Mad City Labs Micro-Manager Tutorial

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Getting Started

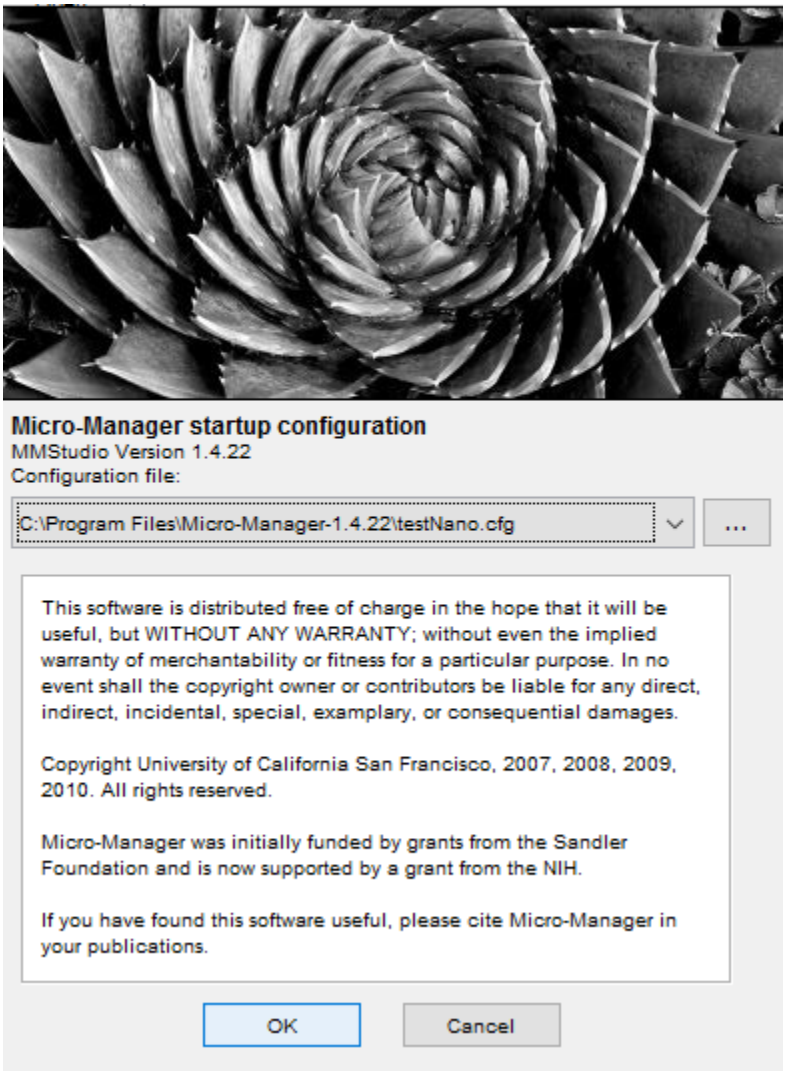
This guide will take you through the steps of setting up Micro-Manager (http://micro-manager.org/) to use your Mad City Labs device. This guide will not cover everything Micro-Manager has to offer, but will show everything that can be used with a Mad City Labs device. For more information on how to use Micro-Manager, check out the Micro-Manager user guide at:
https://micro-manager.org/wiki/Micro-Manager_User%27s_Guide

Downloading Micro-Manager

Micro-Manager can be downloaded from the Micro-Manager downloads website:
https://micro-manager.org/wiki/Download%20Micro-Manager_Latest%20Release
This guide was written to work with Micro-Manager version 1.4.22.

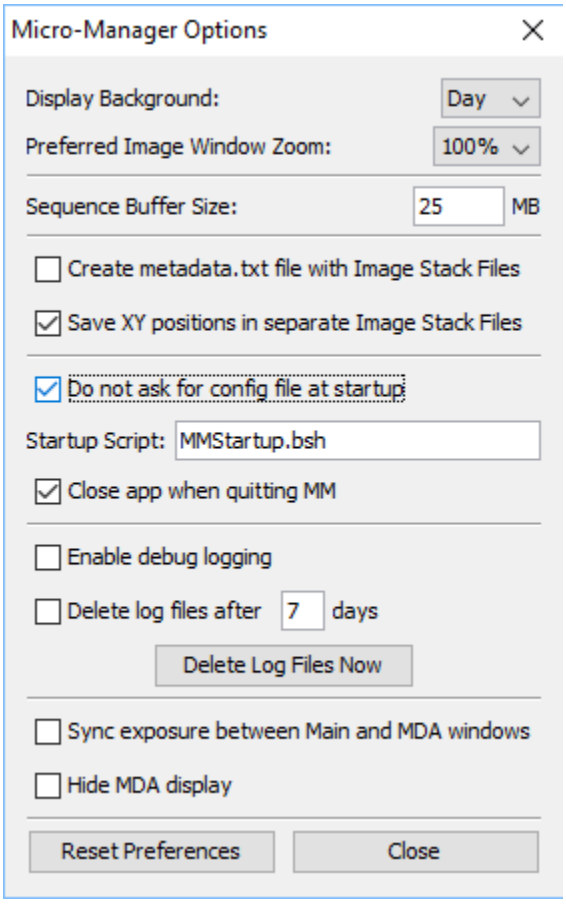
Running Micro-Manager

When you run Micro-Manager, two screens pop up. One is the ImageJ program and the other is the Micro-Manager plugin.



Micro-Manager loads the Micro-Manager Startup screen after being run. From here, a configuration file can be loaded (for more information see **Configuration Files**). The most recently used configuration file will be shown (or the demo configuration file if Micro-Manager is being run the first time). Clicking "OK" will take you to the Micro-Manager main screen.

The Micro-Manager Startup window can be shut off in the Options window (choose Tools->Options from the main menu). In the Options window, check "Do not ask for config file." If this box is checked, Micro-Manager will automatically load the most recently used configuration file.



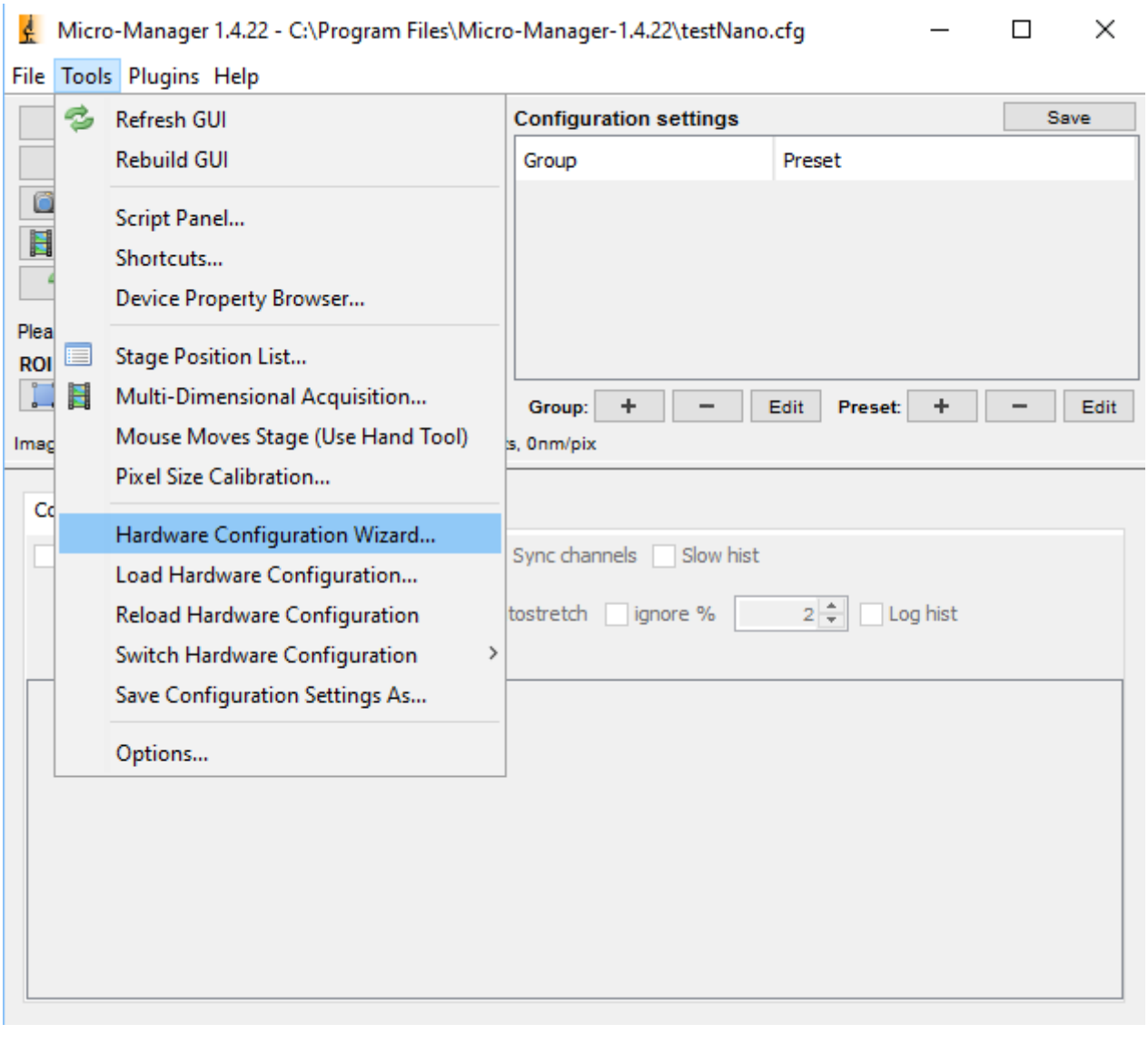
Hardware Configuration

In order to get your Mad City Labs device working with Micro-Manager, Micro-Manager needs to be correctly configured. Users may use the **Hardware Configuration Wizard** or load a user generated configuration file. Both methods will successfully load your Mad City Labs Device. Using the Hardware Configuration Wizard will result in a saved configuration file.

Hardware Configuration Wizard

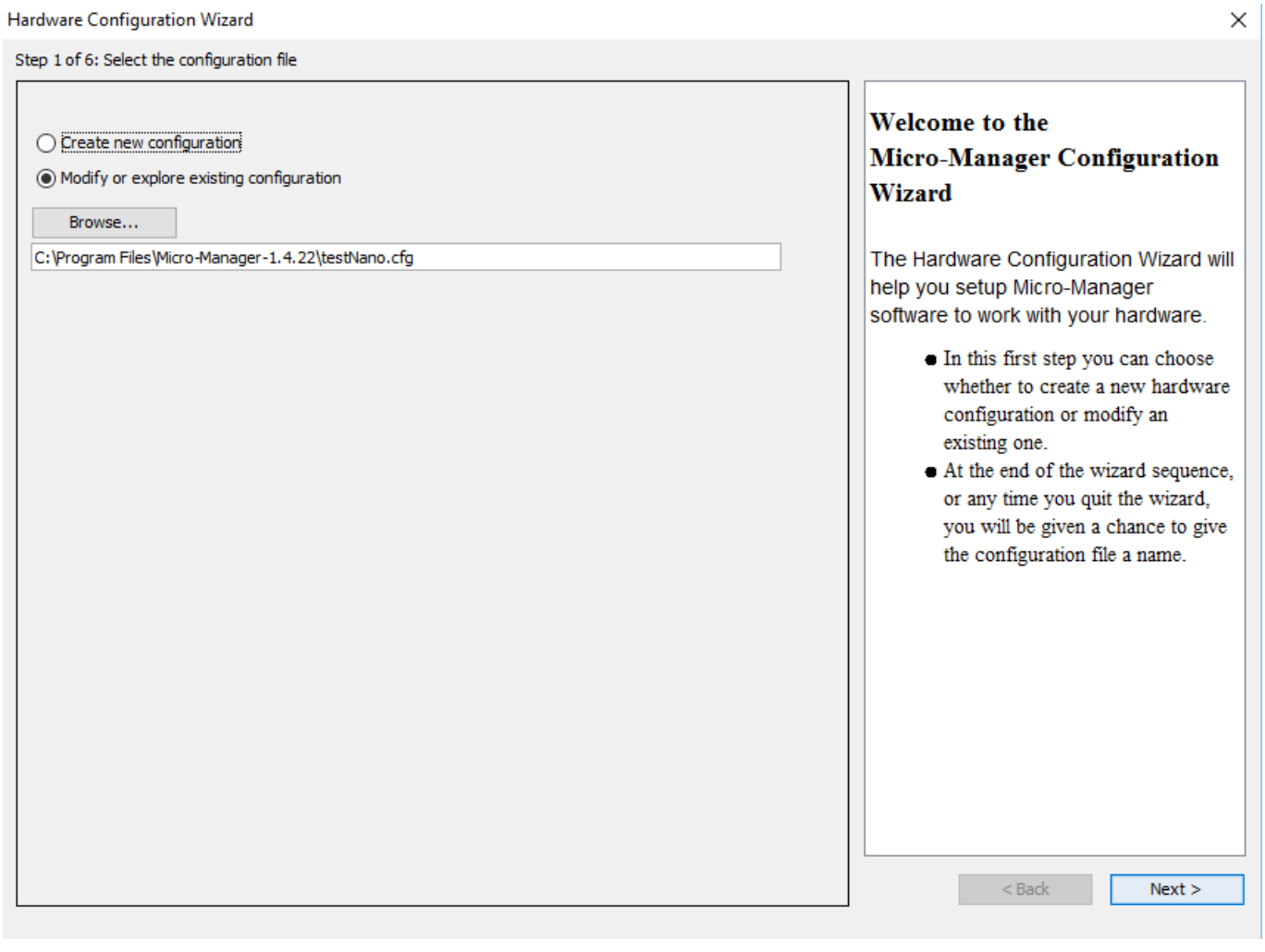
The Hardware Configuration Wizard allows you to manually load devices through Micro-Manager. The Hardware Configuration Wizard takes you through six steps. This tutorial will highlight the steps that will involve a Mad City Labs device. If you are new to Micro-Manager, it is recommended that you setup your device through the Hardware Configuration Wizard since it is an easy way to make sure your device will be correctly setup in Micro-Manager.

To access it, choose Tools->Hardware Configuration Wizard from the main menu.



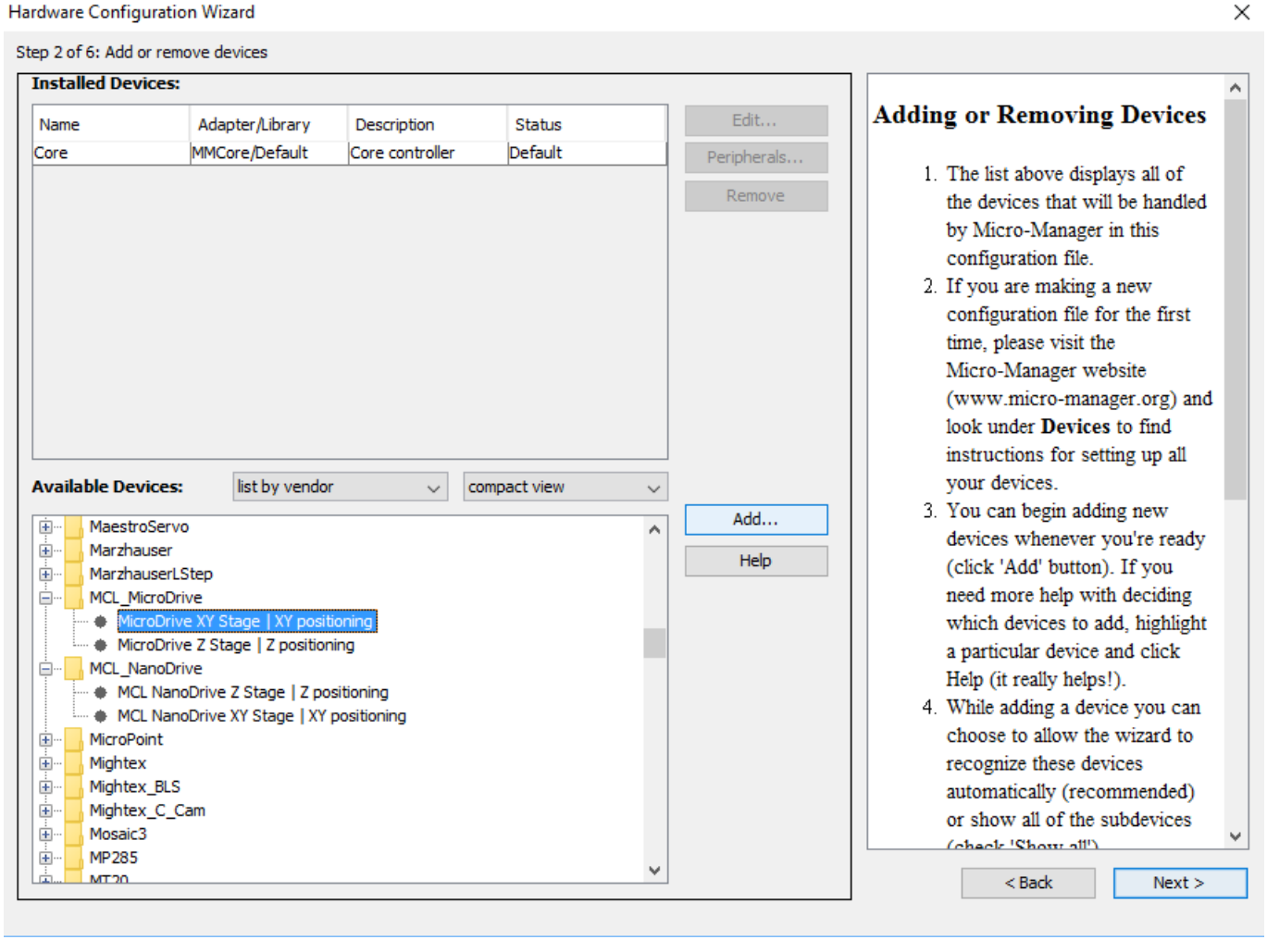
Step 1: Select the configuration file

If you already use other devices with Micro-Manager and have a configuration file, choose "Modify or explore existing configuration" and load the configuration file you wish to use. Otherwise, choose "Create new configuration."



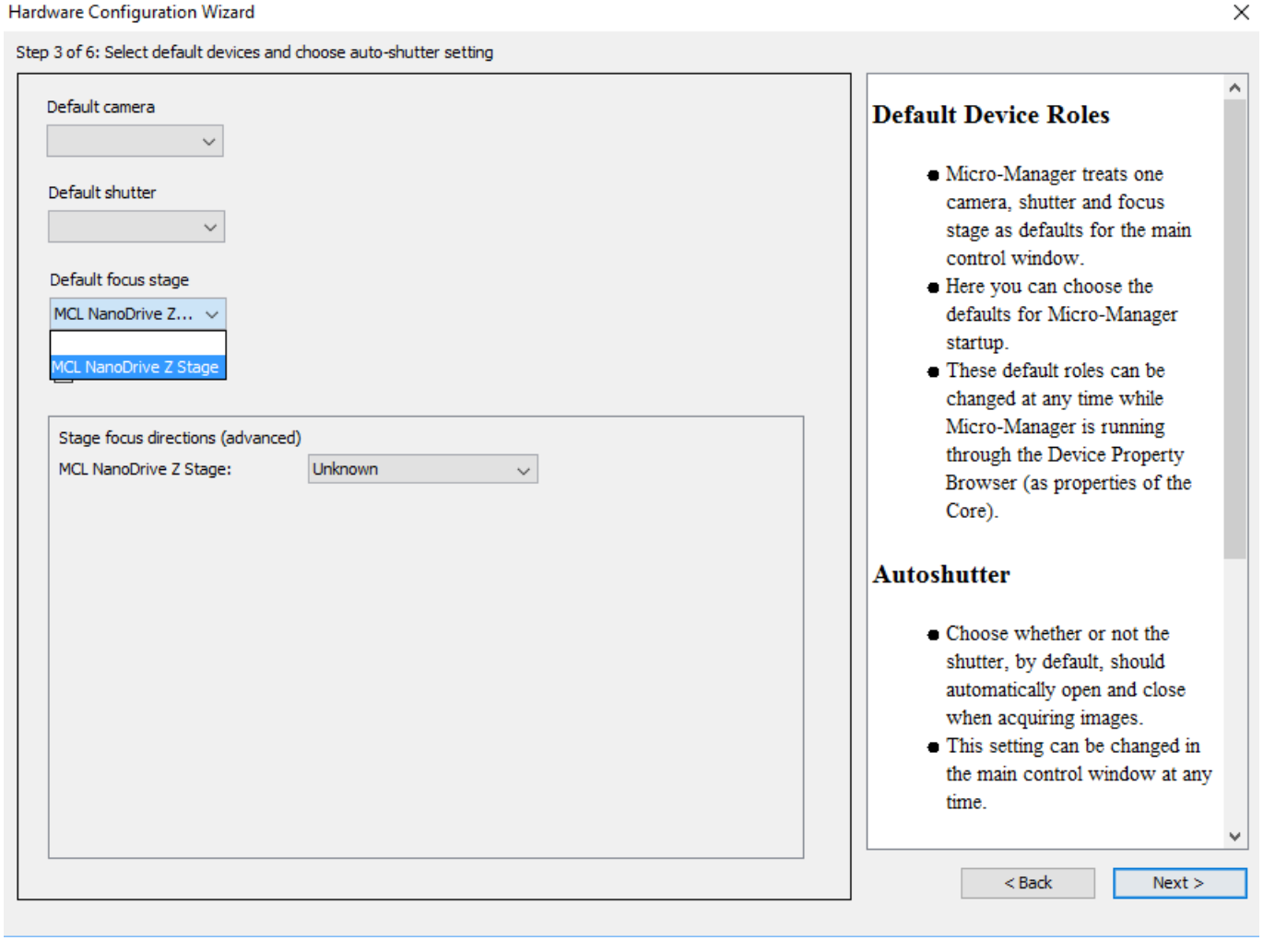
Step 2: Add or remove devices

This window will show which devices Micro-Manager is already connected to. If you are creating a new configuration file, the only device that will appear is Core, which cannot be removed. Search the list of available devices for MCL_NanoDrive. Expand the tree heading. Select the type of stage you wish to add. Finally press "Add..". When you press "Add," it will prompt for a device name. This name is arbitrary. It allows Micro-Manager to keep track of multiple devices of the same type. Note that if you have an XYZ stage you may add both a XY stage and a Z stage device. After adding all of the desired devices click next.

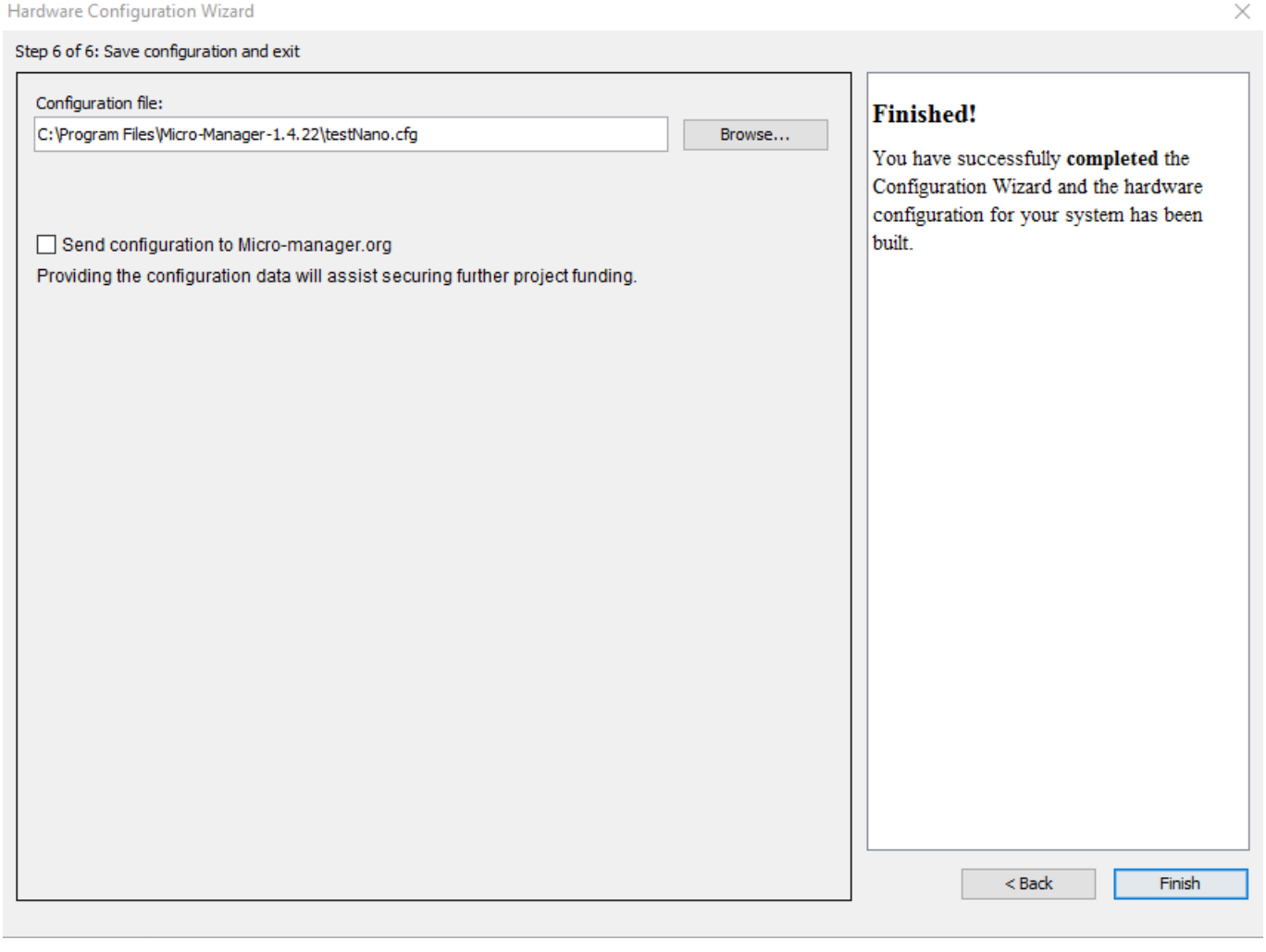


Step 3: Set default devices and choose auto-focus setting

If your Mad City Labs device has a Z axis, you need to tell Micro-Manager that you want it to be the default focusing device. Choose the device from the "Default focus stage" drop down menu.



Step 6: Test configuration, save, and exit
This is the final step in the Hardware configuration wizard. Enter the path and name of the configuration file you just created. Configuration files must have a .cfg file extension. Click "Finish" to save the configuration and exit the wizard.

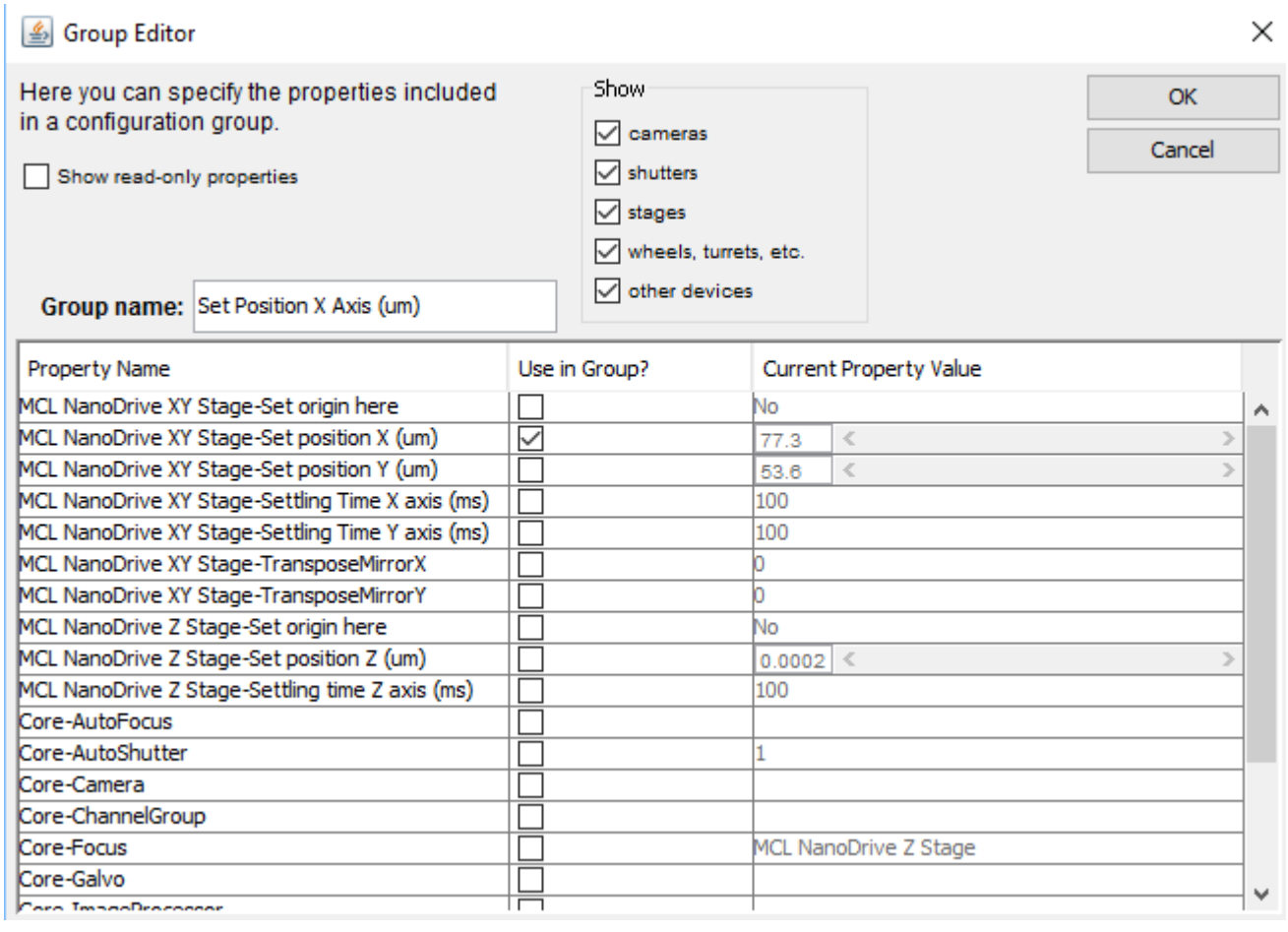


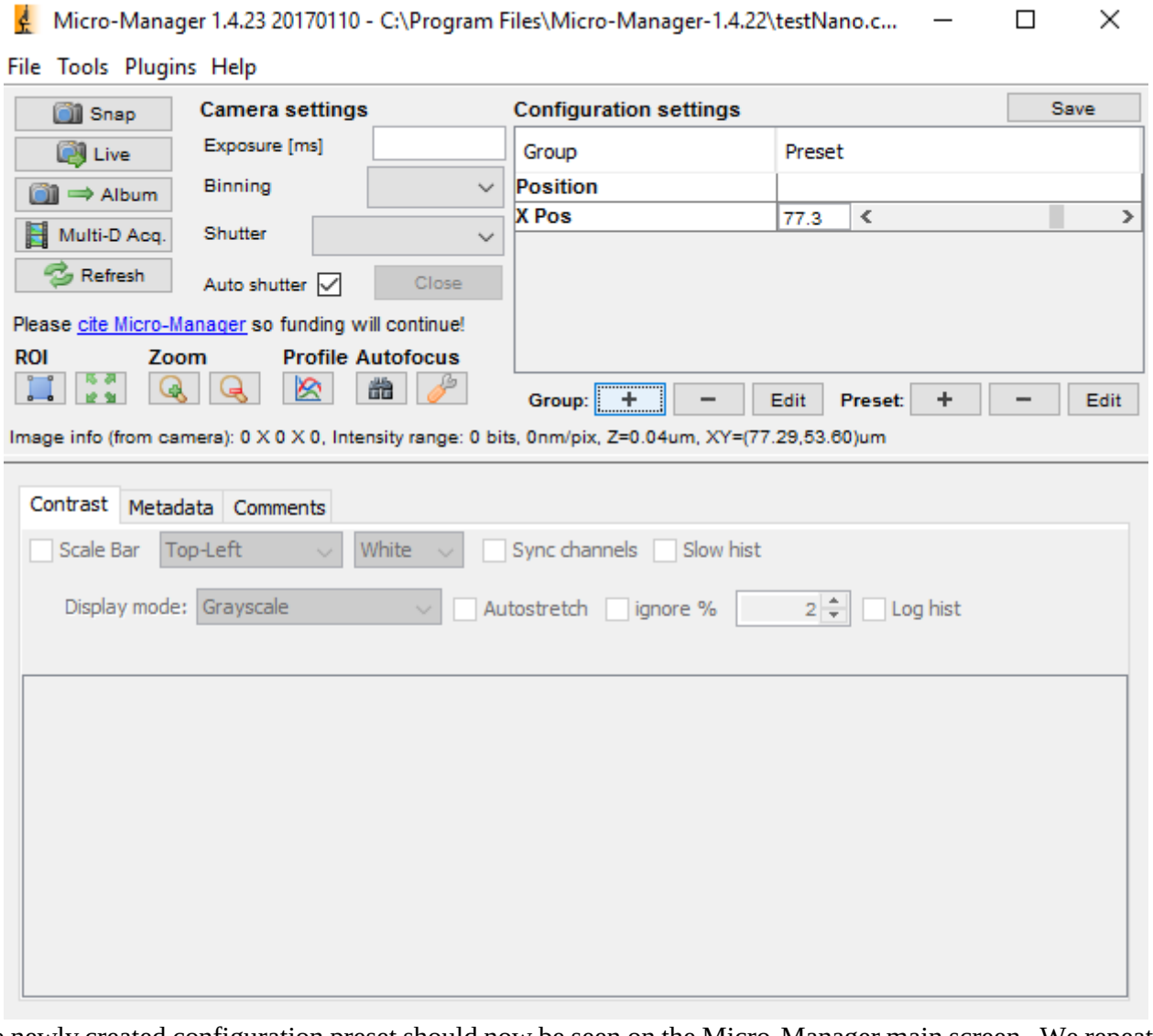
Configuration Settings

In order to see and change the properties of your Mad City Labs device, you have to look at the **Device Property Browser** found in the **Tools** menu. However, properties that will be changed quite frequently (i.e. change position) can be placed on the Micro-Manager main screen under Configuration settings. Note that read-only properties cannot be loaded into a configuration settings.

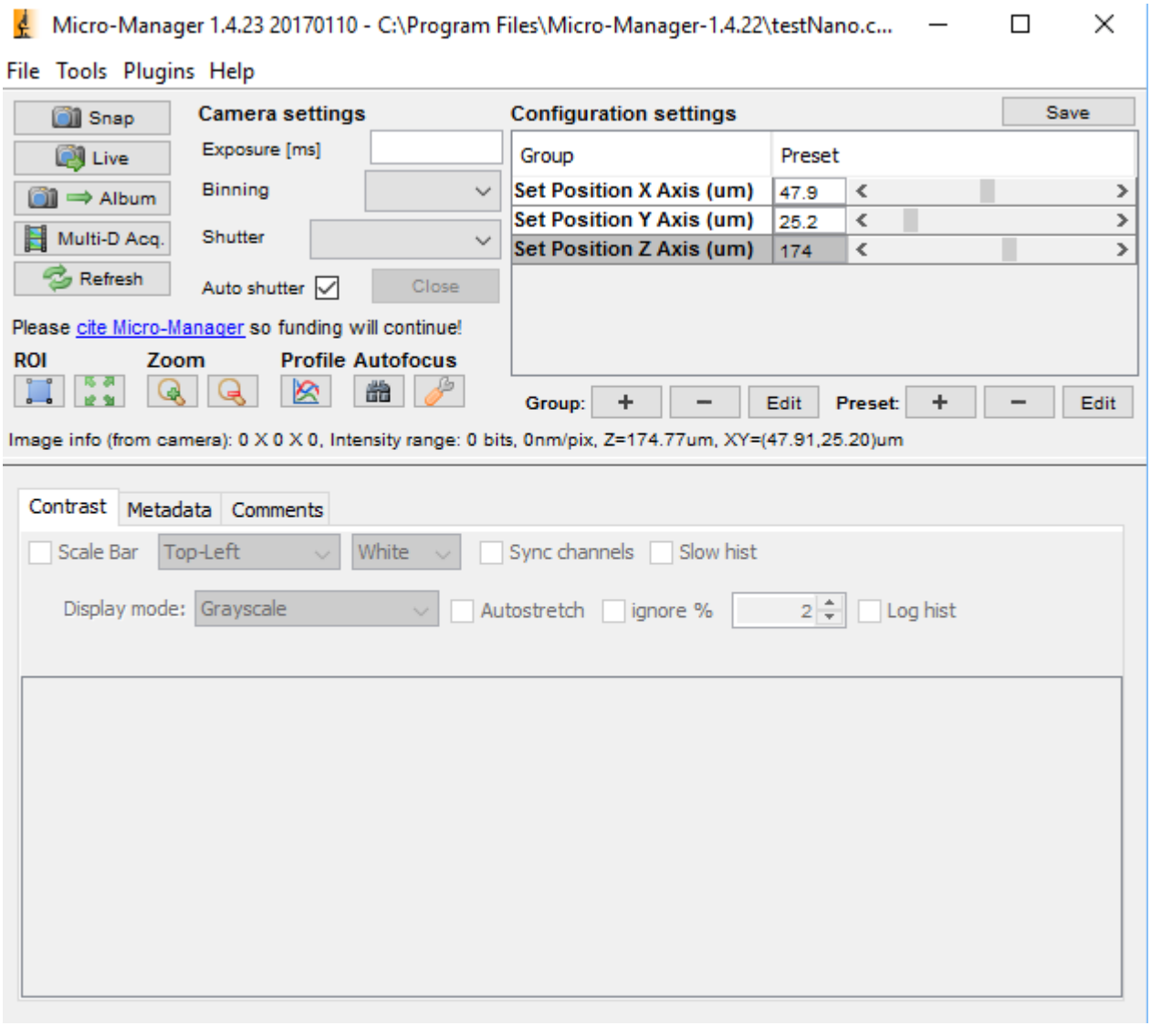
In this example we will add presets that allow you to change the position on the X,Y, and Z axes. To add a new group of presets, click on the Group "+" button.

The Group Editor will be launched. Set a name for the group. In this example we chose "Set position X axis (um)". Check the "Use in group?" box corresponding to MCL NanoDrive XY Stage Set position X(um) and then press ok.





The newly created configuration preset should now be seen on the Micro-Manager main screen. We repeated these steps and added similar presets for the Y and Z axes.



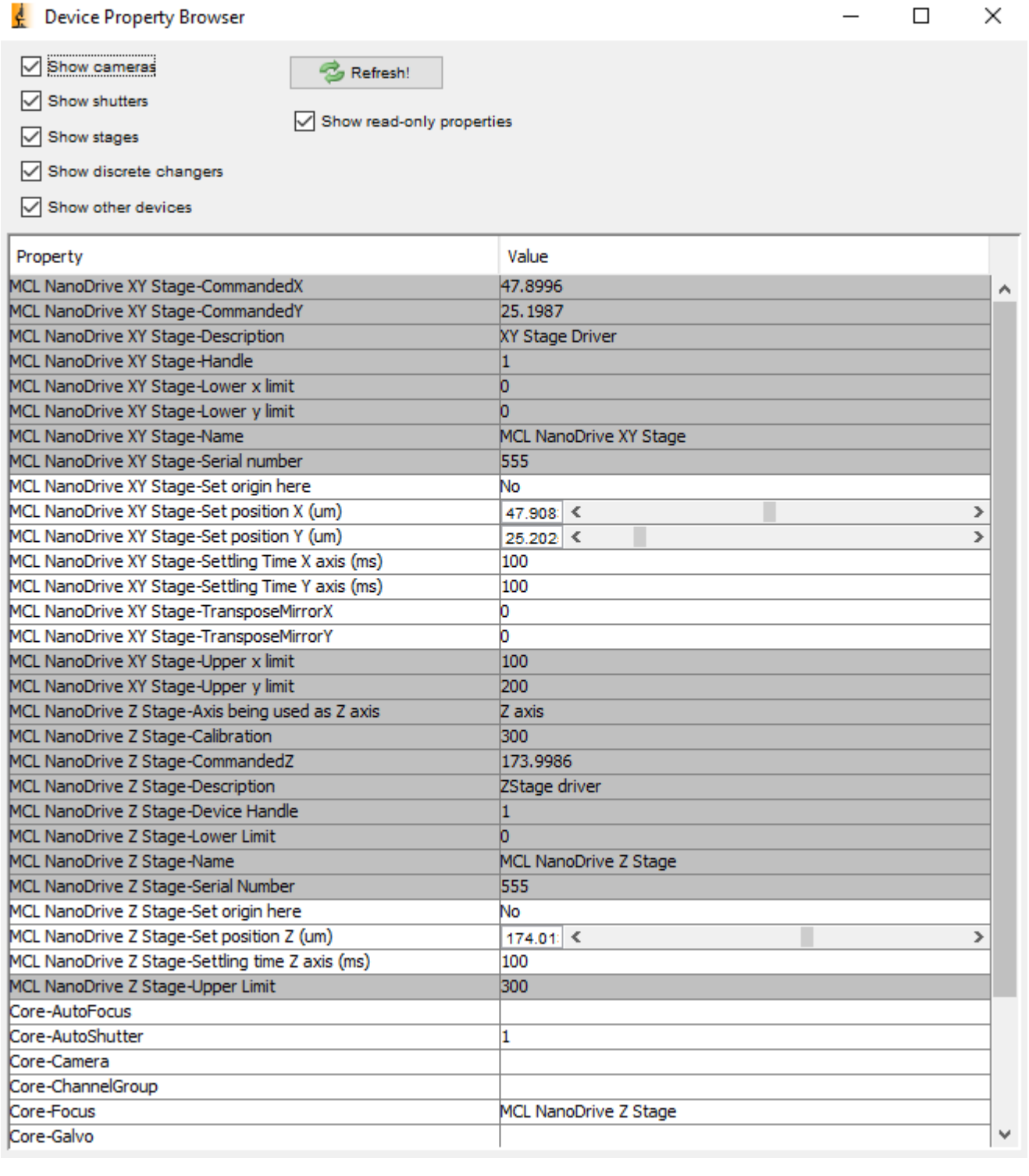
Changes can be made by clicking on the “Edit” button. The rightmost set of “+” and “-” buttons allow you to add or remove specific configurations from a group.
Click on the “Save” button on the top right. This will save the presets just created to your configuration file, so you don't have to recreate these presets every time you start Micro-Manager.

Micro-Manager Tools

The following sections go over various tools and features of Micro-Manager. The tools can be found by selecting Tools from the main menu. Some of the tools also have buttons you can click on the left side of the main page.

Device/Property Browser

The Device/Property Browser can be found by selecting Tools->Device/Property Browser from the main menu.



This shows all of the properties for every device connected to Micro-Manager. Under the "Property" column, properties are listed as "Device adapter name – Device Property." The "Value" column lists the current value associated with each property. White values can be changed, while grayed-out values cannot be changed since they signify read-only properties.

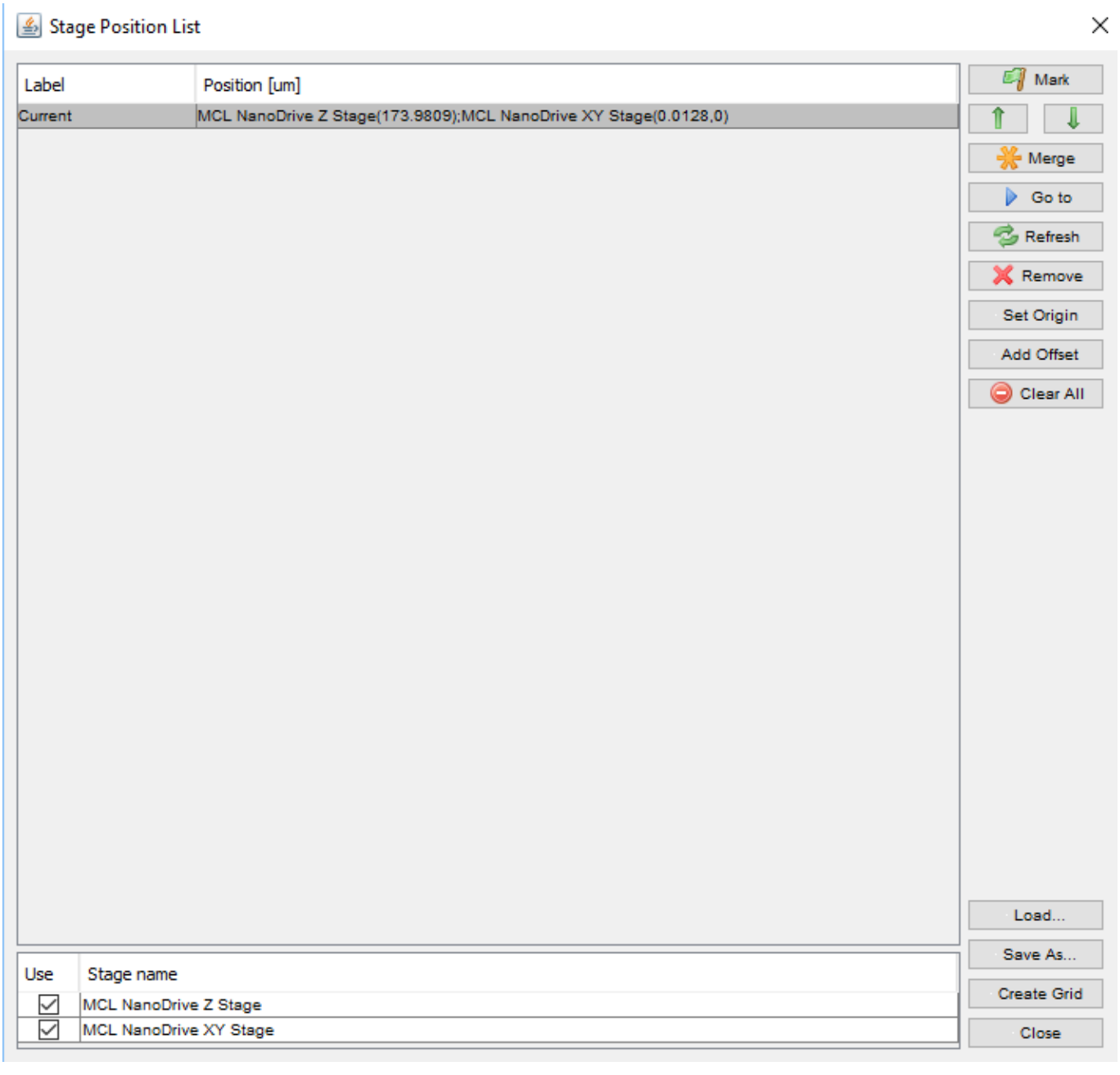
The following properties can be changed:

- Set position: Each of the X, Y, and Z axes have a slide bar that allow for movement along that axis.
- Set Origin here: Sets the current position as the origin.
- Settling Time: Sets the time (in ms) the Nano-Drive waits after moving before reading the current position. This value can be different for each of the three axes. The default time is 100ms. Please note that choosing an unreasonably small settling time will cause errors.
- "Core" is the Micro-Manager application. "Core-XYStage" and "Core-Focus" can be changed to tell Micro-Manager which XY and Z device it should currently use.

As seen in the **Configuration Settings** section, the non-read only properties can be added to the Configuration Presets box on the main screen so the Device/Property Browser doesn't need to be opened every time a value is changed.

Stage Position List

Assuming you are connected to a Stage, the Stage Position List can be accessed through the main menu (Tools->Stage Position List). This will open the "Stage-position List" window. This allows you to create a list of positions you want the Stage(s) to move. To actually tell the device to move to all the positions, check the **Acquisition** section.



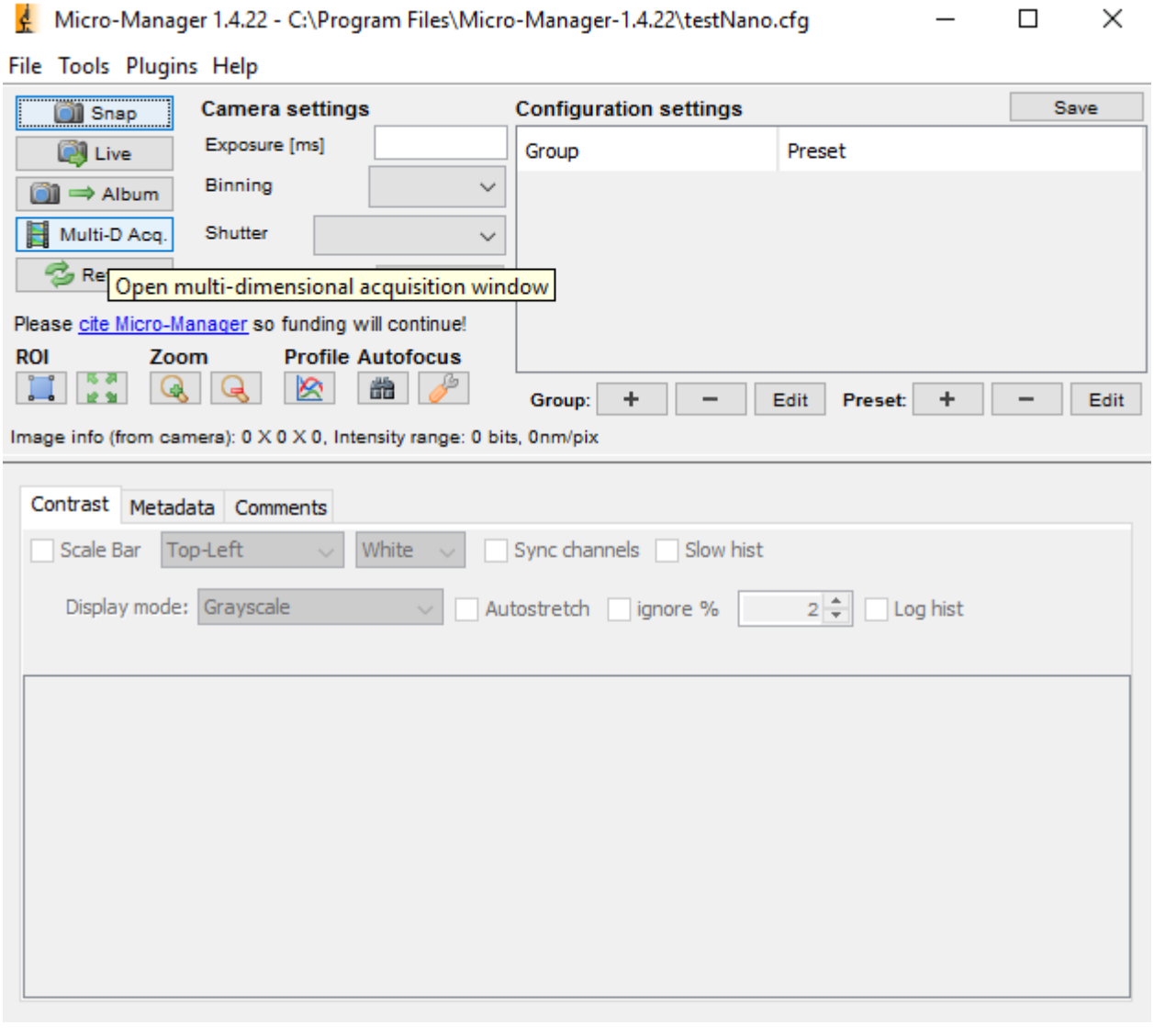
Overview of the buttons:

- Mark: Adds the current position of the XY Stage to the position list
- Up and Down Arrows: Move the selected position up or down in the list.
- Merge: Modify the selected position by using the current XY or Z position instead of the existing XY or Z position of the selected position.
- Go to: Moves the Stage(s) to the position selected on the position list
- Refresh: Reload the GUI
- Remove: Removes the selected position on the position list
- Set Origin: Sets the origin to be 0 for all stage axes. For calibrating the Micro-Drive, see the **Micro-Drive Specific Features** section.
- Add Offset: Create a new position by adding an offset in XY or Z to the current position.
- Clear All: Clears the position list
- Load: Load a position file (*.pos) to the position list

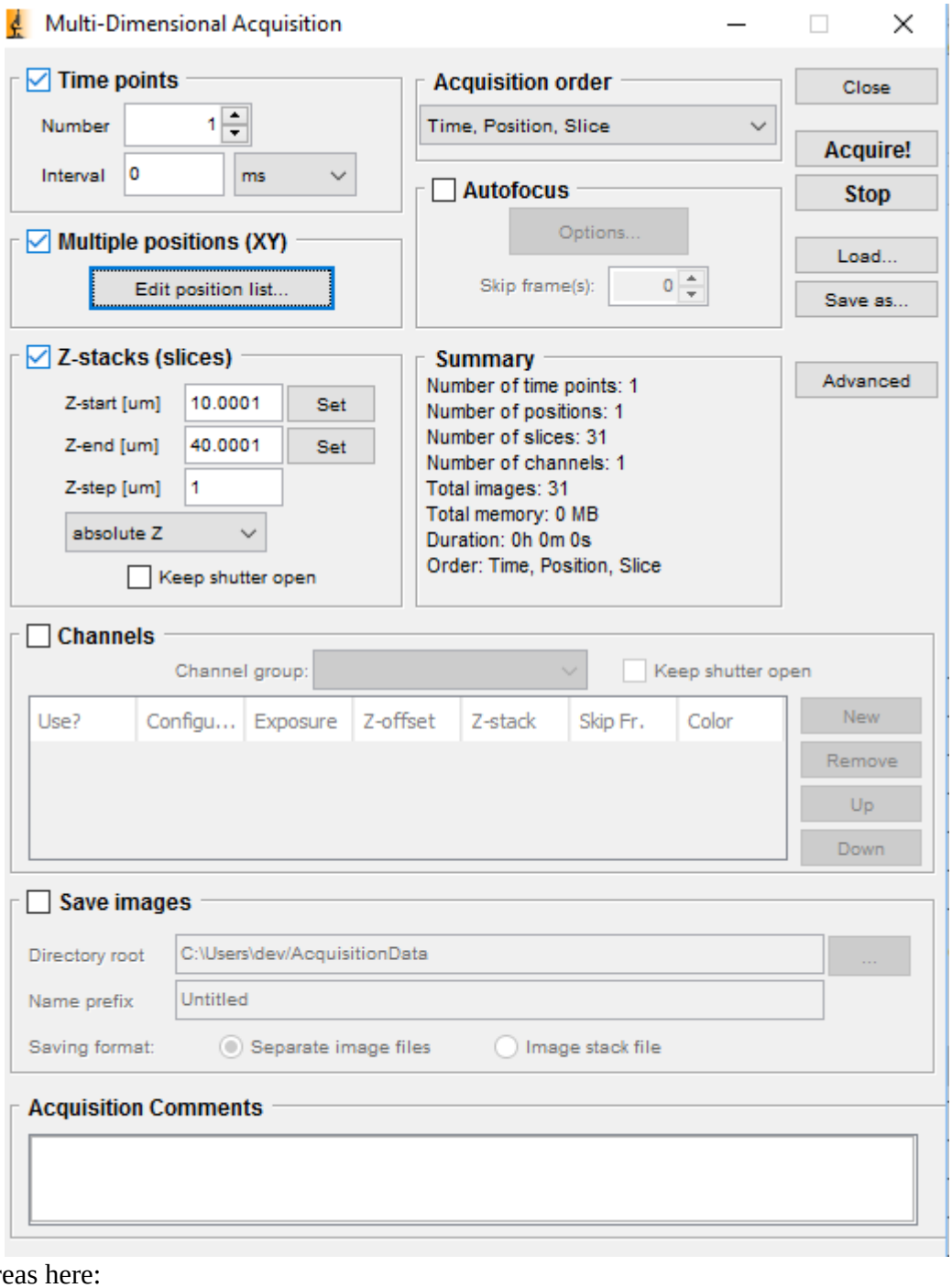
- Save As: Save the current position list as a position file
- Create Grid: Create a square position list.
- Close: Return the Micro-Manager main screen

Multi-Dimensional Acquisition

Assuming you are connected to a camera device through Micro-Manager, you can acquire multi-image stacks through the Acquisition feature. This can be accessed either through the main menu (Tools>Multi-Dimensional Acquisition) or by clicking on the "Multi-D Acq" button on the Micro-Manager main screen.



This will open the "Multi-dimensional Acquisition" window.



Some key areas here:

Time Points

- Number: The number of times to go through the acquisition
- Interval: Time to pause in between each frame

Multiple Position (XY)

- Pressing the “Edit position list...” button launches a Stage Position List window which can be used to define multiple XY positions.
- Autofocus: Turn autofocus on/off

Slices (Z)

- Z-start (um) – The starting position in microns
- Z-end (um) – The ending position in microns
- Z-step (um) – The size of the steps in microns when going from Z-start to Z-end

- Relative or Absolute Z – Choose which type of positioning you want to use for the acquisition.

Save Images

- If you check "Save images" Micro-Manager will automatically save the acquisition files to the specified directory. Otherwise you must manually save the acquisition file after you finish acquiring it.

Acquire button

- Once everything is setup as desired, click on the "Acquire!" button to acquire your data. Micro-Manager will move the XY and Z Stages as specified and take pictures at each position

Micro-Drive Specific Features

Going through this tutorial would have showed you how to correctly setup your Mad City Labs Device. The Micro-Drive, however, has a few additional properties that are not available to other devices, like the Nano-Drive.

These properties can be seen by opening the **Device/Property Browser** and can also be added as **Configuration Settings**.

- Calibrate: Selecting "Yes" will move the Micro-Drive to the X and Y forward limits and set this position as the origin. Then the Micro-Drive will move back to the original position where it was when it was told to calibrate. Selecting "Yes" here or clicking on the "Calibrate"
- Return To Origin: Selecting "Yes" will move the Micro-Drive back to the last location that was set as the origin.

