Dosimetry Technology For Radiation Oncology

Tech Transfer Workshop 2018

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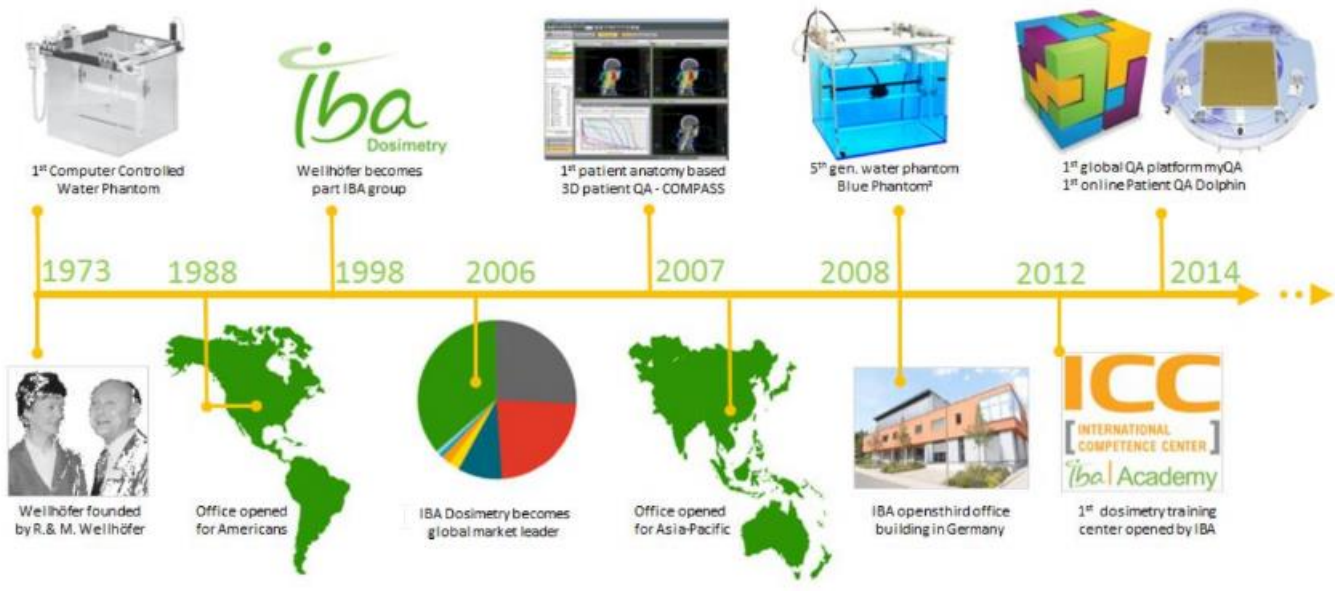
Product Specialist

Personal Introduction

- Product Specialist – IBA Dosimetry
- ARRT Board Certified
  - Radiography
  - Therapy
- Experience
  - Clinical
    - Facility Director
    - Therapist
  - Vendor
    - Applications Specialist
      - Hardware
      - Software
    - Project Management
    - EMR Implementation Consultant

Introduction to IBA

- Proton Therapy
- Dosimetry
  - 220 International Employees
  - 4 Offices
    - USA, Germany, China, France



Radiation Oncology

- Radiation Oncology
  - ‘Mysterious’ Portion of Healthcare
- Radiation has been an effective tool for treating cancer for more than 100 years.
- About two-thirds of all cancer patients will receive radiation therapy as part of their treatment.
- Radiation therapy works by damaging the DNA within cancer cells resulting in cell death.
- The goal is to destroy as many of the cancer cells as possible while committing as little damage to the healthy cells as possible.

Radiation therapy is used different ways.

- Destroy Tumors
- Shrink Tumors
  - Pre / Post Surgery or Chemotherapy
    - Pre – reduce size for resection
    - Post – residual / microscopic
- To reduce symptoms - Palliation
  - Shrink tumors affecting quality of life, like a lung tumor that is causing shortness of breath or tumor causing compression.

Traditional Radiation Oncology

- **Photon Beam (X-Ray):**
  Energy: 6 MV and 15 MV

- **Electron Beam:**
  Energy: 6, 9, 12, 15 and 18 Mev

Radiation Oncology QA - Dosimetry

- Treatment is the point of no return…..
- Similar to a pharmacist checking a Rx
- QA is extremely important…..
  - Short Term: Disease Management
  - Long Term: Side Effects

IBA Dosimetry Product Line

- Medical Imaging
- Radiation Therapy
  - Photon
  - Electron
  - Proton
- Software
  - MyQA Product Suite
    - Machine QA
    - Patient QA
    - Real Time Analysis
    - Trending / Analytics

Detectors

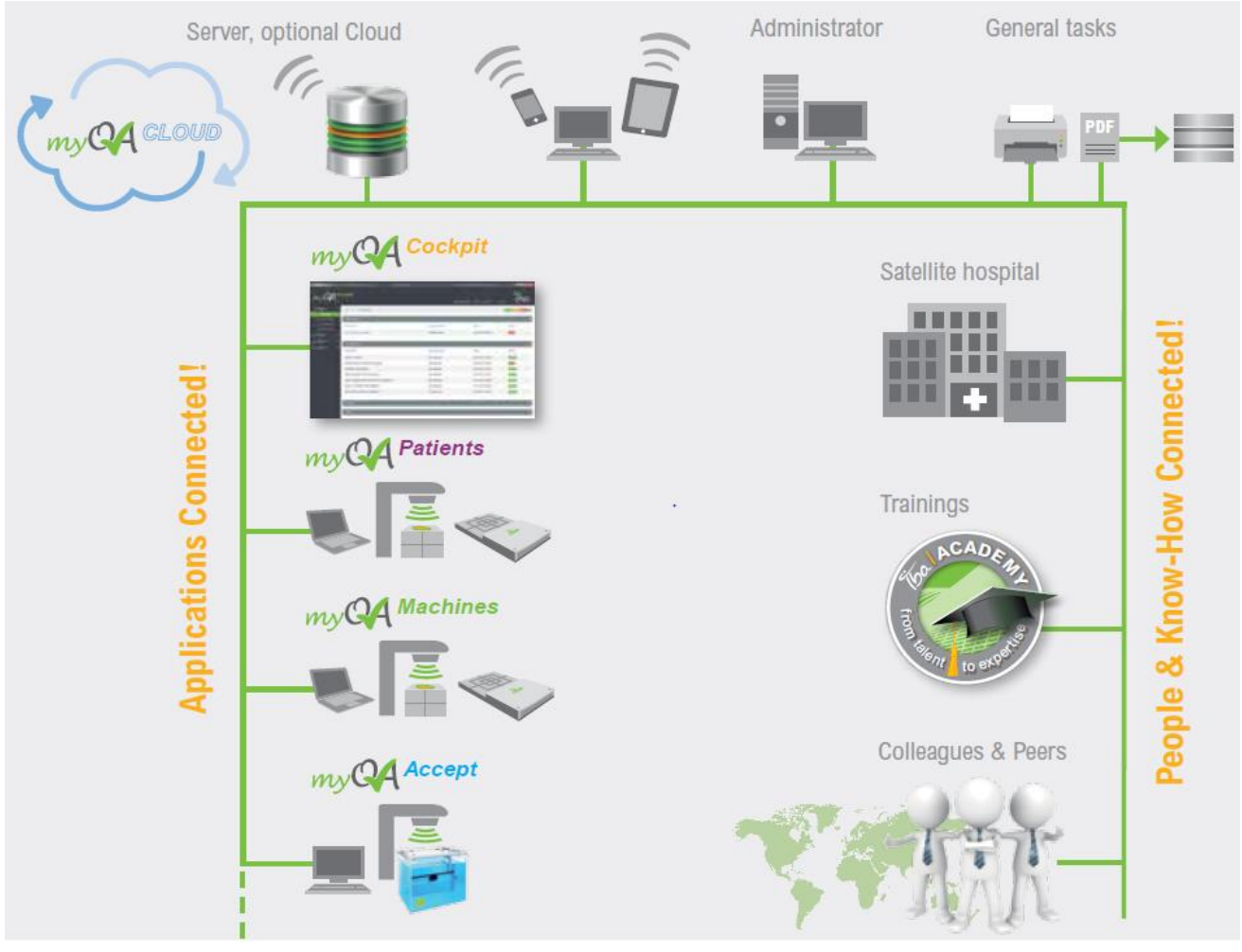
- StarTrack
  - Machine QA
  - 452 Chambers
  - 5mm Resolution

- MatriXX
  - Machine QA
  - Patient QA
  - 1020 Chambers
  - 7.6mm Resolution

myQA™
Your All-in-One Platform

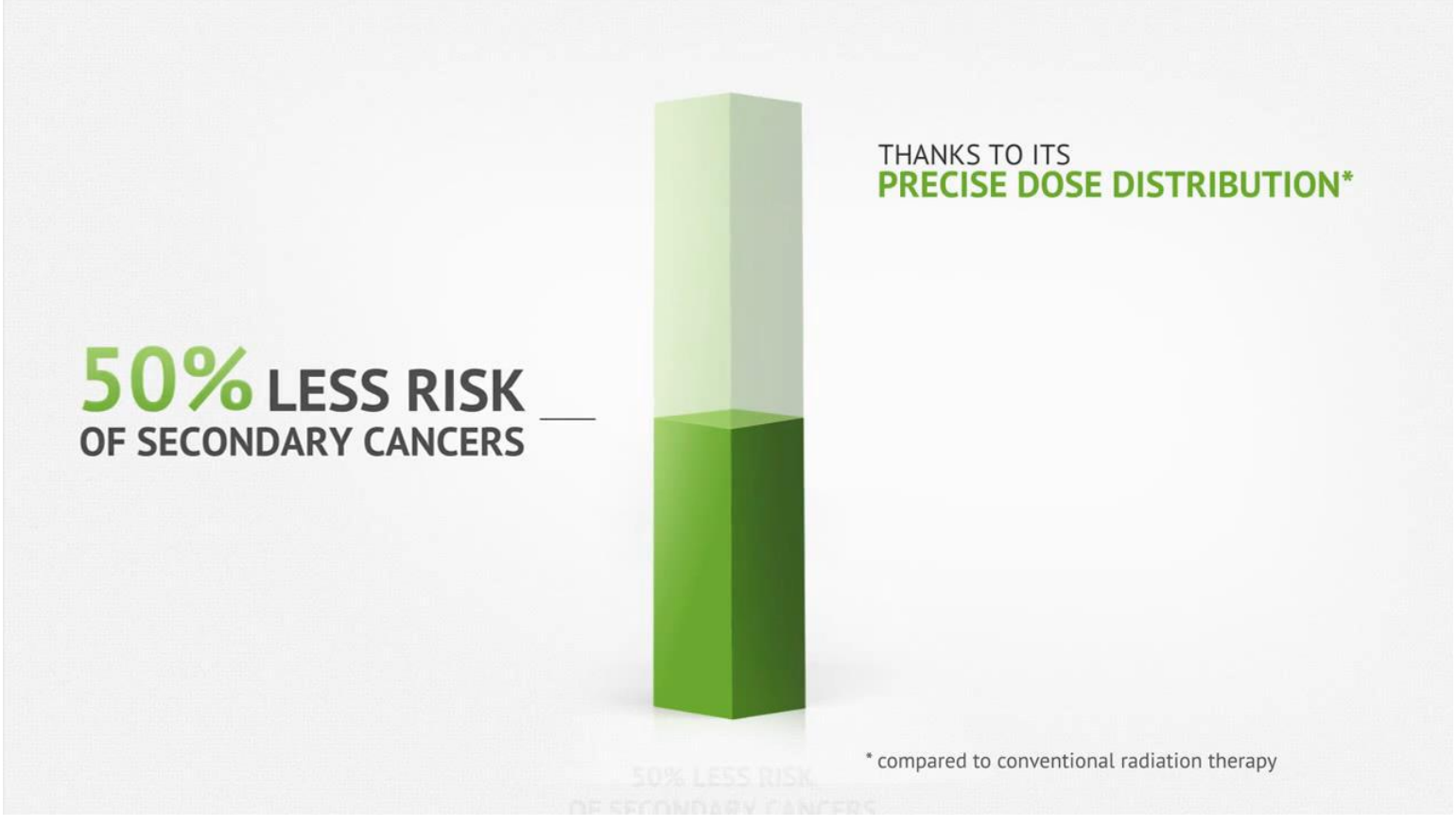
- ✓ All QA applications integrated
- ✓ Instant QA overview
- ✓ Intuitive and unique interface
- ✓ Simple and clear reporting

All data
- managed by one Platform
- saved into one database (SQL)



IBA Proton Dosimetry Product Line

- Beam Models
  - PBS
  - DS
- QA Equipment
  - Commissioning



  - Patient QA

From Commissioning to Patient QA

Blue Phantom²

Lynx PT

Commissioning

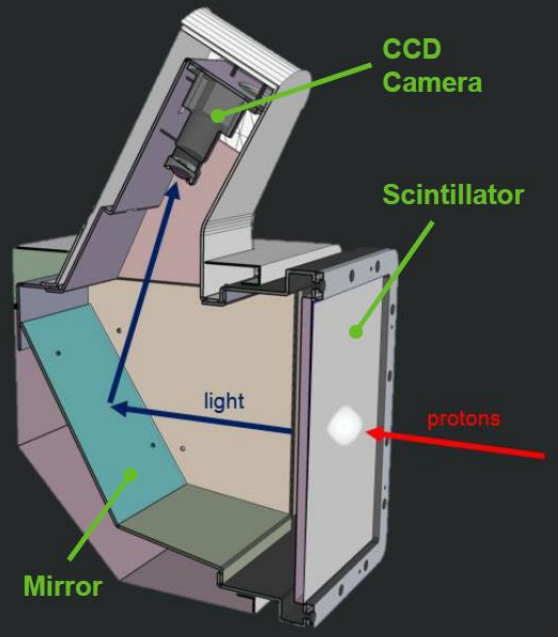
Machine QA

Patient QA

Stingray

Lynx

How it works

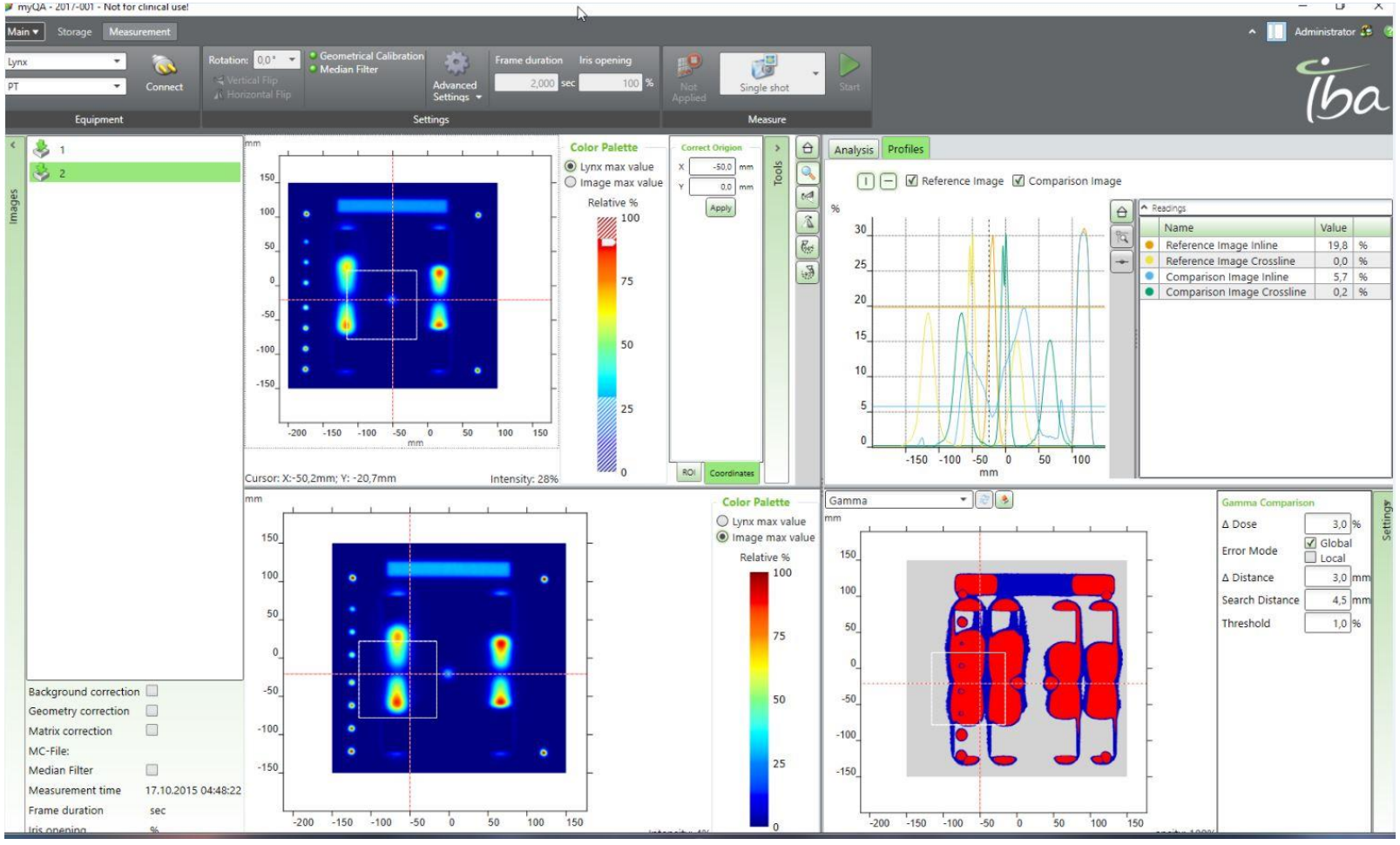


- Scintillator
  - Active surface: 30 x 30 cm
  - Gadolinium based
- Mirror
- CCD Camera
  - Resolution= 0.5 mm
  - 1024x1024, 12-bit
  - Controllable Iris
    - For beam current saturation control
  - Different modes

Protect, Enhance and Save Lives

47

MyQA – Lynx Plugin



From Commissioning to Patient QA

Blue Phantom²

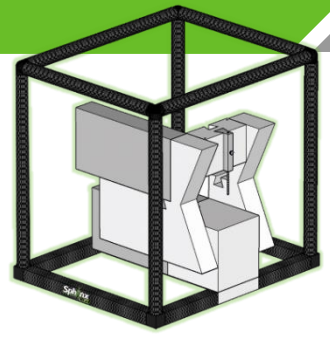
Lynx PT

Giraffe

Commissioning | Machine QA | Patient QA

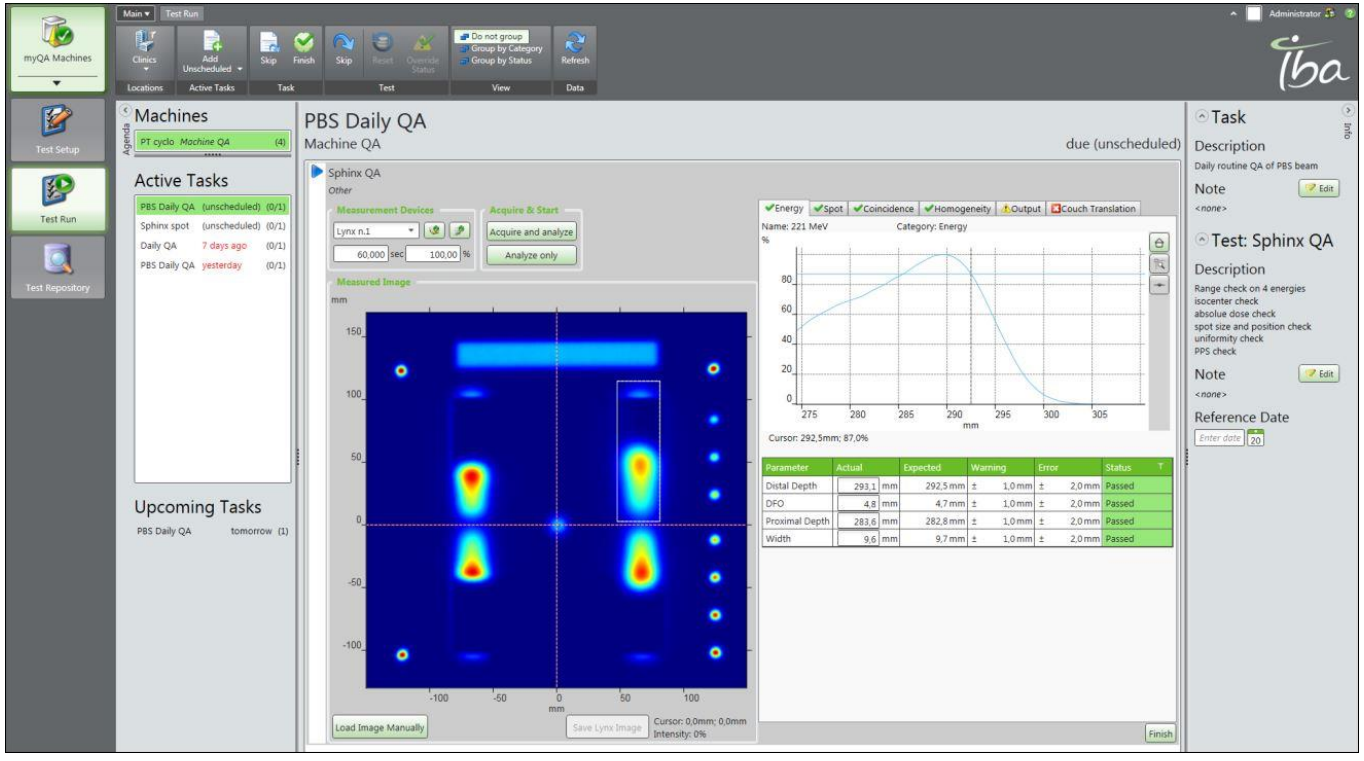
Stingray

Zebra



Sphinx PT

Sphinx - MyQA


myQA Machines
Test Setup
Test Run
Test Repository
Machines
PT cyclo Machine QA (4)
Active Tasks
PBS Daily QA (unscheduled) (0/1)
Sphinx spot (unscheduled) (0/1)
Daily QA 7 days ago (0/1)
PBS Daily QA yesterday (0/1)
Upcoming Tasks
PBS Daily QA tomorrow (1)
PBS Daily QA
Machine QA
due (unscheduled)
Sphinx QA
Other
Measurement Devices
Acquire & Start
Lynx n.1
Acquire and analyze
Analyze only
Measured Image
Energy
Spot
Coincidence
Homogeneity
Output
Couch Translation
Name: 221 MeV
Category: Energy
Cursor: 292,5mm; 87,0%
Parameter
Actual
Expected
Warning
Error
Status
Distal Depth
DFO
Proximal Depth
Width
Passed
Load Image Manually
Save Lynx Image
Finish
Task
Description
Daily routine QA of PBS beam
Note
Test: Sphinx QA
Range check on 4 energies
isocenter check
absolue dose check
spot size and position check
uniformity check
PPS check
Reference Date


Sphinx


Sphinx

From Commissioning to Patient QA

Blue Phantom²

Lynx PT

Giraffe

MatriXX PT

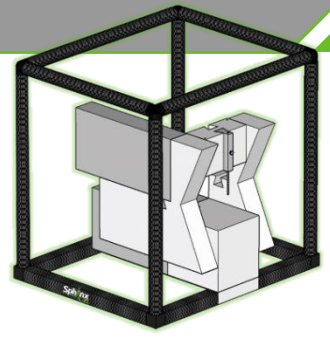
Commissioning

Machine QA

Patient QA

Stingray

Zebra



Sphinx PT

DigiPhant PT

Customer Needs / Challenges

- More Efficiency
  - Less QA Time = More Patient Care Time

- Peace of Mind
  - SBRT
    - High Dose
    - Small Fractions
    - One incorrect treatment = 20% Error

Absolute and Relative Dosimetry

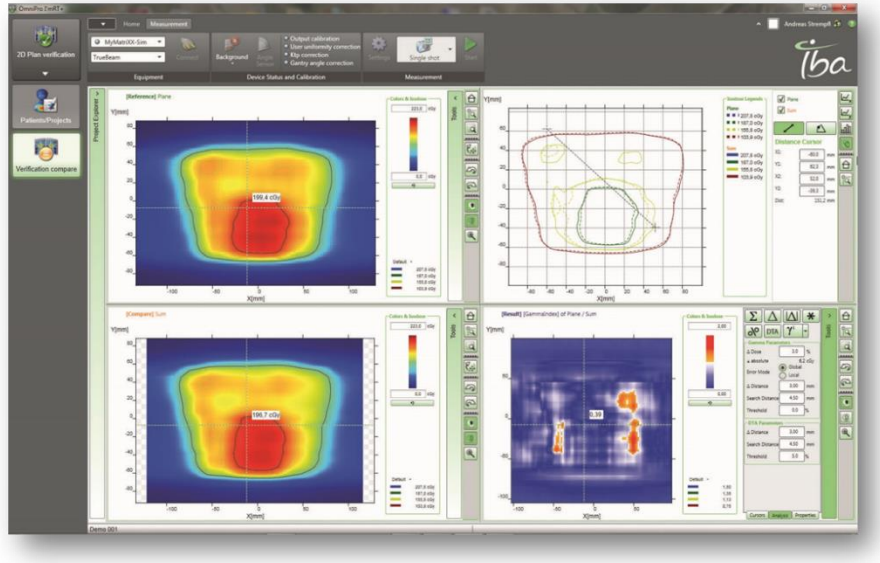
- AAPM TG 142 Protocol
- Overwhelming amount of QA for Physics teams
  - Daily, Weekly, etc.
  - kV, mV, CBCT, SRS, SBRT, etc.
- Water Phantoms
  - Cumbersome
  - Time consuming: Long setup and measurement time
  - Gold Standard

LINAC QA

- Needs
  - Equipment
    - Dosimetric
    - Imaging
    - Mechanics
- Challenges
  - Different Vendors
  - File Formats
- Solution?
  - ‘Standard’ Detectors
  - Single File Protocol

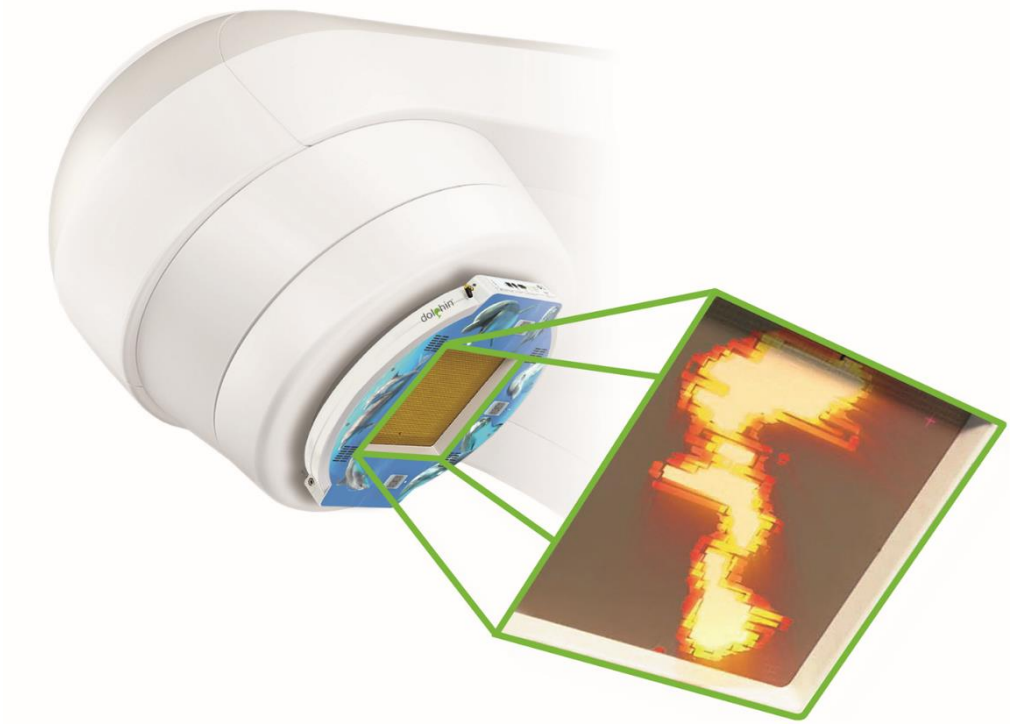
Patient Treatment QA - Pretreatment

- Most Time Intensive QA
  - Trend = Adopt Most Effective Method
    - Quick Verifications
      - EPID
      - Calibration Concerns by customers
    - Additional Measurements only when necessary (Europe)
      - Not currently strong in US
        - Mandatory
        - Reimbursed
  - Normal Fractionated IMRT
    - Solutions are abundant
    - Rotational QA
  - Stereotactic Treatment
    - Small Fields need small resolution
    - Measurement at Isocenter
    - Currently there are no good solutions



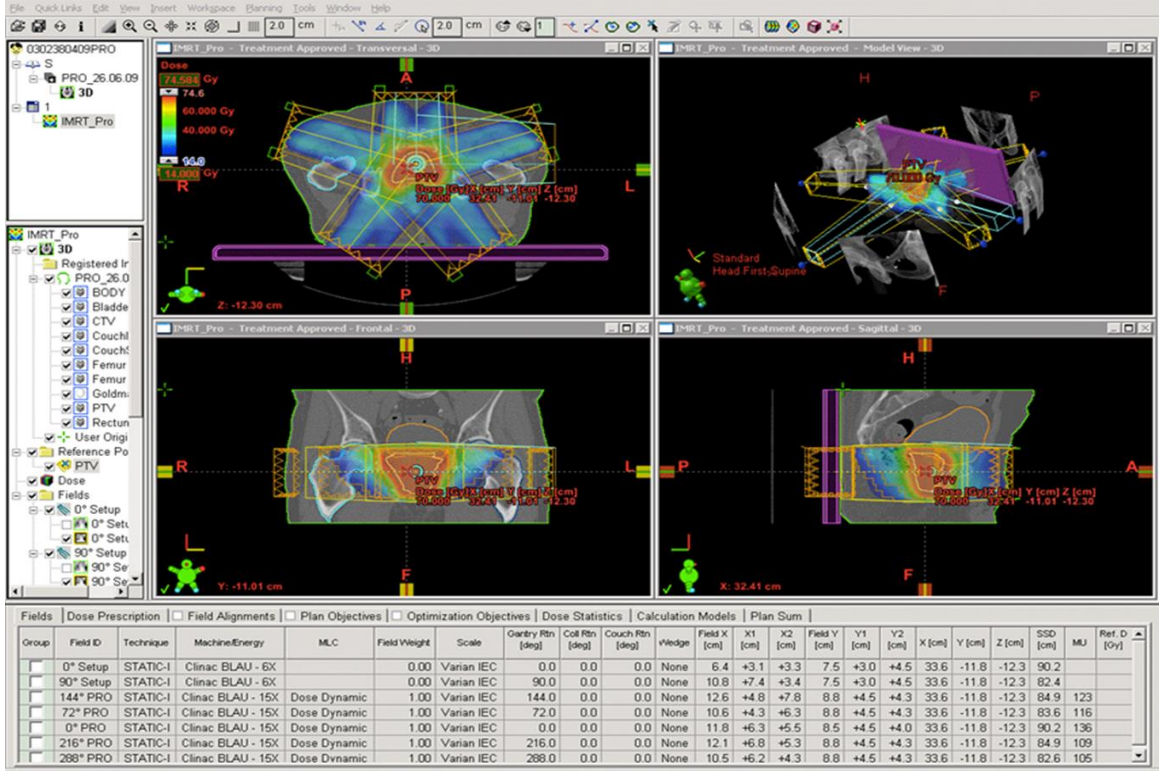
Patient Treatment QA – ‘Online’

- EPID
  - Same concerns with calibration
  - 2D Analysis
    - Good for Patient positioning and Anatomy
    - Not good for dose distribution
  - Transmission Detectors
    - Measures' ‘clean’ data without patient anatomy
    - Beam Attenuation
      - Multiple Vendors
        - Nominal Resolution
        - Pre-treatment measurement with phantom
        - No fluence map = No Dose
  - Log Files
    - Not real measurement?
    - Not independent of machine manufacturer under test



Patient QA – Data

- How is it utilized?
  - TPS
  - QA Dose Engines
  - Adaptive Radiation Therapy (Real Time)
    - Registration of Components
      - CBCT
      - Dose Distribution
      - Planning CT
  - Leads to Automated Re-planning
  - Requires more patient time
  - Requires more CMD resources



Additional Challenges

- Many Vendors
  - Different File formats
  - Competition – leads to inability to work together for a solution
    - Proprietary Hardware / Software
- MR Linacs
  - Elekta
  - ViewRay
- IT
  - Network Concerns
    - Data Breaches
    - Wireless Connectivity
    - HIPAA
- Cardiac Treatments

Future?

- AI
- New Technologies
- More Automation

Thank you for your time!