THE IASA RACETRACK MICROTRON FACILITY

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Abstract

The Institute of Accelerating Systems and Applications (IASA) is pursuing research and facilitates postgraduate studies in traditional and cross-disciplinary areas where accelerators play an important role. The first major facility of IASA, now under construction, is a 246 MeV two-stage CW Cascade microtron. The planned experimental programs and facilities include nuclear and particle physics, nuclear medicine, archeometry and material science.

Institutional Framework

The Institute for Accelerator Systems and Applications (IASA) is a research institute operating under the auspices of the Ministry of Education in Greece. It is affiliated with six departments (Medicine, Physics, Electrical and Computer Engineering, Chemical Engineering and General Sciences) of the National and Capodistrian University of Athens (NCUA) and the National Technical University of Athens (NTUA). It is open to researchers from the international community and access is determined purely on scientific merit.

The IASA Racetrack Microtron Accelerator

The IASA CW Racetrack Microtron (IASA-RTM) is being constructed largely out of the components of the NBS/LANL CW Racetrack Microtron and the University of Illinois R&D RTM project [1]. Our Institute has acquired substantial additional equipment, adequate to insure realization of the design described below. The design is now based on a cascade (2 stage) microtron [2] (see Table 1). This choice was made based upon an evaluation [3], [4], presented at the PAC-95 Conference, and which included three different variants for the IASA microtron. The cascade scheme described below has been adopted, following the review and recommendation of an international review panel.

Table 1. NBS/LANL and the IASA RTM parameters

RTM variants	NBS/ LANL	IASA-1	IASA-2
Type	single stage	cascade	
Injection Energy (MeV)	5	6.5	42.3
Gain per turn (MeV)	12	1.43	8.5
Number of recirculations	15	25	24
Max. output energy (MeV)	185	42.3	246.7
Maximum current (mA)	550	100	100
Duty factor (%)	100	100	100
Frequency (MHz)	2380	2380	2380
Incremental # n	2	1	1
Magnet field (T)	1.	0.2379	1.414
Linac RF losses (kW)	305	30	143
Asymptotic phase angle f (^{o})	0	18	18
End magnets spacing (m)	12.5	3.25	8.6

The accelerator comprises of the 6.5 MeV injector followed by the first stage 42 MeV RTM the second stage 246 MeV RTM. The design for the injector includes two electron guns : a thermionic 100 keV electron gun and a polarized electron source using a mode-locked laser [5]; they are followed by a capture and pre-accelerating section to 6.5 MeV [6] and a chopping, bunching system. The first stage RTM will reach 42 MeV, after 25 recirculations, and the 2nd stage will reach the energy of 246 MeV, again after 24 recirculations [6].

This scheme requires substantial mechanical modifications of the original two 4m main side coupled linacs of LANL for its realisation. A new linac for the first stage RTM (IASA-1), and additional section for the upgrade of the injector energy are required. This is achieved by reconfiguring the available two linac sections [6], [7]. In this case a 6m linac will be used for IASA-2, and two 1m linacs for the injector (from 5 to 6.5 MeV) and the IASA-1. A detailed description of the optics of the IASA CW racetrack microtron is given in [8].

The availability and use of two pairs of identical end magnets allows for the realisation of the cascade scheme. Also the choice of n=1 leads to a more simplified tuning and operation of the accelerator, and, to a decrease in RF consumption. Calculated values of sensitivity factors and longitudinal and normalised transverse acceptances, suggest a clear improvement [3] over the values of the original n=2, NBS/LANL design, a design optimized for performing a series of accelerator experiments.

Layout of the Facility

A preliminary schematic view of the cascade scheme and layout of the IASA Laboratory is given in Fig.1. In this figure the accelerator vault and the first three experimental halls are shown. The installation and operation of the machine will be completed in two phases. In Phase-1, the injector will be fully operational and all the necessary tests will be performed in experimental hall 1. The construction of the RTM IASA-1 will proceed while operating the 6.5 MeV injector by separating the RTM from the injector with temporary shielding. Experimental hall 2 and 3 will then house the experimental instrumentation for the applied research program. In Phase-2, the installation of the second stage of the microtron IASA-2 will begin without substantially affecting the operation of IASA-1 and the applied research program. The complex allows for possible expansion so as to accomodate future expansions including a third stage and/or a FEL facility.

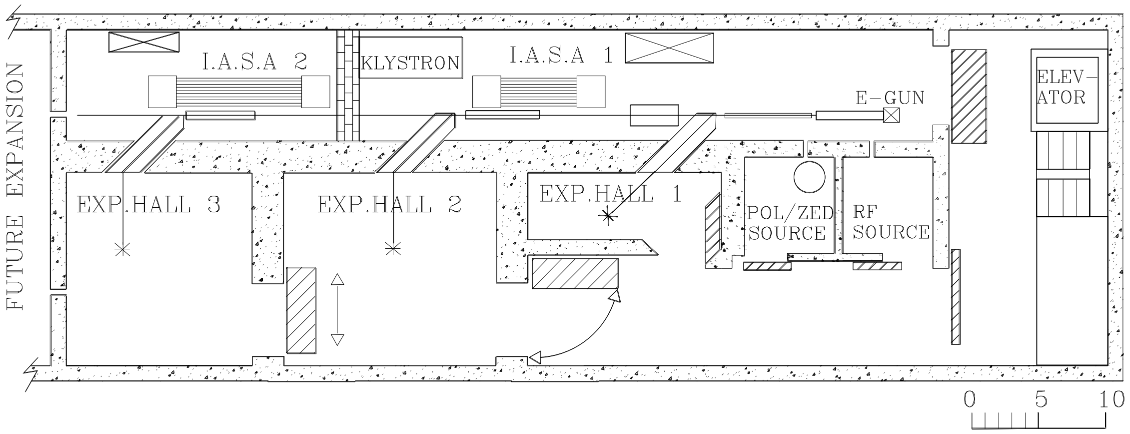

Figure 1. Layout of the IASA RTM facility.

Present Status : The “Maquette” Projects

During the on going period of construction of the accelerator vault and associated experimental areas of the IASA RTM Laboratory, a staging area has been set up which provides adequate space and supporting facilities for the installation and operation of three important projects for the realization of the accelerator described above. As they incorporate important aspects of the first accelerator projects they have been named “maquttes”; (a) the injector maquette, (b) the RF maquette and (c) the magnet maquette. All three projects are being developed during the period of construction of the accelerator vault. We have begun construction of the 100 keV injector line. We expect to get the 100 keV DC electron beam later this year, and a chopped/bunched beam by the beginning of 1997. A completely new control system is being implemented in our accelerator based on the EPICS control system [9]. Supporting facilities (vacuum, electrical, electronics, machine , drafting) are already operational. The RF maquette project concerns the modification from US to European voltage standards and testing needed for the HV power supply of the 500 kW klystron and its power supply. The magnet maquette project is dealing with the final scheme and the construction of a mapping system for any small as well as for the large 4 end magnets. Two as well as three dimensions codes are being used for magnetic field calculations.

The Research Program

IASA is charged with the responsibility of conducting research and aiding postgraduate studies in those areas of science where accelerators and associated instrumentation play a vital role. Its planned research activities include research in accelerator physics and engineering, instrumentation, control, nuclear and particle physics, cancer treatment by radiotherapy, angiography, archeometry, material sciences and food preservation [10]. The RTM facility will provide a very important first capability towards realizing some of its research goals. It will be capable of producing high intensity, high quality polarized electron and photon beams which allow for an ambitious research program especially in nuclear and particle physics and angiography.

A theory group also operates under the auspices of IASA, drawing mostly from the Physics Departments of NCUA and NTUA. This group, modeled after similar in scope institutions, is addressing theoretical issues connected with the experimental program carried by IASA experimentalists within the Institute and abroad.

Conclusions

The first major facility of IASA will be a RTM reaching 246 MeV capable of providing intense polarized electron and photon beams. The adopted cascade scheme offers the advantage of reaching up to 42 MeV max output energy (starting at 6.5 MeV in increments of approx. 1.4 MeV), with a current of 100 mA in Phase-1. The beam will be used in many areas of our applied research program. Also, an electron beam up to 246 MeV (starting from 42 MeV in increments of 8.5 MeV) will be produced from the second stage to match the needs of our pure research program. This scheme meets our requirements for simplicity, stability of the operation of the machines, economy as well as the benefit of an early start of our research program.

References

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