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The CNGS Neutrino Beam: performance summary and future prospects

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Abstract

The CNGS facility completes in 2010 its third year of physics with $9.39 \cdot 10^{19}$ protons delivered on target and with the first ν_τ event observed in the OPERA experiment [1]. The experience gained in operating this 500 kW neutrino beam facility, highlights of the beam performance and future prospects will be briefly discussed here.

Keywords: CERN, CNGS, Neutrinos, LNGS

Introduction: The CERN Neutrinos to Gran Sasso facility aims at directly detecting $\nu_\mu \rightarrow \nu_\tau$ neutrino oscillations. An intense ν_μ beam (10^{17} ν_μ per day) is generated at CERN and directed over 732 km towards the Gran Sasso National Laboratory in Italy, where two large detectors, OPERA and ICARUS, are located. The facility started in July 2006 for an approved physics program of five years with $4.5 \cdot 10^{19}$ protons on target per year ($22.5 \cdot 10^{19}$ total). In 2010 the third year of physics is completed with $9.39 \cdot 10^{19}$ protons delivered on target.

Beam performance: In a nominal CNGS cycle of 6 s, two pulses of $2.4 \cdot 10^{13}$ protons at 400 GeV/c separated by 50 ms are fast extracted from the CERN SPS, corresponding to an average beam power of 510 kW. So far CNGS runs with close to 300 kW of beam power, partly due to beam losses in the PS-to-SPS beam transfer and RF instabilities in SPS, that limit the pulse intensity to 83% of the nominal, and partly due to beam sharing that limits the duty factor to 60–70%. In 2010 $4.04 \cdot 10^{19}$ pot achieved.

Operational experience: Running a high-intensity beam facility is always a challenge, and CNGS in spite of the careful design of the facility confirms it. In the first two years of operations, we experienced failures in the secondary beam equipment mainly on peripheral components [2]. Repairs in-situ were organized as the radiation levels were low, and special tooling had to be made. Induced radiation damage to the installed services electronics was mitigated by about 60 m³ of addi-

tional shielding and reorganization of their installation in the tunnels. The presence of H-3 and other radio-nuclei in the air volume of the target chamber requires careful tuning of the ventilation system of the facility.

Future prospects: Assuming the same performance for the following years, CNGS would complete its approved program by 2015, including one year without beam due to the scheduled LHC upgrade. A new extraction scheme from the PS is under study to address the PS-to-SPS beam transfer limitations, and allow to increasing the beam intensity to about 92% of the nominal [3]. The possibility within the SPS upgrade for LHC (LIU project) to reach a beam power of 750 kW is under study. Other upgrade possibilities coupled to possible new experiments either in the Grand Sasso direction [4] or to a remote LAGUNA site [5] are under discussion and presented in recent workshops. The final choice of a future program would depend on neutrino oscillation physics results from the present program and other ongoing experiments worldwide.

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