FullAnalysis-withHaroon_18-10-04-Copy2

October 4, 2018

1 PSB extracted values (from get_WS_pytimber_PSB.ipynb)

```
In [62]: (epsnzi, #long emit as per design
          epsnxd, #deconvolved emit x mean
          epsnxde, #deconvolved emit x std deviation
          epsnyc, #core emit y mean
          epsnyce, #core emit y std deviation
          epsnxn, #full Gauss emit x mean
          epsnxne, #full Gauss emit x std deviation
          epsnyn, #full Gauss emit y mean
          epsnyne, #full Gauss emit y std deviation
          ) = ([1.3, 1.3, 1.6, 1.6, 1.9, 1.9, 2.3, 2.3, 2.6, 2.6, 2.6, 2.6],
           [1.6185964301955338,
            1.957506813509126,
            1.508605514087423,
            1.9831716662218652,
            1.8034800719545698,
            2.2287336724284796,
            1.5854403915137698,
            2.0625698065038565,
            1.5538348681888317,
            1.5193227880841362,
            2.1218609539942737,
            1.8633080143641596],
           [0.056221915890368242,
            0.049821187880799617,
            0.023547396399823013,
            0.013177786566115584,
            0.032497446310415248,
            0.051380627758197163,
            0.065989351791013104,
            0.057937074198358265,
            0.031627660220885943,
            0.16993714464834916,
            0.058133763851647507,
            0.14315164470252942],
           [1.6379993484965214,
            2.128469363126162,
            1.7499657718084558,
            2.2174195206573026,
            1.611601134988653,
            2.257811007298832,
            1.6840794004842214,
```

```
 2.2207367961342444,
 1.7090435085744877,
 1.7025650738848019,
 2.2958739092300631,
 2.2294058957540659],
[0.051068885363298046,
 0.059034828886130472,
 0.070041643167276138,
 0.090841905817667309,
 0.05429851483397747,
 0.055500358657448762,
 0.057900533315396623,
 0.024669250629044848,
 0.026810071023174127,
 0.055114046282035208,
 0.072512288746947332,
 0.047245786478588334],
[1.7588229675846285,
 2.1267997685462587,
 1.6657933550948283,
 2.1723397698945242,
 2.0030979272049549,
 2.4294618916877204,
 1.8785645739469756,
 2.3704844189920991,
 2.0115046793075311,
 1.9227197844919131,
 2.5083210422885194,
 2.2359248878716462],
[0.060827722010814975,
 0.048444822108975175,
 0.022289949452387992,
 0.022794747979130753,
 0.036836539052546531,
 0.059084479470028824,
 0.058353631072838565,
 0.057260696202334205,
 0.040742788205511658,
 0.15435908222236217,
 0.0699601972746592,
 0.15979304590478305],
[1.7795404811158706,
 2.3195008639697958,
 1.8861926849202855,
 2.4066998574406697,
 1.7643361887773572,
 2.4656747497589966,
 1.8400965380850487,
 2.4393798088679781,
 1.8786837449743752,
 1.8540214314049381,
 2.4878706586788408,
 2.4071267440221051],
[0.047365715935455237,
```

```
            0.047133842458663179,
            0.050043418131231213,
            0.064896768315119577,
            0.05413573078740562,
            0.058464522188145948,
            0.056707332422596415,
            0.025448597669286522,
            0.028371025896054416,
            0.042879169562746441,
            0.089436493130150771,
            0.026643879013937361])
```

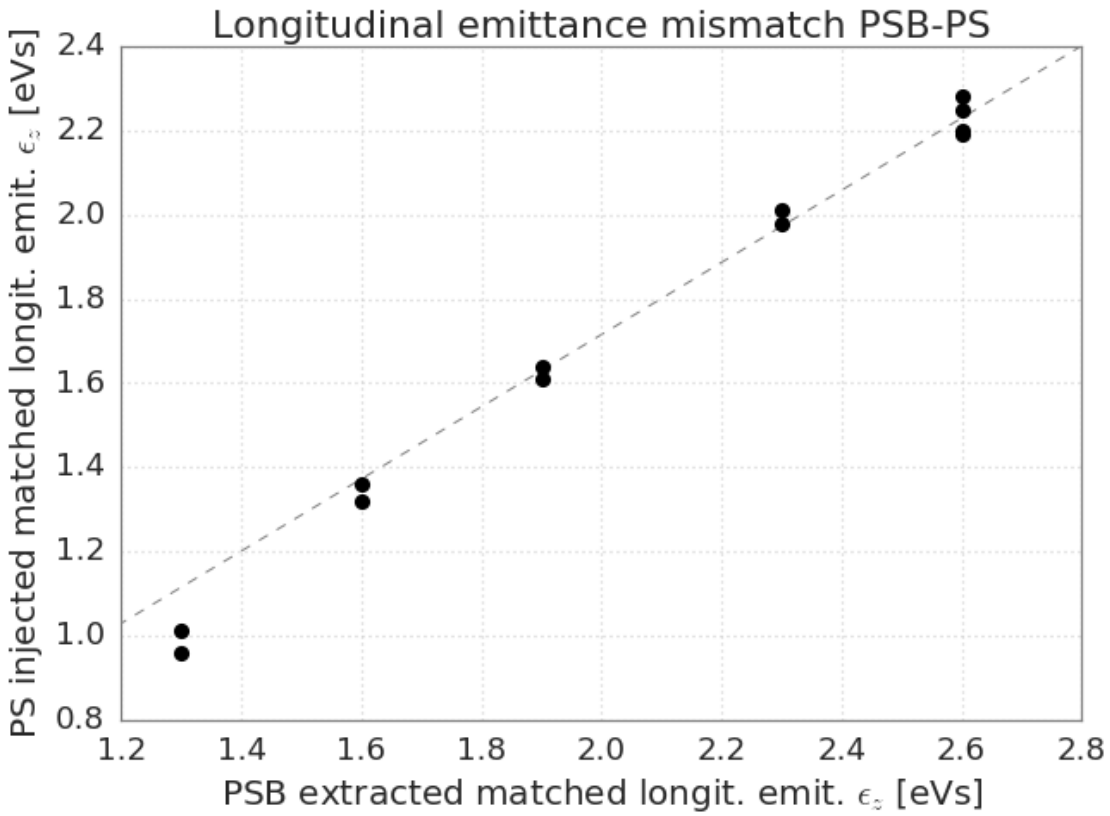
In [63]:
```
epsnz_fromtomo = [
        0.96, #1.3eVs 28.11. 1.6e11
        1.01, #1.3eVs 28.11. 2.0e11
        1.36, #1.6eVs 28.11. 1.6e11
        1.32, #1.6eVs 28.11. 2.0e11
        1.61, #1.9eVs 24.11. 1.6e11
        1.64, #1.9eVs 24.11. 2.0e11
        2.01, #2.3eVs 24.11. 1.6e11
        1.98, #2.3eVs 24.11. 2.0e11
        2.19, #2.6eVs 24.11. 1.6e11
        2.25, #2.6eVs 28.11. 1.6e11
        2.2,  #2.6eVs 24.11. 2.0e11
        2.28, #2.6eVs 28.11. 2.0e11
        ]
```

In [64]:
```
psb_keys = ['1.3eVs 1.6e12',
 '1.3eVs 2.0e12',
 '1.6eVs 1.6e12',
 '1.6eVs 2.0e12',
 '1.9eVs 1.6e12',
 '1.9eVs 2.0e12',
 '2.3eVs 1.6e12',
 '2.3eVs 2.0e12',
 '2.6eVs 1.6e12',
 '2.6eVs 1.6e12 2',
 '2.6eVs 2.0e12',
 '2.6eVs 2.0e12 2']
```

In [65]:
```
psb_to_ps_mapping = {
    'parabolic_1.3eVs_N1.6e12/': '1.3eVs 1.6e12',
    'parabolic_1.3eVs_N2.0e12/': '1.3eVs 2.0e12',
    'parabolic_1.6eVs_N1.6e12/': '1.6eVs 1.6e12',
    'parabolic_1.6eVs_N2.0e12/': '1.6eVs 2.0e12',
    'parabolic_2.6eVs_N1.6e12/': '2.6eVs 1.6e12 2',
    'parabolic_2.6eVs_N2.0e12/': '2.6eVs 2.0e12 2',
    '../2017-11-24-MDwithSimon/parabolic_1.9eVs_N1.6e12/': '1.9eVs 1.6e12',
    '../2017-11-24-MDwithSimon/parabolic_1.9eVs_N2.0e12/': '1.9eVs 2.0e12',
    '../2017-11-24-MDwithSimon/parabolic_2.3eVs_N1.6e12/': '2.3eVs 1.6e12',
    '../2017-11-24-MDwithSimon/parabolic_2.3eVs_N2.0e12/': '2.3eVs 2.0e12',
    '../2017-11-24-MDwithSimon/parabolic_2.6eVs_N1.6e12/': '2.6eVs 1.6e12',
    '../2017-11-24-MDwithSimon/parabolic_2.6eVs_N2.0e12/': '2.6eVs 2.0e12',
}
```

2 PS vs. PSB

In [58]:
```
plt.figure(figsize=(10, 7))
plt.plot([
1.3,
1.3,
1.6,
1.6,
1.9,
1.9,
2.3,
2.3,
2.6,
2.6,
2.6,
2.6,
], epsnz_fromtomo, marker='o', ls='none', color='black')
ylims = plt.ylim()
xlims = plt.xlim()
plt.plot([0,2.6*2], [0, np.mean(epsnz_fromtomo[-4:])*2], ls='--', lw=1, color='gray', zorder=-
plt.ylim(ylims)
plt.xlim(xlims)
plt.xlabel(r'PSB extracted matched longit. emit. $\epsilon_z$ [eVs]')
plt.ylabel(r'PS injected matched longit. emit. $\epsilon_z$ [eVs]')
plt.title('Longitudinal emittance mismatch PSB-PS')
plt.savefig('long_emit_psb-ps.pdf', bbox_inches='tight')
```



```
In [78]: from pprint import pprint
```

2.0.1 ϵ_x horizontal plane:

```
In [100]: pprint (zip(
              psb_keys[:-2:2] + [psb_keys[-3]],
              epsnxd[:-2:2] + [epsnxd[-3]],
          ))
          print ('\n\naverage PSB epsn_x deconvolved: {:.3f} mm mrad for N=1.6e12 ppb\n\n'.format(
              np.mean(epsnxd[:-2:2] + [epsnxd[-3]])))
```

```
[('1.3eVs 1.6e12', 1.6185964301955338),
 ('1.6eVs 1.6e12', 1.508605514087423),
 ('1.9eVs 1.6e12', 1.8034800719545698),
 ('2.3eVs 1.6e12', 1.5854403915137698),
 ('2.6eVs 1.6e12', 1.5538348681888317),
 ('2.6eVs 1.6e12 2', 1.5193227880841362)]


average PSB epsn_x deconvolved: 1.598 mm mrad for N=1.6e12 ppb
```

```
In [101]: pprint (zip(
              psb_keys[1:-3:2] + psb_keys[-2:],
              epsnxd[1:-3:2] + epsnxd[-2:],
          ))
          print ('\n\naverage PSB epsn_x deconvolved: {:.3f} mm mrad for N=2.0e12 ppb\n\n'.format(
              np.mean(epsnxd[1:-3:2] + epsnxd[-2:])))
```

```
[('1.3eVs 2.0e12', 1.957506813509126),
 ('1.6eVs 2.0e12', 1.9831716662218652),
 ('1.9eVs 2.0e12', 2.2287336724284796),
 ('2.3eVs 2.0e12', 2.0625698065038565),
 ('2.6eVs 2.0e12', 2.1218609539942737),
 ('2.6eVs 2.0e12 2', 1.8633080143641596)]


average PSB epsn_x deconvolved: 2.036 mm mrad for N=2.0e12 ppb
```

```
In [102]: pprint (zip(
              psb_keys[:-2:2] + [psb_keys[-3]],
              epsnxn[:-2:2] + [epsnxn[-3]],
          ))
          print ('\n\naverage PSB epsn_x full Gaussian: {:.3f} mm mrad for N=1.6e12 ppb\n\n'.format(
              np.mean(epsnxn[:-2:2] + [epsnxn[-3]])))
```

```
[('1.3eVs 1.6e12', 1.7588229675846285),
 ('1.6eVs 1.6e12', 1.6657933550948283),
 ('1.9eVs 1.6e12', 2.003097927204955),
 ('2.3eVs 1.6e12', 1.8785645739469756),
 ('2.6eVs 1.6e12', 2.011504679307531),
 ('2.6eVs 1.6e12 2', 1.922719784491913)]


average PSB epsn_x full Gaussian: 1.873 mm mrad for N=1.6e12 ppb
```

```
In [103]: pprint (zip(
              psb_keys[1:-3:2] + psb_keys[-2:],
              epsnxn[1:-3:2] + epsnxn[-2:],
          ))
          print ('\n\naverage PSB epsn_x full Gaussian: {:.3f} mm mrad for N=2.0e12 ppb\n\n'.format(
              np.mean(epsnxn[1:-3:2] + epsnxn[-2:])))
```

```
[('1.3eVs 2.0e12', 2.1267997685462587),
 ('1.6eVs 2.0e12', 2.172339769894524),
 ('1.9eVs 2.0e12', 2.4294618916877204),
 ('2.3eVs 2.0e12', 2.370484418992099),
 ('2.6eVs 2.0e12', 2.5083210422885194),
 ('2.6eVs 2.0e12 2', 2.2359248878716462)]


average PSB epsn_x full Gaussian: 2.307 mm mrad for N=2.0e12 ppb
```

2.0.2 ϵ_y vertical plane:

```
In [104]: pprint (zip(
              psb_keys[:-2:2] + [psb_keys[-3]],
              epsnyc[:-2:2] + [epsnyc[-3]],
          ))
          print ('\n\naverage PSB epsn_y core fit: {:.3f} mm mrad for N=1.6e12 ppb\n\n'.format(
              np.mean(epsnyc[:-2:2] + [epsnyc[-3]])))
```

```
[('1.3eVs 1.6e12', 1.6379993484965214),
 ('1.6eVs 1.6e12', 1.7499657718084558),
 ('1.9eVs 1.6e12', 1.611601134988653),
 ('2.3eVs 1.6e12', 1.6840794004842214),
 ('2.6eVs 1.6e12', 1.7090435085744877),
 ('2.6eVs 1.6e12 2', 1.702565073884802)]


average PSB epsn_y core fit: 1.683 mm mrad for N=1.6e12 ppb
```

```
In [105]: pprint (zip(
              psb_keys[1:-3:2] + psb_keys[-2:],
              epsnyc[1:-3:2] + epsnyc[-2:],
          ))
          print ('\n\naverage PSB epsn_y core fit: {:.3f} mm mrad for N=2.0e12 ppb\n\n'.format(
              np.mean(epsnyc[1:-3:2] + epsnyc[-2:])))
```

```
[('1.3eVs 2.0e12', 2.128469363126162),
 ('1.6eVs 2.0e12', 2.2174195206573026),
 ('1.9eVs 2.0e12', 2.257811007298832),
 ('2.3eVs 2.0e12', 2.2207367961342444),
 ('2.6eVs 2.0e12', 2.295873909230063),
 ('2.6eVs 2.0e12 2', 2.229405895754066)]


average PSB epsn_y core fit: 2.225 mm mrad for N=2.0e12 ppb
```

```
In [106]: pprint (zip(
              psb_keys[:-2:2] + [psb_keys[-3]],
              epsnyn[:-2:2] + [epsnyn[-3]],
```

```
        ))
        print ('\n\naverage PSB epsn_y full Gaussian: {:.3f} mm mrad for N=1.6e12 ppb\n\n'.format(
            np.mean(epsnyn[:-2:2] + [epsnyn[-3]])))
```

```
[('1.3eVs 1.6e12', 1.7795404811158706),
 ('1.6eVs 1.6e12', 1.8861926849202855),
 ('1.9eVs 1.6e12', 1.7643361887773572),
 ('2.3eVs 1.6e12', 1.8400965380850487),
 ('2.6eVs 1.6e12', 1.8786837449743752),
 ('2.6eVs 1.6e12 2', 1.8540214314049381)]


average PSB epsn_y full Gaussian: 1.834 mm mrad for N=1.6e12 ppb
```

```
In [107]: pprint (zip(
            psb_keys[1:-3:2] + psb_keys[-2:],
            epsnyn[1:-3:2] + epsnyn[-2:],
        ))
        print ('\n\naverage PSB epsn_y full Gaussian: {:.3f} mm mrad for N=2.0e12 ppb\n\n'.format(
            np.mean(epsnyn[1:-3:2] + epsnyn[-2:])))
```

```
[('1.3eVs 2.0e12', 2.319500863969796),
 ('1.6eVs 2.0e12', 2.4066998574406697),
 ('1.9eVs 2.0e12', 2.4656747497589966),
 ('2.3eVs 2.0e12', 2.439379808867978),
 ('2.6eVs 2.0e12', 2.487870658678841),
 ('2.6eVs 2.0e12 2', 2.407126744022105)]


average PSB epsn_y full Gaussian: 2.421 mm mrad for N=2.0e12 ppb
```