This file is to plot emittance growth after cooling in JSPEC simulation.

He Zhnag: Interaction time betwenn proton beam and electron beam is given by

Interaction time = total time (hrs) in simulation * cooler length/ring circumference

In [1]:
```
import pandas as pd
import numpy as np
```

In [2]:
```
df=pd.read_csv("cool2.txt",sep="\s+",skiprows = [0,1,3,4])
df
```

Out[2]:

	t	emit_x	emit_y	dp/p
0	0.00	0.000003	4.500000e-07	0.000660
1	1.08	0.000003	4.497735e-07	0.000662
2	2.16	0.000003	4.495446e-07	0.000656
3	3.24	0.000003	4.495644e-07	0.000655
4	4.32	0.000003	4.494804e-07	0.000659
...	...	...	...	...
9996	10795.68	0.000007	4.963973e-07	0.000620
9997	10796.76	0.000007	4.964953e-07	0.000613
9998	10797.84	0.000007	4.965041e-07	0.000624
9999	10798.92	0.000007	4.965375e-07	0.000621
10000	10800.00	0.000007	4.963149e-07	0.000619

10001 rows × 4 columns

In [3]:
```
for ind, row in df.iterrows():
    df.loc[ind,"time"] = row["t"]/3600
for ind, row in df.iterrows():
    df.loc[ind,"emitx"] = row["emit_x"]*1000000
for ind, row in df.iterrows():
    df.loc[ind,"emity"] = row["emit_y"]*1000000
```

In [4]:
```
df
```

Out[4]:

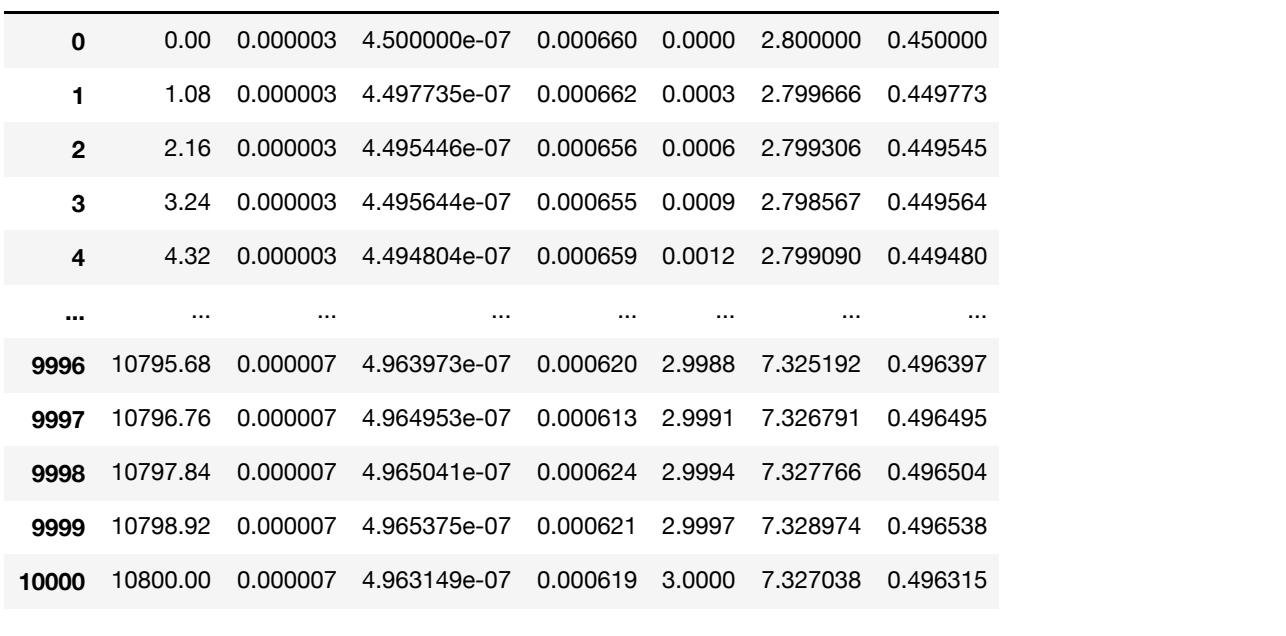
	t	emit_x	emit_y	dp/p	time	emitx	emity
0	0.00	0.000003	4.500000e-07	0.000660	0.0000	2.800000	0.450000
1	1.08	0.000003	4.497735e-07	0.000662	0.0003	2.799666	0.449773
2	2.16	0.000003	4.495446e-07	0.000656	0.0006	2.799306	0.449545
3	3.24	0.000003	4.495644e-07	0.000655	0.0009	2.798567	0.449564
4	4.32	0.000003	4.494804e-07	0.000659	0.0012	2.799090	0.449480
...	...	...	...	...	...	...	...
9996	10795.68	0.000007	4.963973e-07	0.000620	2.9988	7.325192	0.496397
9997	10796.76	0.000007	4.964953e-07	0.000613	2.9991	7.326791	0.496495
9998	10797.84	0.000007	4.965041e-07	0.000624	2.9994	7.327766	0.496504
9999	10798.92	0.000007	4.965375e-07	0.000621	2.9997	7.328974	0.496538
10000	10800.00	0.000007	4.963149e-07	0.000619	3.0000	7.327038	0.496315

10001 rows × 7 columns

In [5]:
```
import matplotlib.pyplot as plt
%matplotlib inline
```

In [8]:
```
#fig, ax1 = plt.subplots()
ax1 = df.plot(x = 'time',y=['emitx','emity','dp/p'],kind="line",figsize=(10,5))
ax1.set_xlabel('time (hour)')
ax1.set_ylabel('Emittance(mm.mrad)')
ax2 = ax1.twinx()  # instantiate a second axes that shares the same x-axis
ax2.set_ylabel(r'momentum spread $ \times 10^{-4}$')  # we already handled the x-label with ax1
ax2.tick_params(axis='y')
ax1.legend(['$\epsilon_x$','$\epsilon_y$','$\delta_{p}/p$'])

fig.tight_layout()  # otherwise the right y-label is slightly clipped
plt.savefig("phase-space.pdf")
plt.show()
```



In [ ]:
```
```