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STATUS OF THE ARES RF GUN AT SINBAD: FROM ITS CHARACTERIZATION AND INSTALLATION TOWARDS COMMISSIONING *

B. Marchetti†, R. W. Assmann, S. Baark, F. Burkart, U. Dorda, K. Floettmann, I. Hartl, J. Hauser, J. Herrmann, M. Huening, L. Knebel, O. Krebs, G. Kube, W. Kuropka, S. Lederer, F. Lemery, F. Ludwig, D. Marx, F. Mayet, M. Pelzer, I. Peperkorn, F. Poblotzki, S. Pumpe, J. Rothenburg, H. Schlarb, M. Titberidze, G. Vashchenko, T. Vinatier, P. A. Walker, L. Winkelmann, K. Wittenburg, S. Yamin, J. Zhu, DESY, 22607 Hamburg, Germany

Abstract

The SINBAD facility (Short and INnovative Bunches and Accelerators at DESY) is foreseen to host multiple experiments relating to the production of ultra-short electron bunches and novel high gradient acceleration techniques. The SINBAD-ARES linac will be a conventional S-band linear RF accelerator allowing the production of low charge (0.5 pC - tens pC) ultra-short electron bunches (FWHM length ≤ 1 fs - few fs) with 100 MeV energy. The installation of the linac will proceed in stages. In this paper we report on the status of the characterization of the ARES RF gun and the installations of the related infrastructure.

THE SINBAD FACILITY AND THE ARES LINAC AT DESY

The SINBAD facility at DESY [1] will be hosted in the former DORIS III tunnel. In the last few years the infrastructure has been refurbished to host the first two experiments: ARES [2] and AXSIS [3].

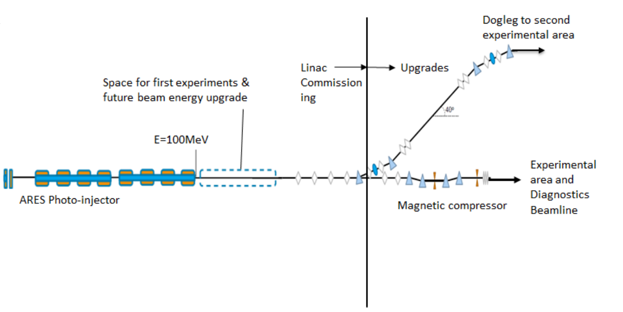

Figure 1: Sketch of the SINBAD-ARES linac.

The ARES linac will allow the production of fs and sub-fs electron bunches with arrival time stability less than 10 fs RMS, which will be injected into novel acceleration structures [4]. The SINBAD-ARES linac (illustrated in Fig. 1) will be installed in stages. In the first stage only the RF-gun area will be installed, afterward the complete linac will be placed and finally the bunch compressor, dogleg and experimental areas will be mounted. The accelerating components are a 2.998 GHz RF gun and two travelling wave structures.

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† barbara.marchetti@desy.de

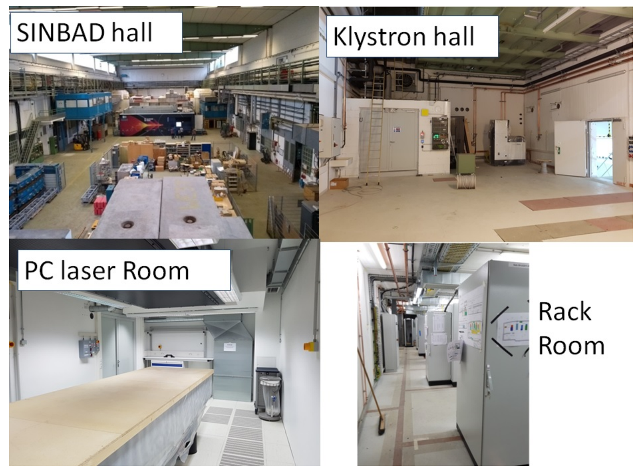

Figure 2: SINBAD infrastructure.

Figure 2 shows the current state of the infrastructure relating to the SINBAD-ARES linac.
In the klystron hall (top right picture of Fig. 2) the installation of the the RF station belonging to the RF gun is ongoing. The RF station is composed by a Toshiba E37326 A Klystron and a Scandionva K1 modulator. The bottom picture shows the inside of the photo-cathode laser room, in which soon a PHAROS-SP-200 laser (already commissioned) will be moved. This laser allows working with 3 different wavelengths: 1030nm (fundamental wavelength, not used so far in our project), 515nm (second harmonic, having potential application for testing electron's emission quality from green cathodes) and 257nm (fourth harmonic, used for electron emission with metallic and Cs_2Te cathodes).
In the first stage the ARES RF gun and its diagnostics will be installed. In the next paragraph we will focus on the status of the installation and characterization of the elements belonging to this part of the beamline.

LAYOUT OF THE RF GUN AREA AND STATUS OF THE INSTALLATIONS

Figure 3 shows the technical design of the RF gun area.
The gun cavity is constituted by 1.5 cells resonating at 2.998 GHz. It was originally designed for the REGAE experiment at DESY [5]. The RF gun is equipped with an in-vacuum cathode exchange system, two solenoids and a bucking coil. During the commissioning of the ARES gun

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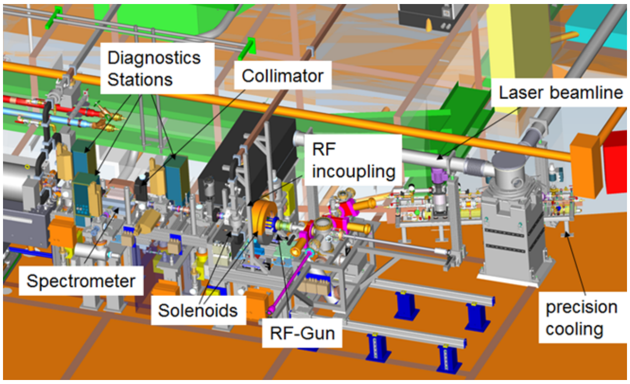

Figure 3: RF-gun region layout.

only one solenoid, located after the gun coupler, will be installed. Next year the second solenoid surrounding the gun cavity and its bucking coil will be added as an upgrade of the RF gun region.
In the RF gun region there will be three diagnostics stations. The first station contains a screen for spot-size measurement [6], several TEM grids for performing single shot emittance measurements in combination with the second screen located in the straight beamline [7], and a Faraday cup.
A second Faraday cup and screen are located in the diagnostics station after the dipole spectrometer, on the 90 degrees beamline.
Right after the first diagnostics station a collimator will be installed. It is designed in such a way that several round holes adjustable in both the horizontal and vertical directions can be used. Moreover in this part of the line a dark current monitor for online charge monitoring will also be available [8].
Finally some space has been reserved in this area for the future installation of a Beam Arrival-time Cavity (BAC) [9].
Figure 4 presents the current status of the installations in the SINBAD tunnel. The support system has been completely

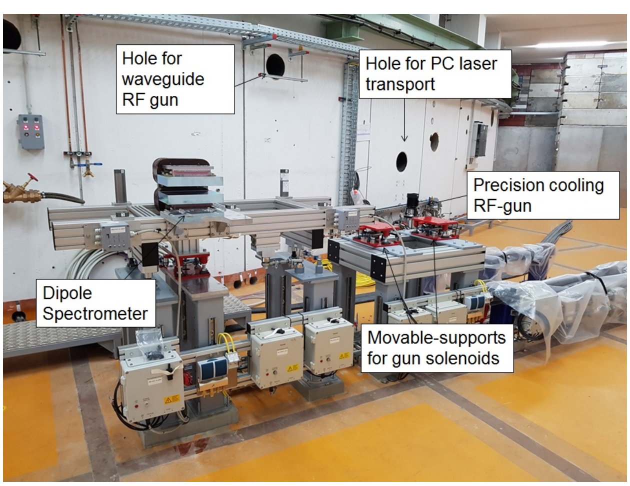

Figure 4: Status of the installations in the SINBAD tunnel.

installed as well as the precision cooling system of the RF gun. The installation of the diagnostics and the remaining elements is presently ongoing.

CHARACTERIZATION OF THE RF GUN CAVITY

The design of the RF coupler for SINBAD has been modified with respect to the REGAE version. The length of the latter one has been increased in order to allow the integration of the second gun solenoid and its bucking coil.
The characterization of the field properties of the cavity with the new coupler design has been recently carried out, as shown in Fig 5.

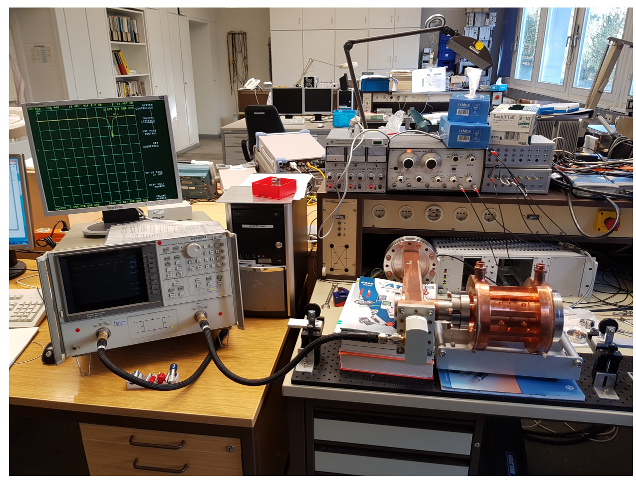

Figure 5: Bead pull measurements of the RF gun cavity during its tuning.

Figure 6 shows the measured field profile of the π and 0 modes after the tuning of the cavity. The measured loaded quality factor for the π-mode was 5410 and its resonant frequency was tuned to 2.9976 GHz at room temperature, corresponding to 2.9979 GHz for in-vacuum operation at $42^o C$.

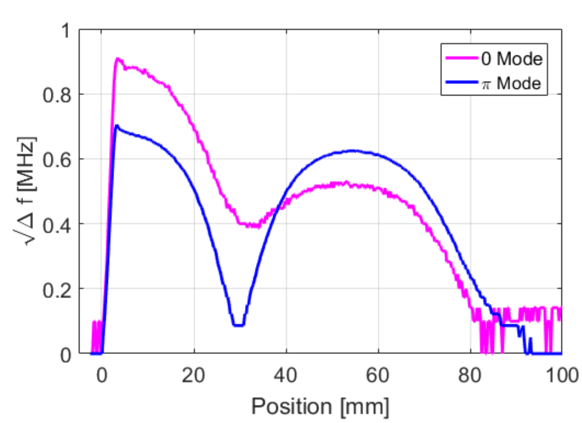

Figure 6: Measured bead-pull profile after the gun tuning. The π-Mode is used for accelerating the electrons.

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CONCLUSIONS AND OUTLOOK

We have described the status of the installations of the RF gun and its diagnostics, which are currently ongoing in the SINBAD facility. In parallel the characterization and tuning of the RF gun cavity and coupler recently took place. The first power in the RF gun is foreseen to be sent in June this year and the conditioning and commissioning of the cavity will follow.

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