ICTP November 7th, 2025

NHS Humber Health Partnership

VERT – a computer simulation tool for radiotherapy training: case study TRS398/483

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If you see this ….

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…..You might want to snap a picture with your phone

Might be something useful to refer back to when we do the practical session after the coffee break

Declaration

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I am a co-inventor of VERT, Founder and Director of Vertual Ltd

Real World

VERT World

Background - Andy

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- Radiotherapy Physicist since 1992
- Head of Medical Physics in East Yorkshire, UK
  - Appointed as Medical Physics Expert ‘by’ Secretary of State
  - Lead Healthcare Scientist for hospital system of 17000 employees
- Founder/ CSO/ Radiotherapy Director of Vertual Ltd
- UK Pioneer/ advocate of high-end RT clinical applications
- Comprehensive background in RT/ imaging
- Well published – varied research
- Experience teacher/ educator (internationally)
- International network of collaborators

- Innovator/ advocate of computer simulation training for RT
- Guided our department through developments from 2D/Cobalt therapy to IG/IMRT

Background – Vertual/ VERT

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Established 2007

Algeria, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, England, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Malta, Mexico, Morocco, Netherlands, New Zealand, Northern Ireland, Poland, Russia, Saudi Arabia, Scotland, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, United States, Wales

Bring the Linac into the classroom!

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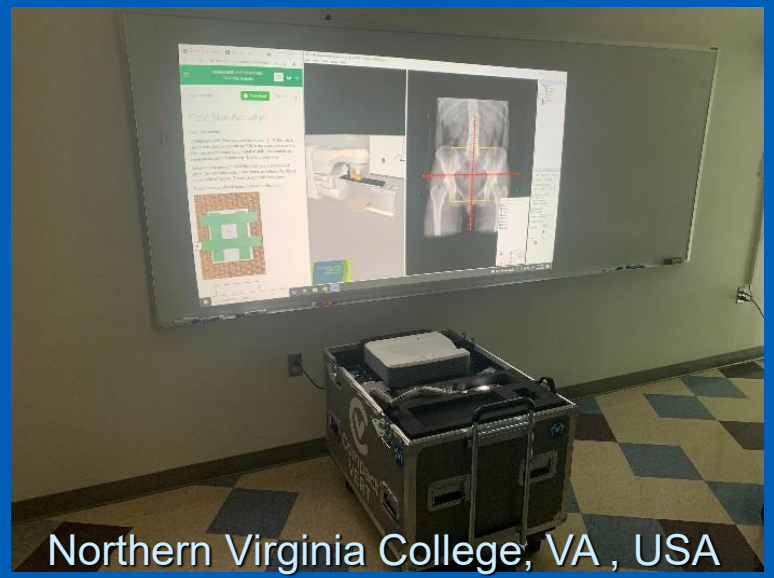
Immersive VERT

MD Anderson, Houston, Tx, USA

Seminar VERT

Grote Schuur, Cape Town, SA

Compat VERT



Northern Virginia College, VA , USA

- Turn-key systems
- Incl training the trainer
- Install into training centres
- ‘traditional VERT systems’

VERT software

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- Accurate 3D Linac models
- Use DICOM data from local TPS, to simulate:
  - Patient, PTVs, OARs, imaging, delivered dose, treatment techniques
- patient models
- Imaging matching
  - CT, CBCT, MRI, PET
- Physics QA process and equipment
  - TRS 398/ TRS483, machine dosimetry, QC tests

- Ideal for supporting the transition to state of the art radiotherapy
  - IMRT (VMAT), IGRT, SGRT, ART, 4D planning, Proton, ...
- Functionality designed to illustrate RT concepts, need for treatment accuracy and safety
  - Create and explore simulations of Patient set up error and Linac mis-calibration

……and much, much more!

Background: VERT

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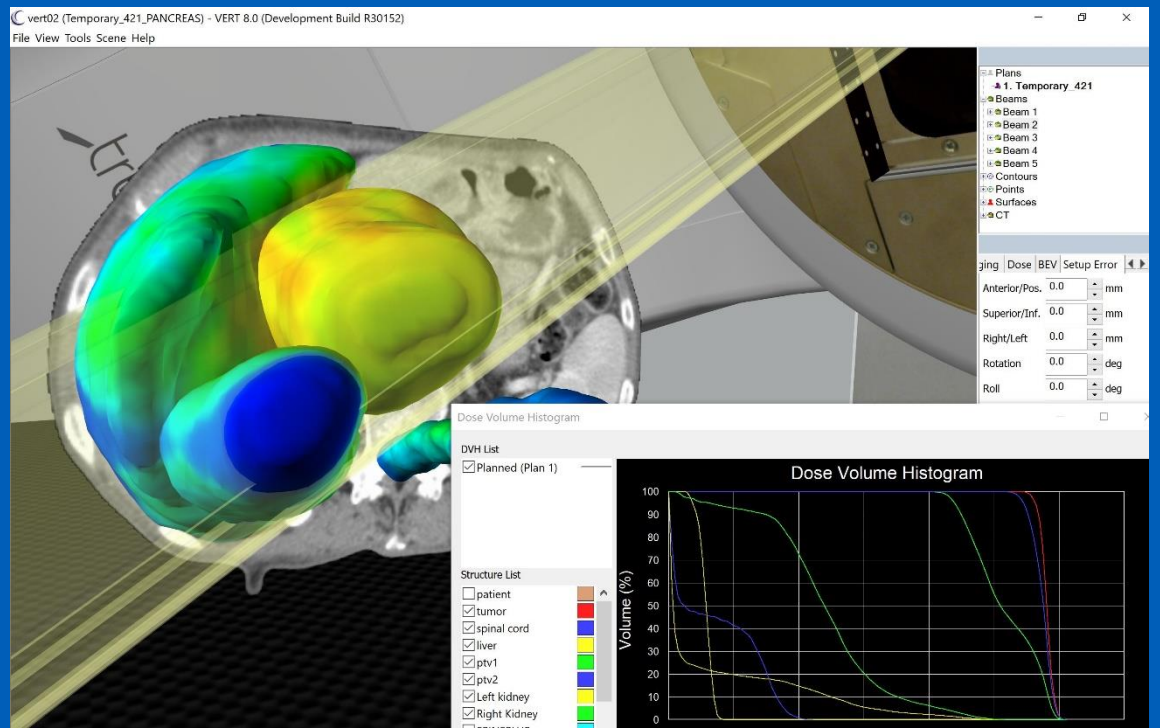
- VERT is used in 38 countries to provide simulation/ experiential learning for radiation therapy (mainly Radiographer) training
  - Since 2008

- Used to teach basic concepts for radiation therapy
- Practice delivery of treatments
- Understand treatment plans
- Can explore things that cannot do in the real treatment bunkers
  - Perfectly set up Pancreas patient



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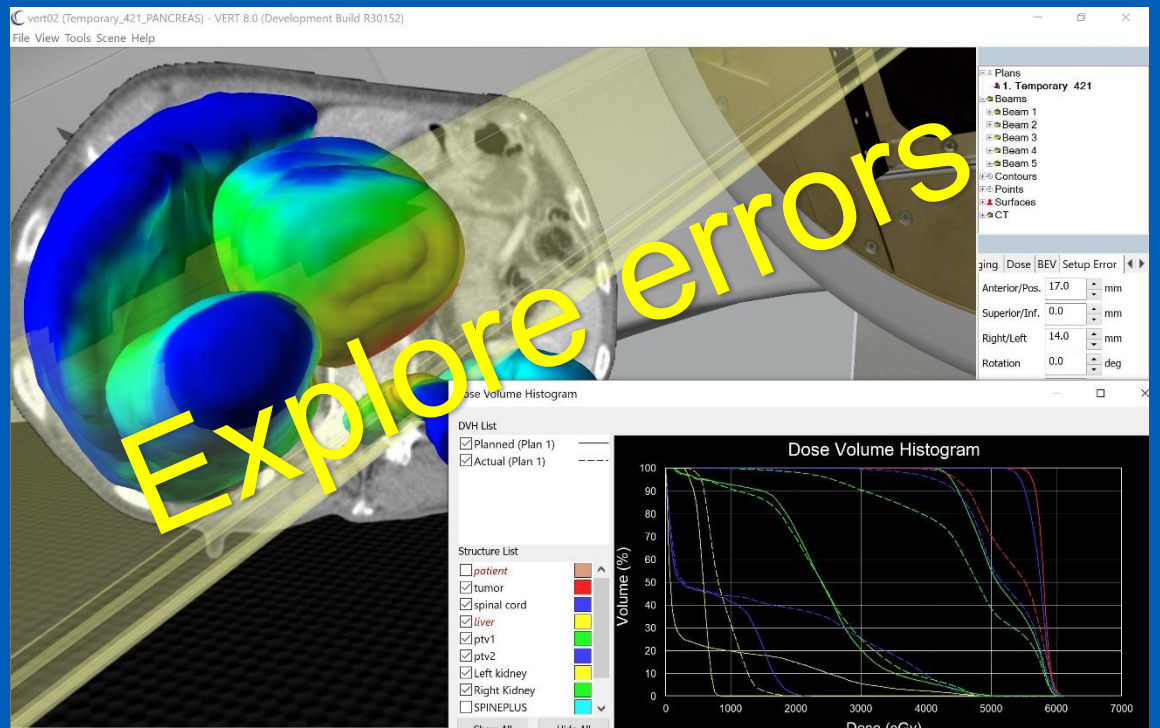
  - 17mm ANT, 14mm R set-up error



Background: VERT

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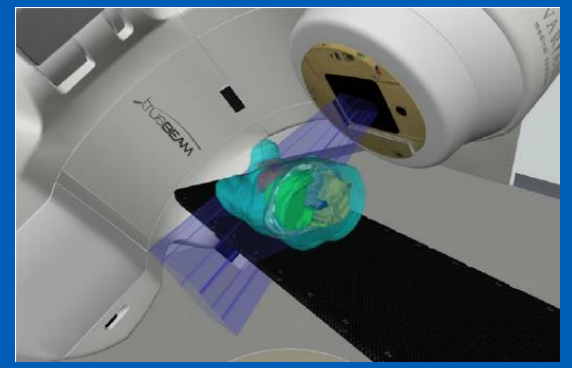

- Linac and Proton gantries to the classroom
  - Fully functional articulated 3D models

    …….. except they don't produce ionising radiation!
- Patients/ treatments modelled using TPS DICOM data
  - Structure sets, CT/ CBCT/ MRI/ PET, Dose, Plan/ Ion-Beam file
- Has embedded beam models: photon, electron, proton
- 'Deliver' treatments – correctly or with simulated errors/ challenge
  - simulate and explore actual clinical errors (misposition patient; explore impact)

Background: VERT

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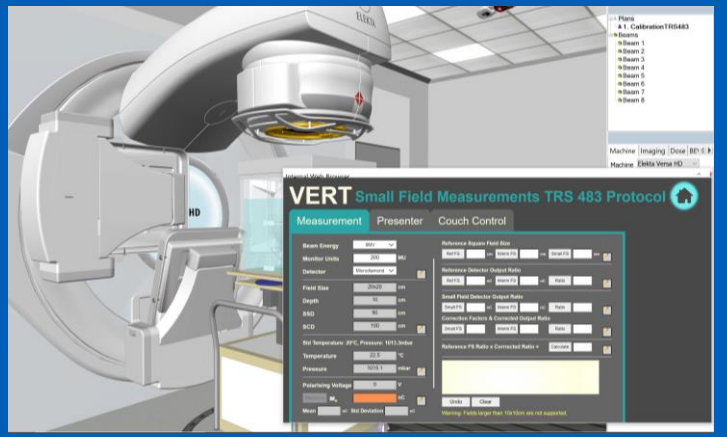
- Establishing user base with Physics MSc courses
- Physics module provides simulation of QC, clinical processes to allow simulation training for physicists
  - Incl: TG51, TRS398, TRS483, IPEM CoP, plotting tank simulations, QC measurements, ……..
- Physics module: QC, calibration, commission equipment, …
  - Explore the impact of Linac mis-calibrations and errors
- And much more is planned……..



VERT - bringing the Linac and practical dosimetry training into the classroom

VERT on Demand – cloud solution

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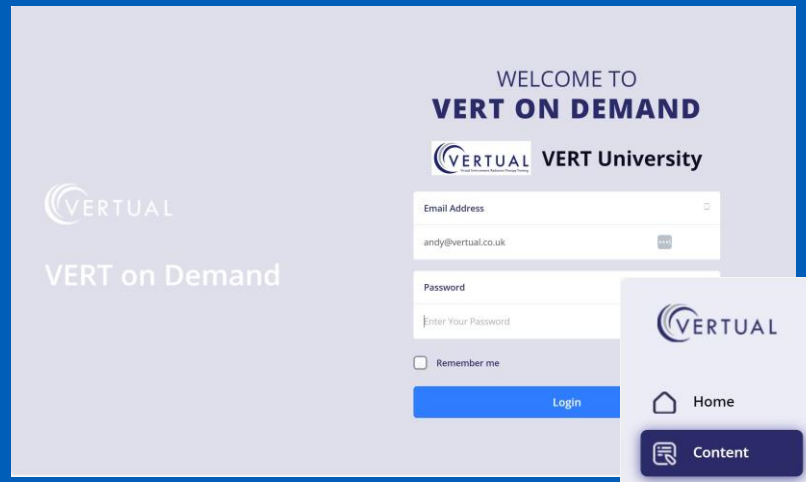
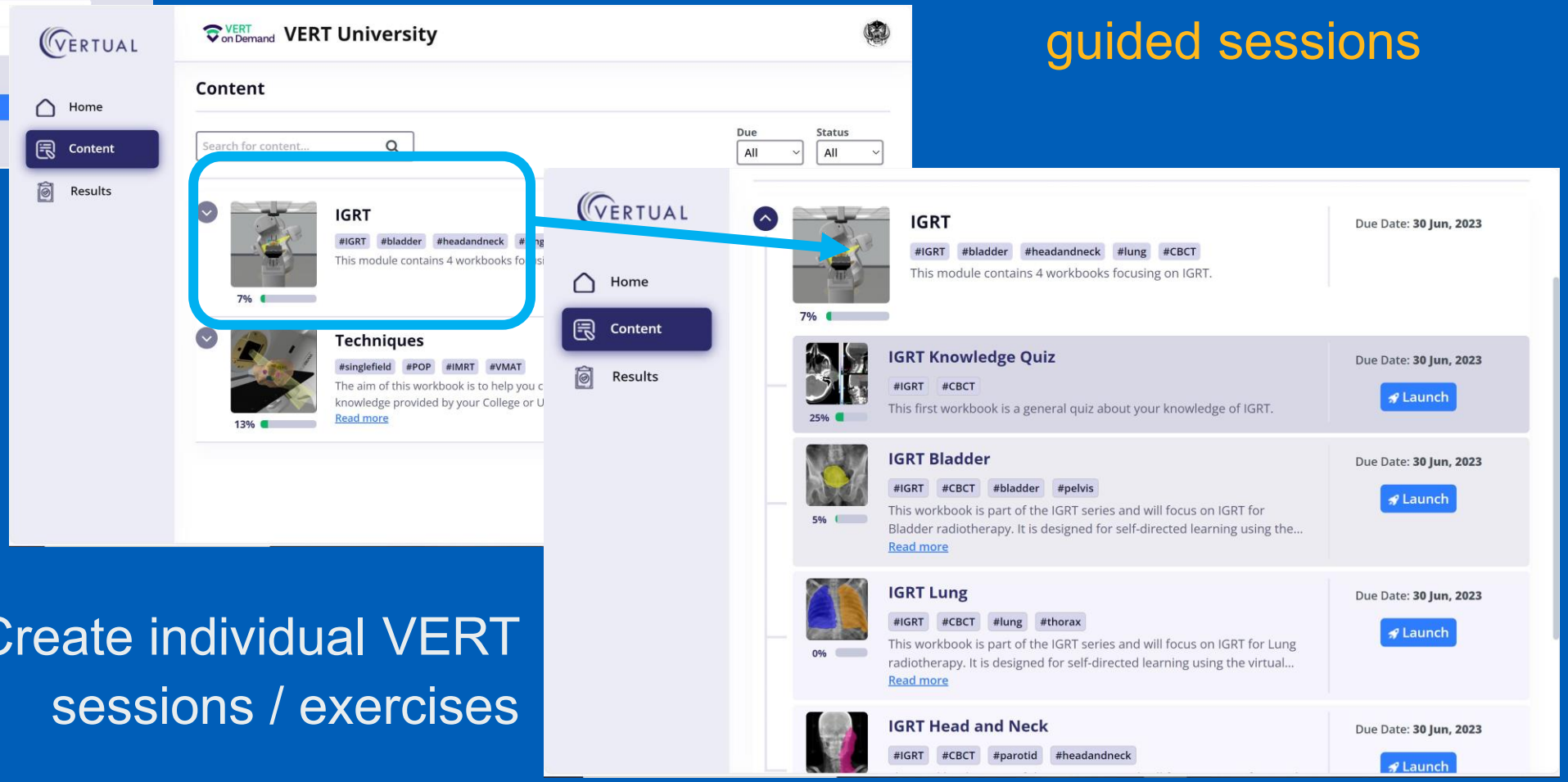
Login with own account, provided by course admin



Workbooks/ exercises/ guided sessions

Course admin controls which workbooks the trainee should work through



Create individual VERT sessions / exercises

VERT on Demand

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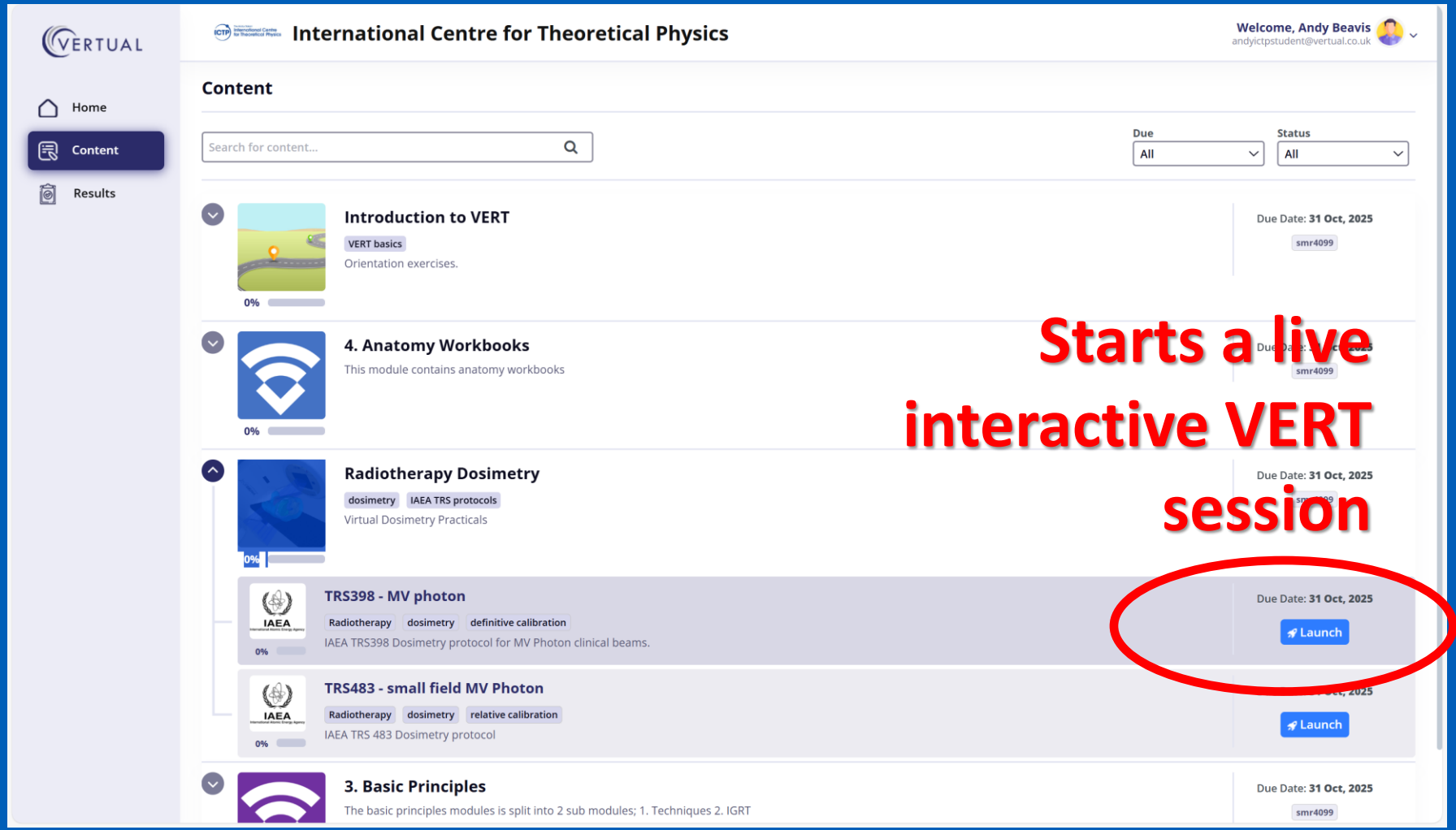
- Configure modules in line with curriculum
- Design practical sessions (learning exercises/ assessments)
- Launches INTERACTIVE session: configured to use a specific Linac, patient (or equipment) and e-learning package



Starts a live interactive VERT session

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Example: Simulation Training for Absolute Dosimetry/ TRS398

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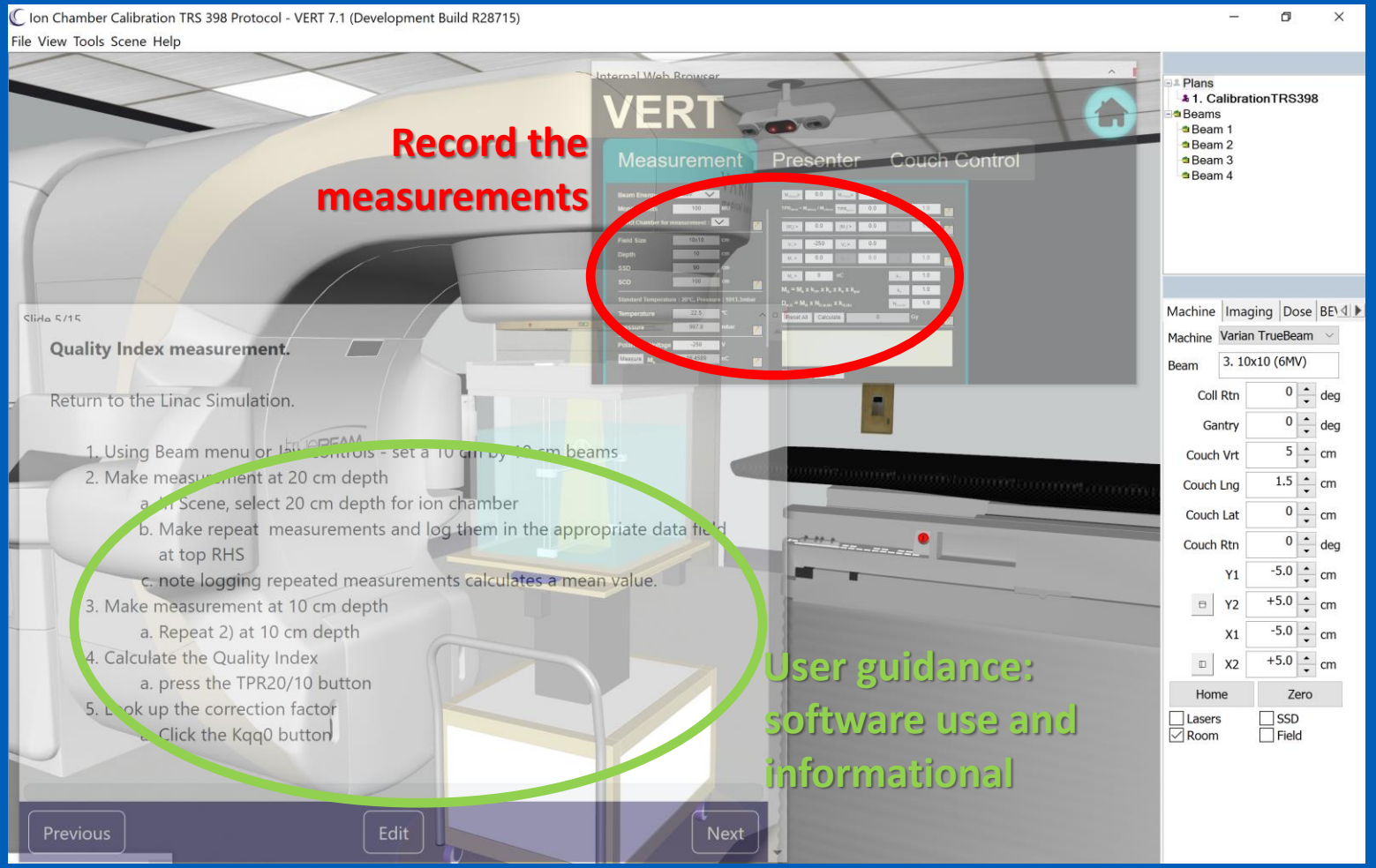
- The TRS398 workbook leads the user through the software and the IAEA protocol/ exercise
- Using VERT, the user makes the required measurements
- User has to interactively set up the Linac/ equipment to make and record the measurements



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Simulation Training for Absolute Dosimetry/ TRS398

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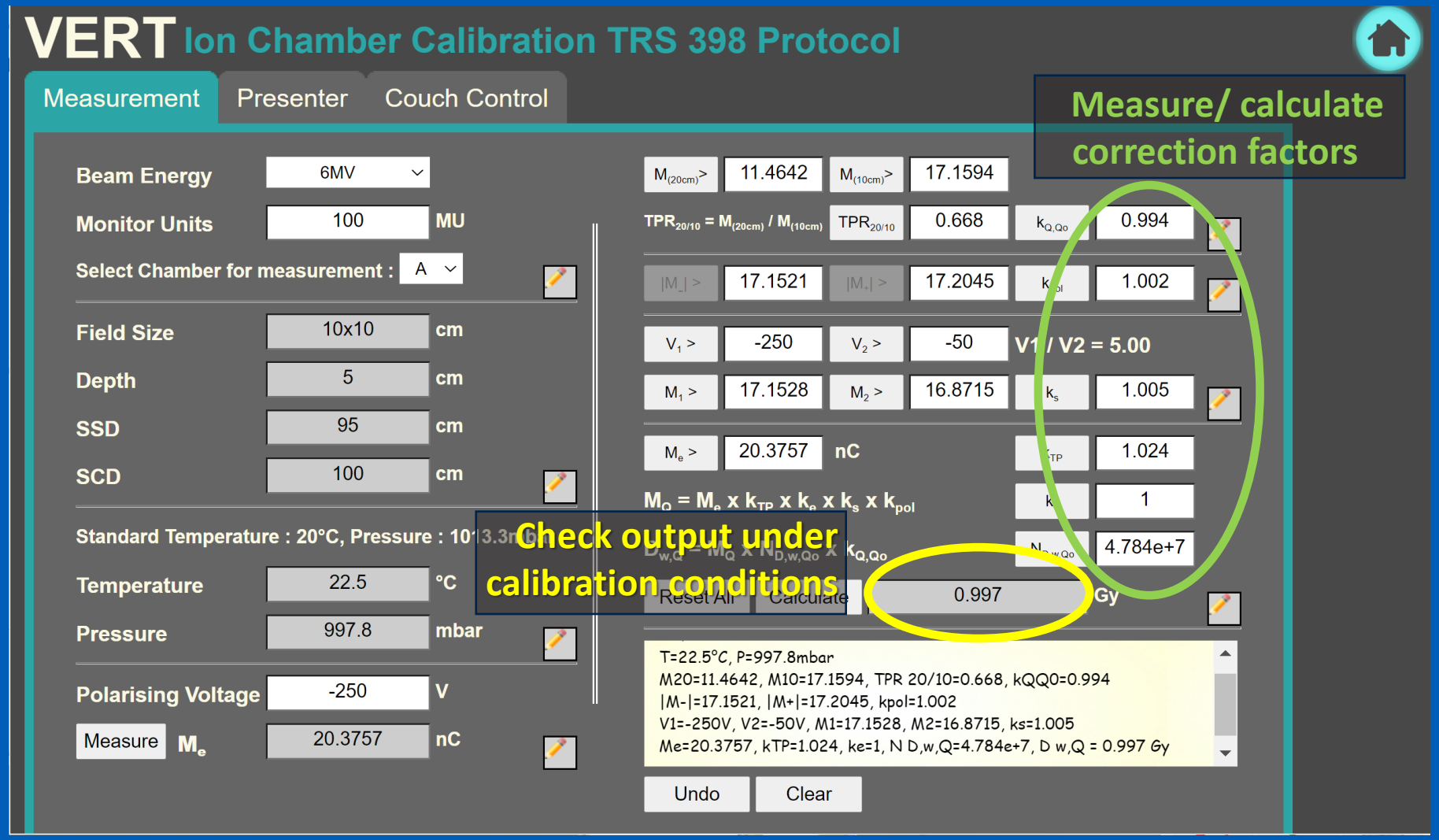
- Charge measurements are simulated to reflect the set-up
- set-up or procedural errors will impact the observed results
  - T,P, Pol V, chamber set up, wrong field size, …
- Can configure uncertainties



Please note

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- If you haven't already accepted the invitation to create your VoD password – please do so
- Use your own laptop if available, or try to use the PC you used yesterday
- If you need to use a different one or haven't yet used one – you will have to create your ICTP account first
- Go to: vod.vertual.co.uk/ictp
- Login with your details – own email and created password

- This is the second time we have tried this on such a large scale – please be patient if necessary

Exercise:

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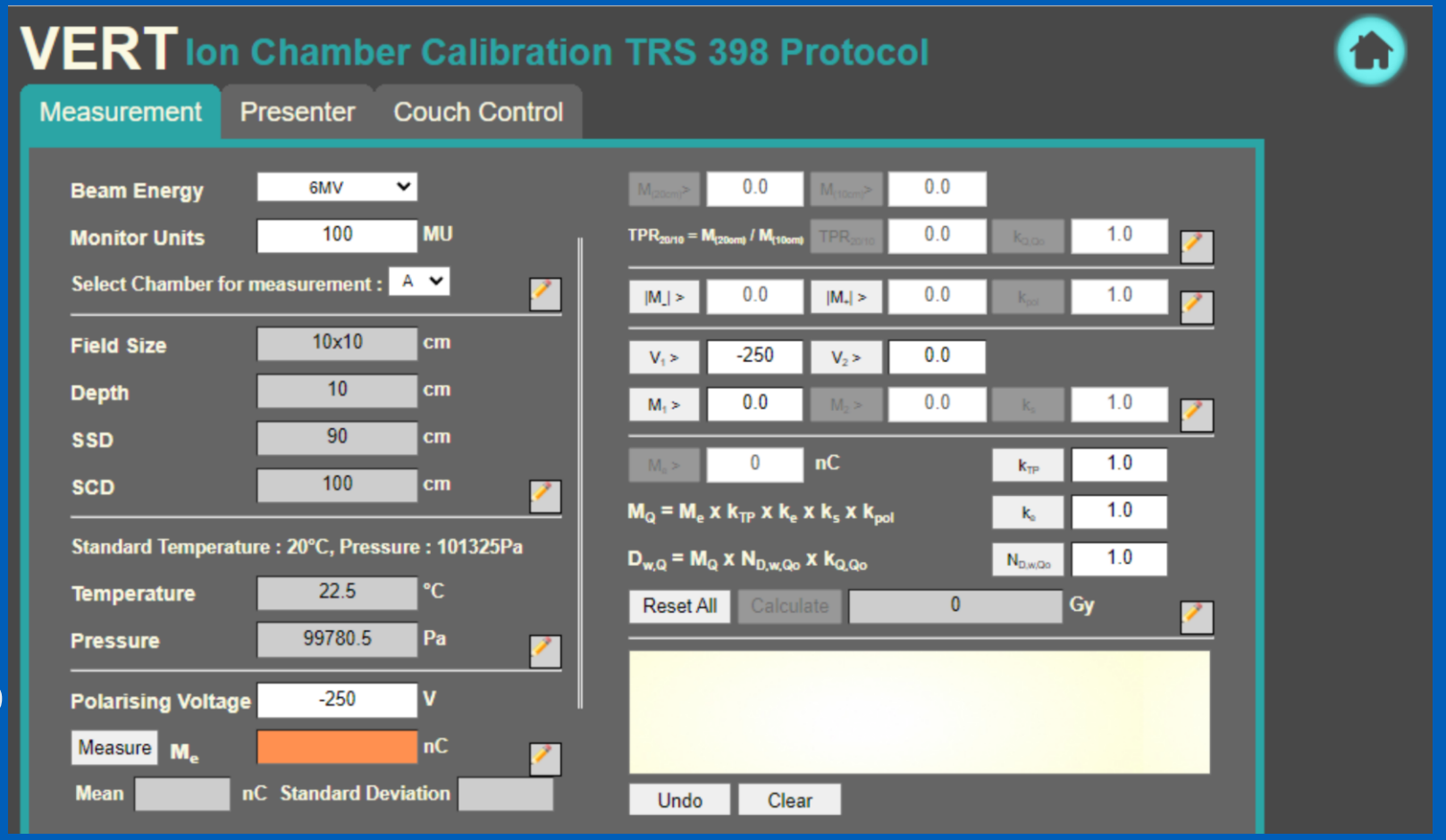
Work through the steps and measurements required by the TRS398 protocol for 6MV

1) Chamber A is a Farmer
   Use -250V as default PV
2) Some updates have been made
3) Linac calibrated to unity at 5cm depth, isocentrically with a 10x10 field

Test at end – use all factors to Check calibration is correct



Updates

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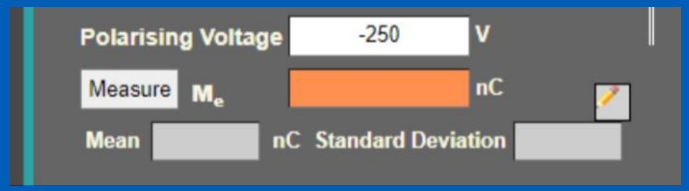

1) Use measure tool and consider the StDev as an uncertainty

2) When satisfied with mean – click in appropriate box on RHS to transfer the value across, can then start on next data collection

3) The ‘pencils’ record some of the data in the scratch pad – can use it for reference.

4) To change the polarity of the PV – edit the sign (kpol)

5) When select the 1/2, 1/3, 1/4, 1/5 values for PV (ks) MUST click on V2 on RHS to register the value.

Ideas for further simulations….

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1) Explore impact of only taking one measurement
2) Explore what would happen if you make QI measurement with a 20 x 20 field
3) Repeat for 15 MV
4) Try Ch B for 6MV – the kpol has been artificially set high (1%) to illustrate the role of kpol
   - You could make the output measurement with -250V and then repeat at +250V, with/without kpol and explore….

Implementation in Physics courses

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- Have used TRS398/483 and IPEM CoP applications in VERT during practical courses run at the National Physical Lab in Teddington, UK
  - Exploration of uncertainties/ commonly experienced mistakes in practice
  - Practical virtual demonstrations
- ESTRO Practical Dosimetry Audit course 2023 and will be used again Dec 2025
- NPL Practical Course on Reference Dosimetry (PCRD) 2023
  - Added VERT TRS483 (small field) application for PCRD 2024
- Working on use of VERT on Demand for the pre-course study for the 2026 PCRD course
- UCL – used in the Med Phys MSc in 2025; to be integrated fully into the Radiotherapy module in the 25/26 academic year
- ICTP – biggest group we have tried!!!!!!

Conclusions – use of comp sim for Physics training

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- Computer Simulation (VERT) is widely implemented for Therapist / Radiographer/ RTT training globally and is now a key feature of NPL training courses for Physicists
- VERT continues to be developed
  - update release each year
  - Including specific Physicist training features (focus)
- Physics module is essentially a virtual experimental platform
  - Rather than an illustrative or demonstration platform

After this course

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You have access to VERT on Demand until the end of January 2026

All we ask for is lots of feedback

If you like it and suggest to your Head of Department that colleagues should have access then please get in touch, we will add more content/ exercises

We will work out some introductory offer to reflect your connection with the ICTP

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www.vertual.co.uk

Thank you

- For your attention and your interest, we hope you enjoyed it.
- To Marco and Zakithi for the opportunity to present in this session
- My colleagues and project collaborators
  - CHH
  - National Physical Lab, UK
  - Univ College London
  - Vertual Ltd (James Ward)

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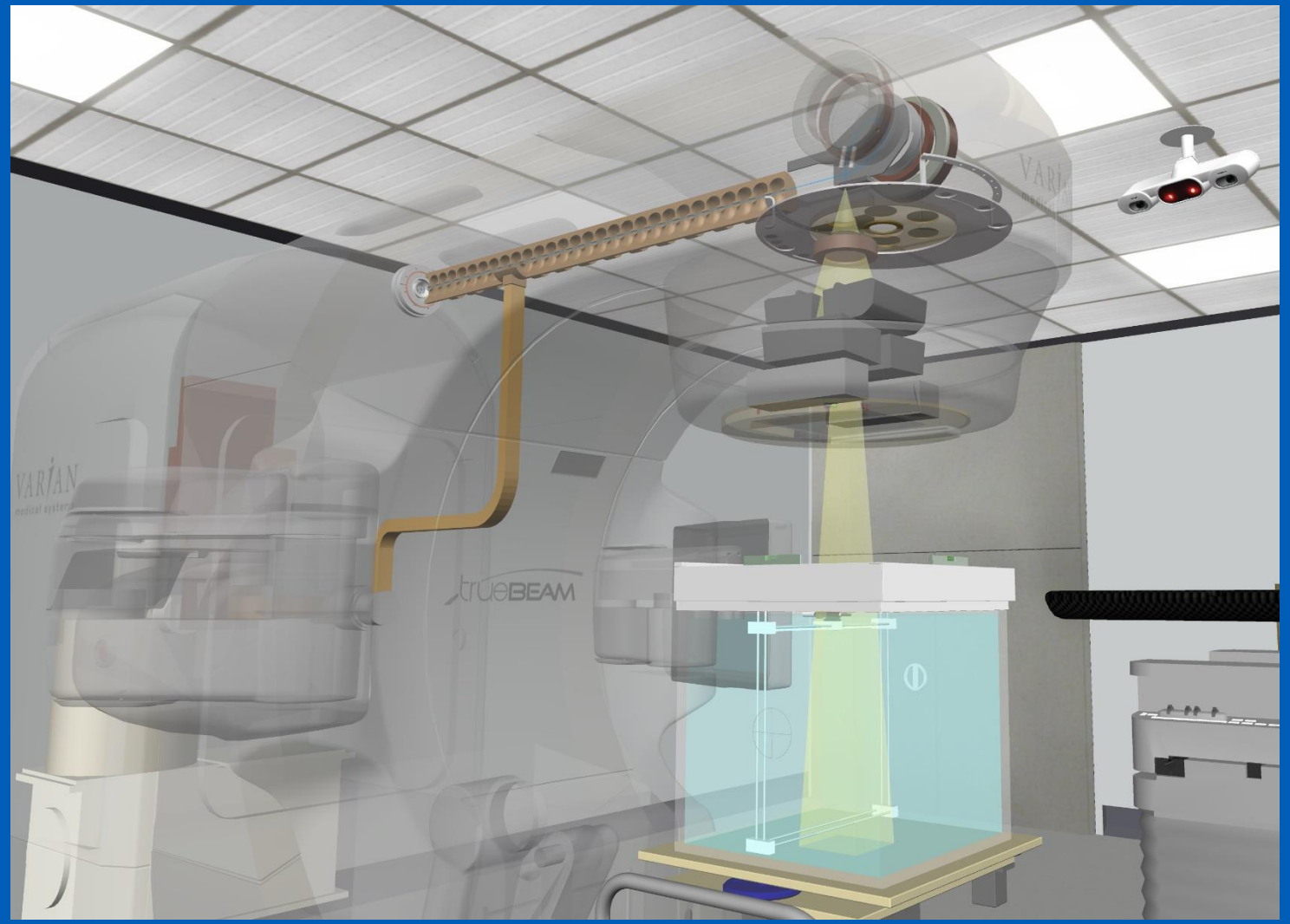

New: anatomy of a Linac feature