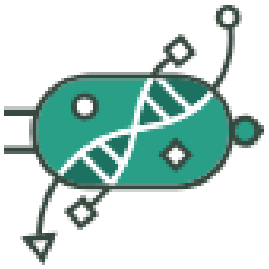
Jun 07, 2024

Setting and Customizing OT-2 for LAP Entries



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We use this protocol and it's working

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Abstract

Automation scripts such as those included in the LAP repository (**https://www.laprepo.cbgp.upm.es/repository/**) require set up steps that not directly part of the experimental process but are essential for execution.

This protocol is divided into 5 sections: connecting to an OT-2, transferring files between the robot and the user system, creating and uploading custom labware to the OT app and robot system and preparing the robot system.
These steps establish the necessary environment for running experiments with the LAP entry scripts and user-specific variables.

Not all sections are required for every LAP entry run. For more information on each script in the LAP repository, visit www.laprepo.com and refer to the documentation attached to each entry. LAP repository entries can contain links to protocols.io entry to provide a step by step experimental validation protocol.

Before start

This protocol consists of various sections with interlinked steps to transfer files to an OT-2 robot such as variables files, script or customized labware. It is not always necessary to complete all of them to run a LAP entry protocol (i.e your protocol does not use customized labware)

Connect to the OT-2

1 **Creation ssh-key connection**

An OT-key should be generated to connect to the robot, and it is done with the ssh-keygen command and transferring the public key to the OT.

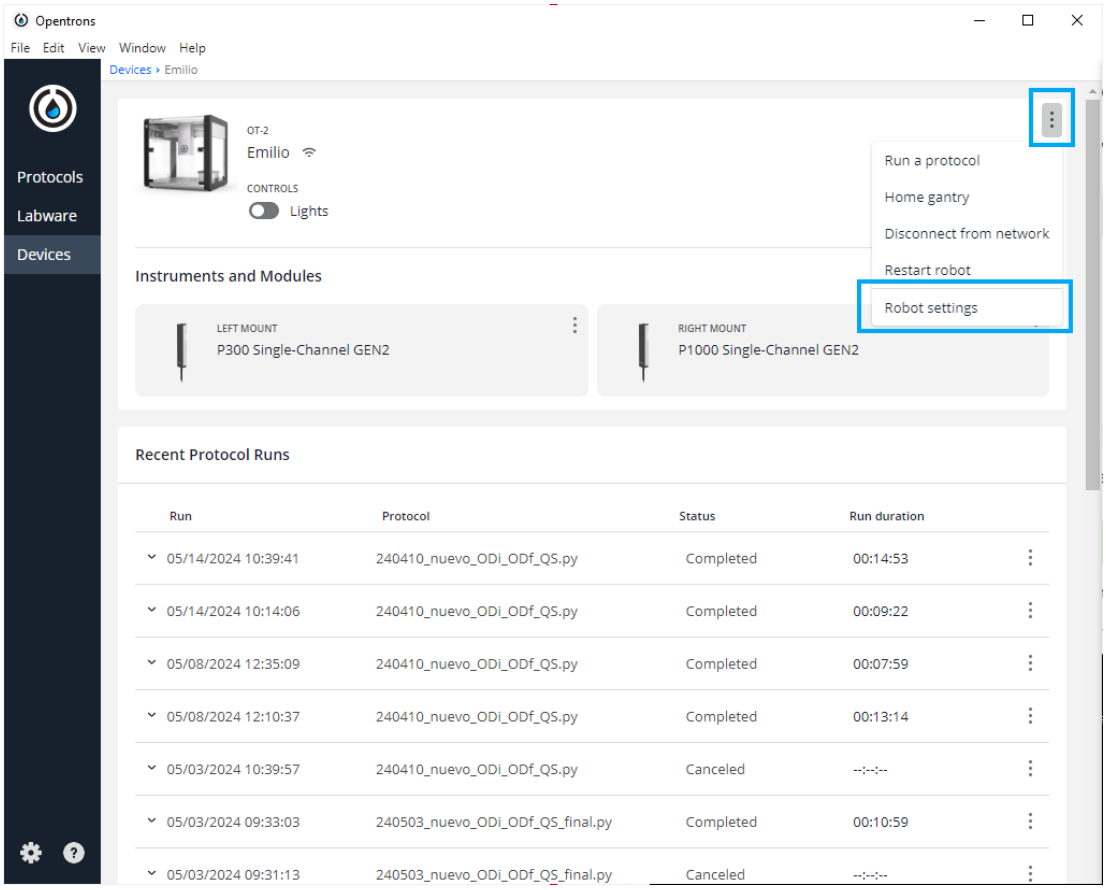
For more information about how to generate and set the connection between your computer and the Opentrons robot, visit https://support.opentrons.com/s/article/Setting-up-SSH-access-to-your-OT-2

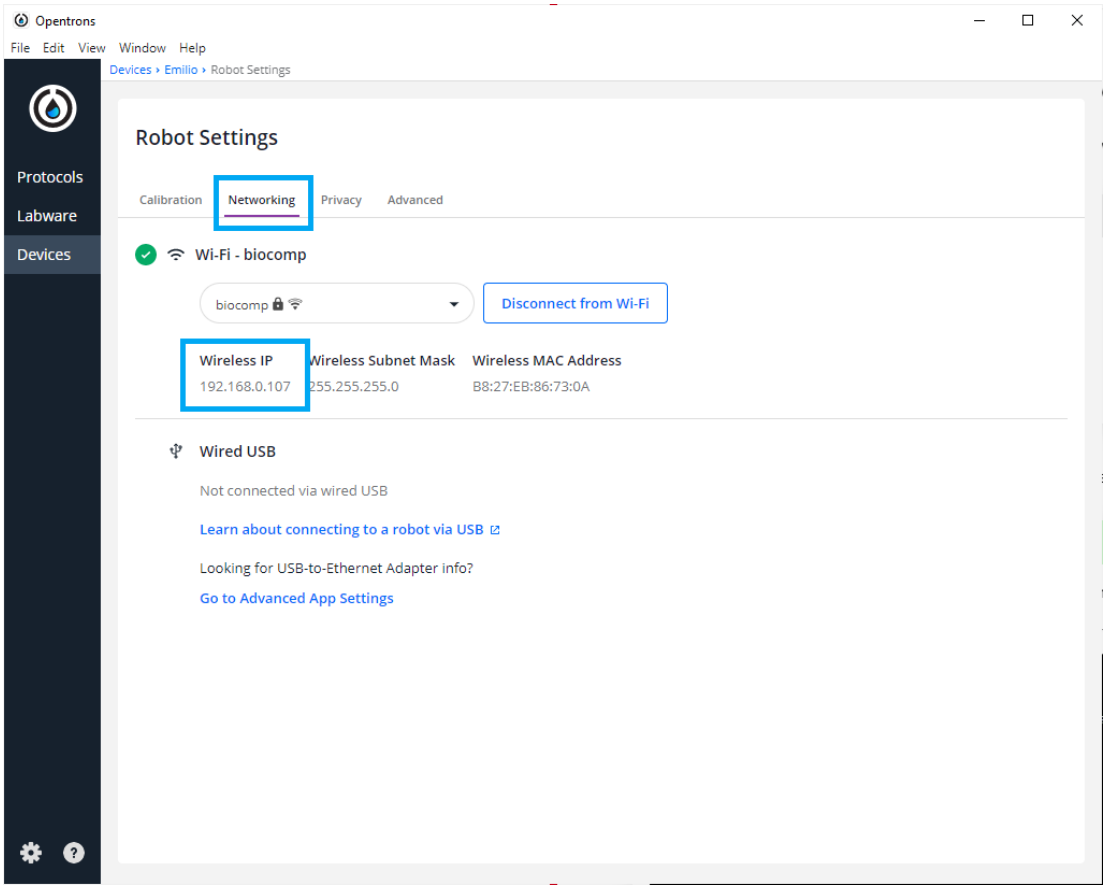
2 **Connect to the robot**

To connect to the robot's system to perform different actions such as installing packages, check files that are in the system, etc.

2.1 *Find the IP of the robot*

In the OT app go to *Devices -> Robot you want to connect -> Superior 3 dots -> Robot Settings -> Networking*


Opentrons
File Edit View Window Help
Devices › Emilio
Protocols
Labware
Devices
OT-2
Emilio
CONTROLS
Lights
Run a protocol
Home gantry
Disconnect from network
Restart robot
Robot settings
Instruments and Modules
LEFT MOUNT
P300 Single-Channel GEN2
RIGHT MOUNT
P1000 Single-Channel GEN2
Recent Protocol Runs
Run
Protocol
Status
Run duration
05/14/2024 10:39:41 240410_nuevo_ODi_ODf_QS.py Completed 00:14:53
05/14/2024 10:14:06 240410_nuevo_ODi_ODf_QS.py Completed 00:09:22
05/08/2024 12:35:09 240410_nuevo_ODi_ODf_QS.py Completed 00:07:59
05/08/2024 12:10:37 240410_nuevo_ODi_ODf_QS.py Completed 00:13:14
05/03/2024 10:39:57 240410_nuevo_ODi_ODf_QS.py Canceled --:--:--
05/03/2024 09:33:03 240503_nuevo_ODi_ODf_QS_final.py Completed 00:10:59
05/03/2024 09:31:13 240503_nuevo_ODi_ODf_QS_final.py Canceled --:--:--



Note

Take into account that the IP of the robot could chang from time to time or if you change the network where the robot is connected so it is a good practise to check the IP regularly

Note

In case you are phyisically connected to the robot via USB the IP will appear in the same window but under the section **Wired USB**

2.2 *Connect to the robot*

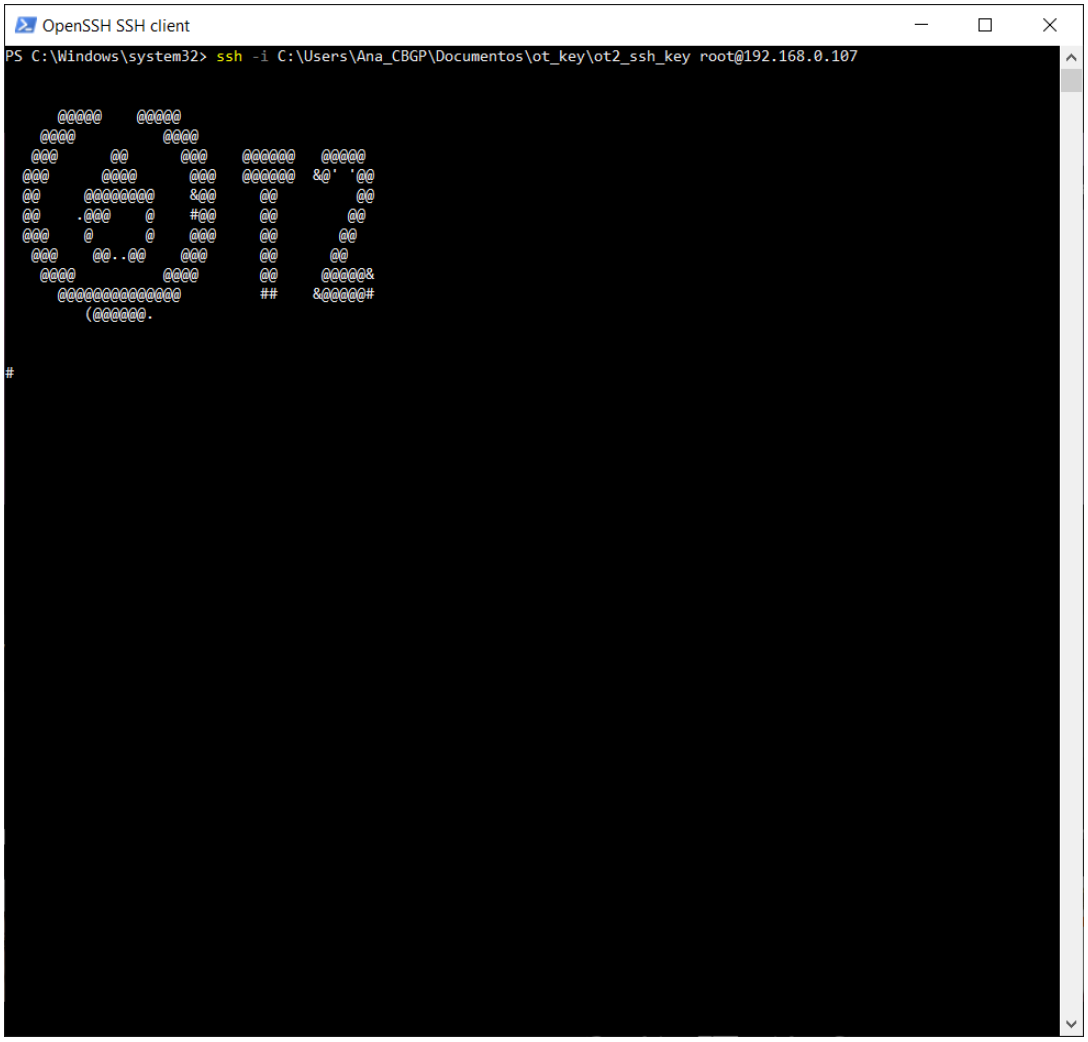
Either in a bash (unix systems) or powershell (windows systems) use the command ssh

Command

Connect to Linux based OT via ssh

```
ssh -i [path ot_key] root@[Robot_IP]
```

Expected result



Window in a Powershell that shows an OT logo which is a sign of being inside of the robot system

Transferring files between user system and robot system

3 **Connect to the robot**

You can either connect on the same inalambric network as the robot or by USB

4 **Find the IP of the robot**

go to step #2.1

5 Transfer the files

In different systems you can/must transfer the files in different ways always taking in account that the system of the OT-2 robot is a Linux Raspberry

5.1 *MacOS/Linux*

We can use the bash or command line to transfer the file(s) with the following command

Command

Passing Files to OT

```
scp -i [ot_key] [file_to_send] root@[IP_OT]:[final_path]
```

The ot_key is referring to the private key created in step 1, go to step #1

You can face difficulties transferring files in MacOS Ventura (13) and Sonoma (14). These problems can be solved by adding the argument -O (uppercase o) to the command

Command

Transferring files to OT (MacOS 13 and 14)

```
scp -O -i [ot_keypath] [file path to send] root@[IP_robot]:
[final_path]
```

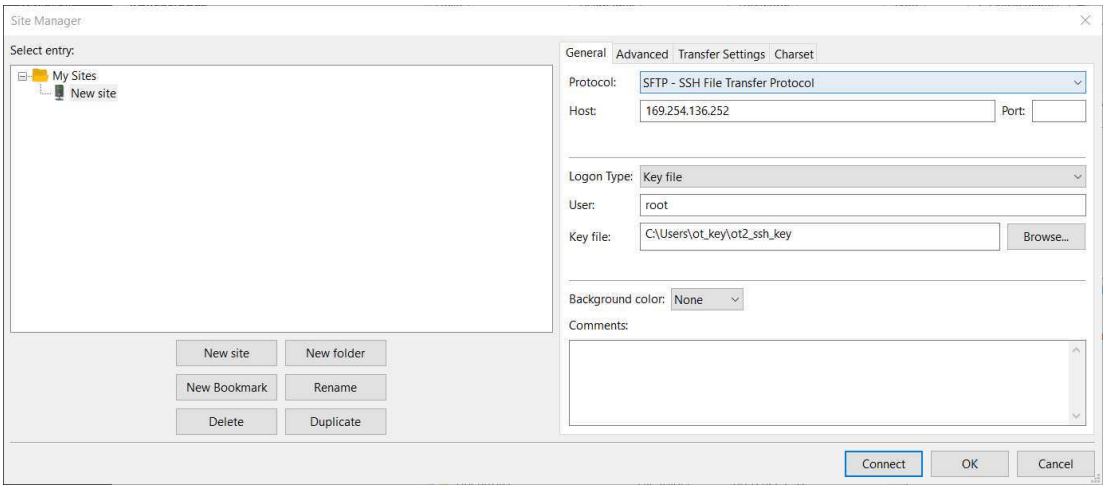
5.2 *Windows*

There are several ways to send files from a Windows to a Linux system (for example, with a virtual machine or Windows Powershell in the latest versions of Windows). With the latter you

can use the same steps as in 5.1 go to step #5.1

Another way is using **FileZilla** (https://filezilla-project.org/download.php?type=client).

You can set the connection between your computer and the OT-2 robot system as follows. Open Filezilla -> **File (in the toolbar) -> Site Manager -> New Site (Press button) -> Rename Site** Now that the site is created you can see on the right the settings of that particular site. In the General tab **Change Protocol to SFTP**. Then, introduce in Host the OT IP, change the **Logon Type to key file**, change **User to root** and give the directory where the OT key is. It should look something like the following image



Example of setting the FileZilla to transfer files from Windows (our computer) to Linux (OT)

Then press **Connect**, and we will have a connection between our computer and the robot.

After this connection, we should be able to move the files that we want to the final path of the robot that we desire to send them.

This method can be used as well in some *Linux* and *MacOS* systems

6 **Exit the robot**

To return to your system you only need to type *exit* in the command line

Preparing Robot OS

7 **Check needed packages and versions of LAP entry**

In the *Requirements Section* of each LAP Entry you can find that the protocol/entry needs more packages than the ones are installed in the OT-2 system

8 **Check python packages of robot**

To know which packages are needed to be installed in the opentrons robot you can connect to the robot ()and get a list of all the packages and their versions installed in that scpecific python

Take in account that there are some packages like math or random which versions are specified or linked to the python version

8.1 *Connect to robot*

go to step #2

8.2 *Use pip command*

You can use the pip command to get the entire packages that are installed in your robot's version of python. Take in account that the packages that are by default in python such as math will not appear in that list

Command

List installed pip packages (Unix)

```
pip list
```

To store the packages of the robot in a file for the future you can use the pipe >

Command

List installed pip packages and save (Unix)

```
pip list > [name_file_store_packages]
```

If you want to store this information in your computer you can transfer that created file

go to step #4

You can check for a specific package with the following command

Command

List installed pip specific package (Unix)

```
pip show [name_package]
```

With this last command you can have 2 type of results:

1. A small piece of text giving you the name, version and summary of the package, within other information. This will mean that the package is installed on the python
2. Warning message telling you that the package does not exist. This means that either the package has not been installed in that version of python or that it is not installed with pip (it is by default in python or it is installed with other vias like conda)

9 Install needed packages

To install 1 or more packages you can use any of the following 2 commands

Command

Install package Python

```
python -m pip install [name_package_1] [name_package_2]
[name_package_3]
```

Command

Install packages with pip

```
pip install [name_package_1] [name_package_2] [name_package_3]
```

Make sure that the robot has access to the internet so it can download the packages

Note

For more information about installing packages in the opentrons robots, check the following Opentrons page: https://support.opentrons.com/s/article/Using-Python-packages-in-Python-API-protocols

10 **Exit the robot**

To return to your system you only need to type *exit* in the command line

Uploading custom labware

11 **Creation of .json custom labware file**

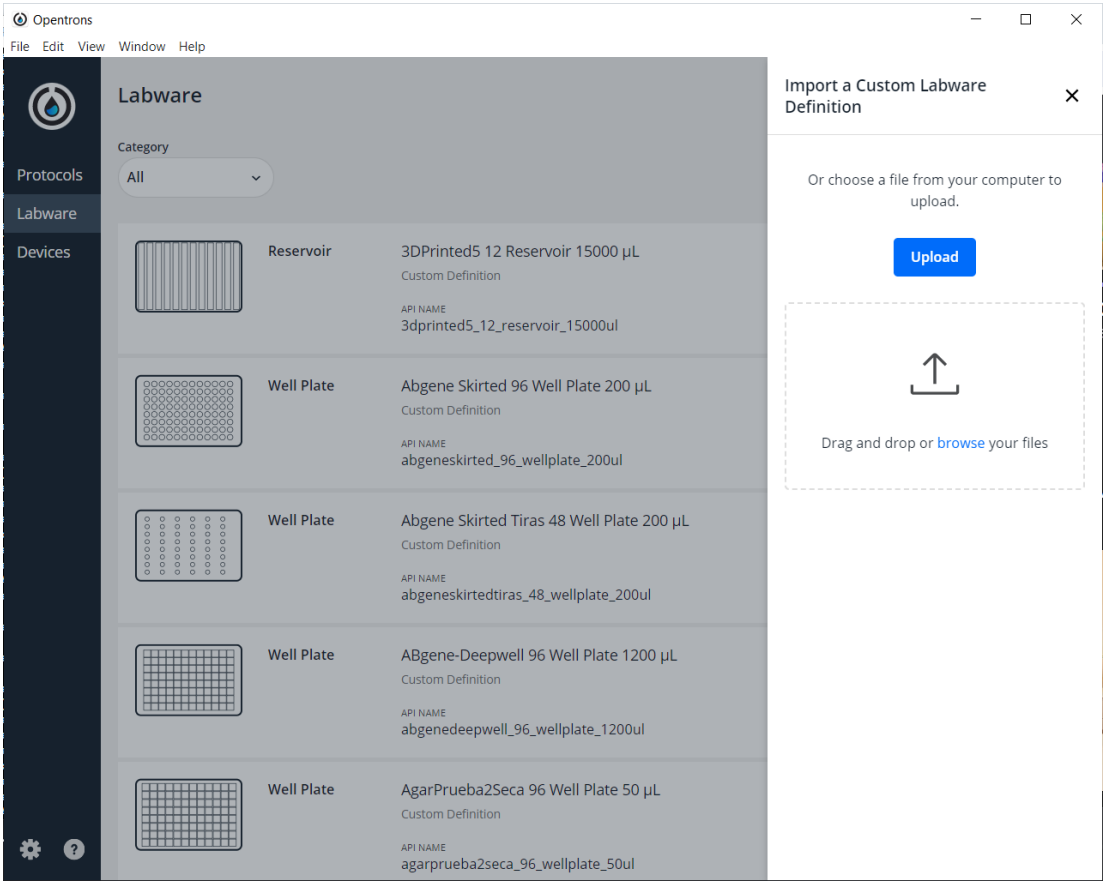
The description file can be obtained by describing the labware dimensions at **https://labware.opentrons.com/create/**

Expected result

You will receive from this page a zip with a .py script in which you can test the labware and a .json file that is the actual definition of the labware

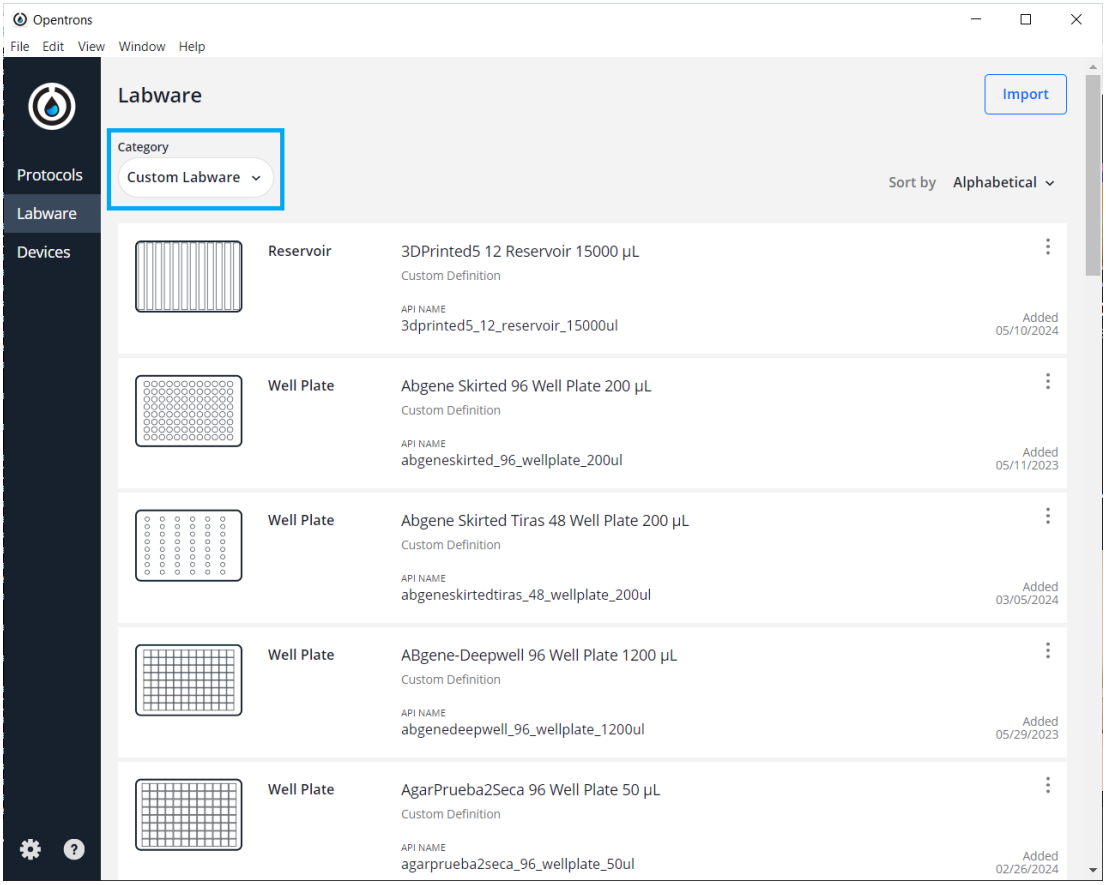
12 **Uploading file to the OT App**

In the OT app, we need to perform the following route: **Labware -> Import -> Choose File -> Select file we have created in step 9** go to step #11



Expected result

After uploading the labware you should be able to see the new labware in the Labware tab of the OT App, all custom labware can be found more easily in the category *Custom Labware*



In some LAP entries or in versions of them there is a need to upload in 2 places the created files so you need to complete as well the following steps.

13 Uploading definition to OT robot system

> **Note**
>
> We do not need to execute this part every time the protocol is used, only when that labware is not included in the OT official labware and the labware file is not in the robot

13.1 *Create a directory with the defintion*

We need to create a directory with the API name of the labware, the name that we are going to use to load it in the opentrons

13.2 *Rename .json file*

We need to rename the .json file that the opentrons labware creation to 1.json and place it inside of the directory created in Step 13.1

13.3 *Transfer the directory to a specific location*

To upload the directory with the .json file that represents the custom labware that has been created in step 11 go to step #11 to the robot systems we are going to use the steps from 3 to 6 transferring the file to the final path */data/labware/v2/custom_definitions/custom_beta* with some changes with the argument *-r* as shown in the following command

Command

Transferring the used custom labware to OT (Linux)

```
scp -i [ot_key] -r [custom labware directory path]
root@[IP_OT]:/data/labware/v2/custom_definitions/custom_beta
```

You can face difficulties transferring files in MacOS Ventura (13) and Sonoma (14). These problems can be solved by adding the argument -O (uppercase o) to the command

Command

Transferring the used custom labware to OT (Linux)

```
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root@[IP_OT]:/data/labware/v2/custom_definitions/custom_beta
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