

Spring 2014, CIS II Project #8, Johns Hopkins University

**Mini-checkpoint Presentation
A New Generation of Quality Assurance
For Radiation Oncology**

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**Mentors:
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**Johns Hopkins University
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RAVEN QA

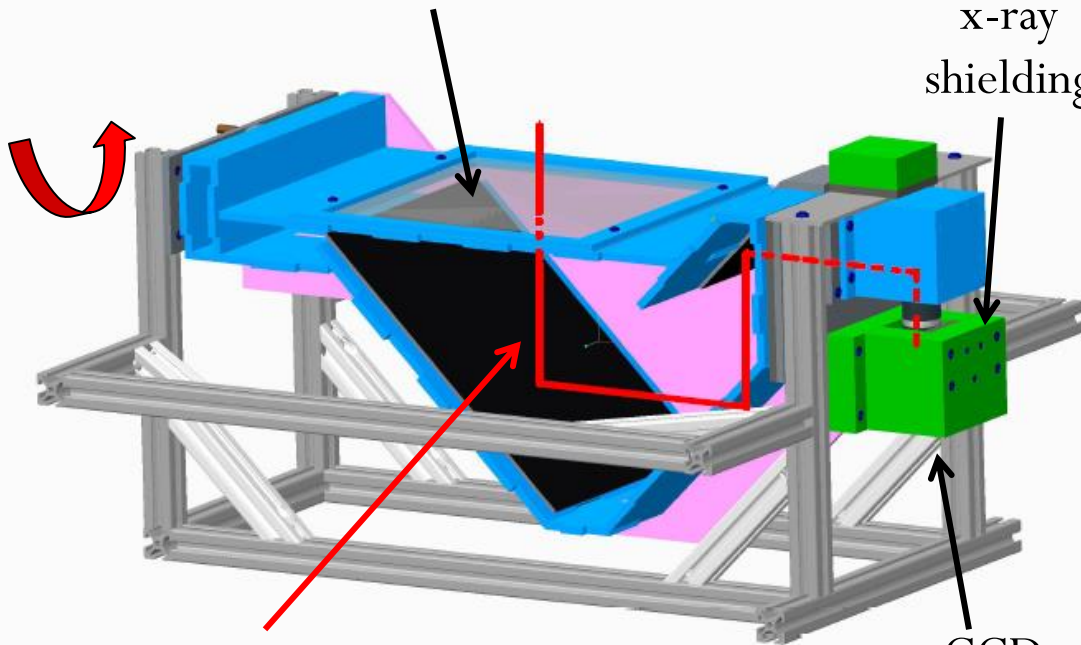


1. Project Overview

Design and release a **commercial software** for Raven QA which includes:
Image Acquisition; Image Processing
Motor Control; User Workflow Guidance.

Semi-transparent phosphorus screen

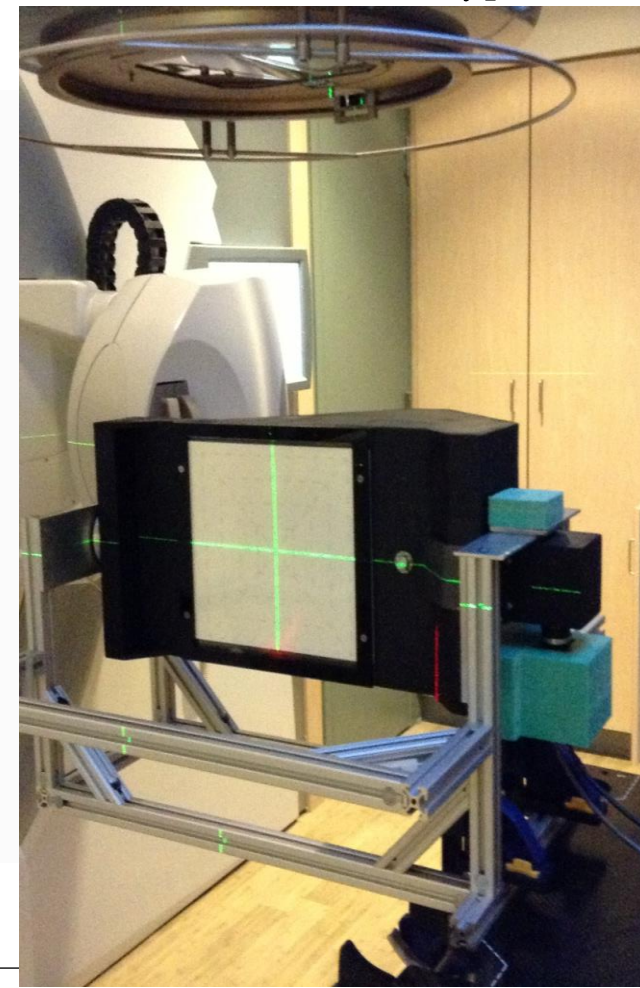
Neutron/
x-ray
shielding



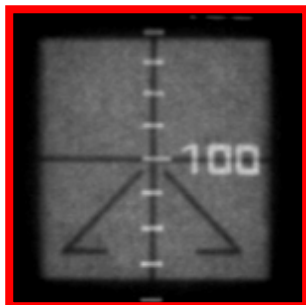
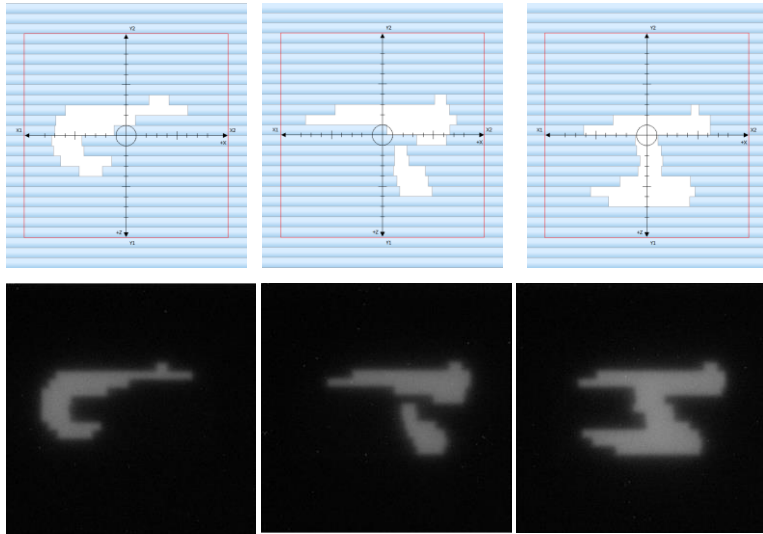
Optical path

CCD
camera

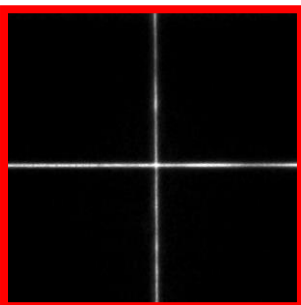
Second Prototype



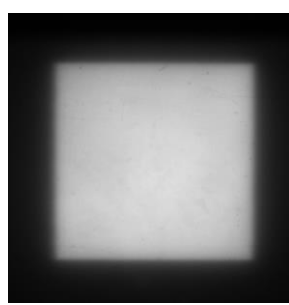
1. Project Overview: What do we do in QA?



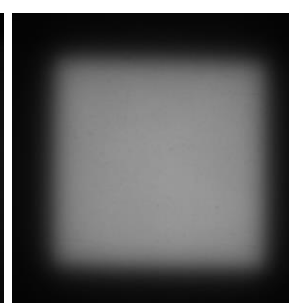
*Light field with
ODI*



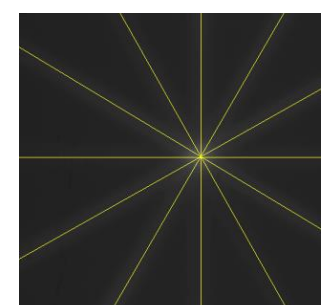
*Room Lateral
Laser*



*6 MV x-ray at
dmax*



*12 MeV electron at
dmax*

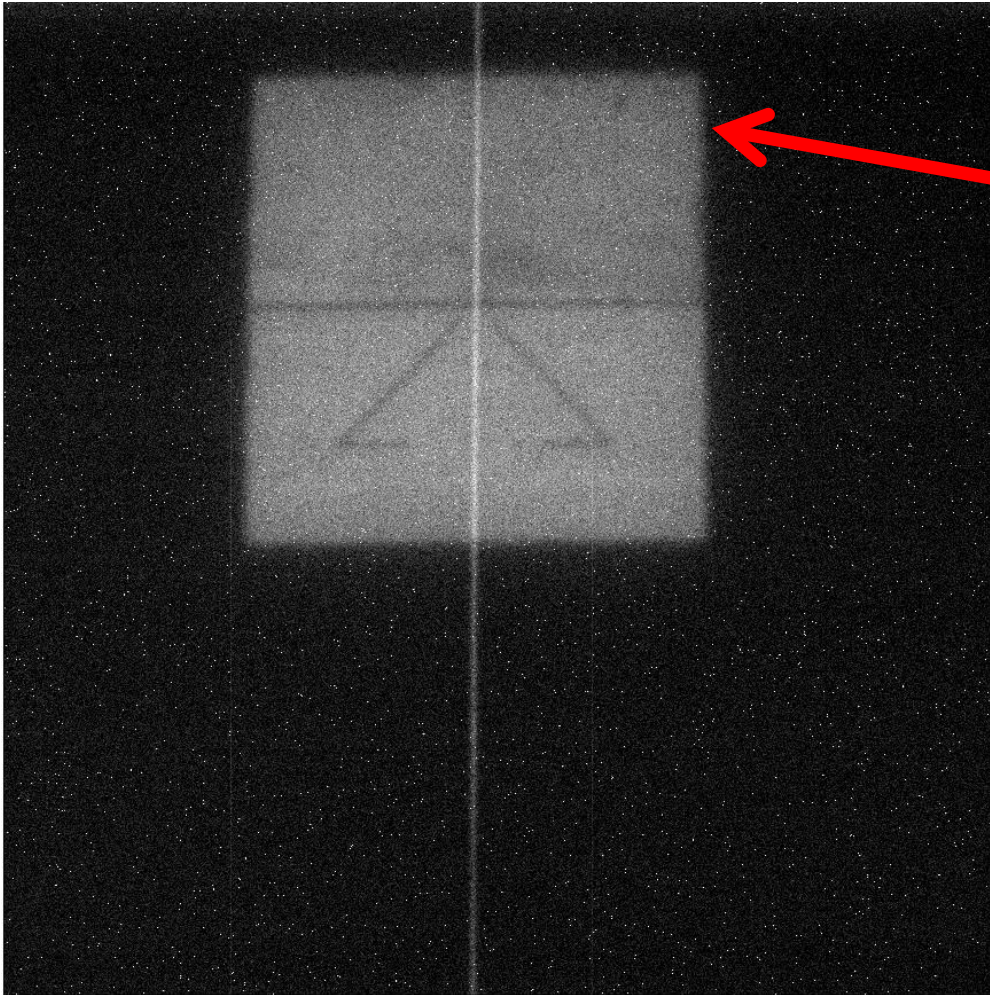


2. Deliverables Status



- **Minimum Deliverables:**
 - **Image Acquisition**
 - **Camera Correction**
 - **Alignment Map** Done
 - **Distortion Map (New)** Done
 - **Uniformity Map (New)** In Progress
 - **Image Processing** Done
 - **Motor Controlling**
 - **Step Motor Control** Done
 - **Inclinometer Control** Waiting for the device
- **Expected Deliverables:**
 - **3D Rendering** Done
 - **Workflow Guidance** Done
 - **Report Generation** Done
- **Maximum Deliverables:**
 - ~~Internet~~ Local database Done
 - **Software Documentation** Draft Done
 - **Auto-alignment Map (New)** Done

3. Distortion Map & Uniformity Map

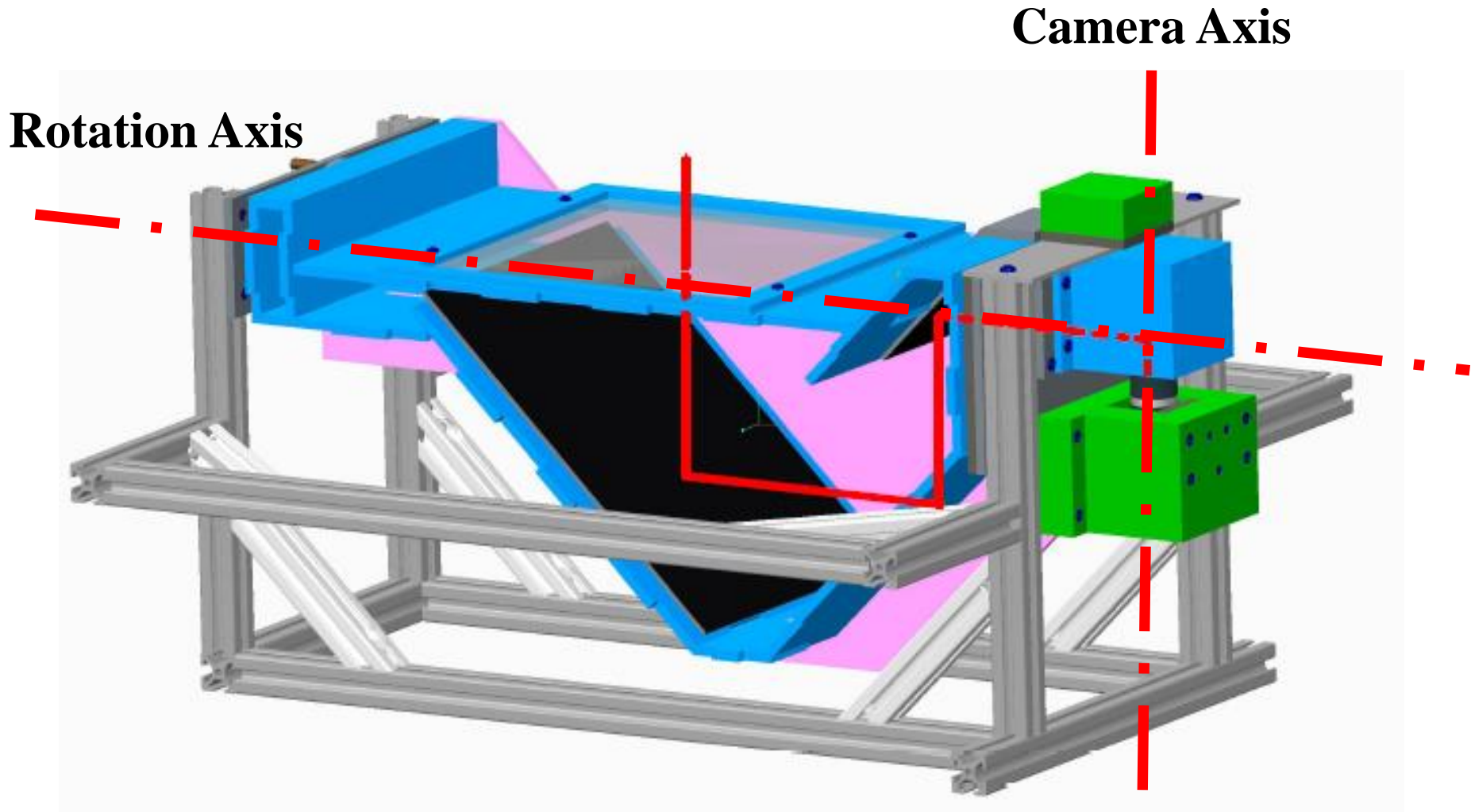


**Points Position Shift:
Distortion Map**

**Points Greyscale Shift:
Uniformity Map**

Distortion map and Uniformity map is fixed. They can be generated manually.

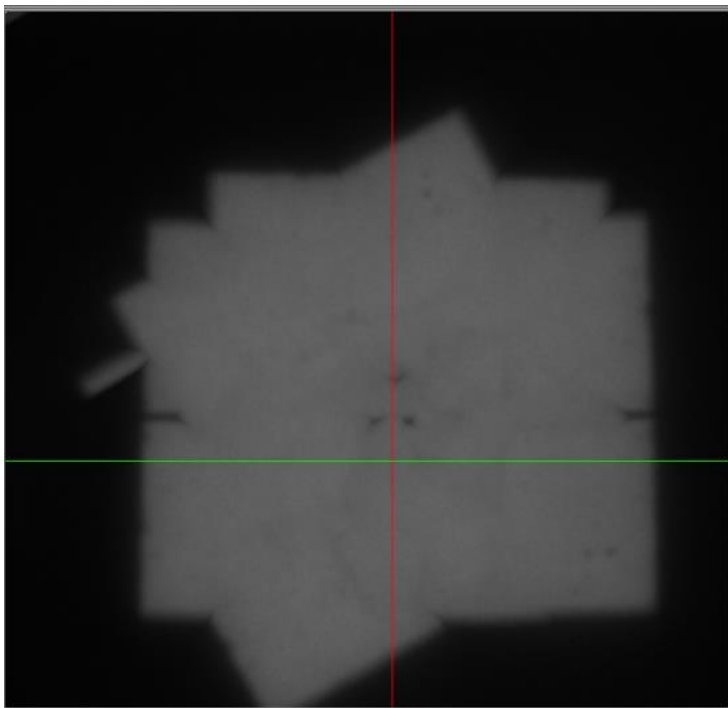
4. Auto-alignment Map



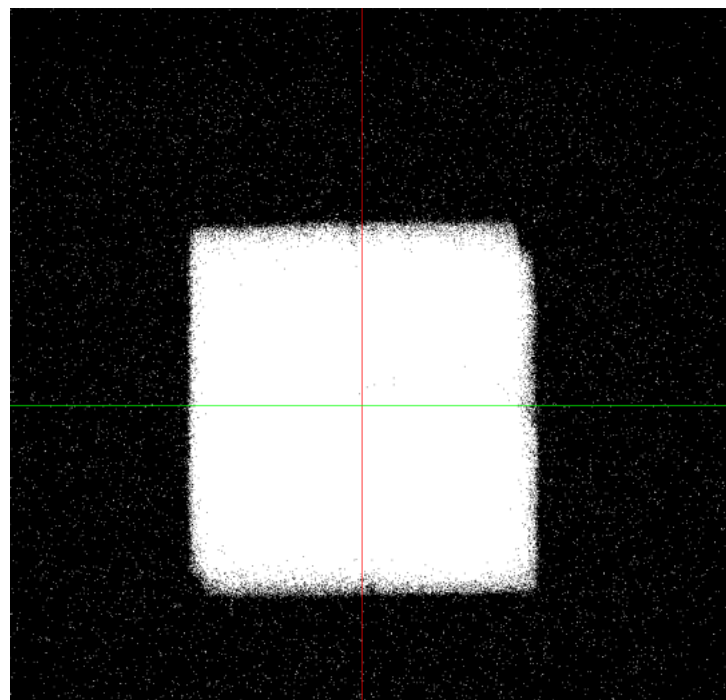
Alignment map changes when the QA box rotates very frequently, so it must be regenerated every time before our QA.

4. Auto-alignment Map

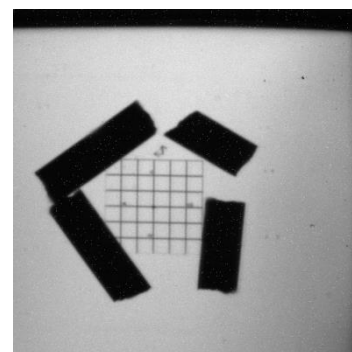
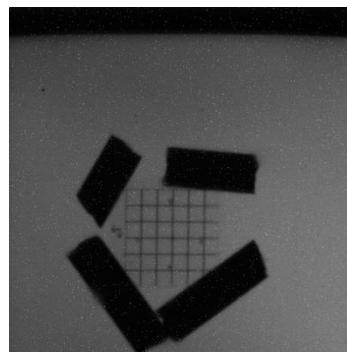
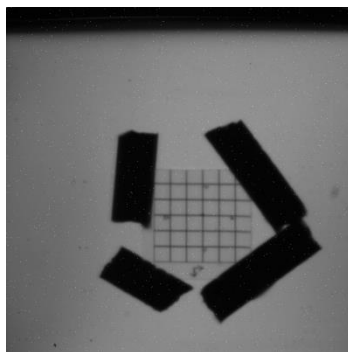
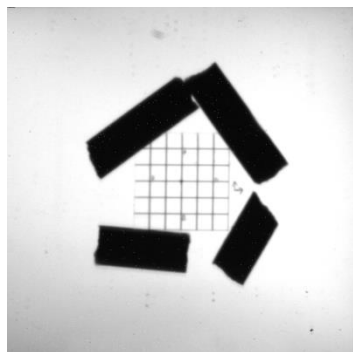
Before Alignment



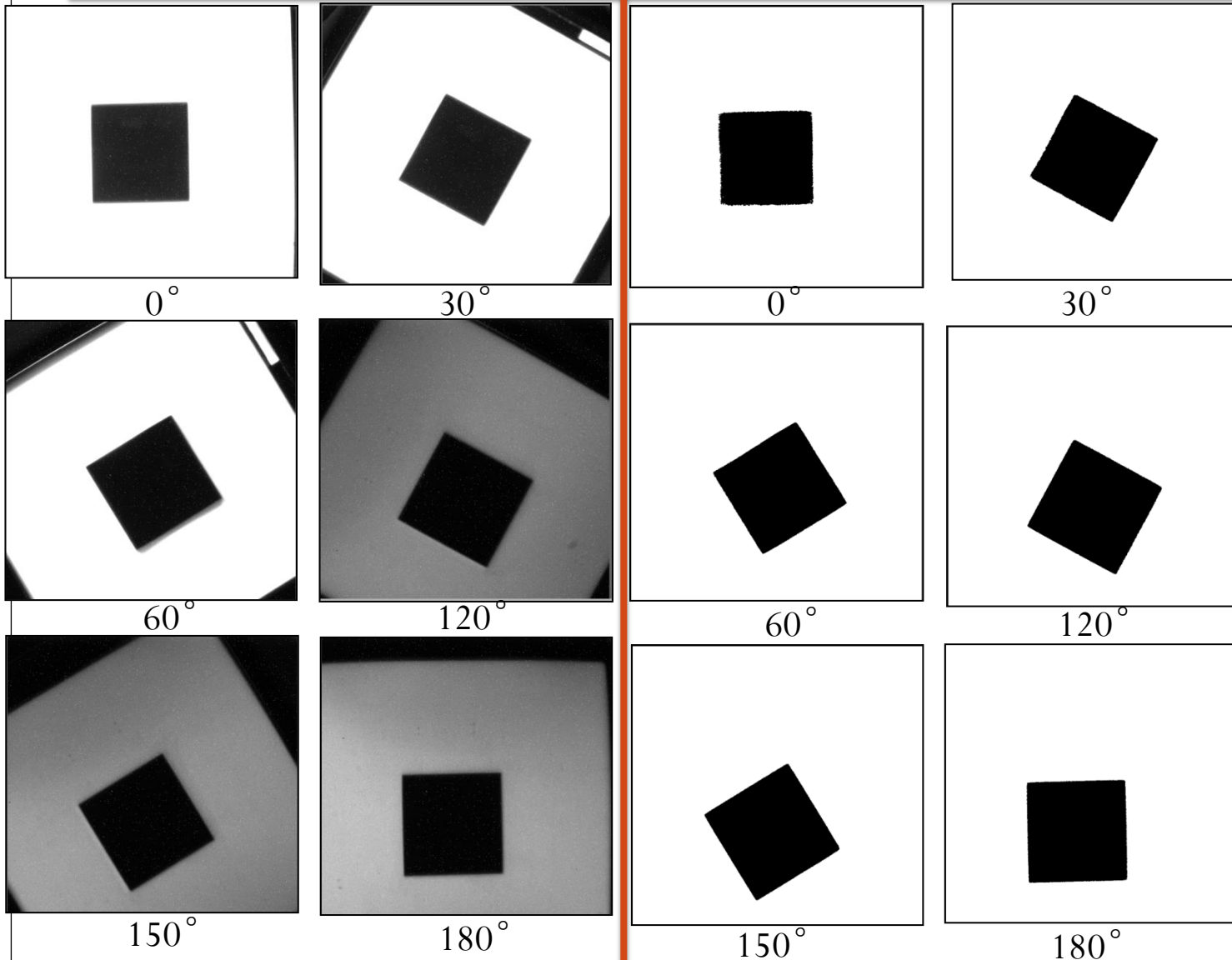
After Alignment



Manual
Alignment
Map



4. Auto-alignment Map



Algorithm:

QA Box Rotation

Capture Images

Pre-filter

Hough Algorithm

Point Cloud Regist

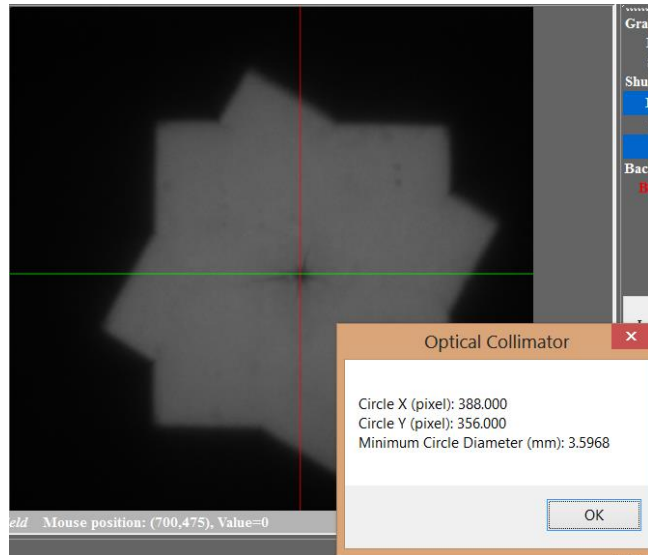
Time Cost:

**Monthly: 3 min
(Rough Check)**

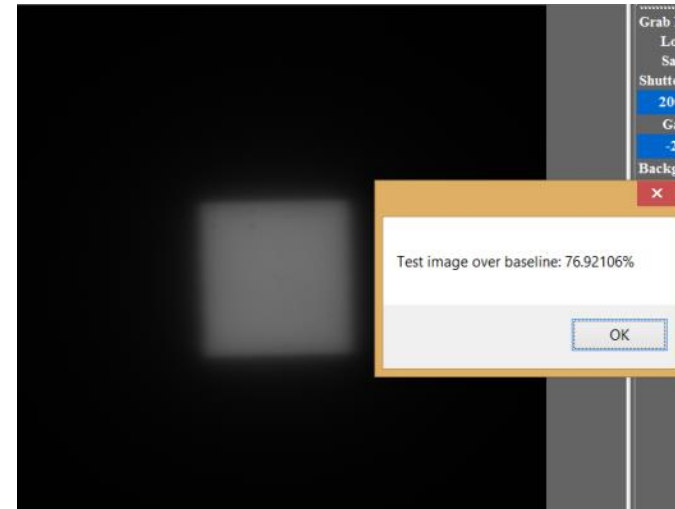
**Yearly: ~15min
(Fine Check)**

5. Image Processing

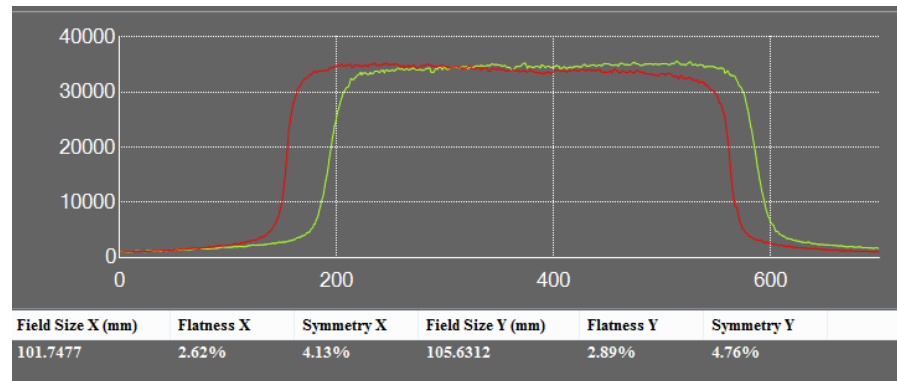
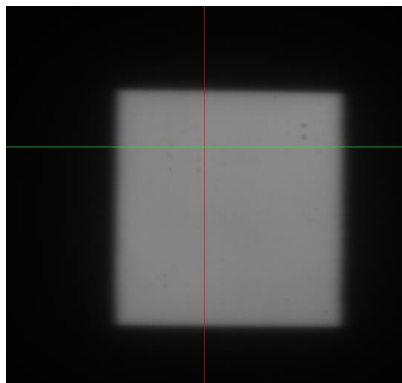
MLC Collimator Rotation Test



Energy Comparison Test



Flatness and Symmetry Test



6. Workflow Guidance: TG-142 Standard

- Facility
- Machine
- Month
- Collimator Rotation**
 - Gantry Rotation
 - Table Rotation
 - Table Longitudinal Movement
 - Table Lateral Movement
 - Table Vertical Movement
 - Light Field
 - Laser Coincidence
 - Light Field Radiation Coincidence
 - Collimator Rotation
 - Gantry Rotation
 - Table Rotation
 - Photons
 - Electrons
 - Photons
 - Electrons
 - Photons
 - Electrons

Machine Setup

- INFINITY
 - 6MV
 - INFINITY1
 - 6MV
 - 15MV
 - 6MeV
 - 9MeV
 - 12MeV
 - 15MeV
 - 18MeV
 - 10FFF
 - tryOptical
 - Optical

Machine Label: INFINITY

Serial Number: _____

Type: _____

Comments: _____

- Add Template to Machine

Energy: _____ MV + Add

Existing Templates: 6MV

Create Machine
Delete Machine
Exit

Raven QA

- INFINITY
 - 6MV**
 - INFINITY1
 - 6MV
 - 15MV
 - 6MeV
 - 9MeV
 - 12MeV
 - 15MeV
 - 18MeV
 - 10FFF
 - tryOptical
 - Optical

Display Parameters

Light Field Radiation Coincidence

Collimator Rotation

Gantry Rotation

Table Rotation

Output Photons

Output Electrons

Energy Check Photons

Energy Check Electrons

Flatness And Symmetry Photons

Flatness And Symmetry Electrons

Data Query

QA Date: 2014-01

Date	Light Field Radiation Coincidence	Collimator Rotation	Gantry Rotation	Table Rotation	Output Photons	Output Electrons	Energy Check Photons	Energy Check Electrons	Flatness And Symmetry Photons	Flatness And Symmetry Electrons
2014-01	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
2014-02	-2.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
2014-03	-1.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
2014-04	1.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
2014-05	-1.500%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
2014-06	-1.500%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%

Query Result	Baseline	Offset (Relative)
QA Date = 2014-01 Light Field Radiation Coincidence = 2.3 Collimator Rotation = 0 Gantry Rotation = 0 Table Rotation = 0 Output Photons = 0 Output Electrons = 0 Energy Check Photons = 0 Energy Check Electrons = 0 Flatness And Symmetry Photons = 0 Flatness And Symmetry Electrons = 0	QA Date = 2014-01 Light Field Radiation Coincidence = 2.3 Collimator Rotation = 0 Gantry Rotation = 0 Table Rotation = 0 Output Photons = 0 Output Electrons = 0 Energy Check Photons = 0 Energy Check Electrons = 0 Flatness And Symmetry Photons = 0 Flatness And Symmetry Electrons = 0	QA Date = 2014-01 Light Field Radiation Coincidence = 0.000% Collimator Rotation = 0.000% Gantry Rotation = 0.000% Table Rotation = 0.000% Output Photons = 0.000% Output Electrons = 0.000% Energy Check Photons = 0.000% Energy Check Electrons = 0.000% Flatness And Symmetry Photons = 0.000% Flatness And Symmetry Electrons = 0.000%

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8. Summary

- **Falls behind schedule, over estimates shipping speed.**
- **Cross-check with other QA products is needed.**
- **Documents and software manual are needed.**
- **A demo for QA Box and Software will be shown on AAPM 2014 in July.**

Thanks for your attention!

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