Instructions to analyze the MCP-PMTs CAEN digitizer data

A. Get a copy of the data:

In you terminal, do this command:

git clone https://github.com/Hattawy/MCPs_PHYs_HEP.git

The previous command will create "MCPs_PHYs_HEP" directory that looks like this:

```
[mhattawy@16] MCPs_PHYs_HEP:>ls -lth
drwxrwxr-x 8 mhattawy mhattawy 4.0K Jun 20 14:08 wavedump-3.7.4/
drwxrwxr-x 2 mhattawy mhattawy 4.0K Jun 16 15:05 documents/
drwxrwxr-x 2 mhattawy mhattawy 4.0K Jun  5  16:49 data/
drwxrwxr-x 8 mhattawy mhattawy 4.0K Jun 29 16:03 g-2_data/
-rw-rw-r--    1 mhattawy mhattawy  51K Jun 30 14:22 MCPs_run_sheet.pdf
drwxrwxr-x 3 mhattawy mhattawy 4.0K Jul 10  13:33 python-scripts/
drwxrwxr-x 7 mhattawy mhattawy 4.0K Jul 10  11:11 mcpanalysis_v3
```

- swavedump-3.7.4: has the software source files for the CAEN digitizer.
- documents: has CAEN digitizer pdf manuals.
- data: has data taken at Ed's Lab, at bldg 362, without magnetic field.
- g-2_data: has all the data acquired using the g-2 magnet at bldg 366.
- MCPs_run_sheet.pdf: documentation for the g-2 recorded data.
- python-scripts: has python scripts written by Ed May to analyze the data.
- mcpanalysis_v3: has the updated lappd framework to analyze CAEN data.

B. Analyzing the data using lappd framework:

- Installation

1. Install the latest version of root on your linux/MasOS machine (www.root.cern.ch).
2. Create a new folder Rootdev/ in any directory on your machine.
3. Create sub-folders lib/, include/ and bin/ in Rootdev/

4. In .bashrc, add the following lines:

```
#ROOT setting
export ROOTDEV=ROODEVTDIR/ # Replace ROOTDEVDIR by your path
export PATH=$ROOTDEV/bin/:$PATH
export LD_LIBRARY_PATH=$ROOTDEV/lib:$LD_LIBRARY_PATH
```

5. Start a new terminal
7. Go to folder MCPs_PHYs_PEH/mcpanalysis_v3
8. Run install.sh (you may need to do chmod +x install.sh)

Now the installation is done. The files can be found in Rootdev/bin

- Analysis

1. Create an analysis folder, for example mcpanalysis_v3/doAnalysis/. It doesn't necessarily have to be inside mcpanalysis_v3/. Any directory is fine.

2. copy Bin2TxtConv_CAEN.cc to the new created directory.

```
cp ~/MCPs_PHYs_PEH/mcpanalysis_v3/convert/convert_caen/Bin2TxtConv_CAEN.cc ~/doAnalysis/
cp ~/MCPs_PHYs_PEH/mcpanalysis_v3/paf/paf_agilent ~/doAnalysis/
cp ~/MCPs_PHYs_PEH/mcpanalysis_v3/analysis/SplineFitDB.rdb ~/doAnalysis/
```

2. To convert the CAEN binary data to .txt file, type command as:

```
root -b -q "Bin2TxtConv_CAEN.cc(\"../../../../MCPs_PHYs_HEP/g-2_data/tube69-HV-diff-B-1st-set/CAENData2028\")"
```

where in blue is the path to the input data run.

The converted file will appear in the current folder. The name is run2028.txt for instance.

3. To analyze the data, type command:

```
lappd run2028.txt run2028.root paf 1000
```

The 1st argument is the path of the converted .txt file.
The 2nd argument is the path of the output .root file.
The 3rd argument is the analysis parameter file name
The 4th argument is the number of events that the user wants to analyze.
All the information is store in the output .root file. The user can view the tree structure and do furthur analysis.

4. Copy the root analyzer:

```
cp -rf ~/MCPs_PHYs_HEP/mcpanalysis_v3/global_analyzer/root-analyzer/   ~/doAnalysis/
```

5. Add the output root file of step 3 to the chain in Global_analyzer.h as:

```
chain->Add("run2028.root/lappd");
```

6. Run the root analyzer as:

```
root -b run.cc
```

7. The previous script will create a folder “result-plots”, and saves the different plots with the label of the input run number as:

- amplitudes_run_2028.png
- signals_run_2028.png
- gain_run_2028.png
- time_resolution_run_2028.png
- position_resolution_run_2028.png

Please feel free to ask if you have any question about running the scripts.

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