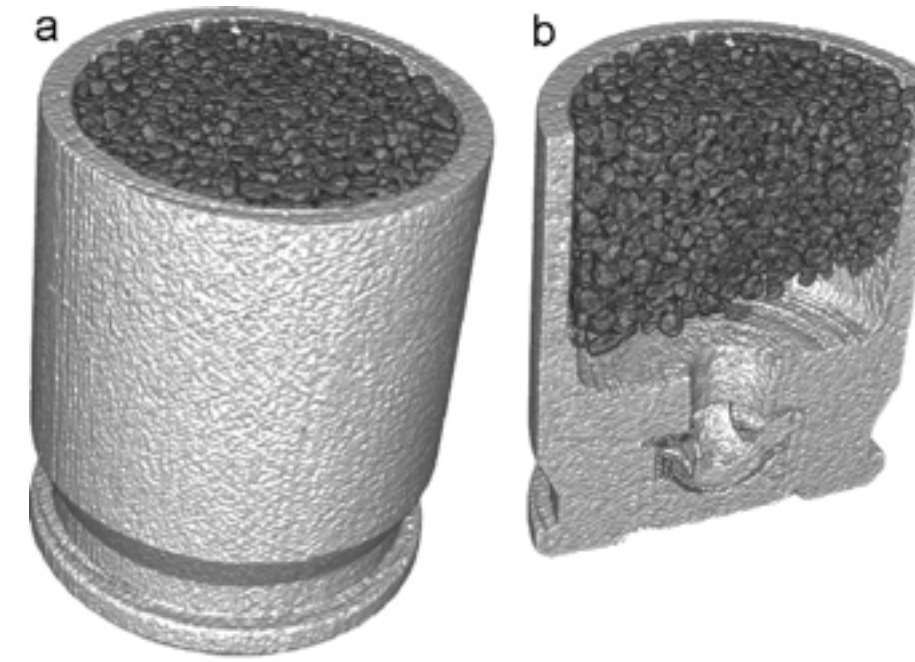


ImageJ: binary files and HDF5 files exploration of the bullet volume



cartridge

To prepare:

- 1) Moodle: download Week 1 /bullet dataset (binary, 26.8 MB)
- 2) Moodle: download Week 2 /bullet dataset (HDF5, 107 MB)
- 3) Launch your ImageJ. Does Plugins /HDF5 exist? If not, double check Week 0 /Installing ImageJ (NIH) /Download the HDF5 plugin instructions.

filenames and file sizes

volume_bullet_p134_uint16.bin, 26,808,246 bytes

volume_bullet_p134.h5, 107,235,032 bytes

```
In[24]:= listOfFileNames = FileNames["volume*", NotebookDirectory[]]
Map[FileByteCount, listOfFileNames]
```

```
Out[24]= {/Users/lesbutler/Documents/h4581/volume_bullet_p134.h5,
/Users/lesbutler/Documents/h4581/volume_bullet_p134_uint16.bin}
```

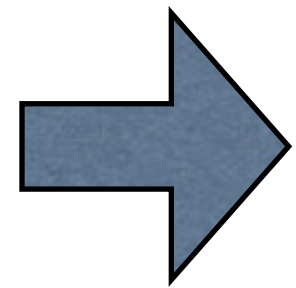
```
Out[25]= {107 235 032, 26 808 246}
```

```
In[33]:= volume = Import[listOfFileNames[[1]], {"Datasets", "/volume"}];
{rows, columns, slices} = Dimensions[volume]
```

```
Out[34]= {243, 243, 227}
```

```
In[35]:= 243 × 243 × 227 × 2
```

```
Out[35]= 26 808 246
```



volume_bullet_p134_uint16.bin
is stored with 2 bytes per number

```
In[39]:= 243 × 243 × 227 × 8
```

```
Out[39]= 107 232 984
```

volume_bullet_p134.h5
is stored with 8 bytes per number plus a header
that is 2048 bytes long

```
In[40]:= 107 235 032 - %
```

```
Out[40]= 2048
```

Use ImageJ to inspect the binary file

volume_bullet_p134_uint16.bin, 26,808,246 bytes

```
In[24]:= listOfFileNames = FileNames["volume*", NotebookDirectory[]]  
Map[FileByteCount, listOfFileNames]
```

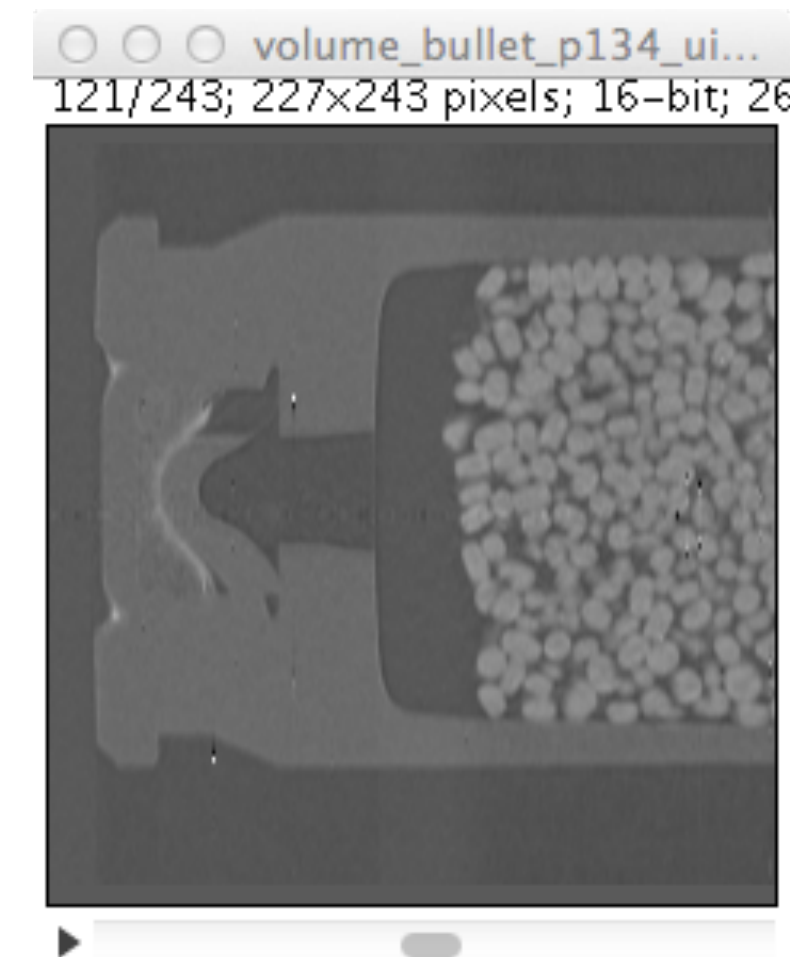
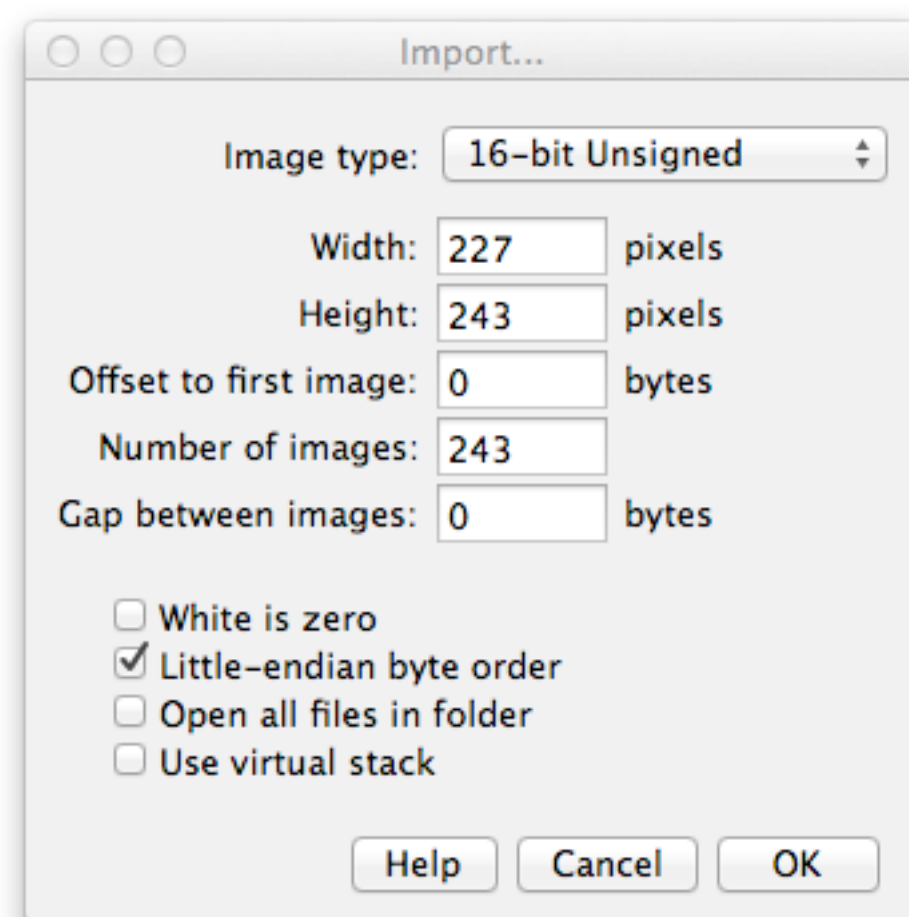
```
Out[24]= {/Users/lesbutler/Documents/h4581/volume_bullet_p134.h5,  
/Users/lesbutler/Documents/h4581/volume_bullet_p134_uint16.bin}
```

```
Out[25]= {107 235 032, 26 808 246}
```

```
In[33]:= volume = Import[listOfFileNames[[1]], {"Datasets", "/volume"}];  
{rows, columns, slices} = Dimensions[volume]
```

```
Out[34]= {243, 243, 227}
```

Use ImageJ File/Import/Raw



Use ImageJ to inspect the HDF5 file

volume_bullet_p134.h5, 107,235,032 bytes

```
In[24]:= listOfFileNames = FileNames["volume*", NotebookDirectory[]]  
Map[FileByteCount, listOfFileNames]
```

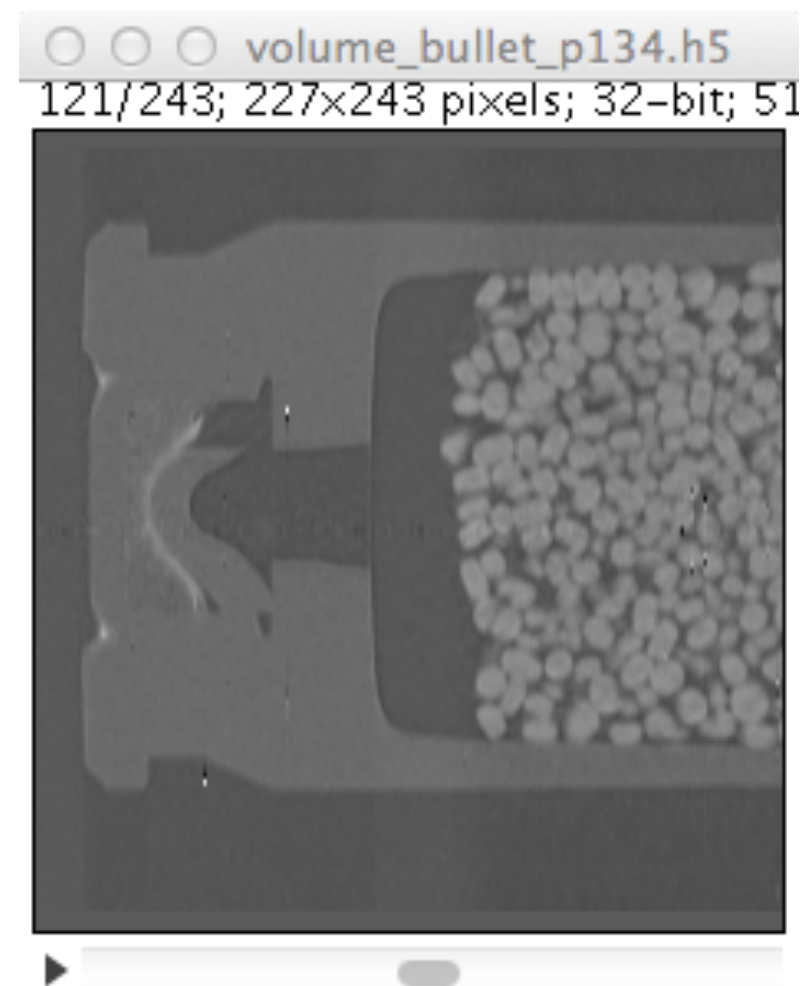
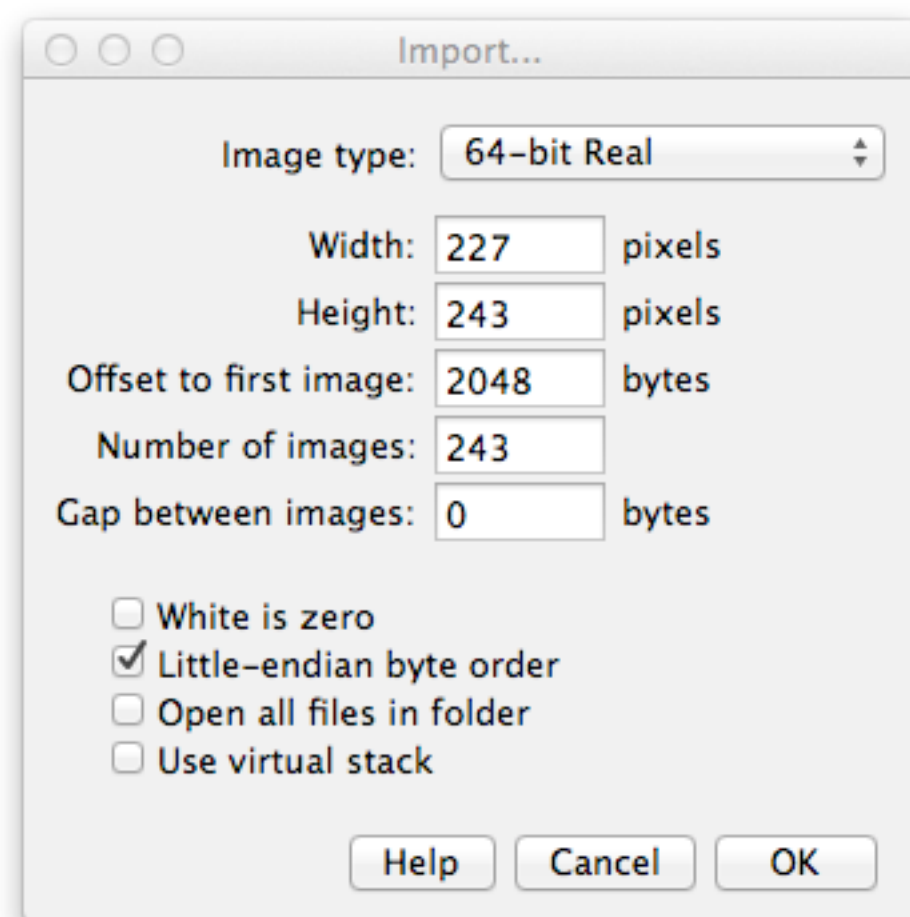
```
Out[24]= {/Users/lesbutler/Documents/h4581/volume_bullet_p134.h5,  
/Users/lesbutler/Documents/h4581/volume_bullet_p134_uint16.bin}
```

```
Out[25]= {107 235 032, 26 808 246}
```

```
In[33]:= volume = Import[listOfFileNames[[1]], {"Datasets", "/volume"}];  
{rows, columns, slices} = Dimensions[volume]
```

```
Out[34]= {243, 243, 227}
```

Use ImageJ File/Import/Raw



Use ImageJ to inspect the HDF5 file

volume_bullet_p134.h5, 107,235,032 bytes

```
In[24]:= listOfFileNames = FileNames["volume*", NotebookDirectory[]]  
Map[FileByteCount, listOfFileNames]
```

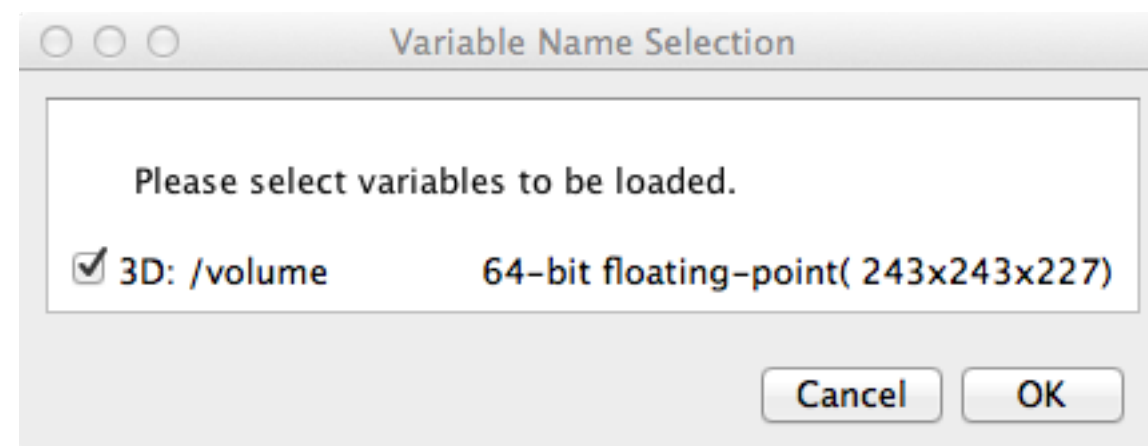
```
Out[24]= {/Users/lesbutler/Documents/h4581/volume_bullet_p134.h5,  
/Users/lesbutler/Documents/h4581/volume_bullet_p134_uint16.bin}
```

```
Out[25]= {107 235 032, 26 808 246}
```

```
In[33]:= volume = Import[listOfFileNames[[1]], {"Datasets", "/volume"}];  
{rows, columns, slices} = Dimensions[volume]
```

```
Out[34]= {243, 243, 227}
```

Use ImageJ Plugins / HDF5 / Load HDF5



Use ImageJ to inspect the binary file

volume_bullet_p134_uint16.bin, 26,808,246 bytes

```
In[24]:= listOfFileNames = FileNames["volume*", NotebookDirectory[]]  
Map[FileByteCount, listOfFileNames]
```

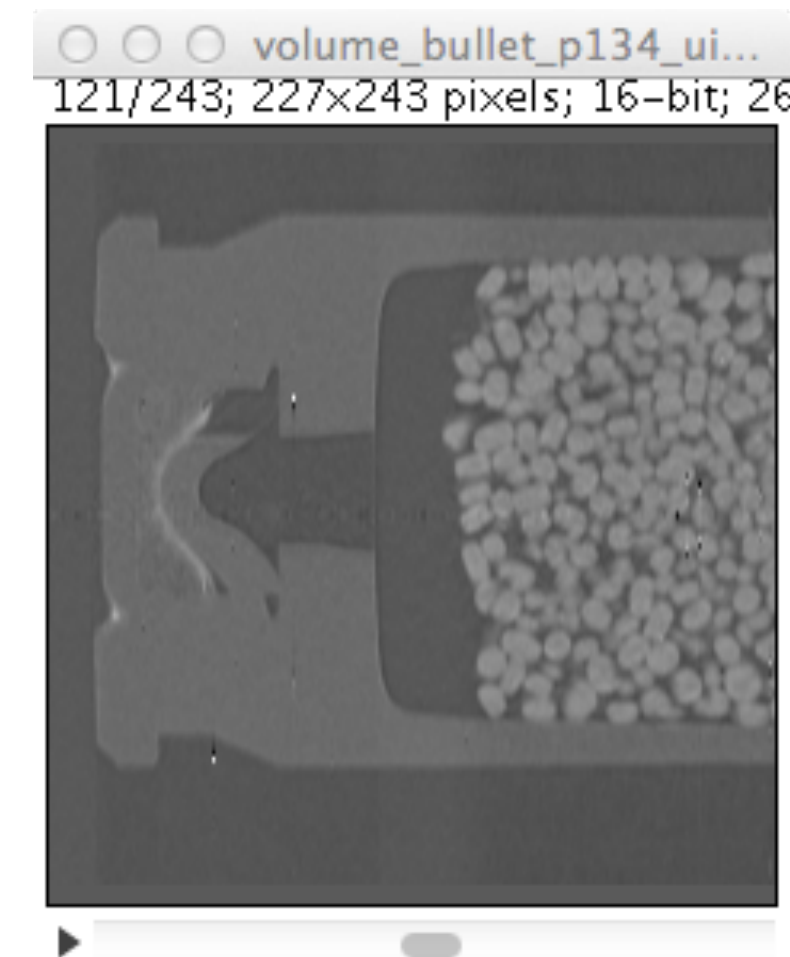
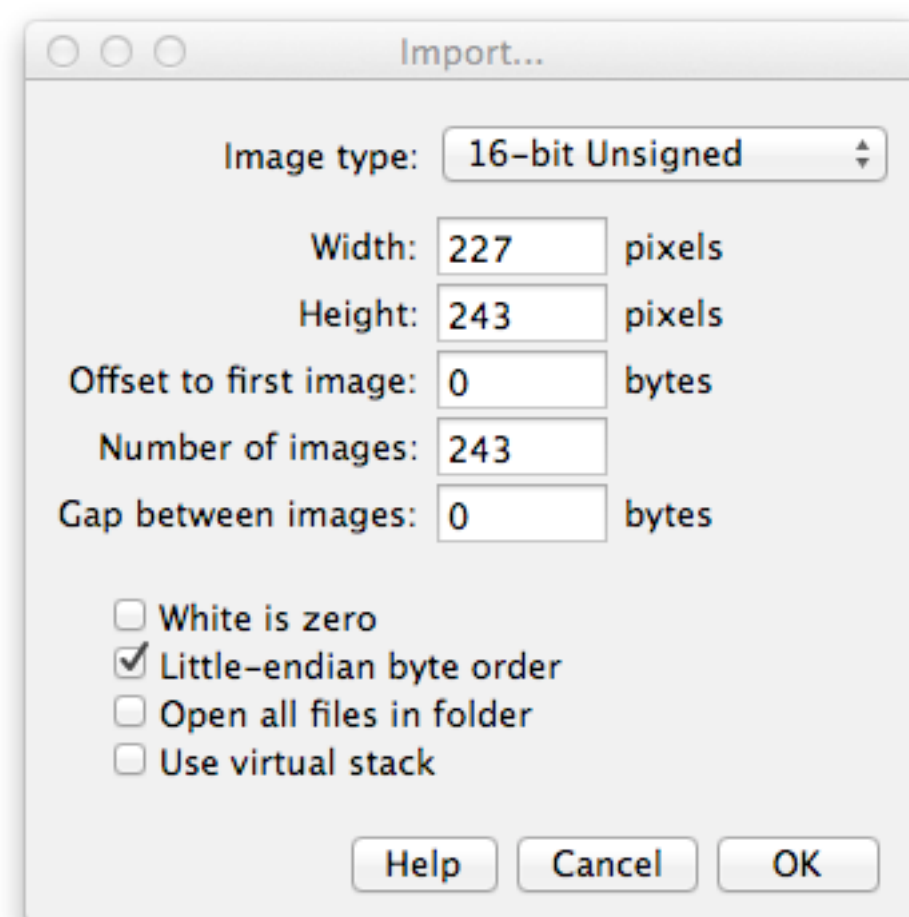
```
Out[24]= {/Users/lesbutler/Documents/h4581/volume_bullet_p134.h5,  
/Users/lesbutler/Documents/h4581/volume_bullet_p134_uint16.bin}
```

```
Out[25]= {107 235 032, 26 808 246}
```

```
In[33]:= volume = Import[listOfFileNames[[1]], {"Datasets", "/volume"}];  
{rows, columns, slices} = Dimensions[volume]
```

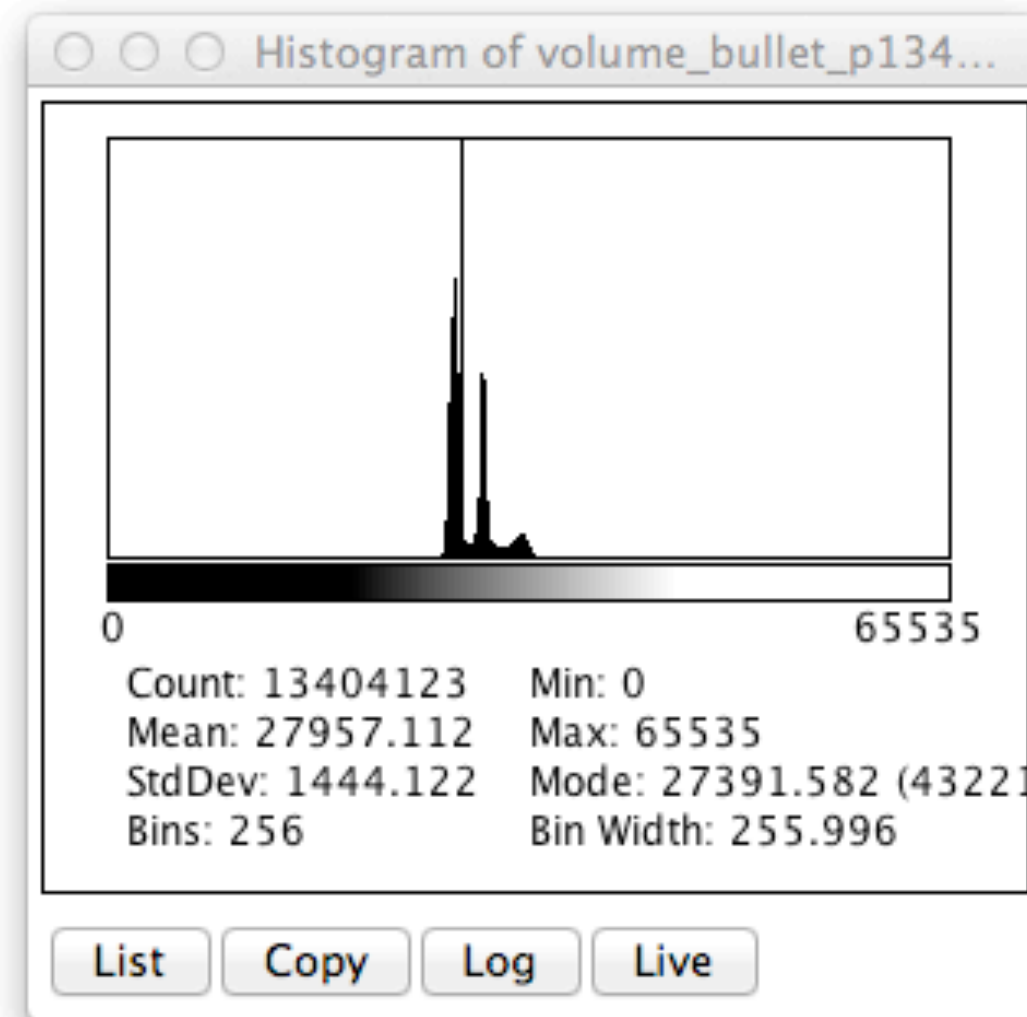
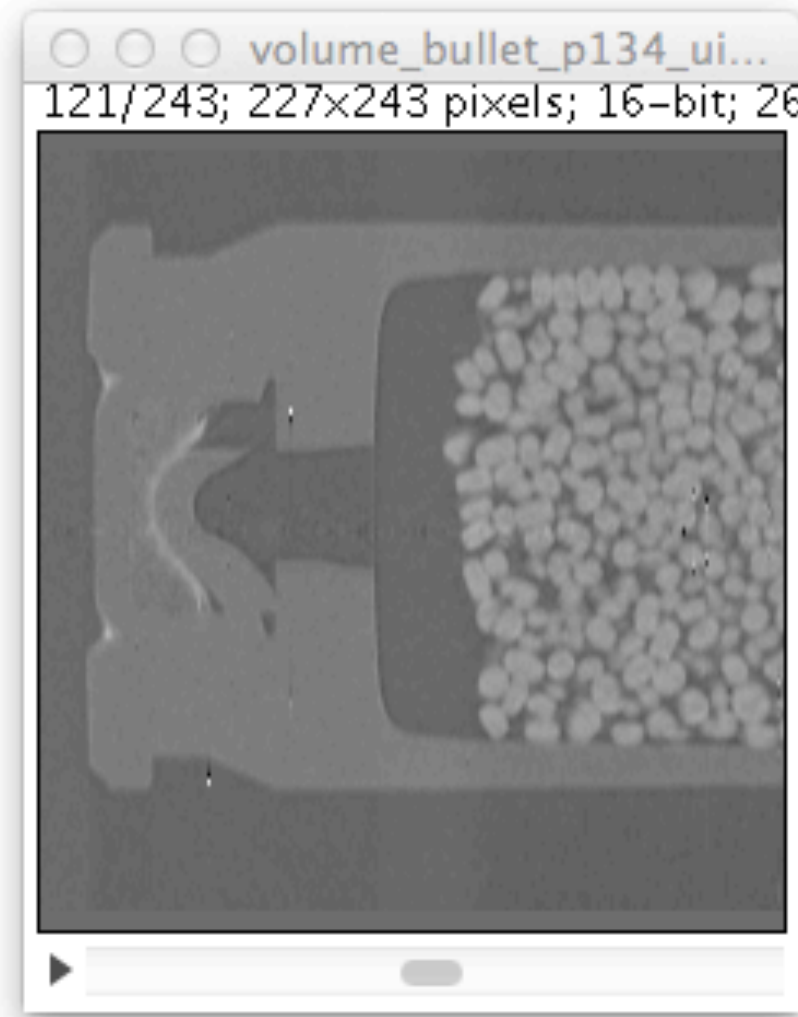
```
Out[34]= {243, 243, 227}
```

Use ImageJ File/Import/Raw



Make histogram with Analyze/Histogram

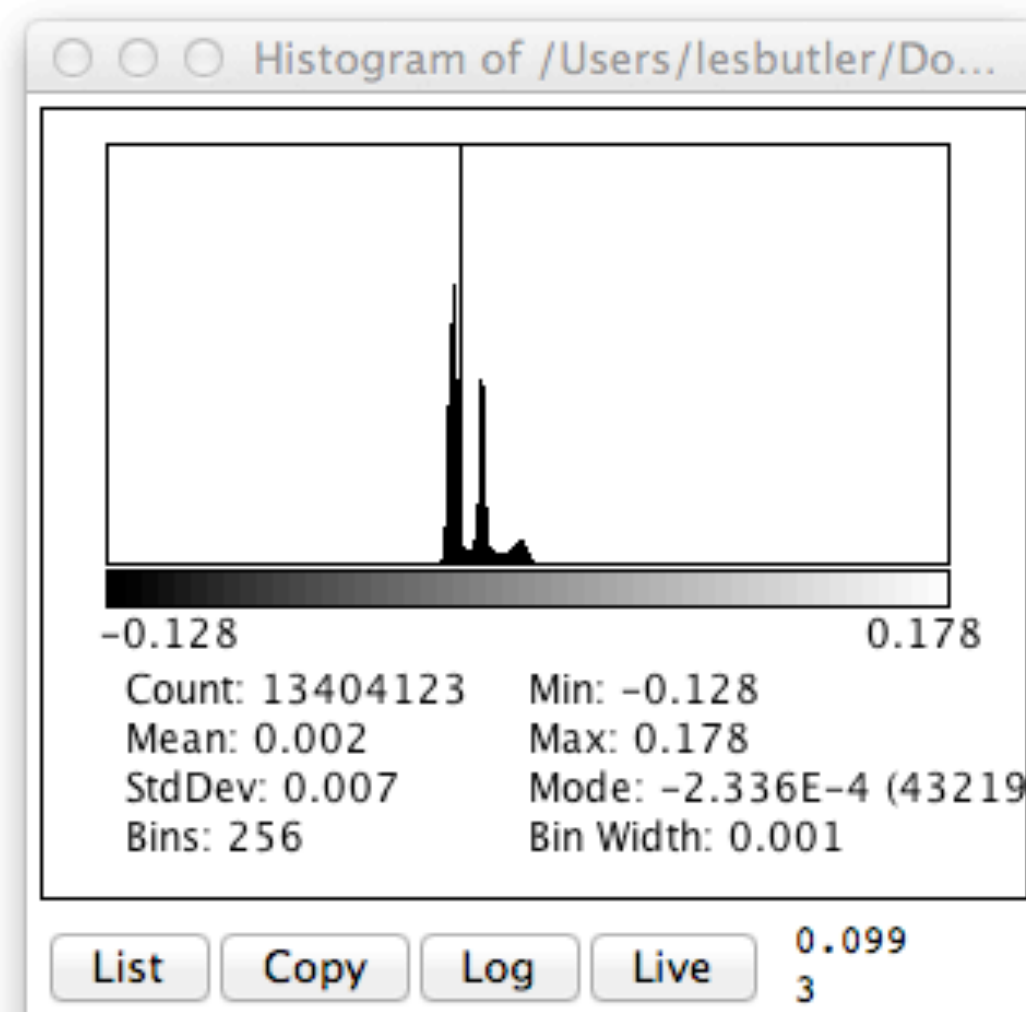
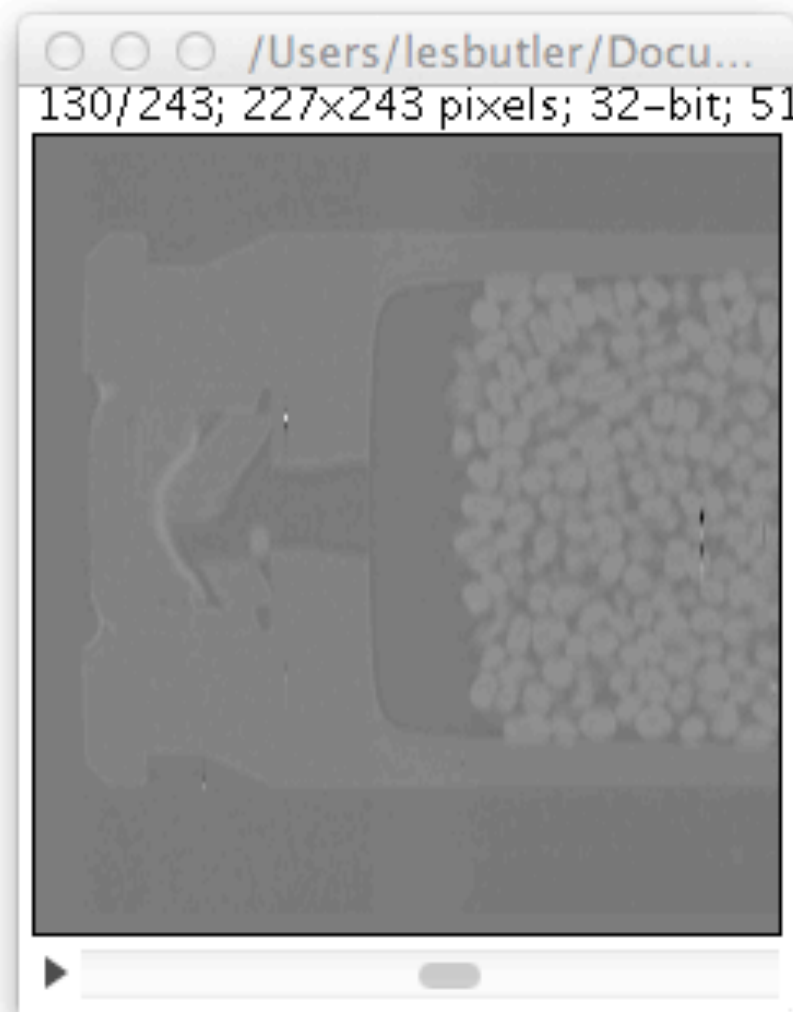
volume_bullet_p134_uint16.bin



unsigned integer-16

- smaller files
 - for ImageJ and Avizo, less memory needed
 - made from expt. data by rescaling
 - Note: 0=black and 65535=white.
- These are {min,max} values in the data.

volume_bullet_p134.h5



real-64

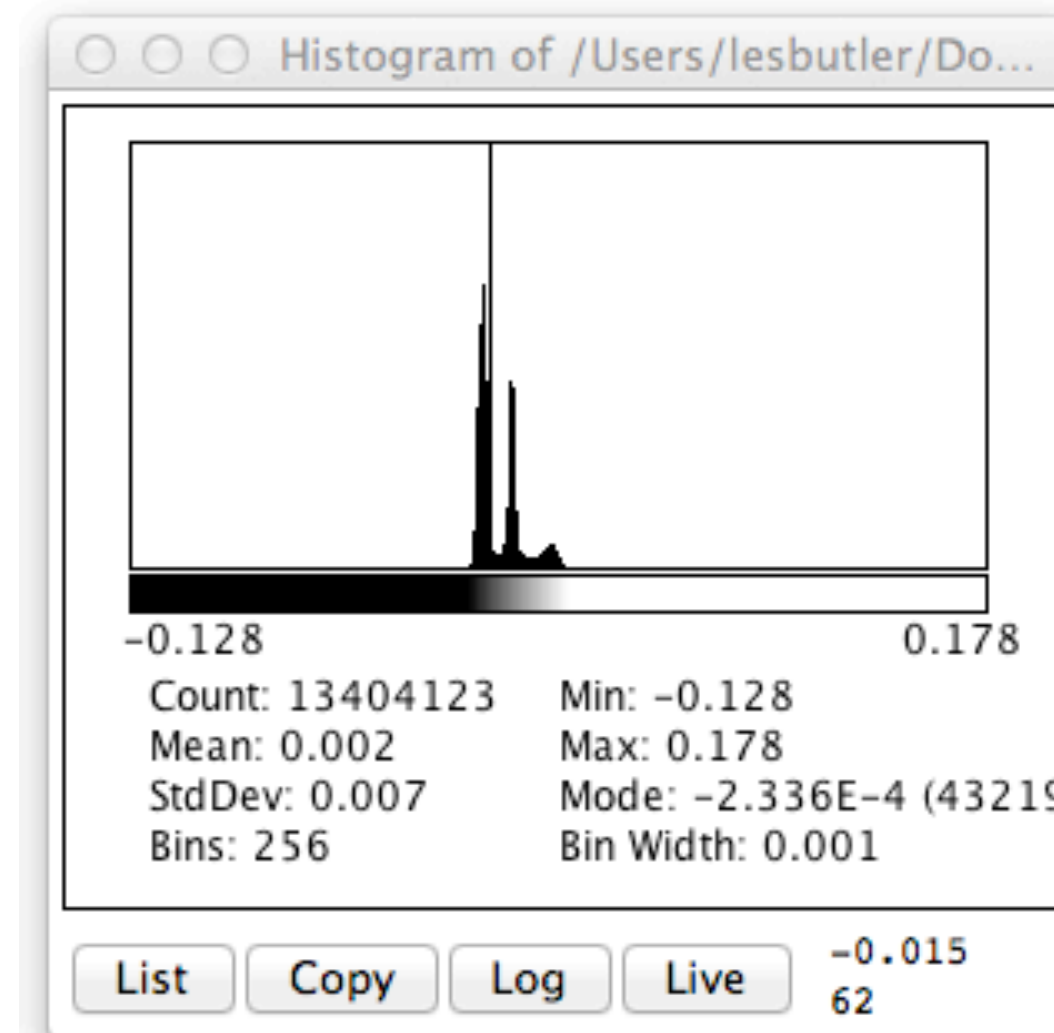
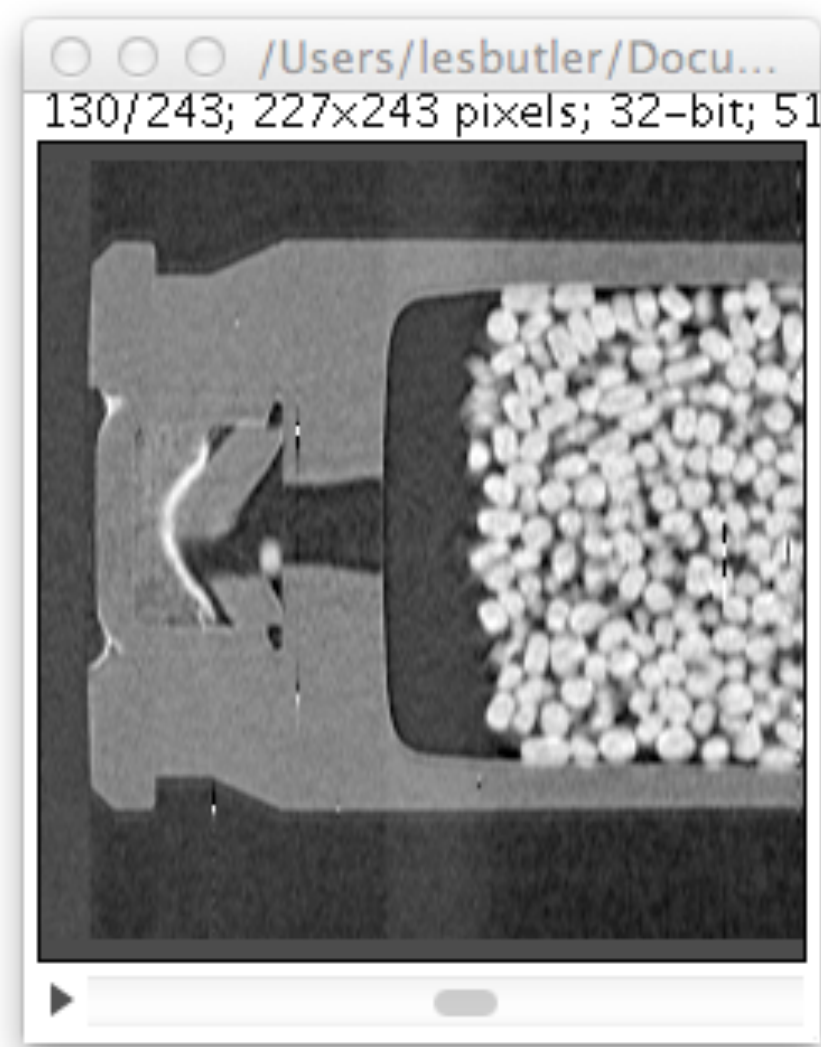
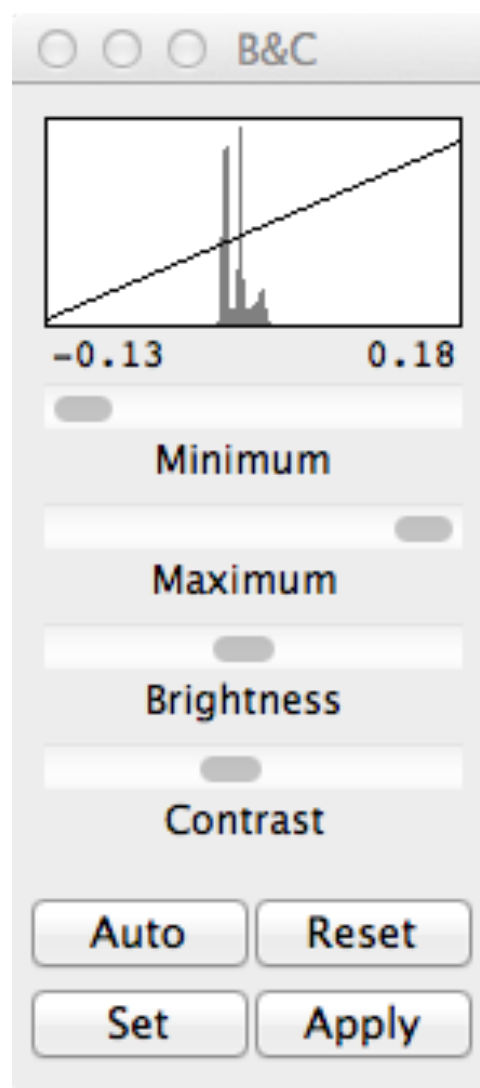
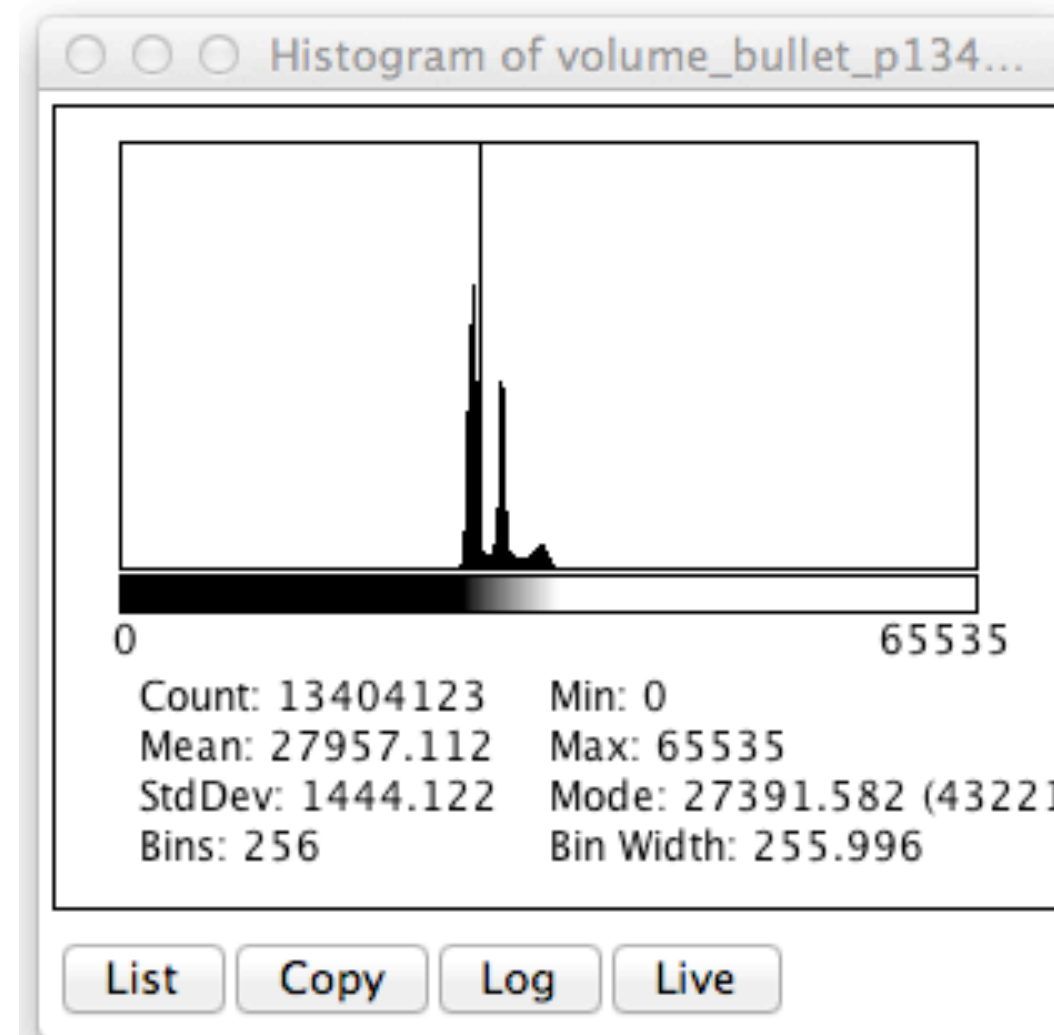
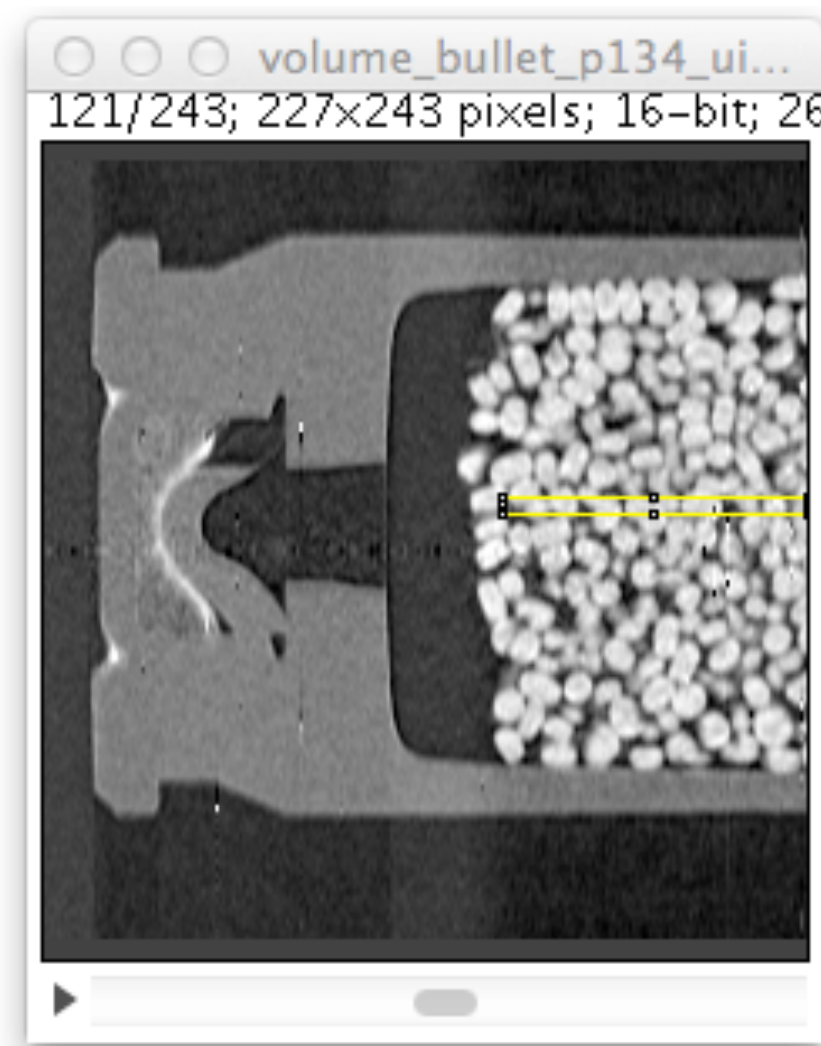
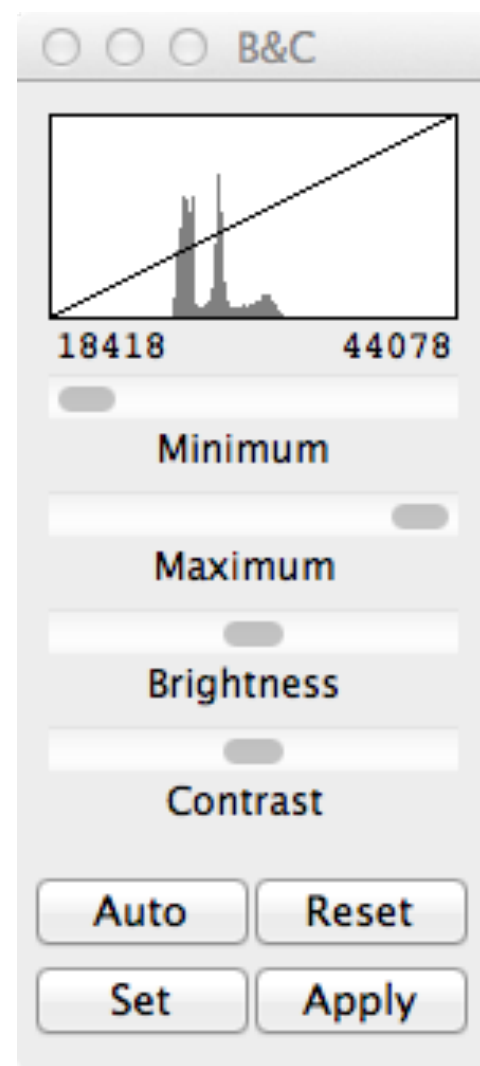
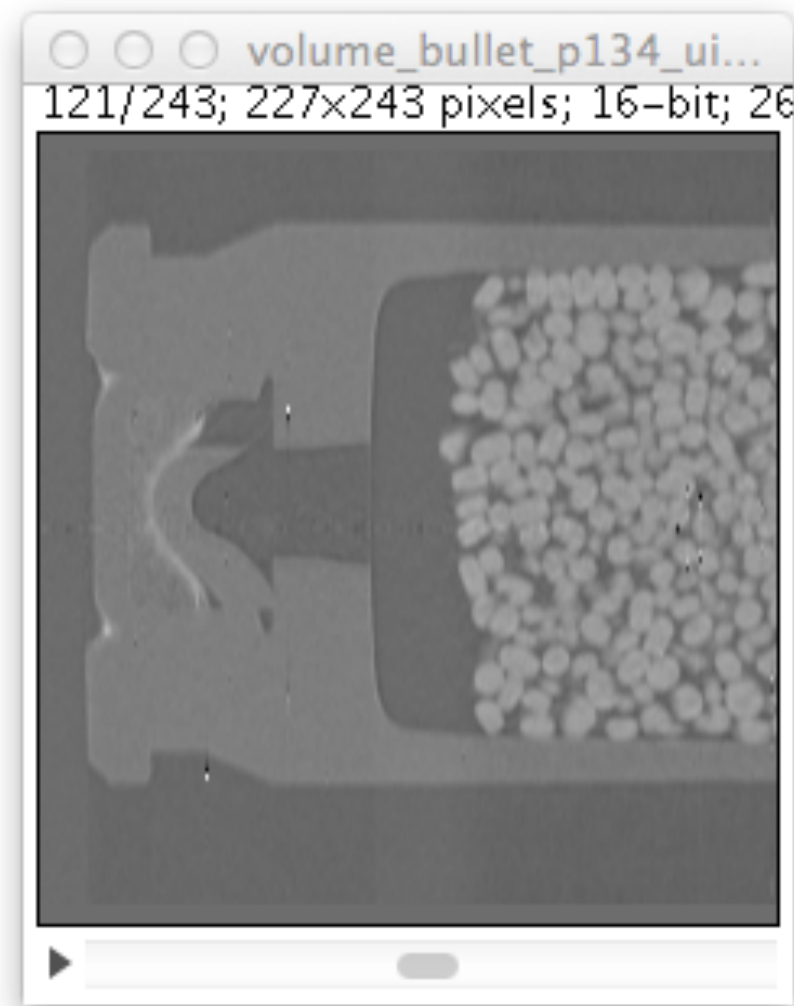
- this is original data
 - numbers can be related back to neutron attenuation values. For example, the values for air should be very close to zero.
 - Note: -0.128=black and 0.178=white.
- These are {min,max} values in the data.

volume_bullet_p134.h5 volume_bullet_p134_uint16.bin

Adjust limits of colormap with Image/Adjust/BrightnessContrast...

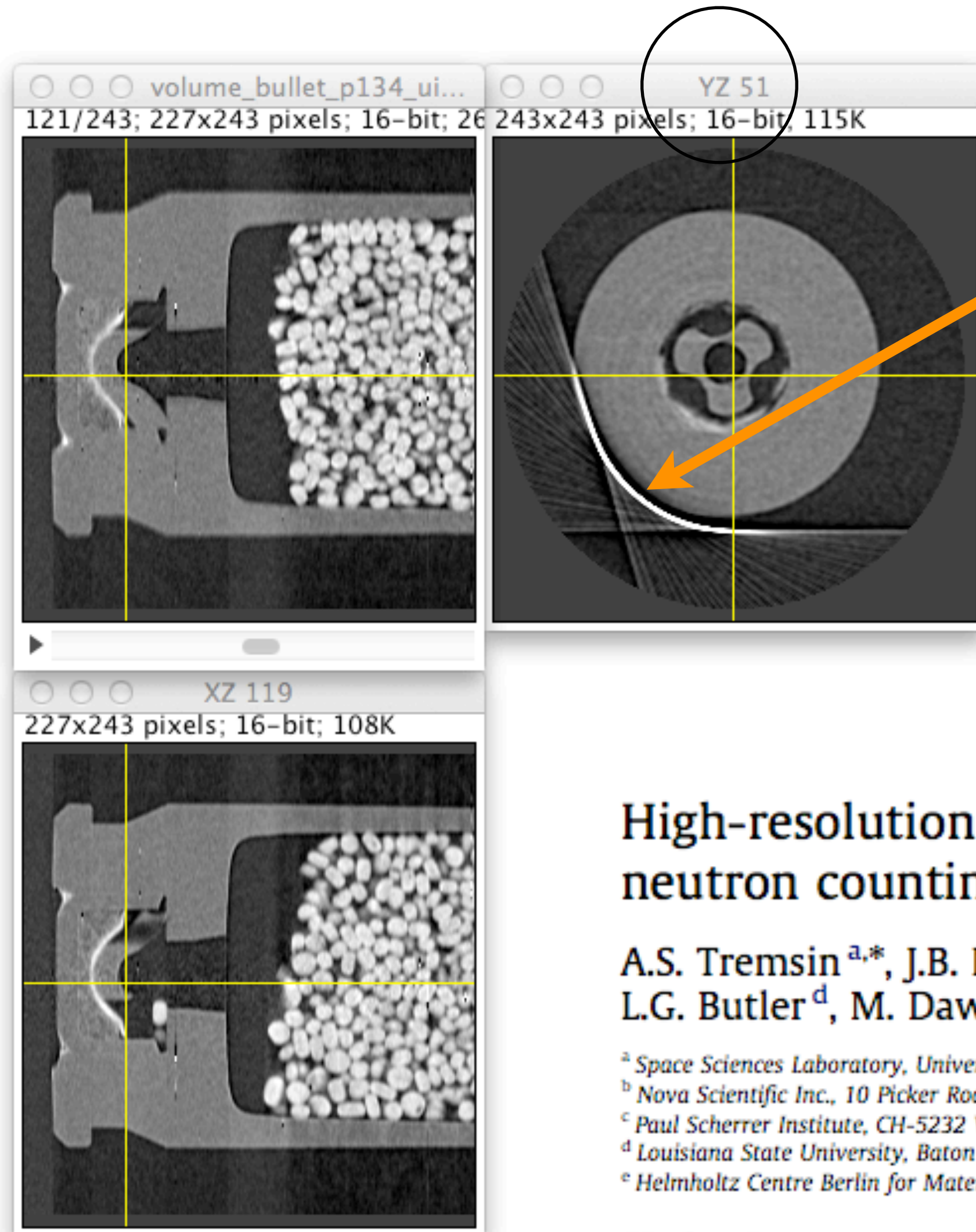
and select "Auto". According to histograms, data values are not changed.

Why has the appearance the of image change?



volume_bullet_p134_uint16.bin

Select the smaller file (...uint16.bin) and Image/Stacks/Orthogonal Views
Navigate to YZ 51



The bright arc is a flaw in the detector.
Please don't try to enhance this flaw in your
Avizo work.

High-resolution neutron microtomography with noiseless neutron counting detector

A.S. Tremsin^{a,*}, J.B. McPhate^a, J.V. Vallerga^a, O.H.W. Siegmund^a, W.B. Feller^b, E. Lehmann^c, L.G. Butler^d, M. Dawson^e

^a Space Sciences Laboratory, University of California, Berkeley, CA 94720, USA

^b Nova Scientific Inc., 10 Picker Road, Sturbridge, MA 01566, USA

^c Paul Scherrer Institute, CH-5232 Villigen, Switzerland

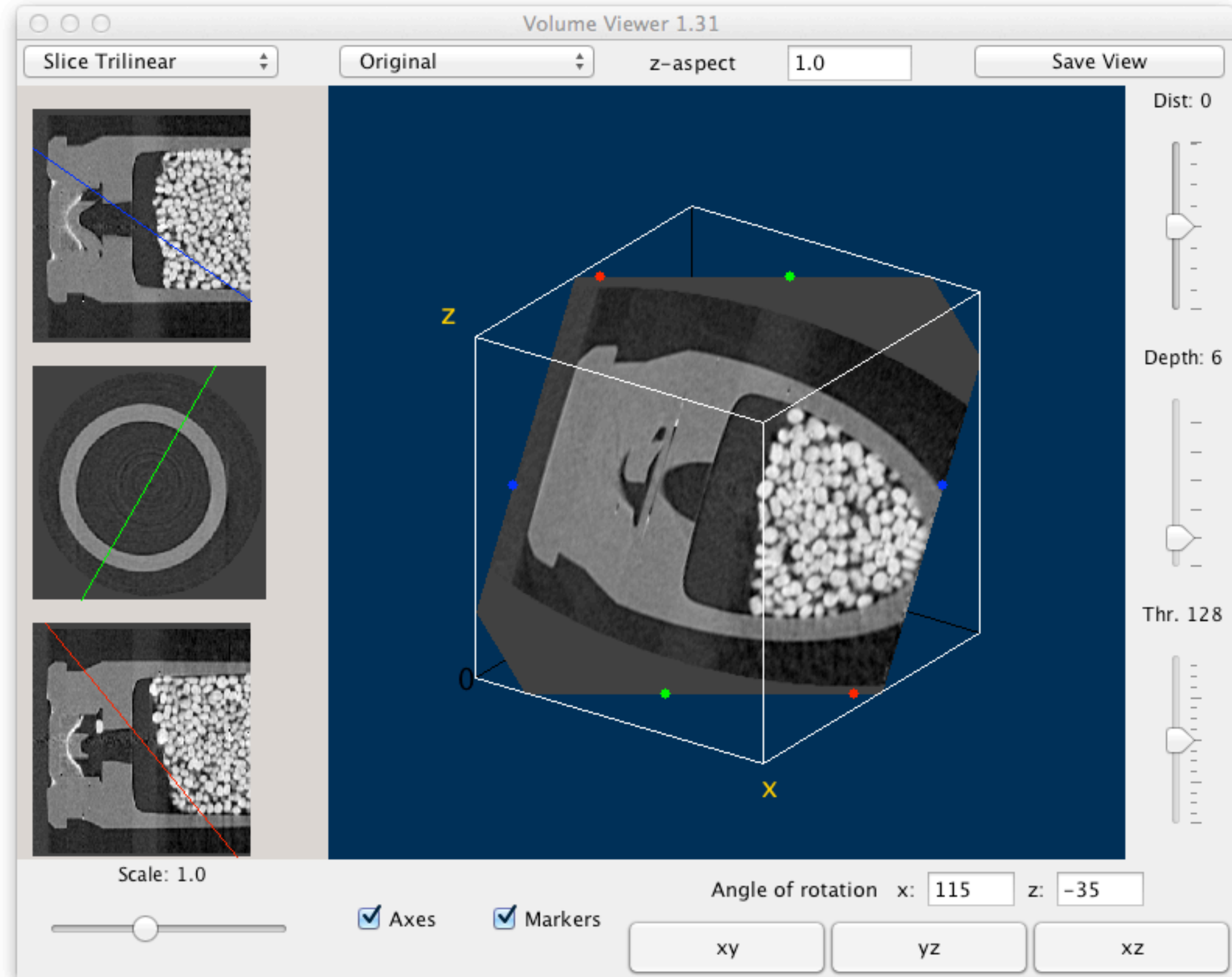
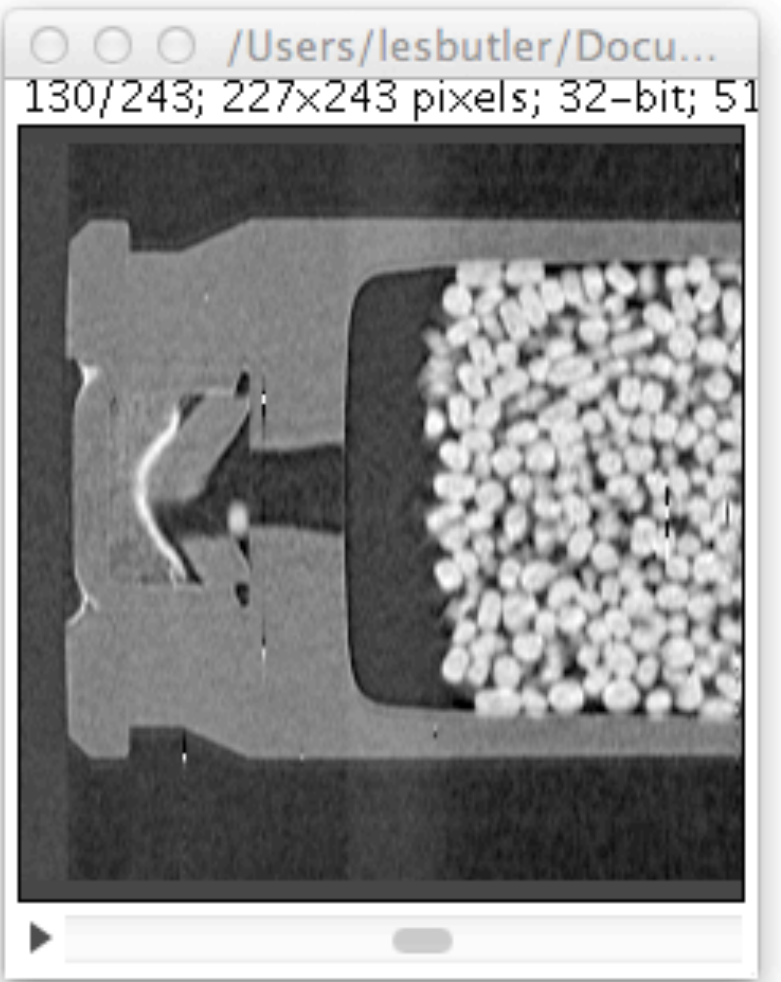
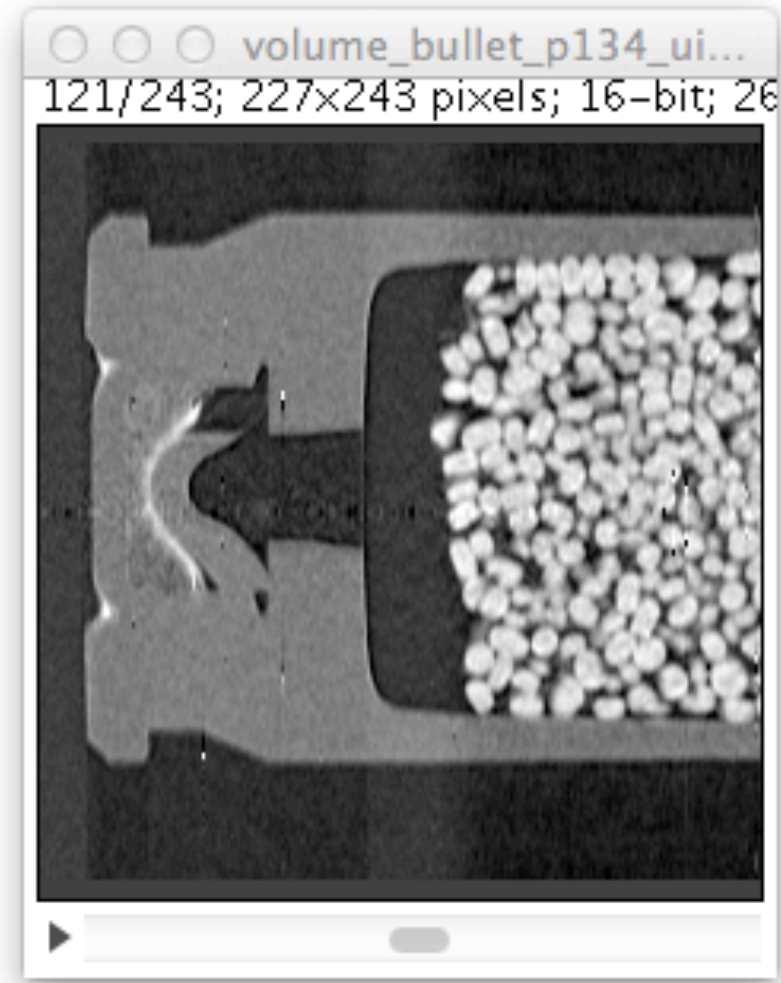
^d Louisiana State University, Baton Rouge, LA 70803, USA

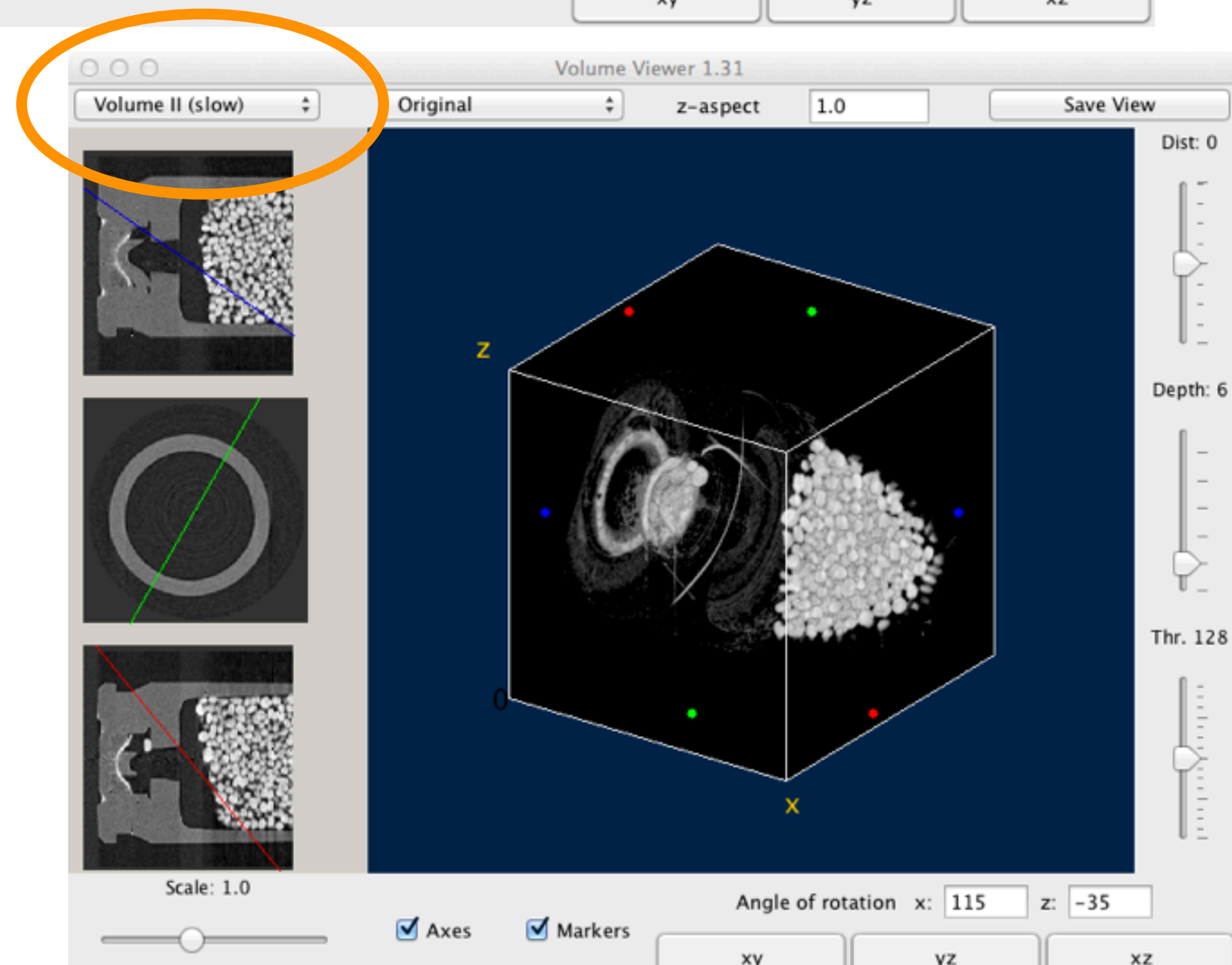
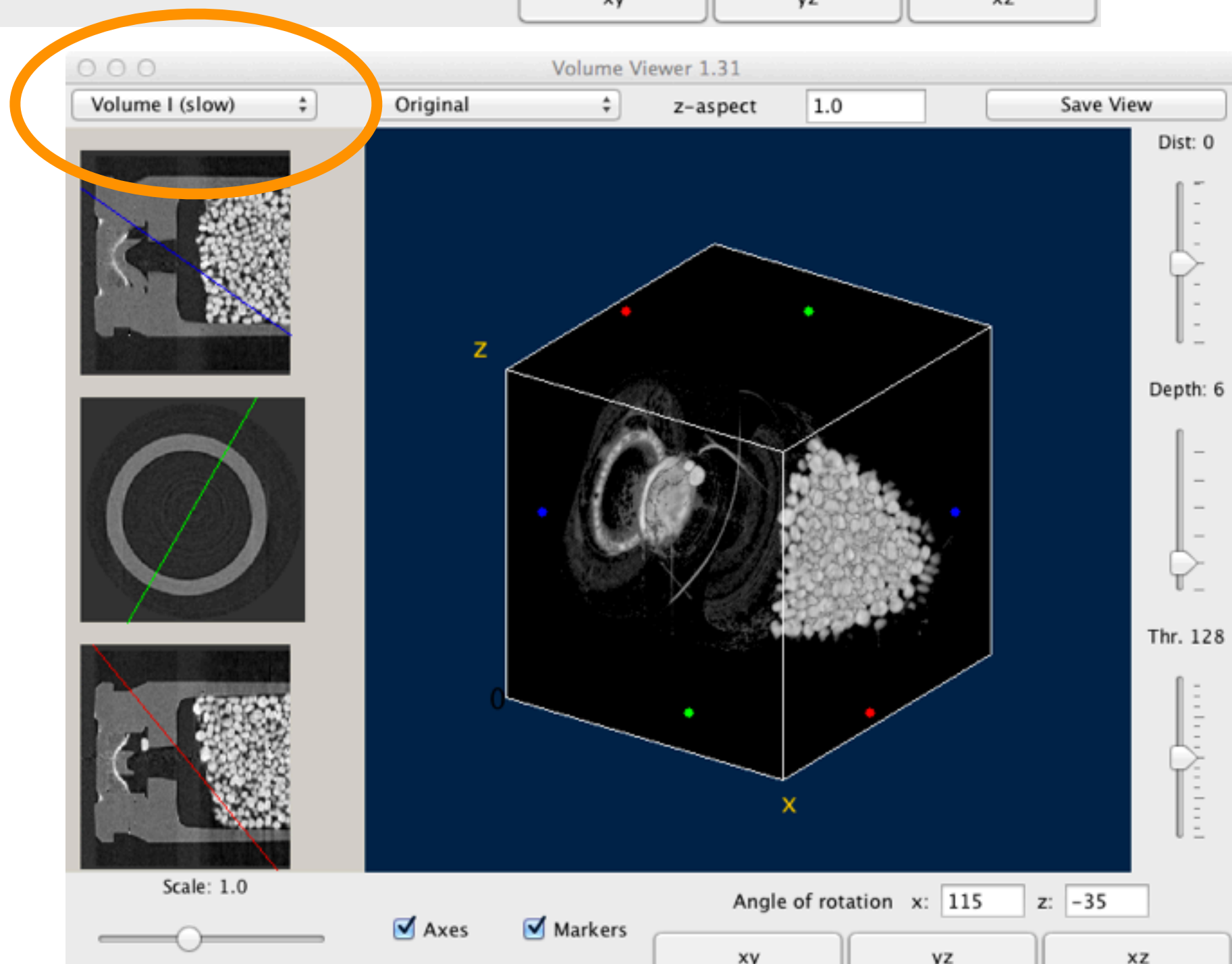
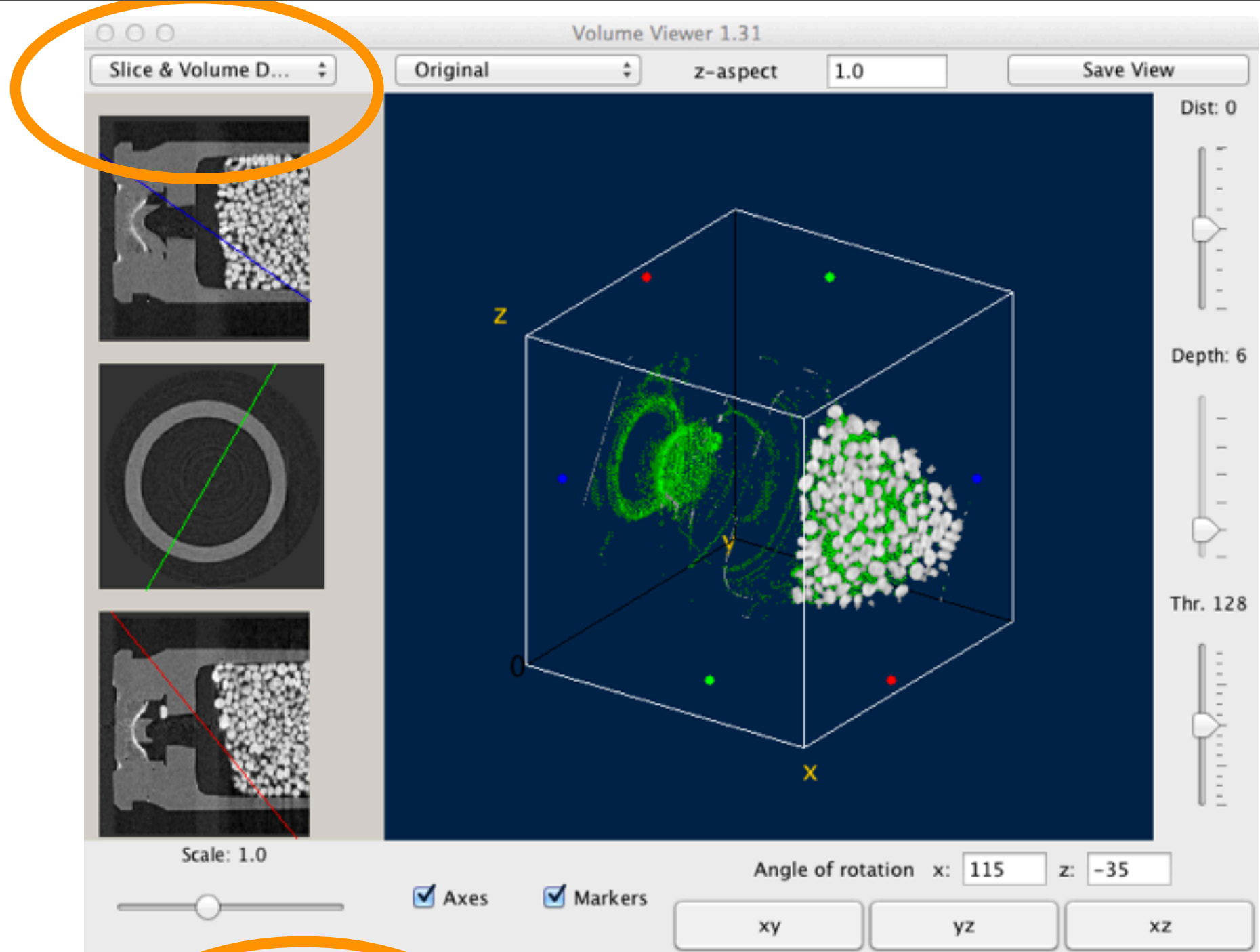
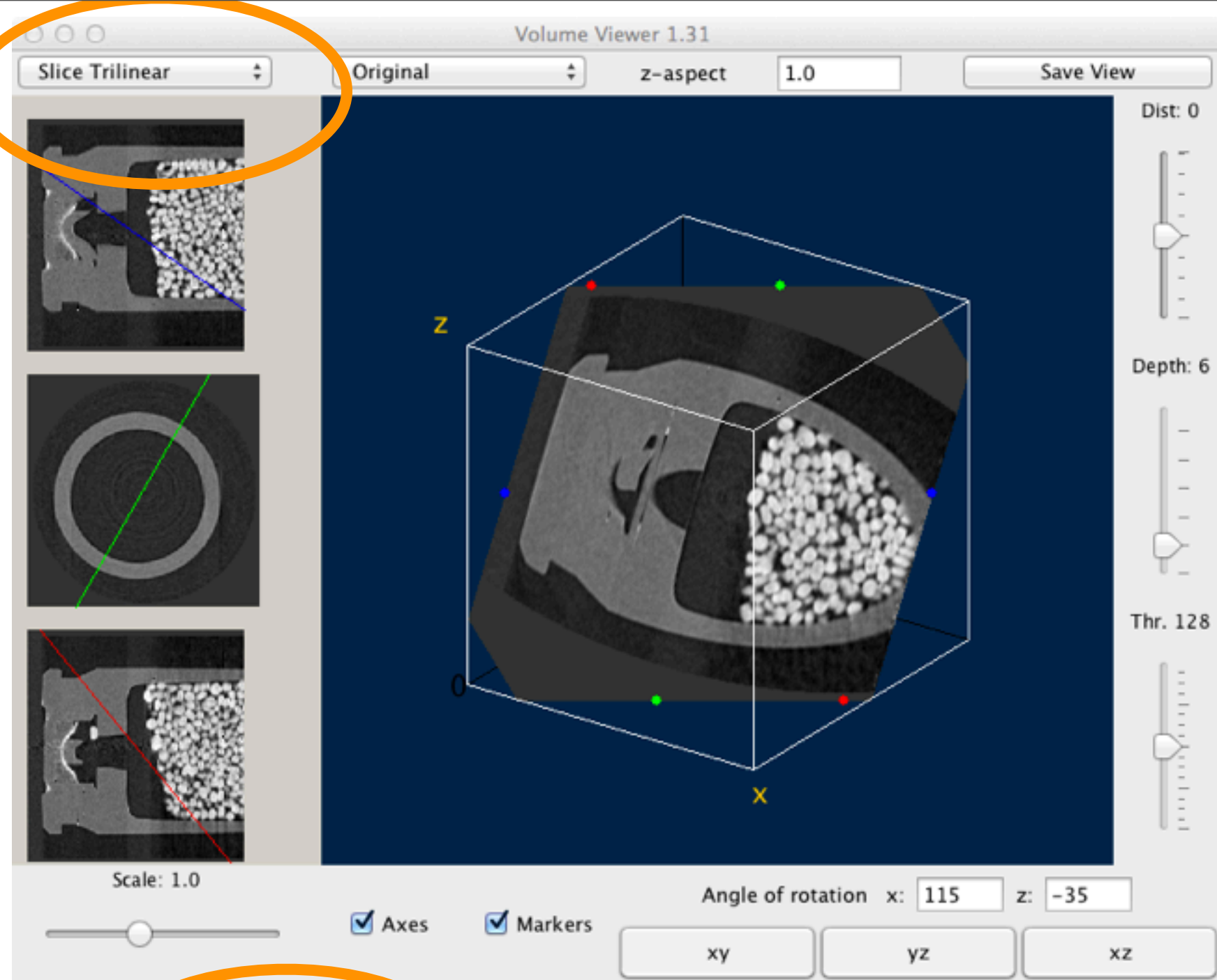
^e Helmholtz Centre Berlin for Materials and Energy, Germany

Nuclear Instruments and Methods in Physics Research A 652 (2011) 400–403

volume_bullet_p134.h5 volume_bullet_p134_uint16.bin

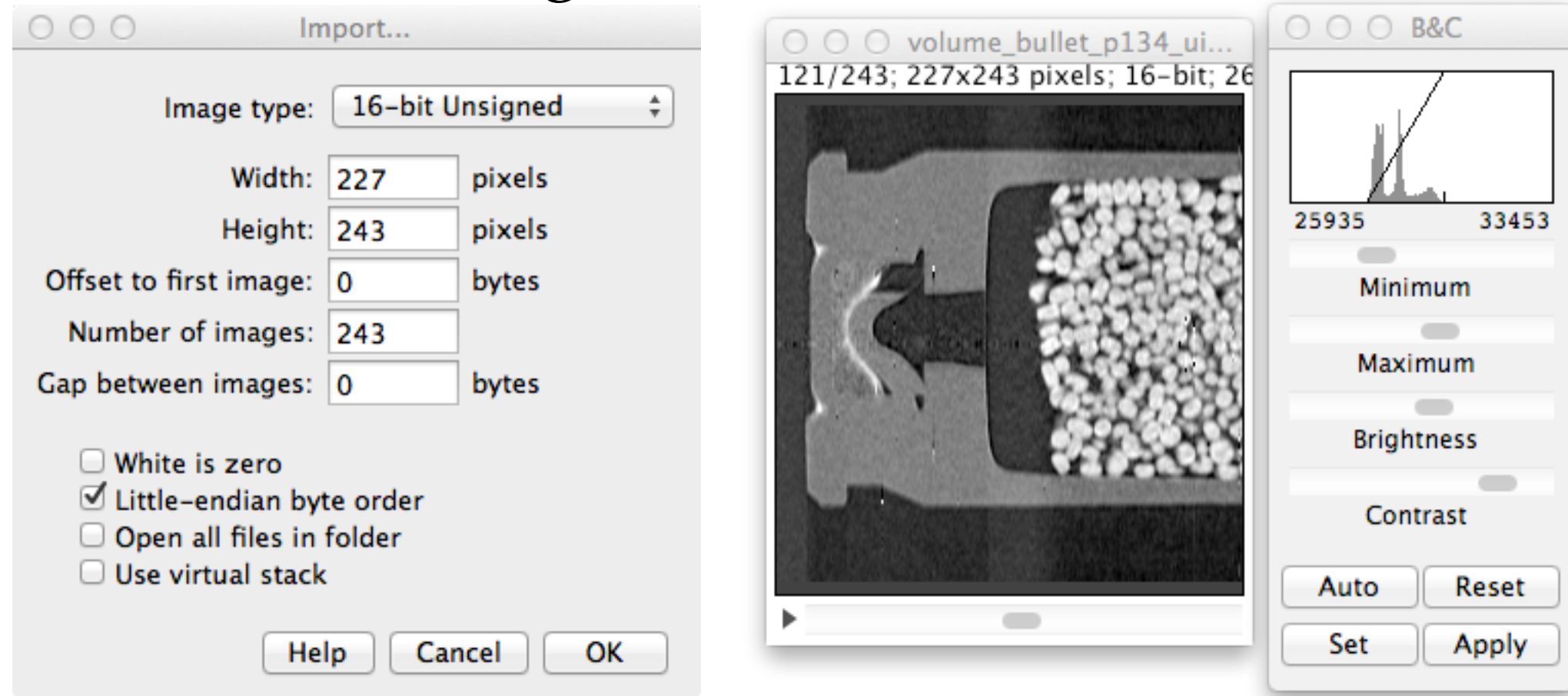
Select the smaller file (...uint16.bin) and Plugins / 3D / Volume Viewer



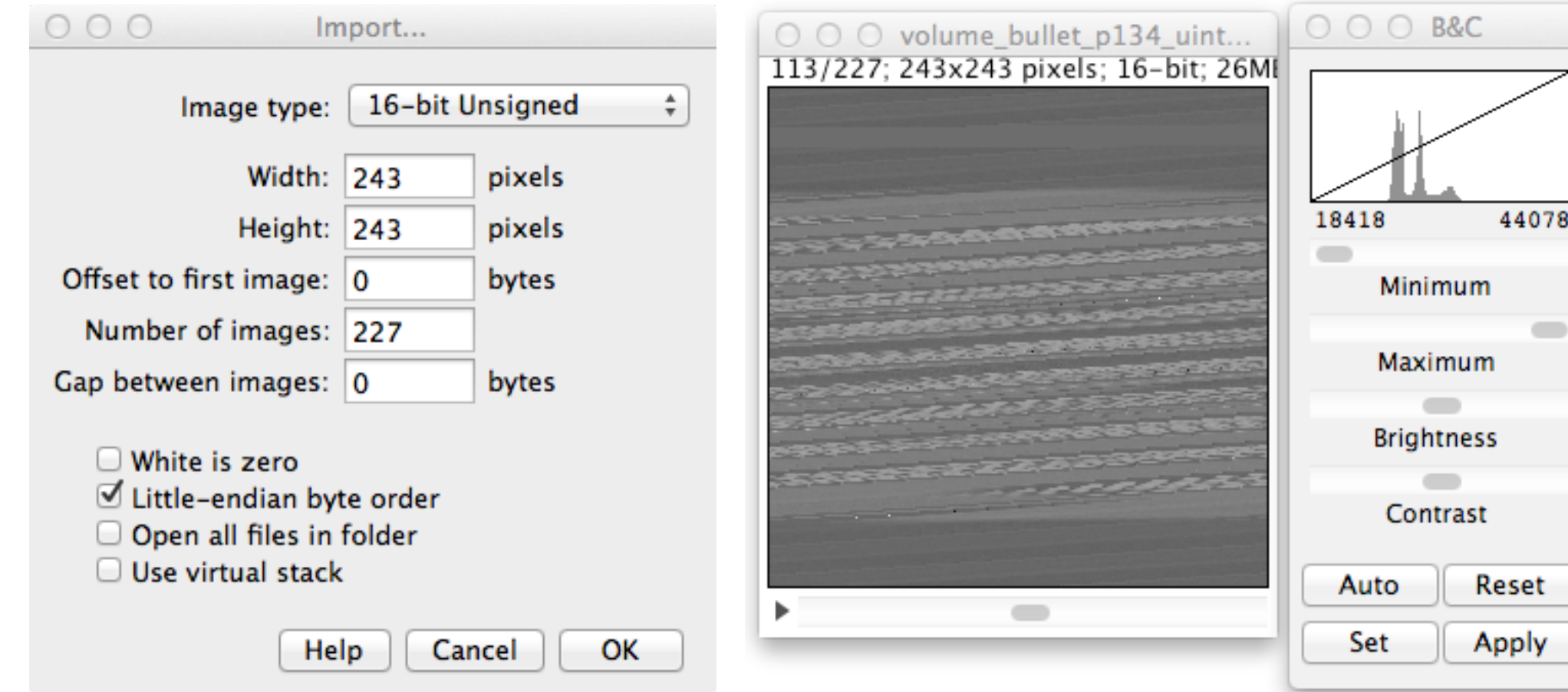


Some common errors with Import/Raw

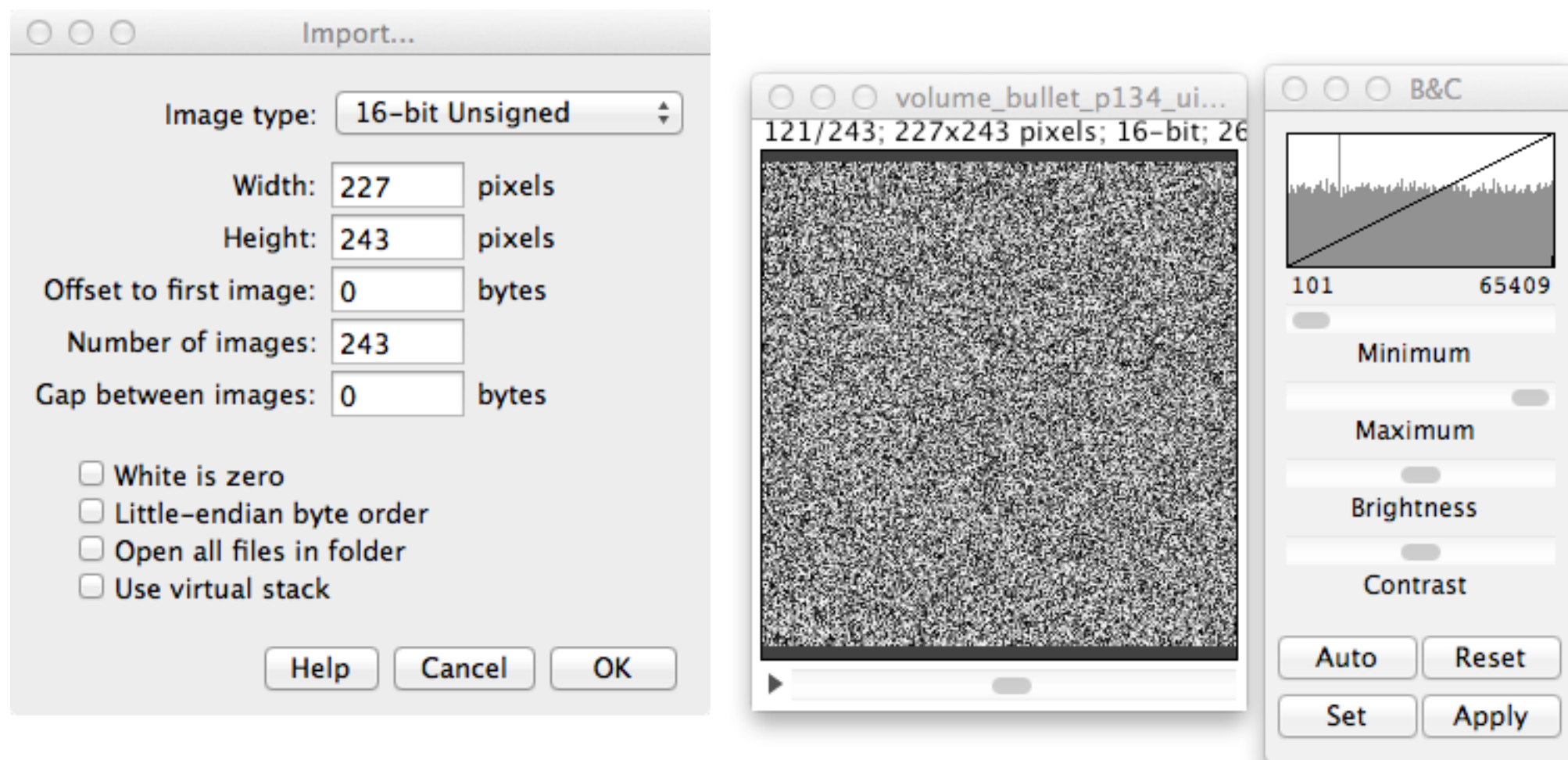
correct settings



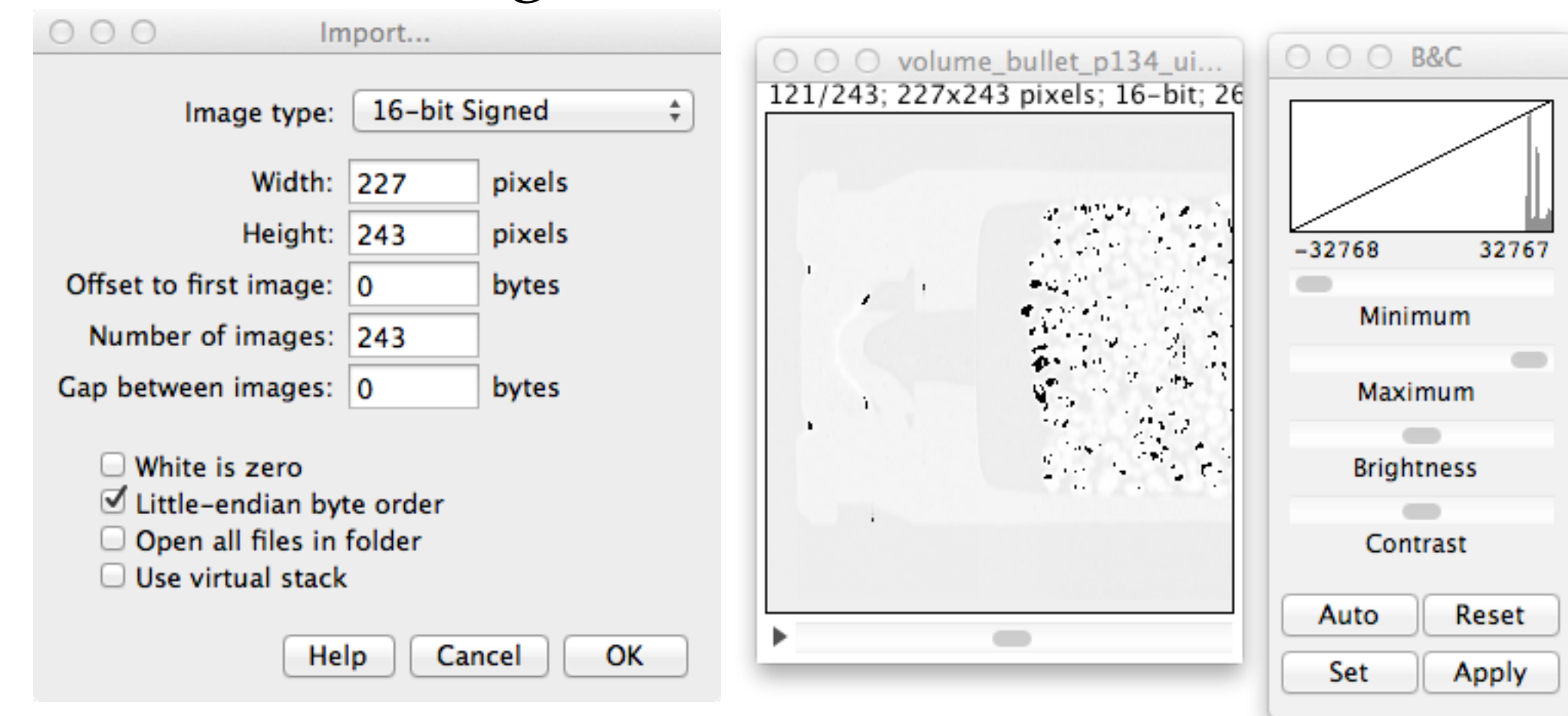
wrong dimension order



wrong endian

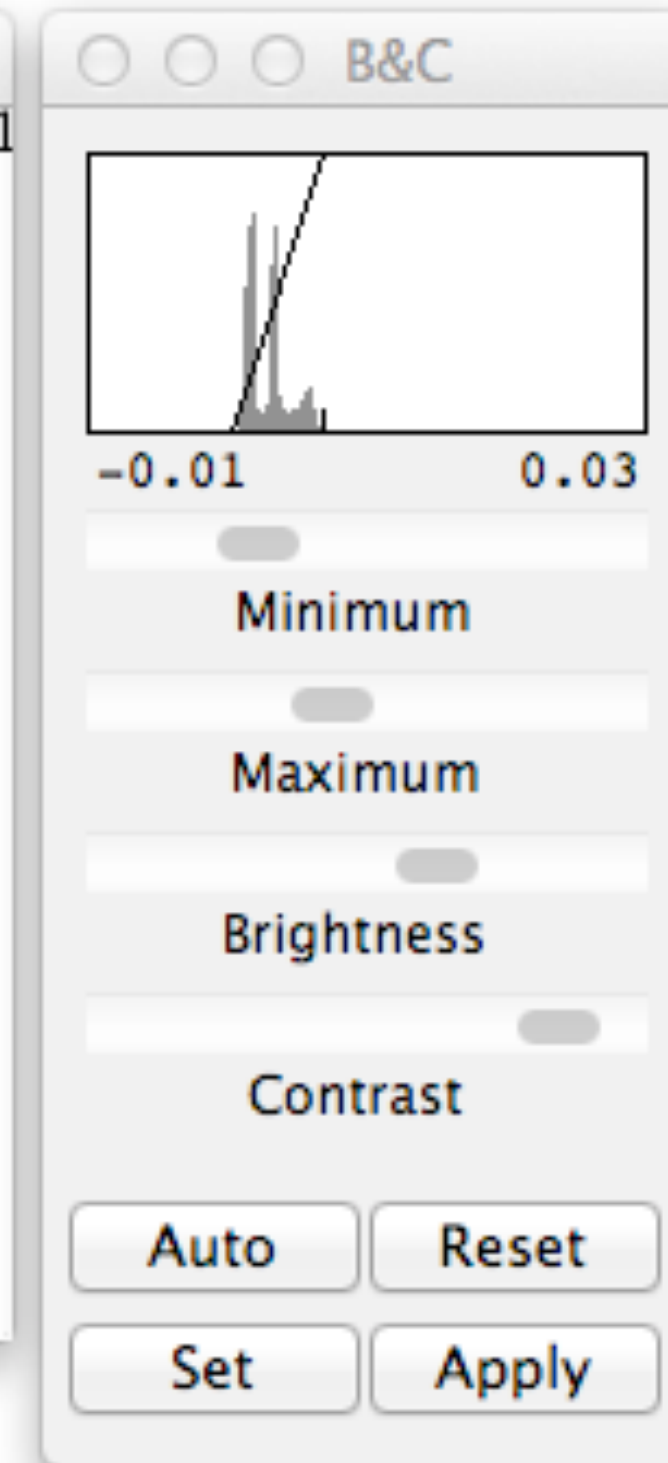
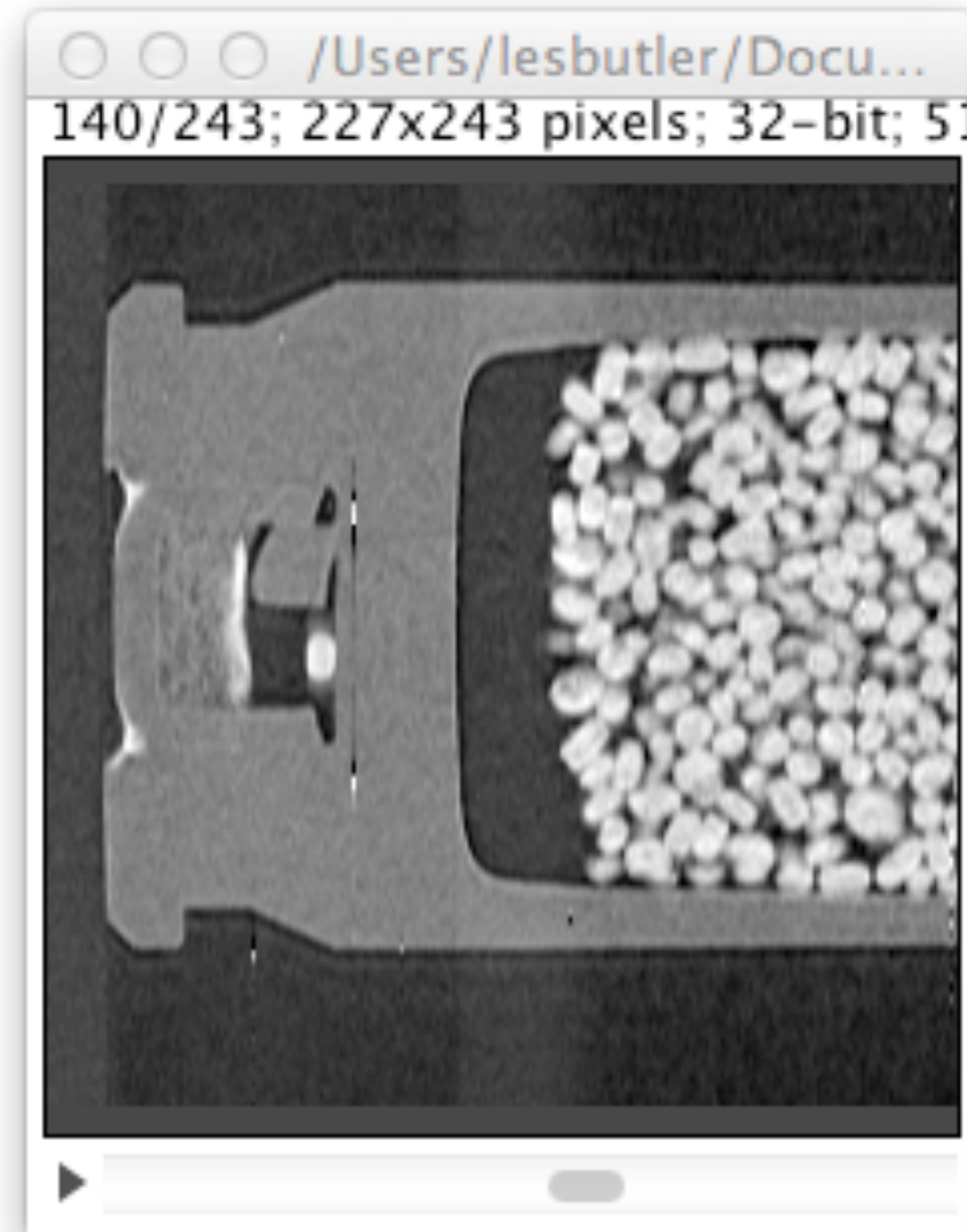
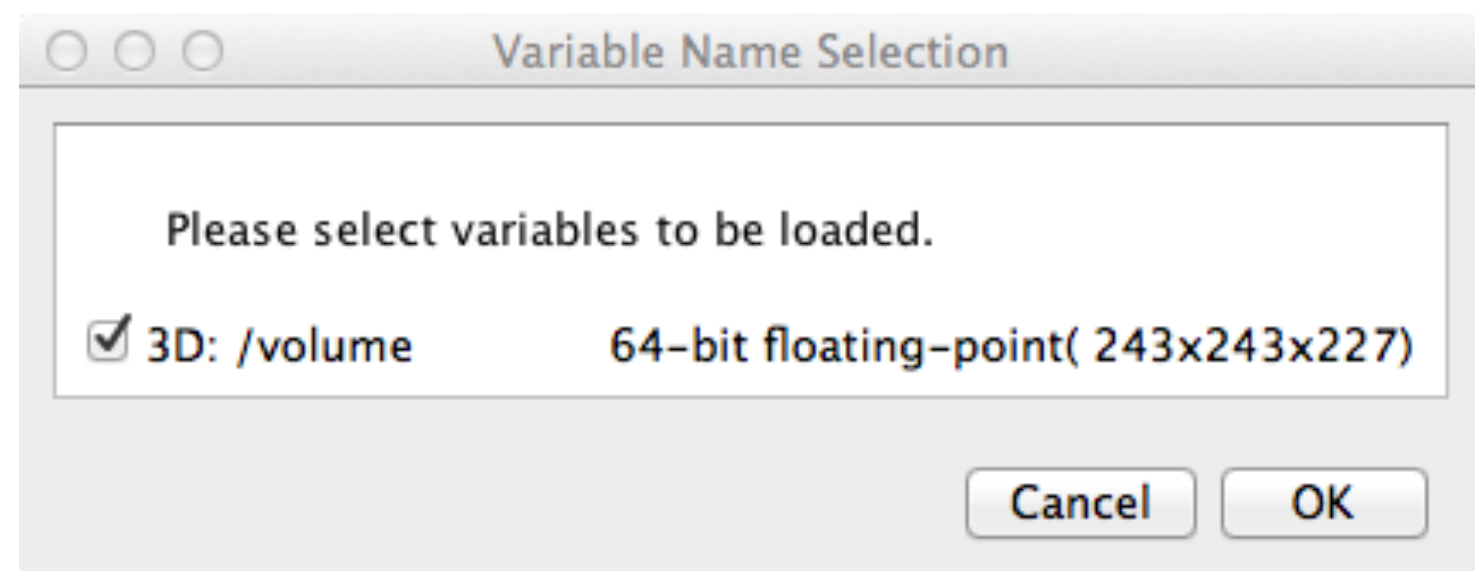


wrong number format



Some common errors with Plugins/HDF5/Load HDF5

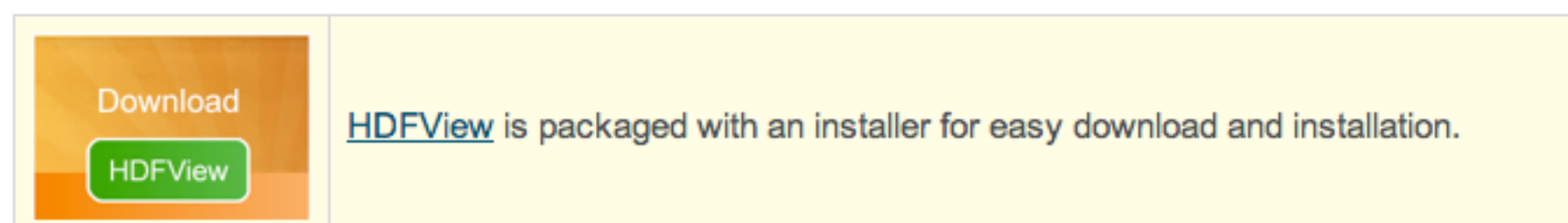
correct settings



HDF5 is a “self-describing” file format and is largely free of data import problems. “HDFView” is a free Java program for inspecting HDF5 files. Good for validating files.



<http://www.hdfgroup.org/HDF5/>



Avizo® FAQs and User documentation

Data input/output, printing

33. What are the supported data formats (input and output)?

A list of supported file formats is contained in the index section of the user's guide.

As yet, Avizo does not support HDF5.

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HW 1: ImageJ

due Monday, 30 Jan

reproduce the common binary import errors.

Suggestion: try the errors from class and make up some of your own errors.

Wednesday: Mathematica and data import.