Commissioning plans

2nd FACET-II Program Advisory Committee Meeting

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Key Performance Parameters:

- The threshold KPPs are the minimum parameters against which the project’s performance is measured when complete.
- The objective KPPs are the desired operating parameters that the project will design to with the intent that those may be achieved during steady operation.
- Taking performance from Threshold to Objective will require operations time to optimize accelerator performance.

### FACET-II Design Parameters:

<table>
<thead>
<tr>
<th>Electron Beam Parameter</th>
<th>Baseline Design</th>
<th>Operational Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Energy [GeV]</td>
<td>10</td>
<td>4.0-13.5</td>
</tr>
<tr>
<td>Charge per pulse [nC]</td>
<td>2</td>
<td>0.7-5</td>
</tr>
<tr>
<td>Repetition Rate [Hz]</td>
<td>30</td>
<td>1-30</td>
</tr>
<tr>
<td>Norm. Emittance $\gamma \varepsilon_{x,y}$ at S19 [(\mu m)]</td>
<td>4.4, 3.2</td>
<td>3-6</td>
</tr>
<tr>
<td>Spot Size at IP $\sigma_{x,y}$ [(\mu m)]</td>
<td>18, 12</td>
<td>5-20</td>
</tr>
<tr>
<td>Min. Bunch Length $\sigma_z$ (rms) [(\mu m)]</td>
<td>1.8</td>
<td>0.7-20</td>
</tr>
<tr>
<td>Max. Peak current $I_{pk}$ [kA]</td>
<td>72</td>
<td>10-200</td>
</tr>
</tbody>
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### Description of Scope

<table>
<thead>
<tr>
<th>Description of Scope</th>
<th>Units</th>
<th>Threshold KPP</th>
<th>Objective KPP</th>
</tr>
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<tbody>
<tr>
<td>Beam Energy</td>
<td>[GeV]</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Bunch Charge (e-)</td>
<td>[nC]</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Normalized Emittance in S19 (e-)</td>
<td>[(\mu m)]</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Bunch Length (e-)</td>
<td>[(\mu m)]</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>
Photoinjector laser is ready for laser cleaning and single bunch operations, Improvements will continue towards better uniformity and two pulse mode.
Photoinjector and laser cleaning

- Gun processed to 10MW with 1us long RF pulse
  - Gun scrubbed in 2018 AIP operations
- Laser spot optimized for cleaning
- Cleaning procedure/GUI checked out
  - Efficiency
  - Safety

Laser cleaning ready for execution week of 10/26
135 MeV Injector

- Injector modulators upgraded with “Mission Readiness” hardware that allows for more stability
- New PLC code checkout
- New Low-Level RF (LLRF) checkout
- New infrastructure to replace old CAMAC hardware commissioned
- RF processing in injector stations proceeding
- Checkout of diagnostics
  - Profile monitors, wire scanner, & Faraday cups
  - BPMs & Toroid
  - Bunch length monitor & deflecting cavity

Injector modulators for Gun, L0A, L0B and Tcav have new technology for better stability
Characterization of 135 MeV beam Weeks of 10/26 and 11/2.
F&O’s CT1201 maintenance project was delayed due to COVID-19 and subcontractor
Temporary cooling towers in Sectors 10 and 11 are used to support 135MeV commissioning
L1: 335MeV electrons through BC11 to TD11

- Establish beam through BC11 chicane
- Tune beam profile on TD11 tune-up dump
- Two RF stations in L1 linac, utilizing legacy control system
- BPM checkout and timing
- Bunch length monitor commissioning
- Profile monitor and toroid checkout
- Verify lattice through TD11

Checkout and commissioning are planned for the week of 11/9
L2: 4GeV to BC14

- Establish 4GeV beam through L2 linac and through BC14 chicane
- Tune RF stations
- Tune beam profile
- Verify lattice through BC14
- ~30 L2 RF stations utilizing legacy control system, 6 currently undergoing maintenance for modulator or tube issues (not all RF needed for KPP verification)

Checkout and commissioning are planned for the week of 11/16
L3: 10GeV to “W” chicane in Sector 20

- Establish 9-10GeV beam through L3 and into FACET chicane
- ~40 RF stations utilizing legacy control system, 10 currently undergoing maintenance for modulator or tube issues (not all RF needed for KPP verification)
- Commission L3 transverse cavity at 15-2 900 girder
- Commission new sector 19 optics and match into the FACET chicane
- Establish beam to FACET dump
- Diagnostics checkout

Checkout and commissioning are planned for the week of 11/23
Conclusion

- FACET-II injector commissioning is under way
- Bunch compressor chicanes commissioning and linac re-commissioning through month of November
- Establish threshold key performance parameters of >100nC charge, >9GeV energy, <100um bunch length, <50um emittance early December

Threshold KPP expected first week of December