

Status of ARIEL e-Linac and Beam Optics

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Beam Physics Group

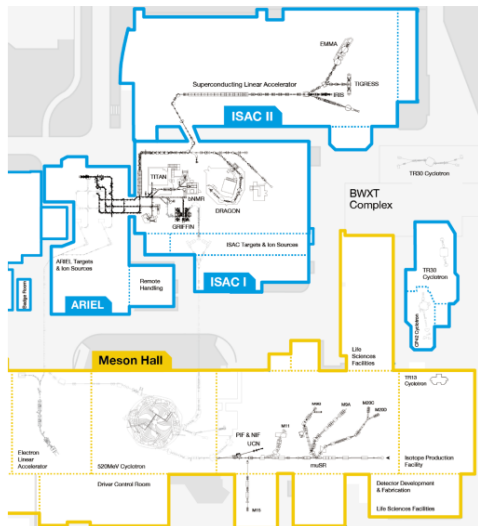
Dark Light Collaboration Meeting,

December 2, 2022



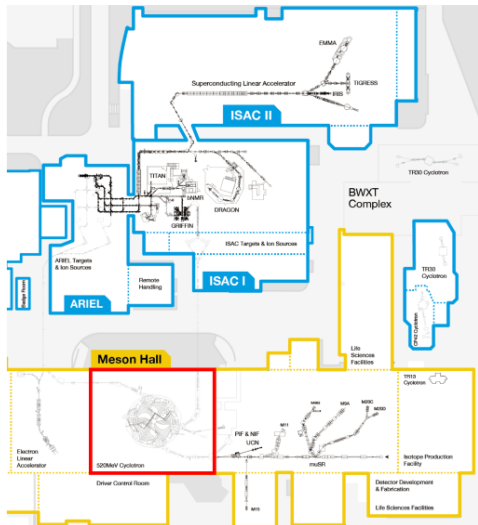
TRIUMF - Canada's Particle Accelerator Centre

- ▶ Cyclotron
- ▶ ISAC
- ▶ ARIEL
- ▶ Electron Hall



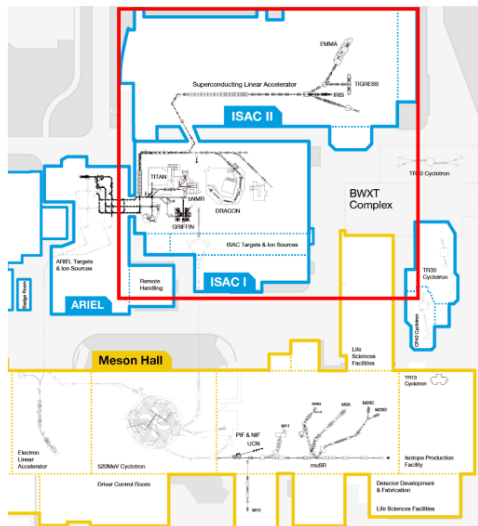
TRIUMF - Canada's Particle Accelerator Centre

- ▶ **Cyclotron**
 - 520 MeV H^- ions
 - Primary beam driver for isotope production
- ▶ ISAC
- ▶ ARIEL
- ▶ Electron Hall



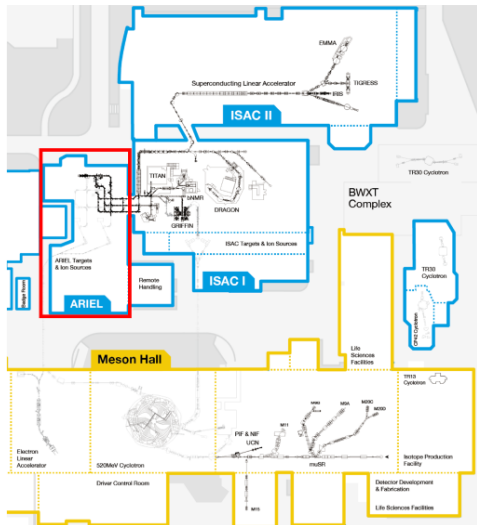
TRIUMF - Canada's Particle Accelerator Centre

- ▶ Cyclotron
- ▶ **ISAC**
 - **Isotope separator and accelerator facility**
- ▶ ARIEL
- ▶ Electron Hall



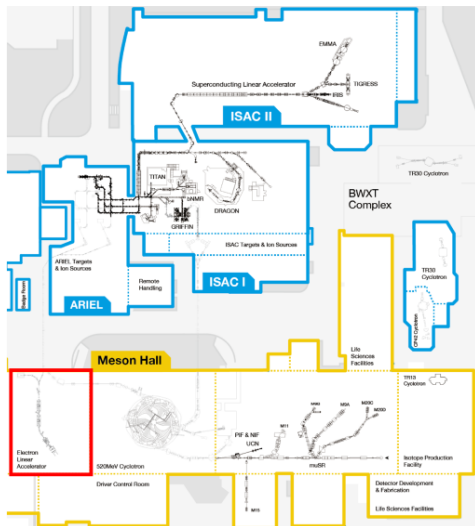
TRIUMF - Canada's Particle Accelerator Centre

- ▶ Cyclotron
- ▶ ISAC
- ▶ **ARIEL (in progress)**
 - **Advanced rare isotope laboratory**
 - **Projected to triple isotope production**
- ▶ Electron Hall



TRIUMF - Canada's Particle Accelerator Centre

- ▶ Cyclotron
- ▶ ISAC
- ▶ ARIEL
- ▶ **Electron Hall**
 - ▶ **Superconducting electron linac**
 - ▶ **Second driver beam for the ARIEL facility**



ARIEL: Advanced Rare Isotope Laboratory

- ▶ New Isotope Separator Online (ISOL) facility.
- ▶ Projected to triple the yield of rare isotopes at TRIUMF.
- ▶ Two additional production targets respectively driven by:
 - ▶ 500 MeV cyclotron beam
 - ▶ 30-50 MeV electron beam

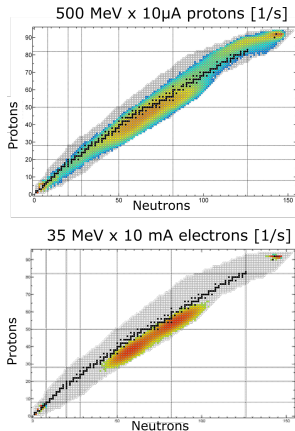
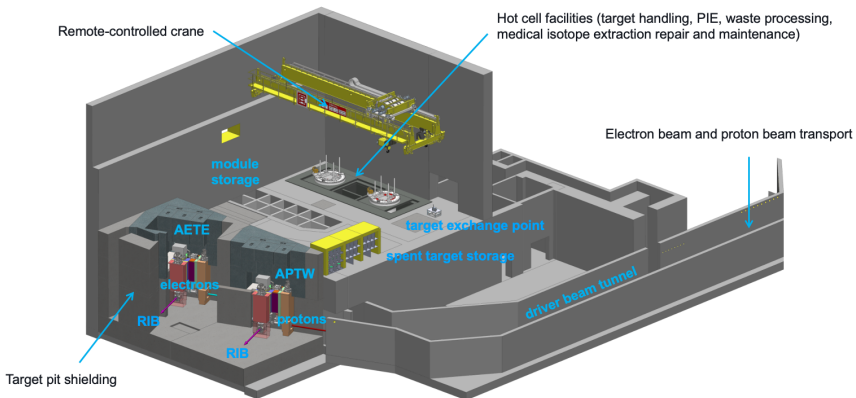


Figure: Projected isotope production from proton and electron beams on $^{238}\text{UC}_x$ targets at ARIEL.

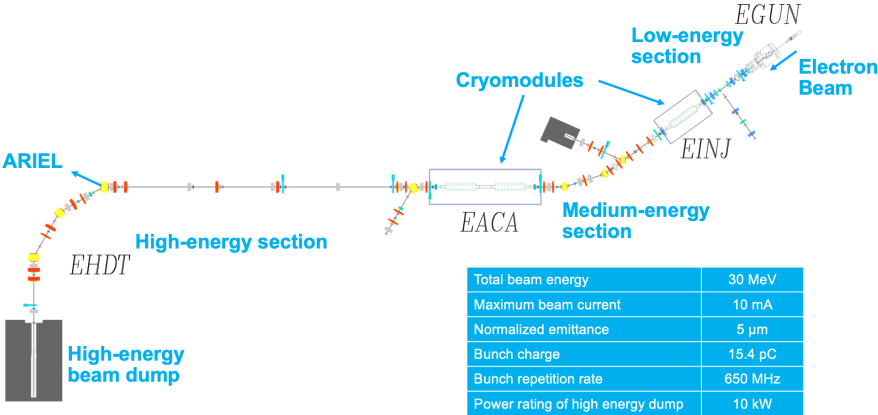
ARIEL: Advanced Rare Isotope Laboratory



TRIUMF E-Linac



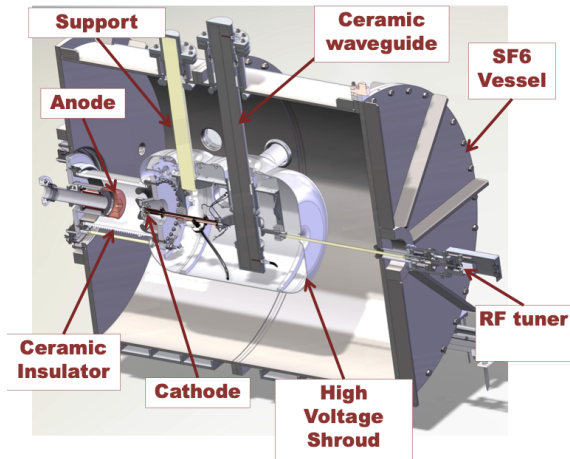
E-Linac Layout and properties



Total beam energy	30 MeV
Maximum beam current	10 mA
Normalized emittance	5 μm
Bunch charge	15.4 pC
Bunch repetition rate	650 MHz
Power rating of high energy dump	10 kW

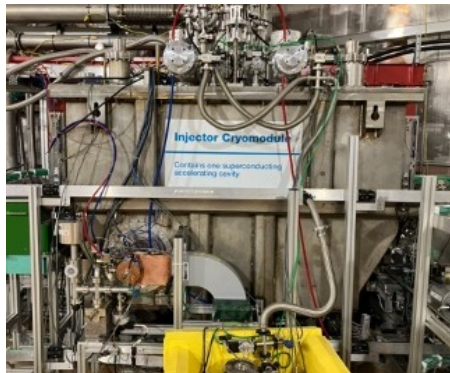
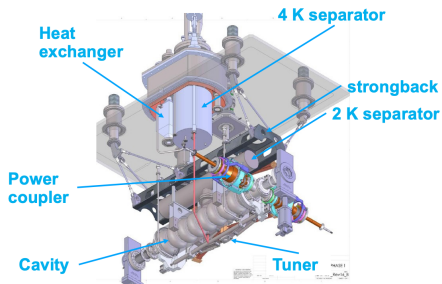
Electron Gun

- ▶ 300 kV thermionic electron gun
- ▶ Contained in a pressurized SF₆ vessel
- ▶ RF frequency 650 MHz



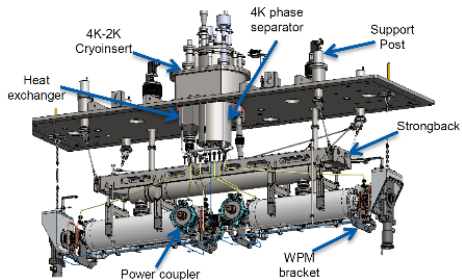
Injector Cavity EINJ

- ▶ Accelerates 300 kV beam from gun to 10 MeV.
- ▶ One 9-cell elliptical superconducting niobium cavity with RF frequency of 1.3GHz operated at 2K.



Accelerator Cavity EACA

- ▶ Further accelerates beam to 30 MeV.
- ▶ Two 9-cell elliptical superconducting niobium cavities with RF frequency of 1.3GHz operated at 2K.



A. Mahon



S. Rädcl

High Power Dump

- ▶ 10 kW tuning dump.



Current Status

E-LINAC	
BEAM	ON
PATH	EHD : DUMP
PEAK CUR.	498 μ A
ENERGY	30.2 MeV
POWER	10.0 kW

- ▶ Initial commissioning completed September 2021.
- ▶ 10 kW beam at 30 MeV.

Issue Tracking

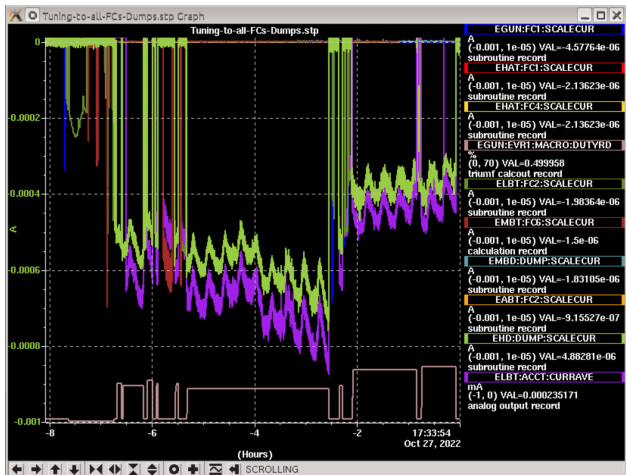
Resolved over 10 issues since last meeting:

- ▶ Upgraded beamline components
- ▶ Update controls systems
- ▶ etc...

Still tracking 15+ issues to improve performance and reliability.

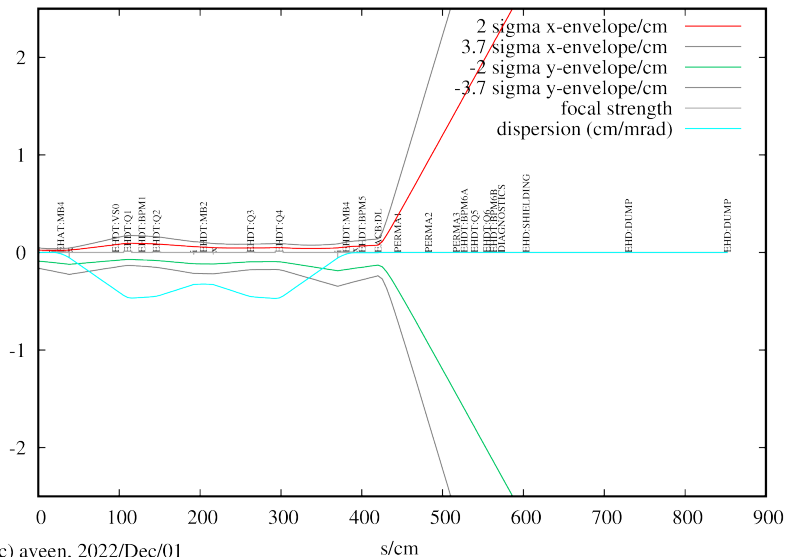
He conditioning of cavities end of 2022/early 2023.

New milestone - 3 hour continuous high power run



- ▶ Still a long way to go for goal of 3-day continuous beam delivery by March 2023.

Target Scattering



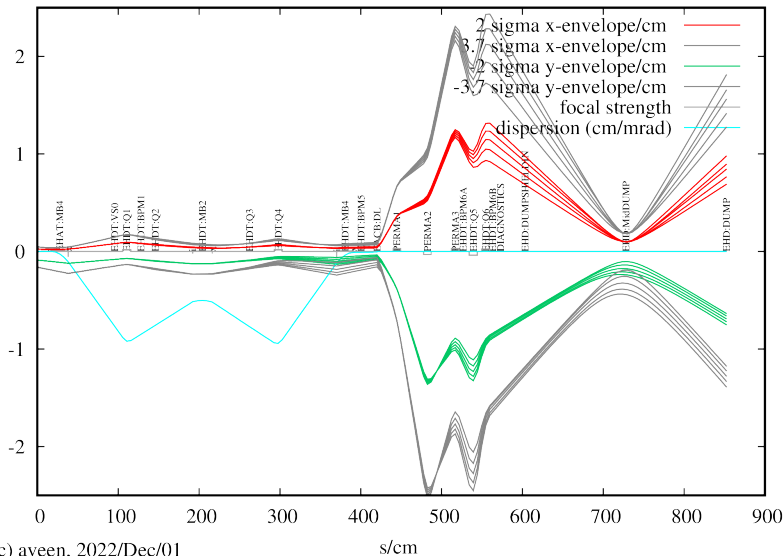
(c) aven, 2022/Dec/01

Beam Optics Model

Requirements:

- ▶ 3.7 sigma envelope fully contained within 1" radius of beampipe
- ▶ Minimize beam size through the dump
- ▶ Valid for energy range of 27-31 MeV
- ▶ Compatible with regular operation (no target)
- ▶ Include sufficient diagnostics elements for operation

Beam Optics Model - Latest



Thank you
Merci

