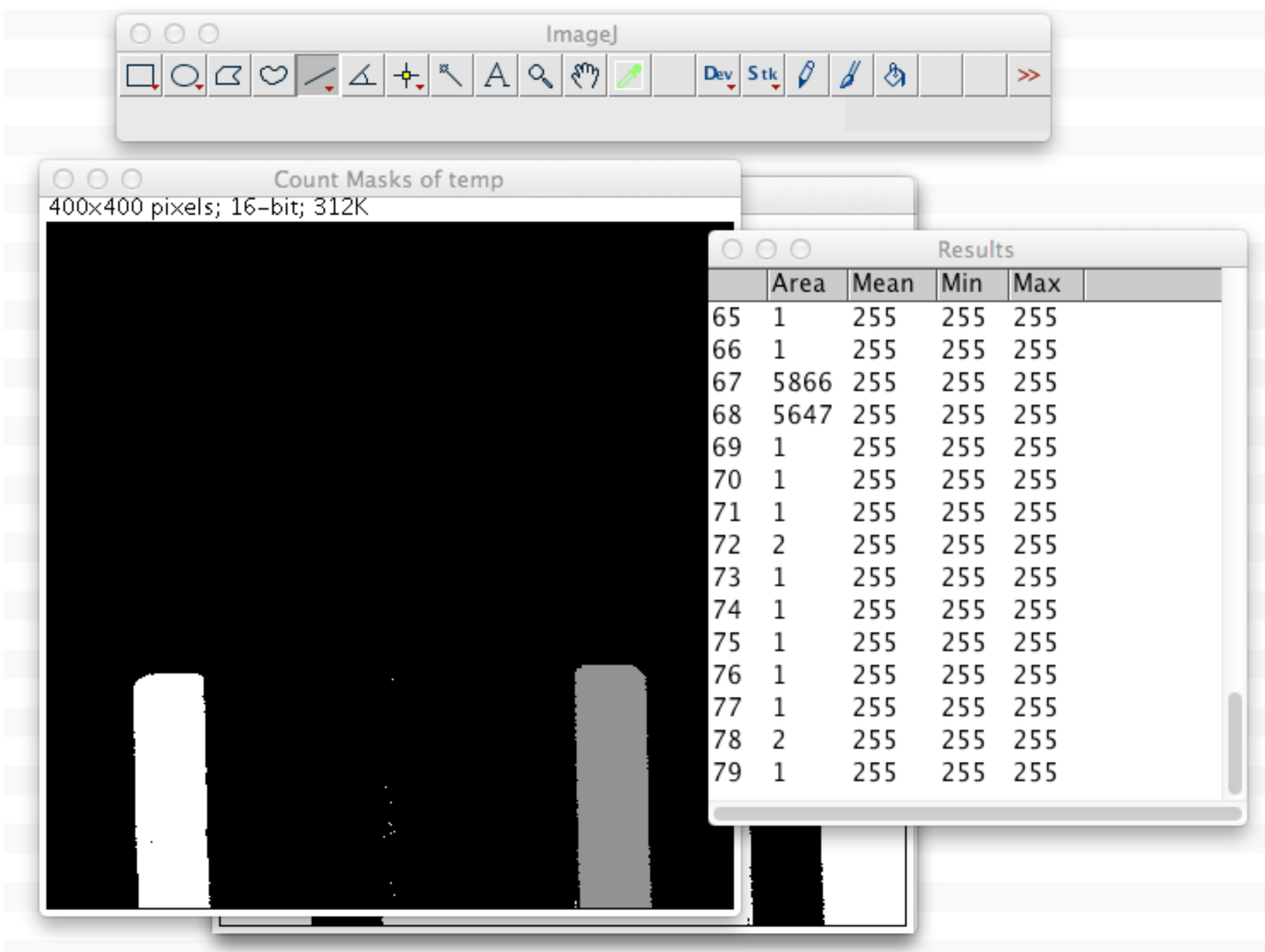
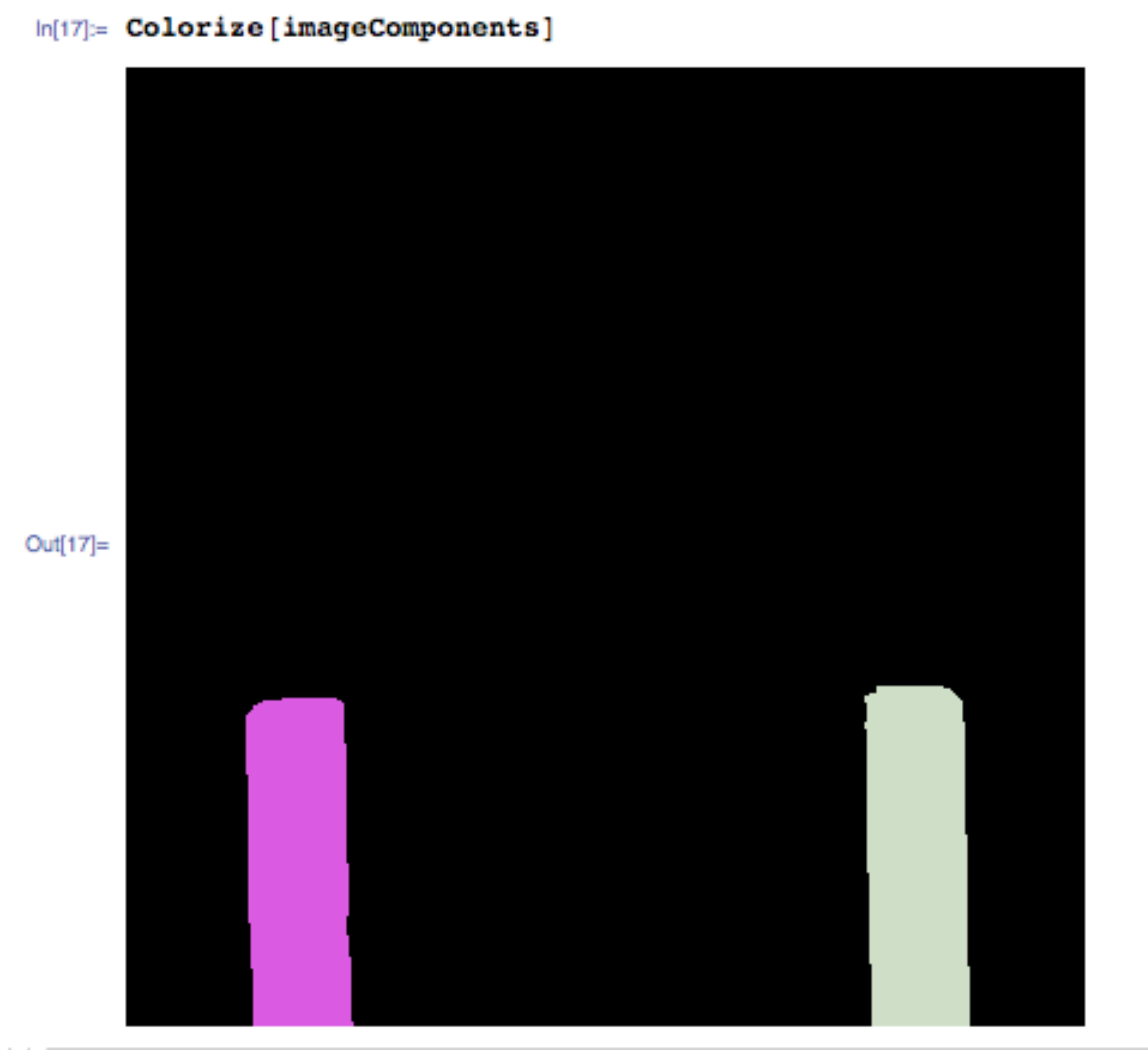
L4 Erosion, Dilation, Label Fields: 30 January, 2012

to begin

1) Moodle: download Week3/Pgm4_erosion_dilation_label.nb
2) Moodle: download Week3/MAS_rotor_slice.h5





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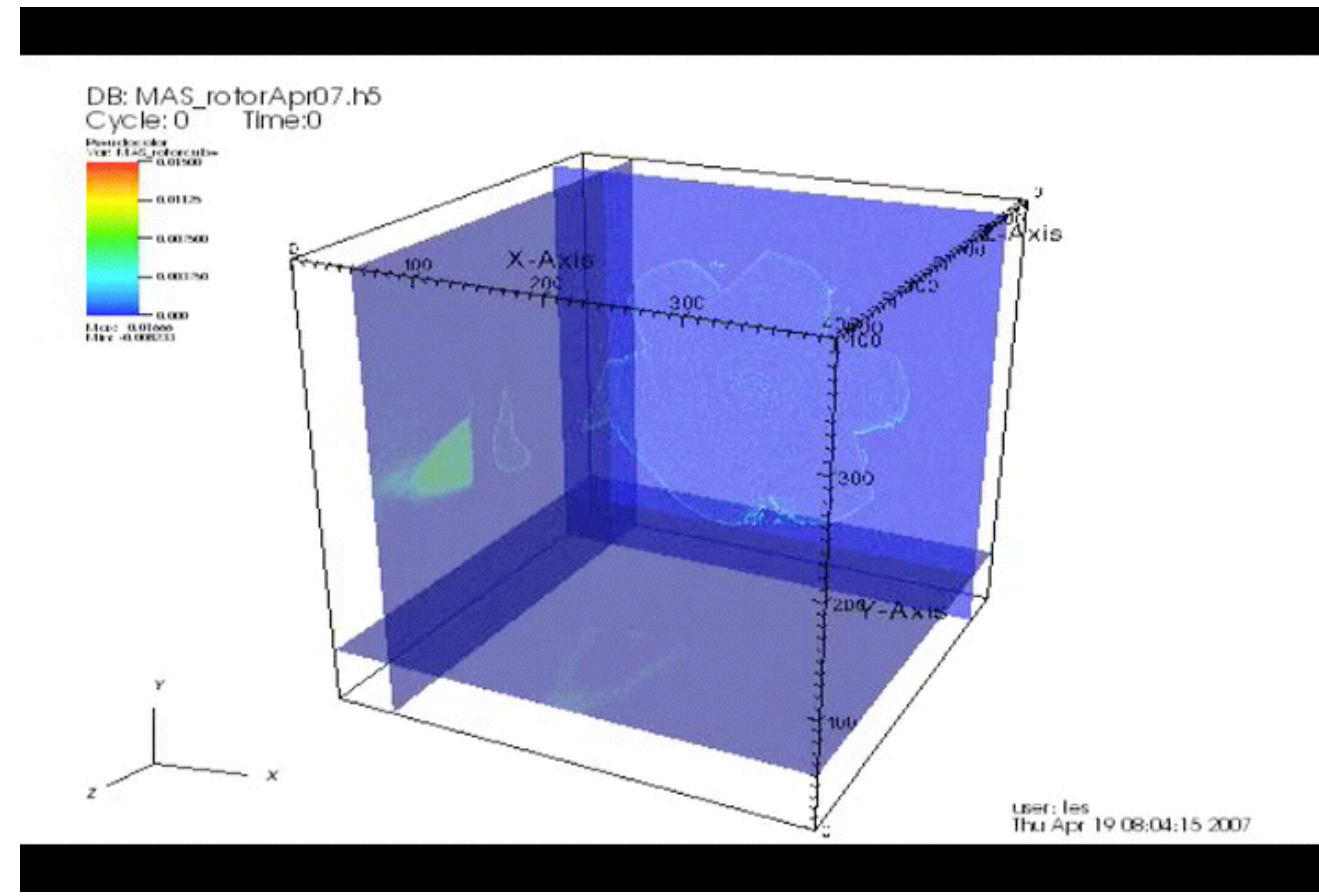
MAS_rotor.h5

This is an X-ray tomography (APS) of a solid-state magic angle spinning sample holder (rotor). In real life, the diameter is 2.5 mm. The rotor is made of zirconium oxide (zirconia) and the cap is Kel-F (a plastic similar to Teflon). This sample holder is about $1,000. My postdoc and I were using this rotor and two others rotors at the National High Magnetic Field Laboratory on their 760 MHz NMR. The sample was a pyrophoric methyl aluminum oxide (MAO). The samples were loaded in a glove box (very difficult with 2.5 mm rotors and caps. De-loading was done on the lab bench (tiny fires). One sample had a stuck cap; I broke the rotor. The next week, I was at APS for tomography experiments, so I imaged the broken rotor (damaged area is out of the field of view).



Example of a movie made with VisIt and a Python script.

Pgm3_HW3_prepare.nb
30 Jan 2012
Les Butler

MAS_rotor.h5 {400x400x400 x Real32}

```
Clear[volume]
```

- **Step 1: Filenames and files sizes**
- **Step 2: Import the HDF5 file**
- **Step 3: Scale to integer16**
- **Step 3: Make the key of {name,rows,columns,slices,endian,format} based on a random number generator.**
- **Step 4: Crop and write binary files**
  Note: BinaryWrite exports in the order {slices,columns,rows}
- **Step 5: Plot a slice. Export MAS_rotor _slice.h5**
- **Step 6: Plot a line**
- **Step 7: Plot two isosurfaces**
- **Step 8: Import MAS_Rotor_slice.h5 and plot**

Name	rows	columns	slices	endian	format
Ashby	335	345	345	little	int16
Galatas	280	250	280	big	uint16
Jeansonne	305	310	275	little	int16
Joshi	275	320	315	little	int16
Kadam	255	260	255	little	uint16
Kiruri	320	305	340	big	int16
Kurtz					
Loeff					
McDar					
Mishr					
Olati					
Potte					
Sartalamacchia	300	335	285	little	uint16
Schneider	285	270	265	little	uint16
Shrestha	315	350	330	little	int16
Skapura	340	315	290	little	uint16
Valles	295	265	350	little	int16
extra1	310	340	335	big	uint16
extra2	330	280	310	little	int16
extra3	265	300	250	little	int16
extra4	290	295	305	little	uint16

warning: not the real answer key

HW3. Determine the file format by trial-and-error of a binary file using ImageJ import.

1) download your file from tezpur.hpc.lsu.edu

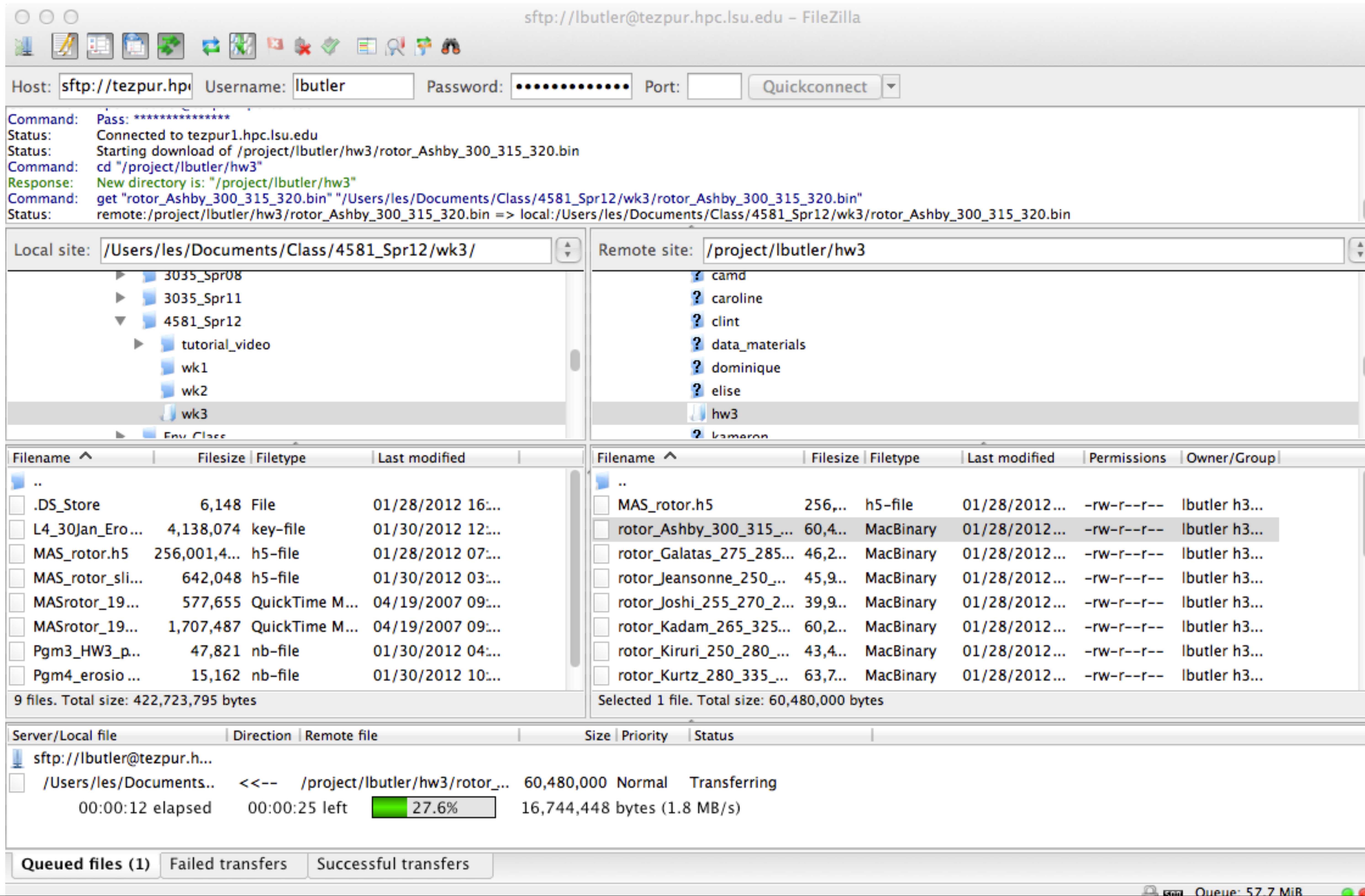
2) the filename has the # of rows, columns, slices, but probably out of order (#s are sorted).

3) This is an evil assignment. Practice your evil laugh.

4) Takes me about 2-5 minutes to solve.

Here is a screenshot of Filezilla caught in the act of transferring rotor_Ashby_300_315_320.bin from tezpur.hpc.lsu.edu/project/lbutler/hw3 to my laptop at /Users/les/Documents/Class/4581_Spr12/wk4/

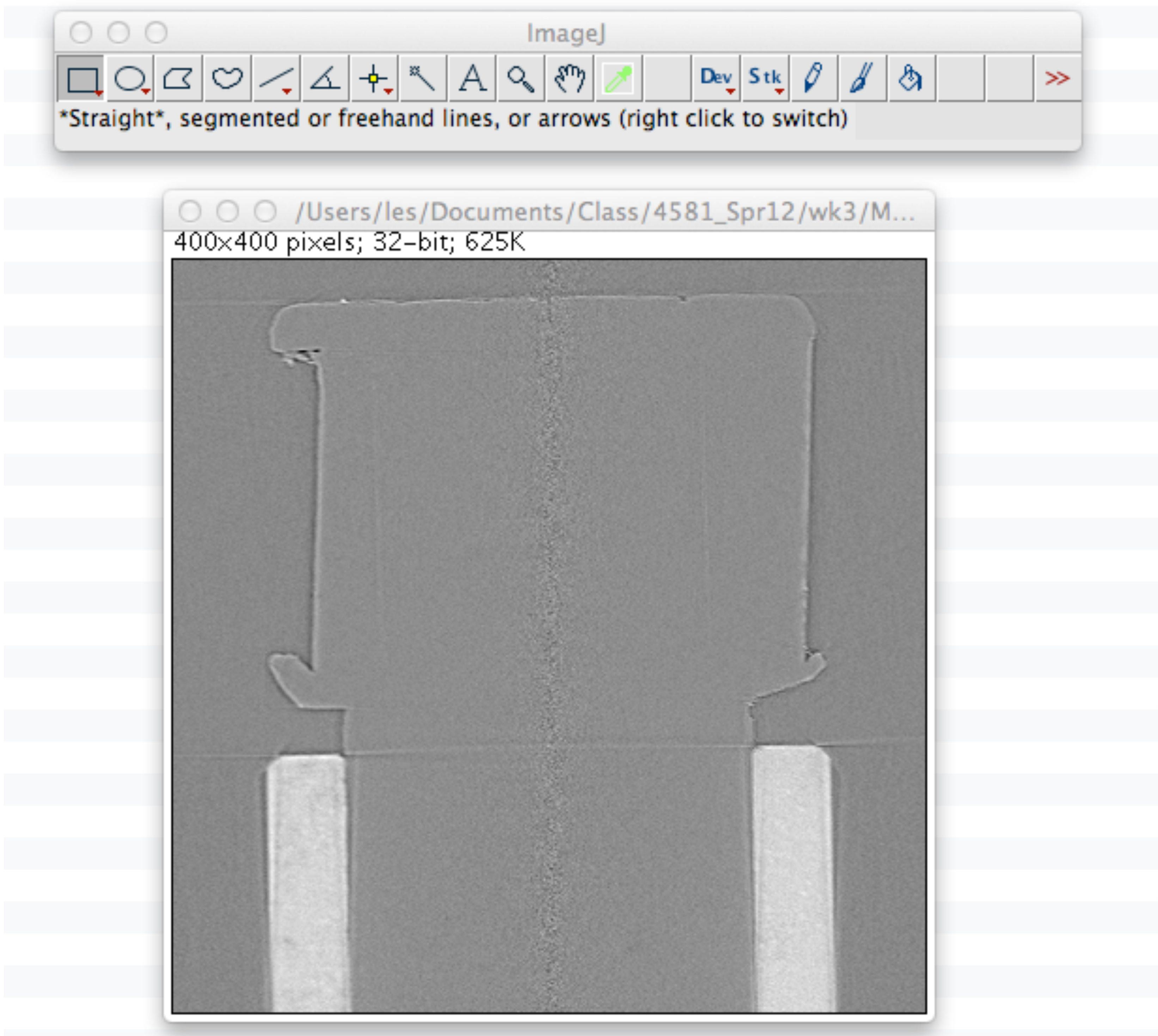
Host = tezpur.hpc.lsu.edu, port = 20, path=/project/lbutler

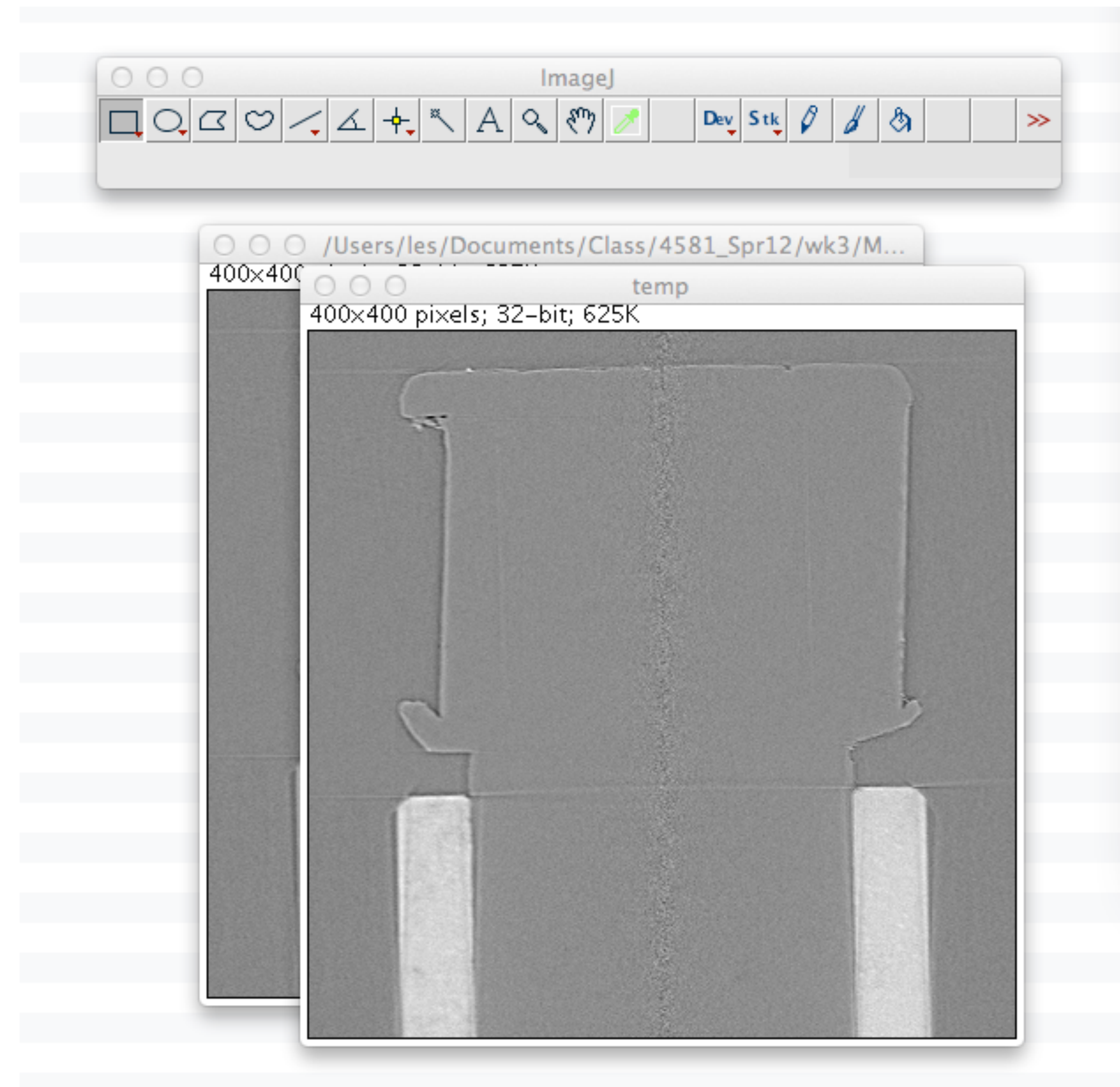


In ImageJ, import the data from MAS_rotor_slice.h5

1) Plugins/HDF5 to get /slice with format “float”

2) To save some time (and this is a small file), make a duplicate with Image/Duplicate and give the result some simple name.



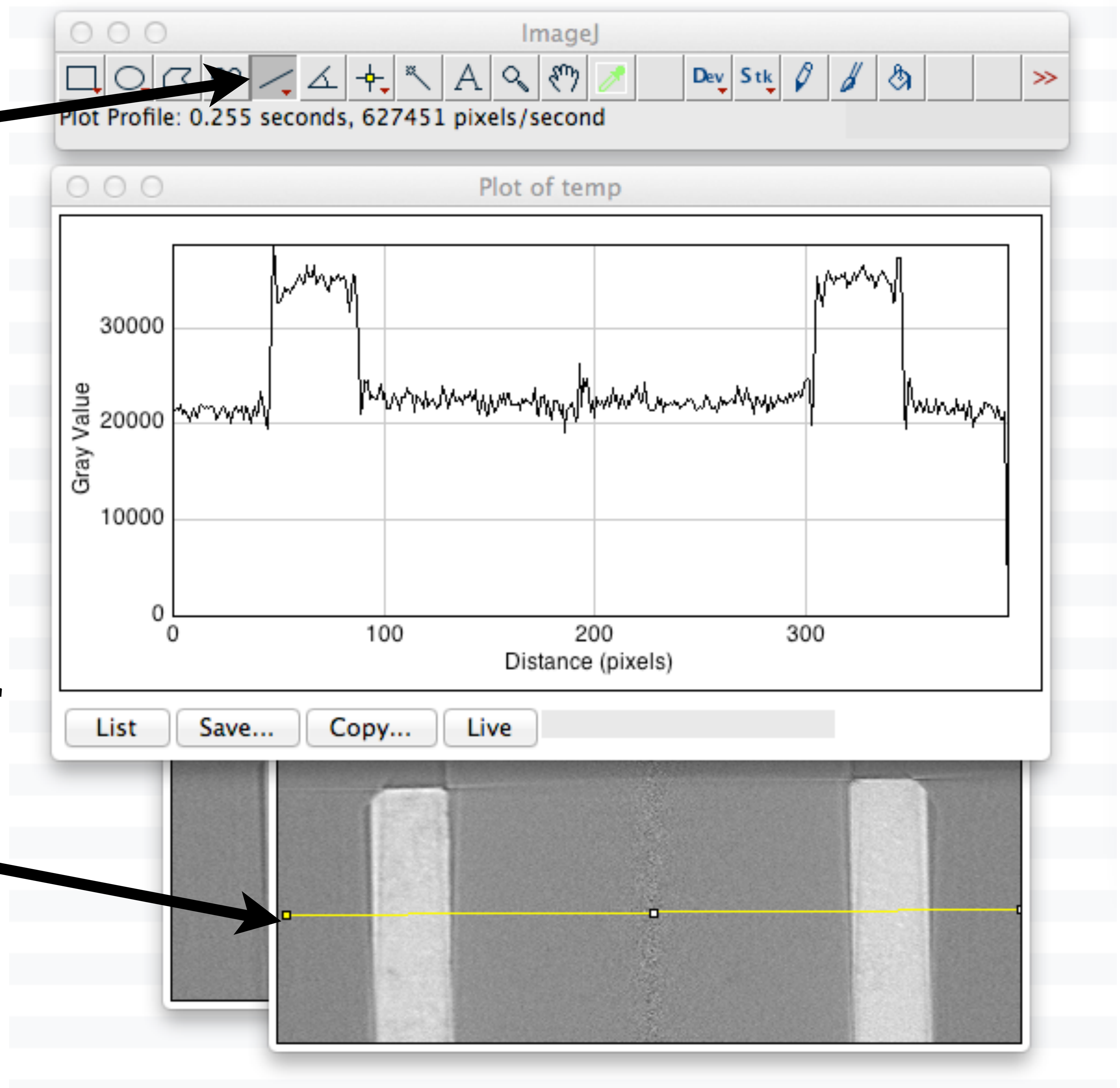


In ImageJ

3) Let's look at the values across the zirconia rotor with the line tool and Analyze/Plot Profile

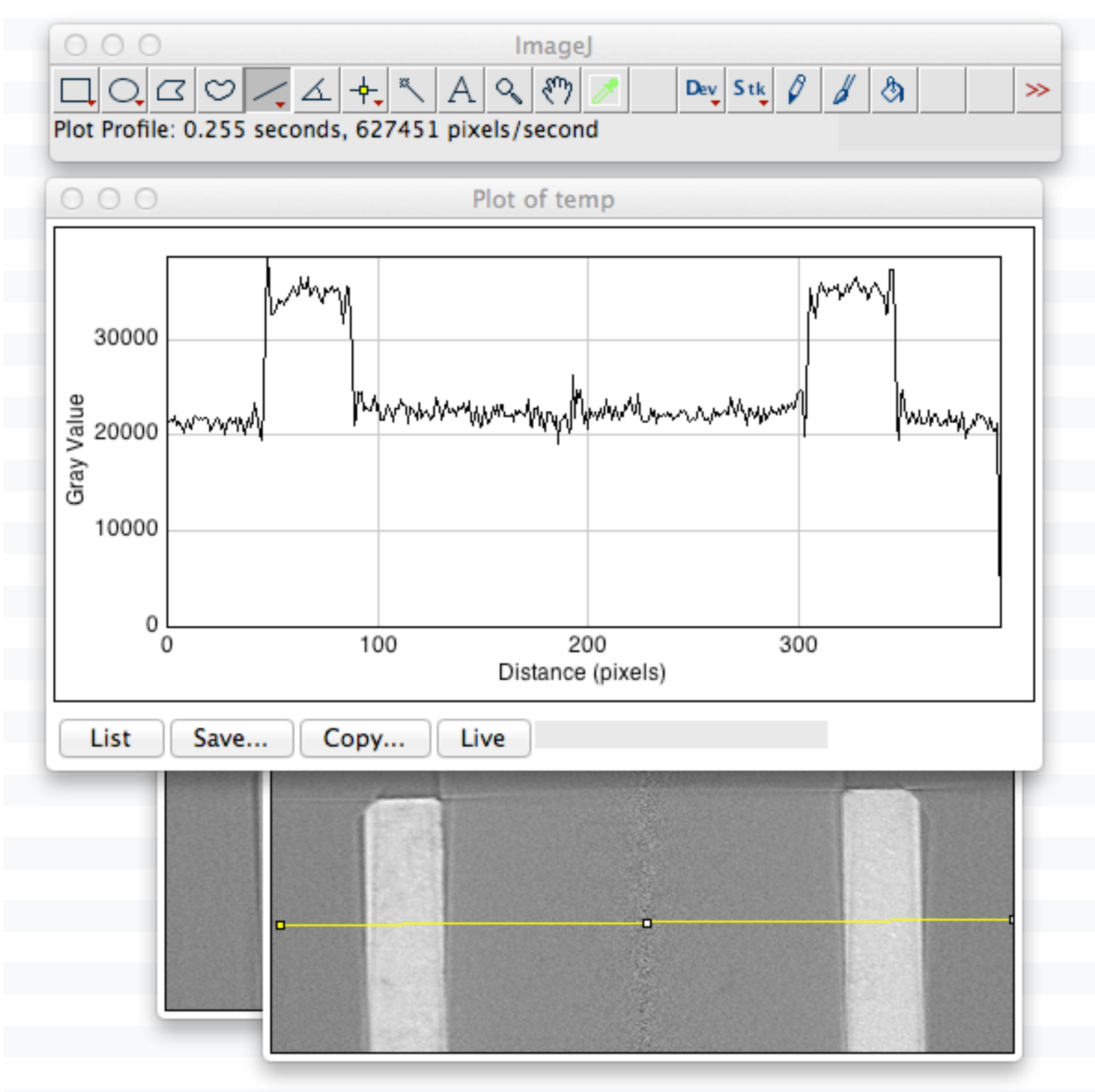
Select the line tool

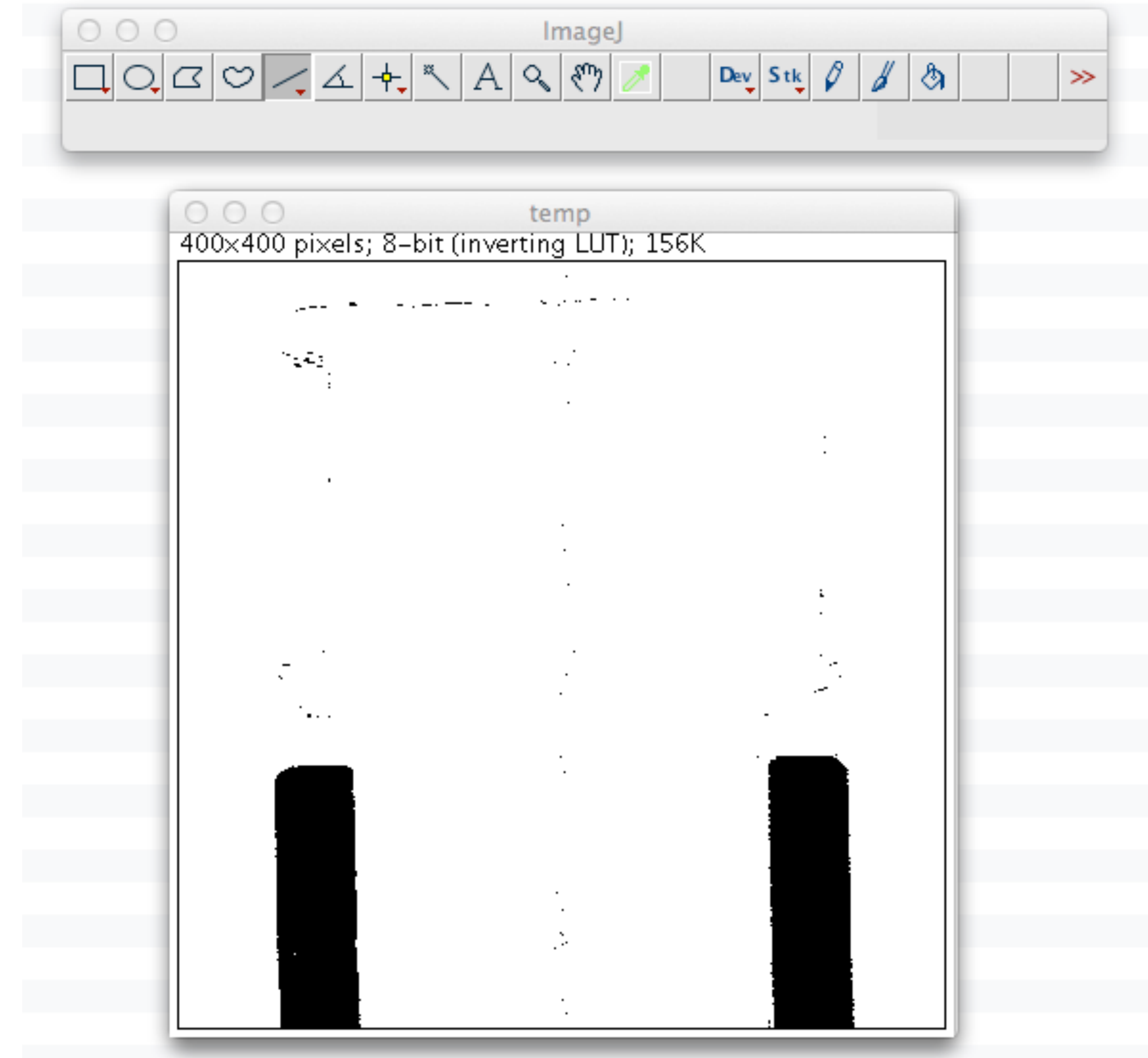
Draw a line across the the zirconia rotor



Select Analyze /Plot Profile

In ImageJ
4) Binarize (using an automatic threshold) with Process/Binary/Make Binary

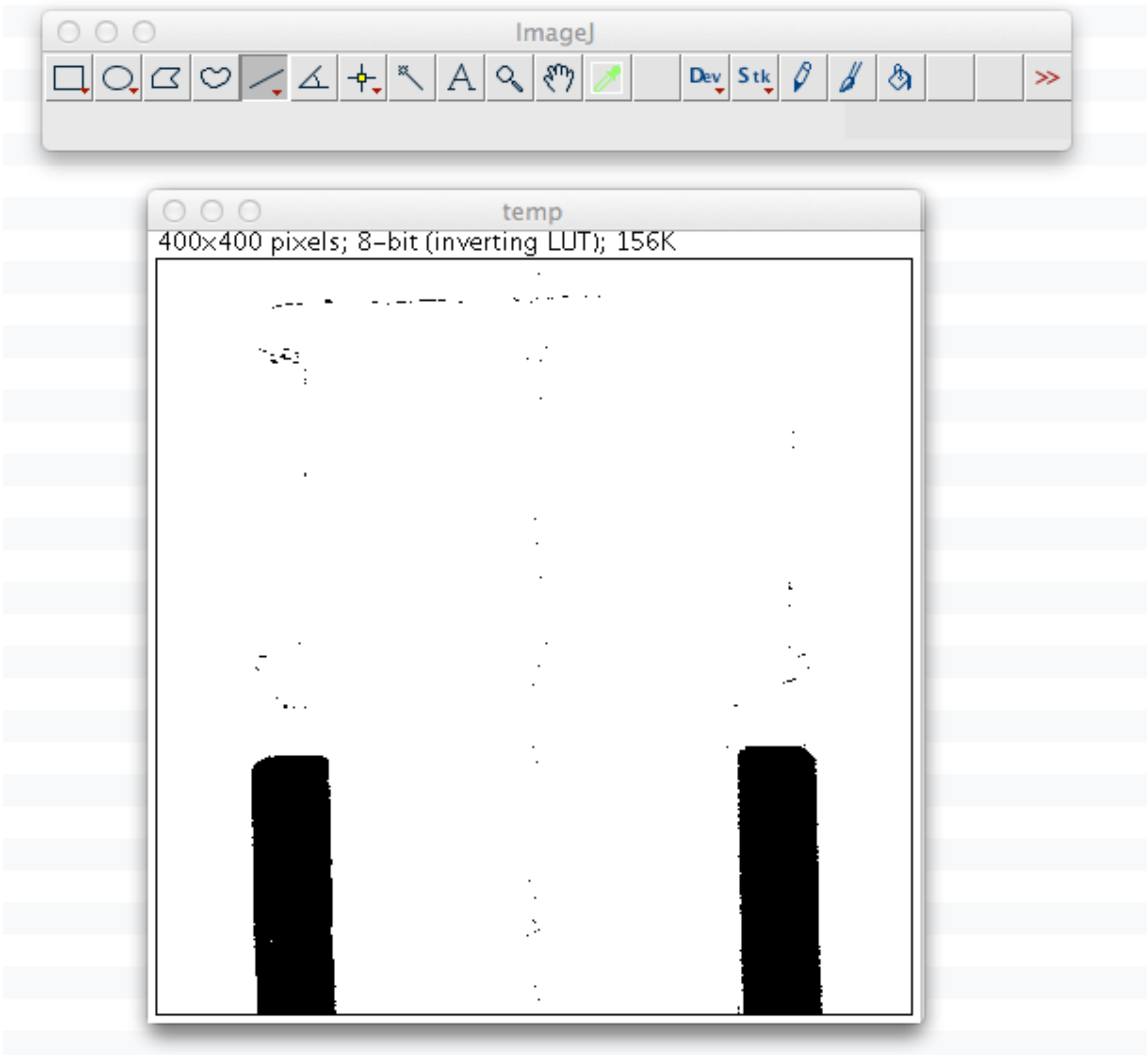




In ImageJ

5) We can (not required) make objects bigger with   Process/Binary/Dilate about 5 times.

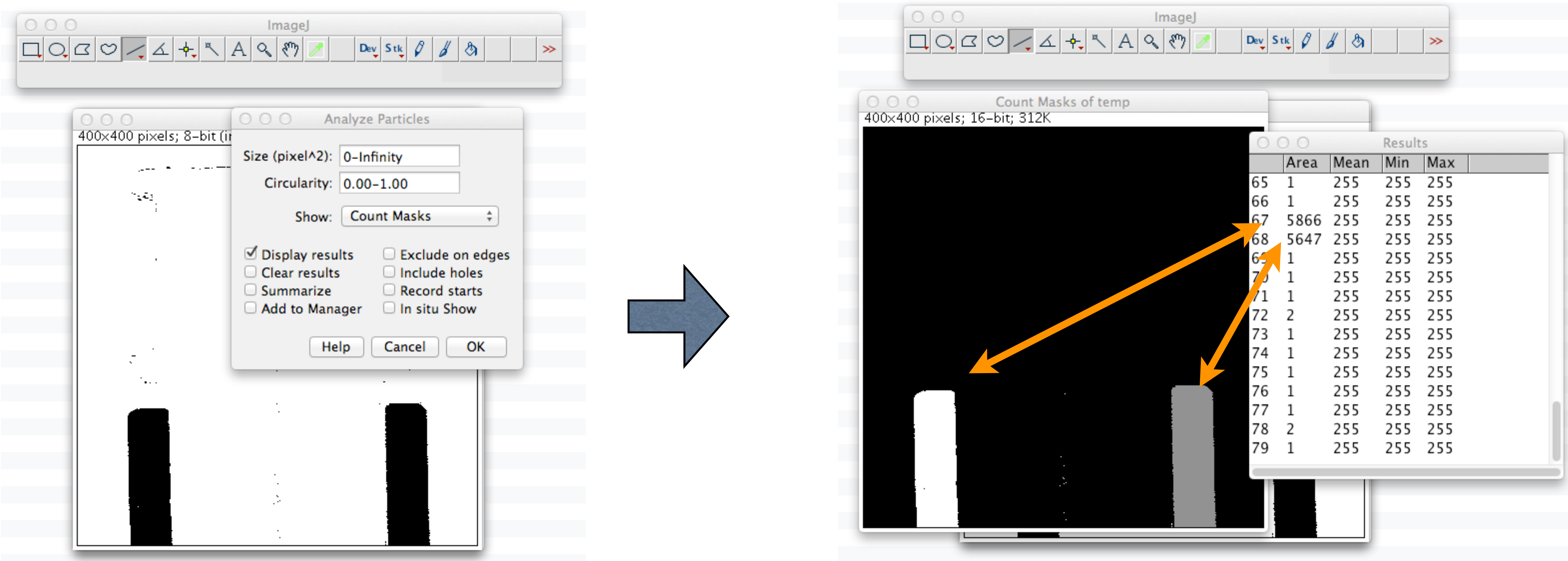
This time, I did not dilate because I wanted a lot of small objects in the label field.



In ImageJ

6) Next, a connected component (label) analysis. Do Analyze/Analyze Particles...

(Use some auto brightness/contrast with Image/Adjust/Brightness/Contrast



- **Step 1: Import MAS_Rotor_slice.h5 and plot**

In[1]:=
```
Import[NotebookDirectory[] <> "MAS_rotor_slice.h5"]
```

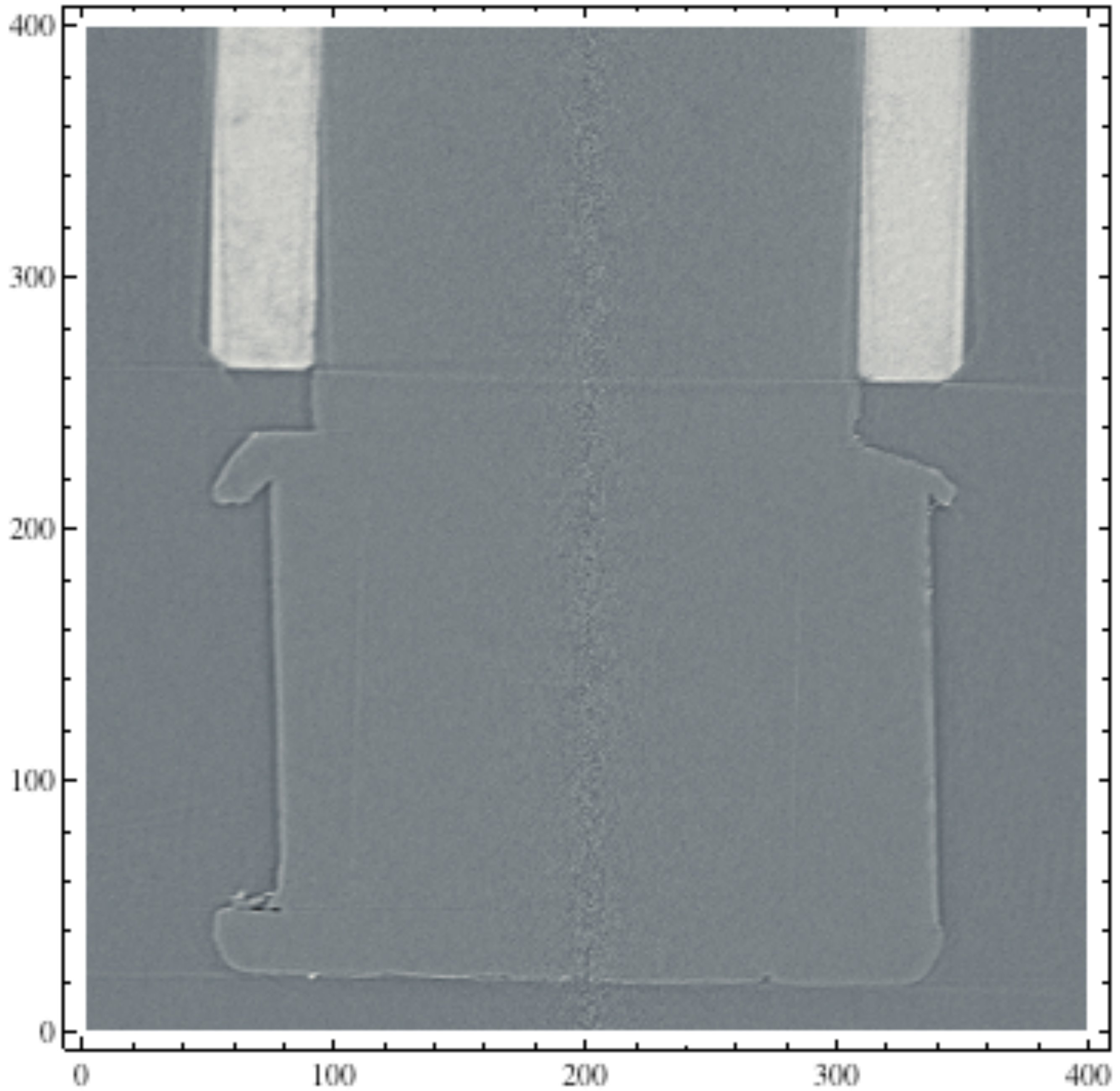
Out[1]= {/slice}

In[2]:=
```
aSlice = Import[NotebookDirectory[] <> "MAS_rotor_slice.h5", {"Datasets", "/slice"}];
Dimensions[aSlice]
```

Out[3]= {400, 400}

In[4]:=
```
gSlice = ListDensityPlot[aSlice, ColorFunction → "GrayTones", PlotRange → {All, All, All}]
```

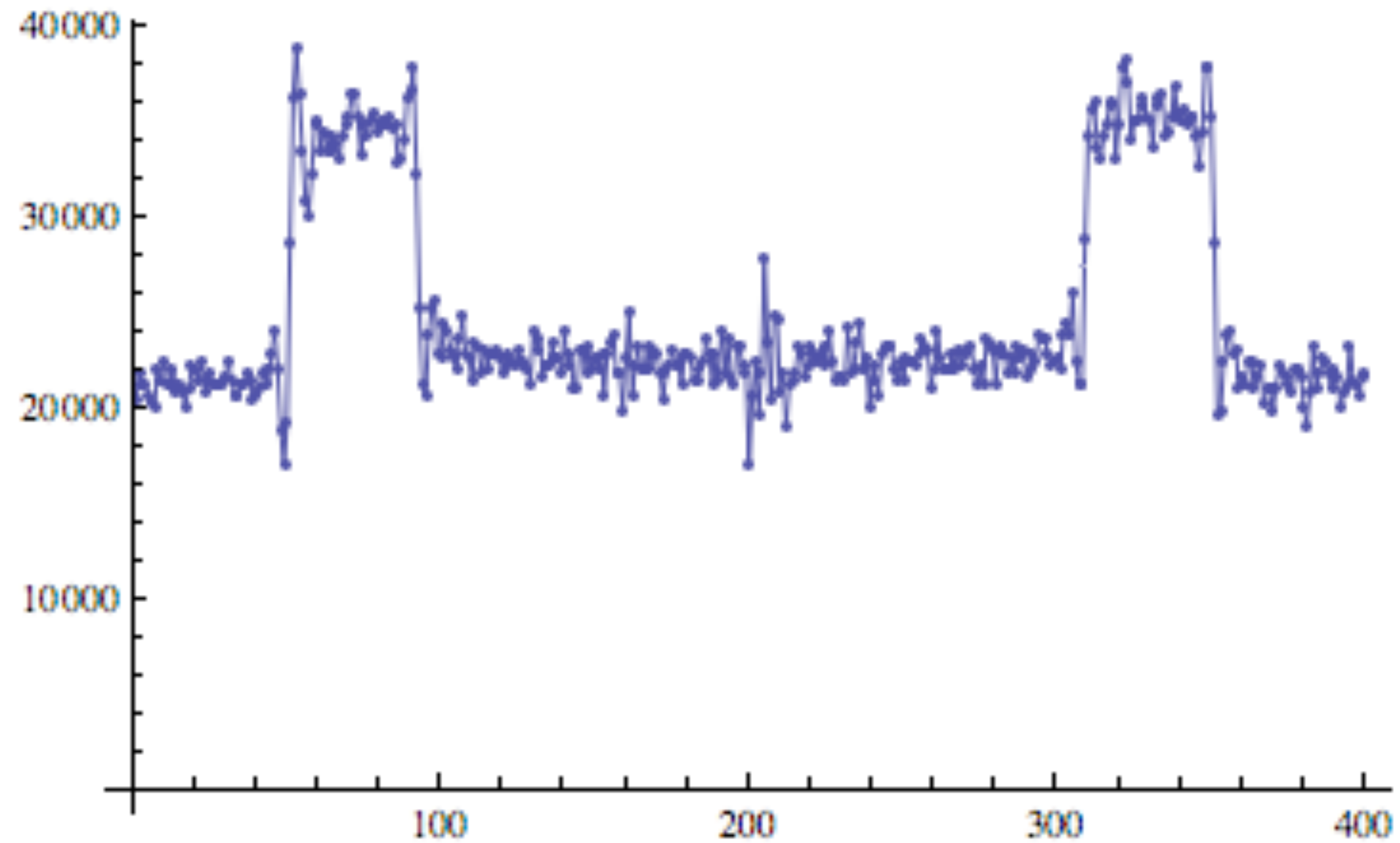
Out[4]=



In[5]:=
```
aLine = aSlice[[300, All]];
{Min[aLine], Max[aLine]}
gLine = ListPlot[aLine, PlotRange → {All, All}];
gLineV2 = ListPlot[aLine, PlotRange → {All, All}, Joined → True];
Show[{gLine, gLineV2}]
```

Out[6]= {17 005, 38 994}

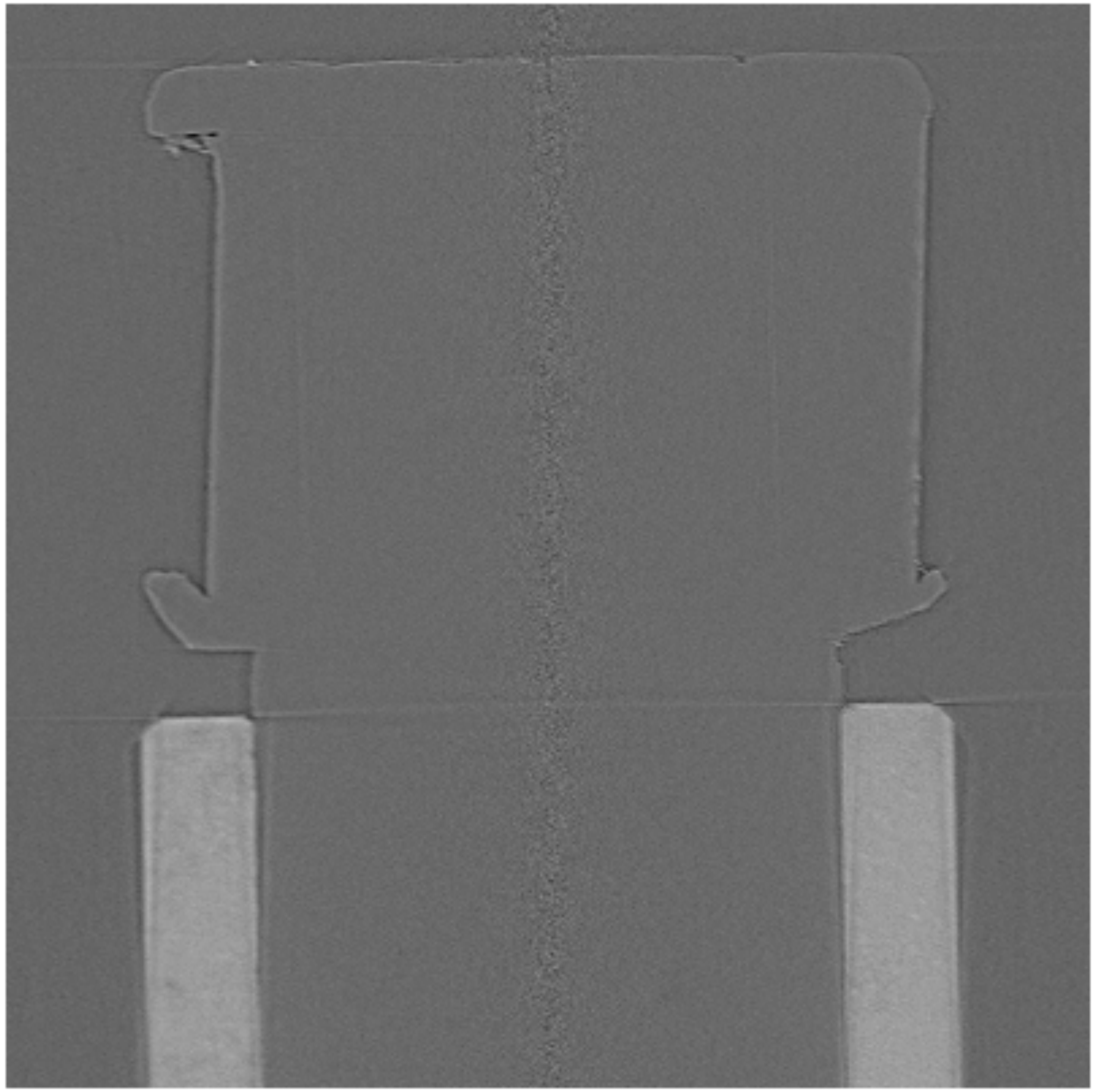
Out[9]=



- **Step 2: Convert into *Mathematica* Image format**

In[11]:= `imageSlice = Image[aSlice, "Bit16"]`

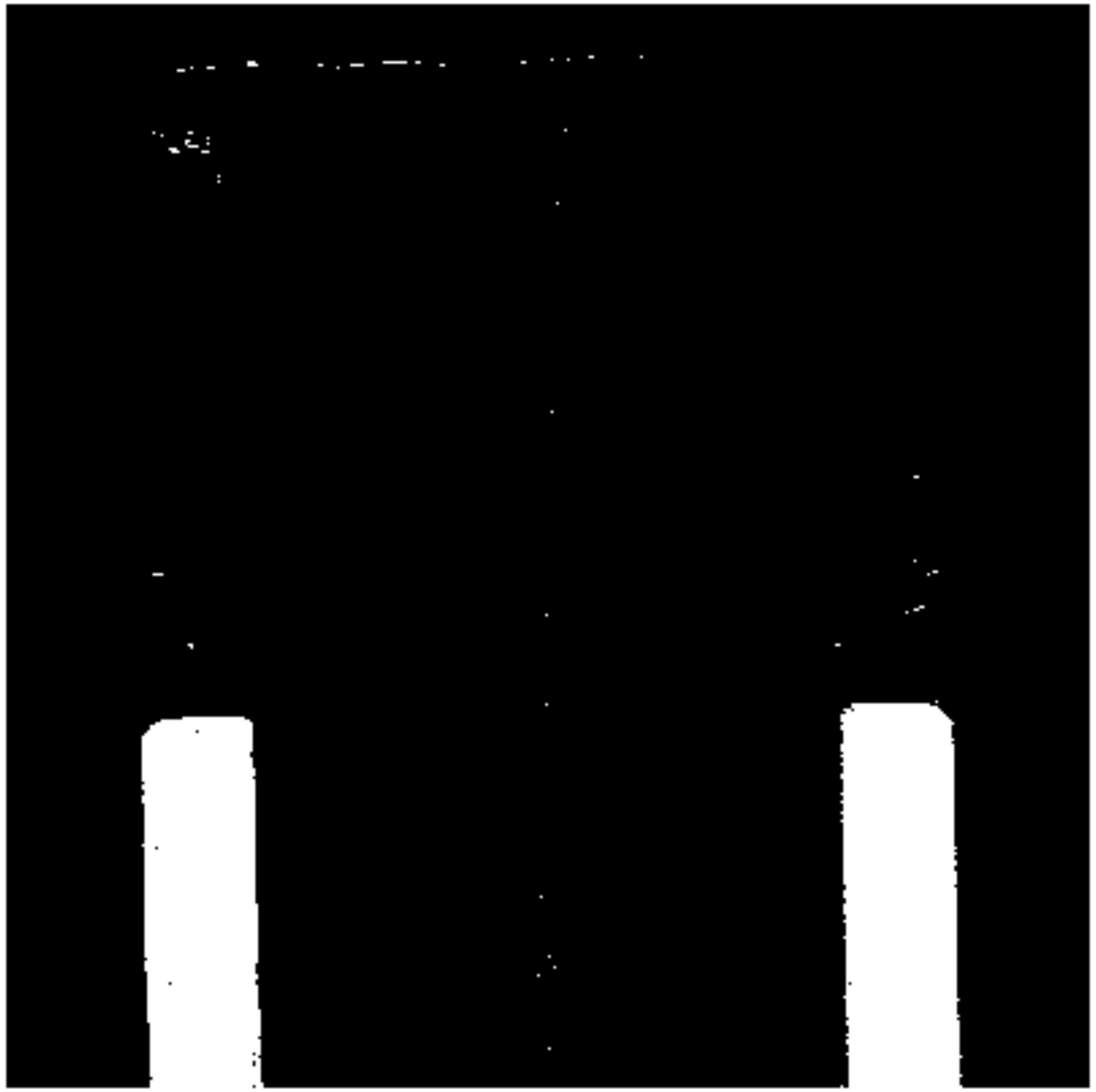
Out[11]=



- **Step 3: Binarize**

[12]:= `imageBinary = Binarize[imageSlice,` [redacted] / 65 535 `]`

t[12]=



- **Step 4: Erode**

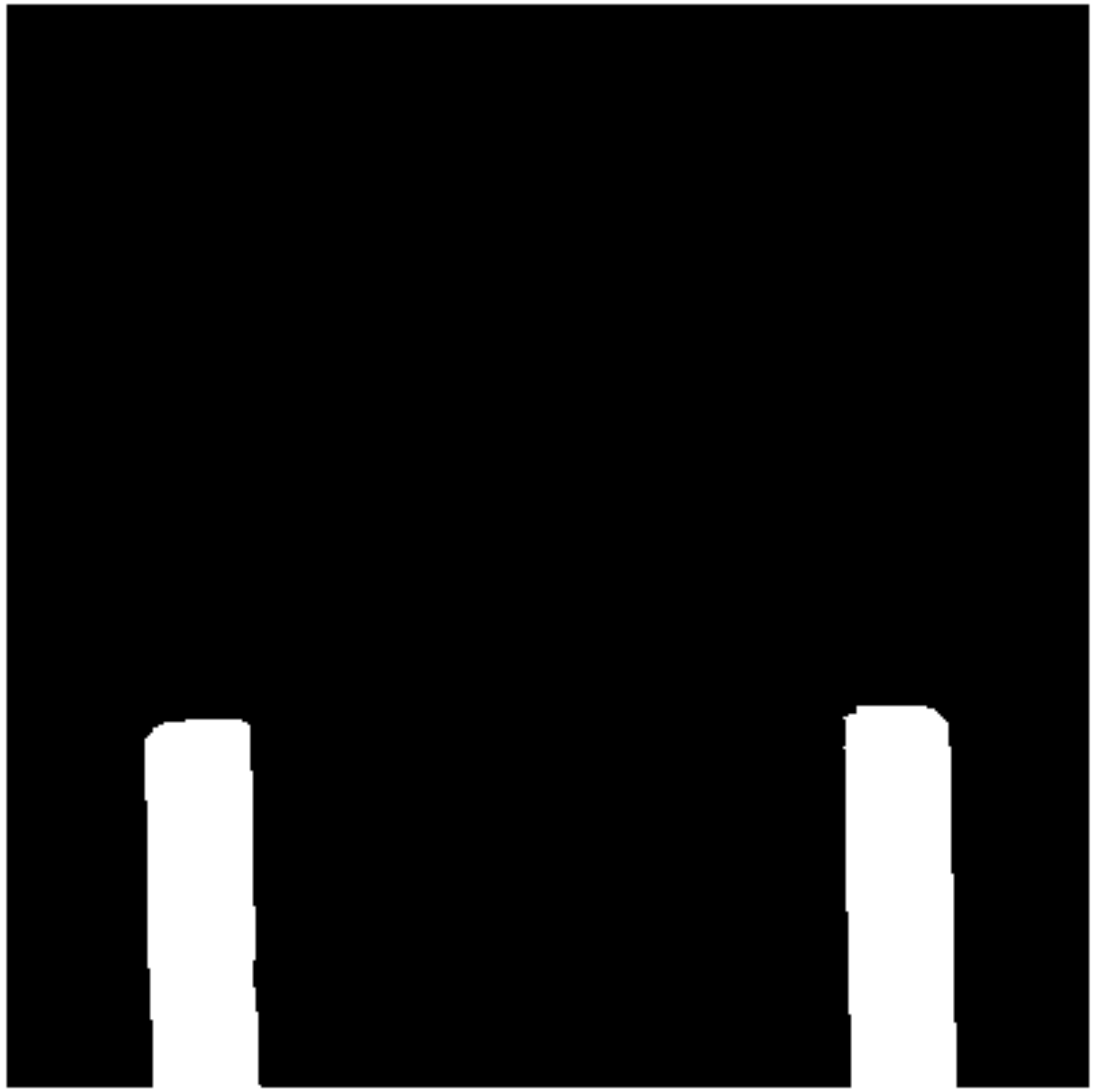
In[13]:=
```
imageErode = Erosion[imageBinary, 1]
```

Out[13]=

- **Step 5: Hole Closing**

In[14]:=
```
imageClose = Closing[imageErode, 4]
```

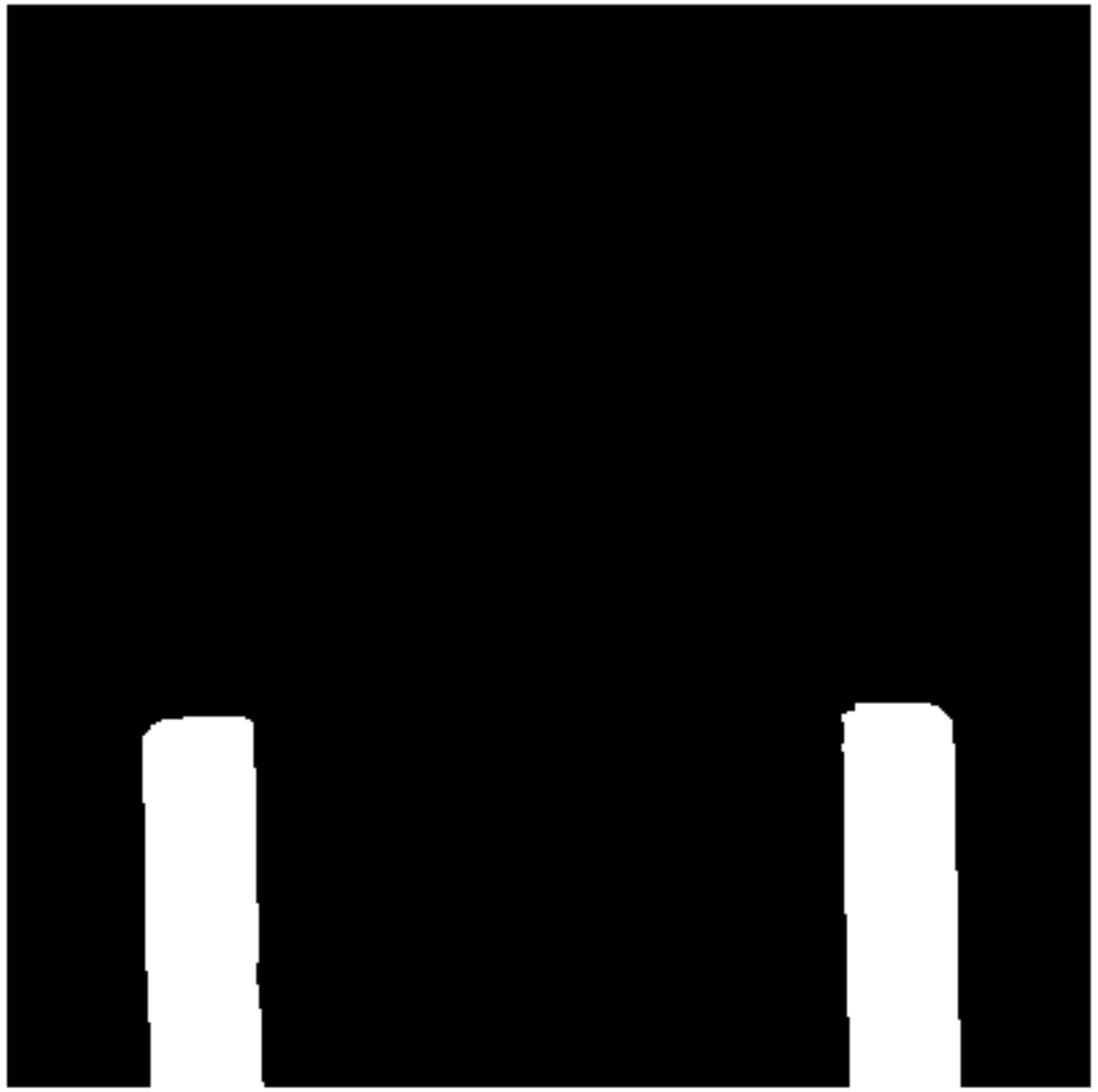
Out[14]=



- **Step 6: Dilate**

In[15]:=
```
imageDilate = Dilation[imageClose, 1]
```

Out[15]=



- **Step 6: Connected Componente (label field) analysis**

```
In[16]:= imageComponents = MorphologicalComponents[imageDilate]
```

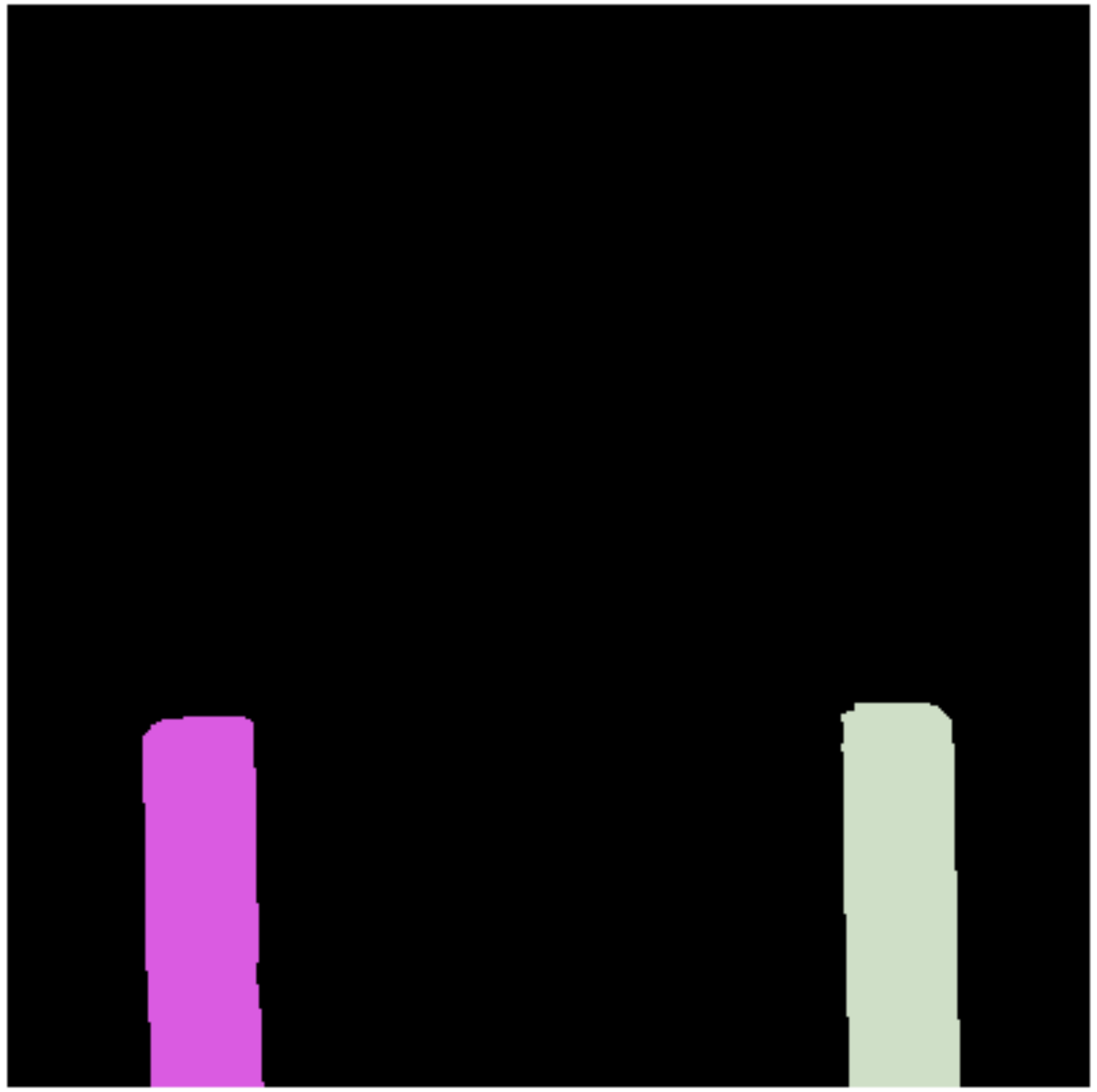
A very large output was generated. Here is a sample of it:

```
Out[16]= { <<1>> }
```

Show Less | Show More | Show Full Output | Set Size Limit...

```
In[17]:= Colorize[imageComponents]
```

Out[17]=



```
In[18]:= Dimensions[imageComponents]

Out[18]= {400, 400}
```