Figure/Plot Example

Please find LaTeX example in:
https://latex.ihep.ac.cn/read/sgqpscdqjdpp#4933c4

Outline

- Introduction
- Inserting Plots in LaTeX
- Example of ROOT Style Macro
- Example of Python Matplotlib Style

Introduction

- About width of figures in LaTeX
  - Single plot: 50%.
  - Two plots: 80% in total, 40% for each.
  - Two plots in same file: 80%.
- ROOT's Style Macro (Kaili Zhang)
  - chap00_example/CEPCStyle.h
- Python Matplotlib Style (Yang Zhang)
  - chap00_example/cepc_style.mplstyle
- Link: https://latex.ihep.ac.cn/read/sgqpscdqjdpp#4933c4

Inserting Single plot

- The width is 50%.

```
\begin{figure}[h]
    \centering
    \includegraphics[width=0.5\linewidth]{chap00_example/figs/E_tau.pdf}
    \caption{Caption name and description}
    \label{fig:enter-label}
\end{figure}
```

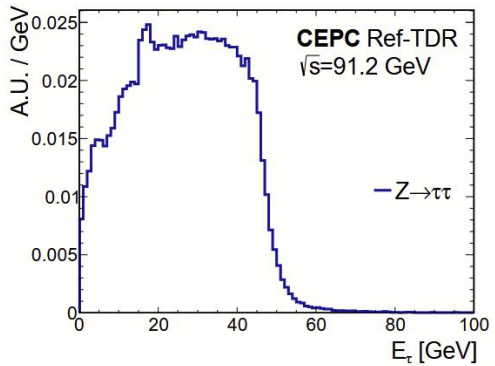


Figure 1: Caption Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac

Inserting Two plots

- The total width is 80%.
- For each plot, the width is 40%

```
\begin{figure}[h]
    \centering
    \includegraphics[width=0.4\linewidth]{chap00_example/figs/E_tau.pdf}
    \includegraphics[width=0.4\linewidth]{chap00_example/figs/E_tau.pdf}
    \caption{Caption \lipsum[1]}
    \label{fig:enter-label}
\end{figure}
```

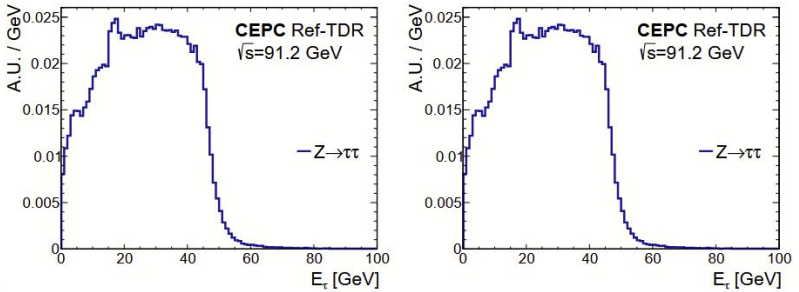


Figure 5: Caption Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue

Inserting Two plots (in the same figure)

- The width is 80%.

```
\begin{figure}[h]
    \centering
    \includegraphics[width=0.8\linewidth]{chap00_example/figs/E_tau.pdf}
    \caption{Caption name and description}
    \label{fig:enter-label}
\end{figure}
```

ROOT Style instruction

- Download CEPCStyle.h
- In your ROOT script, add #include "CEPCStyle.h"
- At the beginning of your script, invoke SetCEPCStyle()
- There are several helper functions:
  - General: FormatAxis, FormatLegend, FormatLatex
  - For Histograms: FormatH1, FormatH2,
  - For Graph: FormatG1,
  - For Labels: AddCEPCtag

ROOT Example (1)

```
#include "CEPCStyle.h"

void InputsTDR()
{
  SetCEPCStyle();

  TChain Tree("Events", "Events");

  Tree.Add("/hpcfs/cepc/higgsgpu/zhangkl/work/pred_0529Z_S.root");

  TCanvas* c1 = new TCanvas("c1", "Tau Distributions", 1200, 900);


  TH1F JE1("Tau_Energy_1", "Tau Energy Distribution;E_{#tau} [GeV];A.U. / GeV", 100, 0, 100);

  Tree.Draw("jet_energy>>Tau_Energy_1","label_tau+label_taubar==1");

  TLatex *tex = new TLatex();
  FormatLatex(tex);
  tex->SetTextSize(60);
  JE1.SetLineColor(kBlue+2);
  JE1.SetLineWidth(4);
```

ROOT Example (2)

```
25
26  JE1.GetYaxis()->SetTitleOffset(1.5);
27  JE1.DrawNormalized();
28
29  TLegend *legend = new TLegend(0.75, 0.3, 0.95, 0.66);
30  FormatLegend(legend);
31  legend->AddEntry("Tau_Energy_1", "Z#rightarrow#tau#tau",   "L");
32  legend->Draw("SAME");
33
34  tex->DrawLatexNDC(0.6, 0.88, "#bf{CEPC} Ref-TDR");
35  tex->DrawLatexNDC(0.6, 0.8, "#sqrt{s}=91.2 GeV");
36
37  c1->SaveAs("E_tau.pdf");
38  c1->SaveAs("E_tau.png");
39
40  TH2F JE2("Tau_Energy_CosTheta_1", "Tau Energy vs CosTheta;Cos(#theta_{#tau});E_{#tau} [GeV];", 100, -1, 1, 100, 0, 100);
41  Tree.Draw("jet_energy : jet_costheta>>Tau_Energy_CosTheta_1", "label_tau+label_taubar==1","colz");
42
```

ROOT Example (3)

```
43      gPad->SetRightMargin(0.2);
44      gPad->SetTopMargin(0.08);
45      gPad->Update();
46      TPaletteAxis *palette = (TPaletteAxis*)JE2.GetListOfFunctions()->FindObject("palette");
47      if (palette) {
48          palette->SetX1NDC(0.82);
49          palette->SetX2NDC(0.86);
50          palette->SetY1NDC(0.12);
51          palette->SetY2NDC(0.92);
52          JE2.GetZaxis()->SetTitle("Events");
53      }
54      JE2.Draw("colz");
55      tex->DrawLatexNDC(0.16, 0.94, "#bf{CEPC} Ref-TDR, #sqrt{s}=91.2 GeV");
56      // tex->DrawLatexNDC(0.6, 0.94, "#sqrt{s}=91.2 GeV");
57      c1->SaveAs("E_tau_Costheta.pdf");
58      c1->SaveAs("E_tau_Costheta.png");
```

PyROOT Example (from Boping)

- In order to load the style file in PyROOT, use following:
  - ROOT.gROOT.LoadMacro("CEPCStyle.C")

```
import os
import ROOT
from ROOT import TH1D, TCanvas, TLegend, TLine, TPaveText
from ROOT import gStyle
from ROOT import gROOT
from ROOT import TStyle
#gStyle.SetOptStat("rme")
#gStyle.SetOptStat(0)
#gStyle.SetLegendBorderSize(0)
#gROOT.ProcessLine(".x /afs/ihep.ac.cn/users/c/chenbp/cepcstyle/cepcStyle.c")
#gROOT.ProcessLine(".L /afs/ihep.ac.cn/users/c/chenbp/cepcstyle/CEPC_RefTDR_StyleGuide/Root_Style/CEPCStyle.h")
ROOT.gROOT.LoadMacro("/afs/ihep.ac.cn/users/c/chenbp/cepcstyle/CEPC_RefTDR_StyleGuide/Root_Style/CEPCStyle.C")
ROOT.SetCEPCStyle()
```

  - Then invoke the functions with ROOT module:

```
ROOT.AddCEPCtag(0.2,0.9)
ROOT.FormatLegend(legend)
ROOT.FormatAxis(ecbarrel.GetXaxis(), 1, "Title")
```

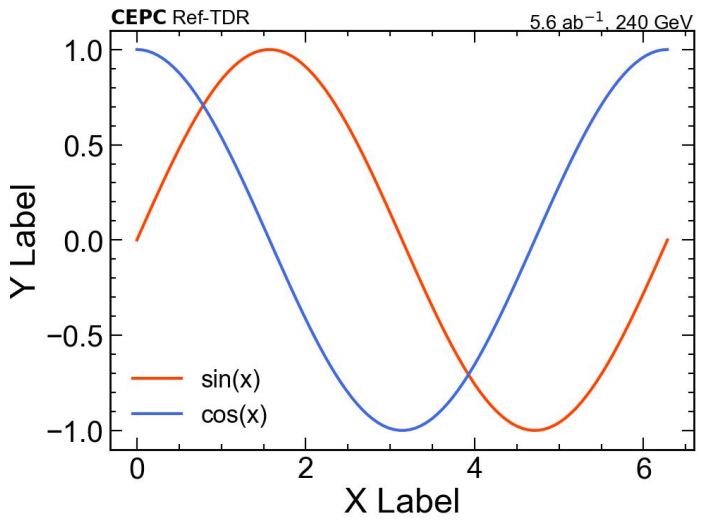
Python draw style instruction

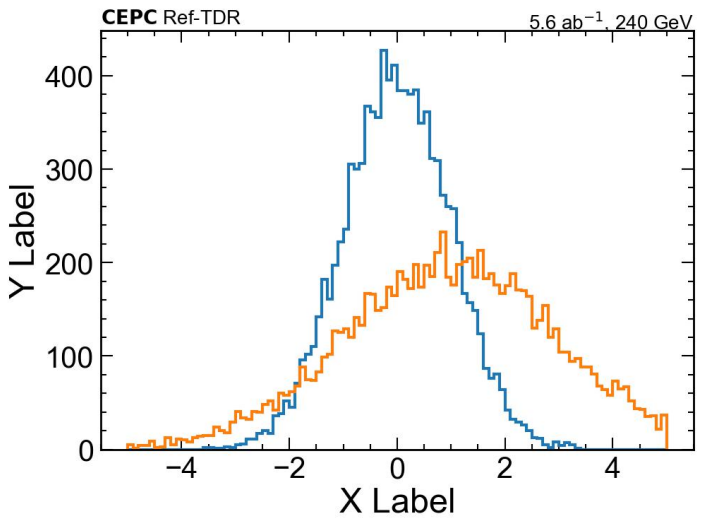
1. Download the project of *cepc-style* on Gitlab:

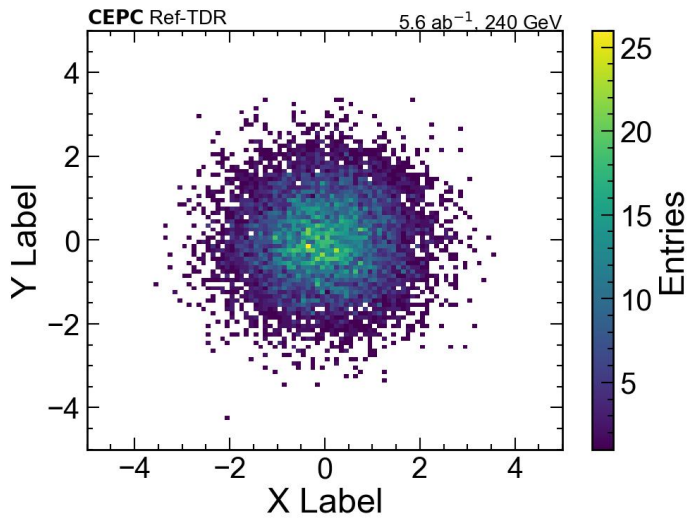
   $git clone git@code.ihep.ac.cn:zhangyang98/cepc-style.git

2. Go to the directory of *cepc-style* and run *examples.py*:

   $cd cepc-style
   $python examples.py







Python draw style instruction

In *examples.py* (or in your own python scripyts), you should add the following code at first:

```
import numpy as np
import matplotlib.pyplot as plt
# Apply style BEFORE creating figures
plt.style.use('./cepc_style.mplstyle')
```

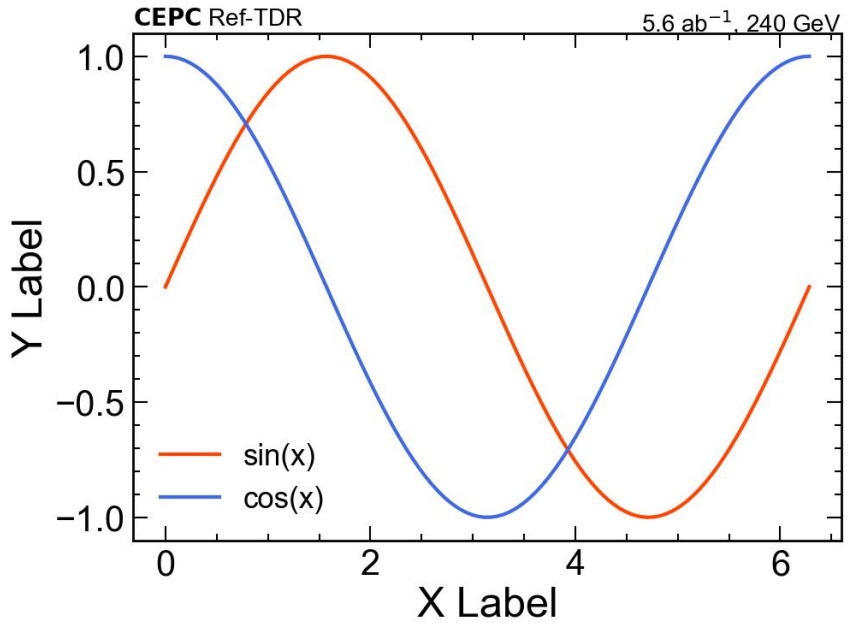
cepc_style.mplstyle sets the styles of your plots, including font, label sizes, layout, etc.
The codes on the right hand side are the contents of *cepc_style.mplstyle*

```
### Tick parameters ###
# Visibility and direction
xtick.top : True
ytick.right : True
xtick.direction : in
ytick.direction : in

# Width settings
xtick.major.width : 1.5
ytick.major.width : 1.5
xtick.minor.width : 1.5
ytick.minor.width : 1.5

# Length settings
xtick.major.size : 12
ytick.major.size : 12
xtick.minor.size : 6
ytick.minor.size : 6

# Padding
xtick.major.pad : 7
ytick.major.pad : 7

### Spine settings ###
axes.linewidth : 2  # Applies to all four spines

### Minorticks ###
xtick.minor.visible : True
ytick.minor.visible : True

### Label sizes ###
# These will be overridden by your function parameters
axes.labelsize : 35    # Default for label_size
axes.titlesize : 35    # Default for label_size
xtick.labelsize : 30   # Default for ticklabel_size
ytick.labelsize : 30   # Default for ticklabel_size

### Layout ###
figure.autolayout : True  # Similar to tight_layout


### Font Family ###
font.family           : sans-serif
font.sans-serif       : TeX Gyre Heros, Arial, Helvetica, DejaVu Sans,
Liberation Sans, sans-serif


### Legend settings ###
legend.frameon : False  # Remove the border around the legend box
```

Python draw style instruction

Example of curves:

```
# Create the data
x = np.linspace(0, 2*np.pi, 100)
y1 = np.sin(x)
y2 = np.cos(x)

# Draw the plot
fig, ax = plt.subplots(figsize=(10, 7.5))
ax.plot(x, y1, lw=3, color='orangered', label='sin(x)')
ax.plot(x, y2, lw=3, color='royalblue', label='cos(x)')

# Set the x and y axis labels if needed
ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
# Or you can choose the set x label in the right side and y label in the top side
# ax.set_xlabel('X Label', loc='right')
# ax.set_ylabel('Y Label', loc='top')

# Add legend if needed
plt.legend(loc='lower left', fontsize=25)

# Add "CEPC Ref-TDR" (bold) on the top left corner if needed
ax.text(0.0, 1.05, r"$\mathbf{CEPC}$ Ref-TDR",
    transform=ax.transAxes, fontsize=20, ha='left', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))

# Add luminosity and energy on the top right corner if needed
ax.text(1, 1.05, r"5.6 ab$^{-1}$, 240 GeV",
    transform=ax.transAxes, fontsize=20, ha='right', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))

# Save the figure in vector format
fig.savefig('./sample_figures/example_plot.pdf', bbox_inches='tight', dpi=1000)
# Show the figure
plt.show()
```



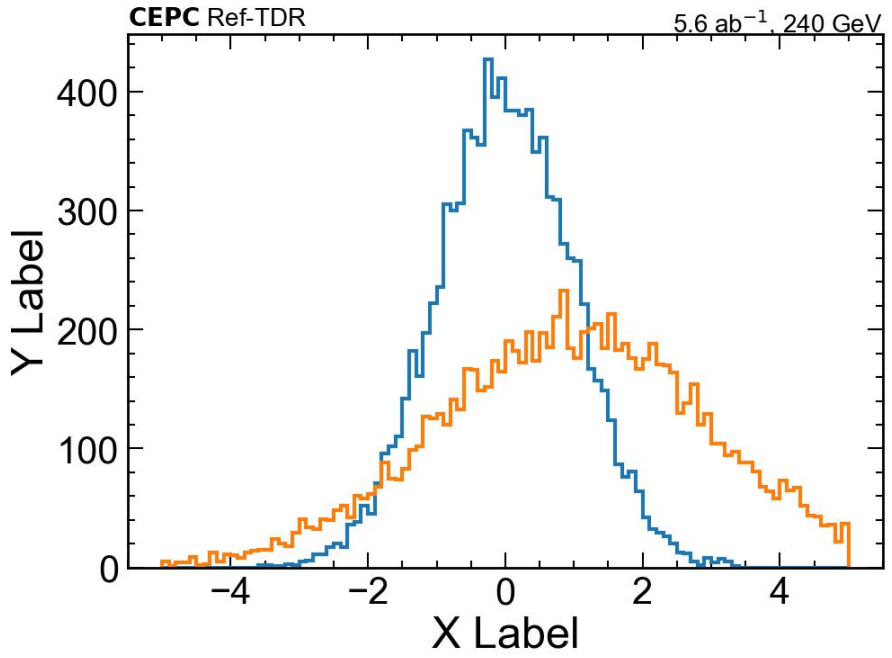
Adjust the position of '**CEPC** Ref-TDR' by modifying the first two parameters.

Add additional text to the plot using the same method.

Python draw style instruction

Example of histogram:

```
# Create the data
x1 = np.random.normal(0, 1, 10000)
x2 = np.random.normal(1, 2, 10000)

# Draw the histogram
fig, ax = plt.subplots(figsize=(10, 7.5))
ax.hist(x1, bins=100, range=(-5, 5), histtype='step', lw=3)
ax.hist(x2, bins=100, range=(-5, 5), histtype='step', lw=3)

# Set the x and y axis labels
ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
# Or you can choose the set x label in the right side and y label in the top side
# ax.set_xlabel('X Label', loc='right')
# ax.set_ylabel('Y Label', loc='top')

## Add "CEPC Ref-TDR" on the top left corner if needed
ax.text(0.00, 1.05, r"$\mathbf{CEPC}$ Ref-TDR",
    transform=ax.transAxes, fontsize=20, ha='left', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))

## Add luminosity and energy on the top right corner if needed
ax.text(1, 1.05, r"5.6 ab$^{-1}$, 240 GeV",
    transform=ax.transAxes, fontsize=20, ha='right', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))

# Save the figure in vector format
fig.savefig('./sample_figures/example_hist.pdf', bbox_inches='tight', dpi=1000)

# Show the figure
plt.show()
```



Python draw style instruction

Example of 2D histogram:

```
# Create the data
x = np.random.normal(0, 1, 10000)
y = np.random.normal(0, 1, 10000)

# draw the 2D histogram
fig, ax = plt.subplots(figsize=(10, 7.5))
ax.hist2d(x, y, bins=(100, 100), range=[[-5, 5], [-5, 5]], cmin=0.99, cmap='viridis')

# Set the x and y axis labels
ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
# Or you can choose the set x label in the right side and y label in the top side
# ax.set_xlabel('X Label', loc='right')
# ax.set_ylabel('Y Label', loc='top')

# Add colorbar if needed
cbar = plt.colorbar(ax.collections[0], ax=ax)
cbar.set_label('Entries')

## Add "CEPC Ref-TDR" on the top left corner if needed
ax.text(0.00, 1.05, r"$\mathbf{CEPC}$ Ref-TDR",
    transform=ax.transAxes, fontsize=20, ha='left', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))
## Add luminosity and energy on the top right corner if needed
ax.text(1, 1.05, r"5.6 ab$^{-1}$, 240 GeV",
    transform=ax.transAxes, fontsize=20, ha='right', va='top',
    bbox=dict(facecolor='white', alpha=0, edgecolor='none'))

# Save the figure in vector format
fig.savefig('./sample_figures/example_hist2d.pdf', bbox_inches='tight', dpi=1000)
# Show the figure
plt.show()
```

For mor colormap (cmap), refer to this link