

Photogrammetry Measurements of a Time-Projection Chamber

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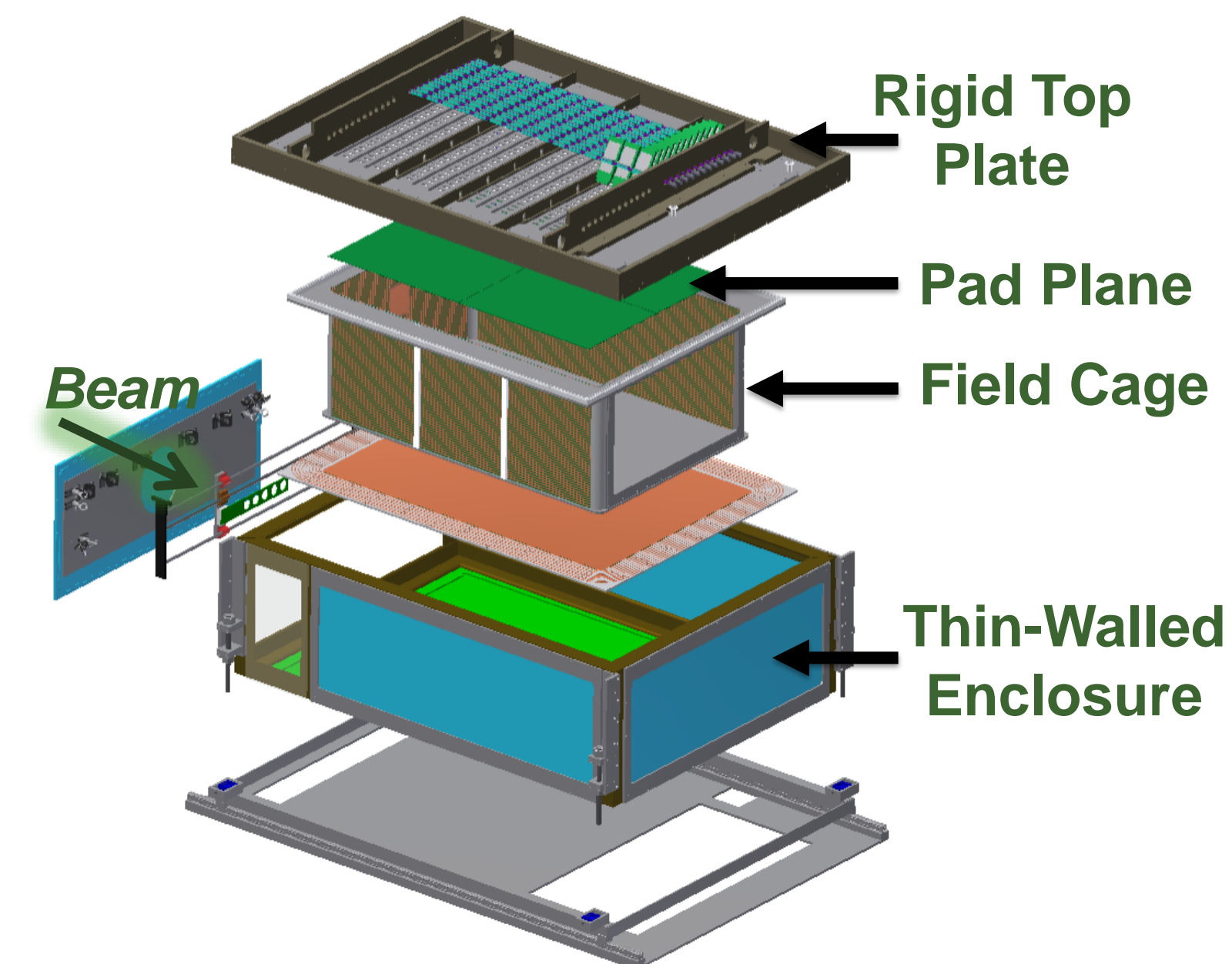
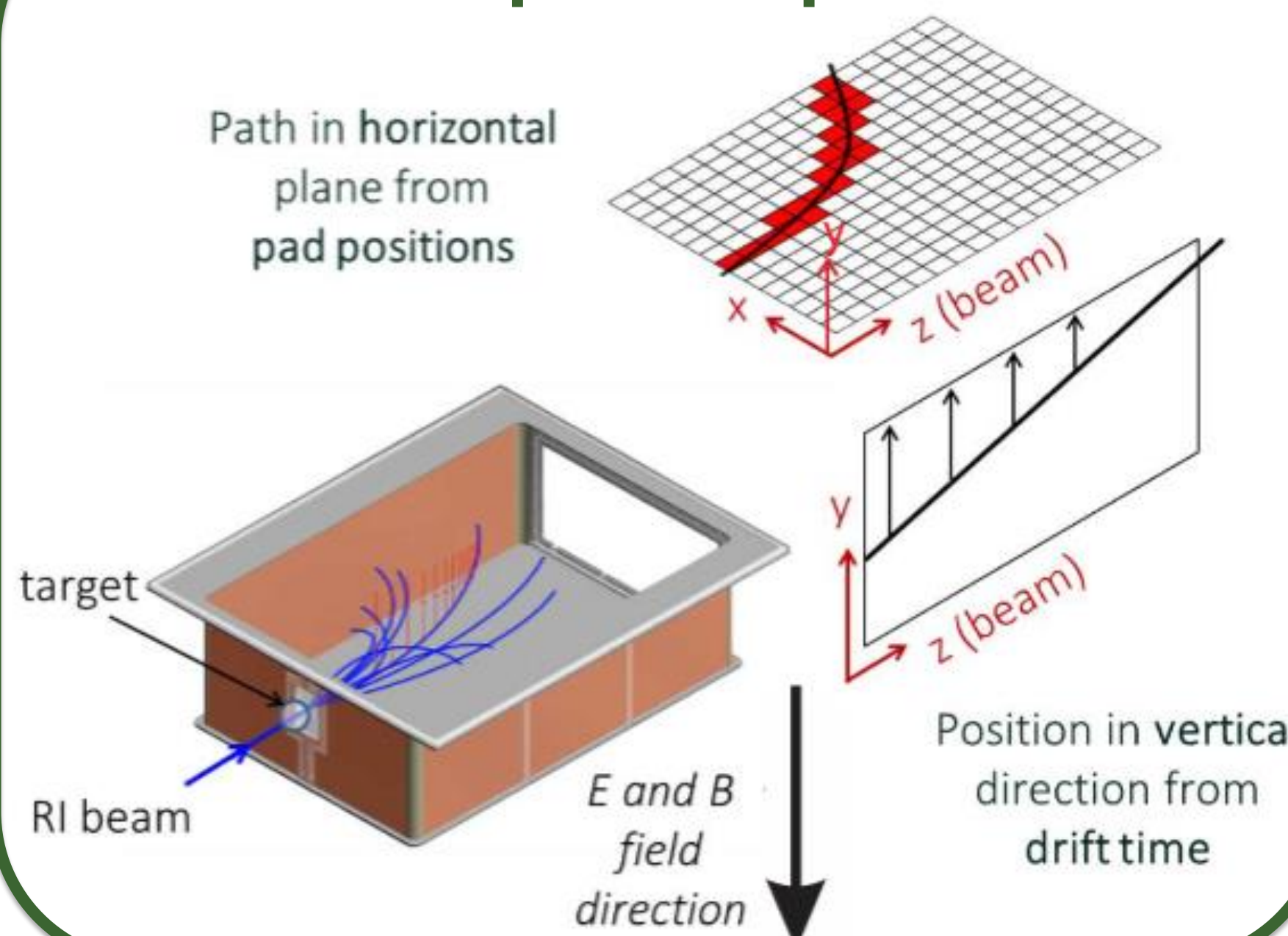
SπRIT Time-Projection Chamber

- “SAMURAI Pion-Reconstruction and Ion-Tracker”
- Motivation
 - Nuclear equation of state
 - Implications to neutron stars
- Detects charged particles as they excite gas in chamber
- Can reconstruct path and identify particles based on known interaction with electric and magnetic fields
- Constructed at NSCL
- Shipped to RIKEN in Japan in 2014

Importance of Precision Measurements

- Damage in shipment to Japan?
- Interested in micron scale precision
- Exact locations of internal components
- Flatness of surfaces
- Sagging of heavy structural components
- Field cage alignment & angle of electric field
- Symmetries of TPC

Principle of Operation

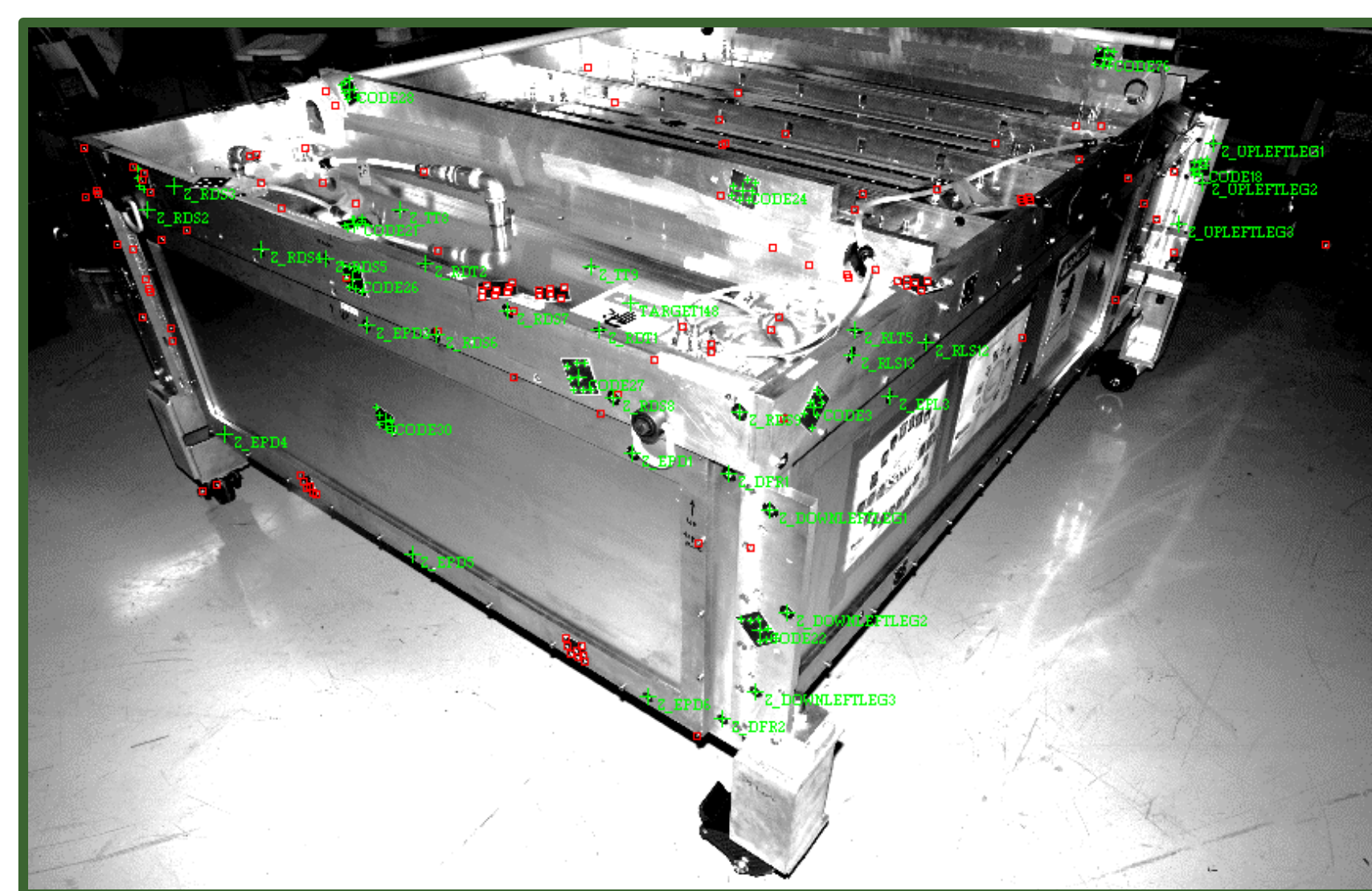
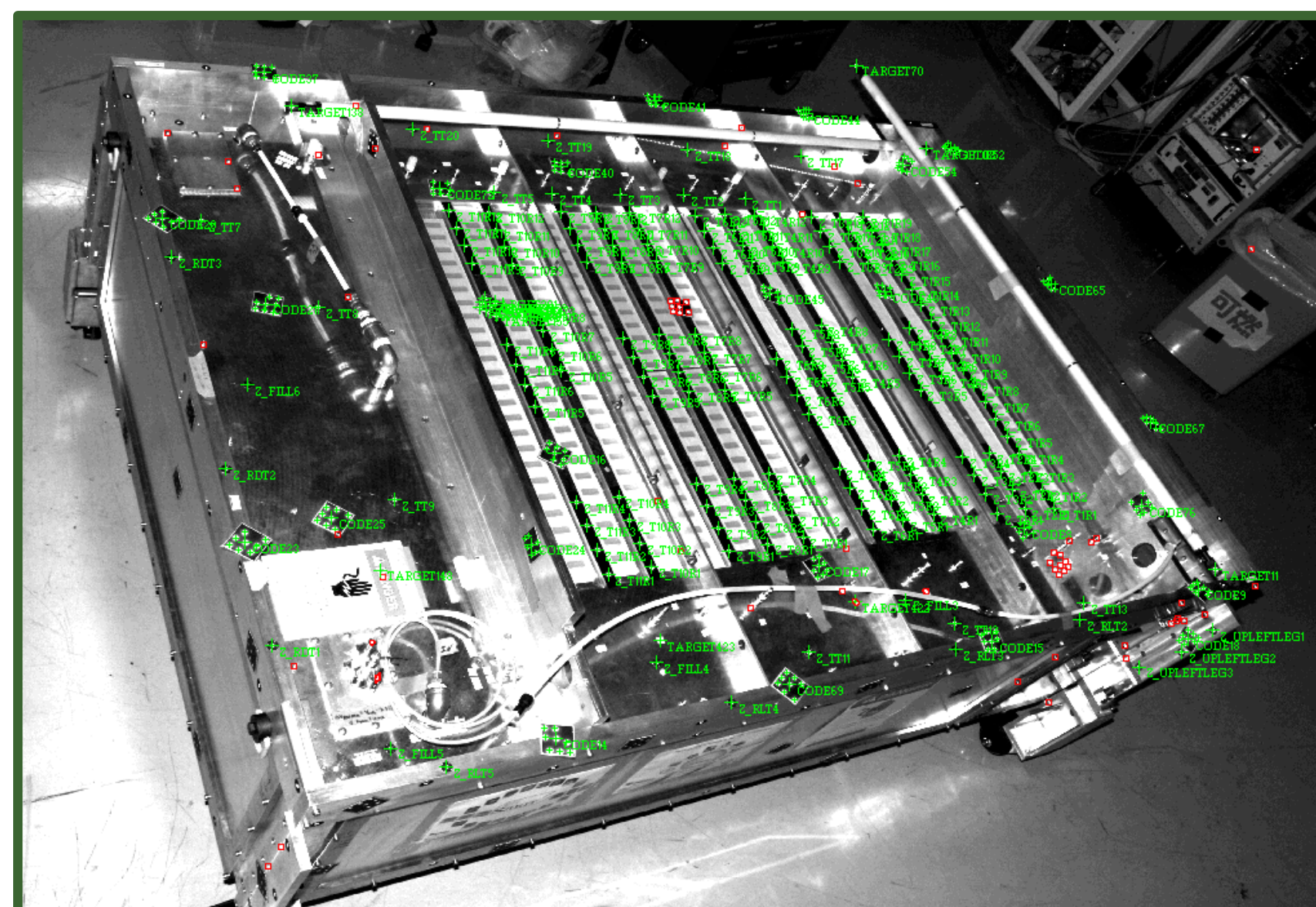


Parts of SπRIT

- Field Cage: Defines uniform electric field, and contains detector gas.
- Rigid Top Plate: Primary structural member, reinforced with ribs. Holds pad plane and wire planes.
- Pad Plane: Mounted to bottom of top plate. Used to measure particle ionization tracks
- Thin-Walled Enclosure: Protects internal components, seals insulation gas volume, and supports pad plane while allowing particles to continue on to ancillary detectors.

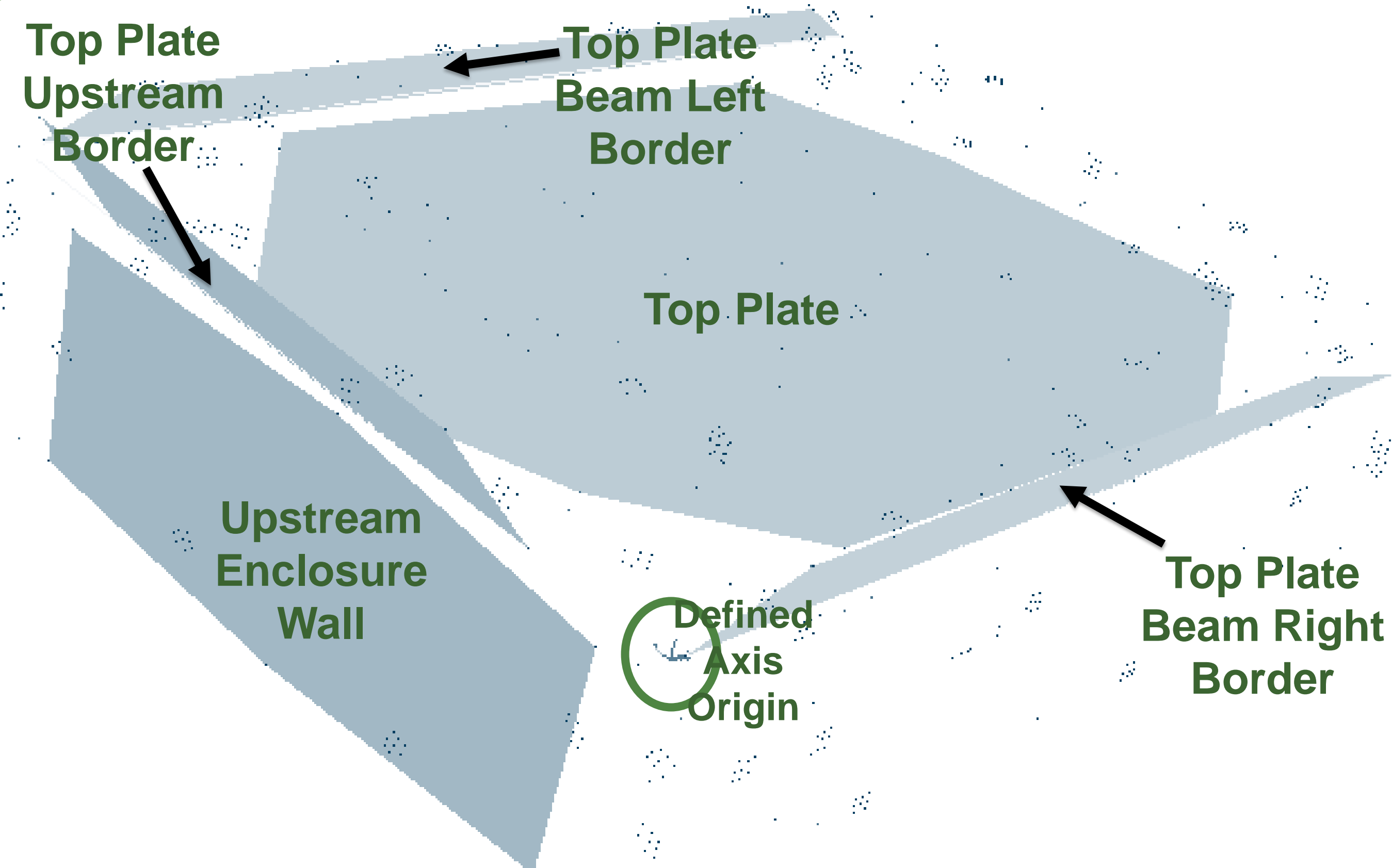
Photogrammetry

- Calibrated camera system from Geodetic
- Multiple photographs of an object can be reconstructed to make 3-D measurements
- Accurate to <100 micrometer.
- Codes placed onto object – 4 per image needed for orientation
- Retro-reflective targets placed on points of interest
 - » Field cage walls
 - » Top plate
 - » Enclosure
- Photography concerns – field of view (50deg), focusing, exposure
- Triangulation – find point position across individual pictures
- Resection – determination of camera location

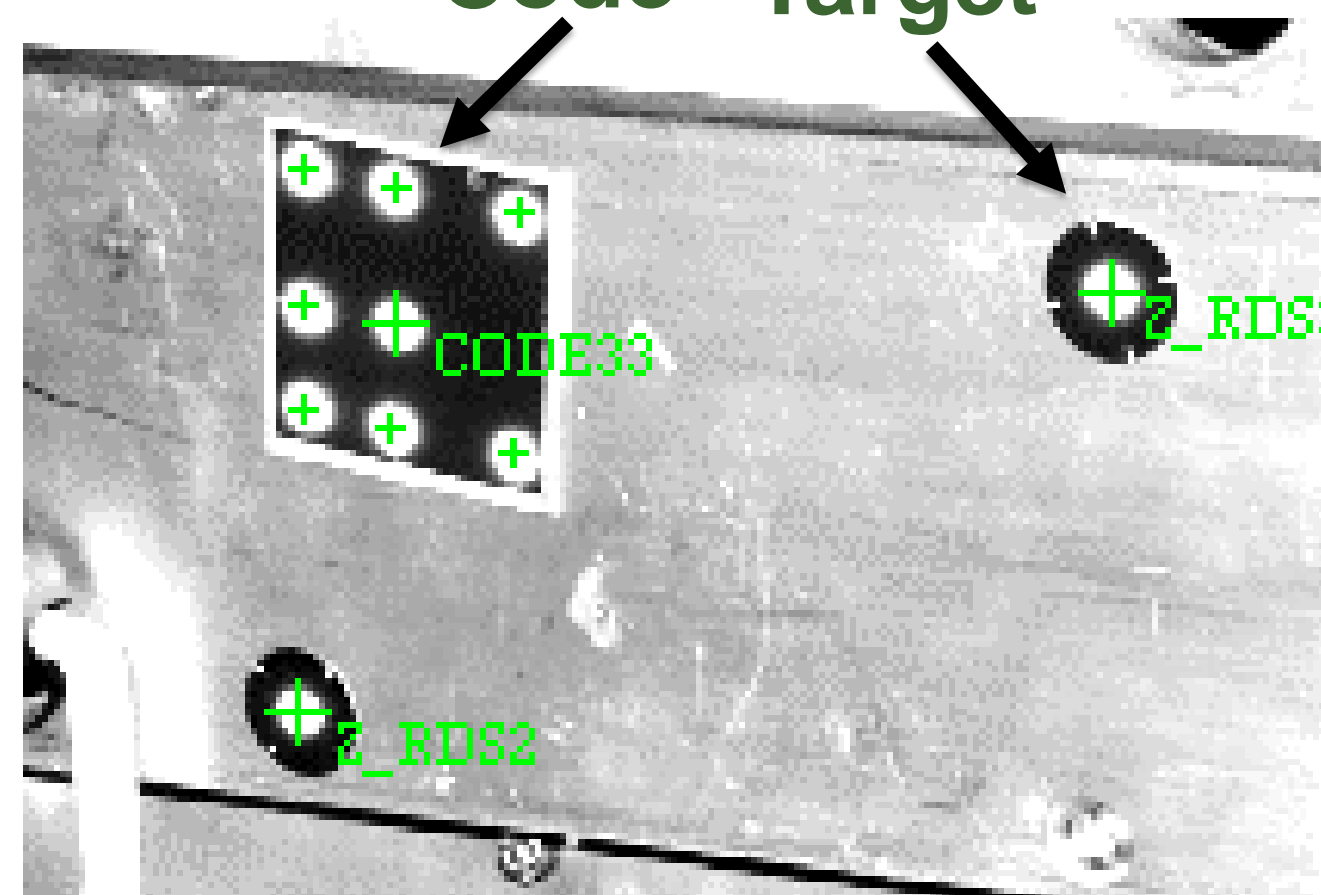


Measurements with V-STARS Software

- Set size, shape, and brightness parameters to identify points
- Filter out “flash points”
- Run bundle using STAR – Self-Calibration, Triangulation And Resection
- Construct planes from points
- Construct points, axes from intersection of planes



Code Target



Images above and left analyzed by V-STARS

- Identified targets and codes with green crosses
- Red crosses are failed matches – either the software failed to match the point with others, or they are reflective spots but not targets

Images above and right – black dots are all identified points displayed in 3-D. Constructed planes on top plate, downstream face of enclosure, 3 top plate walls

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