THE GREEN ENERGY TURBINE AS TURBO GENERATOR FOR POWERING THE HV-SOLENOIDS AT A RELATIVISTIC ELECTRON COOLER

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Introduction

One of the challenges in the development of a relativistic electron cooler is the powering of components, e.g. the HV-solenoids, which sit on different high potentials within a high voltage vessel and therefore need a floating power supply. In this poster we present the turbo generator “Green Energy Turbine” (GET), an assembly of a turbine and a generator, as a possible candidate the for powering e.g. the HV-solenoids.

Experimental Demands for Antiproton Research

<table>
<thead>
<tr>
<th>Momentum Range</th>
<th>High Luminosity</th>
<th>High Resolution</th>
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</thead>
<tbody>
<tr>
<td>$1.5 - 15\text{ GeV}$</td>
<td>$2 \cdot 10^{22} \text{ cm}^{-2}\text{ s}^{-1}$</td>
<td>$2 \cdot 10^{23} \text{ cm}^{-2}\text{ s}^{-1}$</td>
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<tr>
<td>Peak Luminosity</td>
<td>$\Delta \frac{p}{p} = 10^{-4}$</td>
<td>$\Delta \frac{p}{p} = 10^{-5}$</td>
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</tbody>
</table>

To meet this requirements for the high resolution mode, magnetised electron cooling is needed.

Challenge: Powering Components at High Potential

- Many components within a high voltage vessel, e.g. HV-solenoids, sit on high potential
  - Floating power supply is needed
- BINP SB RAS has proposed to build the power supply in a modular way
  - Floating power supply per module which delivers a power of $5\text{ kW}$ is required
- Floating power supply per module should be a turbo generator
  - Potential candidate: “Green Energy Turbine” (GET) from the company DEPRAG

Turbo generator GET

- Assembly of a turbine and a generator
- Compressed air expands through a nozzle
- Accelerated air drives a turbine, consequently driving a generator
- Generator connected in delta configuration
- Turbine and generator supported by ball bearings
  - Lubrication unit is mounted at the GET

Properties of the GET

<table>
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<tr>
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<tbody>
<tr>
<td>Power</td>
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<tr>
<td>Revolution speed</td>
</tr>
<tr>
<td>Pressure (in)</td>
</tr>
<tr>
<td>Pressure (out)</td>
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<tr>
<td>Mass Flow</td>
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<td>Dew point of medium</td>
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<tr>
<td>Voltage phase to phase</td>
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<tr>
<td>Current</td>
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<tr>
<td>Nominal frequency</td>
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Characterisation of the GET

- Needed power of $5\text{ kW}$ could be generated
- Temperature drop of the expanded air is in the order of $(50 \pm 5)\text{°C}$
- Long-term test over 1025 hours was successfully carried out

Further Road Map

- During normal operation, the GET will be in a pressure tank
  - A new set-up with the GET in a pressure tank is in preparation
- Lubrication unit is not pressure resistant
  - Modification of the lubrication unit
- Subsequently some of the characterisation measurements are repeated
- Disadvantage of the lubrication unit is a potential pollution of the driving gas with lubricant
  - Lubrication-free turbo generator would be beneficial
- Another prototype will be built in which the ball bearings are replaced by gas bearings
- The new turbo generator will work with pure nitrogen in a closed circuit instead of ambient air in an open circuit