Centurion™ Mk. I

Ultra-Compact, Portable, High-Brightness 4 MeV-Class Linear Accelerator

Versatile

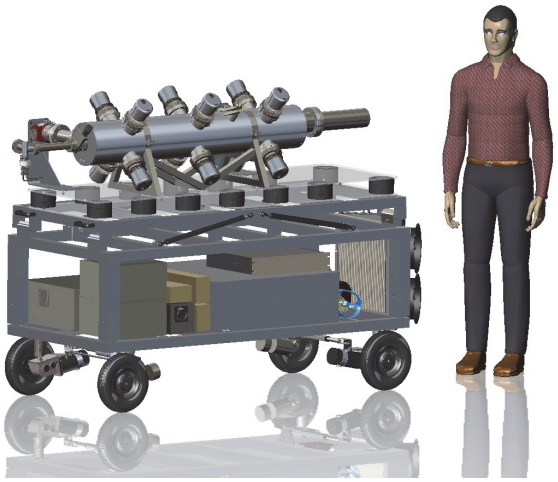
The <2.2m long, <350kg **Centurion™** is an **easy-to-deploy**, high-energy, high-intensity radio-frequency quadrupole (RFQ) ion accelerator suitable for a range of applications, e.g. neutron interrogation, proton injection, isotope generation, nuclear analysis, etc. Patented innovations in RF power delivery, pulsed ECR plasma source, low-emittance ion injection, high-flux thermal management, high-gradient ion acceleration, and novel fabrication methods enable a powerful, versatile, ultra-compact LINAC with high-brightness output. Sized to fit through a standard door, inside building elevators and transport in cargo van, the **Centurion™** is **deployable within your existing facility** to save engineering time, minimize regulatory burden and lower total cost. The entire system fits on a small cart, uses standard wall power and is air cooled.

MeV Ions At Your Command

Users familiar with larger RFQ LINACs can expect similar stability, pulse adjustability and system availability without the racks of equipment, size, weight, power and hassle. Baseline configuration is for 3.86MeV *d* or 1.93MeV *p* pulsed beams at up to 50µA time-average current @ ~0.6% duty factor. Custom energies between 1-5MeV can be accommodated with this platform and a future upgrade for higher duty-factor is planned. For beamline/injector applications our engineering team can work with your accelerator engineer for acceptance and phase space matching. The small target provides close coupling with moderator/collimator assemblies for imaging or personnel shielding for dose limited applications.

The Centurion™ Advantage

- **Mobile; Fits Standard Doors, Hallways & Elevators**
- **Powerful; Air-Cooled, Standard Wall-Plug Power**
- **Ideal For Neutron Imaging**
  - D-D forward-directed 6-7 MeV fast neutrons
    50 µA d^+ @ 3.86 MeV; 4×10^{10} D-D n/s
  - p-Li forward-directed ~50keV epithermal neutrons
    10 µA p^+ @ 1.93 MeV; 5×10^{8} p-Li n/s
  - High brightness neutron emission spot, ~1-3mm
  - Directed neutron output → more flux at object
    Scan objects >100× faster
- **Multiple Modes For Pulsed Operation**
  - Constant pulse spacing v. burst-mode operation
  - Nominal pulse widths of 20-100 µs
- **Easy Output Throttling For Low-Dose Applications**
  - Duty factor controls time-average beam current
  - Decrease intensity of output beam to lower both instantaneous and time-averaged beam currents



Rendering Of The Entire Centurion™
4MeV RFQ LINAC On A Motorized Cart

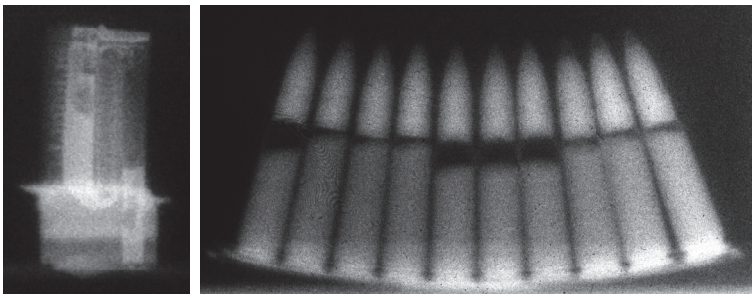
Starfire Centurion™ Travels To Your Site For
Mobile Neutron Radiography & Field Inspection

High-Brightness, Portable Fast/Epi/Thermal Neutron Imaging

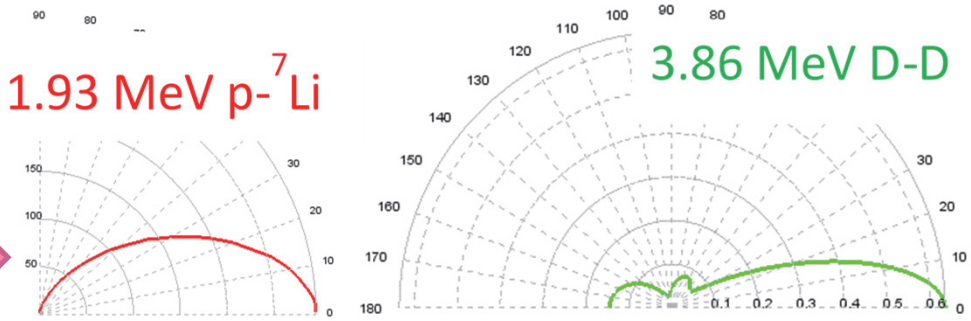
Powered by Starfire Industries Centurion™ Technology

Applications

- **Neutron Imaging**
  Fast, Epithermal, & Thermal
  Determined by choice of ion species and target material; reconfigurable on same unit
- **High Brightness Spot**
  Close coupling with moderator/collimator for greater than 2π solid angle access to the high-flux neutron emission zone
- **Compact Ion Beam Source**
  Single unit is dual use
  3.86 MeV *d* & 1.93 MeV *p* from the same unit



Neutron radiograph of turbine blades highlighting internal cooling channels (left), and ammunition casings (right)



Neutron Angular Flux Distributions for *p* and *d* Ion Beams

*More ion-beam/target combinations possible. e.g. D-^{7}Li, D-Be

Specifications

Output Beam	*d*	*p*
Beam Energy	3.86 MeV	1.93 MeV
Current – Time-averaged	50 µA	10 µA
Current – Pulsed	8.5 mA	1.7 mA
Duty Factor	0.6 % nominal, range: ≤ 1 %	
Pulse Options	20—100 µs pulse widths, Constant pulse spacing or burst-mode	
Spot-Size at Target (Adjustable)	≥ 1 mm	≥ 1 mm
Spot-Size at RFQ Exit Plane	0.5 mm	0.3 mm
Neutron Output*	**D-D**	**p-^{7}Li**
Time-Averaged Output	4×10^{10} n/s	5×10^{8} n/s
Neutron Energy (forward directed)	6-7 MeV	20—130 keV, (avg. 50keV)
Maximum Neutron Flux @ 100:1 L/D	2×10^{7} n/cm^2/s	4×10^{5} n/cm^2/s
System Information		
Total Wall-Plug Power	4—6 kW	
System Size	34" W x 88" L x 62" H	
System Weight	750 lbs (under 40psf)	
Motorized Cart	Handheld Control, Independent Wheels	

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