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PHY 353L - Modern Physics Lab
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Practice Data Analysis - part 1

In order to start, I've imported the necessary Python packages and the data file I'll be using.

In [6]:

```
import matplotlib.pyplot as plt
import numpy as np

data = "SampleData_Summer2023.dat"
```

Next I defined some useful classes that I've made to handle the position data and have particle objects that can hold this data.

In [7]:

```
class Position:
    def __init__(self, time, x_position, y_position, z_position) -> None:
        self.t = time
        self.x = x_position
        self.y = y_position
        self.z = z_position
    def __str__(self) -> str:
        return "(" + ', '.join(str(v) for v in vars(self).values()) + ")"

class Particle:
    def __init__(self) -> None:
        self.t = []
        self.x = []
        self.y = []
        self.z = []

    def add_pos(self, position) -> None:
        self.t.append(position.t)
        self.x.append(position.x)
        self.y.append(position.y)
        self.z.append(position.z)
```

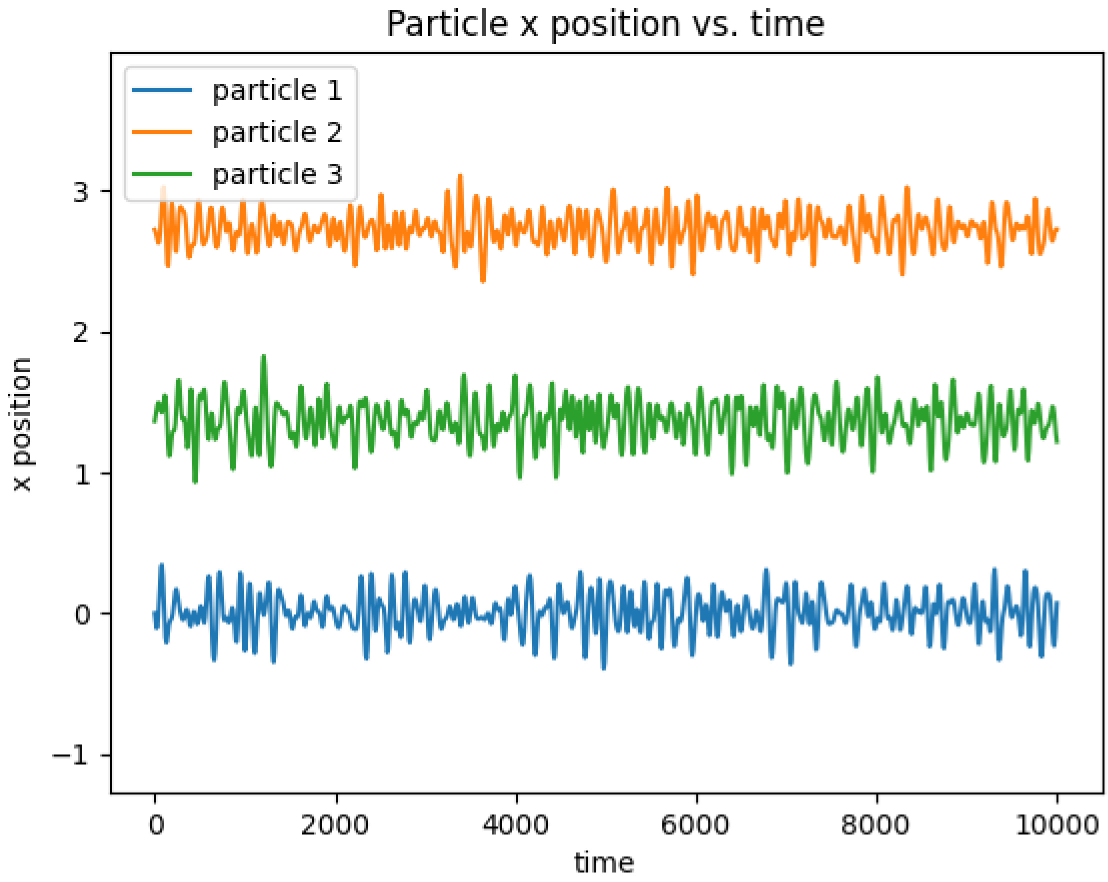
Problem #1

Below I open the data file using the `with open` function. Next I turn each line of the file into an array and comprehend each line to be split into their six respective Particle objects (`objs`). Lastly, I plot all of the x values of the first three particles vs. their times. The figure can be seen below this code block:

In [8]:

```
objs = [Particle() for i in range(6)]
with open(data, "r") as f:
    for line in f:
        line = [float(i) for i in line.split()]
        for i in range(6):
            objs[i].add_pos(Position(line[0], line[(3 * i) + 1],
                                     line[(3 * i) + 2], line[(3 * i) + 3]))
```

```
fig, ax = plt.subplots(1, 1)
for obj in objs[:3]:
    ax.plot(obj.t, obj.x, label = "particle " + str(objs.index(obj) + 1))
    ax.set_ymargin(0.25)
    ax.set_xlabel("time")
    ax.set_ylabel("x position")
    ax.set_title("Particle x position vs. time")
plt.legend()
plt.show()
```



Problem #2

In the code block below I calculated the mean and standard deviation of all six particles on all of their axes. They are printed directly below the code:

In [9]:

```
print("\t\t X Mean\t X SD\t Y Mean\t Y SD\t Z Mean\t Z SD")
for i in objs:
    print("particle", str(objs.index(i) + 1), "\t", np.round(np.mean(i.x), 3),
          "\t", np.round(np.std(i.x), 3), "\t", np.round(np.mean(i.y), 3),
          "\t", np.round(np.std(i.y), 3), "\t", np.round(np.mean(i.z), 3),
          "", np.round(np.std(i.z), 3))
```

```
                 X Mean  X SD    Y Mean  Y SD    Z Mean  Z SD
particle 1       0.002   0.128   0.003   0.119   -0.026  0.144
particle 2       2.722   0.114   0.002   0.11    -0.025  0.177
particle 3       1.363   0.141   2.358   0.118   -0.027  0.16
particle 4       4.082   0.137   2.359   0.11    -0.023  0.165
particle 5       0.001   0.123   1.57    0.097   -2.235  0.11
particle 6       2.721   0.124   1.57    0.102   -2.232  0.123
```