STATUS OF THE LISA SUPERCONDUCTING LINAC PROJECT

A. Aragona, S. Bartalucci, C. Biscari, R. Boni, M. Castellano, N. Cavallo*, F. Cevenini*, V. Chimenti, G. Di Pirro, S. Faini, A. Gallo, U. Gambardella, A. Ghigo, S. Kulinski°, C. Marchetti, C. Milardi, L. Palumbo**, P. Patteri, M.A.Preger, C. Sanelli, M. Serio, B. Spataro, S. Tazzari, F. Tazzioli, F. Tian°°, L. Trasatti, M. Vescovi, J. Xu°°

INFN, L.N.F., P.O. Box 13, 00044 Frascati (Roma), Italy
**INFN, Sezione di Napoli, Mostra d'Oltremare, Pad. 20, 80125 Napoli, Italy*
°On leave of absence from Institute of Nuclear Studies, 05-400 Otwock-Swierk, Poland
***Dip.Energetica Univ. Roma 'La Sapienza', Via A. Scarpa 14, 00161 Roma, Italy*
°°On leave of absence from I.H.E.O., P.O. Box 918, Beijing, P.R. China

Introduction

The construction of a 25 MeV superconducting (SC) electron linac (LISA) is in progress at Frascati INFN National Laboratories.

The machine is aimed at studying the problems of low emittance injectors for SC linear colliders.

Moreover it will be applied to implement a high power FEL in the infrared wavelength region.

The machine will be described and the status of the work presented.

The accelerator

The LISA project has already been introduced in various conferences[1], [2] but, for convenience, it will again be summarily described.

A sketch of the machine is shown in Fig. 1 and the main parameters are given in Tab. I.

Table I - Main Parameters of LISA.

Energy (MeV)	25 ÷ 49
Bunch length (mm)	2.5
Bunch charge (pC)	40
Peak current (A)	5
Duty cycle	≤ 2%
Average macropulse current (mA)	2
Invariant emittance (π m rad)	10^{-5}
Energy spread (@25 MeV)	$2 \cdot 10^{-3}$

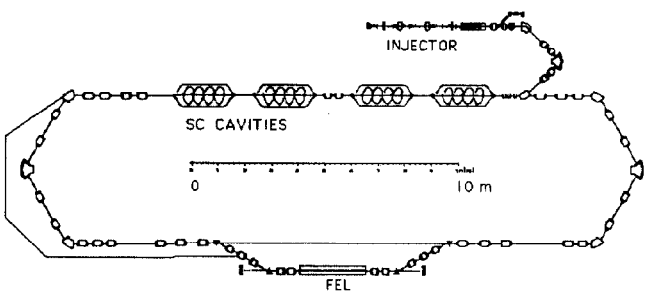
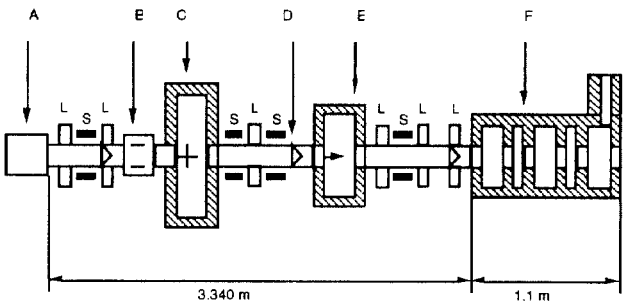


Fig. 1 - Schematic Layout of LISA Accelerator.

The electron beam, as generated in a 100 keV thermionic gun, is chopped and prebunched at the frequency of the SC cavities (500 MHz) and then accelerated to 1 MeV in a 5th harmonic (2.5 GHz) warm linac section before injection into the SC part.

A sketch of the injector is shown in Fig. 2.

A spectrometer, that can work on line by means of a pulsed magnet, will analyze the 1 MeV beam.



A= GUN; B= 50 MHZ CHOPPER; C= 500 MHZ CHOPPER; D= COLLIMATOR
E= 500 MHZ PREBUNCHER; F= 2.5 GHZ BUNCHER
L= LENSES; S= STEERING COILS.

Fig. 2 - Sketch of the Injector.

A 180° achromatic and isochronous bend will transport the beam to the SC cavities. The optical functions along the bend are shown in Fig. 3. More details can be found in the specific paper in this conference[3].

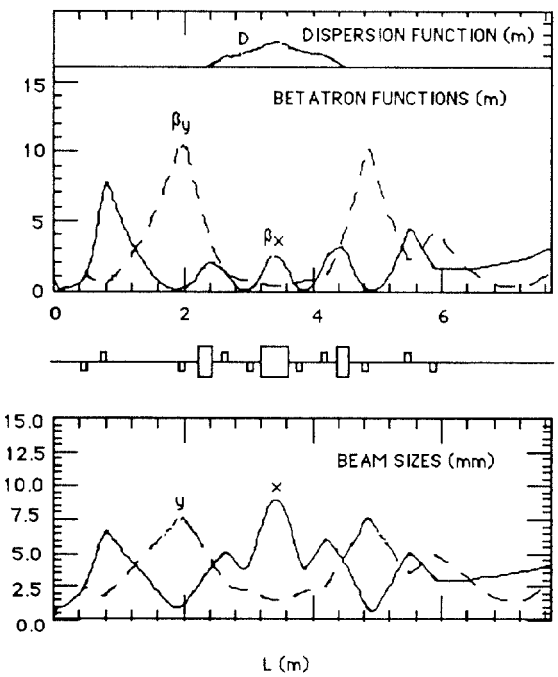


Fig. 3 - Optical Functions Along 1 MeV Bend.

In Fig.1 is also shown a possible recirculation lattice that would allow either to double the beam energy or to recover it after interaction with the FEL undulator. Also this lattice is achromatic and isochronous.

The optical functions for the transport channel up to the undulator are shown in Fig. 4.

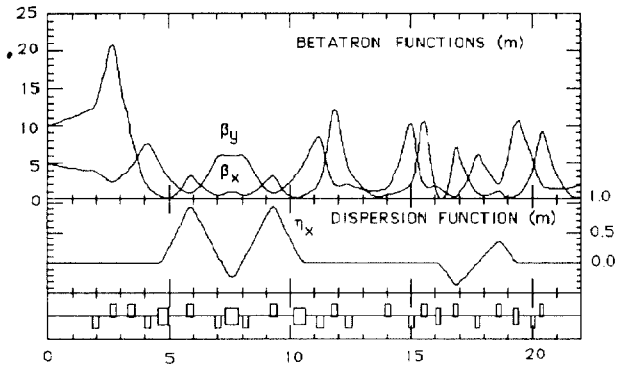


Fig. 4 - Optical Functions from SC Linac to FEL.

The SC accelerating structure is made up of four 4-cells cavities, each one in a separate cryostat, a section of which is shown in Fig. 5.

The characteristics of the cavities are shown in Tab. II.

Table II - Parameters of the RF Cavities.

Frequency (MHz)	499.8
r/Q_0 (Ω/m)	380
Useful length (m)	1.2
Overall length (m)	2.5
Number of cells	4
Accelerating field (MV/m)	5
Q_0 (@ 4.2 K)	$2 \cdot 10^9$
Q_{ext}	$6.5 \cdot 10^6$

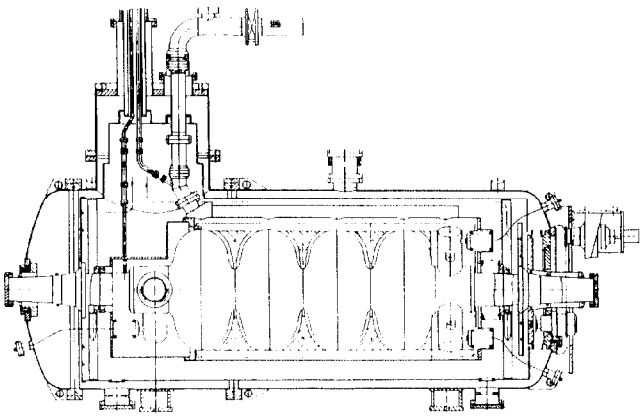


Fig. 5 - 500 MHz Accelerator Module.

The refrigerator is a Sulzer TCF 50 designed to handle 300W at 4.5 °K.

The RF system consists of four independent klystron generators, each capable of delivering 15 kW. Phasing of the generators is accomplished at low power by means of fast phase-lock loops.

The RF system for the warm injector is described in a companion paper in this conference[4].

The machine is situated in an underground hall 14x35x4 m^3. At ground level are placed the control room, the generator room and a hall with facilities for cavity assembling and testing.

The FEL

The quality and the millisecond pulse duration of the beam from a SC linac are well suited for the realization of a high efficiency and high power FEL. The first harmonic will span the wavelength region 11-18 μm. Shorter wavelengths, extending into the visible, can be obtained by doubling the beam energy or working in the third harmonic emission line.

A NdFeB permanent magnet hybrid undulator with 4.4 cm period is in course of fabrication at Ansaldo Ricerche in Genoa.The design of the magnet and of the optical cavity are made in collaboration with the ENEA - FEL Group - in Frascati.

The main parameters of the FEL in its present design are given in Tab III.

Table III - FEL: Main Parameters.

Beam energy (MeV)	25
Number of undulator periods	50
Undulator wavelength (cm)	4.4
Undulator parameter K_{rms}	0.5÷ 1
Radiation wavelength (μm)	11 ÷ 18
Optical cavity length (m)	6
Micropulse frequency	50 MHz
Macropulse frequency	10 Hz
Macropulse averaged power	500 W

Status of the work

The warm injector has been completed and the main parts of it tested (see the specific papers in this conference). A photo of the assembled injector is shown in Fig. 6.

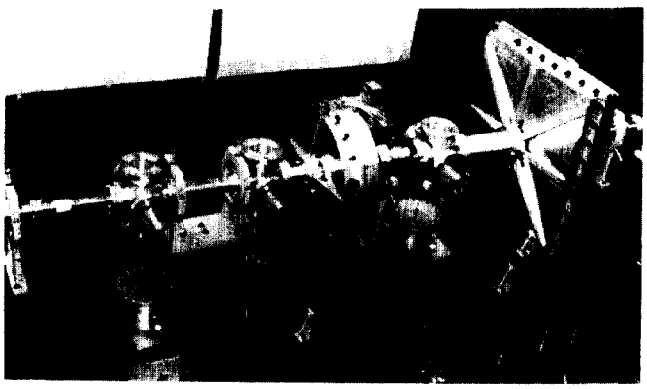


Fig. 6 - Assembled Injector.

The SC cavities are in course of completion at Interatom factory. The RF tests on the first cavity mounted in its cryostat are in course. Delivery of all four cavities is foreseen in autumn of this year. The buildings are practically completed, electricity distribution systems and air conditioning will be available before end of summer. Assembly of the warm injector will start in September of this year and we plan to have the first 1 MeV beam at the beginning of 1991. The SC cavities will be installed within spring 1991.

References

[1] A. Aragona et al.: "The Linear Superconducting Accelerator Project LISA", Proceedings of the 1988 EPAC, p. 52.
[2] A. Aragona et al.: "Work on SC Linacs in Progress in Frascati" Linac Conference 1988, Williamsburgh, p. 680.
[3] C. Biscari et al: "Status of LISA Injector", these Proceedings.
[4] R. Boni et al.: "The Radiofrequency System of the Frascati LISA 1 MeV Injector" these Proceedings.