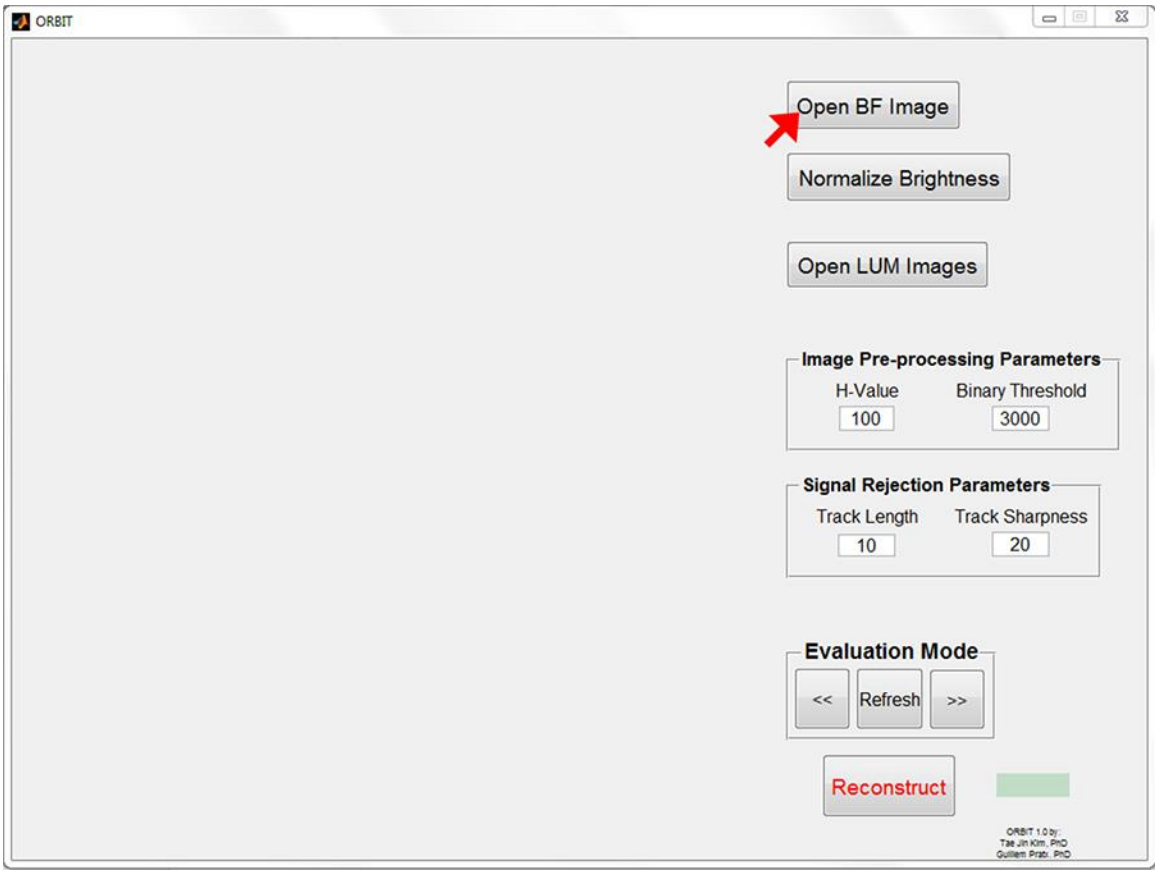
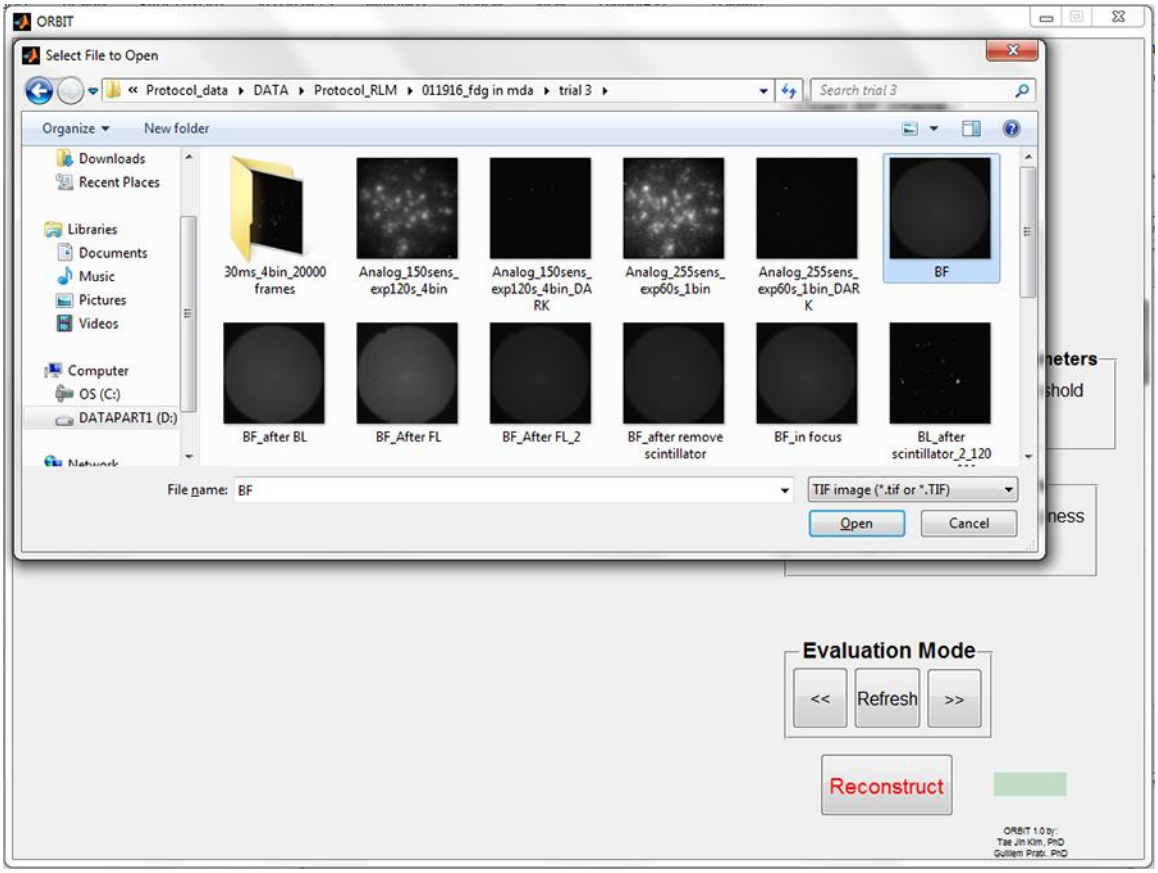
“Optical reconstruction of the beta ionization track” (ORBIT) manual.

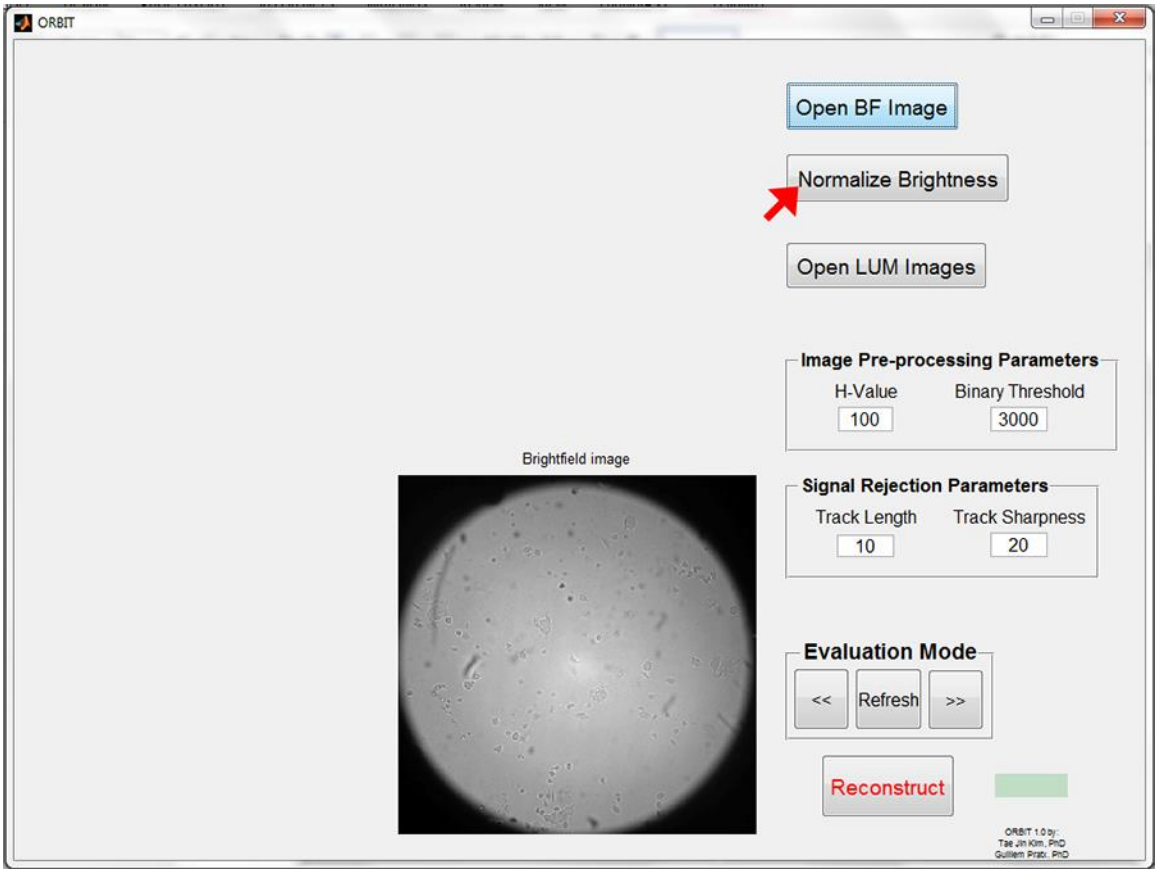
1. Type ‘ORBIT’ in the MATLAB command screen.
2. Initial screen will pop up with a blank area on the left
3. Open brightfield image by pressing ‘Open BF Image’ button.



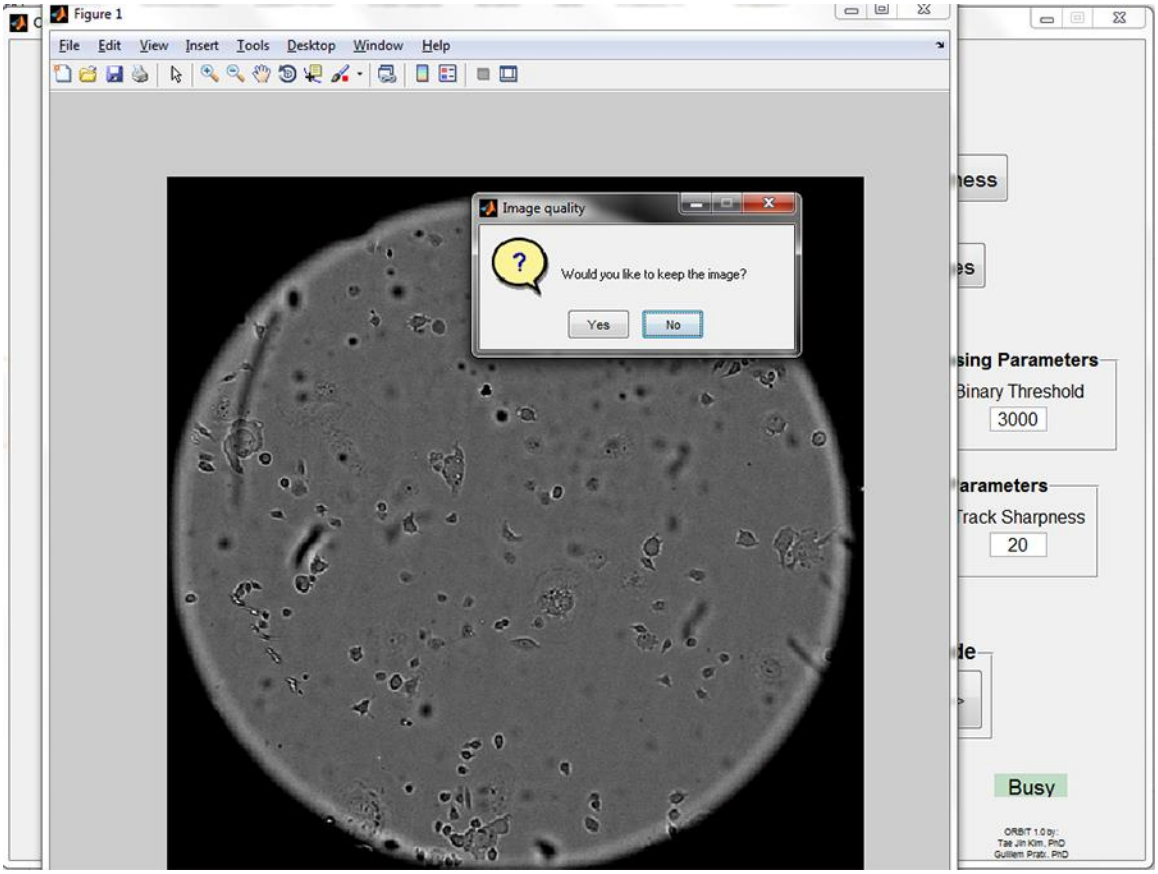
4. Select the appropriate brightfield image file. It should be noted that currently only .tif format is supported.



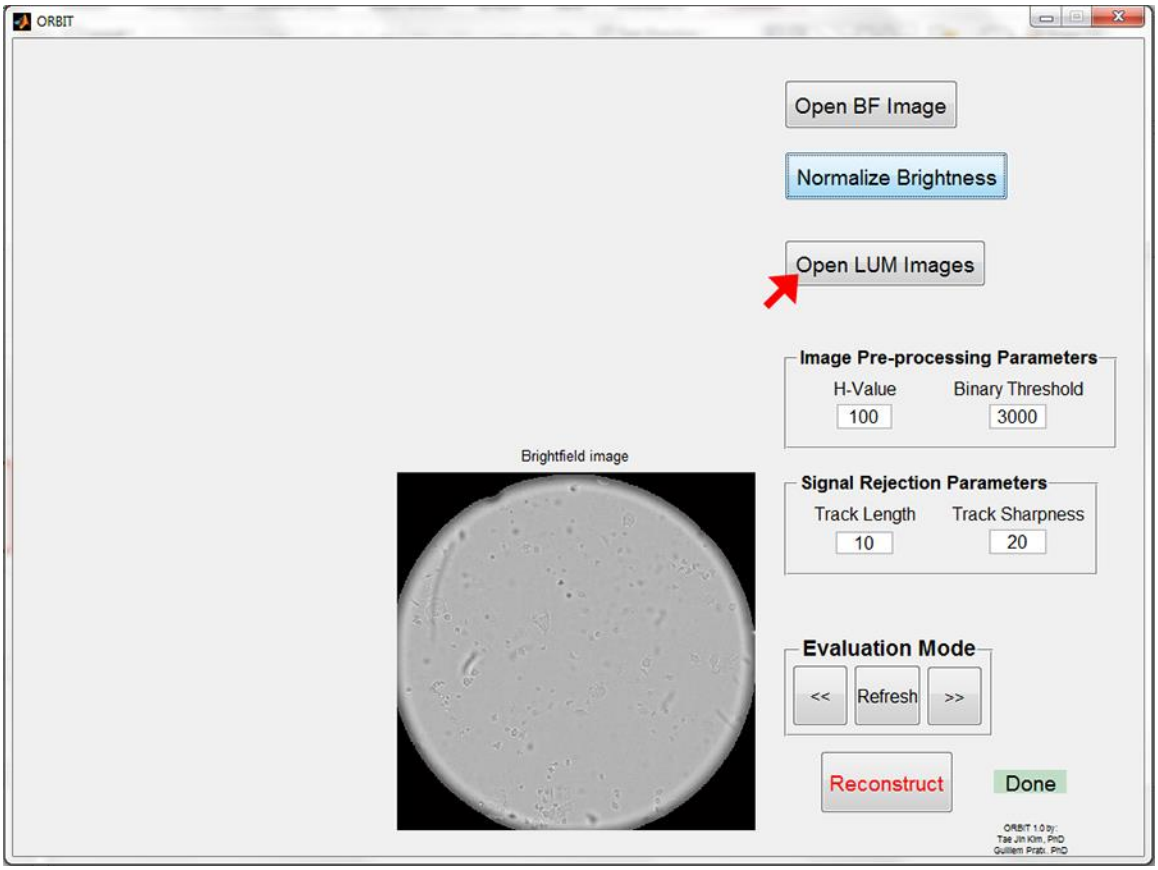
5. The brightfield image will be displayed in the bottom corner of the blank area.
6. Since the light intensity map is non-uniform (brightest in the center and darkest near the edges), the user can normalize the brightness by pressing the 'Normalize Brightness' button.



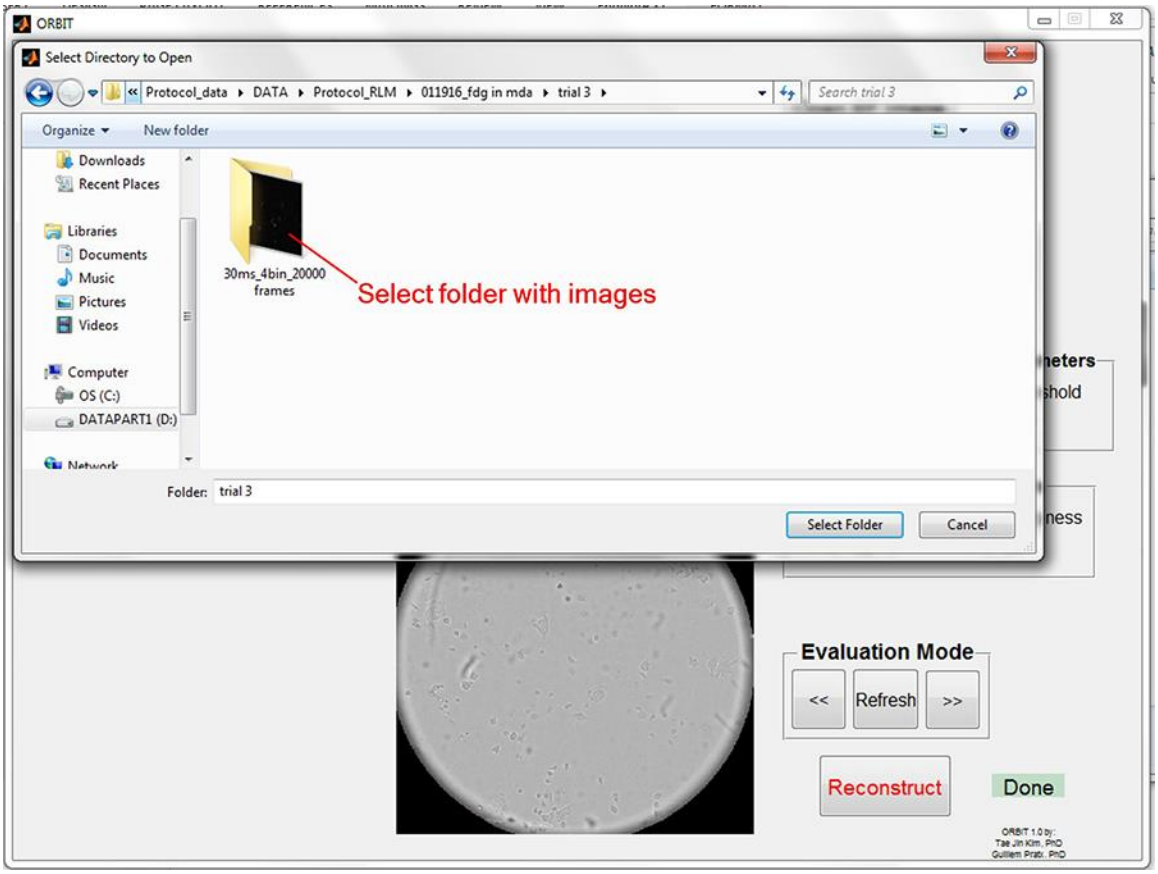
7. A popup screen will appear once the normalization process is complete. The user can choose to keep the normalized image or revert back to the original image if desired.



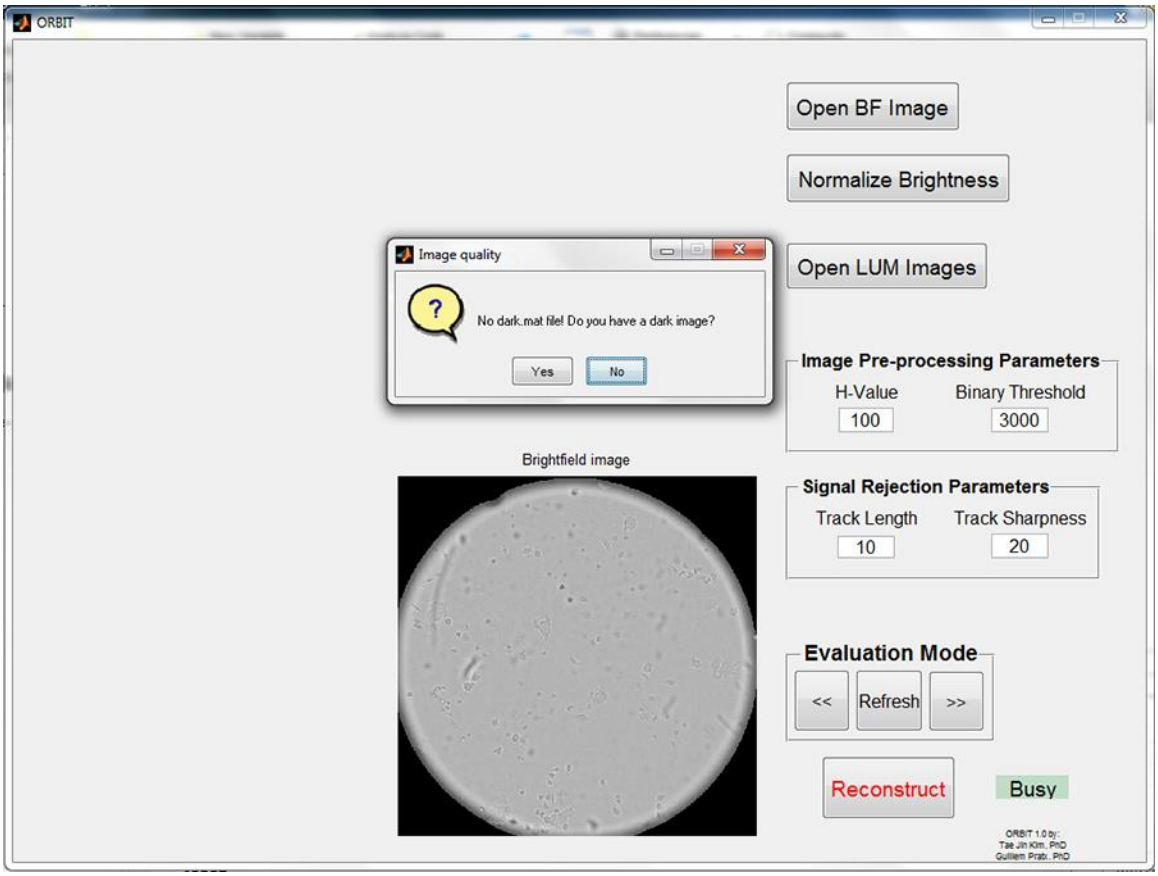
8. Open the scintillation flash images by pressing the ‘Open LUM Images’ button.



9. Select the folder that contains the scintillation images. The images can be saved in a single Multitiff format, multiple Multitiff format, or a set of individual .tiff files. ***IMPORTANT:** The images should only contain scintillation images (no brightfield or dark images).
10. Once the folder is selected, press 'Select Folder' to confirm.



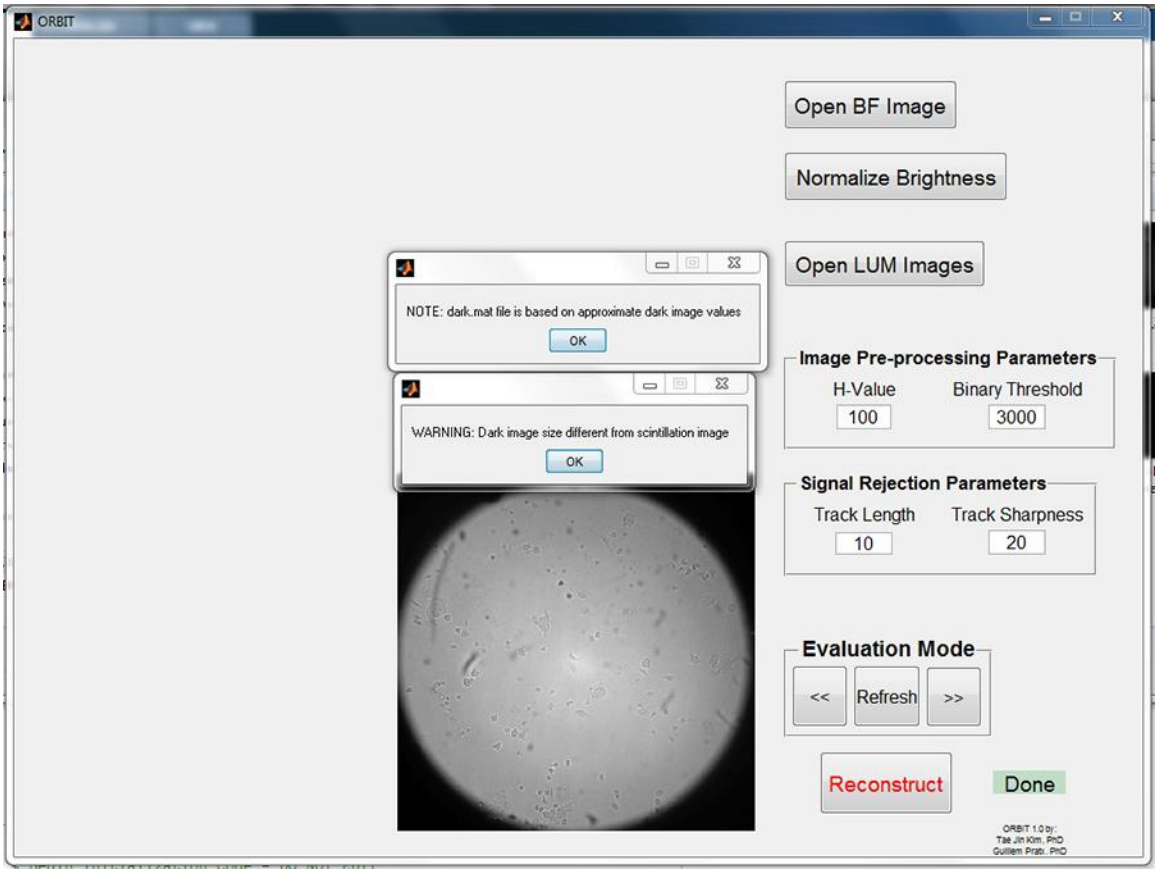
11. If no dark image (dark.mat) is present, a message box will appear querying if a dark image is available.
    a. If 'yes', select the appropriate set of dark images.
    b. If 'no', the ORBIT will automatically extrapolate an approximate dark image based on scintillation images (not recommended).



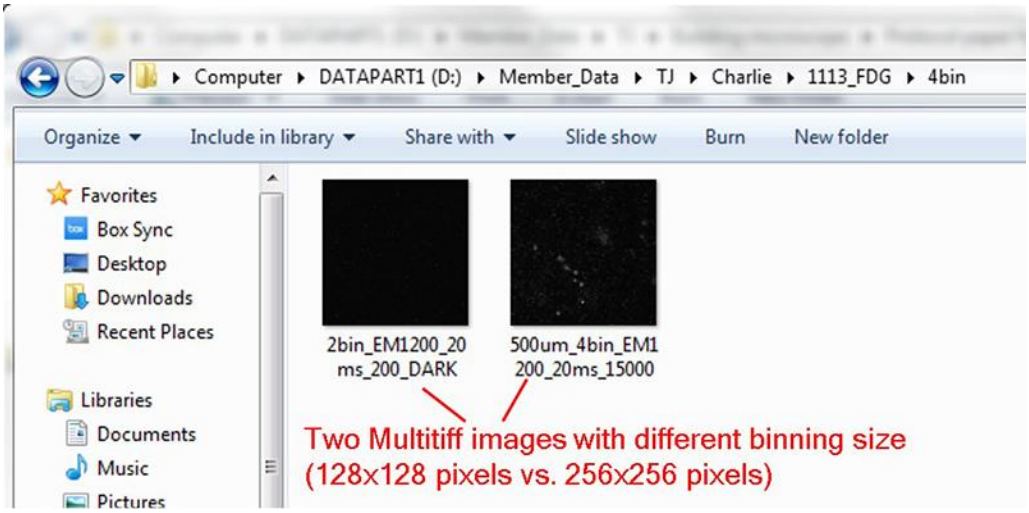
*Error Messages: There are a number of possible messages and are explained below:

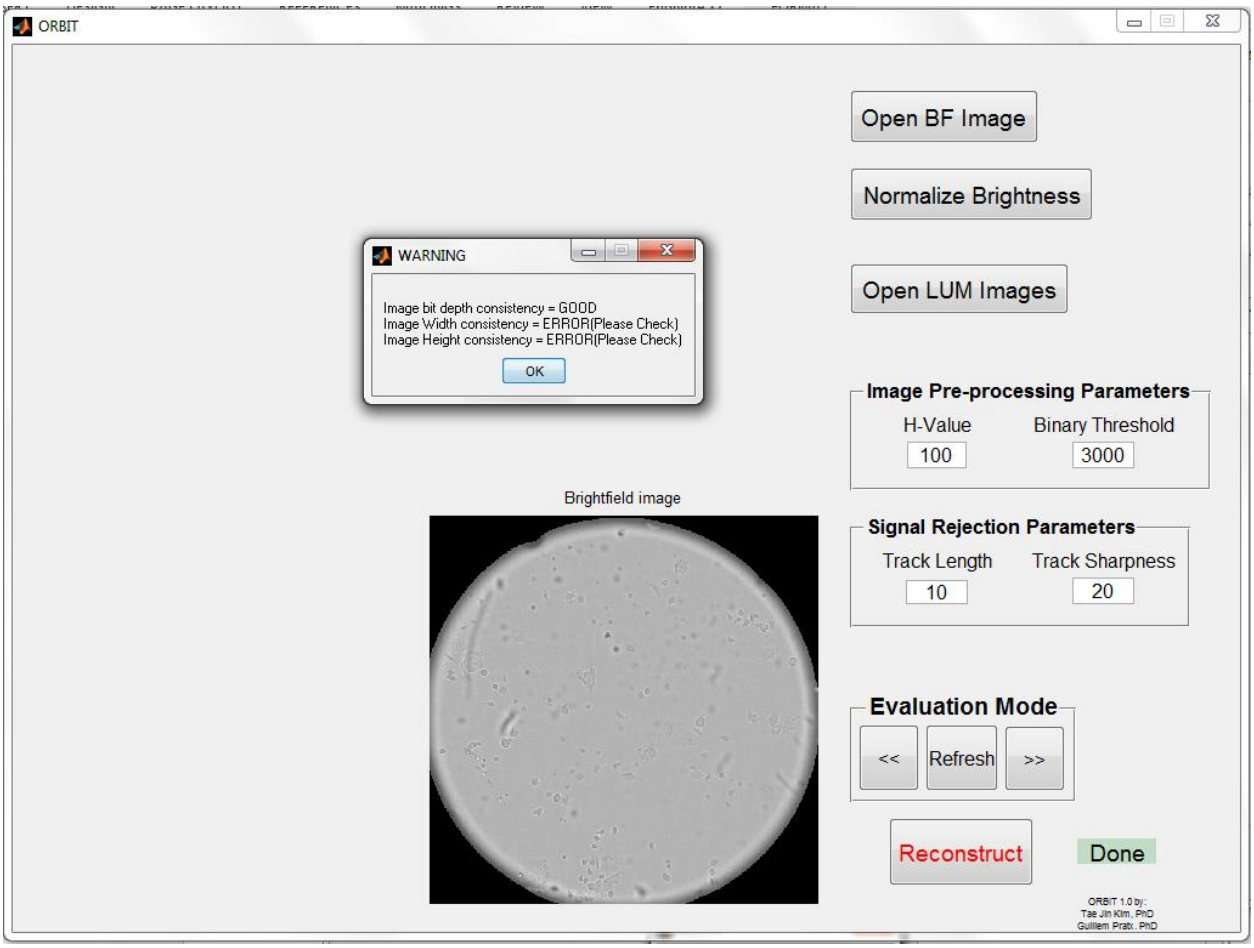
Error 1. If the dark image data (dark.mat) is automatically extrapolated for the radioluminescence scan, a popup screen will appear notifying the user. It is recommended that the user create a ‘dark.mat’ file based on actual dark images. The image reconstruction process will still be operational.

Error 2. If the pixel size of ‘dark.mat’ does not match the acquired scintillation image (e.g. different binning or different camera), the user must provide a corrected ‘dark.mat’ or create a new dark file.

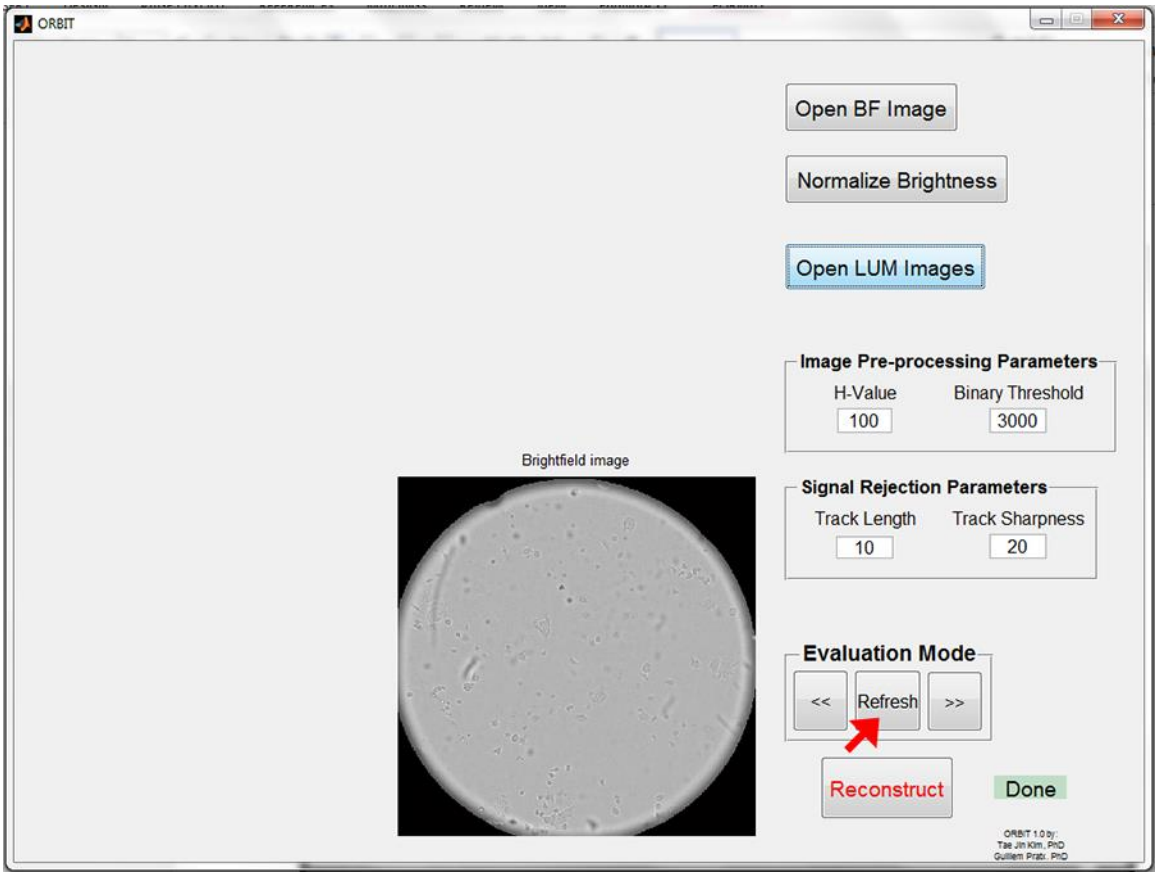


Error 3. If there are inconsistencies between different scintillation images (bit depth and/or pixel sizes), the user will be prompted to make corrections.

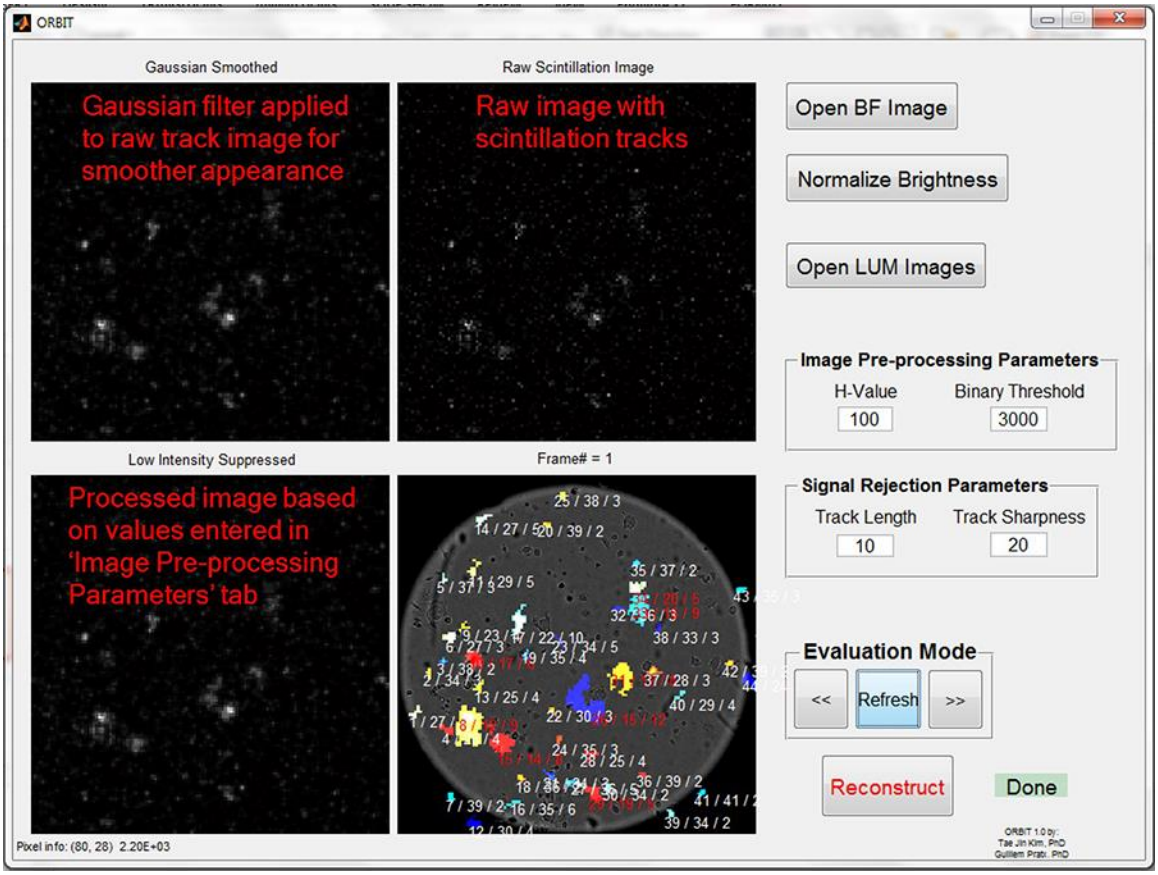




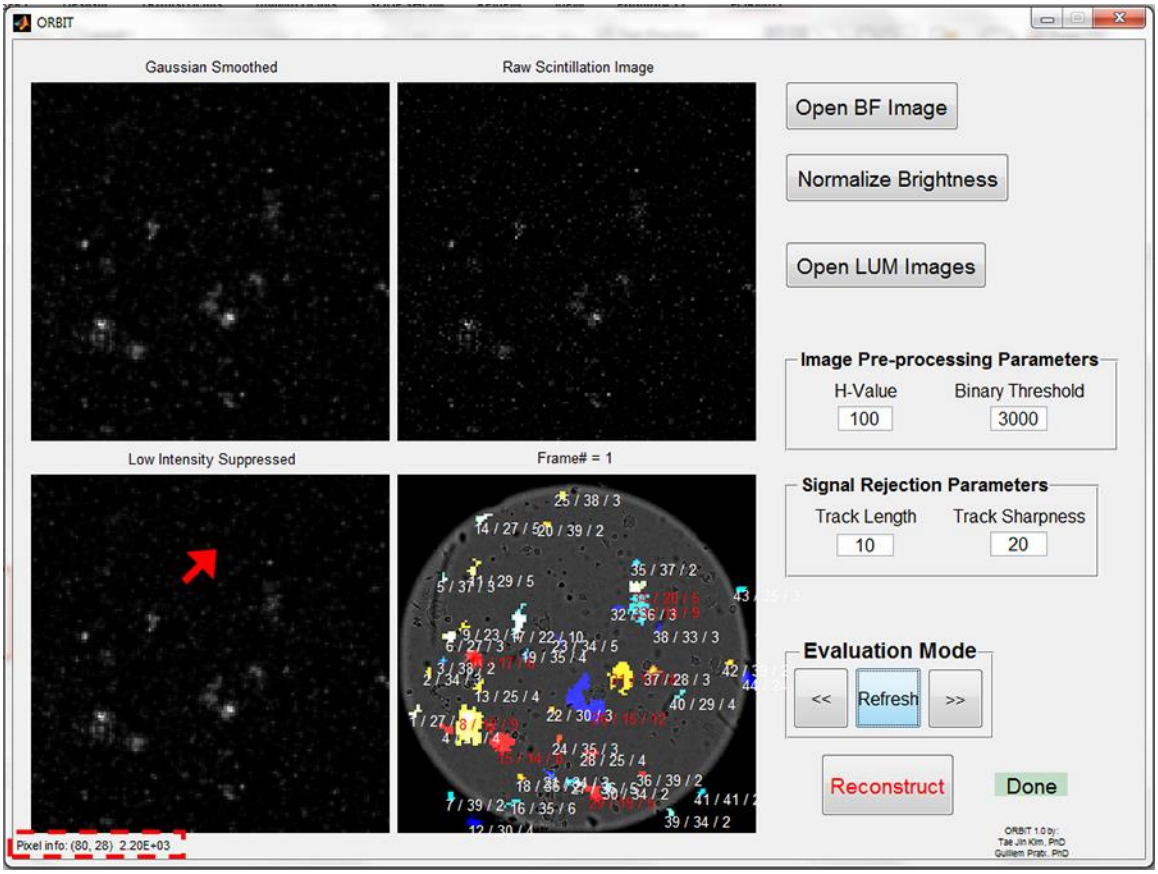
12. Initiate the evaluation mode by pressing ‘Refresh’ button.



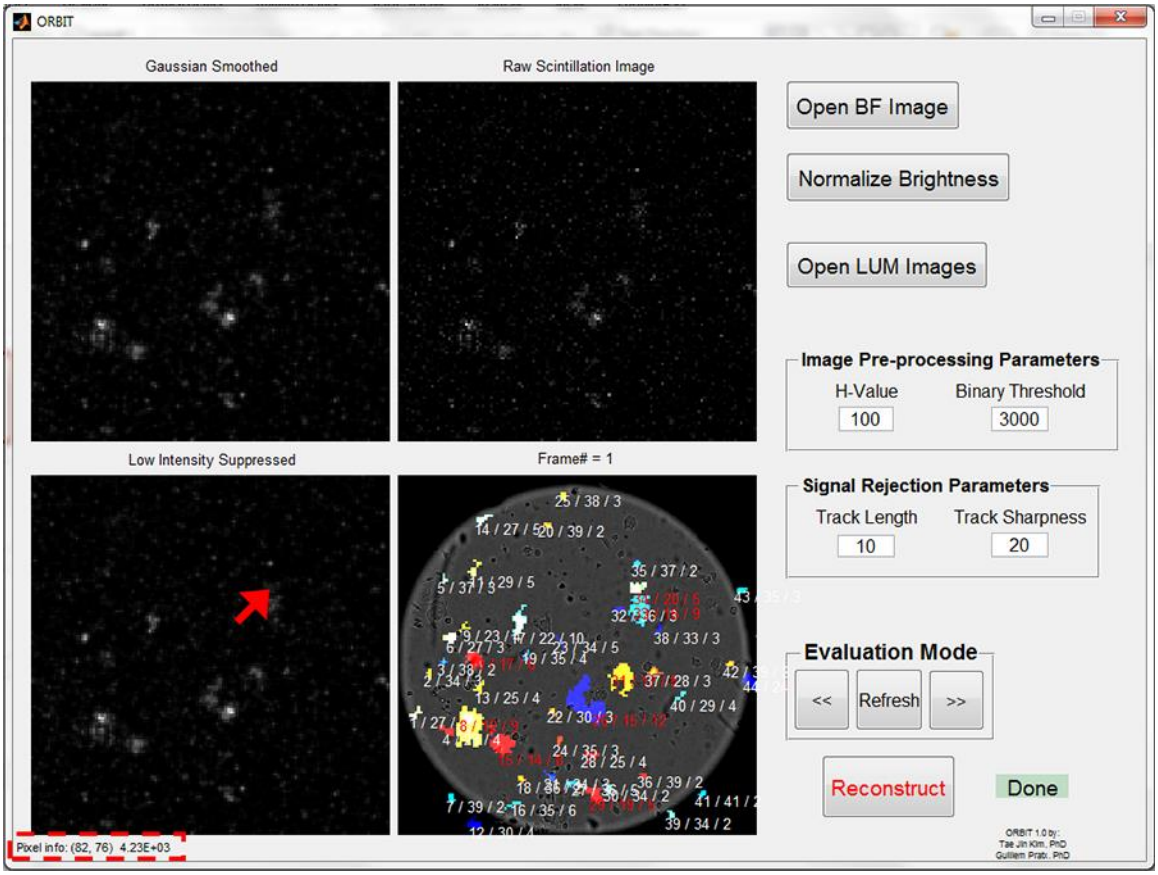
13. The preliminary reconstructed image will be displayed along with the track information (bottom right corner). Since an arbitrary value is entered under ‘Image Pre-processing Parameters’ and ‘Signal Rejection Parameters’, the results will be unrefined.



14. Place the mouse on one of background noise and read the pixel intensity information (eg. 2.20×10^3 in figure).

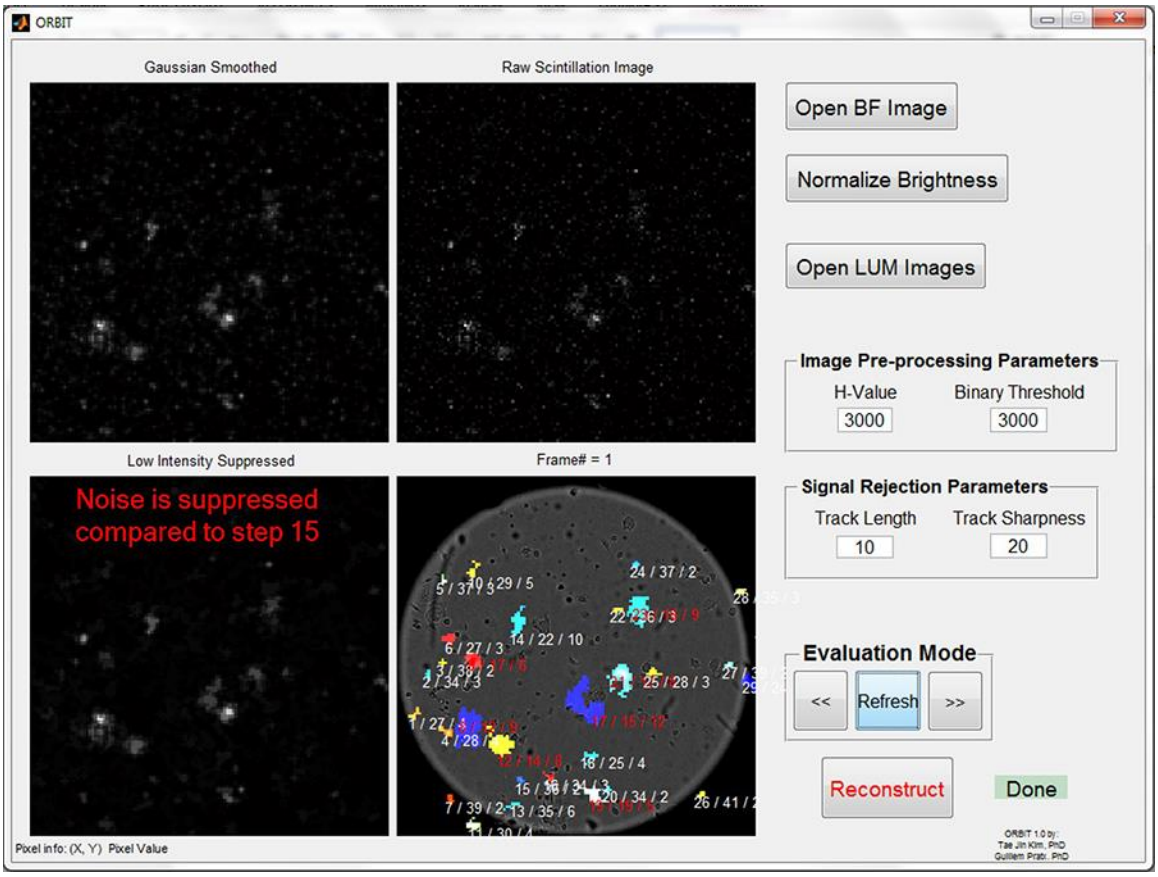


15. Now place the mouse near the edge of a scintillation track and read the pixel intensity information (eg. 4.23×10^3 in figure). These two steps will provide an idea of the intensity range in order to fill in the values under the Image Pre-processing Parameters box.

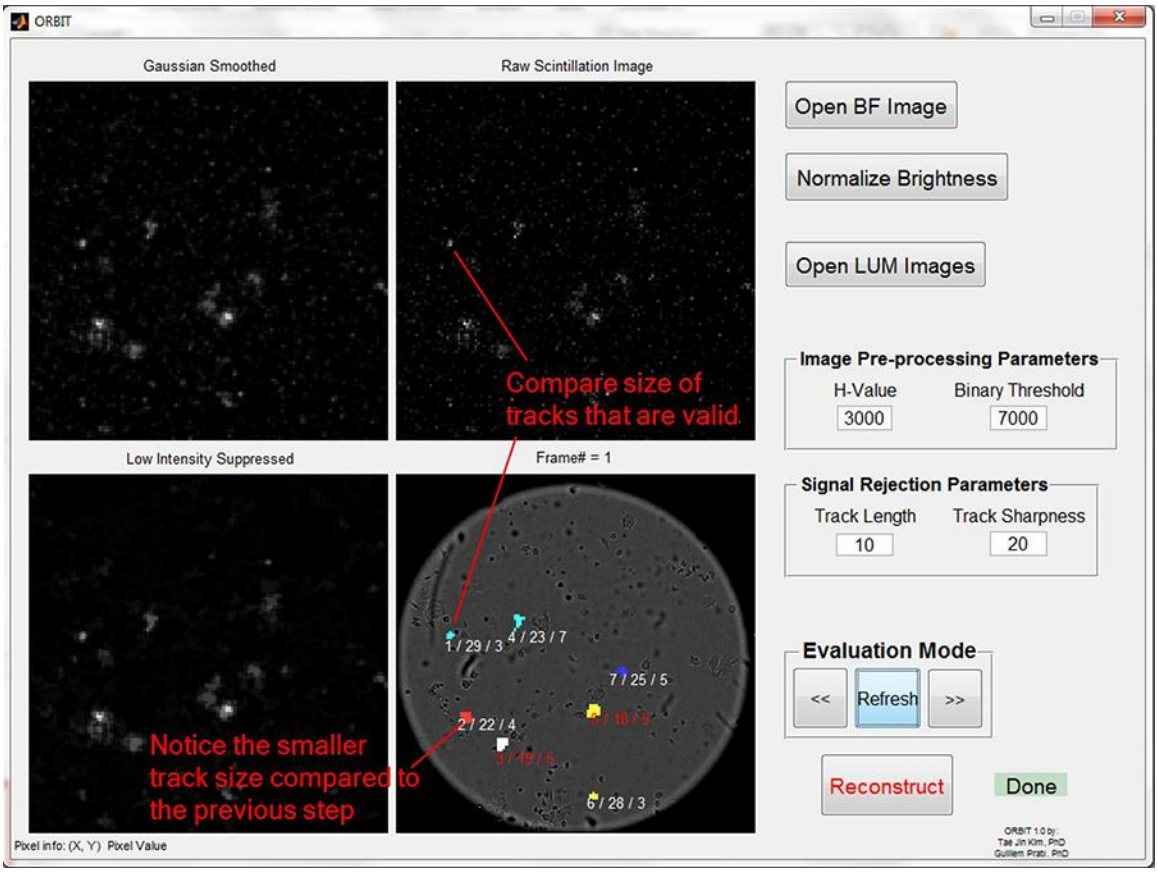


16. Enter the appropriate value under ‘Suppression Value’ to clean the noise. It is recommend to start from the “H value” observed in step 14.
17. Press the “Refresh” button to refresh the screen.

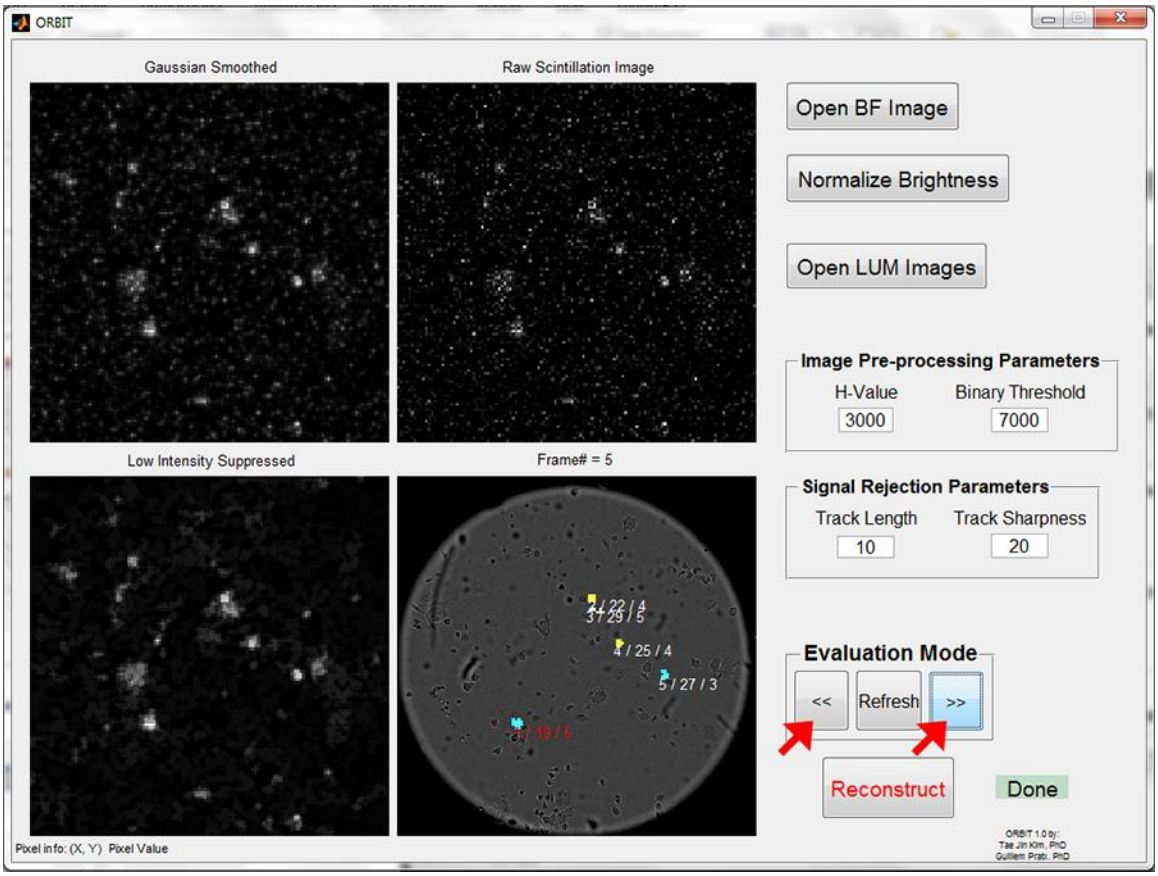
NOTE: It should be noted that changing the suppression value may remove the identified track in the bottom right corner, but does not affect the track size itself.



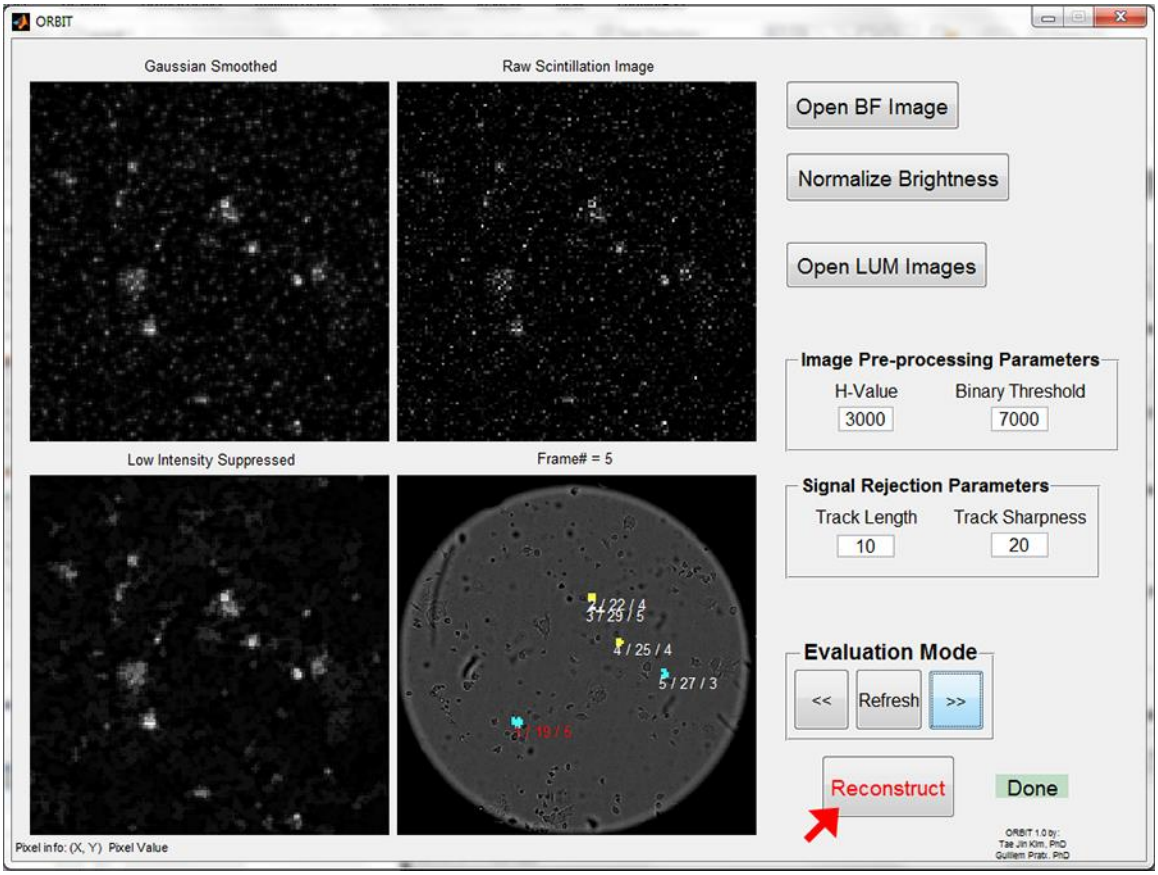
18. Enter the appropriate value under “Binary Threshold”. This will reject any intensity values below the specified value.
19. Press the “Refresh” button. Unlike in Step 16-17, the value here may affect the track size. It is thus important to check if the processed tracks (lower right corner) matches with the raw scintillation signal (upper right corner).



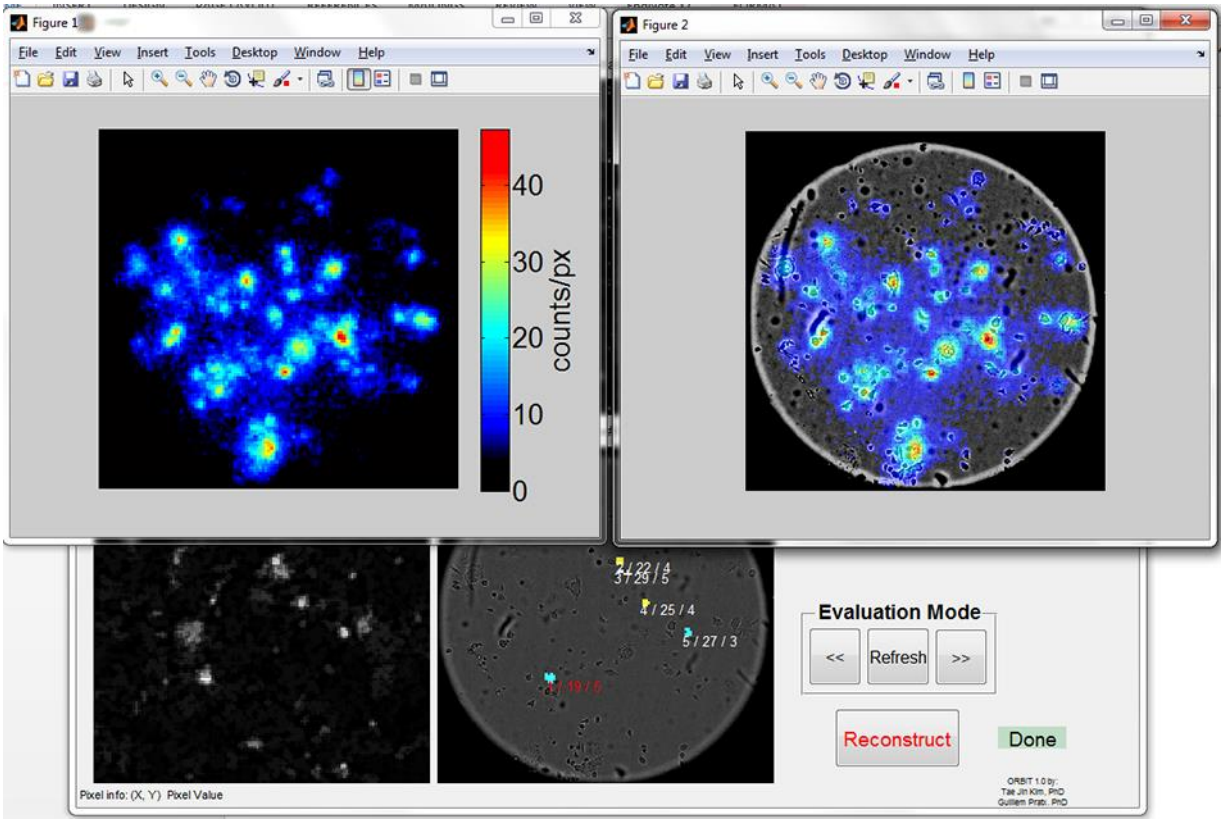
20. Toggle between image frames to check if the scintillation tracks are properly identified.



21. Once all the parameters are checked, press the “Reconstruct” button to initiate the image reconstruction process. This process will take time depending on the computer, thus the user can check if the reconstruction is proceeding by observing the MATLAB command window.



22. Once the image reconstruction is complete, two figures will pop up, one that represents the radionuclide distribution in units of decay count/pixel, and the other the same image overlaid onto the brightfield image.



23. Five files are created in the current workspace: brightfield image (BF.png), scintillation image (DecayMap.png), scintillation image in black/white (DecayMap_BW.png), scintillation image overlapped with brightfield image (Fusion.png) and the actual data saved in workspace including the processing parameters (ScintData.mat). The user can refer back to the 'ScintData.mat' to access the data or perform additional processing.