MAIN RING MULTIWIRE AND FLYING WIRE 
COMPARISONS AT 8 GeV

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Main Ring multiwire and flying wire data were taken during the 28 March evening study session. This note compares the results to each other and to previous measurements summarized in EXP-111 by S. Ohnuma.

Beam Conditions

The one booster batch had 1.1E12 of which 0.8E12 survived at 0.3 sec when the flying wire scans were performed.

Results

Both multiwire and flying wire analysis programs calculate beam widths from the second moment of the measured distributions. The flying wire program stops here and quotes the results as sigma. The multiwire program quotes a set of unnormalized emittances containing 90% of the profiles.

The results from the programs are:

Flying wire: 4.18 mm vertical at VF47
5.49 mm horizontal at HF48

Multiwire: 0.52\(\pi\) mm mrad vertical observed
0.68\(\pi\) mm mrad horizontal observed

Comparison of Results

The flying wire necessarily measures the beam after injection mismatches and steering errors have diluted the emittance. Table I contains the lattice parameters for the flying wires. The multiwire program calculates both an undiluted emittance corresponding to what the Booster is producing, and a diluted emittance corresponding to a mismatch in phase space. It does not take into account injection steering errors.
The prime reference for emittances is the compendium of EXP-111 by S. Ohnuma. These new measurements are compared by calculating 95% of the normalized beam emittance and are displayed in Table II.

Comparison to EXP-111

The relevant distillation is given on page 7 of EXP-111 and is repeated here for reference: "I have translated the results in these references to give the normalized emittance with \( f_2 = 95\% \) as a function of the intensity/bunch (instead of /booster batch):

- 8 GeV (before dilution, \( N = \) number in \( 10^{10} \)/bunch
- horizontal: \( \varepsilon_N = 4.03 + 2.03N + 0.911N^2 \) (in \( \pi \) mm-mr)
- vertical: \( \varepsilon_N = 5.86 + 1.18N + 0.766N^2 \)

Data for \( N \) up to 2.9 used for these."

Figures 1a and 1b compare these new measurements with the curves given above. In addition, Fig. 1b compares the flying wire measurements from EXP-117 and EXP-118.

Summary

The vertical multiwire and flying wire emittance measurements agree quite well (to 3%). They are larger than those in EXP-111 by 15%.

The horizontal flying wire is larger than the multiwire emittance measurements by 5% assuming \( \Delta p/p = 0.1\% \). The new horizontal multiwire measurement is larger than that in EXP-111 by 15%.

Further measurements may uncover the source of these differences.
TABLE I

FLYING WIRE LATTICE PARAMETERS

<table>
<thead>
<tr>
<th></th>
<th>VF47</th>
<th>HF48</th>
<th>HA17</th>
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</thead>
<tbody>
<tr>
<td>Distance from quad</td>
<td>0.457m</td>
<td>1.676m</td>
<td>2.743m</td>
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<tr>
<td>β</td>
<td>93.3m</td>
<td>100.9m</td>
<td>89.4m</td>
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<tr>
<td>Dispersion</td>
<td>0.21m</td>
<td>2.27m</td>
<td>5.14m</td>
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</tbody>
</table>

TABLE II

8 GeV COMPARISON

1.3E10/Booster Bunch
95% Emittance in π mm mrad

<table>
<thead>
<tr>
<th></th>
<th>Multiwire</th>
<th>Flying Wire</th>
<th>EXP-111</th>
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</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>Diluted 11.0</td>
<td>10.7</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Undiluted 10.0</td>
<td>---</td>
<td>8.7</td>
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<table>
<thead>
<tr>
<th></th>
<th>Multiwire</th>
<th>Flying Wire</th>
<th>EXP-111</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δp/p=0 diluted</td>
<td>14.3</td>
<td>16.9</td>
<td>---</td>
</tr>
<tr>
<td>Δp/p=0 undiluted</td>
<td>11.2</td>
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<td>---</td>
</tr>
<tr>
<td>Δp/p=.1% diluted</td>
<td>13.2</td>
<td>13.9</td>
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</tr>
<tr>
<td>Δp/p=.1% undiluted</td>
<td>9.5</td>
<td>---</td>
<td>8.3</td>
</tr>
</tbody>
</table>
95\% \ (8 \text{ GeV}, \gamma\beta = 9.47)\]

\[ \epsilon_v (\pi \text{ mm mrad}) \]