

Status of the Linac for the Italian Hadrontherapy Centre CNAO

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Introduction

The Italian hadrontherapy centre CNAO (Centro Nazionale di Adroterapia Oncologica) in Pavia, Italy, is designed for the treatment of tumours with proton and carbon ion beams and is presently under commissioning [1][2][3]. The accelerator consists of a 7 MeV/u injector linac and of a 400 MeV/u synchrotron. The linac is a copy of the linac of the Heidelberg Ion-beam Therapy centre HIT and consists of a 400 keV/u RFQ and a 20 MV IH-type drift tube linac (IH-DTL) [4]. GSI delivers technical support for manufacturing, assembly, RF tuning, tests, and on-site installation and commissioning of the CNAO linac and its technical systems [5][6][7]. GSI has also delivered various beam diagnostics components to CNAO for LEBT, linac, and MEBT [8].

Linac Status

After completion of assembly, RF tuning, and vacuum tests at GSI early in 2008 [7], the IH-DTL and some further components were shipped to Pavia in April. Various low-level RF and vacuum tests were performed successfully in Pavia with the RFQ and the IH-DTL to check the cavities performances after transportation. Since these tests, the structures were kept under vacuum until installation in the accelerator complex.

The complete electronics, data acquisition systems, and cables for the beam diagnostics devices delivered by GSI were installed and tested in Pavia in 2008. The beam current and profile measurement systems installed in the LEBT and on a subsequent test bench were tested successfully with ion beams in September and were used for systematic beam measurements in January 2009 (Fig. 1).

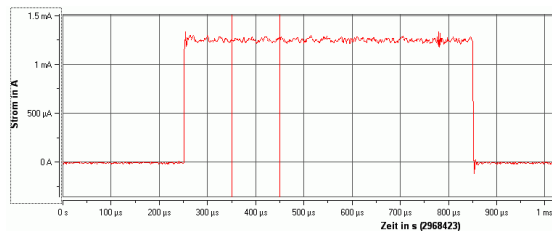


Figure 1: H_3^+ beam pulse (1.2 mA, 600 μ s) measured during LEBT commissioning in front of the solenoid for focusing the beam into the RFQ.

During 2008, all linac control system components were delivered by ECKELMANN and were installed and tested on site in Pavia. First magnet power supplies delivered by JAEGER as well as the high-voltage supply for the LEBT beam chopper were commissioned and tested successfully. Commissioning and on-site acceptance tests of all

linac RF amplifiers (pulse powers of 200 kW, 1400 kW, and 4 kW) delivered by THOMSON B&M were successfully performed on dummy load.

In November 2008, the RFQ was temporarily installed close to its final position and first on-site RF conditioning was done in December 2008 and January 2009. Final installation of the RFQ started end of January 2009. RF tests are ongoing. A special beam diagnostics test bench including an emittance measurement device loaned from GSI was designed for RFQ beam commissioning and was installed behind of the RFQ (Fig. 2).

Commissioning of LEBT and ion sources was finished by CNAO successfully in January 2009. Design ion beam currents and emittances were reached [1][2][3]. The correct matching conditions at the position of the RFQ entrance were checked by beam emittance measurements.



Figure 2: RFQ at final position (centre) and beam diagnostics test bench for RFQ commissioning (left).

Outlook

RFQ beam commissioning is planned for March 2009, followed by installation and commissioning of the IH-DTL from April to June 2009. The GSI services fixed in the CNAO GSI contract will be finished in summer / autumn 2009 with the commissioning of the last beam diagnostics components from GSI and a debuncher cavity installed in the MEBT. We would like to thank all involved colleagues from CNAO, GSI, and the suppliers for their support and for the great hospitality at CNAO.

References

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