The Compact Accelerator based Neutron Source (CANS) project “LvB” at Martonvásár, Hungary

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Neutron Delivery Systems NDS 2023 @ ILL
10-12 July 2023

The Compact Accelerator based Neutron Source (CANS) project “LvB” at Martonvásár, Hungary

Outline: Introduction

Motivation

Design

Construction status

Further plans

Neutron Delivery Systems NDS 2023 @ ILL
10-12 July 2023

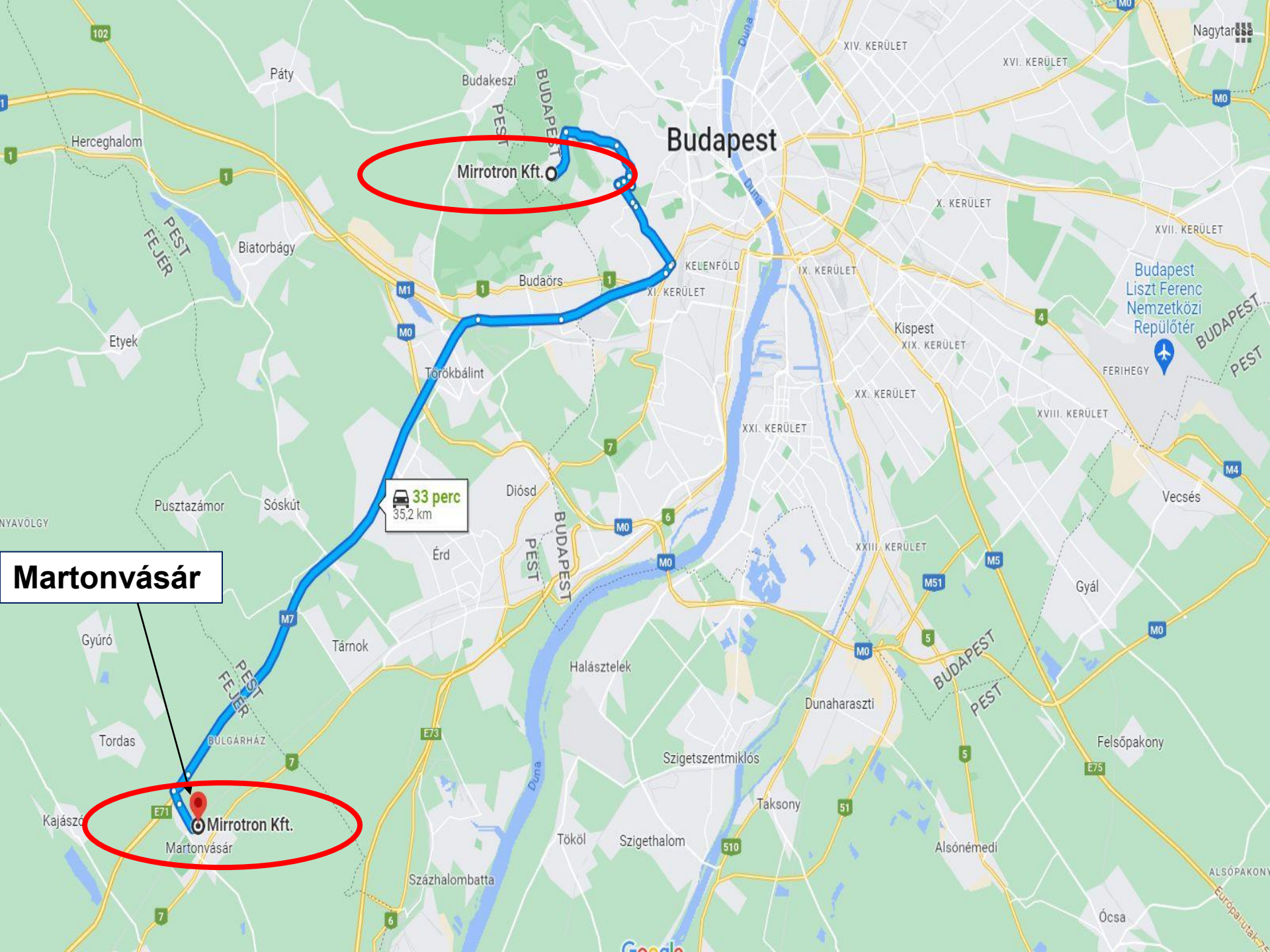
The Compact Accelerator based Neutron Source (CANS) project “LvB” at Martonvásár, Hungary

Private investment + Regional Industrial Development Grant
(Hungarian government & EU structural funds)

Consortium: Mirrotron Ltd. (project leader)
ELKH Center for Energy Research (CER)

Timeline:

Grant application: Sep. 2016
Grant funding contribution approved: May 2017
Project start: Nov. 2017
Mandatory project completion deadline:
- Initially: **Nov. 30, 2021**
- Extended for Covid-19 related delays: **Dec. 31, 2022**


Martonvásár
Mirrotron Kft.
Martonvásár
Mirrotron Kft.
33 perc
35,2 km
Budapest
Budakeszi
Páty
Herceghalom
Biatorbágy
Budaörs
Törökbálint
Etyek
Pusztazámor
Sóskút
Diósd
Érd
Tárnok
Gyúró
Tordas
Kajászó
Halásztelek
Szigetszentmiklós
Taksony
Dunaharaszti
Tököl
Szigethalom
Százhalombatta
Alsónémedi
Gyál
Vecsés
Felsőpakony
Ócsa
Kispest
Budapest Liszt Ferenc Nemzetközi Repülőtér
FERIHEGY
KELENFÖLD
XI. KERÜLET
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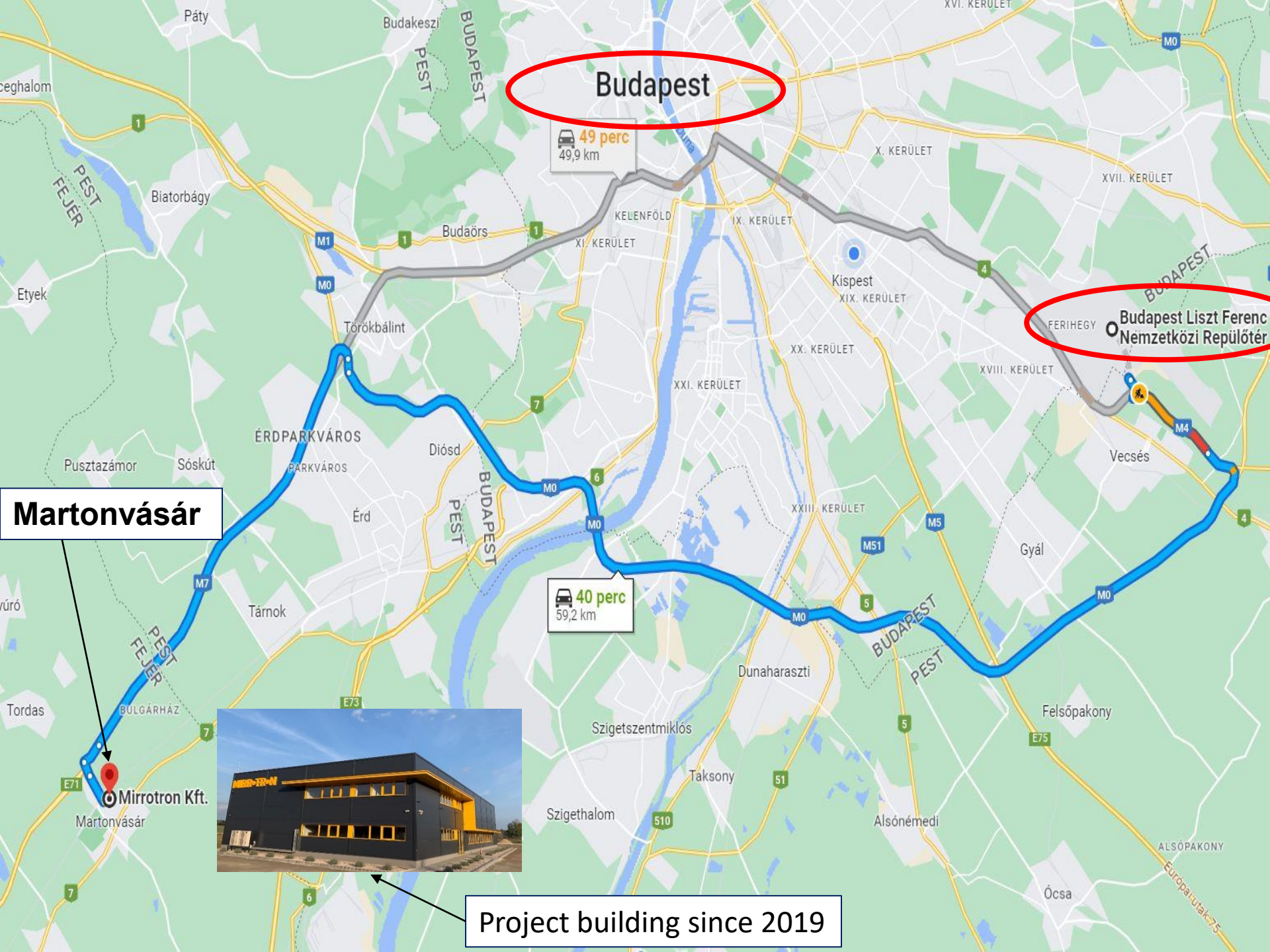

Budapest
49 perc
49,9 km
40 perc
59,2 km
Budapest Liszt Ferenc Nemzetközi Repülőtér
Martonvásár
Mirrotron Kft.
Martonvásár
Project building since 2019


Martonvásár railway station:
25 min from central Budapest
Plantoon Technologies Kft
Vasút u.
AVIA
Mirrotron Kft.
Martonvásári vasútállomás víztornya
8 perc
650 m
Pápay Ágoston Általános Iskola, Készségfejlesztő...
Rózsa u.
Martonvásár
Magyarország
Martonvásári víztorony
Parkoló 3
MÁV 2. parkoló
Brunszvik u.
Rendőrség
Magtár u.
Hortobágyi Ágnes Gyógymasszőr...
Baicsy-Zsilinszky út
Fatölgyes kft
Acer Kft
Dreher út
D-TECH Kft. Szervíz, raktár
Szami 2003. Kft
Kolozsvári
Martonvásári temet

Mirrotron Ltd. business plan for the LvB project:

- Neutron beam quality assurance tests for needs in own neutron research equipment production: saves ~ 100 k€/y (supermirrors, monochromators, detectors etc.)

- Neutron beam quality assurance tests for international partners

- Products and services for neutron source developments

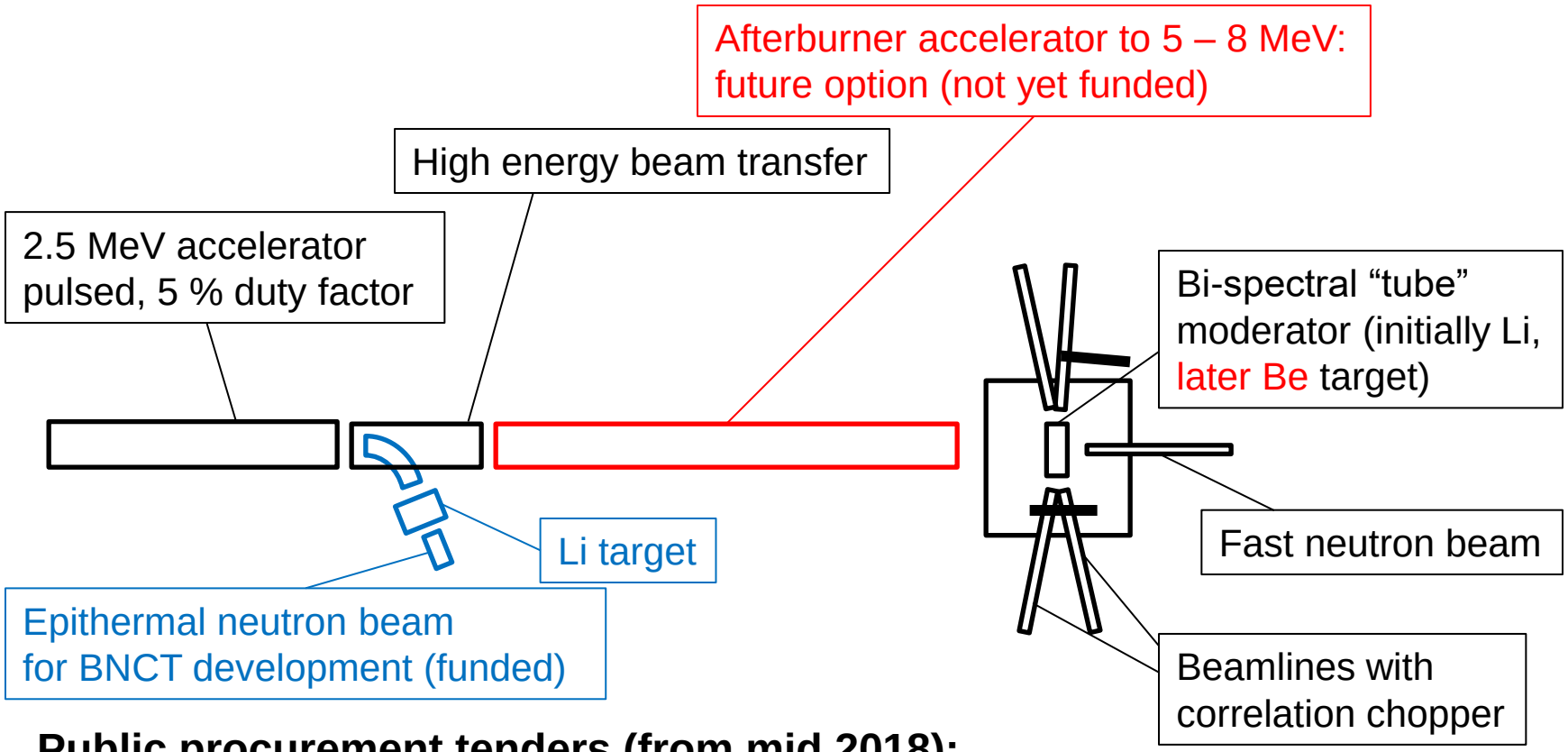
- Neutron scattering experimental work for industrial customers:
  - reflectometry, neutron diffraction (phase 1)
  - neutron diffraction for stress scanning, SANS (phase x)

- Leasing of neutron beams for industrial applications

- Development of irradiation beamline for cancer therapy (BNCT)

- Manufacturing of components for neutron sources and production of turn-key CANS facilities / key components

LvB CANS project lay-out (patents pending)



Public procurement tenders (from mid 2018):

- Ion source + Low energy beam transfer
- 2.5 MeV accelerator, 20 mA peak
- RF amplifier
- Integration and controls

Mirrotron’s own design and production:

- High energy beam transfer
- Target-moderator-reflector (TMR) system

Fast neutron production:

2.5 MeV 2.5 kW $3x10^{11}$ n/s

5.0 MeV 5.0 kW $3x10^{12}$ n/s

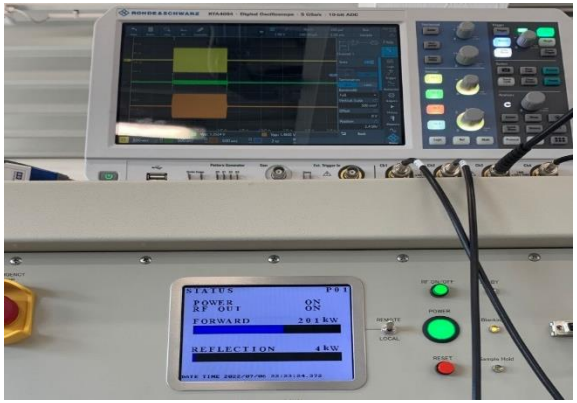
ESS @ 5 MW: $1x10^{18}$ n/s

LvB Project status by June 30 2023

Oct 2019
Project building and utilities completed

LvB Project status by June 30 2023

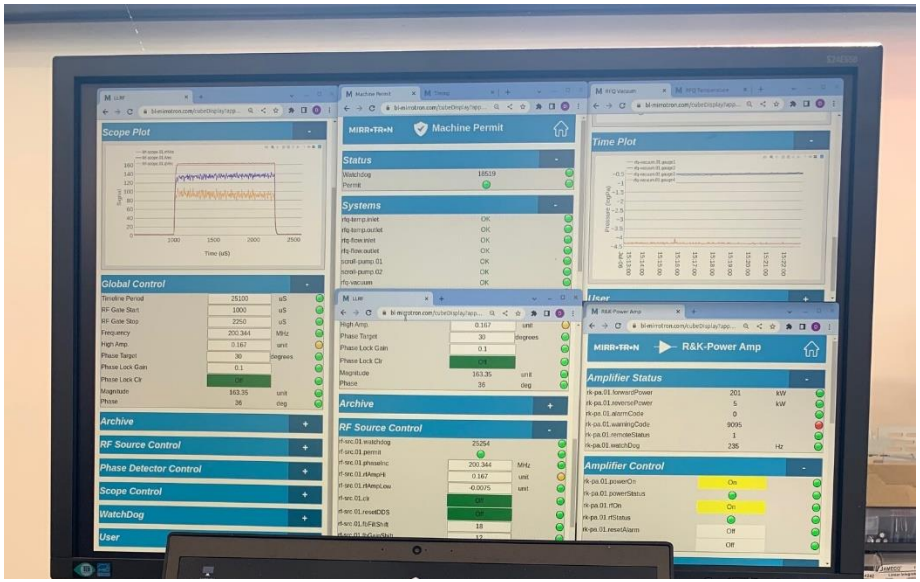
Oct 2021
RF Amplifier delivered
and tested at full power
on a dummy load



Dec 2021
2.5 MeV RFQ accelerator
parts delivered to project site

May 2022
Accelerator assembled,
electrically and mechanically
tested

LvB Project status by June 30 2023



June 2022
Control system with remote communication
capability installed and tested

July 2022
RFQ accelerator connected to RF amplifier
and tested at full power

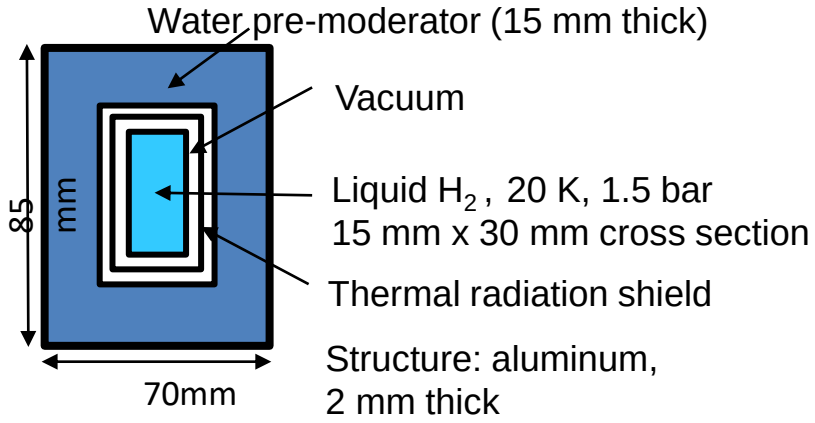
LvB Project status by June 30 2023

Oct 2022
Ion source contracted manufacturer failed to deliver anything; contract cancelled

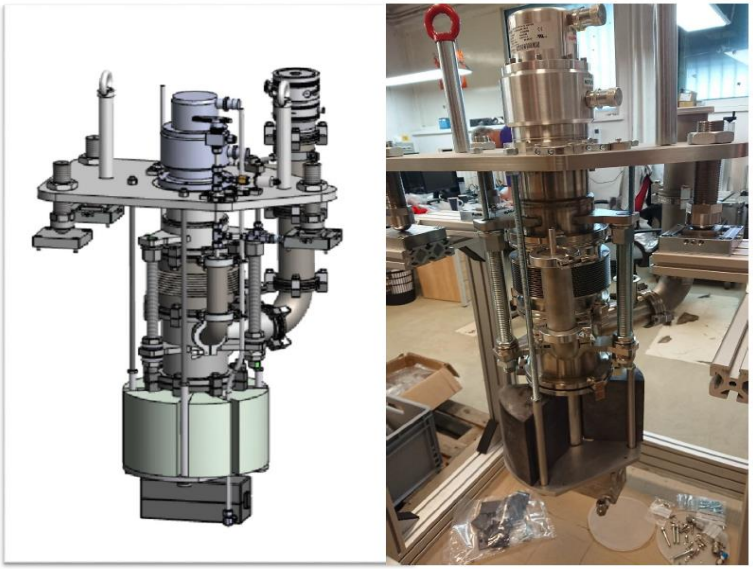
Temporary Solution
Commissioning will start at 1 mA proton beam current, using an available ion source of project partner CER, Budapest

LvB Project status by June 30 2023

LvB bi-spectral moderator lay-out



LvB moderator and cooling system



Nov 2022

Target-moderator-reflector system main components are designed, manufactured, and ready for testing

LvB Project status by June 30 2023

January 2023

Own produced borated-concrete shielding system is installed.

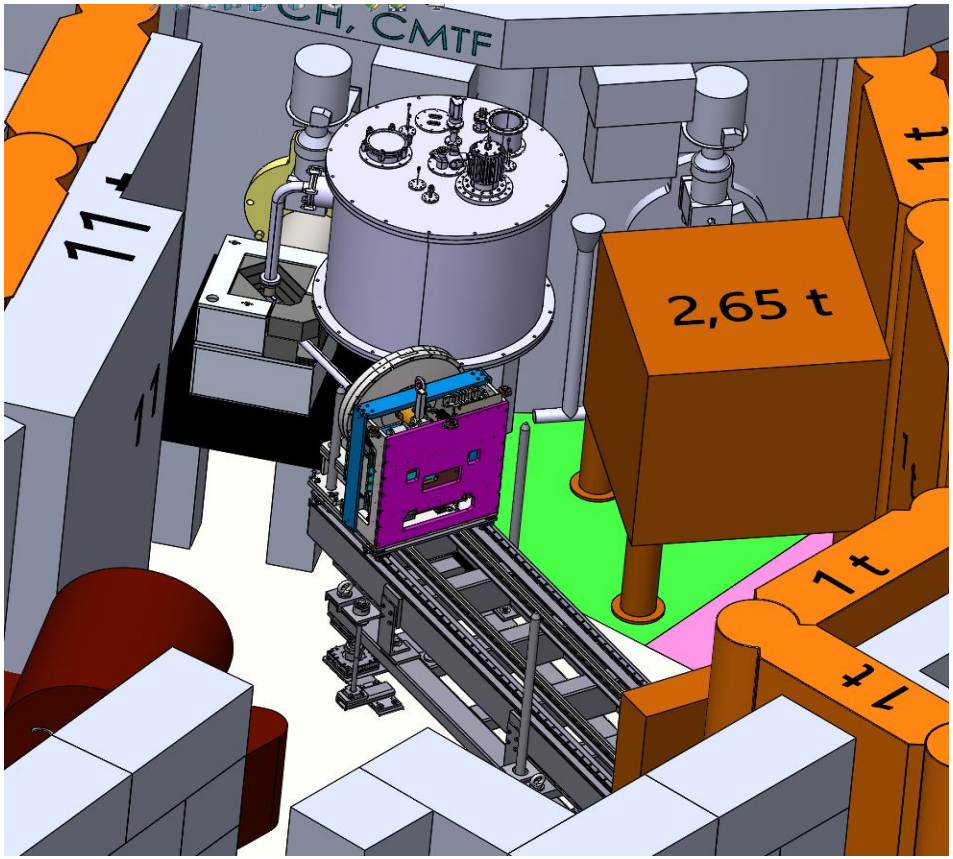
Temporary ion source is installed.

LvB Project status by June 30 2023

January 2023

Project completion report to grant administration submitted
(does not include commissioning)

LvB Project status by June 30 2023



May 2023

Preparations for the neutron test of the LvB Target-moderator-reflector system at the new,
Cold-Moderator Test Facility constructed @ BNC

LvB Project status by June 30 2023

June 2023 CMTF Test setup

The cryostat assembly (without hydrogen)
Cryostat installed at Ch4

The moderator in the reflector,
The moderator part with the neutron window

Further plans – short term

Solid Li target:

manufacturing ready and delivered, target cooling system in manufacturing

Target-moderator-reflector system:

test & planned completion of installation in Q3 2023

Lavender harvest:

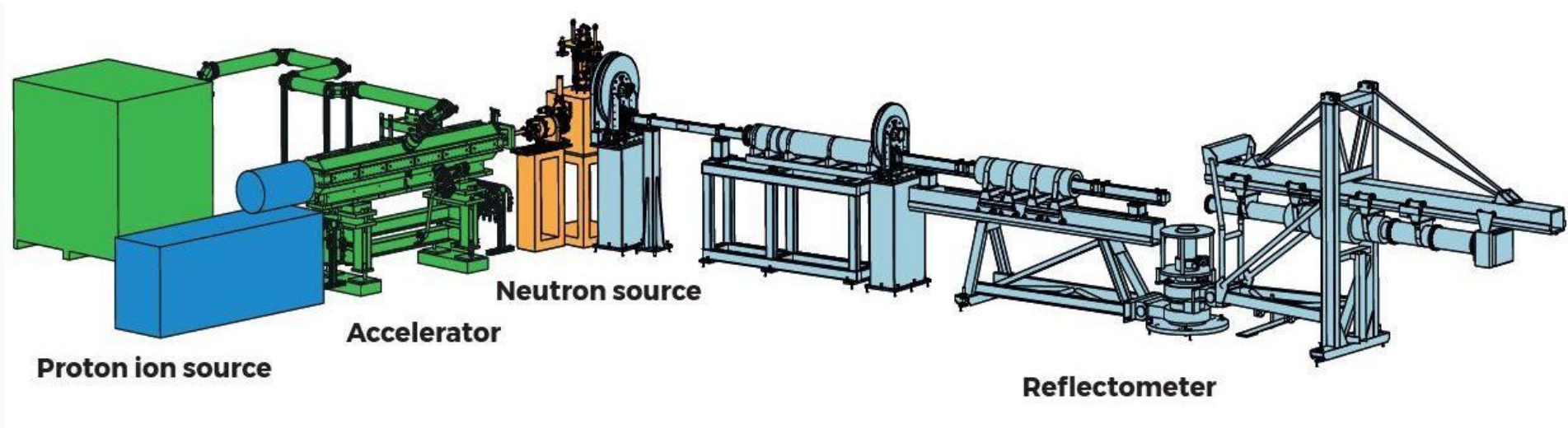
~85% completed by 7th July 2023

Further plans – medium term

Funded beam lines
(design integration, new neutron optics, choppers, installation by Mirrotron Ltd.)

- TOF Reflectometer for testing neutron supermirrors:

- redesign & reconstruction of dismounted IN11
- sensitivity not better than 0.1 – 1 % reflectivity
- polarized neutron and polarization analysis capability
  options to be installed later



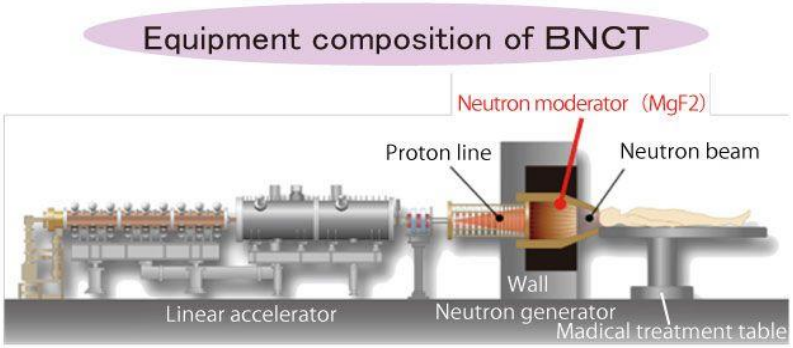
Further plans – medium term

Funded beam lines
(design integration, new neutron optics and installation by Mirrotron Ltd.)

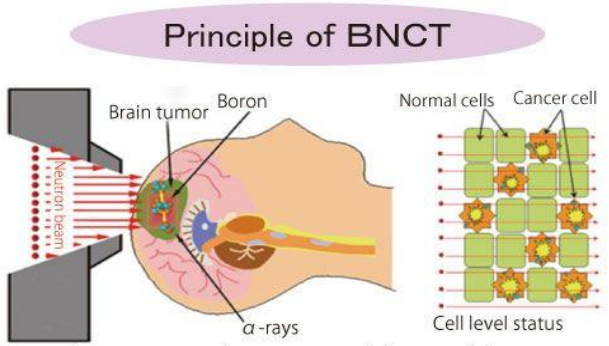
- Large detector solid-angle time-of-flight diffractometer:

- redesign & reconstruction of dismounted IN6
- best intensity basic mode of operation
- optional high-resolution capability by fast quasi-random beam modulation

- Epithermal neutron beam source development for BNCT



Proton beams accelerated in a linear accelerator with a length of about 7m react with beryllium within a neutron generator to generate neutrons. A lesion part is irradiated with energy-regulated neutrons. (Example of the BNCT apparatus of the University of Tsukuba system)



By nuclear reaction of neutrons with boron, alpha rays and lithium particles are released to break cancer cells.

Further plans - long term

Envisaged upgrades, not yet funded.

- Adding afterburner DTL proton accelerator for achieving 5 – 8 MeV proton beam energy on the target

- about 5 - 10 times more fast neutron produced in the target at same proton beam current
- target design simplified by larger proton penetration depth

- Installing a local solar power plant of about 0.5 MW peak power

- for environmentally more sustainable routine operation
- for reduced operational energy costs on long term >5 years

Register and visit us during the event of

UCANS10

10th International Meeting of the Union of Compact Accelerator-driven Neutron Sources
Budapest, 16-19. October 2023.

https://ucans10.org/

Thank you for your attention!

Yes, we still supply supermirror neutron guides.