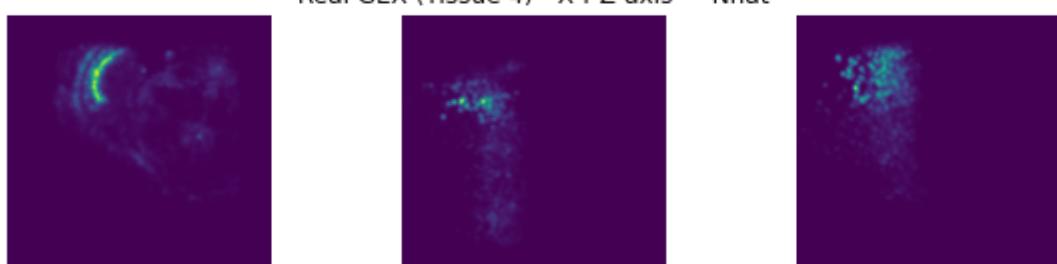
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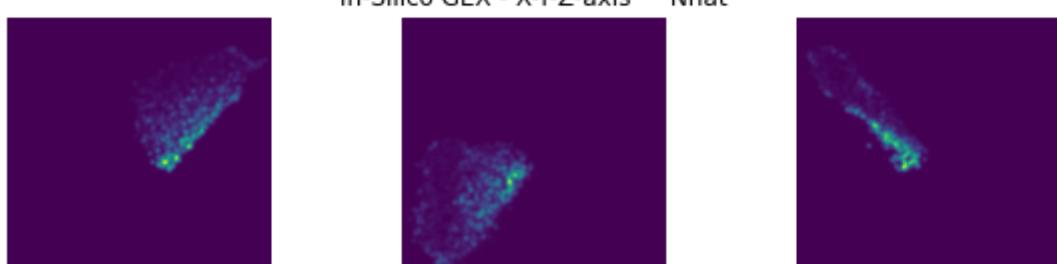
Real GEX (Tissue 3) - X-Y-Z-axis Nnat



Real GEX (Tissue 4) - X-Y-Z-axis Nnat

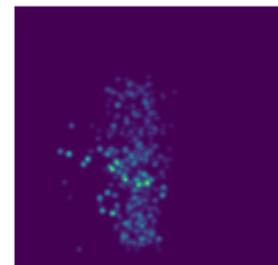
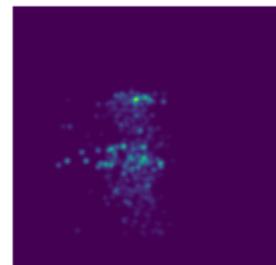
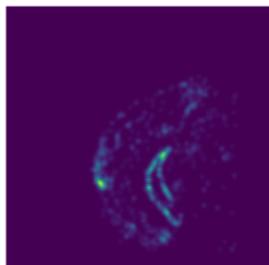


In-Silico GEX - X-Y-Z-axis Nnat

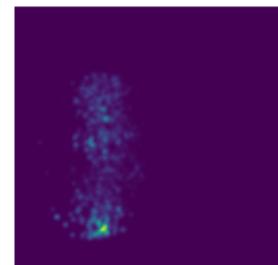
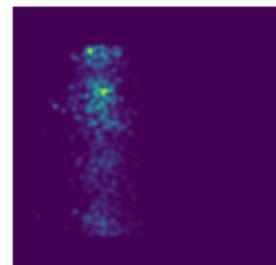
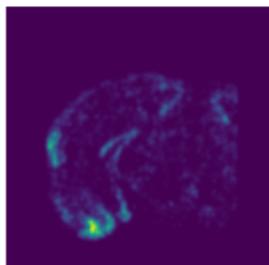


Real GEX Lypd1

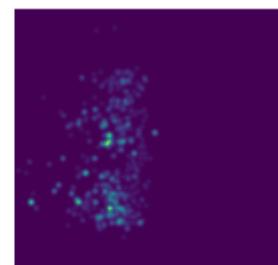
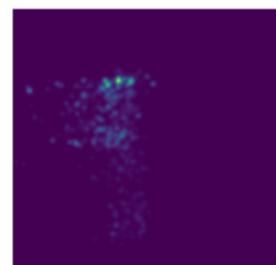
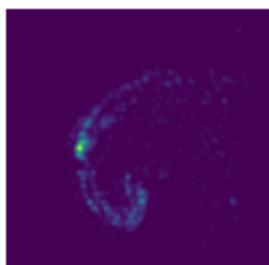
Real GEX (Tissue 1) - X-Y-Z-axis Lypd1



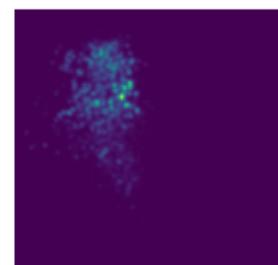
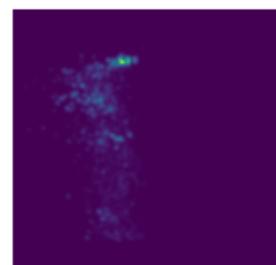
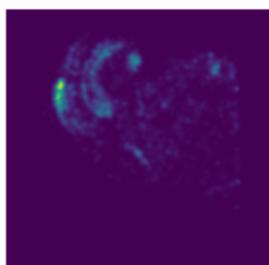
Real GEX (Tissue 2) - X-Y-Z-axis Lypd1



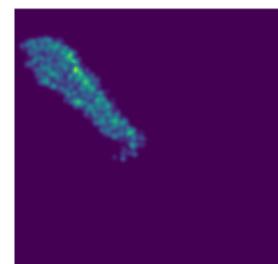
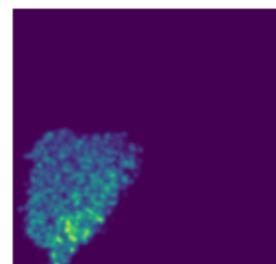
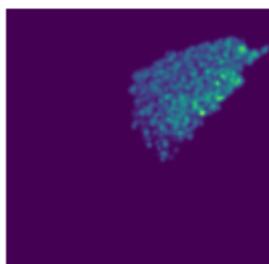
Real GEX (Tissue 3) - X-Y-Z-axis Lypd1



Real GEX (Tissue 4) - X-Y-Z-axis Lypd1

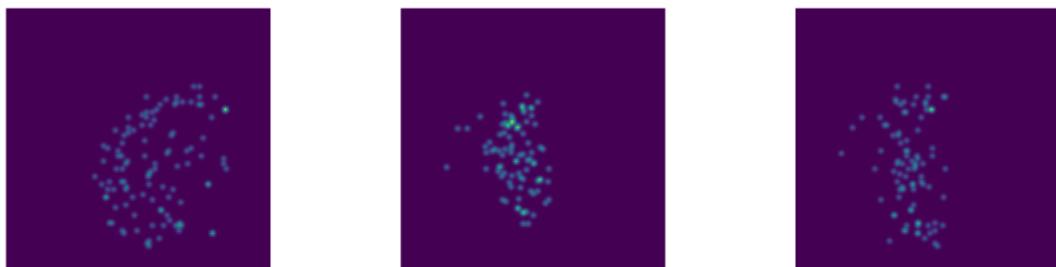


In-Silico GEX - X-Y-Z-axis Lypd1

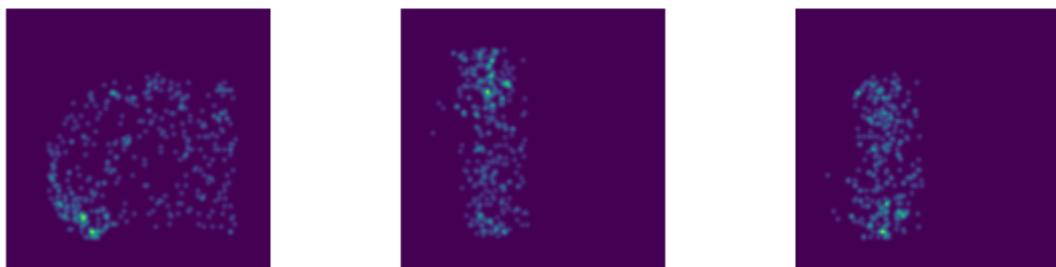


Real GEX Ncam2

Real GEX (Tissue 1) - X-Y-Z-axis Ncam2



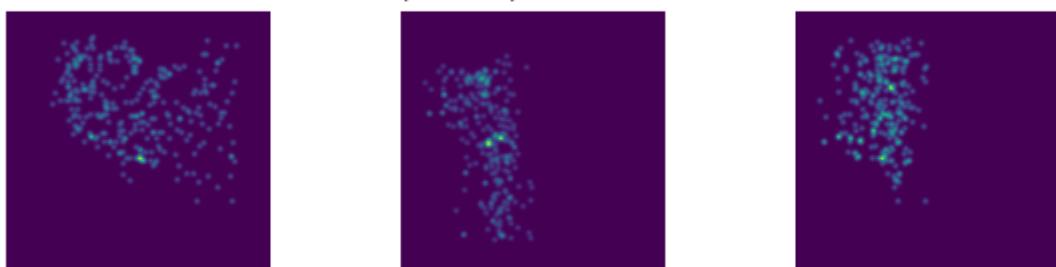
Real GEX (Tissue 2) - X-Y-Z-axis Ncam2



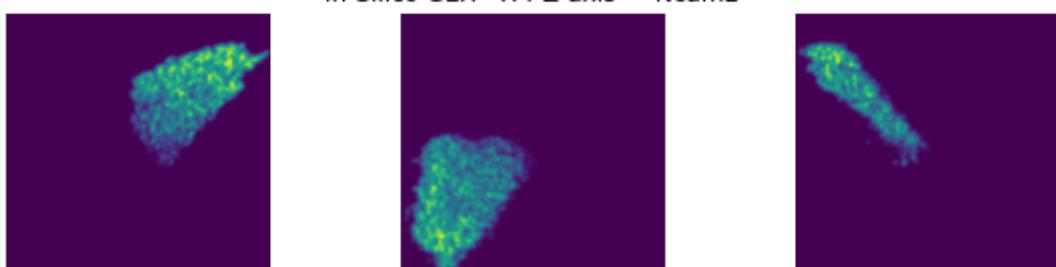
Real GEX (Tissue 3) - X-Y-Z-axis Ncam2



Real GEX (Tissue 4) - X-Y-Z-axis Ncam2

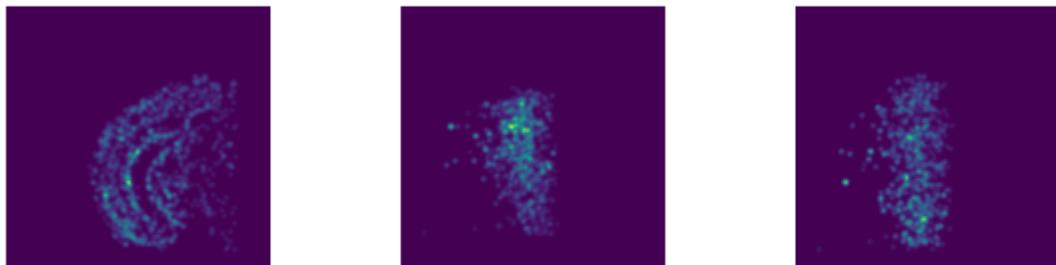


In-Silico GEX - X-Y-Z-axis Ncam2

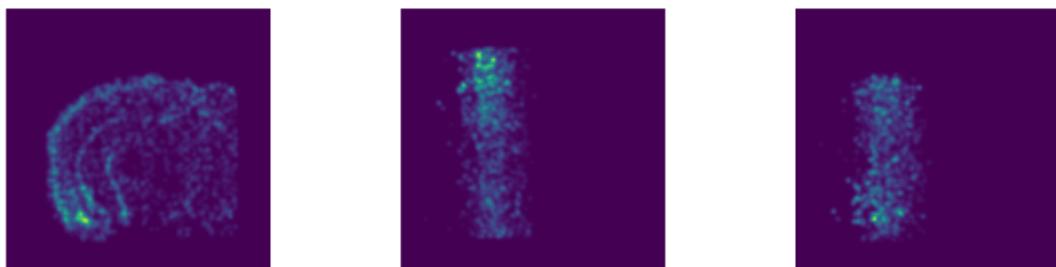


Real GEX Alcam

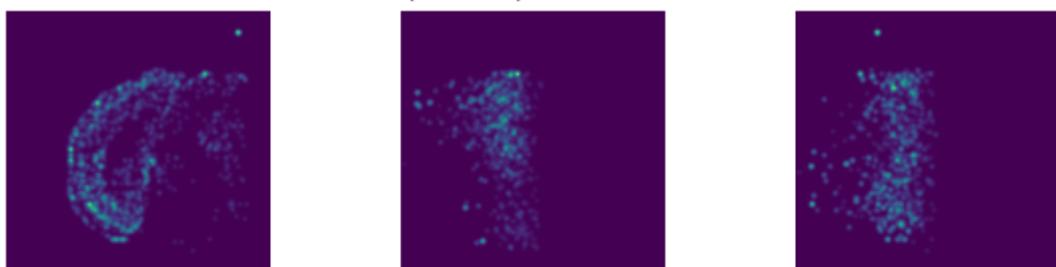
Real GEX (Tissue 1) - X-Y-Z-axis Alcam



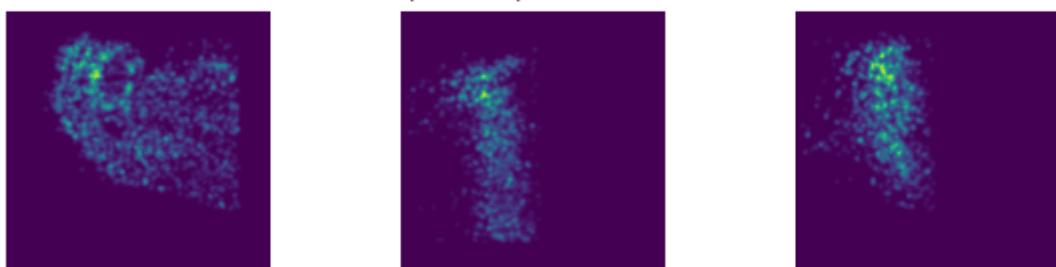
Real GEX (Tissue 2) - X-Y-Z-axis Alcam



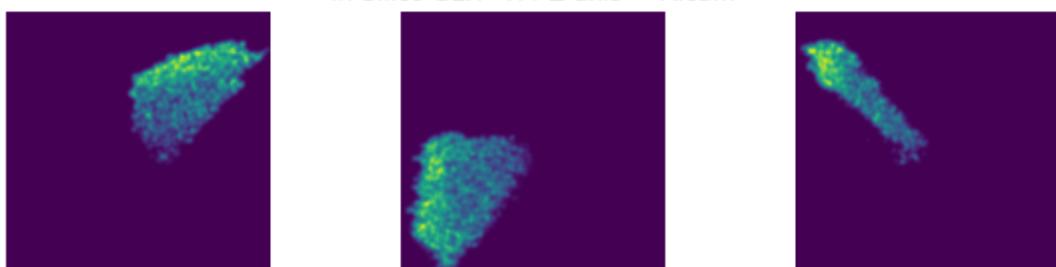
Real GEX (Tissue 3) - X-Y-Z-axis Alcam



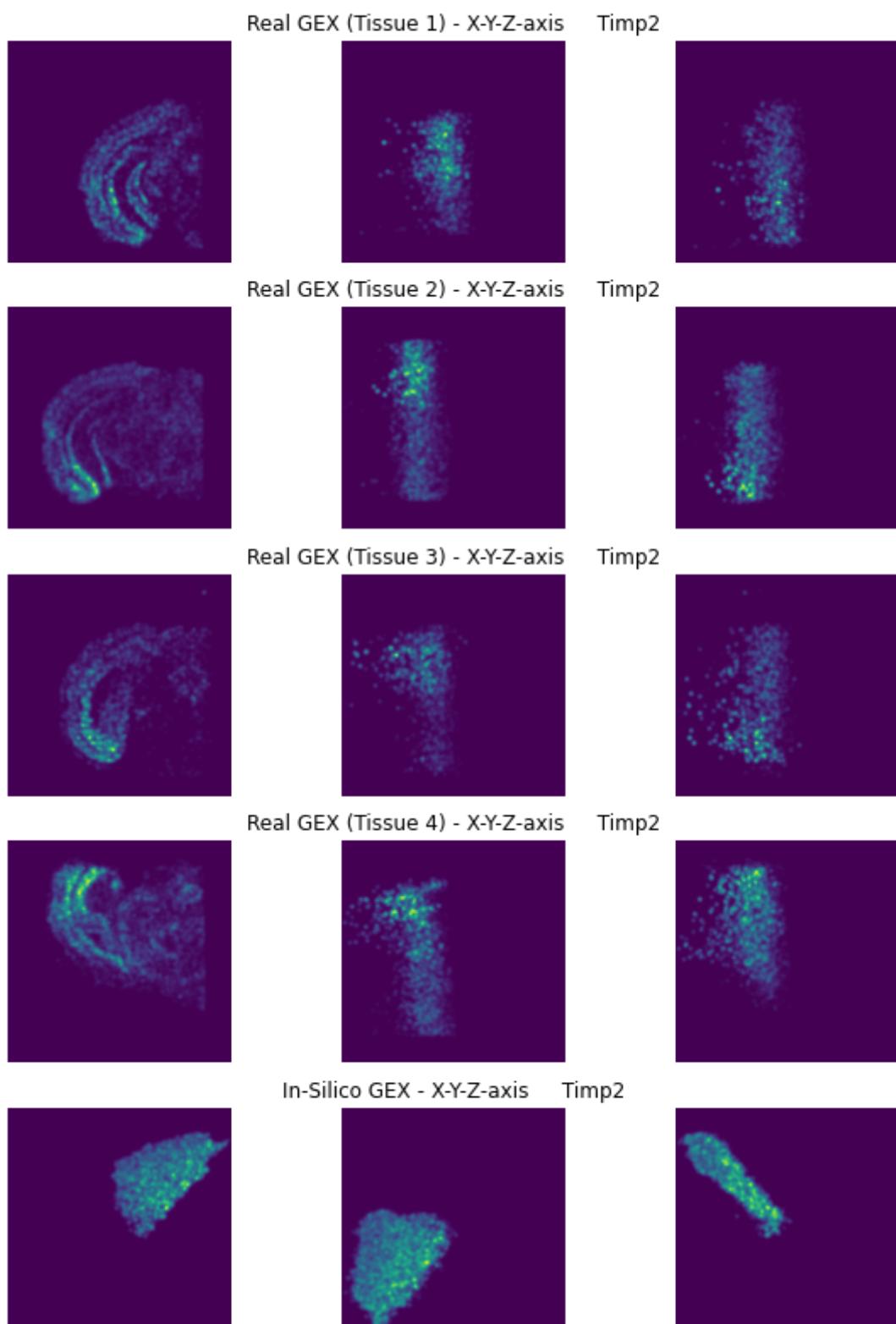
Real GEX (Tissue 4) - X-Y-Z-axis Alcam



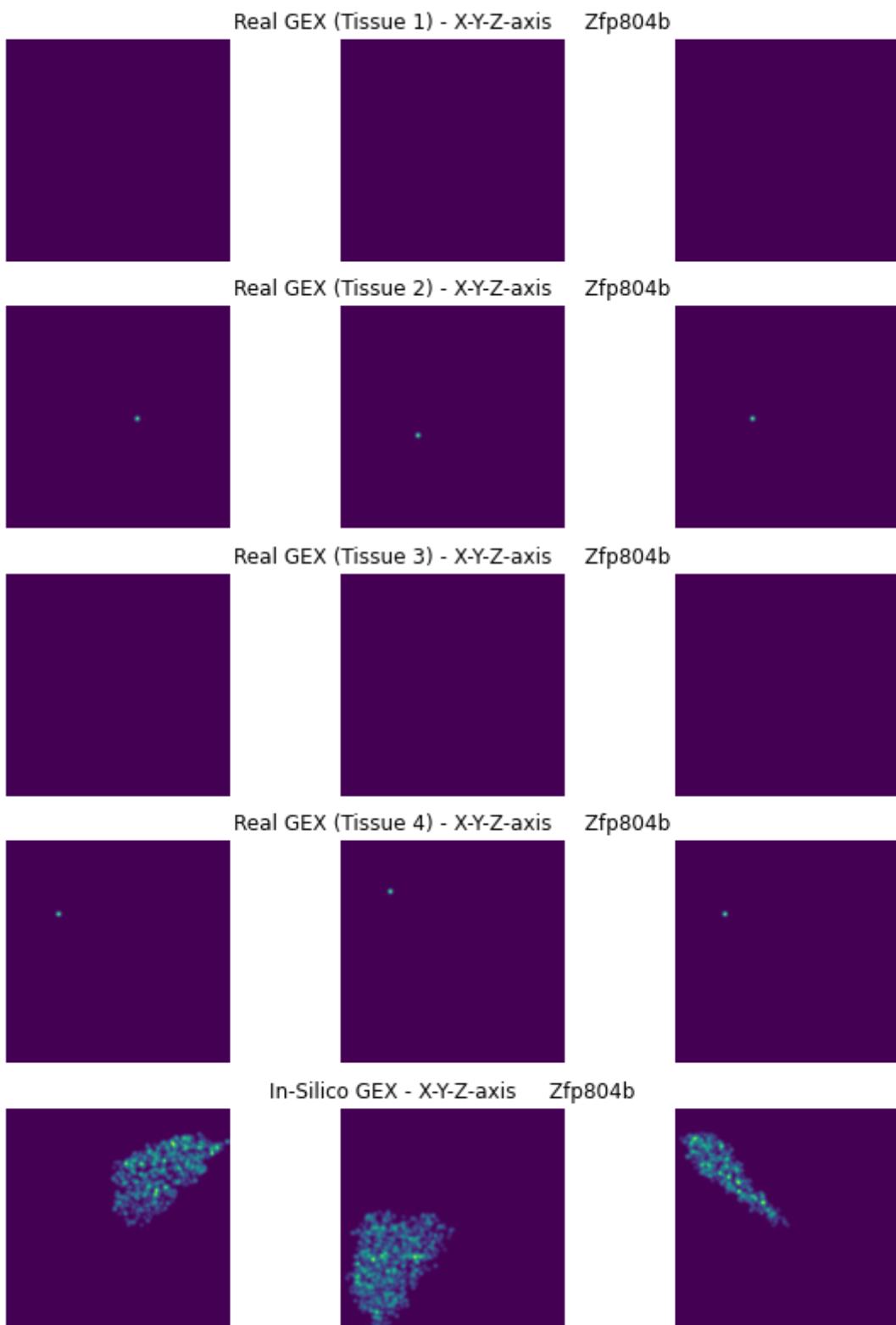
In-Silico GEX - X-Y-Z-axis Alcam



Real GEX Timp2

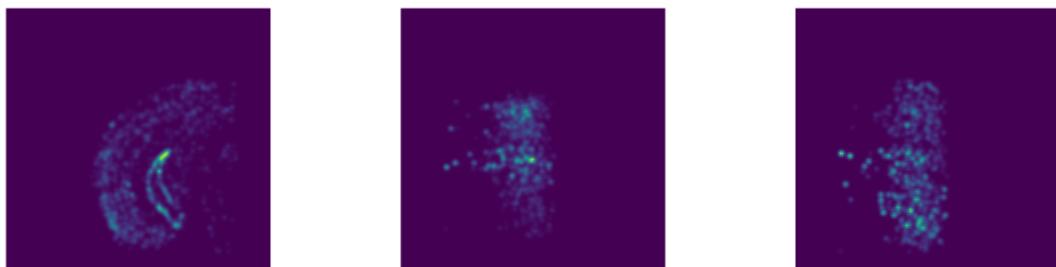


Real GEX Zfp804b

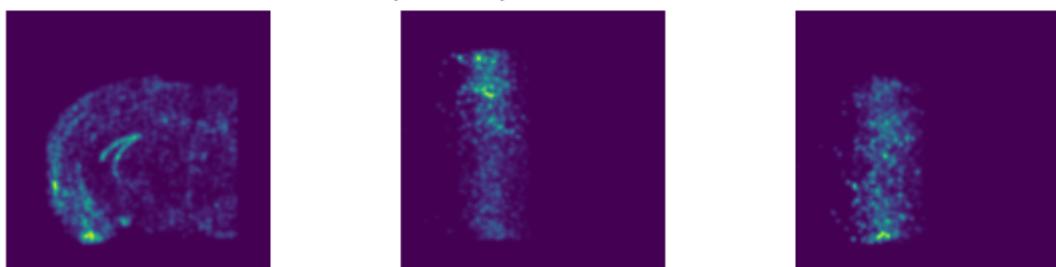


Real GEX MarcksI1

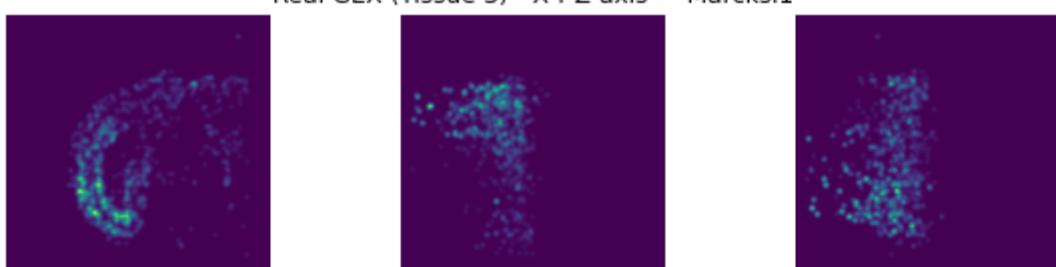
Real GEX (Tissue 1) - X-Y-Z-axis MarcksI1



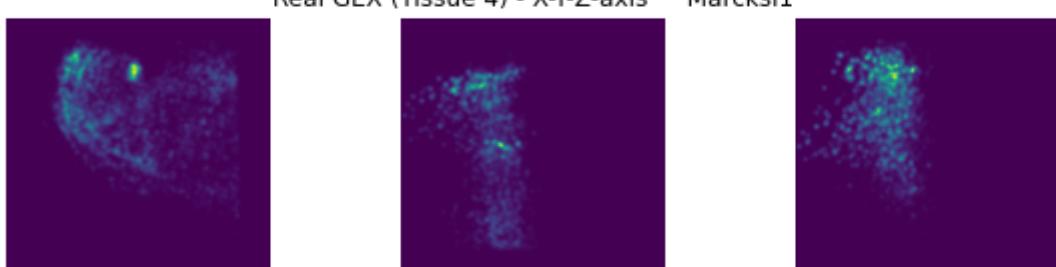
Real GEX (Tissue 2) - X-Y-Z-axis MarcksI1



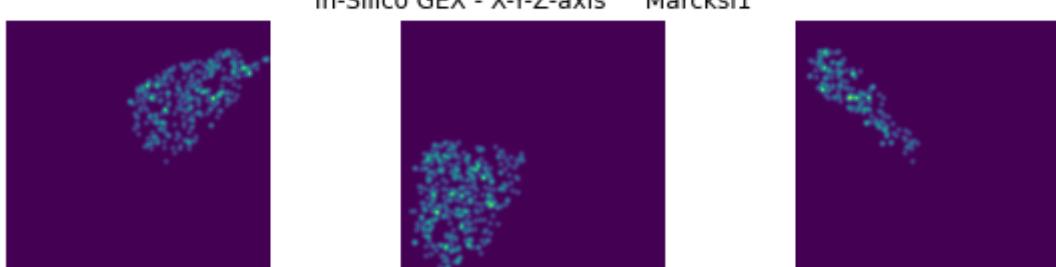
Real GEX (Tissue 3) - X-Y-Z-axis MarcksI1



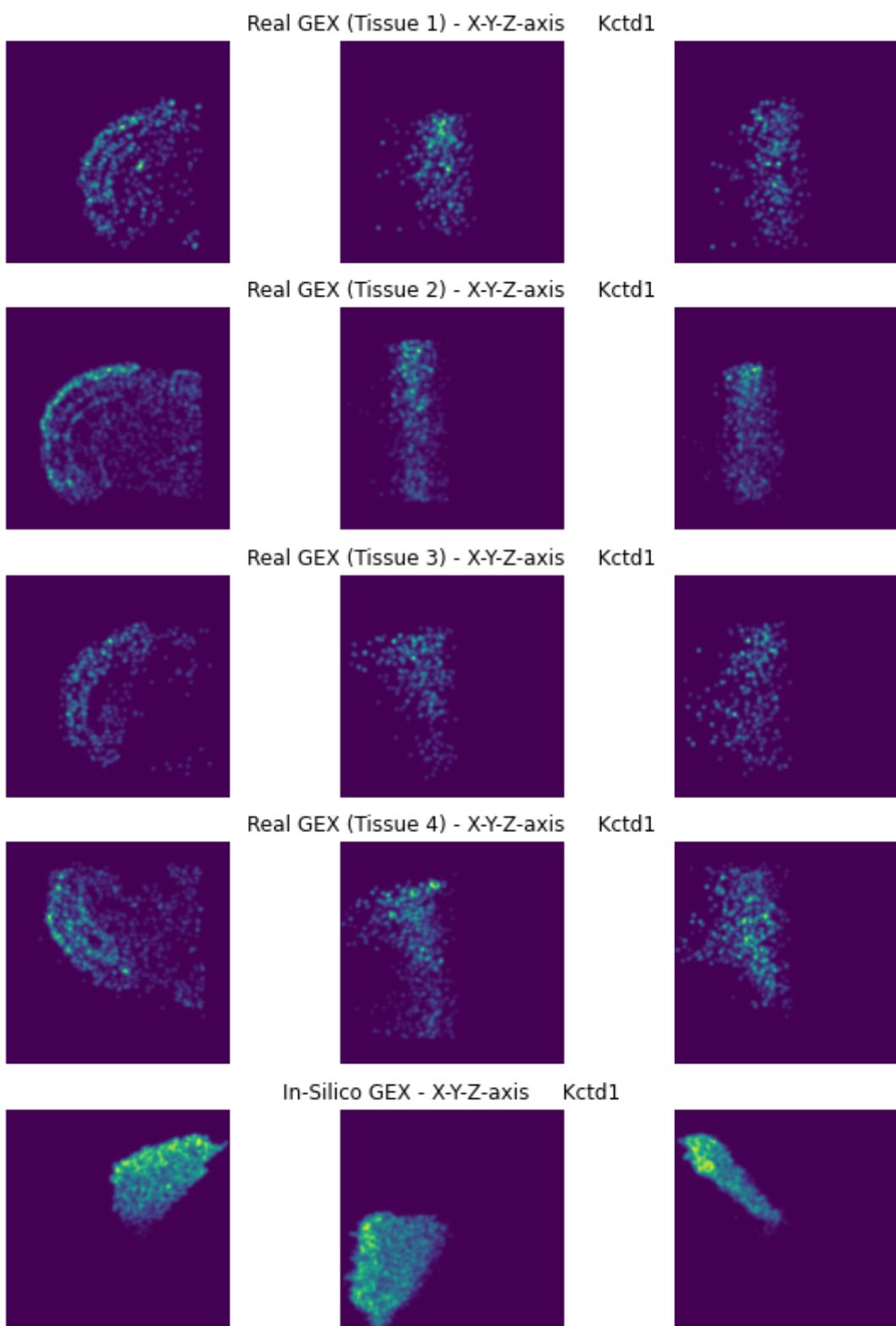
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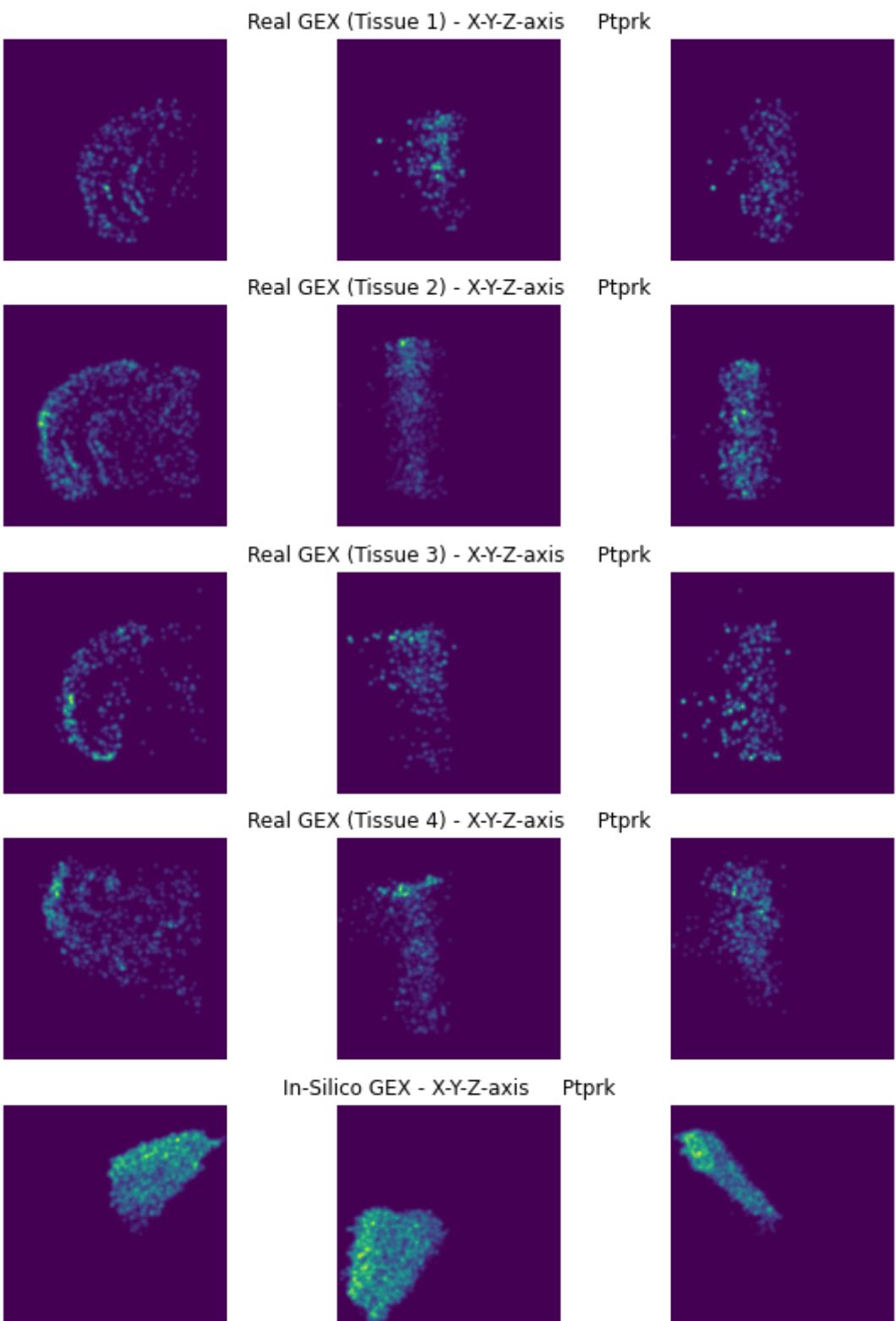
In-Silico GEX - X-Y-Z-axis MarcksI1



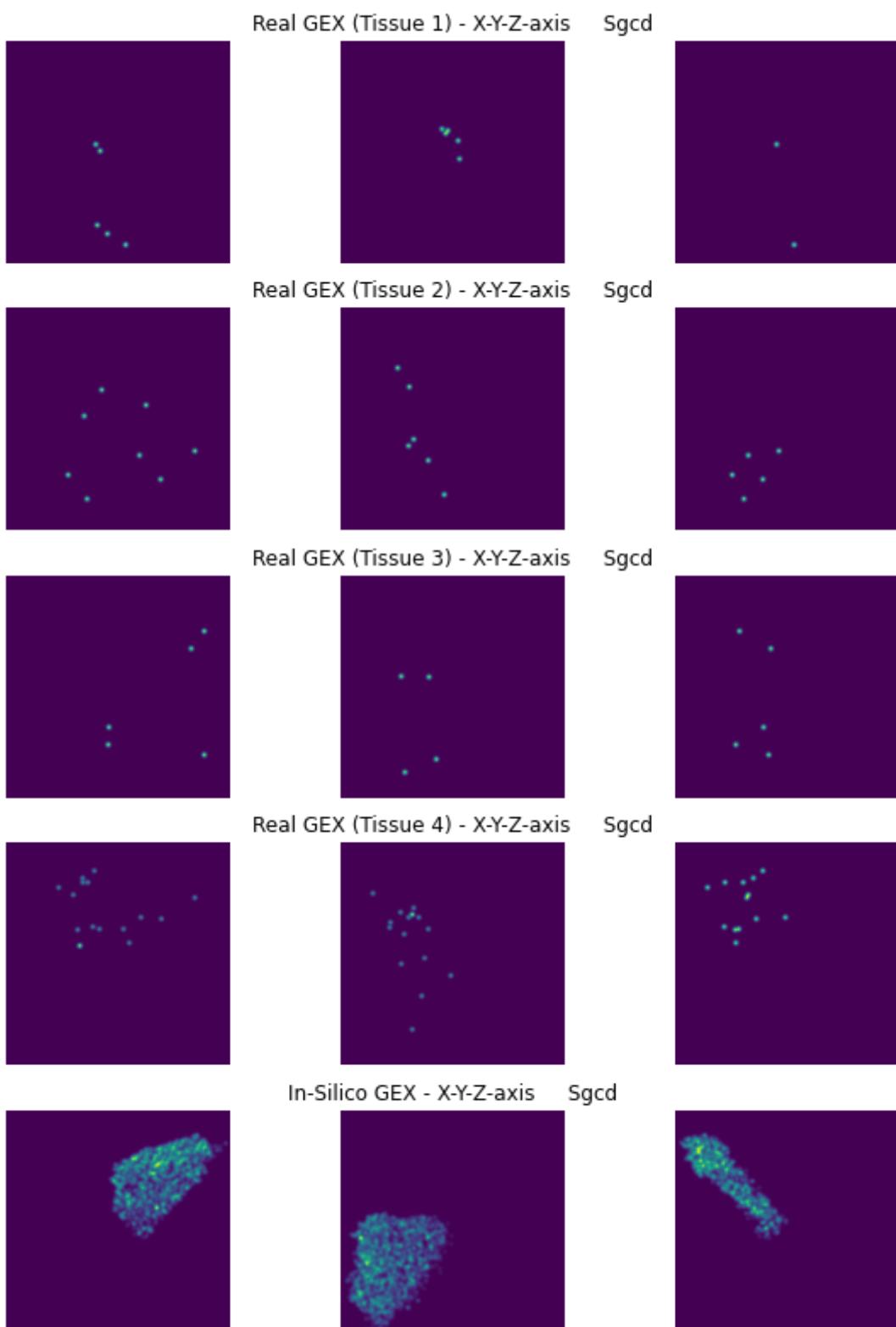
Real GEX Kctd1



Real GEX Ptprk



Real GEX Sgcd

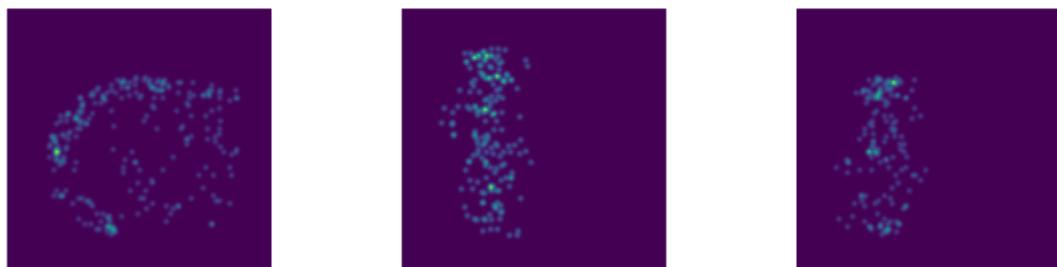


Real GEX Efna5

Real GEX (Tissue 1) - X-Y-Z-axis Efna5



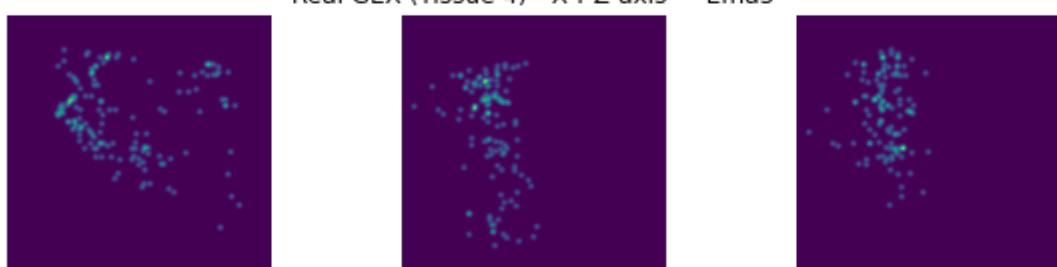
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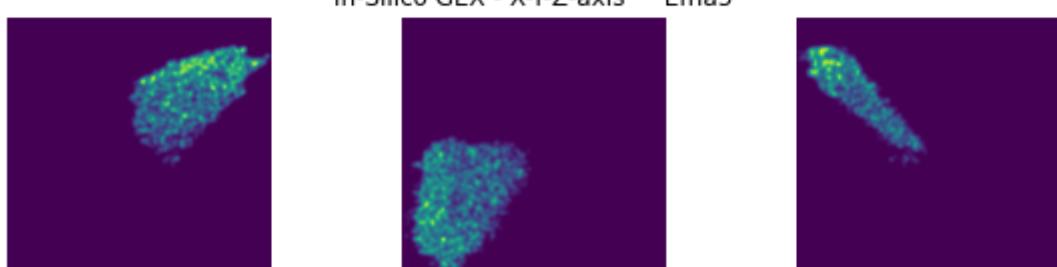
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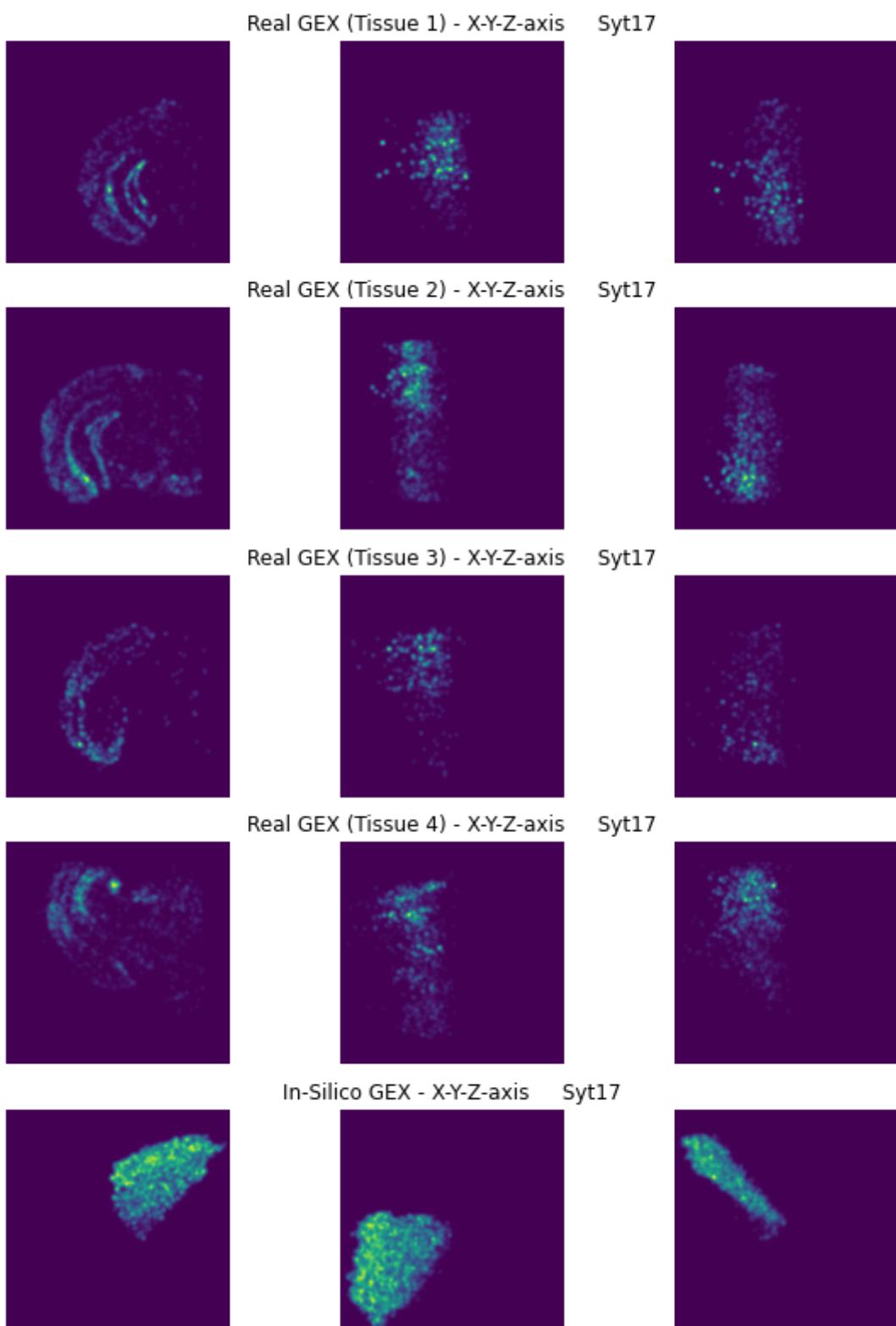
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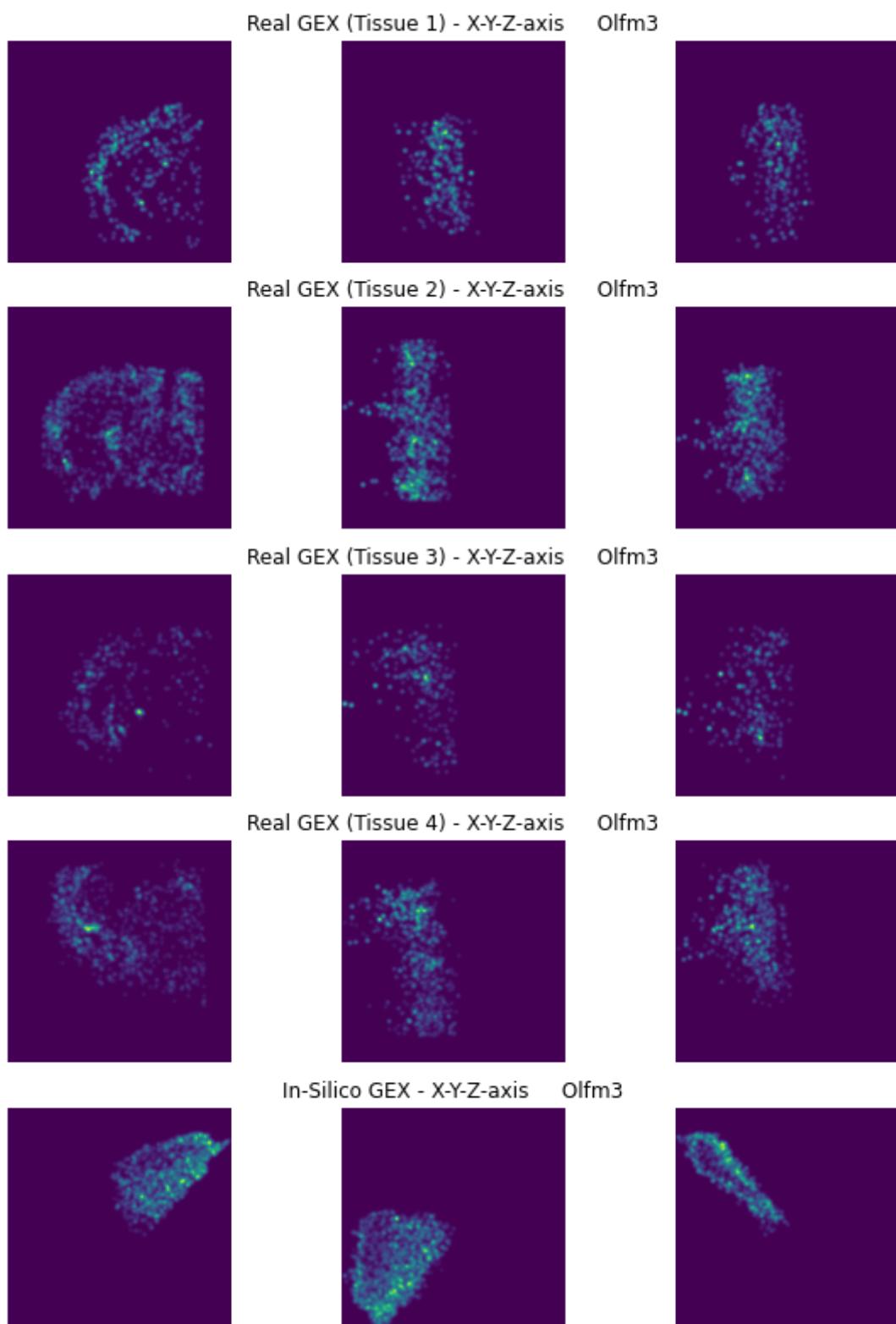
In-Silico GEX - X-Y-Z-axis Efna5



Real GEX Syt17

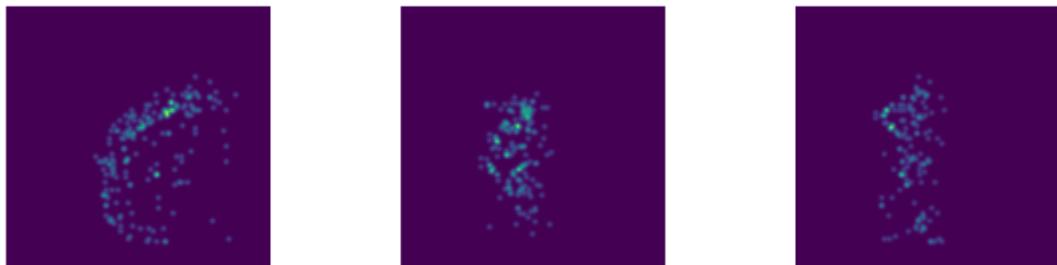


Real GEX Olfm3

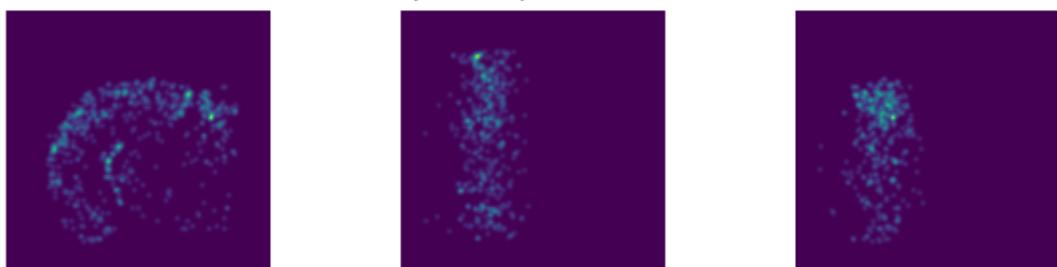


Real GEX Trhde

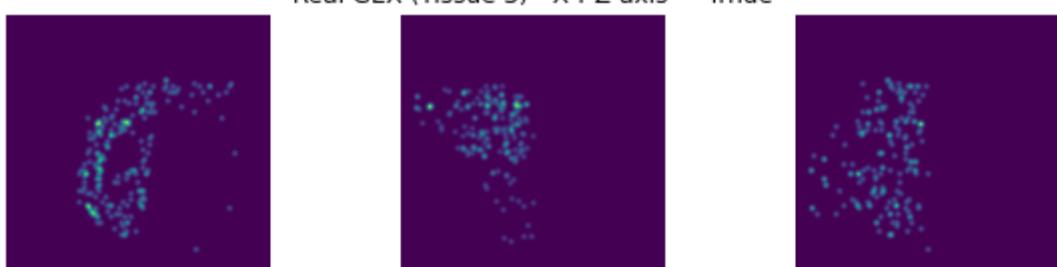
Real GEX (Tissue 1) - X-Y-Z-axis Trhde



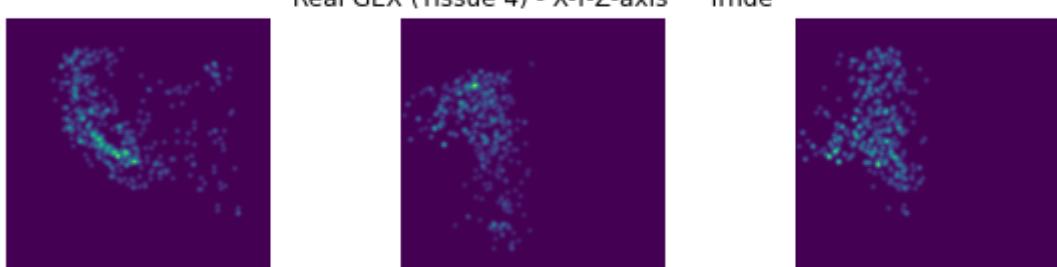
Real GEX (Tissue 2) - X-Y-Z-axis Trhde



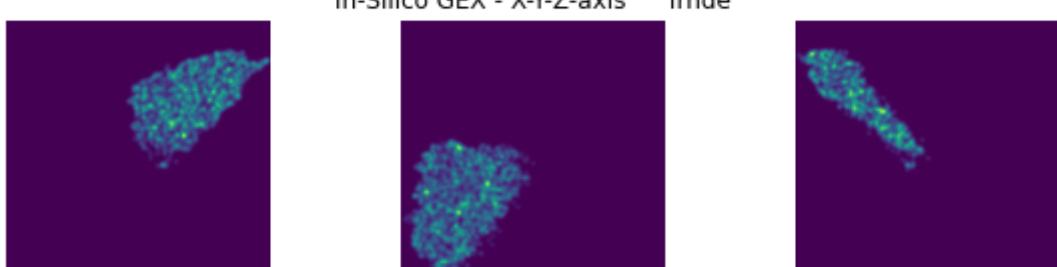
Real GEX (Tissue 3) - X-Y-Z-axis Trhde



Real GEX (Tissue 4) - X-Y-Z-axis Trhde

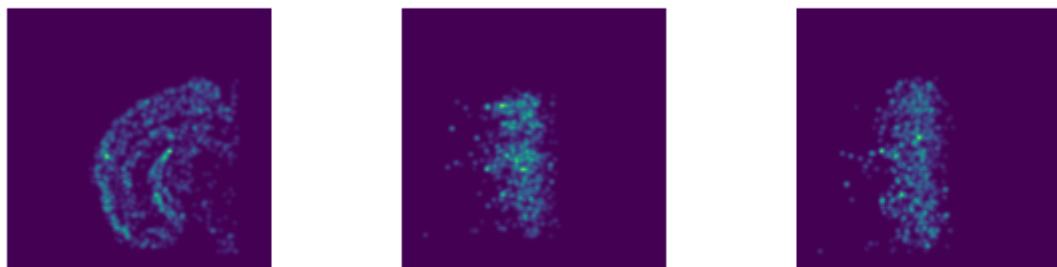


In-Silico GEX - X-Y-Z-axis Trhde

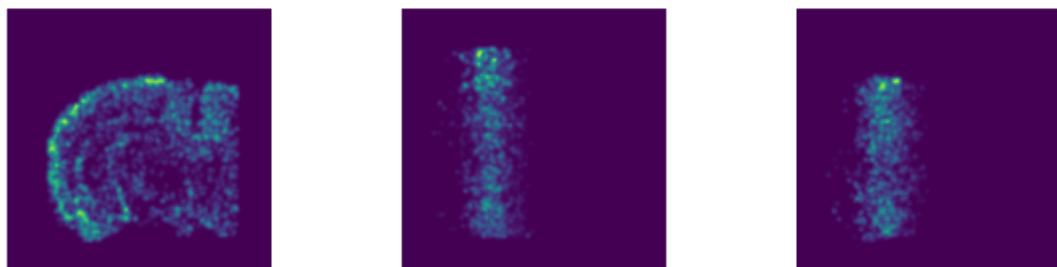


Real GEX Pam

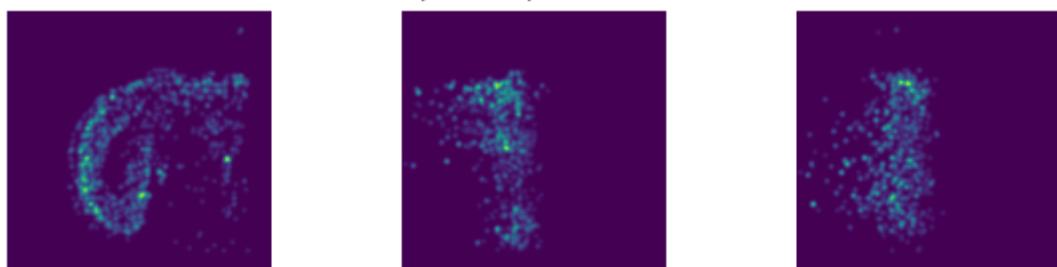
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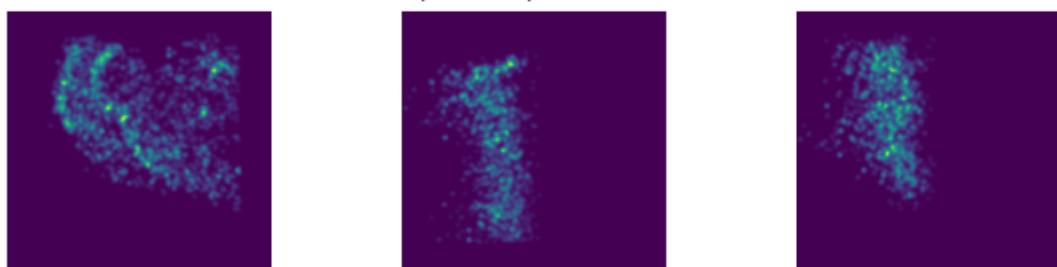
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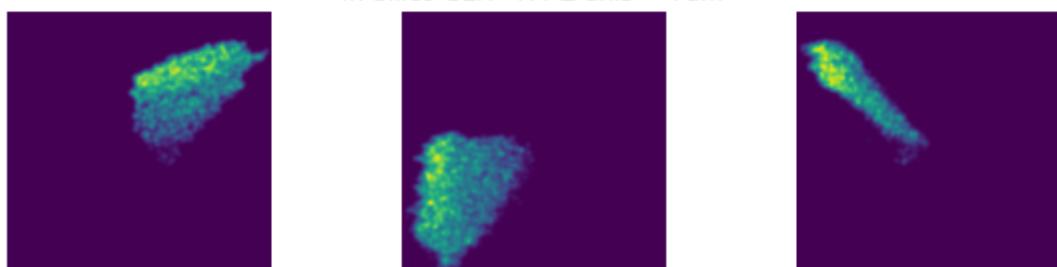
Real GEX (Tissue 3) - X-Y-Z-axis Pam



Real GEX (Tissue 4) - X-Y-Z-axis Pam

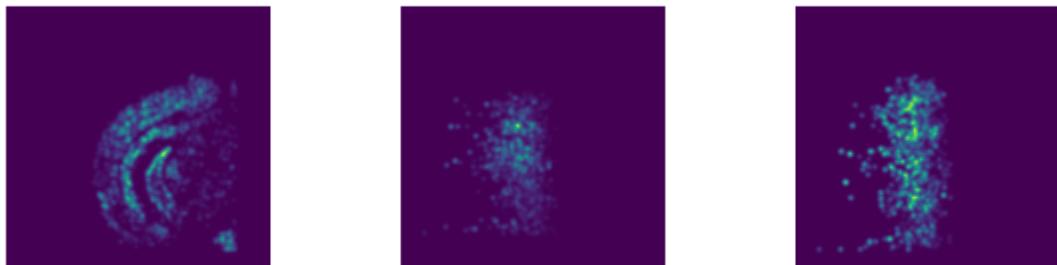


In-Silico GEX - X-Y-Z-axis Pam

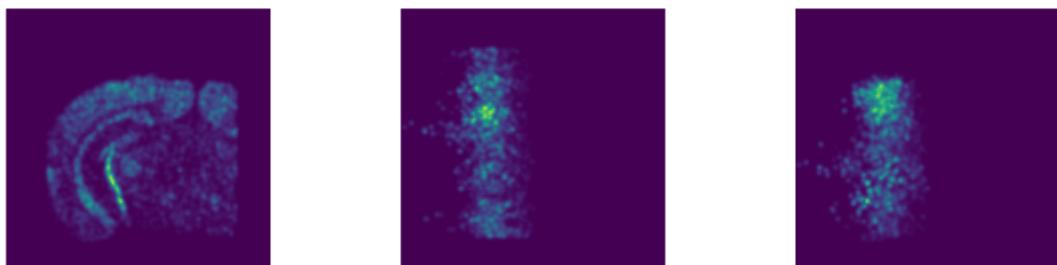


Real GEX Slc24a2

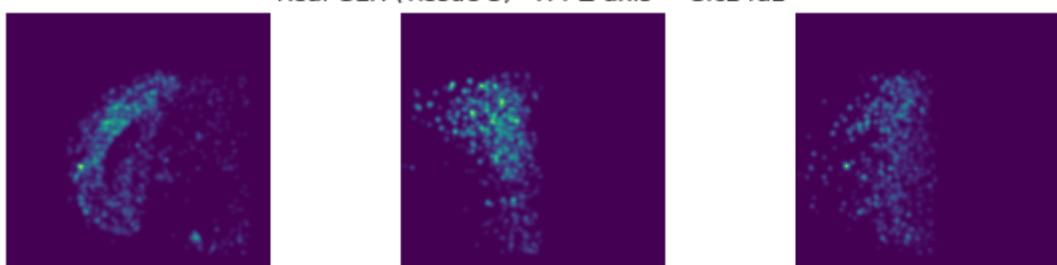
Real GEX (Tissue 1) - X-Y-Z-axis Slc24a2



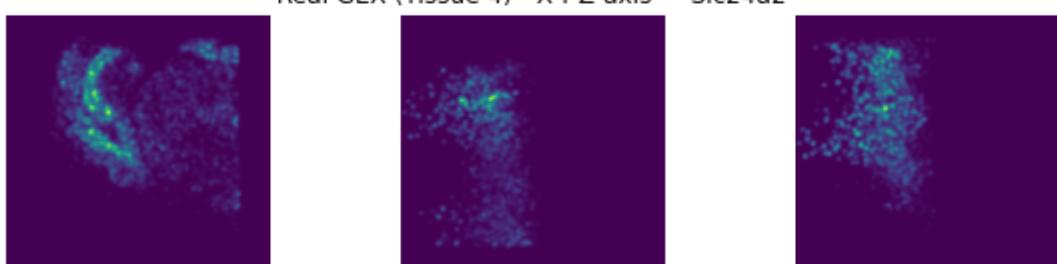
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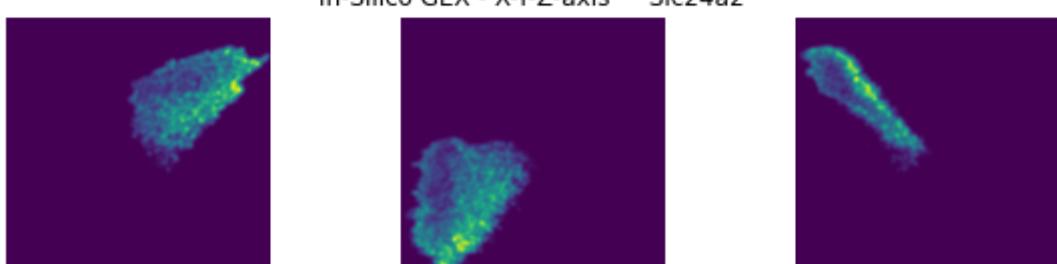
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Real GEX (Tissue 4) - X-Y-Z-axis Slc24a2

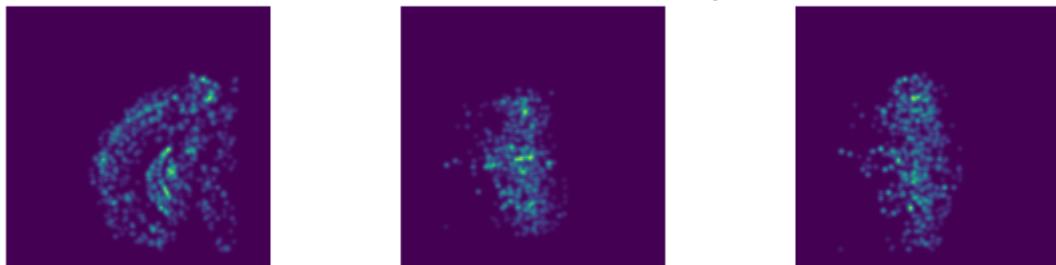


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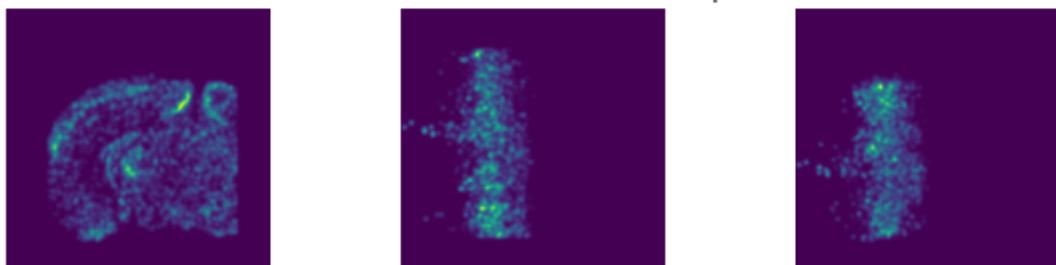


Real GEX Spock3

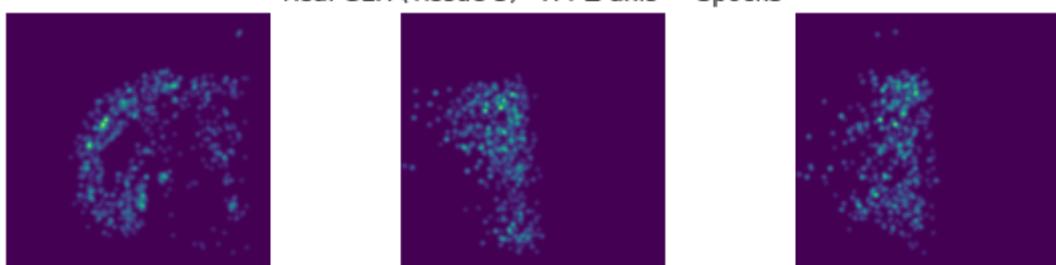
Real GEX (Tissue 1) - X-Y-Z-axis Spock3



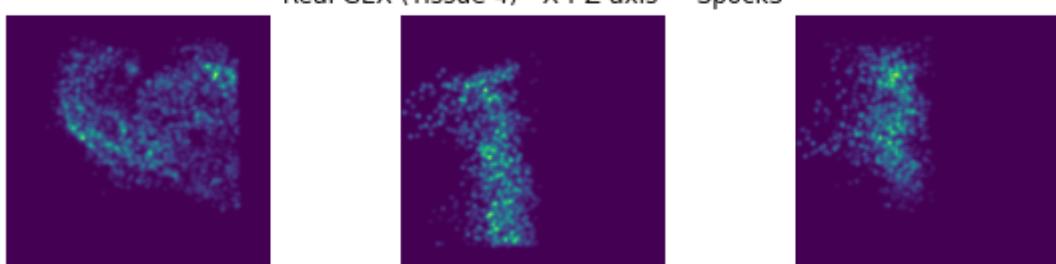
Real GEX (Tissue 2) - X-Y-Z-axis Spock3



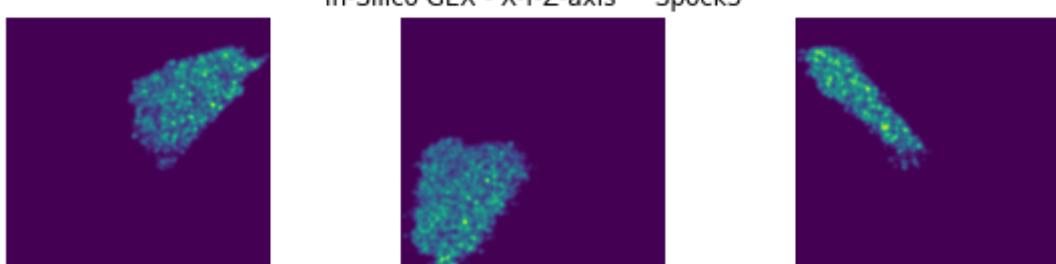
Real GEX (Tissue 3) - X-Y-Z-axis Spock3



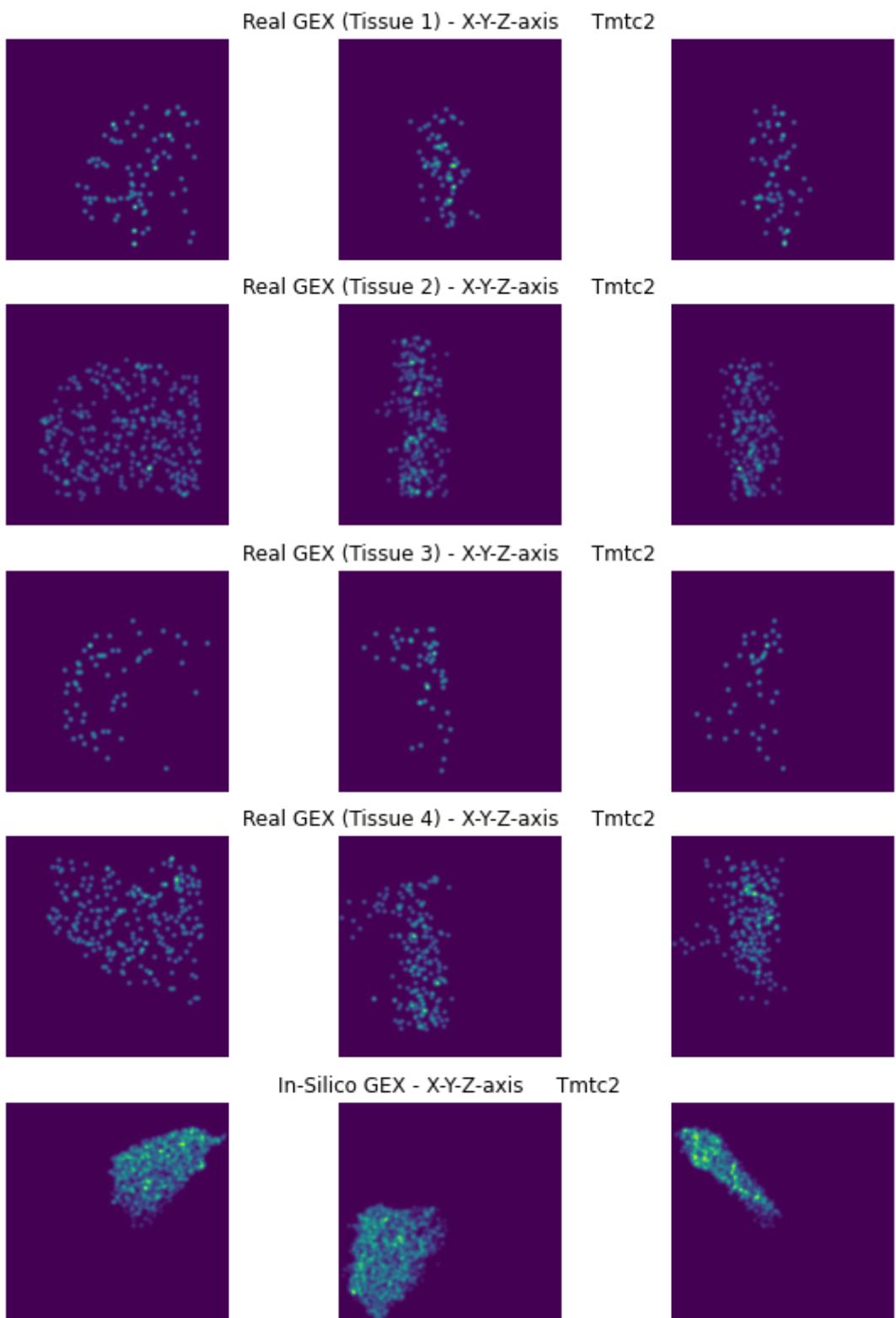
Real GEX (Tissue 4) - X-Y-Z-axis Spock3



In-Silico GEX - X-Y-Z-axis Spock3

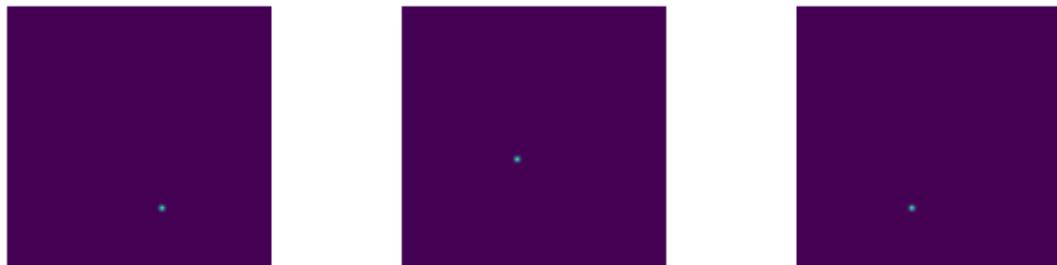


Real GEX Tmtc2



Real GEX Dcc

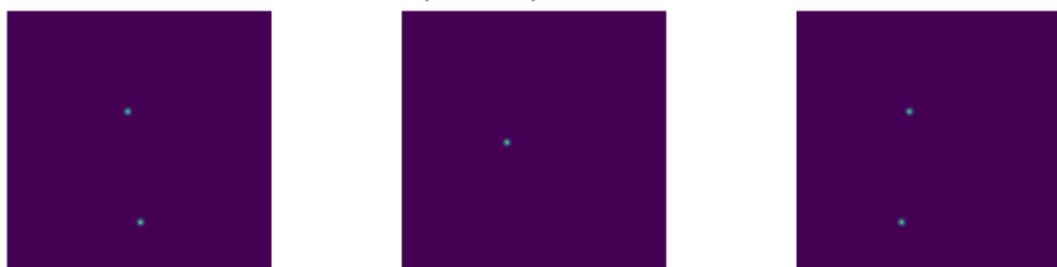
Real GEX (Tissue 1) - X-Y-Z-axis Dcc



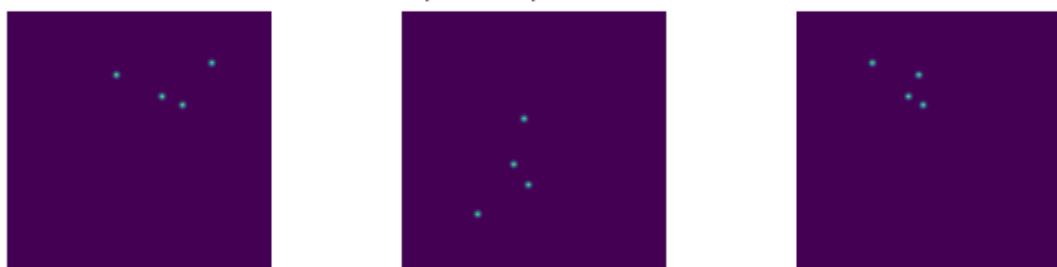
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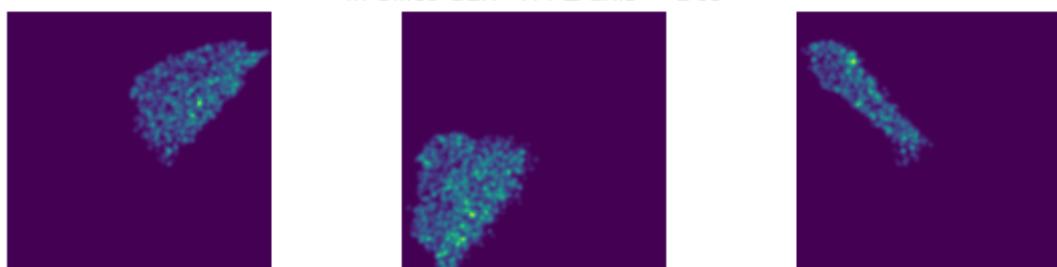
Real GEX (Tissue 3) - X-Y-Z-axis Dcc



Real GEX (Tissue 4) - X-Y-Z-axis Dcc

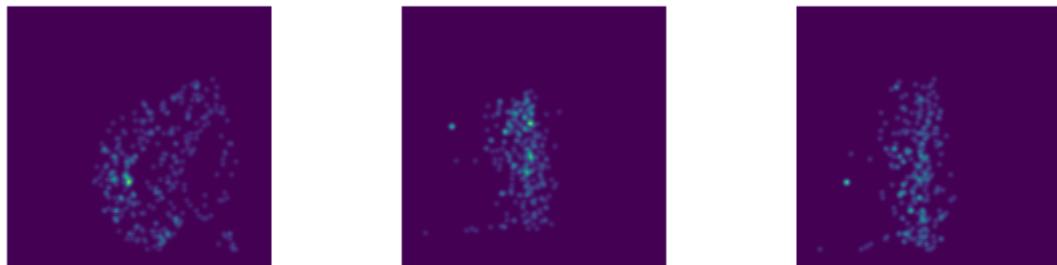


In-Silico GEX - X-Y-Z-axis Dcc

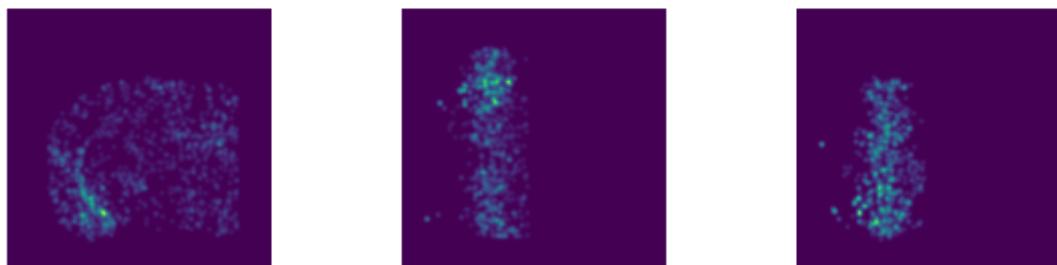


Real GEX Grin3a

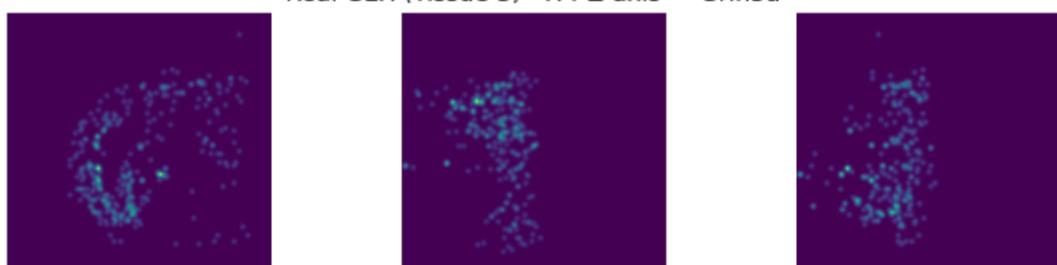
Real GEX (Tissue 1) - X-Y-Z-axis Grin3a



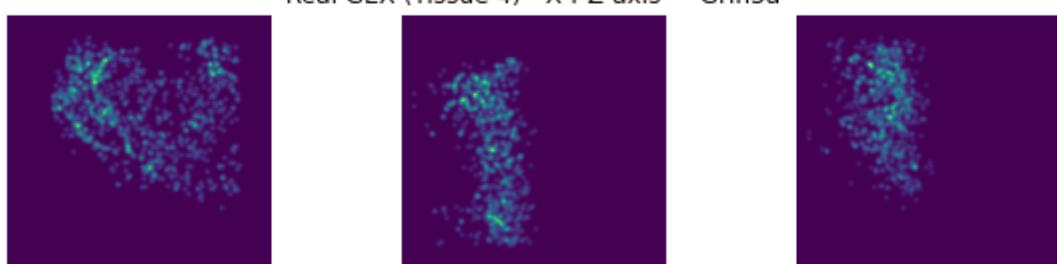
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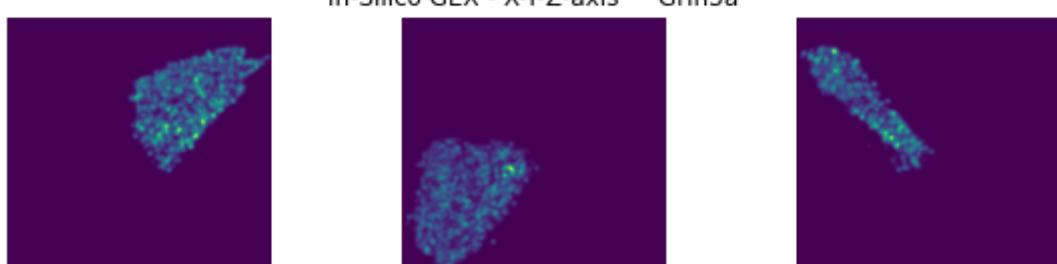
Real GEX (Tissue 3) - X-Y-Z-axis Grin3a



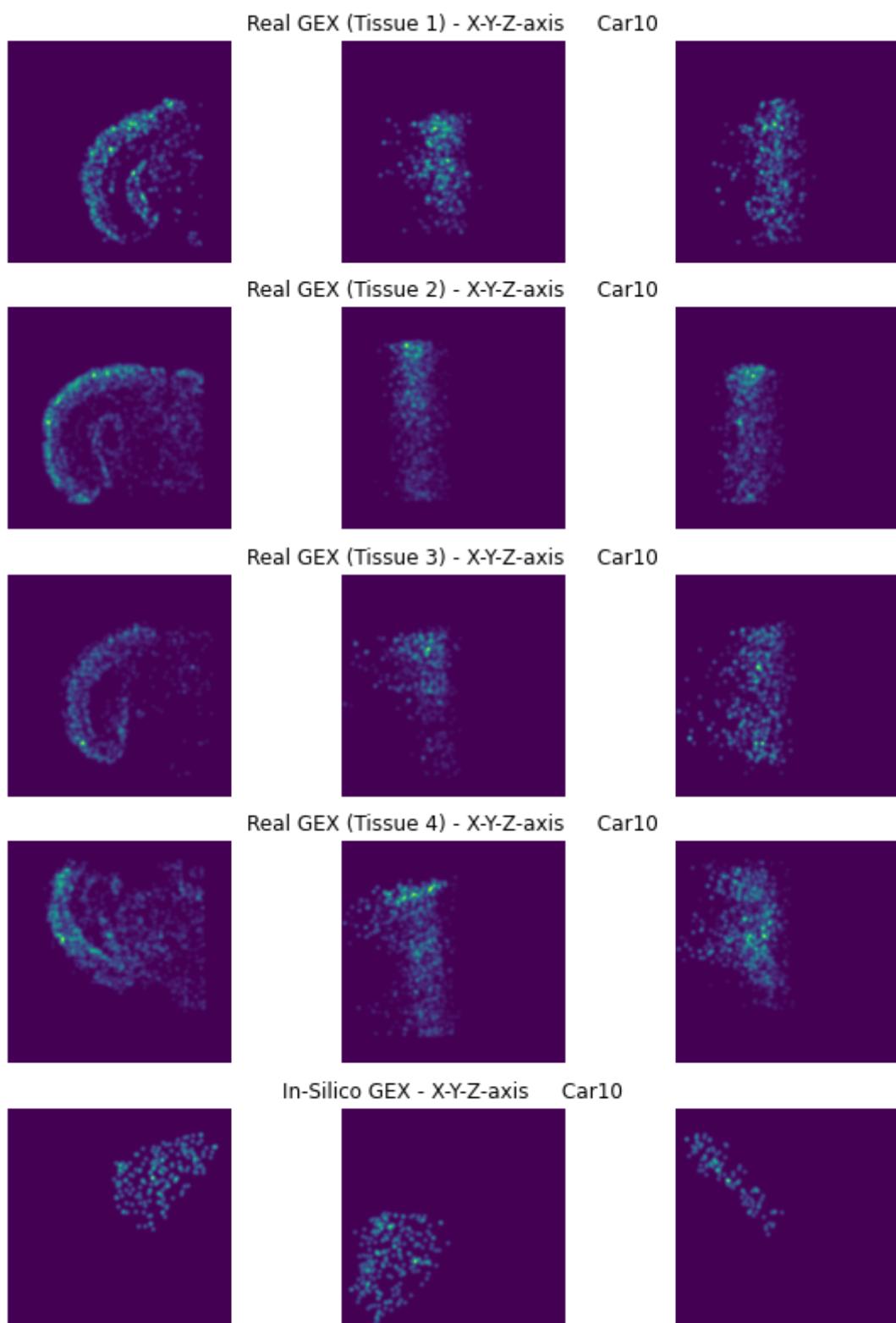
Real GEX (Tissue 4) - X-Y-Z-axis Grin3a



In-Silico GEX - X-Y-Z-axis Grin3a

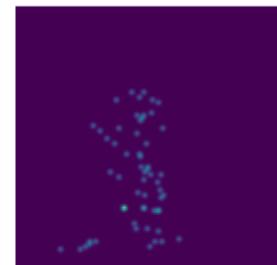
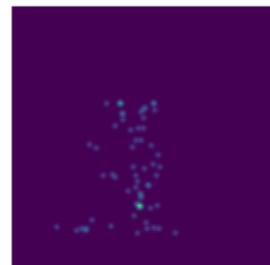


Real GEX Car10

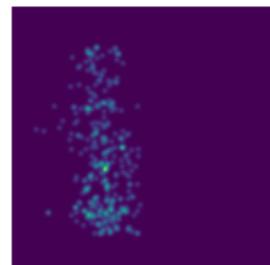
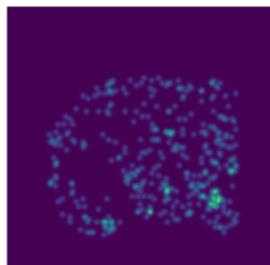


Real GEX Nrg1

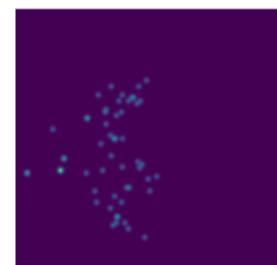
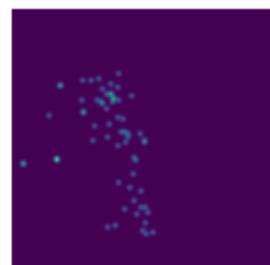
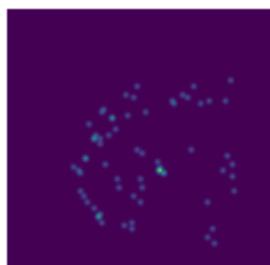
Real GEX (Tissue 1) - X-Y-Z-axis Nrg1



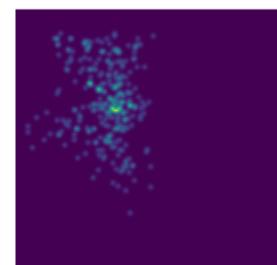
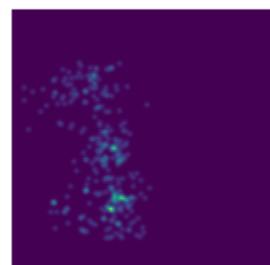
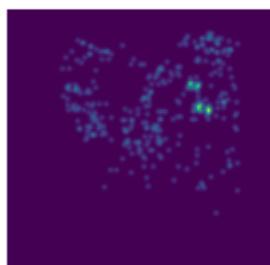
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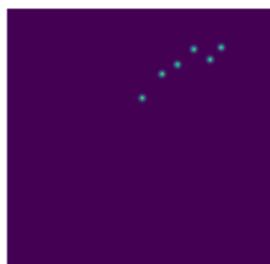
Real GEX (Tissue 3) - X-Y-Z-axis Nrg1



Real GEX (Tissue 4) - X-Y-Z-axis Nrg1

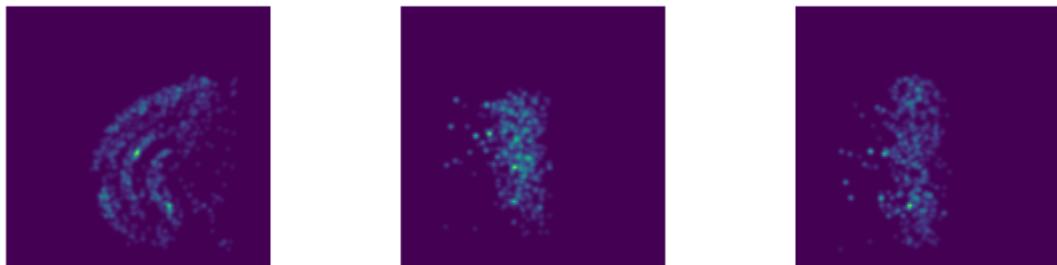


In-Silico GEX - X-Y-Z-axis Nrg1

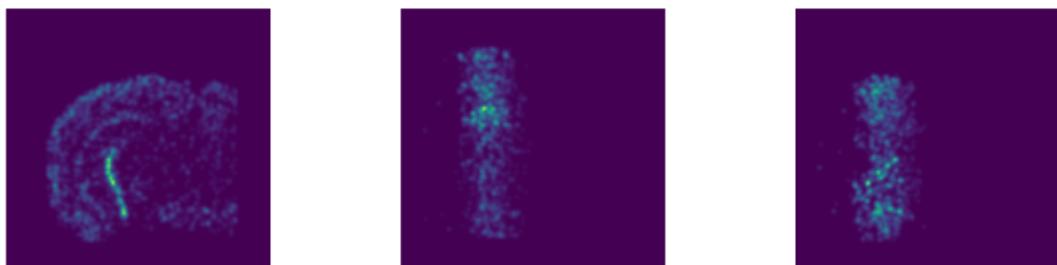


Real GEX Prkca

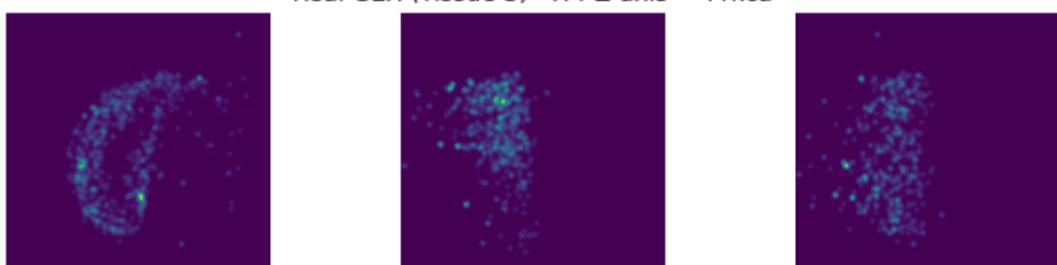
Real GEX (Tissue 1) - X-Y-Z-axis Prkca



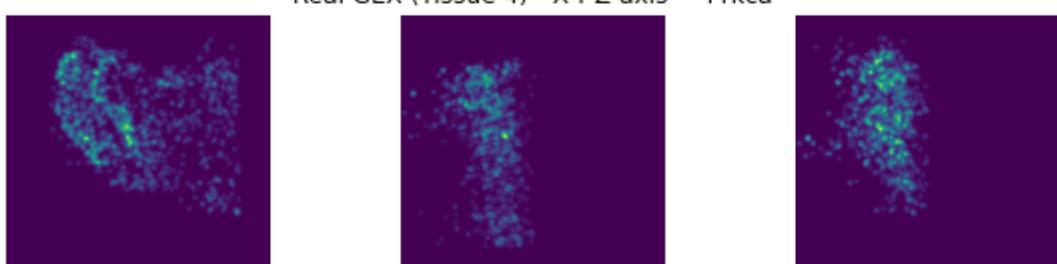
Real GEX (Tissue 2) - X-Y-Z-axis Prkca



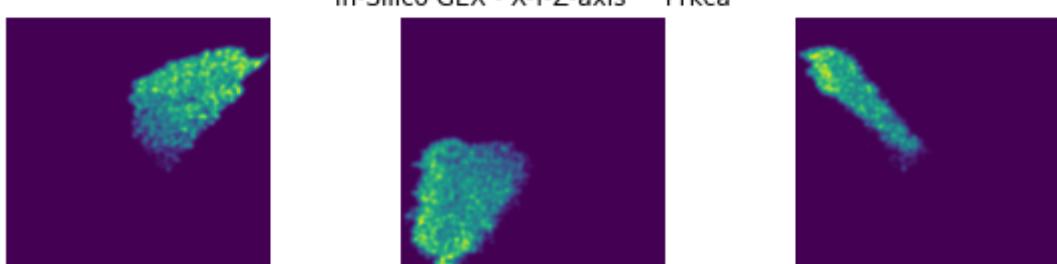
Real GEX (Tissue 3) - X-Y-Z-axis Prkca



Real GEX (Tissue 4) - X-Y-Z-axis Prkca

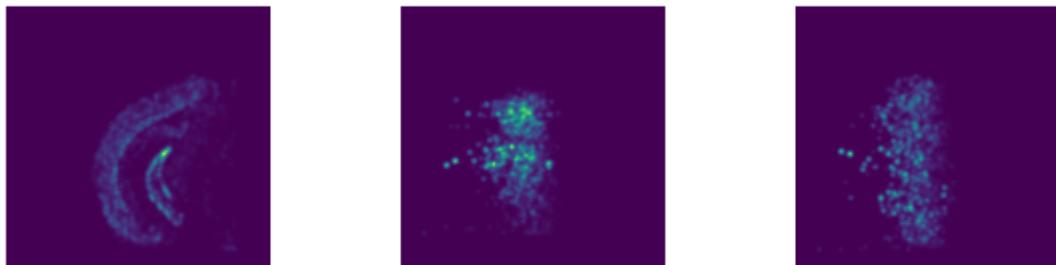


In-Silico GEX - X-Y-Z-axis Prkca

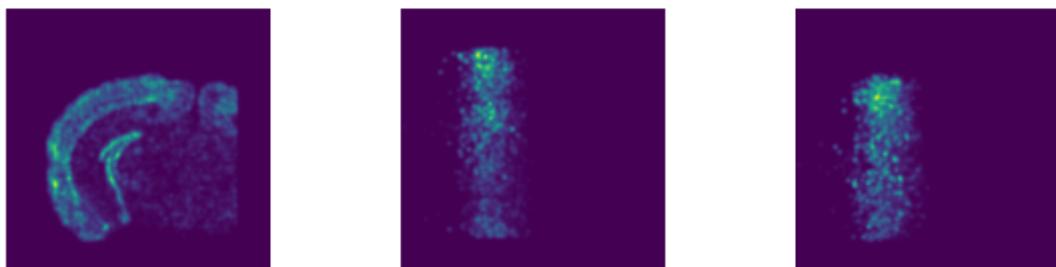


Real GEX Ncald

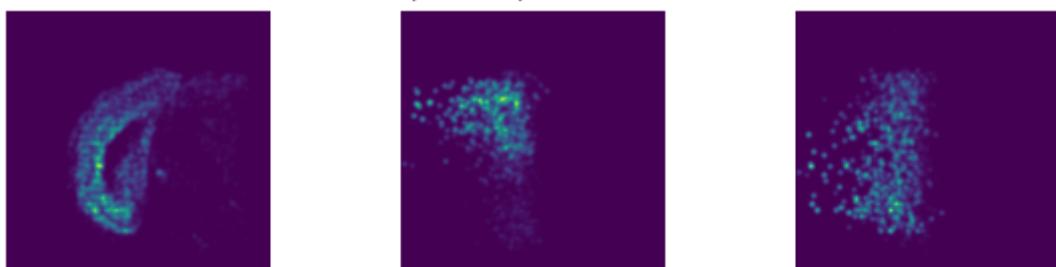
Real GEX (Tissue 1) - X-Y-Z-axis Ncald



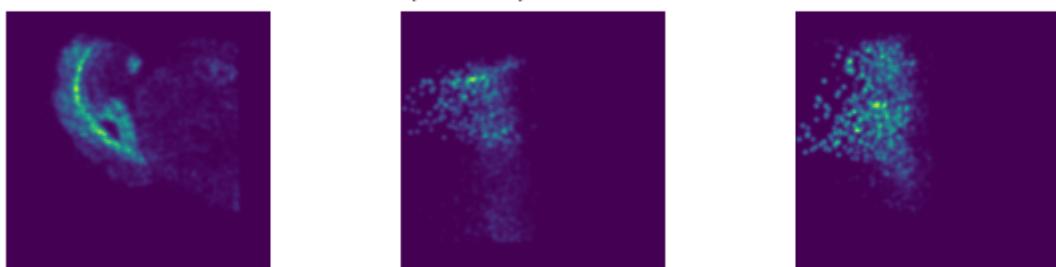
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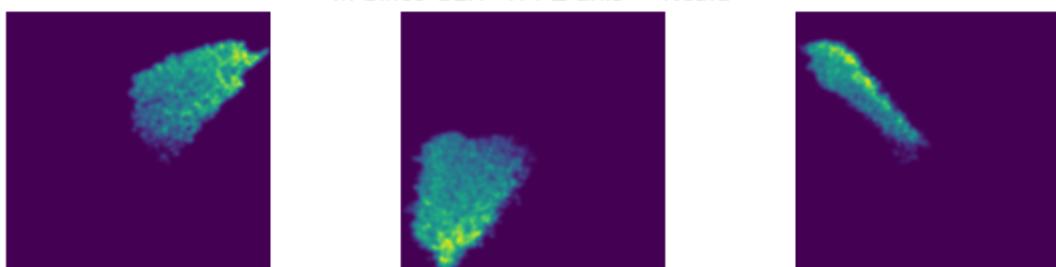
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Real GEX (Tissue 4) - X-Y-Z-axis Ncald

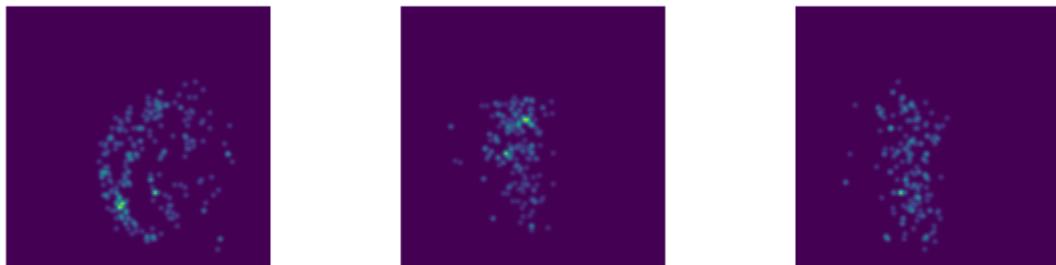


In-Silico GEX - X-Y-Z-axis Ncald

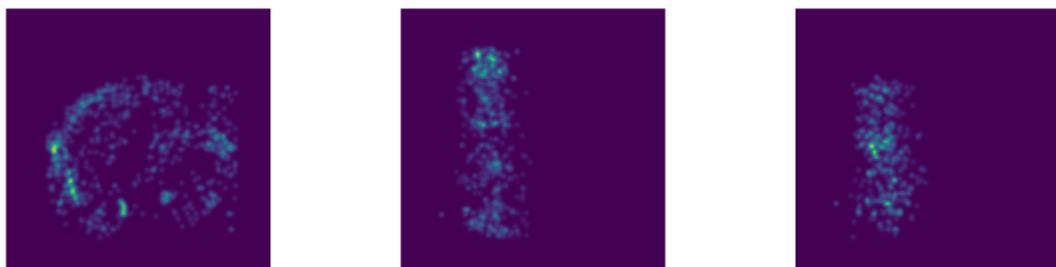


Real GEX Htr2a

Real GEX (Tissue 1) - X-Y-Z-axis Htr2a



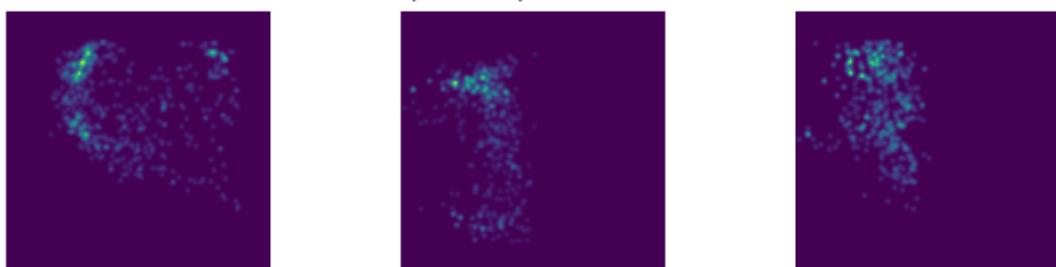
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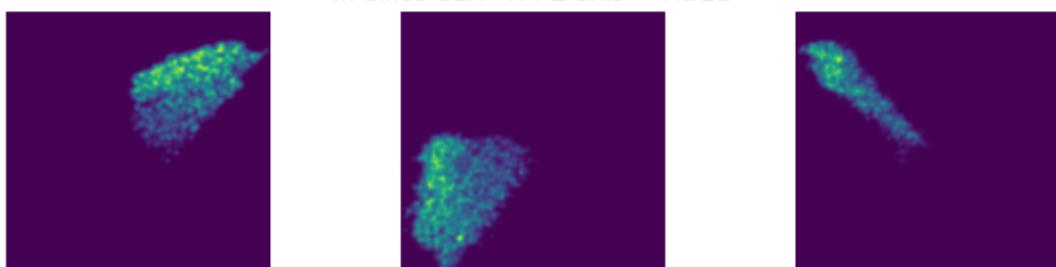
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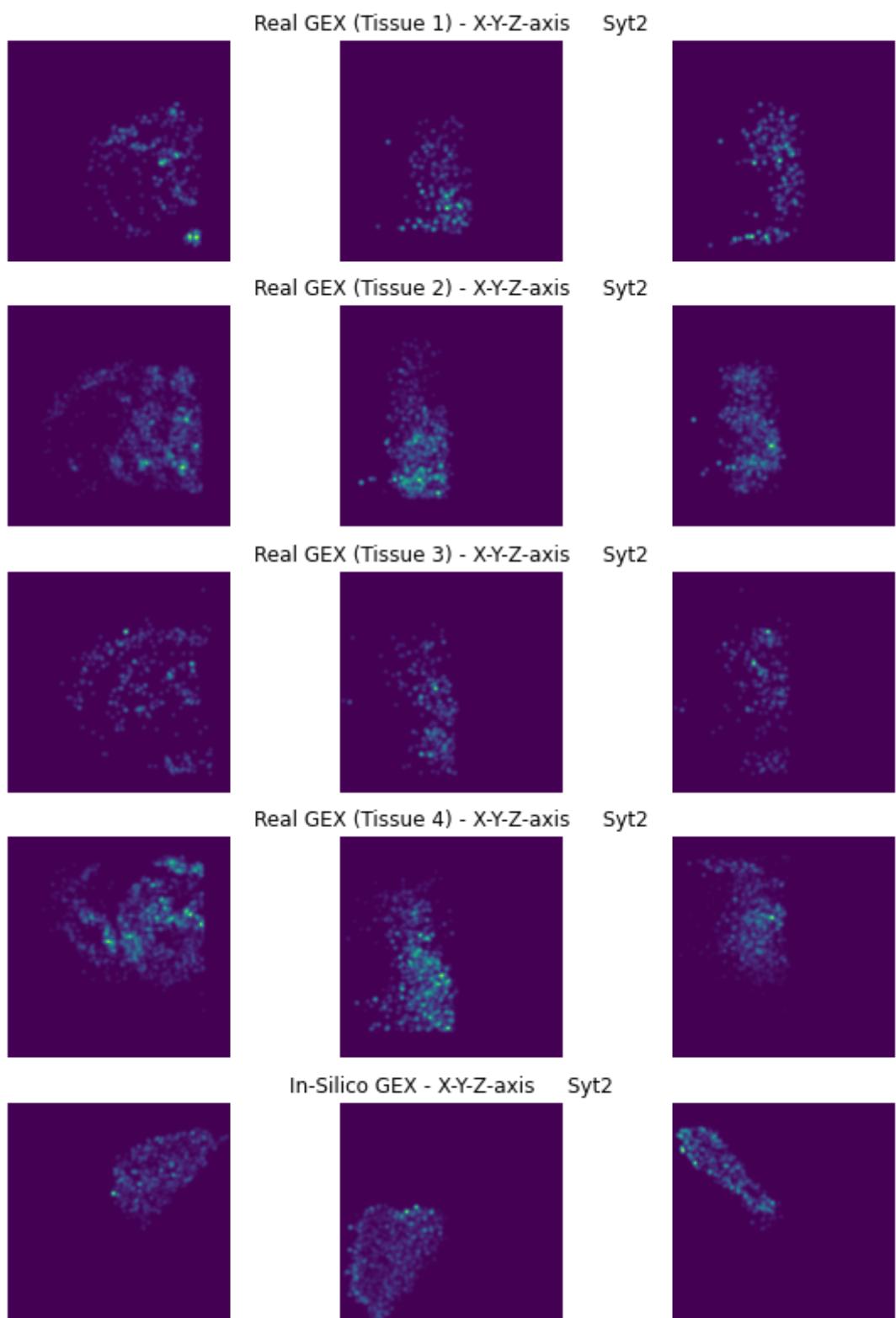
Real GEX (Tissue 4) - X-Y-Z-axis Htr2a



In-Silico GEX - X-Y-Z-axis Htr2a

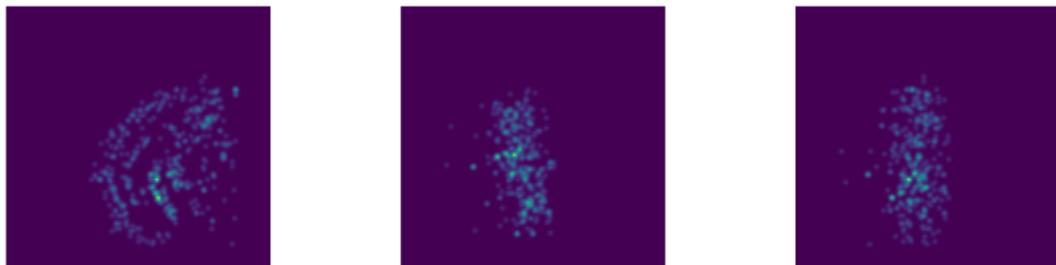


Real GEX Syt2

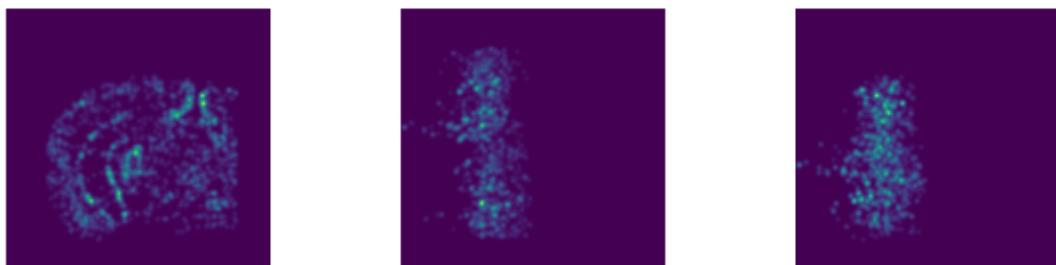


Real GEX Nell1

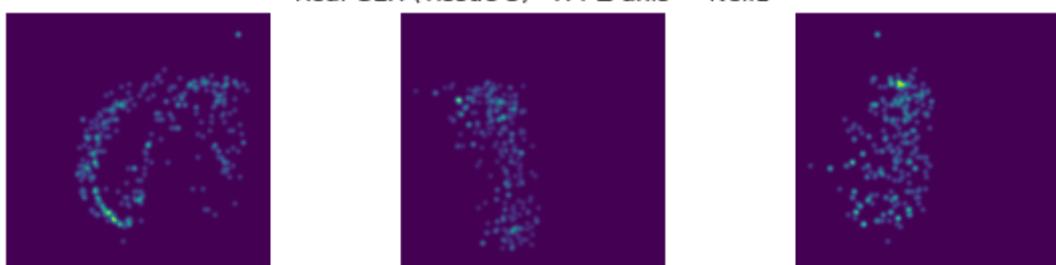
Real GEX (Tissue 1) - X-Y-Z-axis Nell1



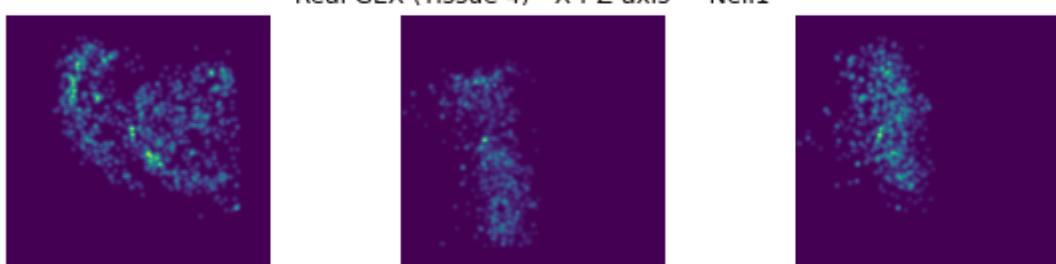
Real GEX (Tissue 2) - X-Y-Z-axis Nell1



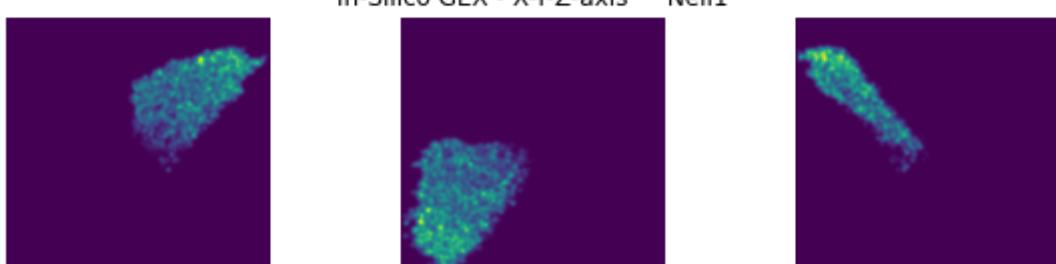
Real GEX (Tissue 3) - X-Y-Z-axis Nell1



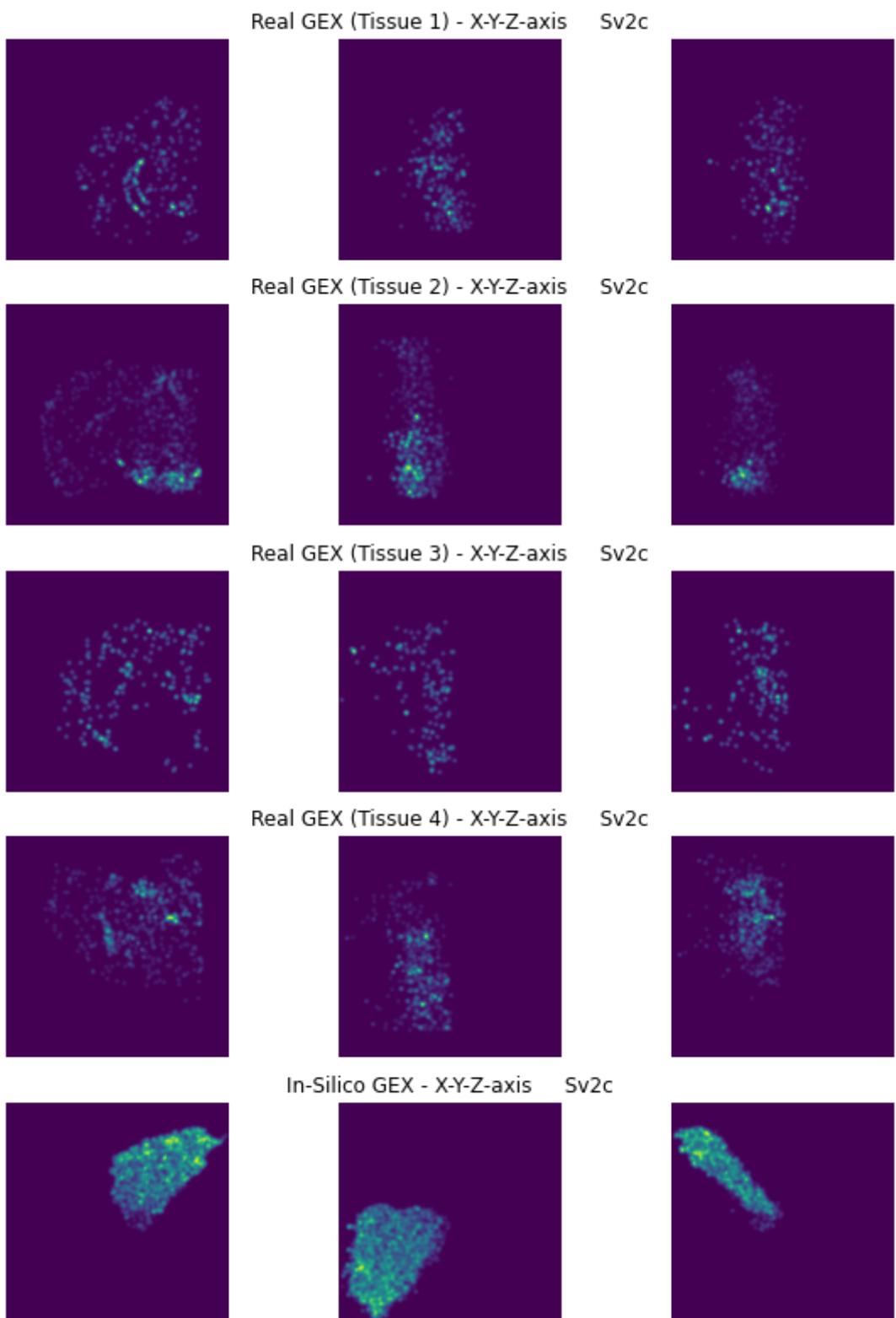
Real GEX (Tissue 4) - X-Y-Z-axis Nell1



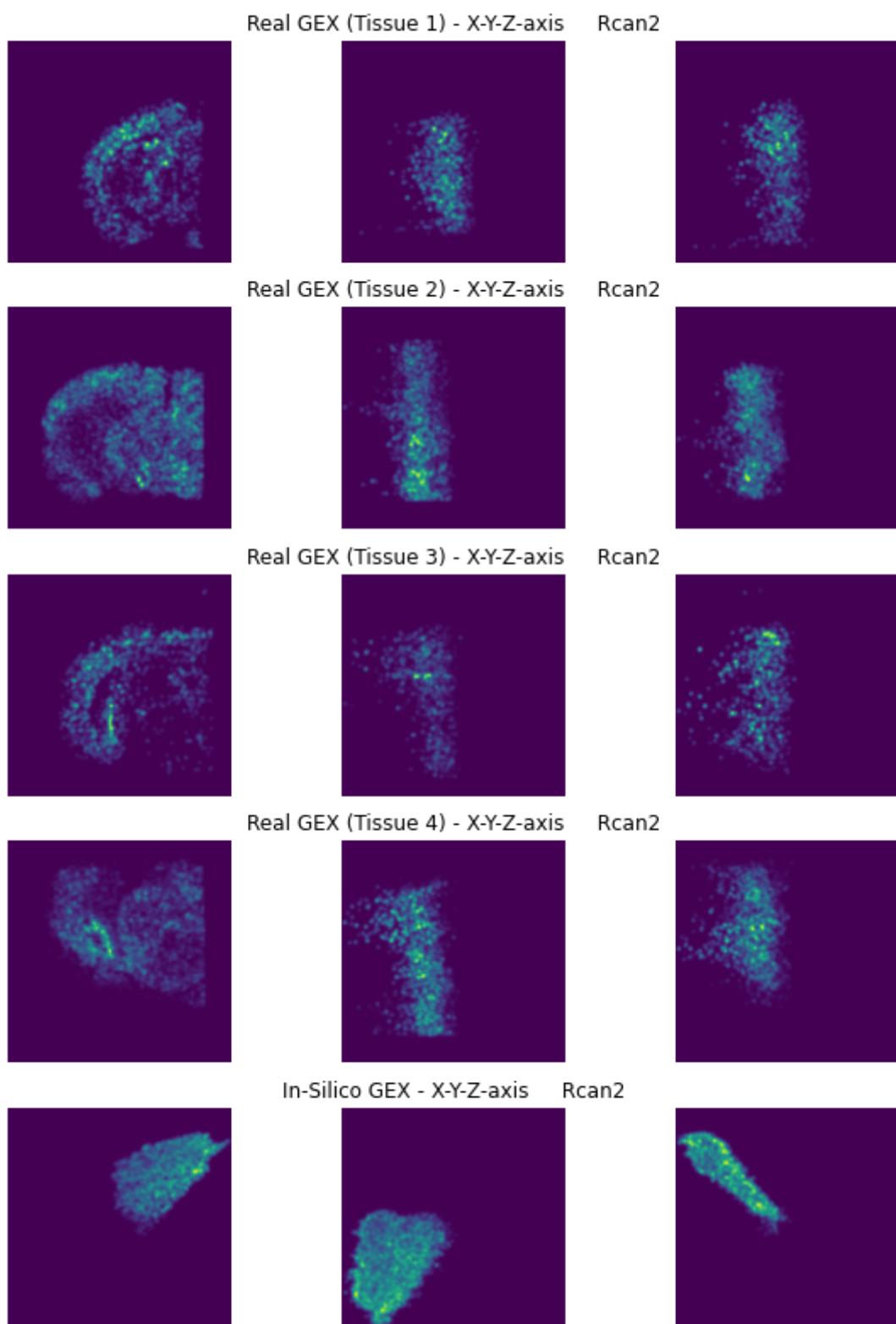
In-Silico GEX - X-Y-Z-axis Nell1



Real GEX Sv2c

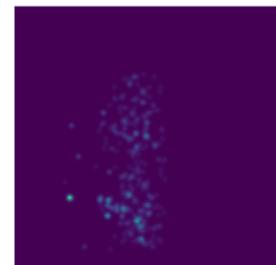
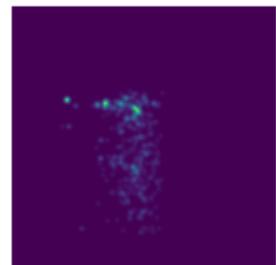
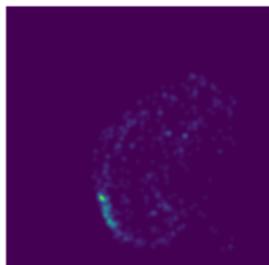


Real GEX Rcan2

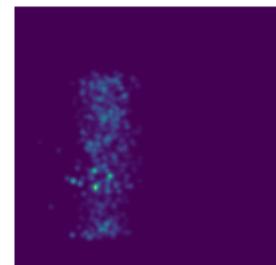
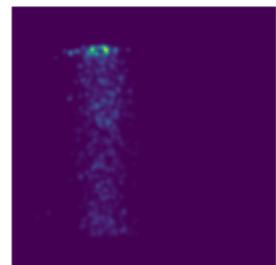
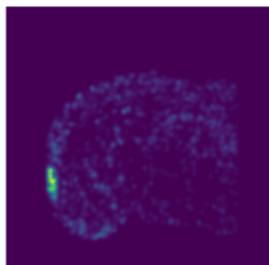


Real GEX Reln

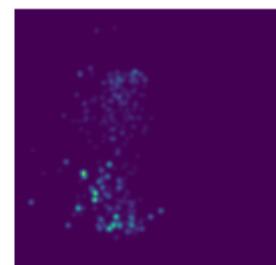
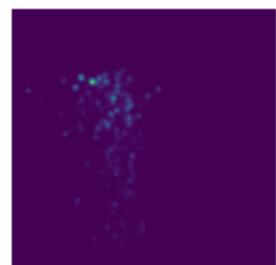
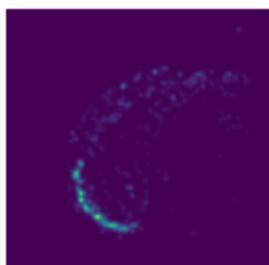
Real GEX (Tissue 1) - X-Y-Z-axis Reln



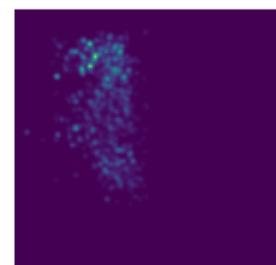
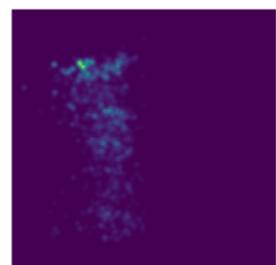
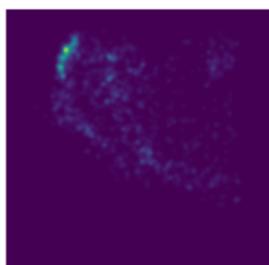
Real GEX (Tissue 2) - X-Y-Z-axis Reln



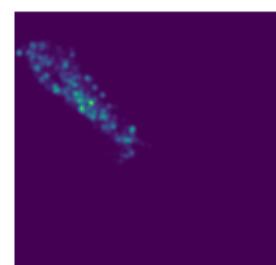
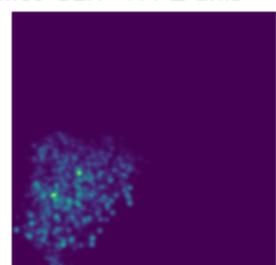
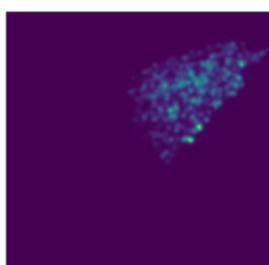
Real GEX (Tissue 3) - X-Y-Z-axis Reln



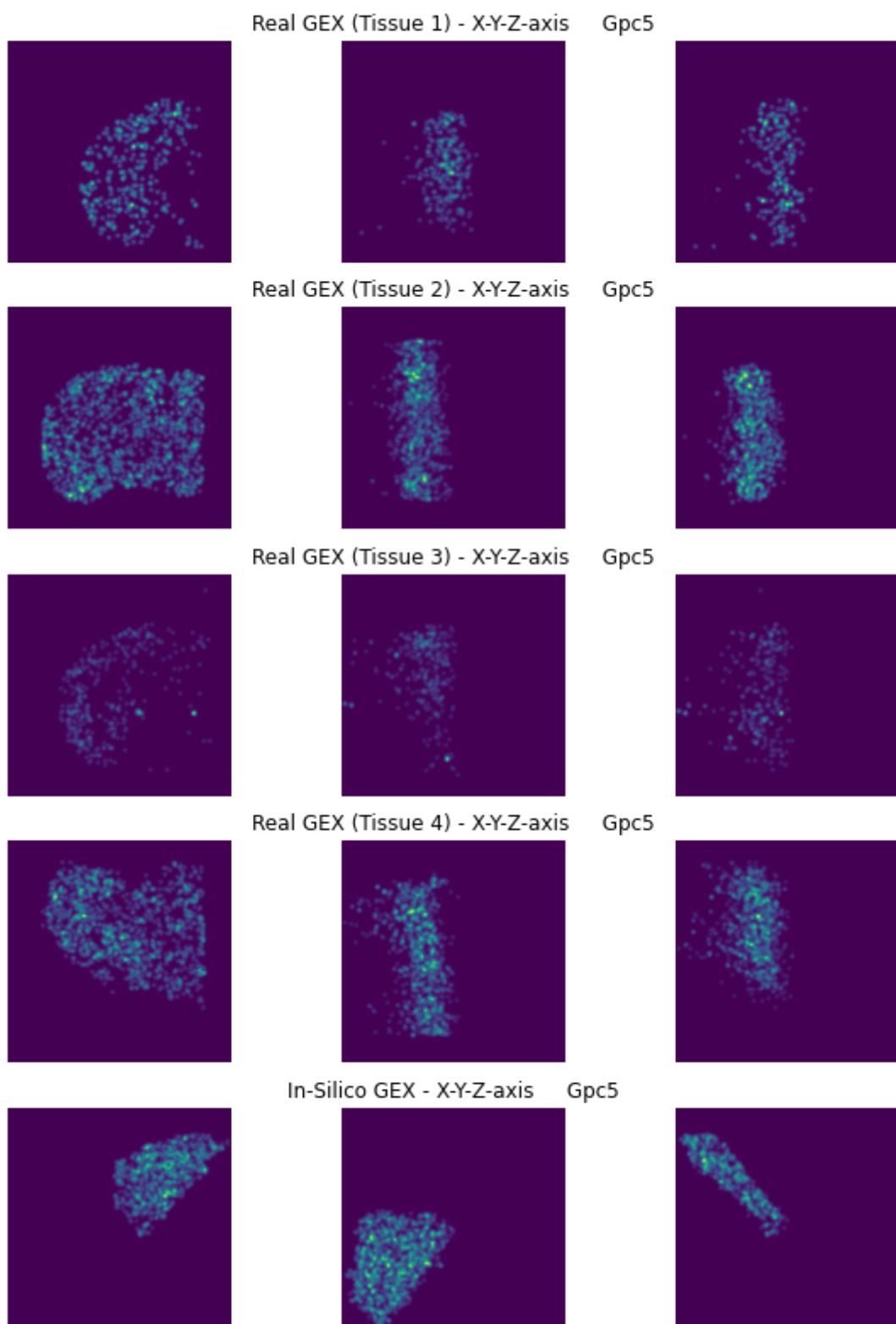
Real GEX (Tissue 4) - X-Y-Z-axis Reln



In-Silico GEX - X-Y-Z-axis Reln

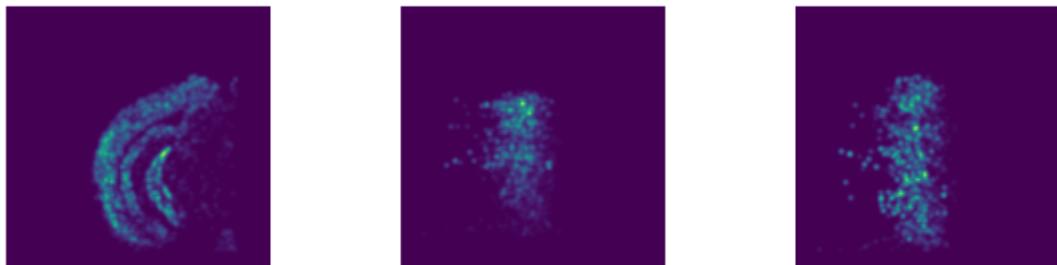


Real GEX Gpc5

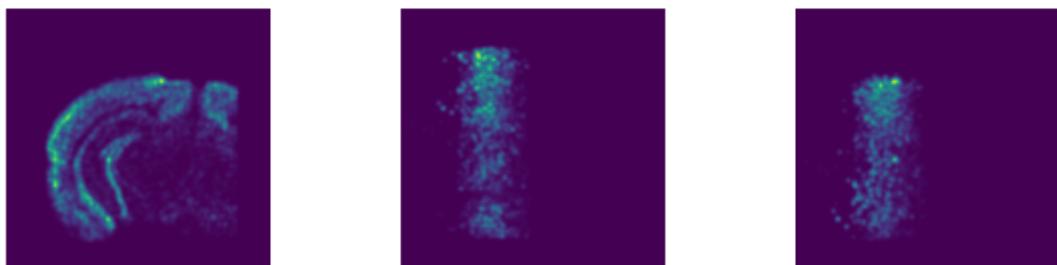


Real GEX Lmo4

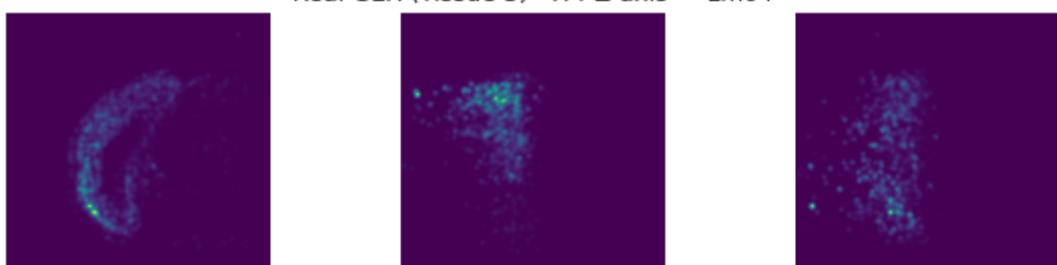
Real GEX (Tissue 1) - X-Y-Z-axis Lmo4



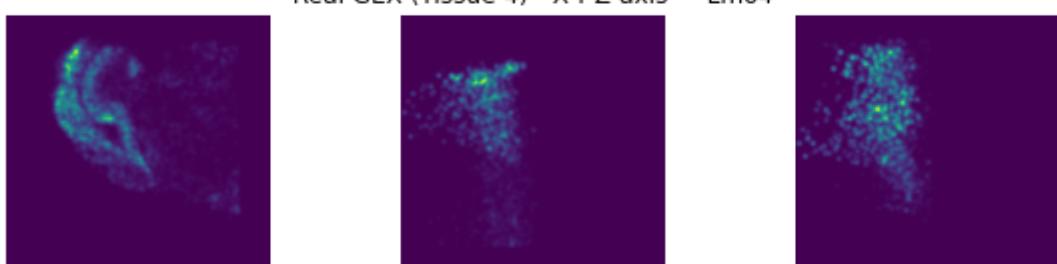
Real GEX (Tissue 2) - X-Y-Z-axis Lmo4



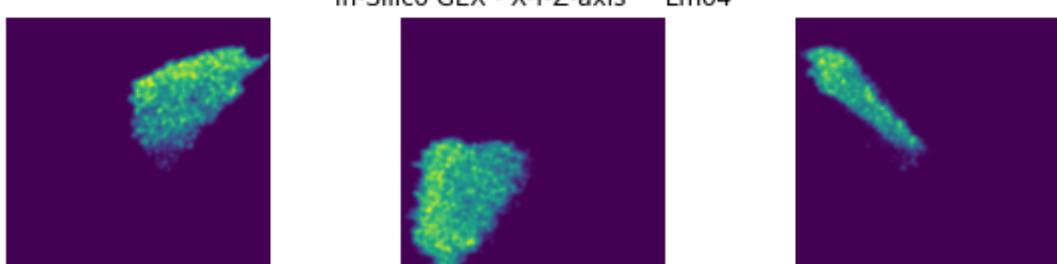
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Real GEX (Tissue 4) - X-Y-Z-axis Lmo4

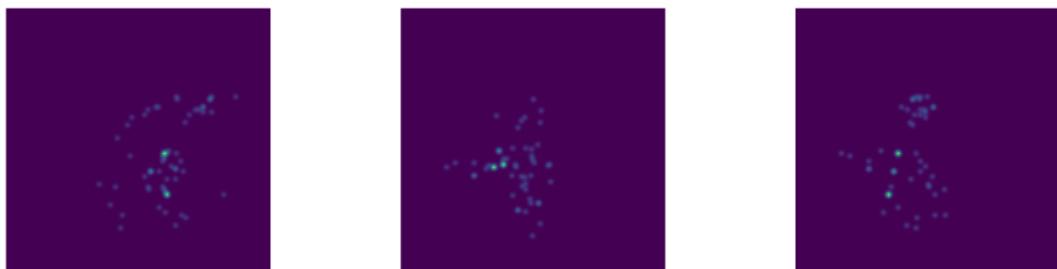


In-Silico GEX - X-Y-Z-axis Lmo4

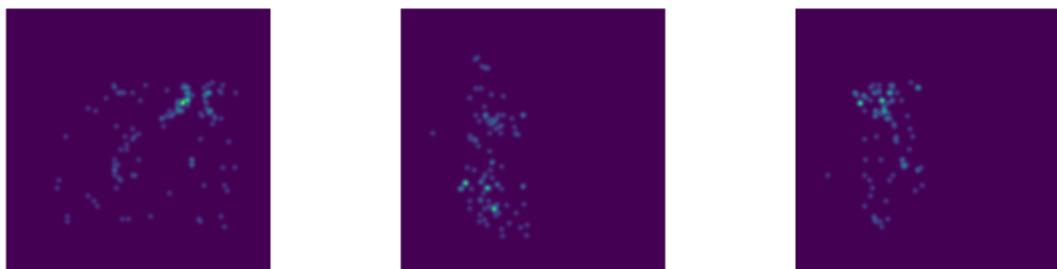


Real GEX Scnn1a

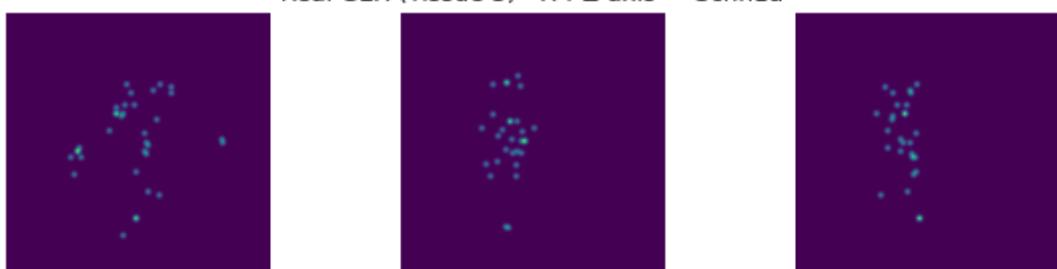
Real GEX (Tissue 1) - X-Y-Z-axis Scnn1a



Real GEX (Tissue 2) - X-Y-Z-axis Scnn1a



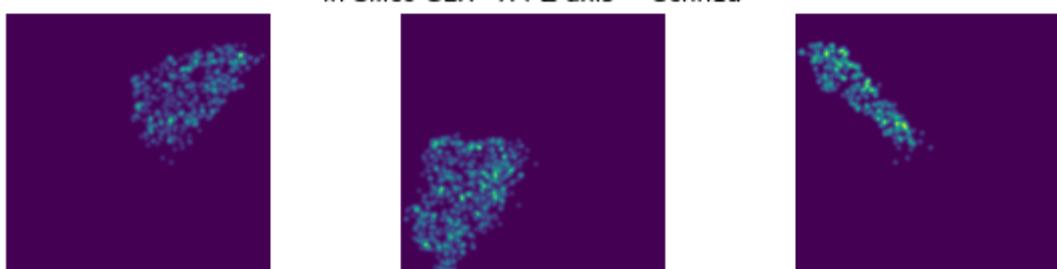
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Real GEX (Tissue 4) - X-Y-Z-axis Scnn1a

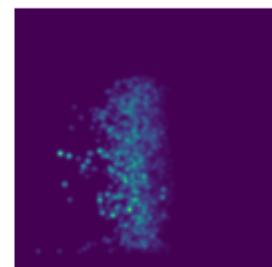
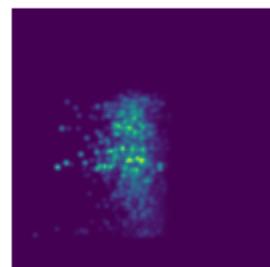
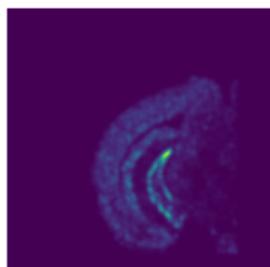


In-Silico GEX - X-Y-Z-axis Scnn1a

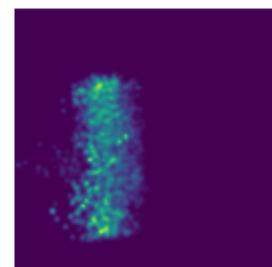
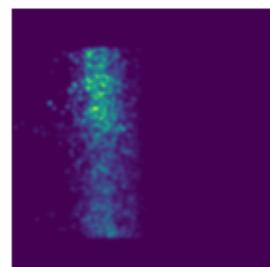
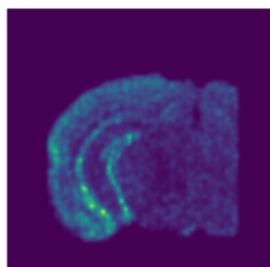


Real GEX Actb

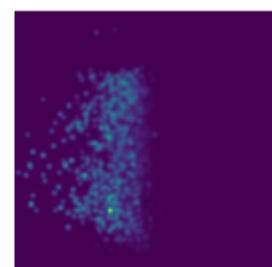
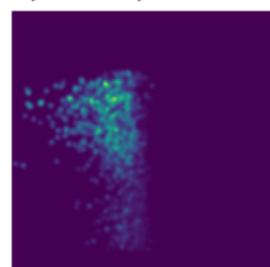
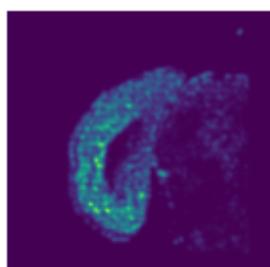
Real GEX (Tissue 1) - X-Y-Z-axis Actb



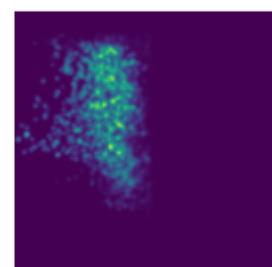
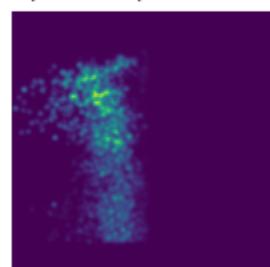
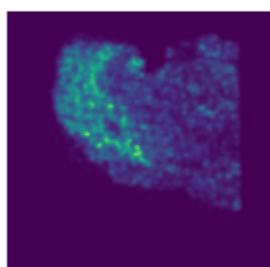
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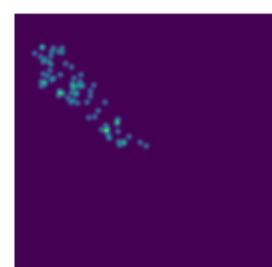
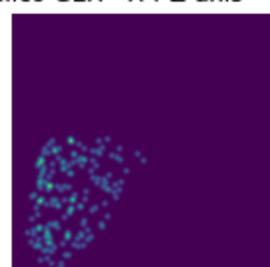
Real GEX (Tissue 3) - X-Y-Z-axis Actb



Real GEX (Tissue 4) - X-Y-Z-axis Actb

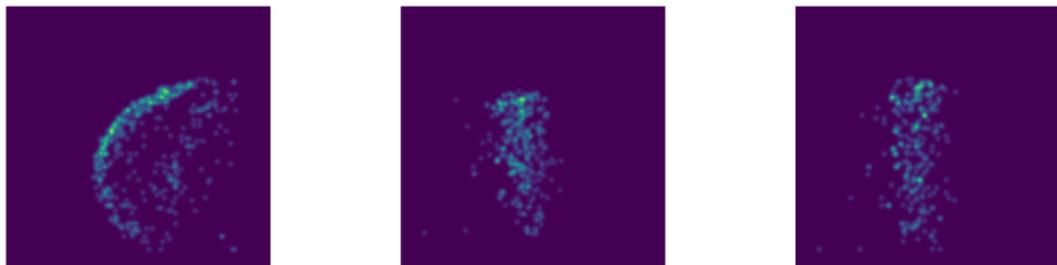


In-Silico GEX - X-Y-Z-axis Actb

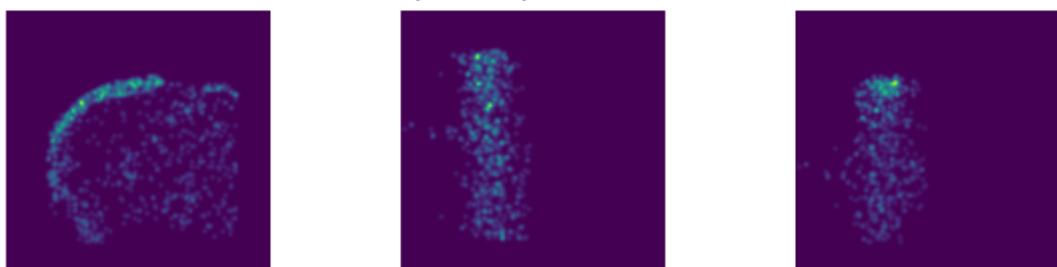


Real GEX Cux2

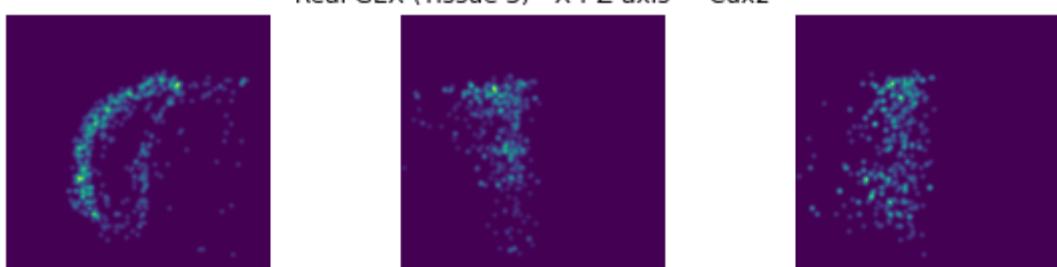
Real GEX (Tissue 1) - X-Y-Z-axis Cux2



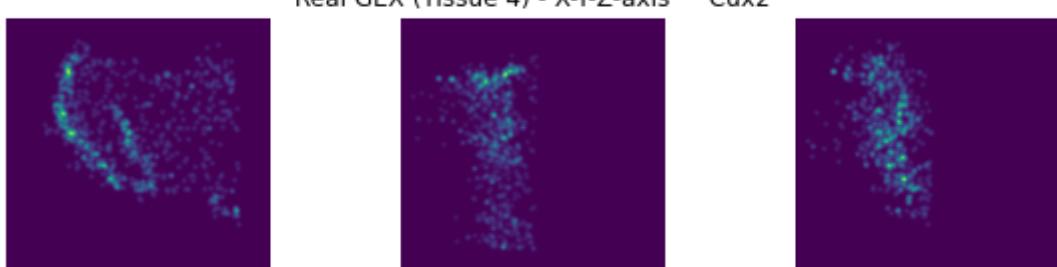
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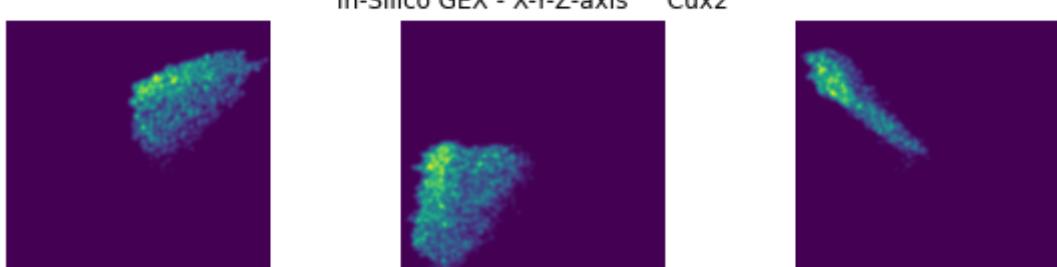
Real GEX (Tissue 3) - X-Y-Z-axis Cux2



Real GEX (Tissue 4) - X-Y-Z-axis Cux2

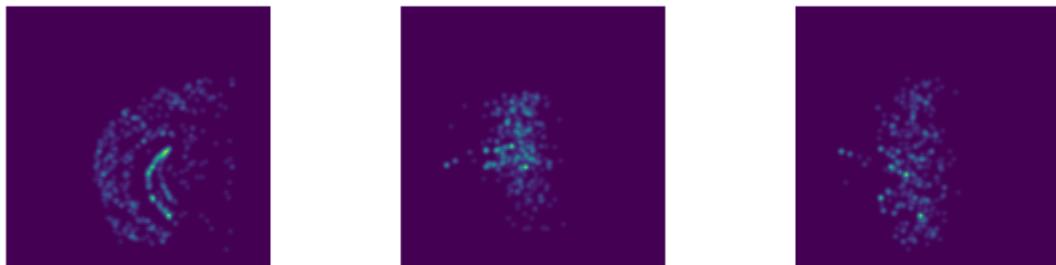


In-Silico GEX - X-Y-Z-axis Cux2

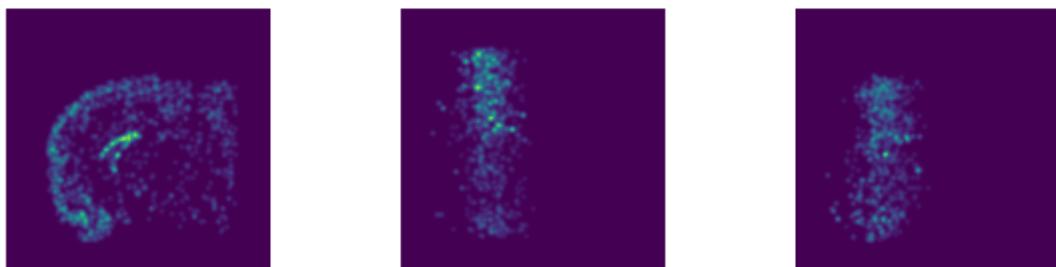


Real GEX Lrrtm4

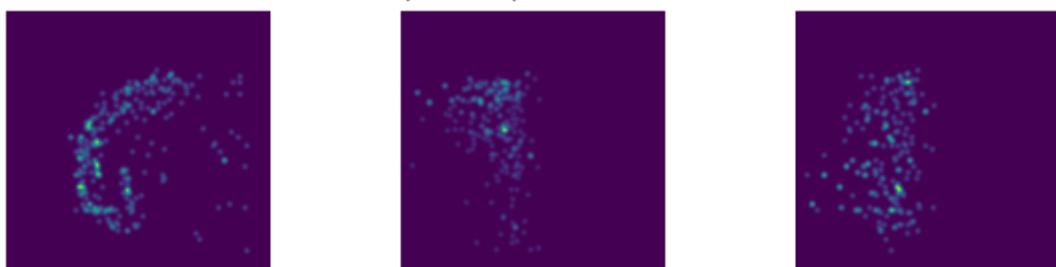
Real GEX (Tissue 1) - X-Y-Z-axis Lrrtm4



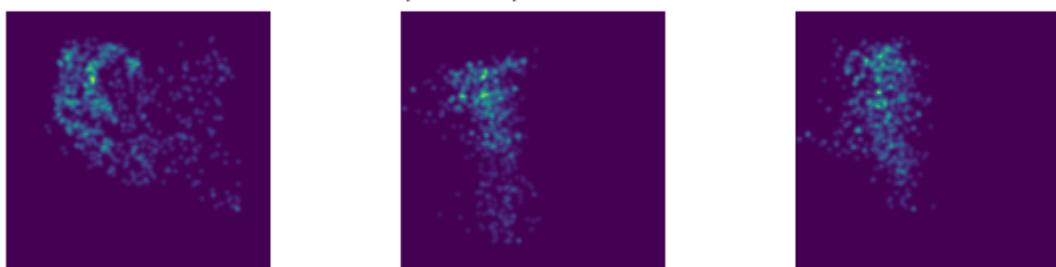
Real GEX (Tissue 2) - X-Y-Z-axis Lrrtm4



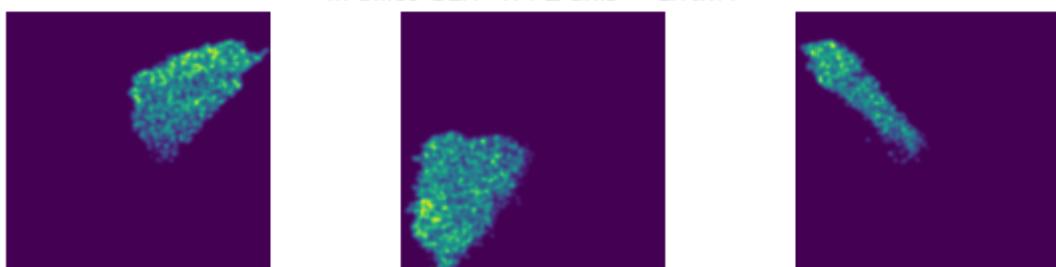
Real GEX (Tissue 3) - X-Y-Z-axis Lrrtm4



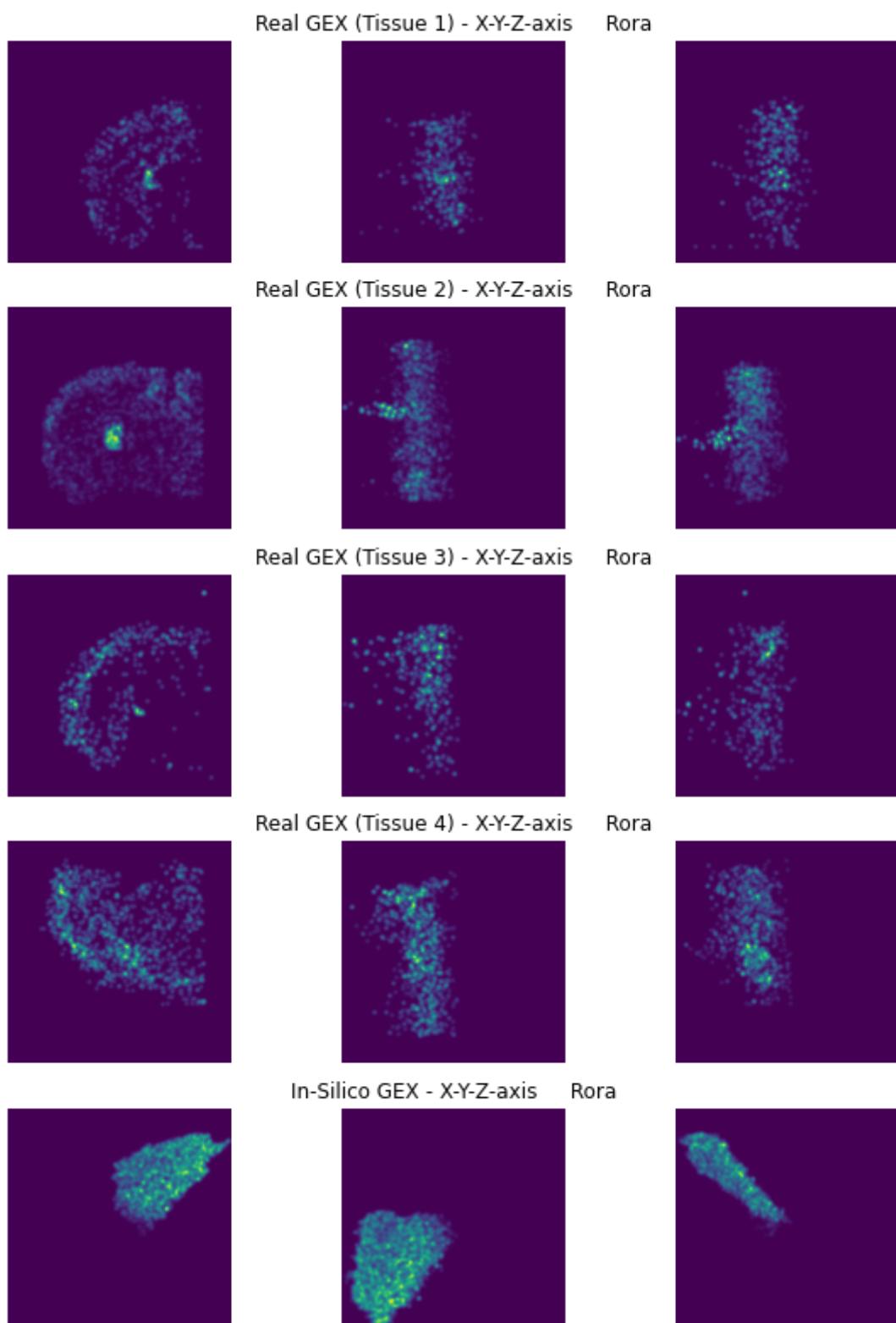
Real GEX (Tissue 4) - X-Y-Z-axis Lrrtm4



In-Silico GEX - X-Y-Z-axis Lrrtm4

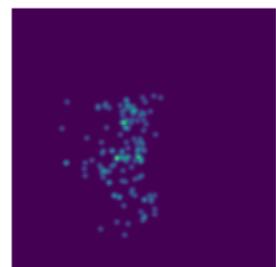
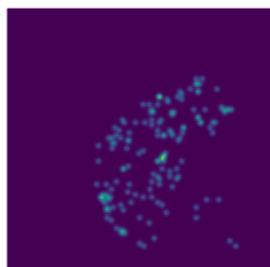


Real GEX Rora

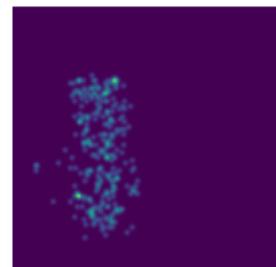
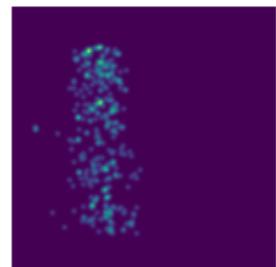
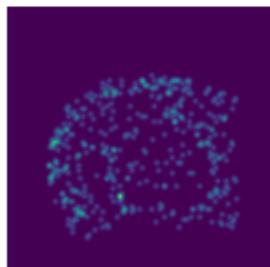


Real GEX Fat3

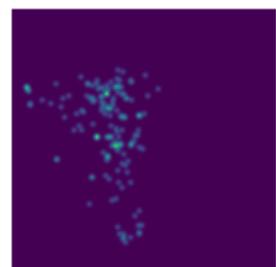
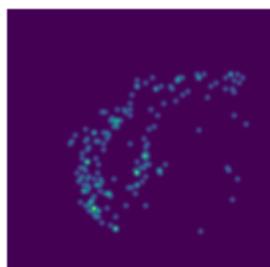
Real GEX (Tissue 1) - X-Y-Z-axis Fat3



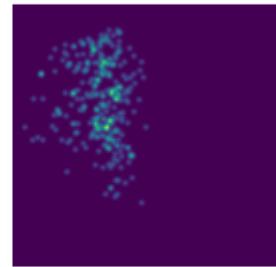
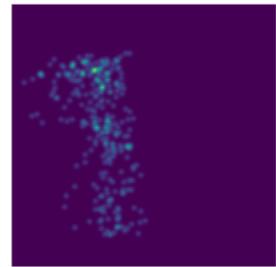
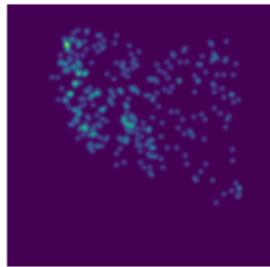
Real GEX (Tissue 2) - X-Y-Z-axis Fat3



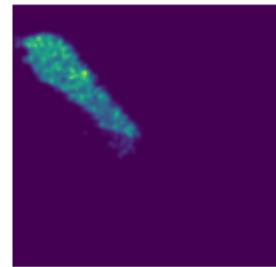
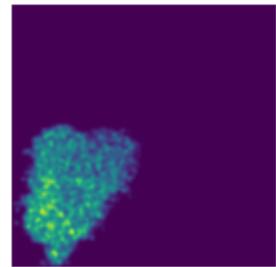
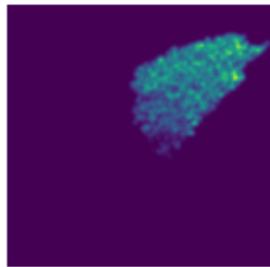
Real GEX (Tissue 3) - X-Y-Z-axis Fat3



Real GEX (Tissue 4) - X-Y-Z-axis Fat3

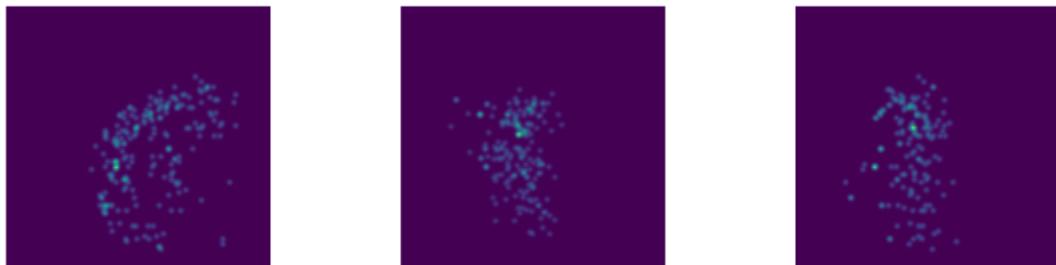


In-Silico GEX - X-Y-Z-axis Fat3

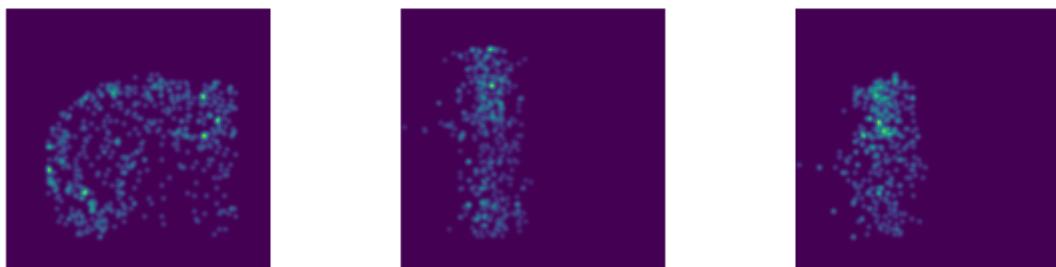


Real GEX Tenm3

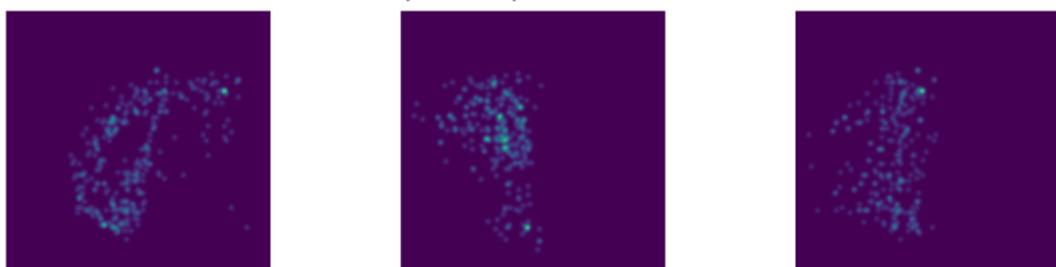
Real GEX (Tissue 1) - X-Y-Z-axis Tenm3



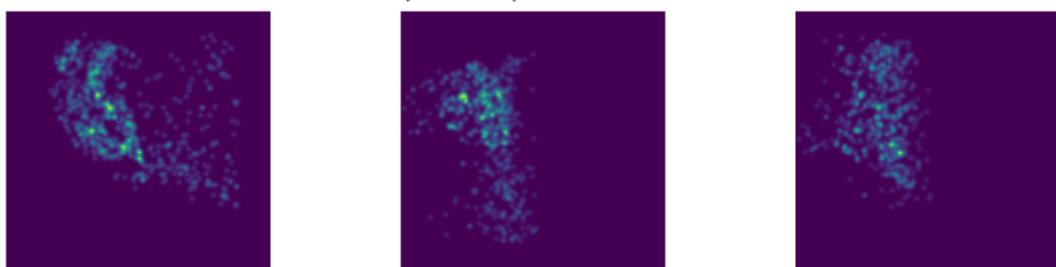
Real GEX (Tissue 2) - X-Y-Z-axis Tenm3



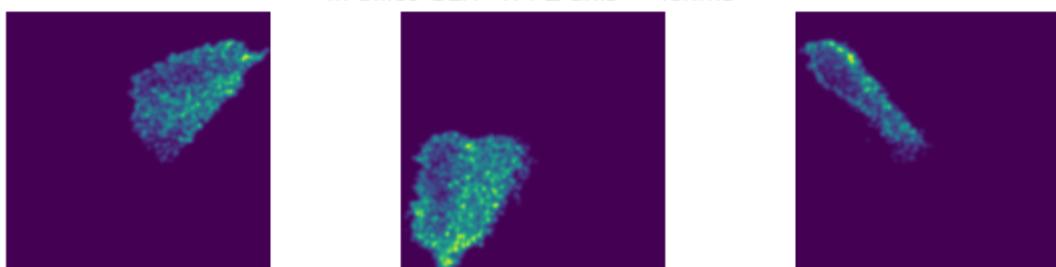
Real GEX (Tissue 3) - X-Y-Z-axis Tenm3



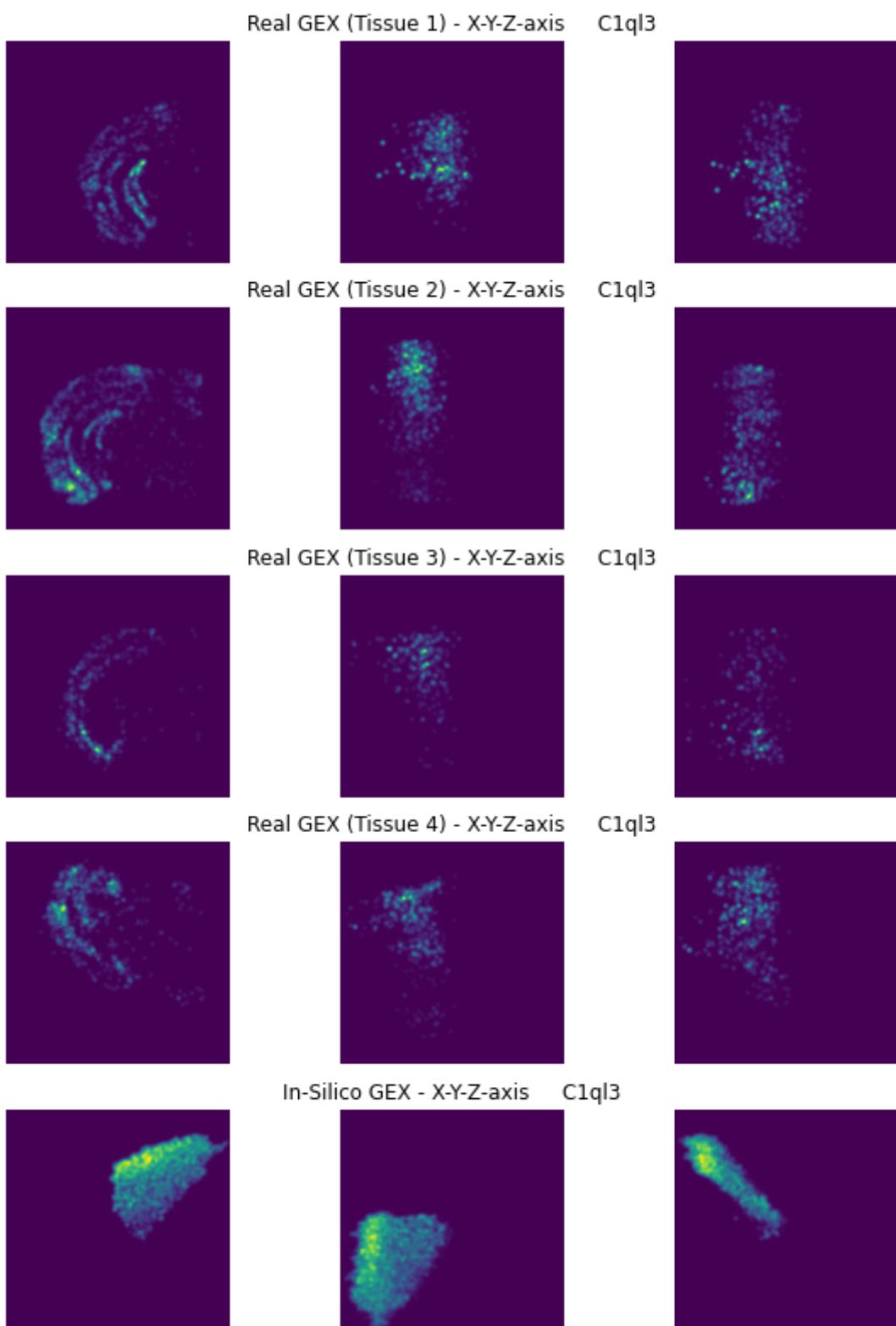
Real GEX (Tissue 4) - X-Y-Z-axis Tenm3



In-Silico GEX - X-Y-Z-axis Tenm3

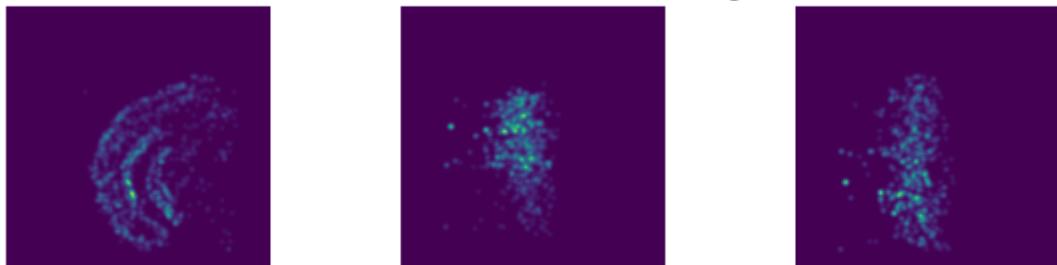


Real GEX C1q|3

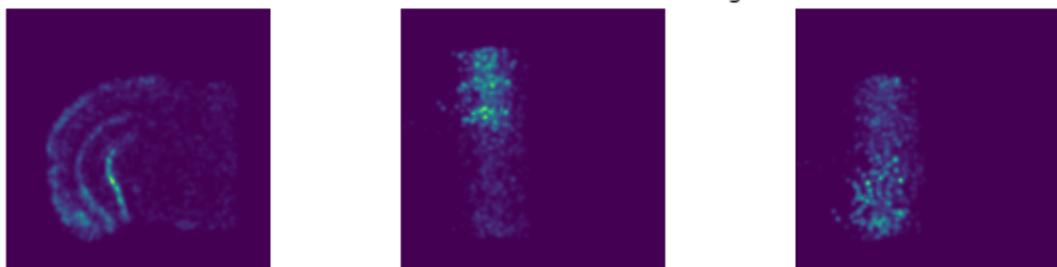


Real GEX Dgkb

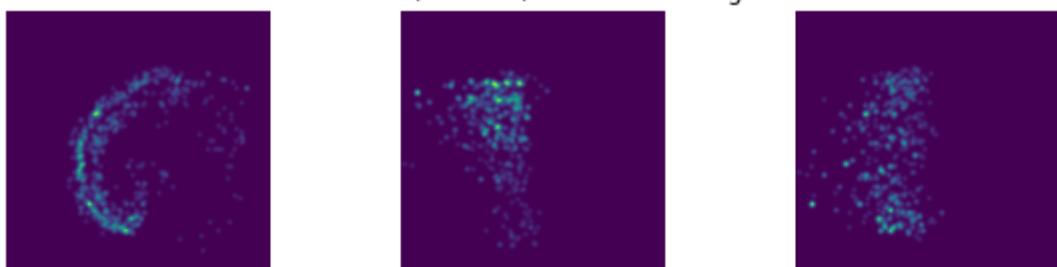
Real GEX (Tissue 1) - X-Y-Z-axis Dgkb



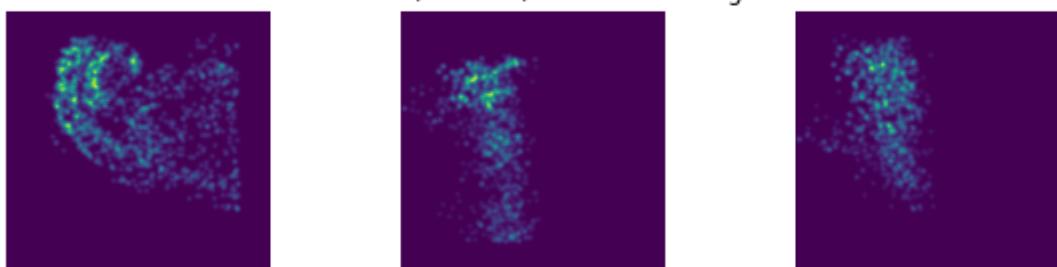
Real GEX (Tissue 2) - X-Y-Z-axis Dgkb



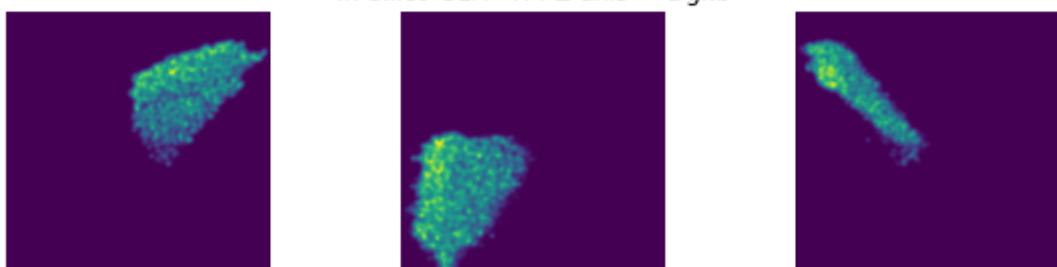
Real GEX (Tissue 3) - X-Y-Z-axis Dgkb



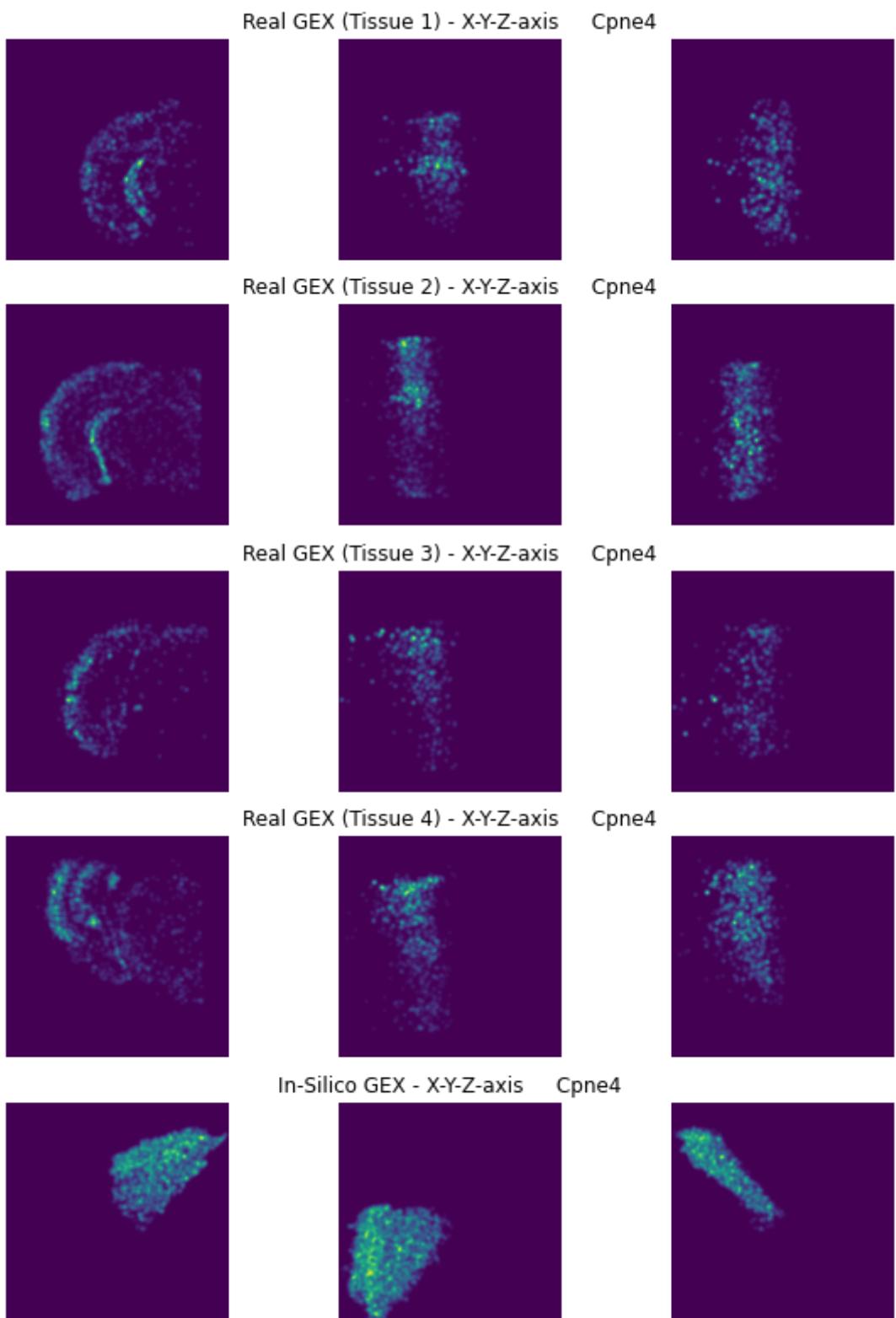
Real GEX (Tissue 4) - X-Y-Z-axis Dgkb



In-Silico GEX - X-Y-Z-axis Dgkb

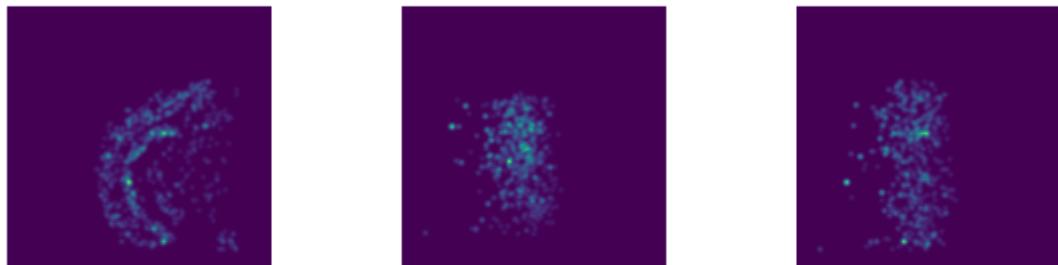


Real GEX Cpne4

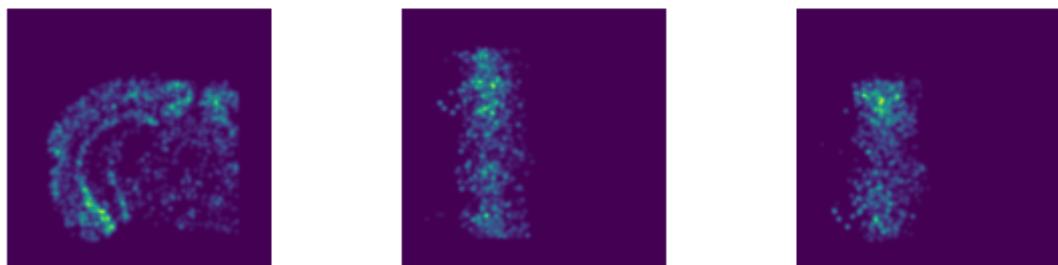


Real GEX Hcn1

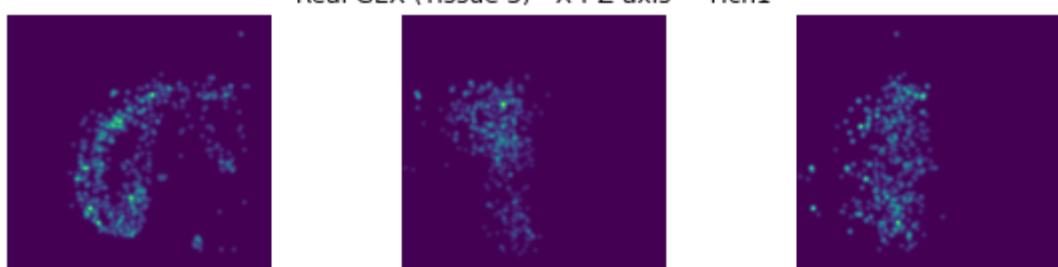
Real GEX (Tissue 1) - X-Y-Z-axis Hcn1



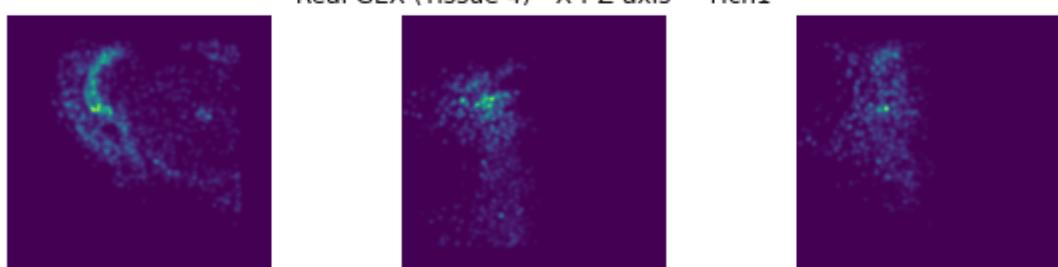
Real GEX (Tissue 2) - X-Y-Z-axis Hcn1



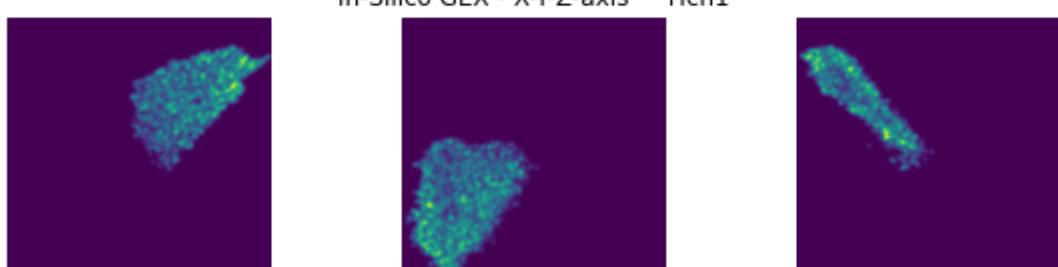
Real GEX (Tissue 3) - X-Y-Z-axis Hcn1



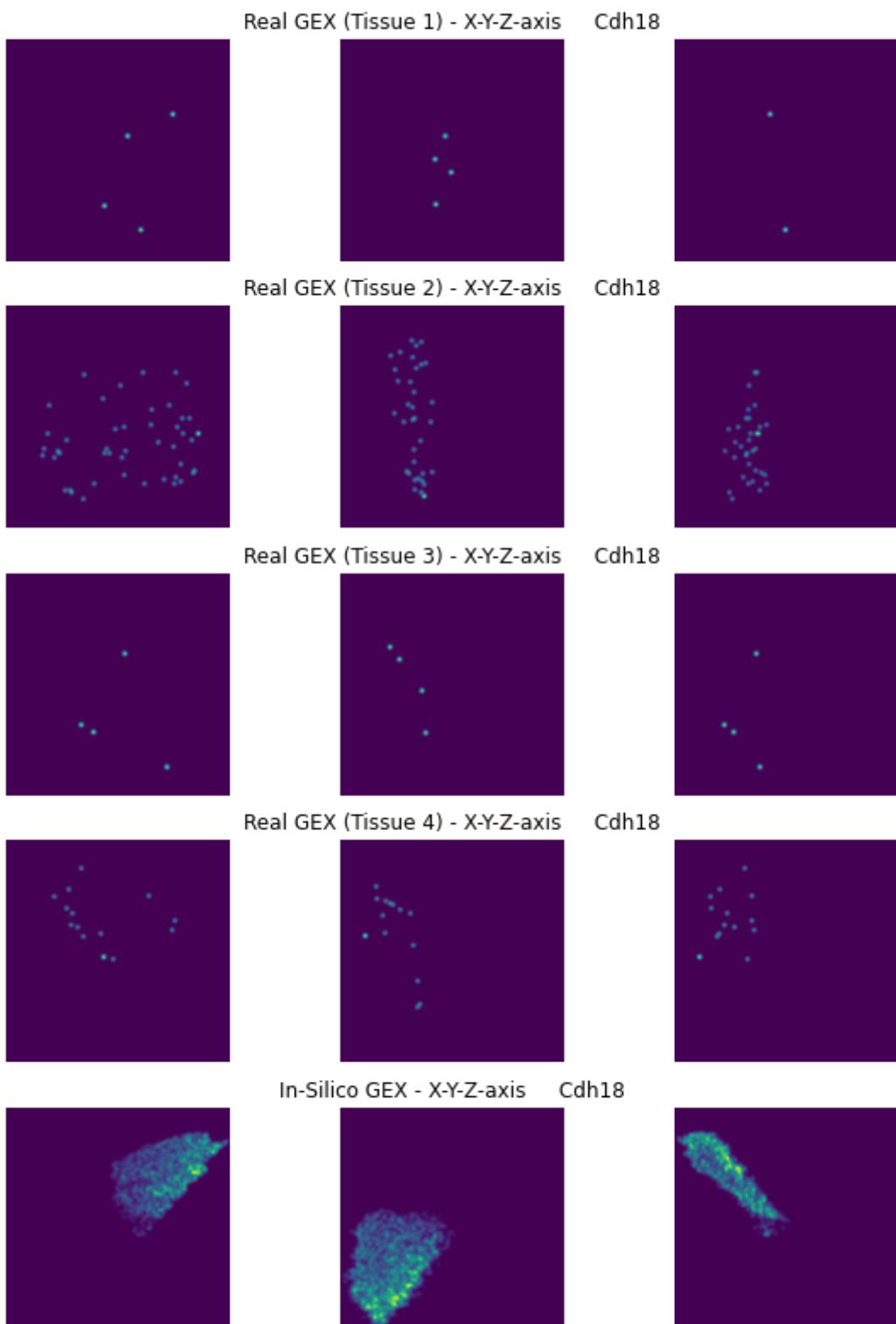
Real GEX (Tissue 4) - X-Y-Z-axis Hcn1



In-Silico GEX - X-Y-Z-axis Hcn1

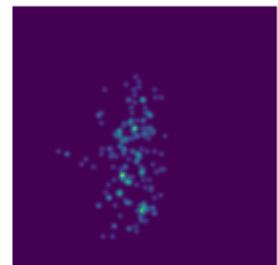
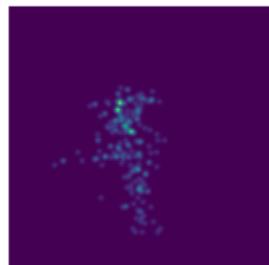
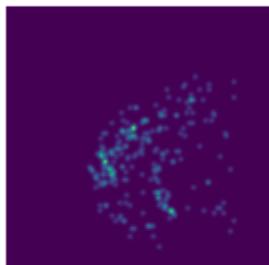


Real GEX Cdh18

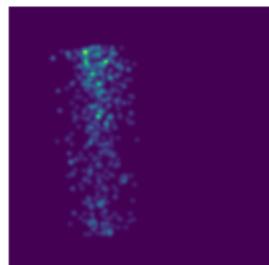
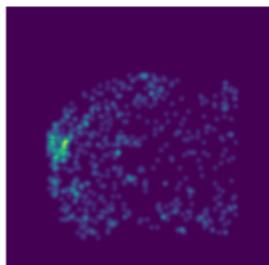


Real GEX Gnb4

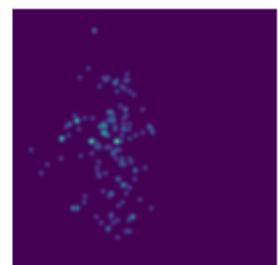
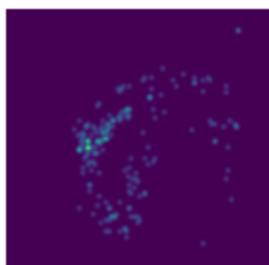
Real GEX (Tissue 1) - X-Y-Z-axis Gnb4



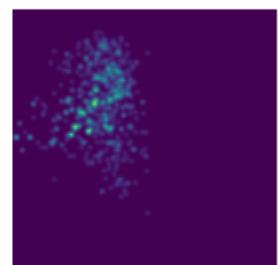
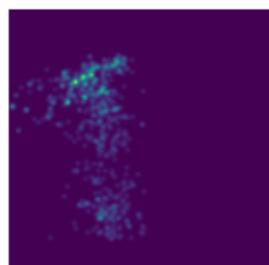
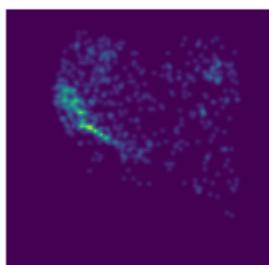
Real GEX (Tissue 2) - X-Y-Z-axis Gnb4



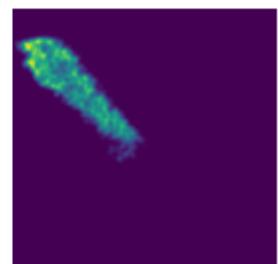
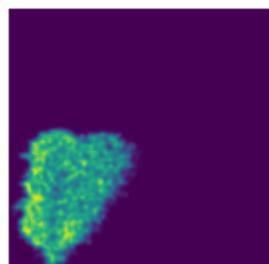
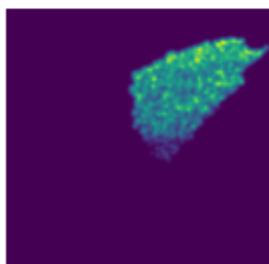
Real GEX (Tissue 3) - X-Y-Z-axis Gnb4



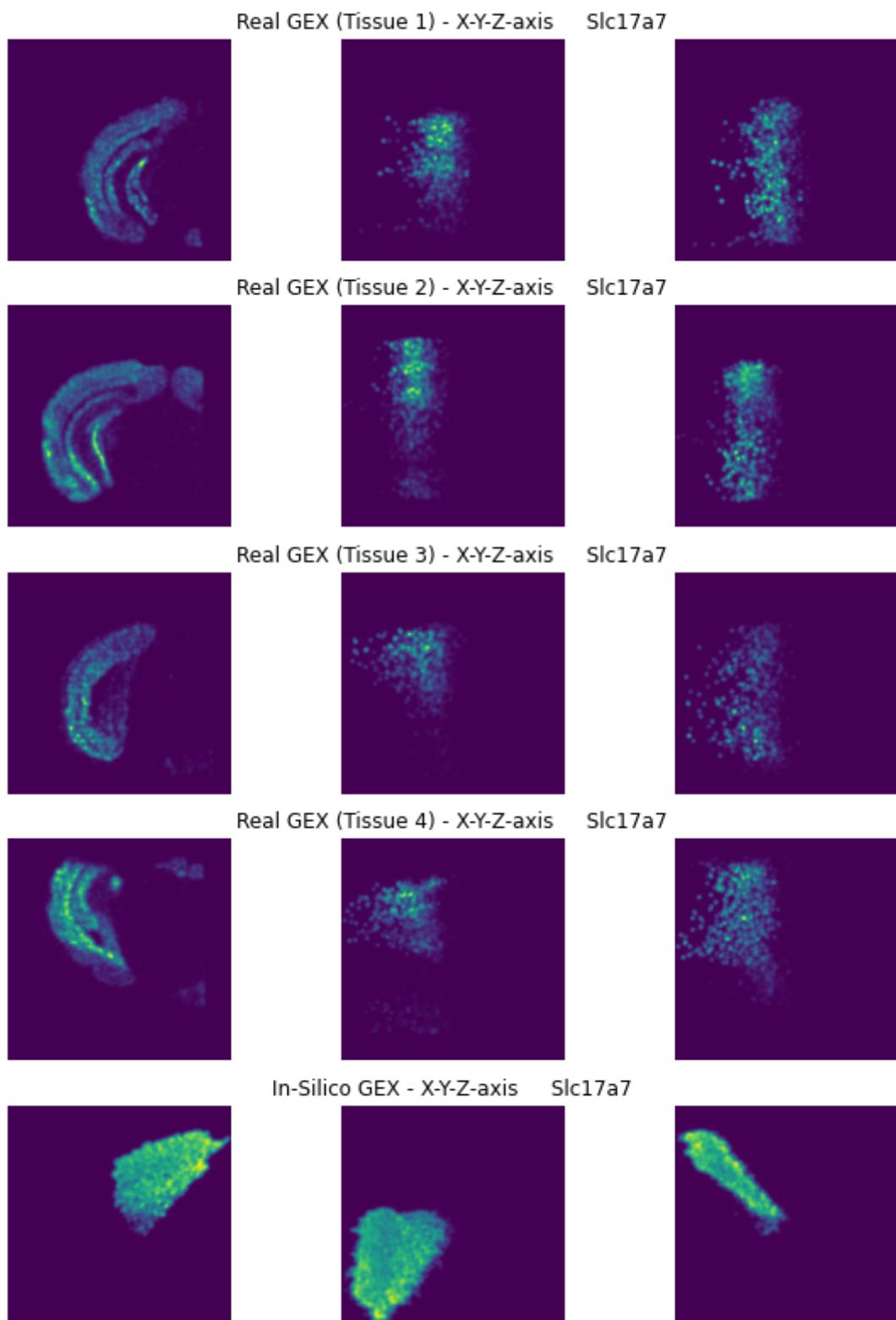
Real GEX (Tissue 4) - X-Y-Z-axis Gnb4



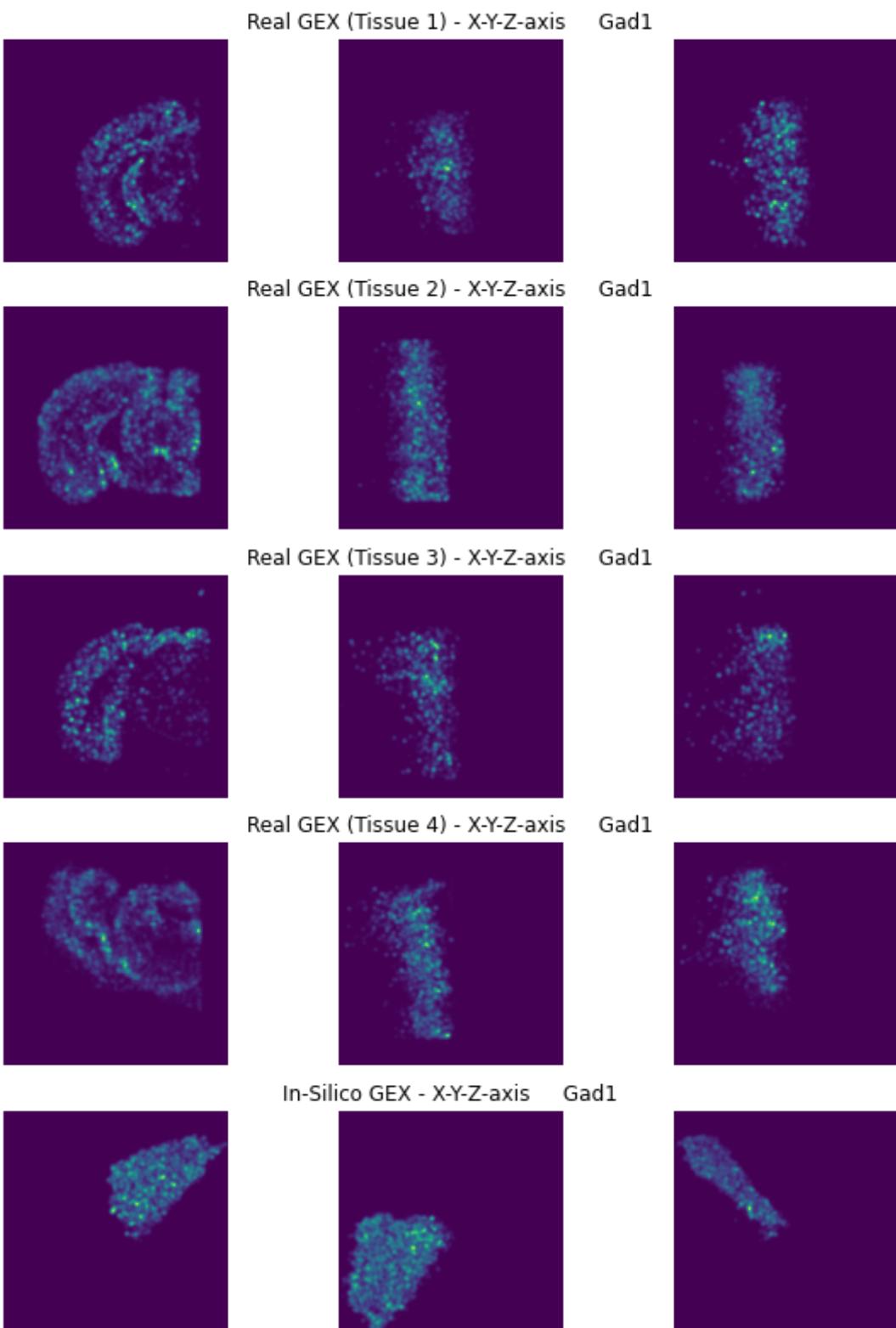
In-Silico GEX - X-Y-Z-axis Gnb4



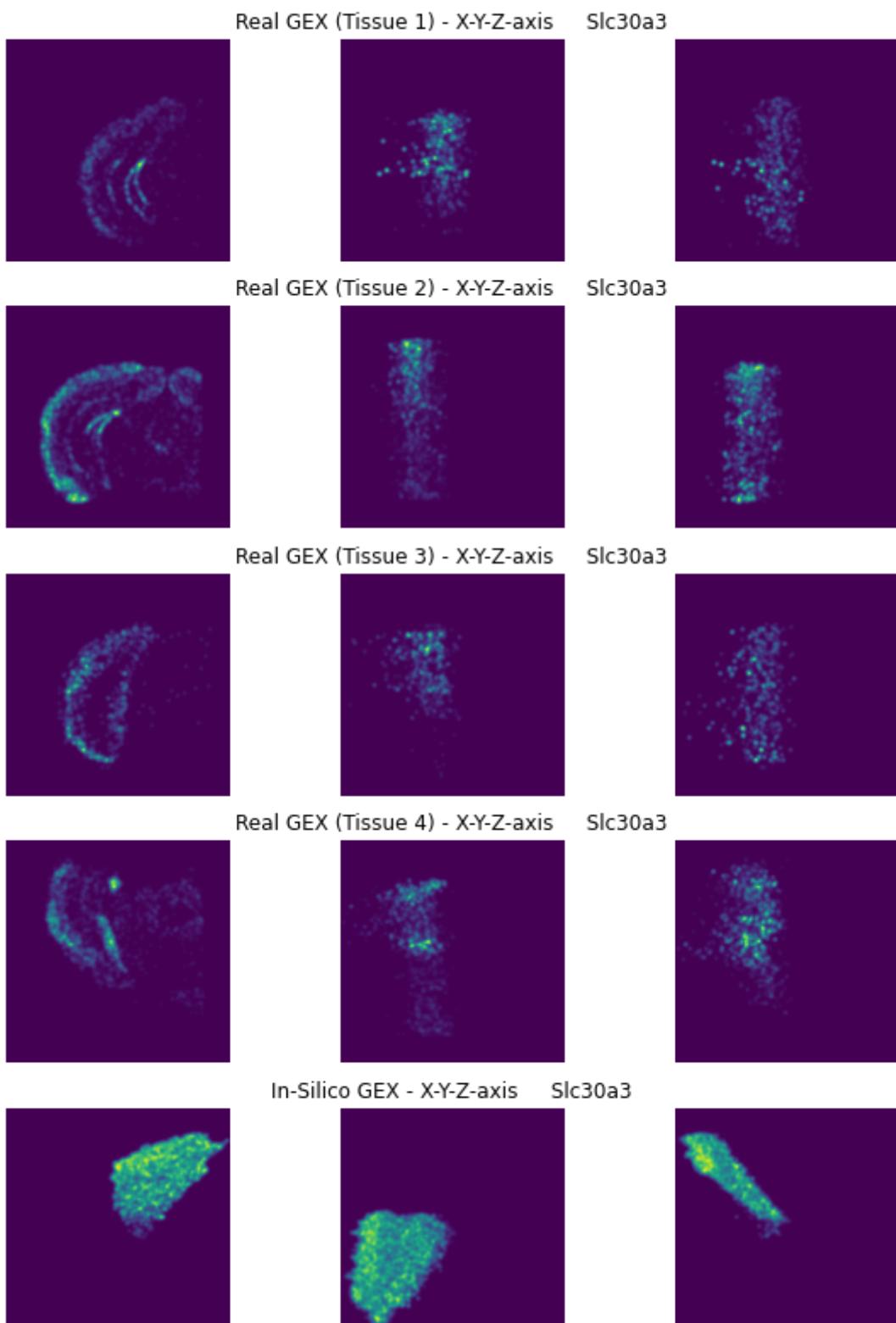
Real GEX Slc17a7



Real GEX Gad1



Real GEX Slc30a3



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