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

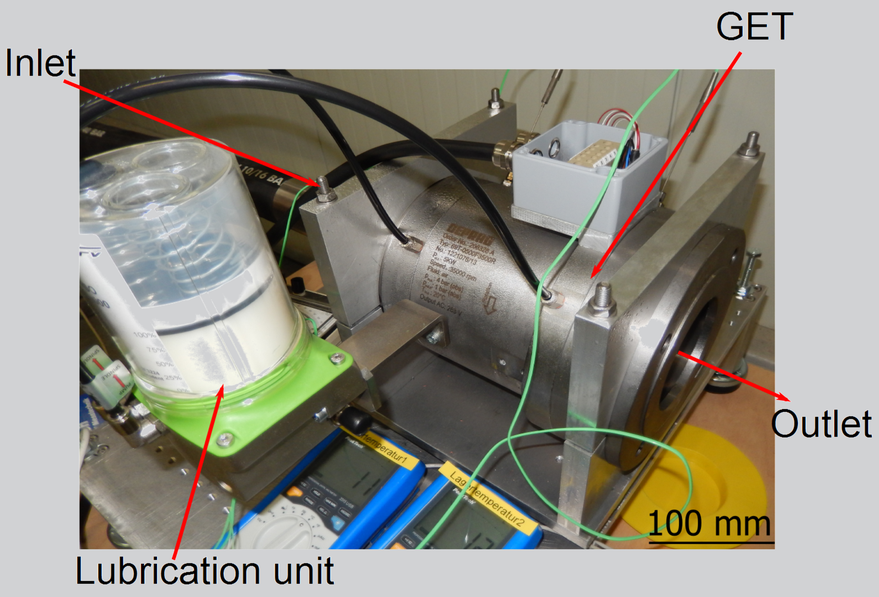
	High Luminosity	High Resolution
Momentum Range	$1.5 - 15\,\frac{\mathrm{GeV}}{\mathrm{c}}$	$1.5 - 9\,\frac{\mathrm{GeV}}{\mathrm{c}}$
Peak Luminositiy	$2 \cdot 10^{32}\,\frac{1}{\mathrm{cm^2 s}}$	$2 \cdot 10^{31}\,\frac{1}{\mathrm{cm^2 s}}$
Momentum Resolution	$\frac{\Delta p}{p} = 10^{-4}$	$\frac{\Delta p}{p} = 10^{-5}$

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 kW is required
- Floating power supply per module should be a turbo generator
  ⇒ Potential candidate: "Green Energy Turbine" (GET) from the company DEPRAG

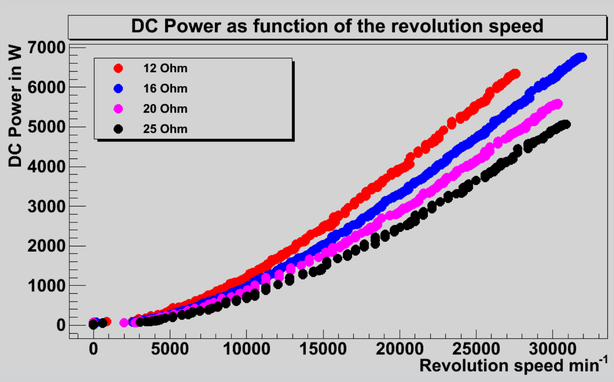
Turbo generator GET

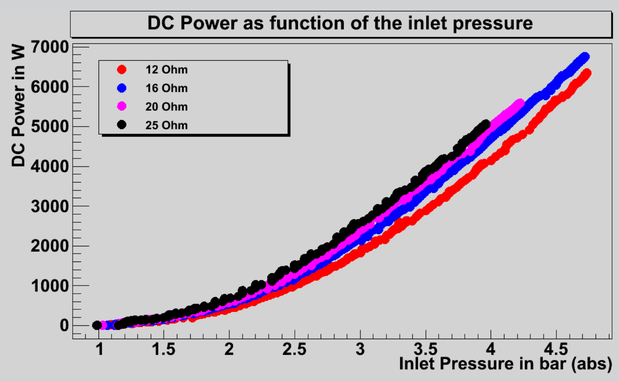


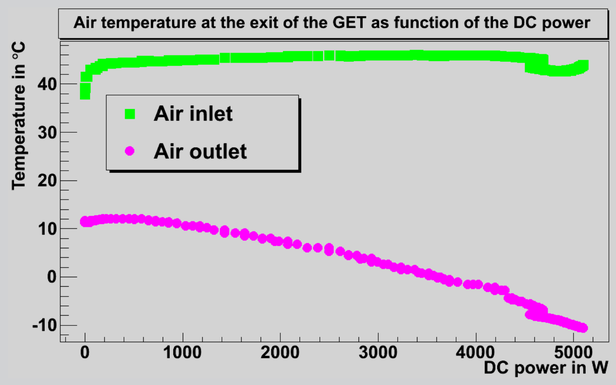
- Assembly of a turbine and a generator
- Compressed air expands through a nozzle
- Accelerated air drives a turbine, consequently driving a generator
- Generator connected in delta configuration
- Turbine and generator supported by ball bearings
  ⇒ Lubrication unit is mounted at the GET

Properties of the GET	
Power	5 kW
Revolution speed	$35000\,\mathrm{min}^{-1}$
Pressure (in)	4 bar
Pressure (out)	1 bar
Mass Flow	$4\,\frac{\mathrm{m^3}}{\mathrm{min}}$
Dew point of medium	−20°C
Voltage phase to phase	263 V
Current	12 A
Nominal frequency	583 Hz

Characterisation of the GET

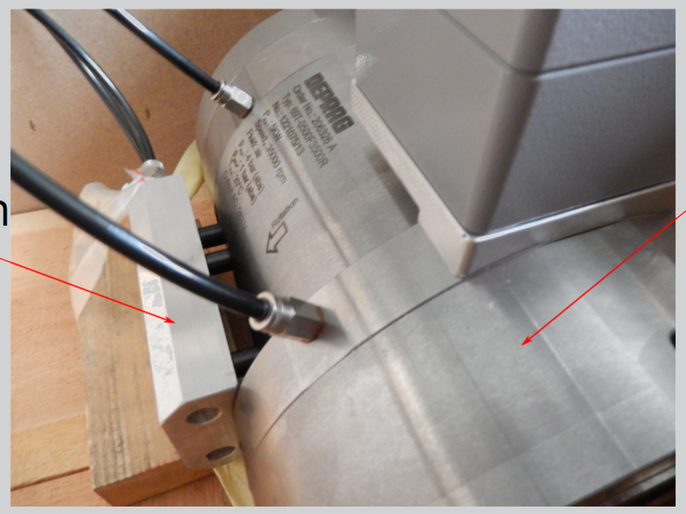






- Needed power of 5 kW could be generated
- Temperature drop of the expanded air is in the order of (50 ± 5)°C
- Long-term test over 1025 hours was successfully carried out

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