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ArcCHECK™

3-DVH Analytik und Planverifikation basierend auf ArcCHECK - Messungen und Patientenplan - und -strukturdaten

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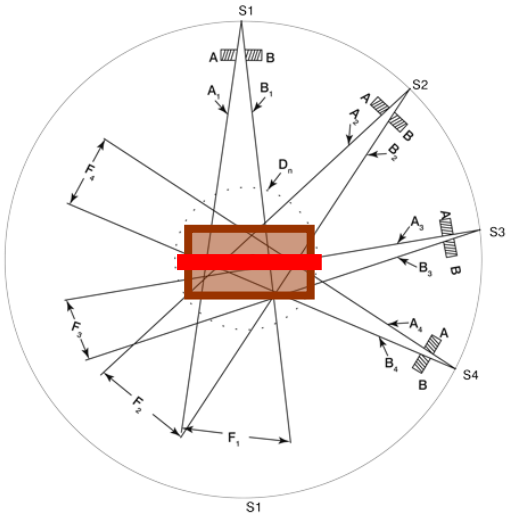
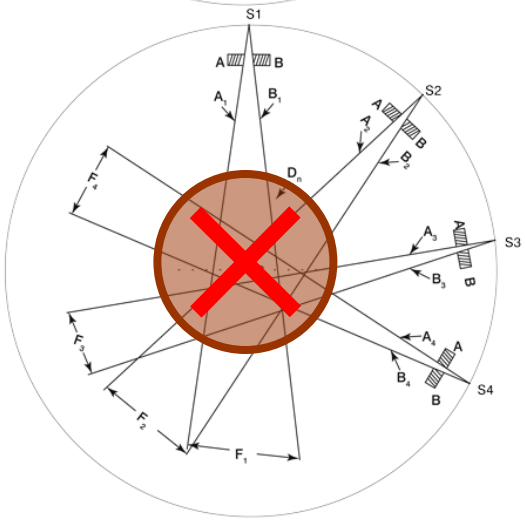
DGMP AK IMRT Hamburg, Donnerstag, den 07.04.2011

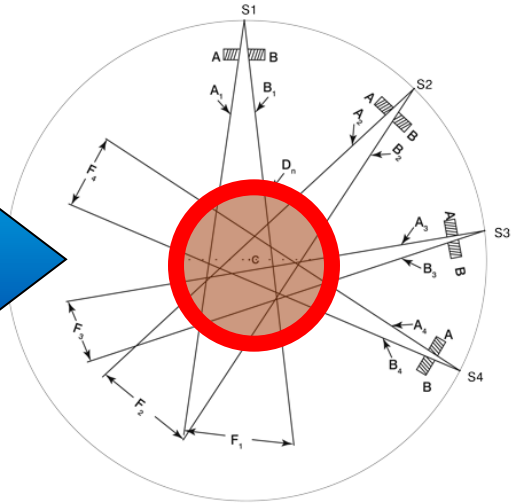
Your Most Valuable QA & Dosimetry Tools

The Future in 3D



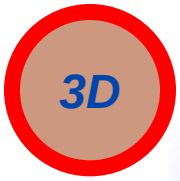


Make the detector plane "coherent" to the beam



Is this 3D?

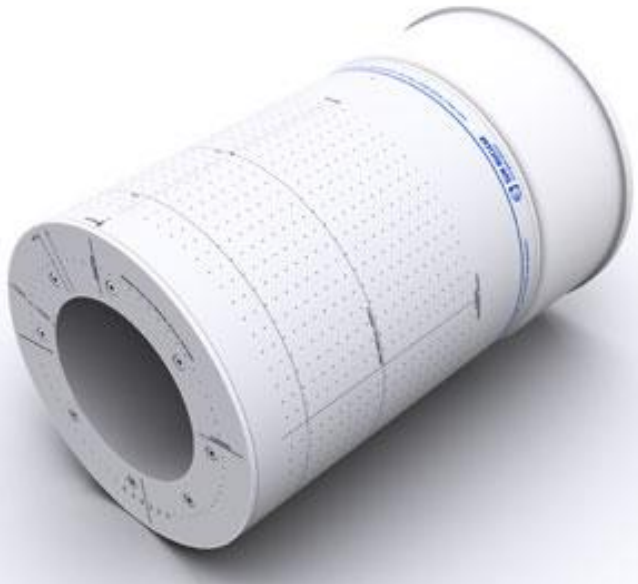
→ ***Yes!***



An isotropic 3D array is defined by the detector geometry, not just by the phantom shape around the detectors!

ArcCHECK Introduction

- Designed for Helical & Arc Delivery
  - **RapidArc®, TomoTherapy®, VMAT**
- **1386** diodes in a helical geometry
  - This detector geometry is patent pending
- 21cm diameter, 21cm length
- 1cm spacing, 2.9cm depth (3.3 cm effective)
- Weight: 16kg
- 4th Dimension = Time
  - **50ms update frequency**



ArcCHECK Easy Setup

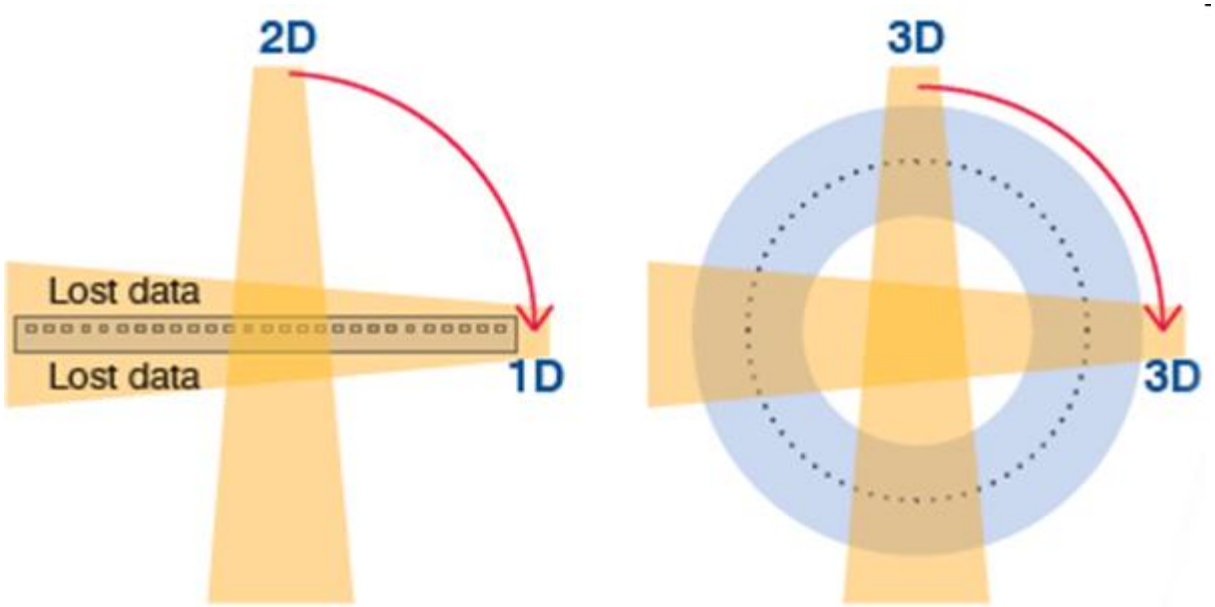
As with all Sun Nuclear solutions, efficiency is an essential part of the ArcCHECK design:

- Single power/data cable
  - Manages all power and data in one connection.
- Integrated electronics
  - ArcCHECK is self-contained with no electronics to setup separately
  - A separate phantom is not needed as with 2D arrays
- Lightweight (16kg)
  - ArcCHECK is easily portable for daily use without the need for a separate cart

Detector Geometry - Coherent

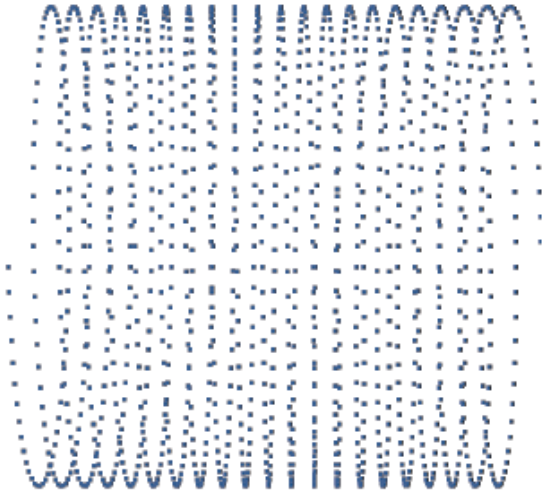
- A 2D array irradiated from the side effectively becomes one dimensional
  - Shadowing effect normally present
  - Even if no shadowing, significant information is lost

- ArcCHECK detectors stay coherent to the beam regardless of gantry angle



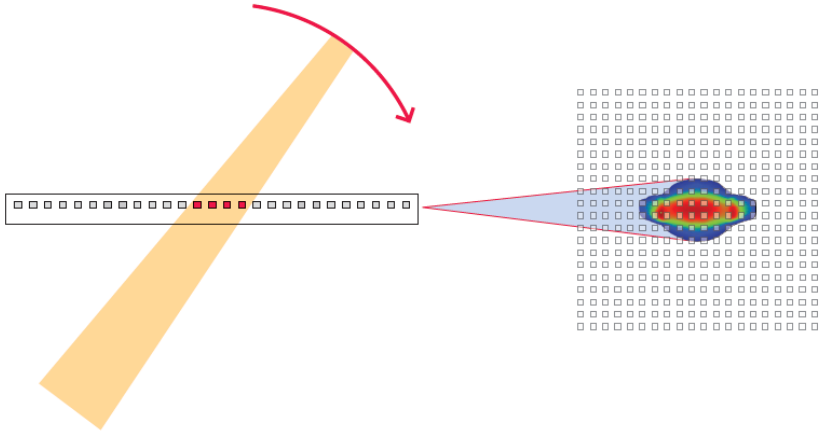
Detector Geometry

- Entrance and exit dose are measured
  - Effectively doubling the detector density in the measurement field.
- Central 10x10 contains approximately 221 detectors - same as MapCHECK 2 10x10
- Detectors are arranged on a HeliGrid™
  - Increase the sampling rate and reduce detector overlap from the Beams Eye View (BEV)
- Entrance and exit dose can be correlated to determine gantry angle

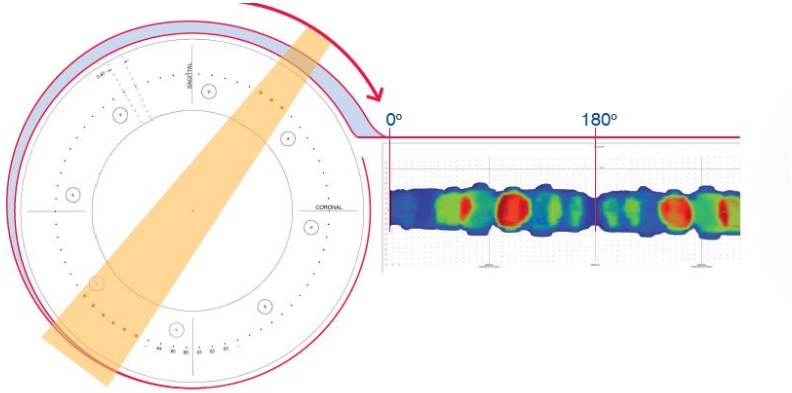


2D versus ArcCHECK

- What you see with a 2D array

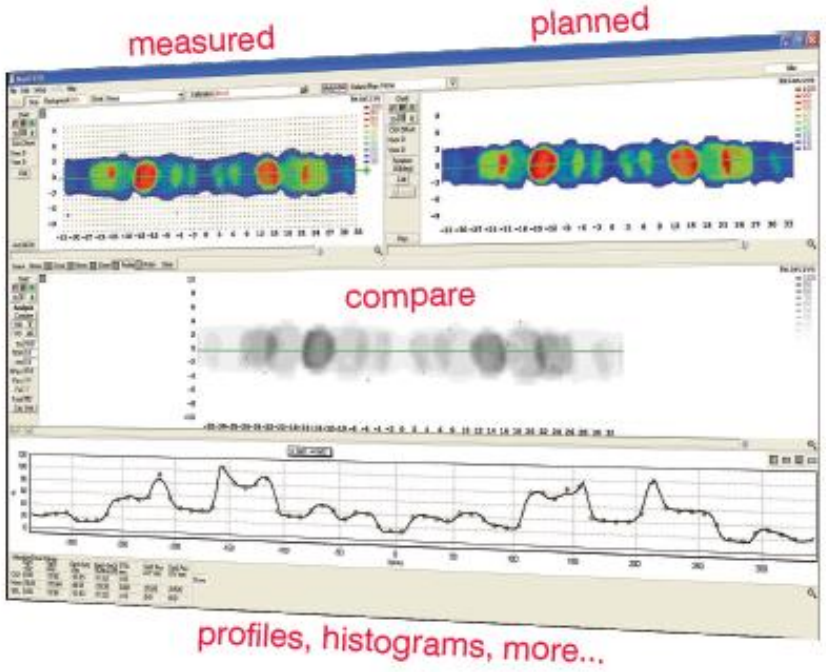


- What you see with ArcCHECK



ArcCHECK Software

- The ArcCHECK interface is a new version of MapCHECK software
  - ArcCHECK QA plans are in three dimensions
    - DICOM RT Dose is imported and ArcCHECK software then extracts 3D dose corresponding to detector locations, and performs a comparison
  - Same analysis and workflow options from MapCHECK are available in ArcCHECK
  - All data files from ArcCHECK are an open format for easy export, including raw data



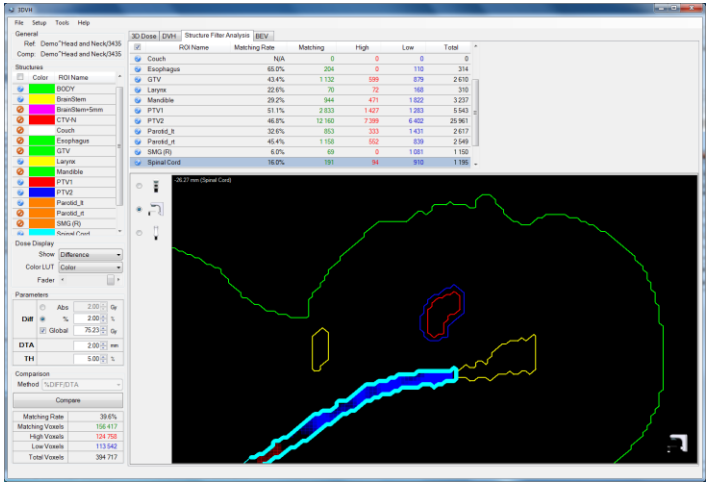
Cavity Plug (Option)

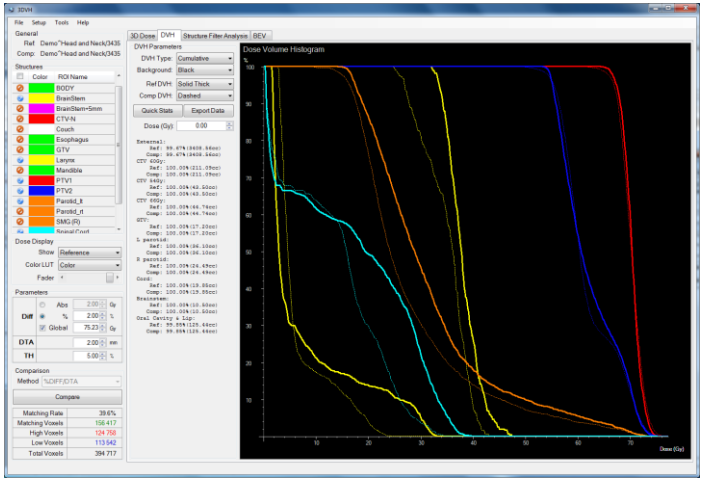
- ArcCHECK features a versatile central cavity for capturing isocenter dose
  - May be used to accommodate different detectors and inserts
  - With the cavity empty the ArcCHECK weighs only 16kg making it very easy to move and setup
  - Empty cavity tests the TPS inhomogeneity planning **Option**

3DVH™ Option

- Expected release is November, 2010

- The most advanced 3D patient dose and DVH tools available
  - Uses existing measurements
  - No secondary dose calculation
  - 3D dose and DVH analysis on patient geometry (not phantom geometry)





What is “3DVH”?

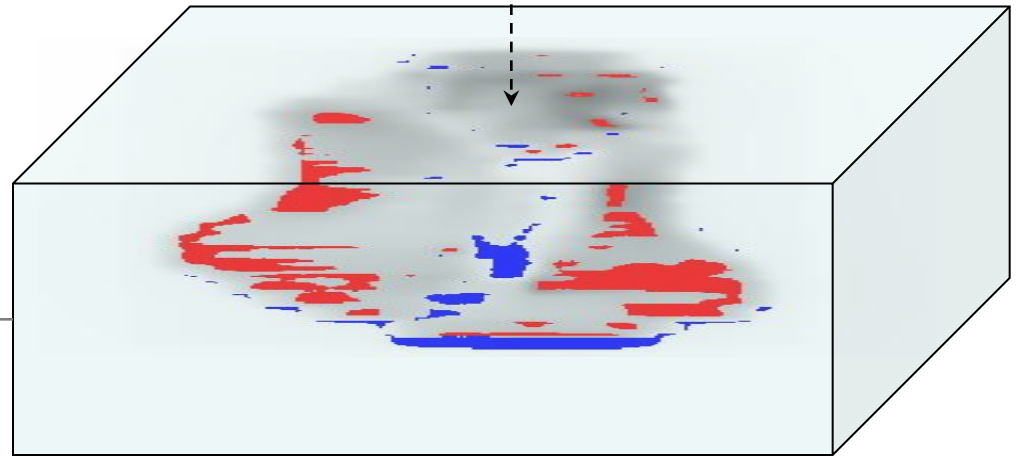
- **Next Generation System for Dose QA**
  - **Dose-to-Patient** estimated (no more guessing based on dose-to-phantom)
- **Unrivaled Analysis Tools for 3D Dose & DVH**
  - Designed for the Physicist/Dosimetrist/Physician who **“wants it all”** in one **easy-to-use** system.
- **Multiple and Distinct Uses:**
  1. **IMRT QA with Clinically-Relevant Analysis**
     - Use conventional Dose QA tools to accurately predict dose in the patient using novel “PDP” method (*Patent Pending*)
  2. **Universal Plan Comparison**
     - Compare and analyze Dose/DVH from any DICOM RT datasets (all TPS, all delivery modalities, all calculation settings, …)

Dose QA Today

What do these errors mean?

Are they clinically significant?

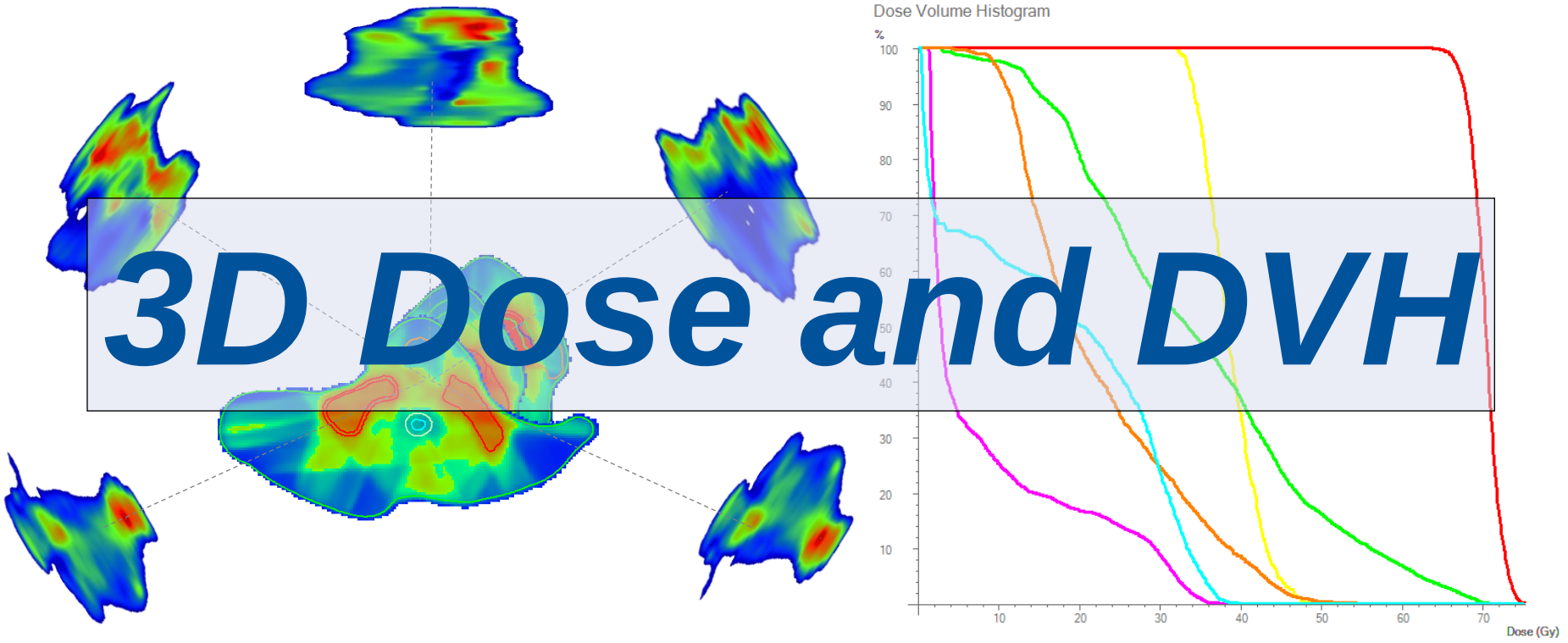
What passing criteria are best?



How Should We Approve Dose QA for a Plan?

- We learn a lot from diligent Dose (IMRT) QA…
  - We detect delivery errors.
  - We detect TPS errors and imperfections.
  - We fix the problems.
- But we still do not know which Dose (IMRT) QA Criteria are good predictors of the impact to patient dose…
  - Thought questions:
    - Why did you choose your % difference/DTA/Gamma criteria? Do you know what your "%" is really a % of (i.e. what is the absolute dose error for X%)?
    - How do 3% / 3 mm DTA results correlate to 3% / 3 mm DTA results in the patient?
- Let us return to a simple question:
  - How was the plan dose approved in the first place?

How was the TPS Plan Approved?



How Should We Approve Dose QA for a Plan?

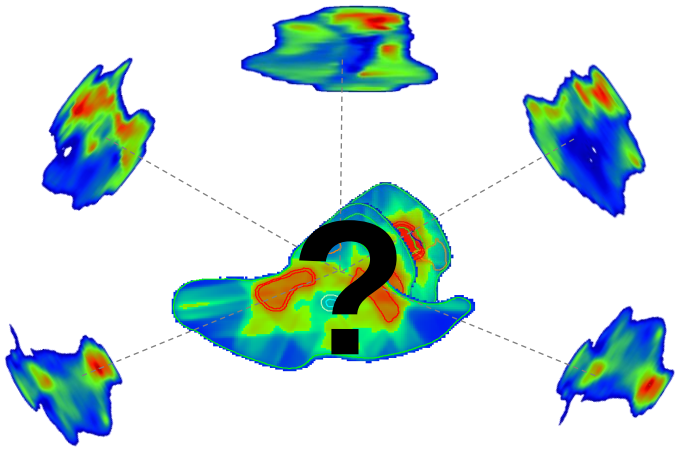
3D Dose and DVH

Ways to Estimate Patient Dose

1. **Derived Fluence => Forward Dose Calculation**
   - Beam fluence is estimated from some form of measurement
   - Full forward dose calculation algorithm calculates dose in patient (like a TPS)

2. **3DVH's Planned Dose Perturbation* (PDP)**
   - Conventional Dose QA errors act as input into a perturbation algorithm
   - The original TPS planned dose (in patient) is "perturbed" to yield a corrected dose

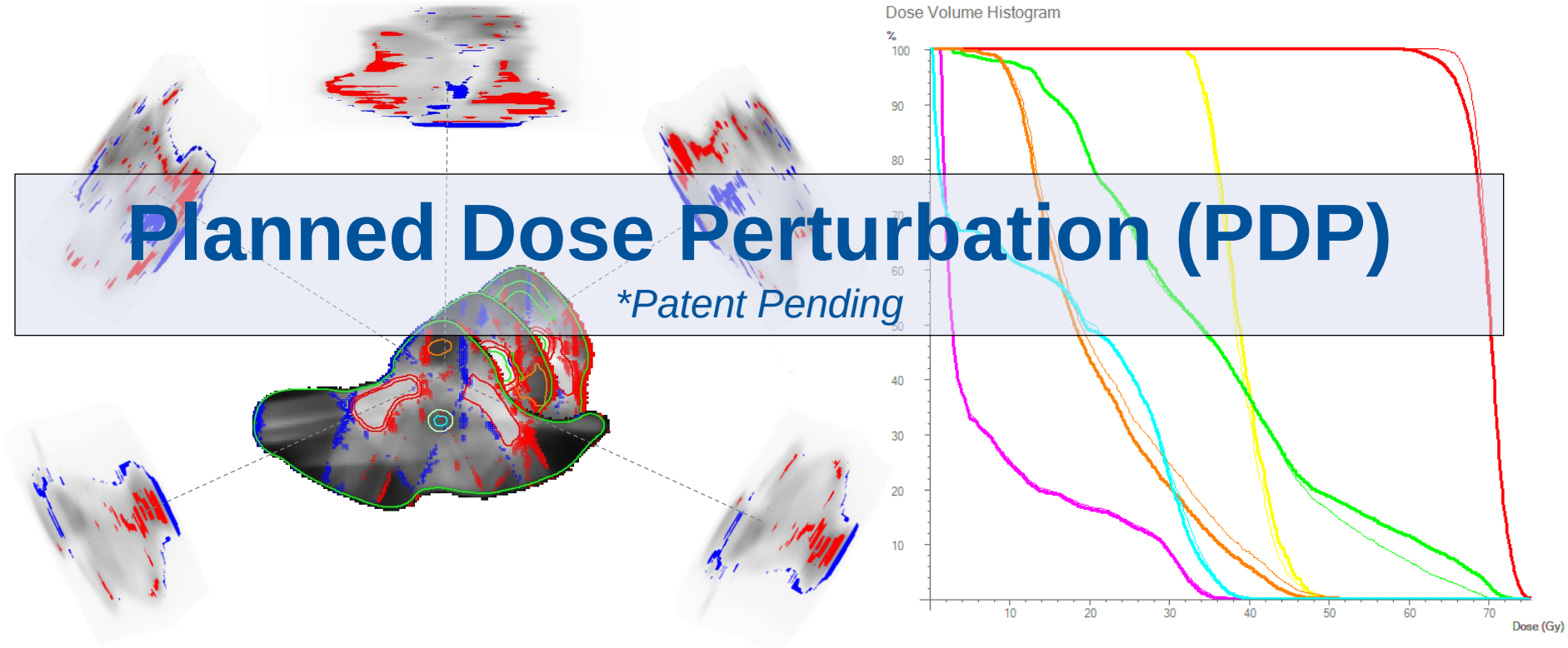
3DVH is not another Dose Algorithm !!



Replacing Dose/IMRT QA with an independent dose calculation algorithm introduces more potential questions…

- Is the QA dose calculation algorithm any better than your TPS?
- Does the dose calculation algorithm introduce errors which were not there to begin with?
- How long will this independent calculation take?
- What additional commissioning effort is needed?

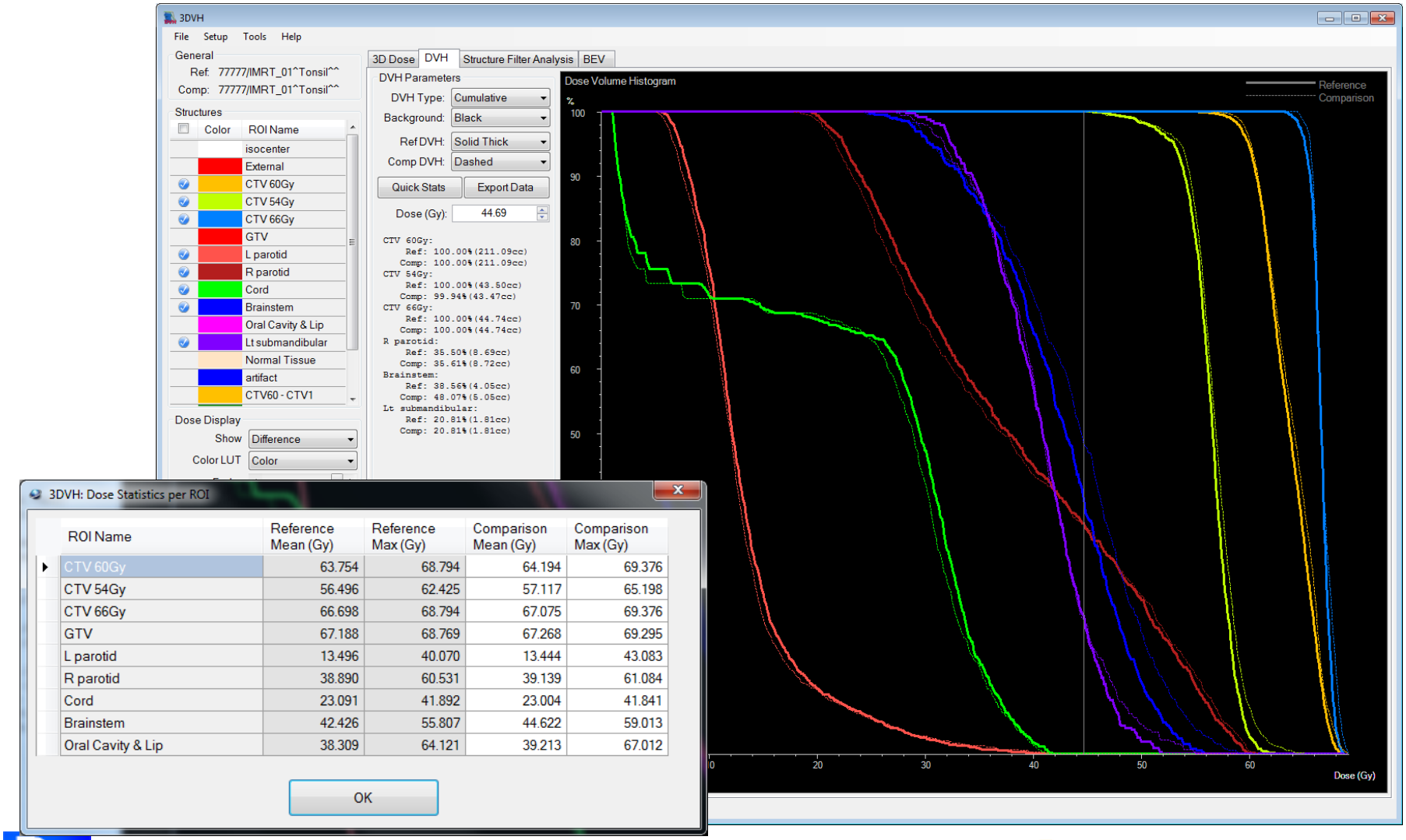
Proven Accuracy with **PDP™**



Planned Dose Perturbation (PDP)

**Patent Pending*

3DVH: Patient Dose & DVH QA



3DVH: Dose Statistics per ROI

ROI Name	Reference Mean (Gy)	Reference Max (Gy)	Comparison Mean (Gy)	Comparison Max (Gy)
CTV 60Gy	63.754	68.794	64.194	69.376
CTV 54Gy	56.496	62.425	57.117	65.198
CTV 66Gy	66.698	68.794	67.075	69.376
GTV	67.188	68.769	67.268	69.295
L parotid	13.496	40.070	13.444	43.083
R parotid	38.890	60.531	39.139	61.084
Cord	23.091	41.892	23.004	41.841
Brainstem	42.426	55.807	44.622	59.013
Oral Cavity & Lip	38.309	64.121	39.213	67.012

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Thank you,

Questions?

Your Most Valuable QA & Dosimetry Tools