Abstract

Experiments planned at the CERN Large Hadron Collider (LHC) will require a well-equipped test area with low momentum (<15 GeV/c) secondary particle beams. These beams will be used to test some of the LHC detectors components (ALICE, ATLAS, CMS, LHC-B). In addition another recently approved experiment (DIRAC) will be installed in the PS East Area. This experiment will require a primary proton beam of 24 GeV/c to test QCD predictions. In this context, the EHNL project (East Hall New Look) has been launched. The major modifications include (i) an extension of the present area with a primary 24 GeV/c beam line, (ii) a new secondary beam line layout with test areas at 3.5, 7, 10 and 15 GeV/c, (iii) an additional irradiation area, (iv) an improved facility for beam sharing between the various users. This paper describes the scope of the project, its new features, the planned facilities and its installation schedule.

1 INTRODUCTION

Following the approval of the Large Hadron Collider, the planned LHC experiments are now preparing parts of their detectors. Before full scale manufacture and assembly are launched, tests and optimization of these components are needed under adequate beam conditions. Part of these tests require low-energy particle beams and can be performed in the East Hall, either with a primary proton beam provided by the PS or with secondaries produced by the PS beam hitting a target [1]. Merging these needs with the additional request of housing the DIRAC experiment to be running with primary 24 GeV/c protons in the same East Area, led to the decision to carry out a major reshuffling of the PS East Hall under the project name EHNL, for East Hall New Look [2]. This project aims at upgrading and renewing the area for use by physicists before and beyond LHC start-up.

2 SCOPE OF THE PROJECT

The DIRAC experiment [3] will make use of a primary proton beam of 24 GeV/c from the PS delivered by means of a resonant extraction process (300 ms spill) to a new, dedicated channel[4]. This experiment has very stringent requirements on beam quality: very low residual intensity modulation, low beam halo [5], small secondary particles contamination and high geometric stability. LHC experiments will use secondary particles
selected in momentum and polarity but not separated by species, produced from a very similar proton beam hitting a target. As at present, there will be 2 targets in the area: one on the undeflected beam of the North branch, feeding 3 secondary channels, T9, T10 and T11, and another one on the beam deflected to the South branch by the splitter magnet, feeding the secondary channel T7. The equipment modules to be tested are up to several cubic meters in volume and the various test places should be able to house them.

The above requirements have imposed the redesign of three of the secondary lines [6] [7] [8] and major modifications in the target area and the switchyard in addition to the new primary channel. The facility, presently covering 2/3 of the building area, will extend to the whole available space.

Downstream of the DIRAC experiment an irradiation facility has been added using the beam catcher upstream the beam dump. It will be used to test the radiation hardness of voluminous (4 x 4 x 2.4 m³) equipment such as the planned liquid argon calorimeter of ATLAS. The expected rate of secondaries produced by 2 x 10¹¹ primary protons/spill imposes quite a massive shielding.

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Table 1. Users and beam characteristics.

<table>
<thead>
<tr>
<th>User</th>
<th>Line</th>
<th>Momentum</th>
<th>Particle</th>
<th>Particles/s pil</th>
<th>T11</th>
<th>3.5 GeV/c</th>
<th>Secondary</th>
<th>10⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>General use</td>
<td>T10</td>
<td>7 GeV/c</td>
<td>Secondary</td>
<td>10⁶</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALICE</td>
<td>T7</td>
<td>15 GeV/c</td>
<td>Secondary</td>
<td>10⁶</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATLAS/CMS</td>
<td>T9</td>
<td>15 GeV/c</td>
<td>Secondary</td>
<td>10⁶</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIRAC</td>
<td>T8</td>
<td>24 GeV/c</td>
<td>Primary p+</td>
<td>2 x 10¹¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHC-B</td>
<td>T7</td>
<td>24 GeV/c</td>
<td>Secondary</td>
<td>10⁶</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Possible beam sharing combinations between the 5 East Area beam lines.

<table>
<thead>
<tr>
<th>BEAM LINE</th>
<th>SPLITTER MAGNET ON</th>
<th>SPLITTER OFF or Beam outside splitter gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>All beam within splitter gap and deflected to South branch</td>
<td>Beam shared by splitter between North and South (deflected) branch</td>
<td>All beam to North (undeflected) branch</td>
</tr>
<tr>
<td>T7</td>
<td>Primary p+ or Secondaries &lt; 10 GeV/c</td>
<td>No Beam</td>
</tr>
<tr>
<td>T9</td>
<td>No Beam</td>
<td>24 GeV/c p+ (unscraped)</td>
</tr>
<tr>
<td>T10</td>
<td>No Beam</td>
<td>No Beam</td>
</tr>
<tr>
<td>T11</td>
<td>No Beam</td>
<td>No Beam</td>
</tr>
</tbody>
</table>

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5 INSTALLATION SCHEDULE

Installation is planned during a long (9 months) shutdown of the area, starting at the end of September 1997. After dismantling some of the shielding and modifications of the target area and switchyard, transformation of the secondary lines will take place. In parallel, maintenance of recovered elements will be carried out, before their reinstallation. After shielding replacement, during DIRAC installation, the experimental lines will be commissioned and sequentially put back into operation, starting with the least affected line T11 and ending with the new line T8. The whole area coming back again to life in the fall of 1998.

6 CONCLUSIONS

At the end of 1998, after completion of the EHNL project, the CERN PS East Area will house a major physics experiment while providing the physics community with a convenient detector test facility for the years to come. This facility will then be mainly devoted to tests of parts of LHC experiment including the capacity for testing radiation hardness of key components.

7 ACKNOWLEDGEMENTS

We are indebted to many colleagues in the physics teams for fruitful discussions during the global optimization process. People within and outside the PS division who gave pertinent advice on diverse aspects of the project are too numerous to cite here. We express our thanks to all of them for their inappreciable collaboration.

REFERENCES