STATUS OF THE LINEAR ACCELERATOR-INJECTOR AT TNK FACILITY

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Industrial storage facility at Lukin State Research Institute for Problems in Physics, Zelenograd includes two electron storage rings: the main ring for energy of 2.5 GeV and booster ring for energy of 450 MeV. Linear accelerator for electron energy up to 80 MeV serves as an electron injector of TNK facility. The accelerator was commissioned in December, 2002. The accelerated current of ~50 mA at 55 MeV was obtained. The paper presents the linear accelerator scheme and time diagram for its parts operation. DAW accelerating structure and beam transportation channel to the booster ring are described. The electron beam parameters obtained are listed.

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The functional diagram of the linear accelerator-injector of TNK facility is shown in Fig.1. The injector includes the gun, accelerating structure, electron-optic channel EOC-1, and "Olivin" klystron station. The linear accelerator operates in energy storing regime for ~8 μs RF pulse at excitation of standing wave field in the accelerating structure. Beam injection from the gun takes place at the end of that RF pulse. RF power feeding is realized from the klystron station at 2798.6 MHz. The pulsed diode gun (40 kV/3.8 A/18 ns, repetition rate up to 5 Hz) serves as an electron source. The gun is located on the same axis as LU and separated from it by a valve. The accelerated beam from LU output is transported through EOC-1 into the booster ring as a bunch of micropulses. The beam current is measured by a lamellar probe at LU input and by a current monitor together with Faraday cup at EOC-1 channel.

Fig.2 presents a consecution of physical processes in the injector during operation of pulsed 20 MW RF system "LU–waveguide–Olivin klystron station" [2].

The accelerating structure is assembled from meter brazed-as-whole sections made of oxygen-free copper. All details were manufactured by turn processes. The final processing was diamond turning (~0.3 μm) to provide an improved electrical strength and high Q-factor for the accelerating structure. Fig.3 presents the DAW accelerating structure cell. The structure consists of central "washers" supported by three radial stems which are azimuthally equidistantly located on the structure sidewall. The stems are 5 mm copper tubes with 3 mm steel rods brazed inside.

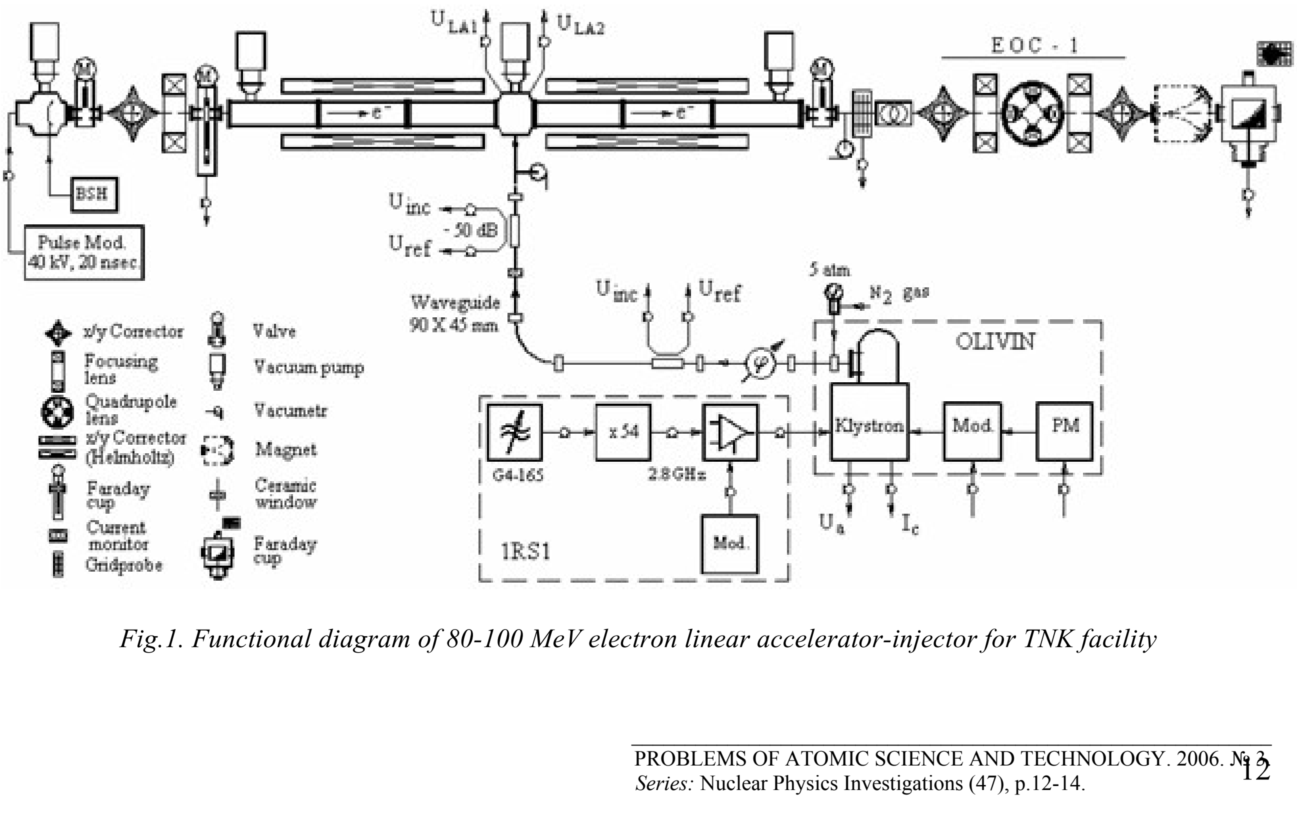
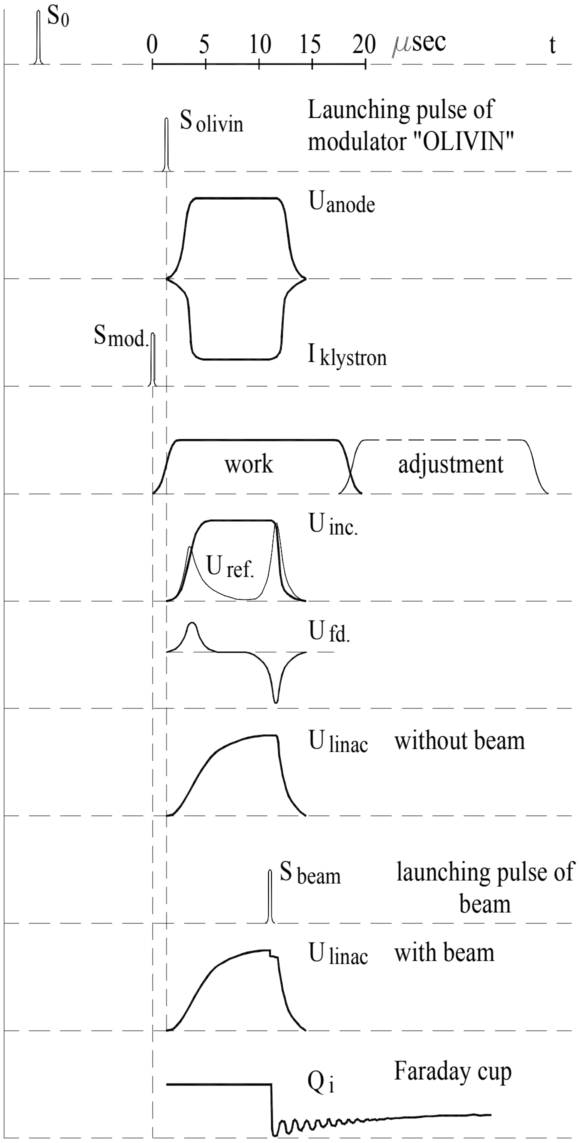


Fig.1. Functional diagram of 80-100 MeV electron linear accelerator-injector for TNK facility



S_0 – Start of the charging device for “Olivin” modulator power source

S_{olivin} – Start of the “Olivin” modulator

Uanode – klystron anode pulse amplitude
$I_{klystron}$ – cathode current pulse of KIU-53 klystron

S_{mod} – Start of radio rack RF amplifier modulator

RF pulse shape of KIU-37A klystron:
“work”- normal mode, “adjustment”- start of the RF amplifier modulator is delayed relative to “Olivin modulator start

Uinc and Uref – incident and reflected wave voltages at linac input. Slot directional coupler -50 dB (cross) is installed into 90×45 mm waveguide channel.
U_{fd} – shape of phase shift between U_{inc} and U_{linac}.

Ulinac – envelope of field rise in linac structure. Inductive probe is placed into the central cavity of the linac structure (regime without beam).

S_{beam} – Beam start.

Ulinac – envelope of field rise in linac structure with beam loading.

Expected shape of voltage on CF-FOC-1 capacitor

Fig.2. Time chart of the “linac-wavaguide-Olivin”RF system operation

Fig.3. Accelerating structure section

The accelerating structure sections and separate elements are united with indium seals. Fig.4 presents the power input cavity with two connected accelerating sections and part of 90×45 mm waveguide [3]. General view of the accelerator is shown in Fig.5.

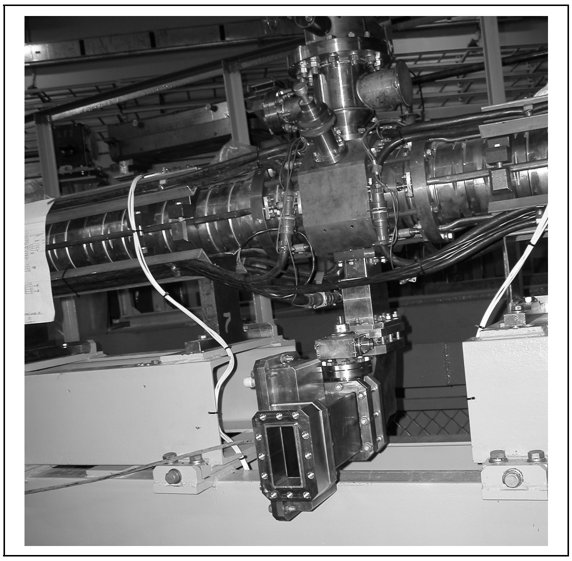


Fig.4. Fragment of the accelerator central part

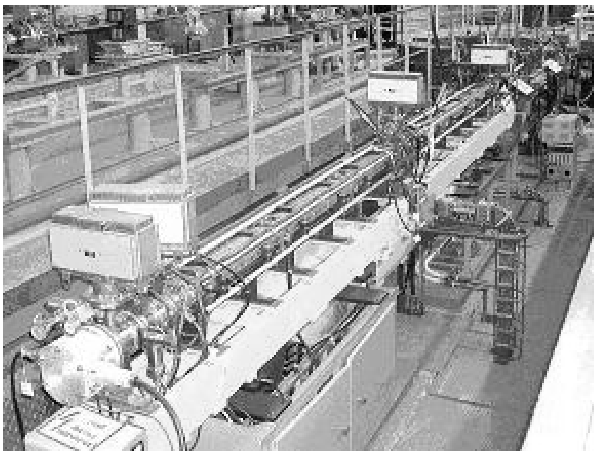


Fig.5. General view of the accelerator

Fig.6. EOC-1 channel with the booste

The electron-optic channel EOC-1 is intended for electron bunch transportation form the linear accelerator to the booster (Fig.6) and for beam emittance matching at LU output with the booster acceptance.

EOC-1 includes:

a) a straightforward interval, where the quadruple triplet is located for β_x, β_z, matching; β_z, may vary within the range 0.3…0.7 m and β_x – within the range 0.5…1.2 m depending on matching requirements at the booster input, at that β'_x, β'_z remains zeros.

b) two turning magnets with straightforward interval between them for beam parallel transportation to the booster input.

Electron beam parameters of LU TNK (55 MeV, 50 mA) allow the works on booster commissioning to be started. On similar facility SIBERIA in RRC Kurchatov Institute [4] the operational beam parameters are:

The operational beam parameters

Maximal energy, [MeV]	85
Pulsed current ($\Delta E/E$=1%), [mA]	80
Transverse size, [mm]	3
Emittance, [mm·mrad]	0.3

Conditioning time during LU TNK commissioning allows us to expect obtaining results listed in Table during accelerator regular operation.

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СТАТУС ЛИНЕЙНОГО УСКОРИТЕЛЯ–ИНЖЕКТОРА КОМПЛЕКСА ТНК

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Технологический накопительный комплекс НИИ ФП им. Лукина г.Зеленоград включает в себя два накопителя электронов: основной накопитель на энергию 2.5 ГэВ и малый накопитель–бустер на энергию 450 МэВ. Инжектором электронов комплекса ТНК является линейный ускоритель на энергию до 80 МэВ. В декабре 2002 г. был осуществлен запуск ускорителя. Получен ускоренный ток ~50 мА с энергией 55 МэВ. В статье рассмотрена схема линейного ускорителя и временная диаграмма работы ее элементов. Дано описание ускоряющей структуры с шайбами и диафрагмами и канала транспортировки пучка к малому накопителю. Приведены достигнутые к настоящему времени параметры пучка электронов.

СТАТУС ЛІНІЙНОГО ПРИСКОРЮВАЧА–ІНЖЕКТОРА КОМПЛЕКСУ ТНК

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Технологічний накопичувальний комплекс НДІ ФП ім.Лукіна м.Зеленоград містить у собі два накопичувача електронів: основний накопичувач на енергію 2.5 ГеВ і малий накопичувач–бустер на енергію 450 МеВ. Інжектором електронів комплексу ТНК є лінійний прискорювач на енергію до 80 МеВ. У грудні 2002 р. був здійснений запуск прискорювача. Отримано прискорений струм ~50 мА з енергією 55 МеВ. У статті розглянута схема лінійного прискорювача і тимчасова діаграма роботи її елементів. Дано опис прискорювальної структури із шайбами і діафрагмами і каналу транспортування пучка до малого накопичувача. Наведено досягнуті до теперішнього часу параметри пучка електронів.