



# End to End Motion QA in Radiation Therapy Treatment Planning

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# Rocco Flores M.R.T.(T)

Clinical Application Specialist

20 years clinical experience as a Radiation Therapist

Specialize in sales and marketing and product development





## End to End Motion QA in Radiation Therapy Treatment Planning

Why is there a need for 4D IGRT?

- Reduction of treatment volumes

- Methods of mitigating patient motion

End to End QA using Modus QA Phantoms

- CT-based systems

- MR-based systems



# Why Is There a Need for 4D IGRT?

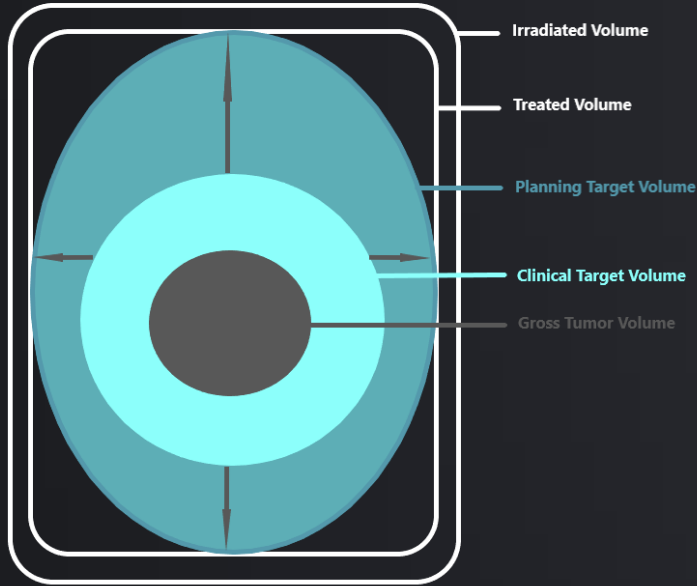


During treatment planning, margins are contoured around target volumes.

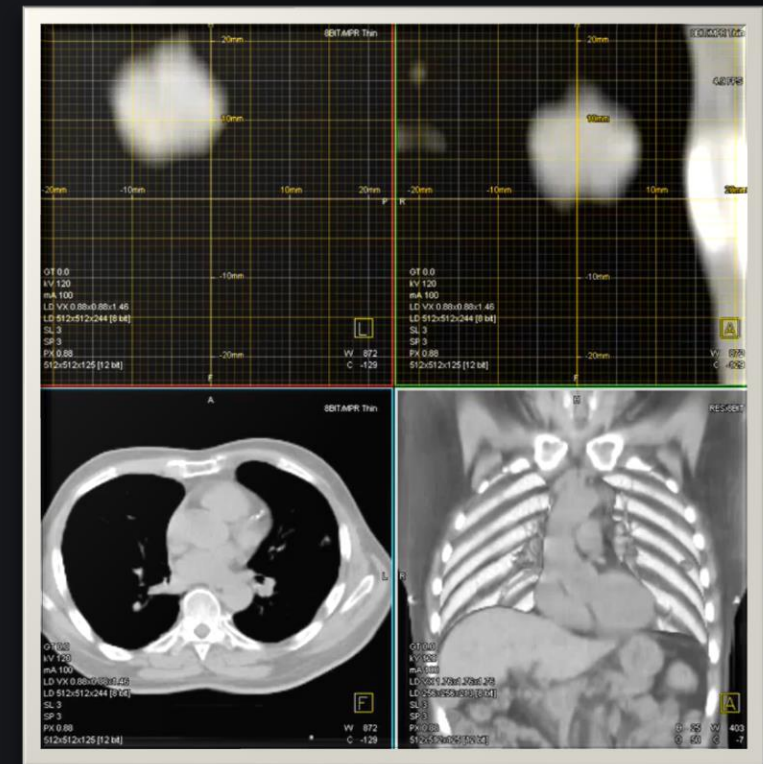
However most tumors are not stationary and exhibit deformation. Volumes closer to the diaphragm can exhibit significant intra-fraction motion.

Without motion guidance, treatment volumes need to increase significantly, causing unnecessary irradiation of healthy tissues, limiting the total therapeutic dose that can be delivered.

4D IGRT offers the ability to increase the therapeutic dose and spare healthy tissues, significantly improving patient outcomes.



Adapted from ICRU Report 50



Courtesy of University of Iowa Health care <https://youtu.be/nZ044EicYO4>

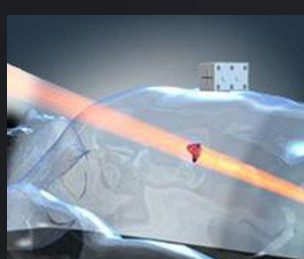


# Mitigating Patient Motion



## Traditional Methods

### Beam Gating



Traditional techniques focus on restricting tumor motion or coordinating treatment delivery with a surface tracking device or SGRT.

Images Courtesy of Elekta.com, Civco.com, Varian.com

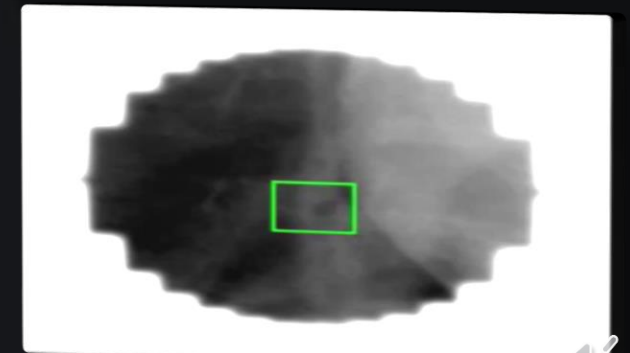
## Advancing Methods

### Live Beam Gating and Adaptive Beam Tracking



Video Courtesy of Viewray.com

Advanced techniques focus on live gating or beam tracking delivery using advanced delivery systems such as MR-LINACs.



Video Courtesy of Dr. Per Poulsen, Aarhus University Hospital, Denmark





# System QA Versatility

**MODUS QA**



Image Courtesy of Elekta.com



Image Courtesy of Varian.com



Image Courtesy of Elekta.com



Image Courtesy of Accuray.com

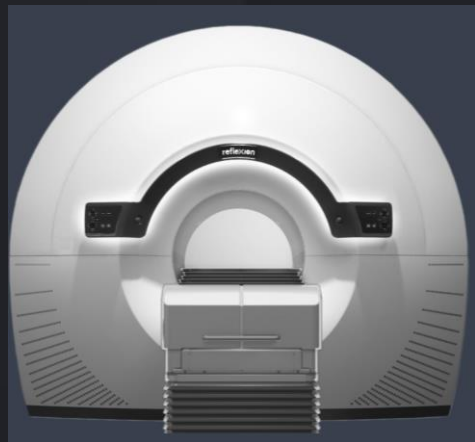


Image Courtesy of Reflexion.com



Image Courtesy of GE Healthcare.com



Image Courtesy of Usa.philips.com



# MODUS QA Solutions

pRE SP  



MODUS QA 

pRESP Motion Platform

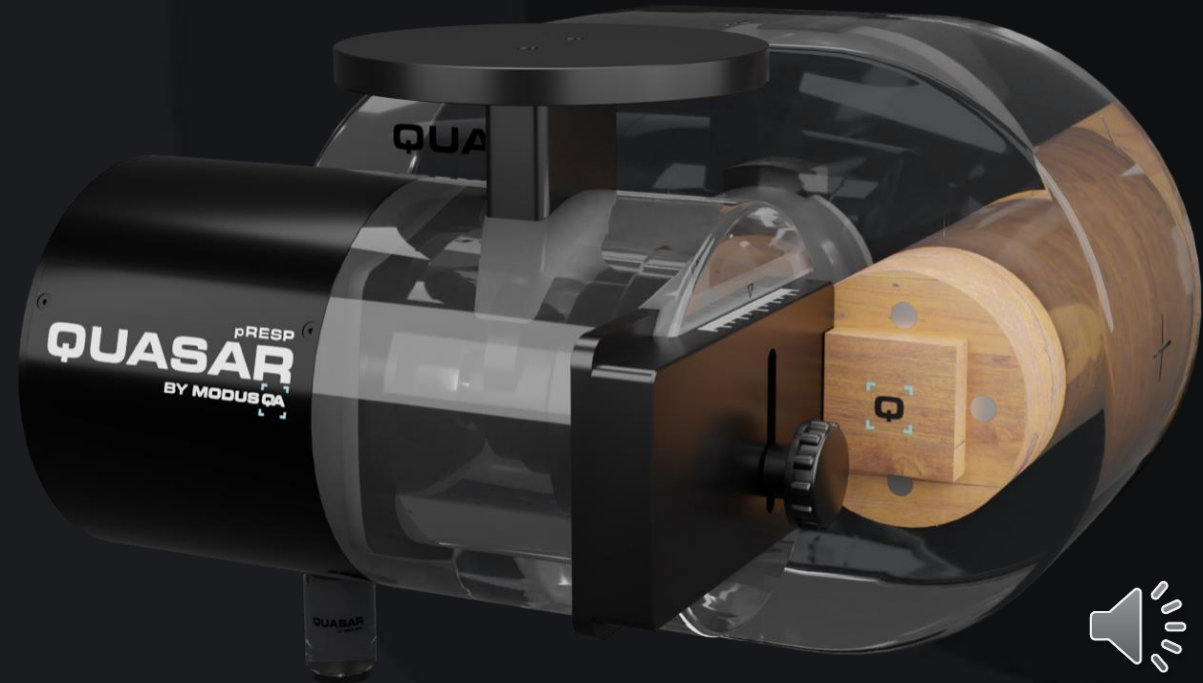


MRI<sub>D</sub>4   



# MODUS QA pRESP

MODUS QA

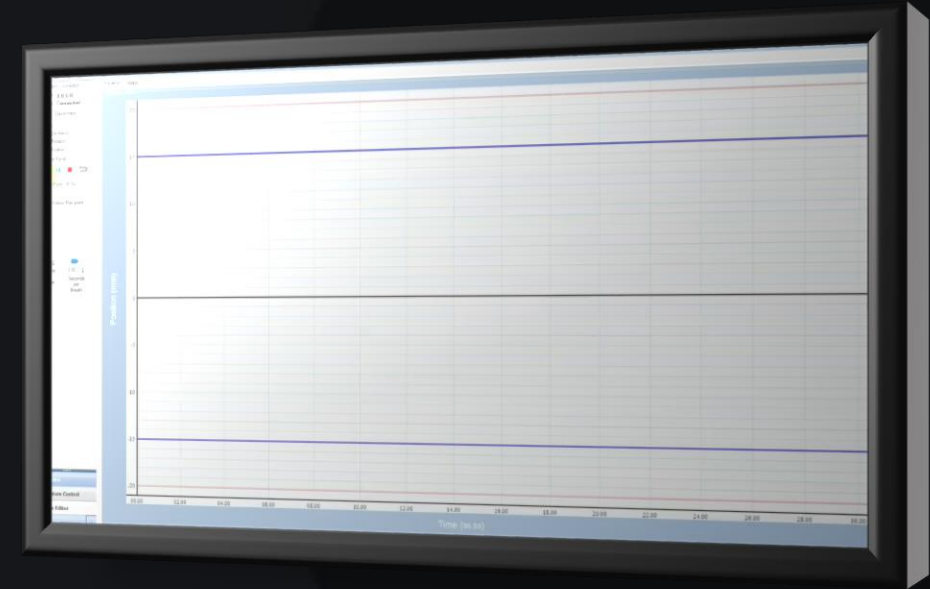




# MODUS QA pRESP Motion Platform



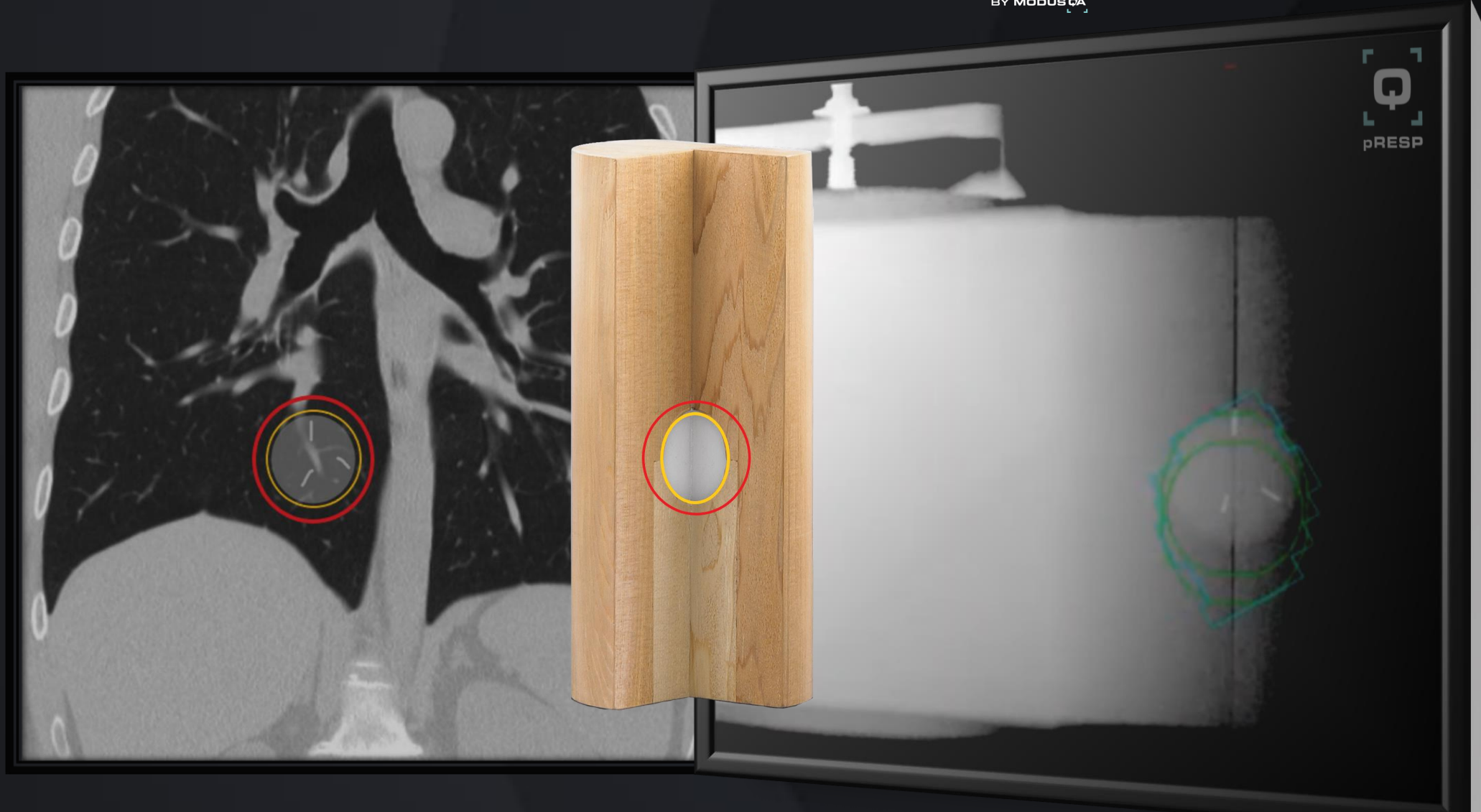
MODUS QA



# CT-Based QA

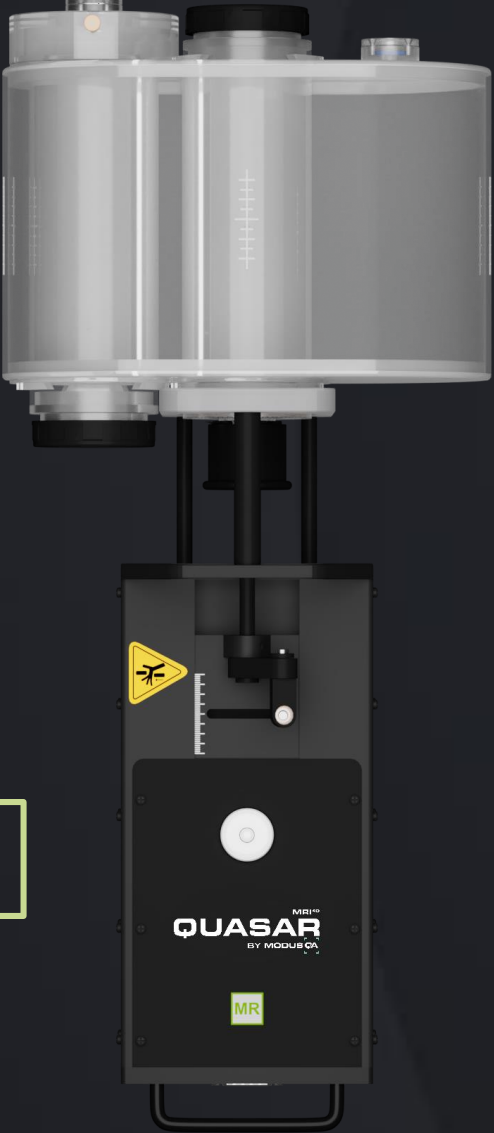
CT planned SBRT-type treatment with CBCT verification

**QUASAR**  
pRESP  
BY MODUS QA



# MODUS QA MRI<sup>4D</sup>

MODUS QA



MR CT PET

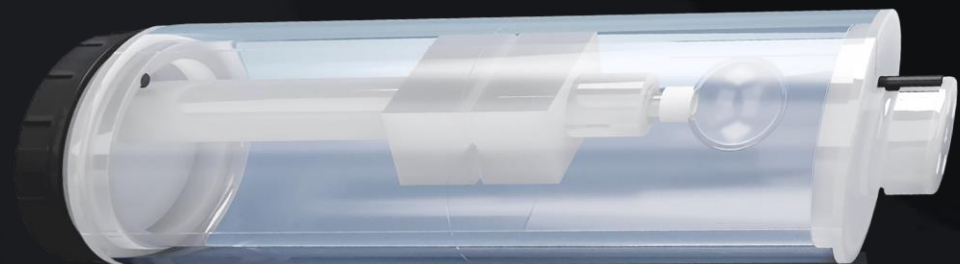
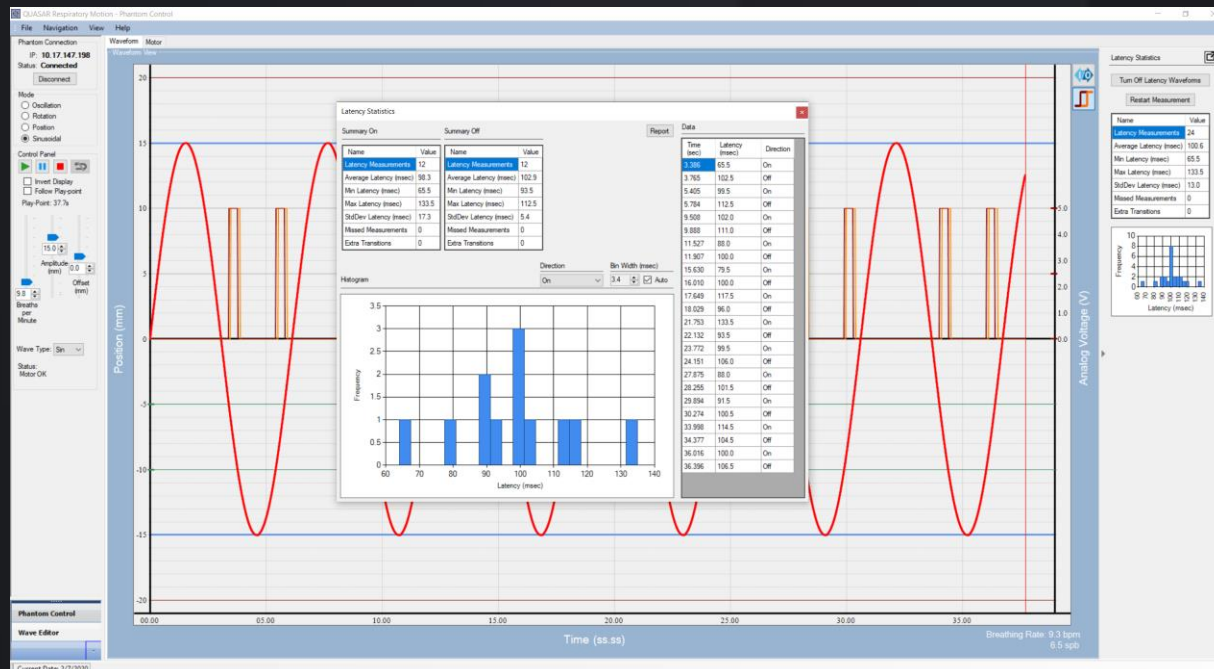
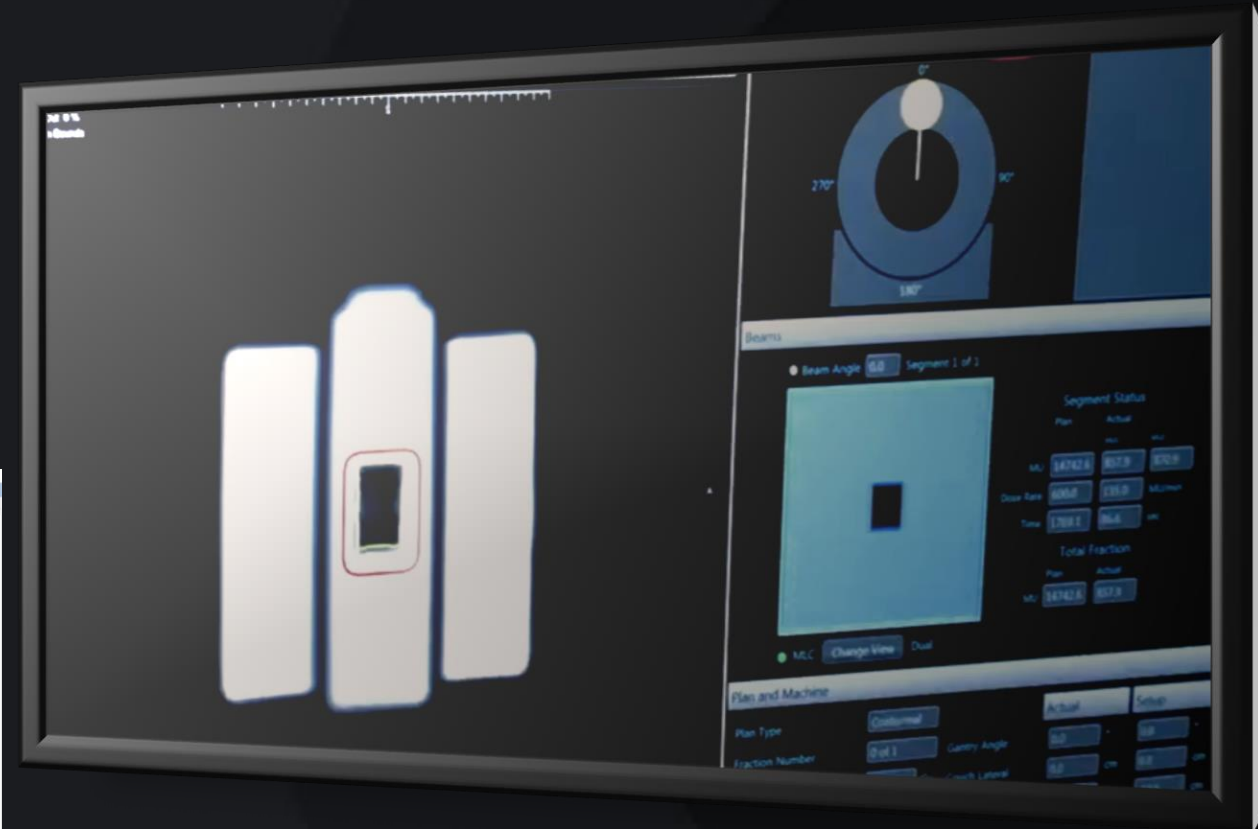




# MRI<sup>4D</sup> System Latency QA

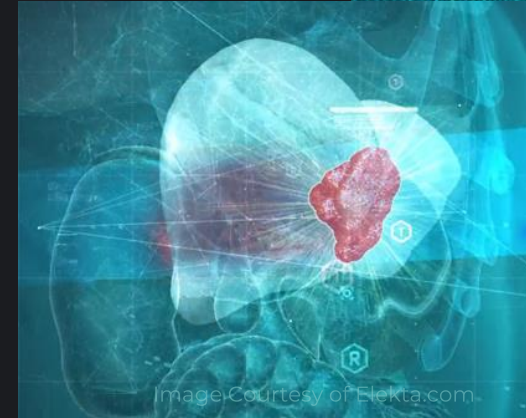
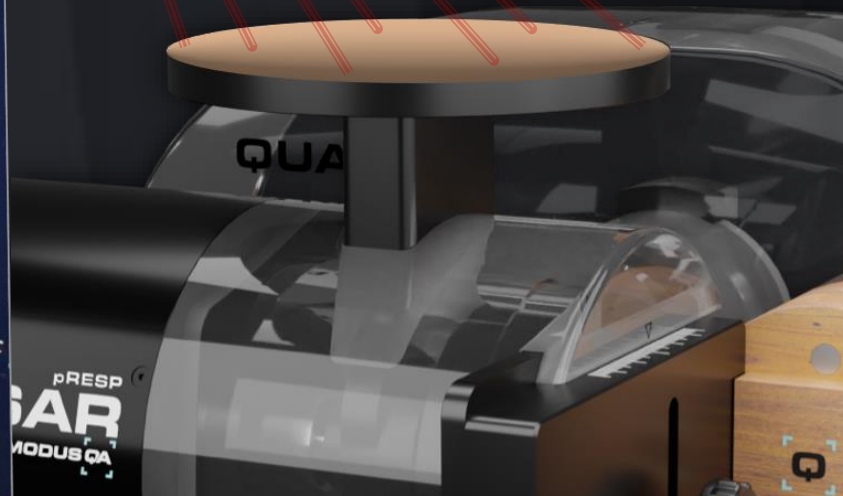
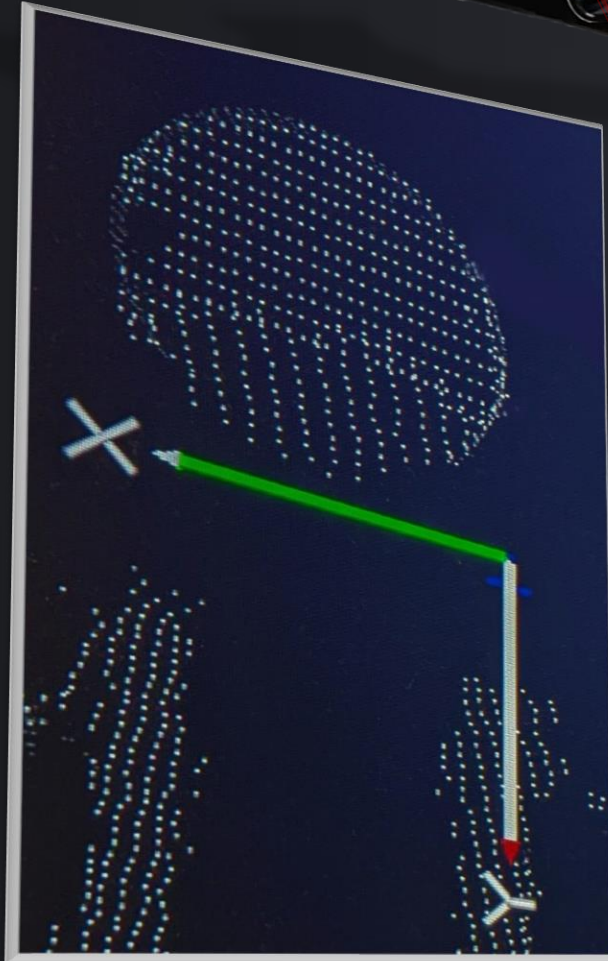


Evaluate total system latency without the need of an external oscilloscope using the MRI<sup>4D</sup> gating signal input and outputs.



**MODUS QA**

SGRT QA



All 3 featured devices are compatible with SGRT tracking systems. The chest wall platform can be modified to capture the breathing motion profile in relation to the internal tumor motion.





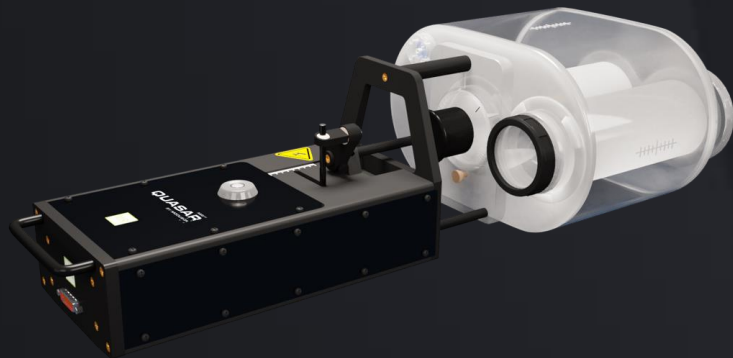
# MODUS QA

A new generation of adaptive radiotherapy systems is set to transform workflows in the radiation oncology clinic.

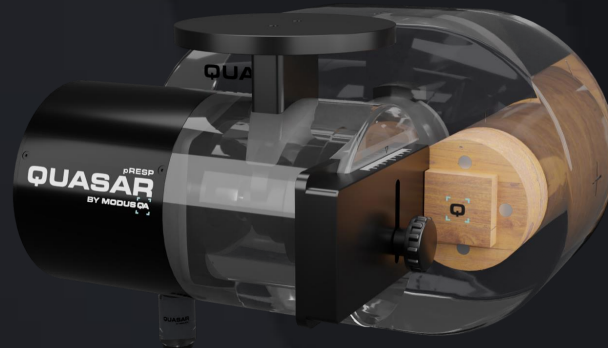
The ability to **visualize the tumour target during treatment and adapting radiation dose in real-time**, improves patient outcomes.

Adapting for motion requires advanced QA tools including the 4D motion management solutions by Modus QA.

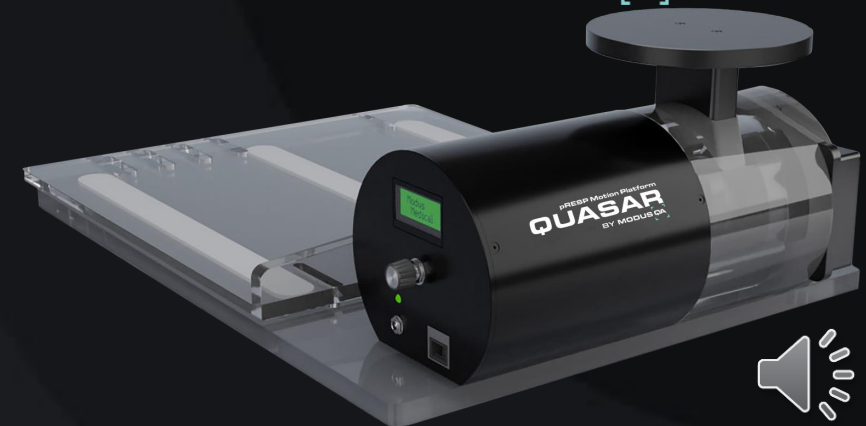
MRI<sup>4D</sup>  
**QUASAR**  
BY MODUS QA



pRESP  
**QUASAR**  
BY MODUS QA



pRESP Motion Platform  
**QUASAR**  
BY MODUS QA





Thank-you for your time during the AAPM/COMP Virtual Meeting

For more information on End to End Motion QA in Radiation Therapy Treatment Planning or any other Quality Assurance needs, please visit:

[www.modusqa.com](http://www.modusqa.com)

