

# A Semi-Autonomous Mobile Diagnostic for CEBAF Operations

- **Goal:** develop a remotely controlled, semi-autonomous, mobile diagnostic that can be integrated into accelerator operations
  - ✓ note, this project does not use machine learning
- the mobile diagnostic system would provide potential benefit to the Lab by:
  - ✓ **reducing accelerator downtime** by enabling remote inspection of beamline components and reducing the need for short, controlled accesses to the accelerator tunnel, and reducing the time required to perform standard radiation surveys, while promoting ALARA principles by minimizing personnel to potentially hazardous conditions
  - ✓ **reducing machine tuning-time** by acquiring dynamic measurements, e.g. beam loss and radiation measurements, under operational conditions at arbitrary locations along the beamline
  - ✓ laying a foundation on which to build future R&D collaborative efforts in robotics with CNU
- represents a technology which is transferable to other accelerator facilities

# Mobile Observatory

## Mobile Observatory Surveys Manhattan Atmosphere

Scientists equipped a pickup truck with a suite of atmospheric research instruments to study microclimates across the Nation's cities.

September 24, 2021

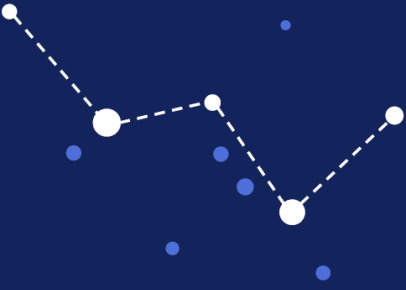
*Rather than relying on stationary instruments, researchers at Brookhaven's Center for Multiscale Applied Sensing (CMAS) have integrated sophisticated research tools into a pickup truck, creating a mobile observatory that captures precise, local data on wind, temperature, rain, and clouds across entire cities.*





# Robots and Accelerators

**CASSIOPeiA**  
*Collaborative Autonomous Sensor System for Intelligent Operation of Particle Accelerators*



C. Tennant, B. Freeman, A. Carpenter, T. McGuckin, R. Michaud  
 Thomas Jefferson National Accelerator Facility

D. Conner, W. Phelps  
 Christopher Newport University



XFEL

## Object Detection and Recognition for Teleoperation #1

➤ Teleoperation is strongly increased during the last years at CERN [7]



Telemax robot



EXTRM robot with single arm (CERN made)



The TIM (CERN made)



Teodor robot



EXTRM robot (CERN made)



CERNbot (CERN made)



CRANEbot (CERN made)

(TN-20-029)

MARWIN: Localization of an Inspection Robot in a Radiation-exposed Environment  
 Andre Dehnd, Nantwin Möller, Thorsten Hermes

(M. Di Castro, EP-DT Technical Seminar)



Rover units



Lidar



Radiation Sensor



Rover GUI



IR Camera

**Remotely Operated Accelerator Monitor (ROAM)**



Rover & Sensors

(courtesy SLAC)

# Sources of Data and Applications

- remote visual beamline inspections
- real-time, localized beam loss information for efficient beam tuning
- optimize diagnostic placement along the accelerator (i.e. BLM)
- mitigate damage from field emitting cavities with the ability to remotely position a radiation sensor near the offending cavity and provide data to operators to take actionable information
- complete regular radiation surveys more efficiently while reducing potential risk to workplace personnel by adhering to the “as low as reasonably achievable” (ALARA) principle





# MARWIN at the XFEL

## OPERATION: is radiation an issue ?

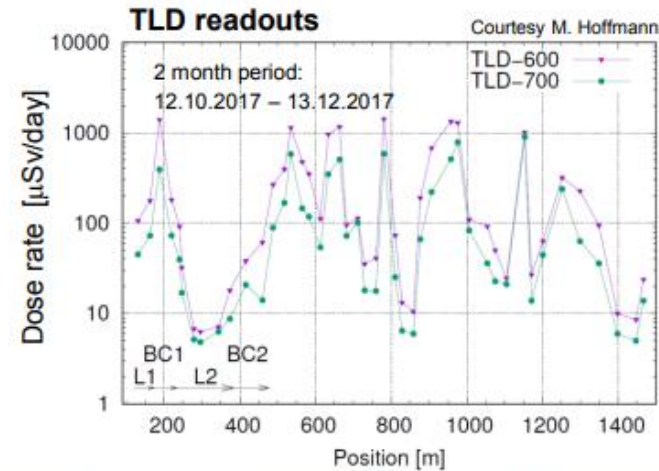
### Radiation

- Online monitor
- Regular survey
- XFEL : MARWIN

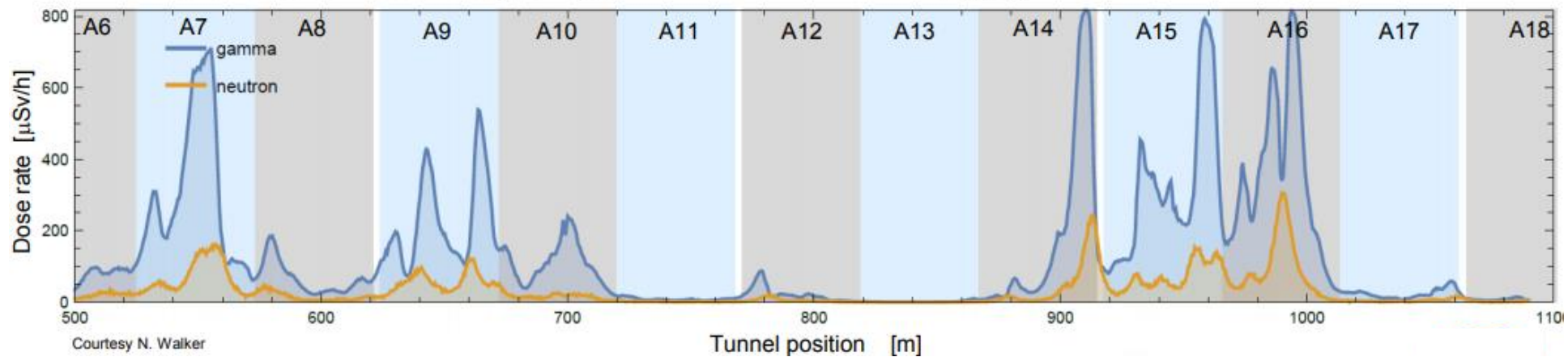
Limit for electronics : 1 Gy / year



MARWIN: Mobiler und Autonomer Roboter für Wartung und INspektion



Film: M. Omet



Courtesy N. Walker

(courtesy J. Branlard)