Particle Accelerators
The Medical Prospective

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Contents

- Particle applications and some challenges
- Diagnostics and therapeutic drivers
- Nuclear Medicine and accelerators
- Options for moving from Reactor to Cyclotron generated diagnostic products

Challenges

- Need to reduce dose in both Diagnostic and Therapeutic applications
- Advancing ranges of treatments
- Optimising access
- Instability in supply chain
- Working at the leading edge of developments

Nuclear Medicine

- Open source radiation
- Uses an agent for:
  - Transportation
  - Visualisation
  - Quantification
- Single Photon with CT or Positron Emission Tomography - PET CT

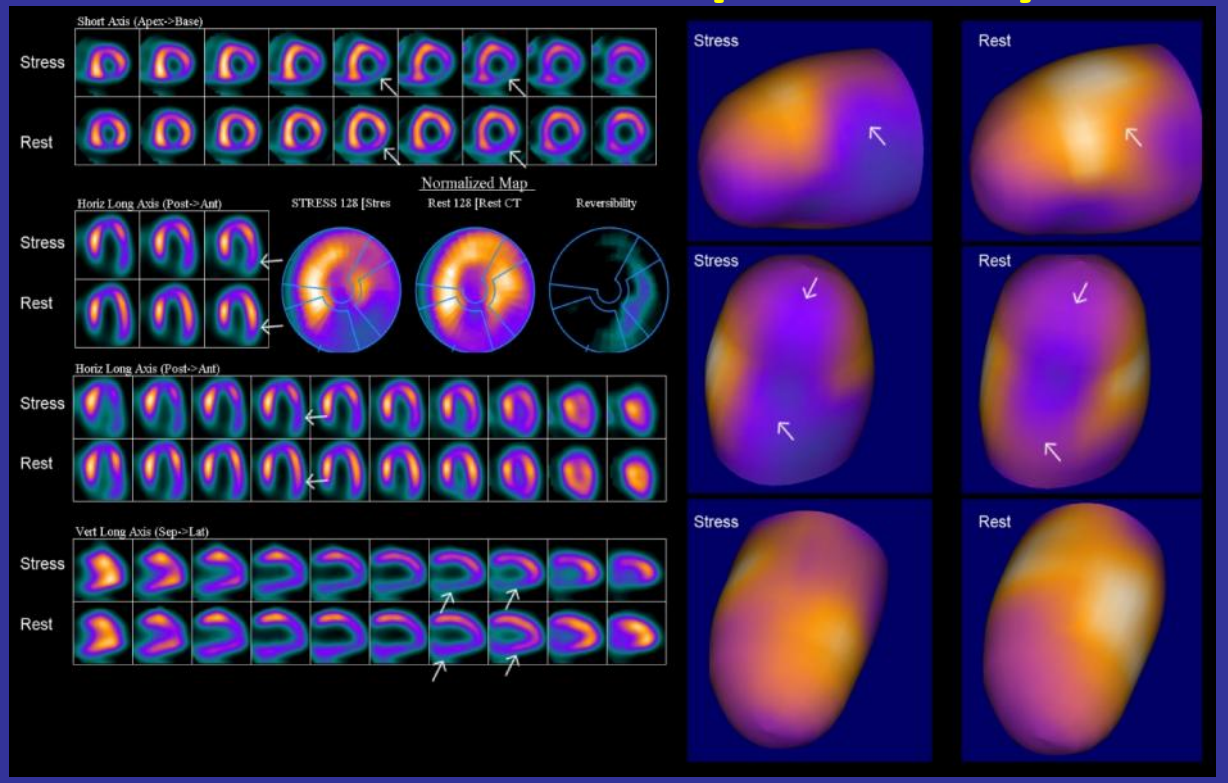
Main uses of Diagnostic Isotopes

- SPECT
  - Visualize heart blood flow and function
  - Scan lungs for respiratory and blood flow problems
  - Evaluate for metastatic bone disease
  - Investigate abnormalities in the brain, such as seizures, memory loss and abnormalities in blood flow
  - locate the presence of infection
  - Measure thyroid function to detect an overactive or underactive thyroid
- PET CT
  - Whole body Tumour localisation and spread
  - Functional imaging with dynamic molecular take up
  - Quantification

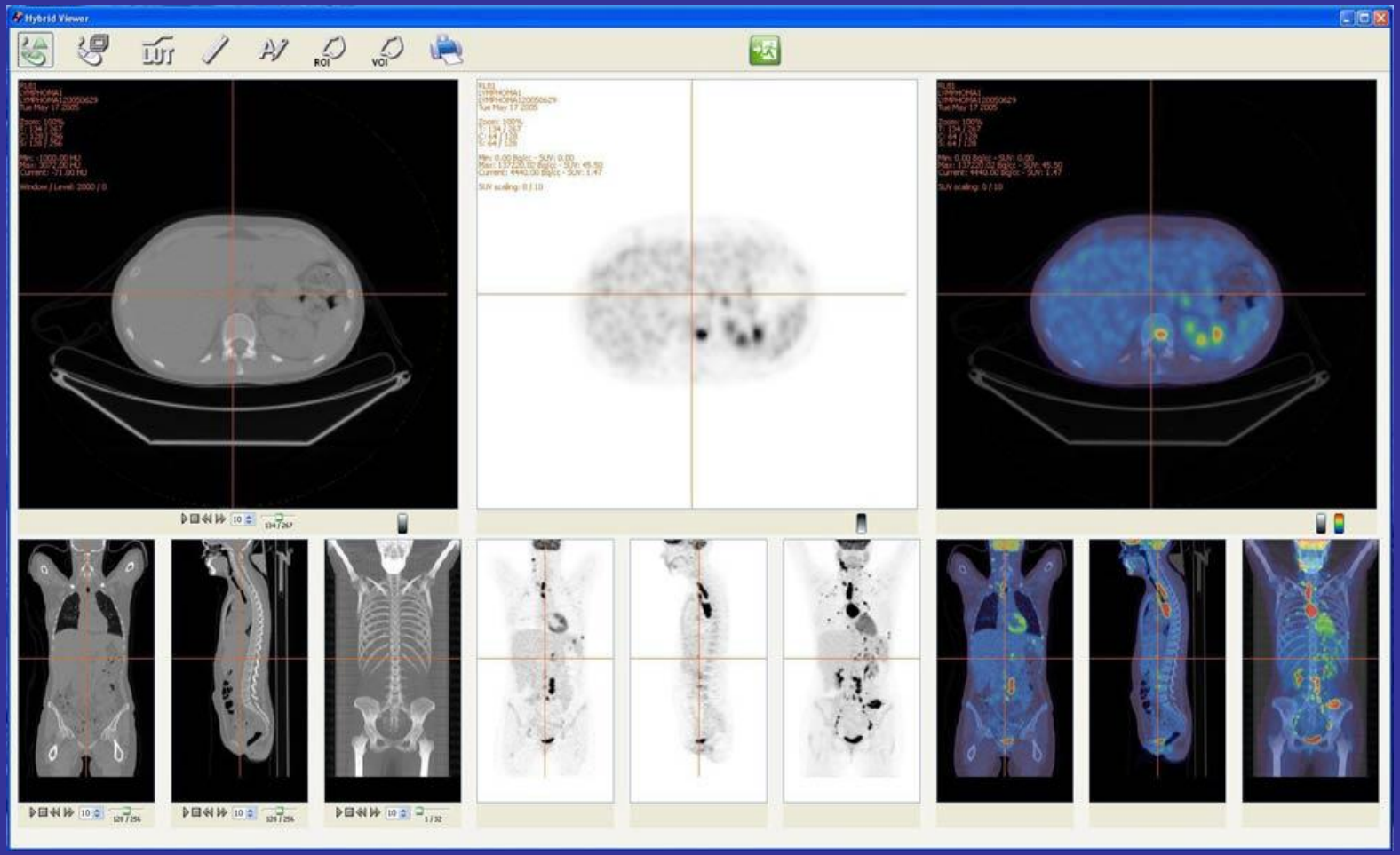
Clinical Management questions for imaging

- When is imaging required?
- Intra organ detection and localisation (to direct biopsies and ?RT boost)
- Prediction of tumour behaviour
- Nodal and distant metastatic staging
- Therapy for optimum response -Targeting

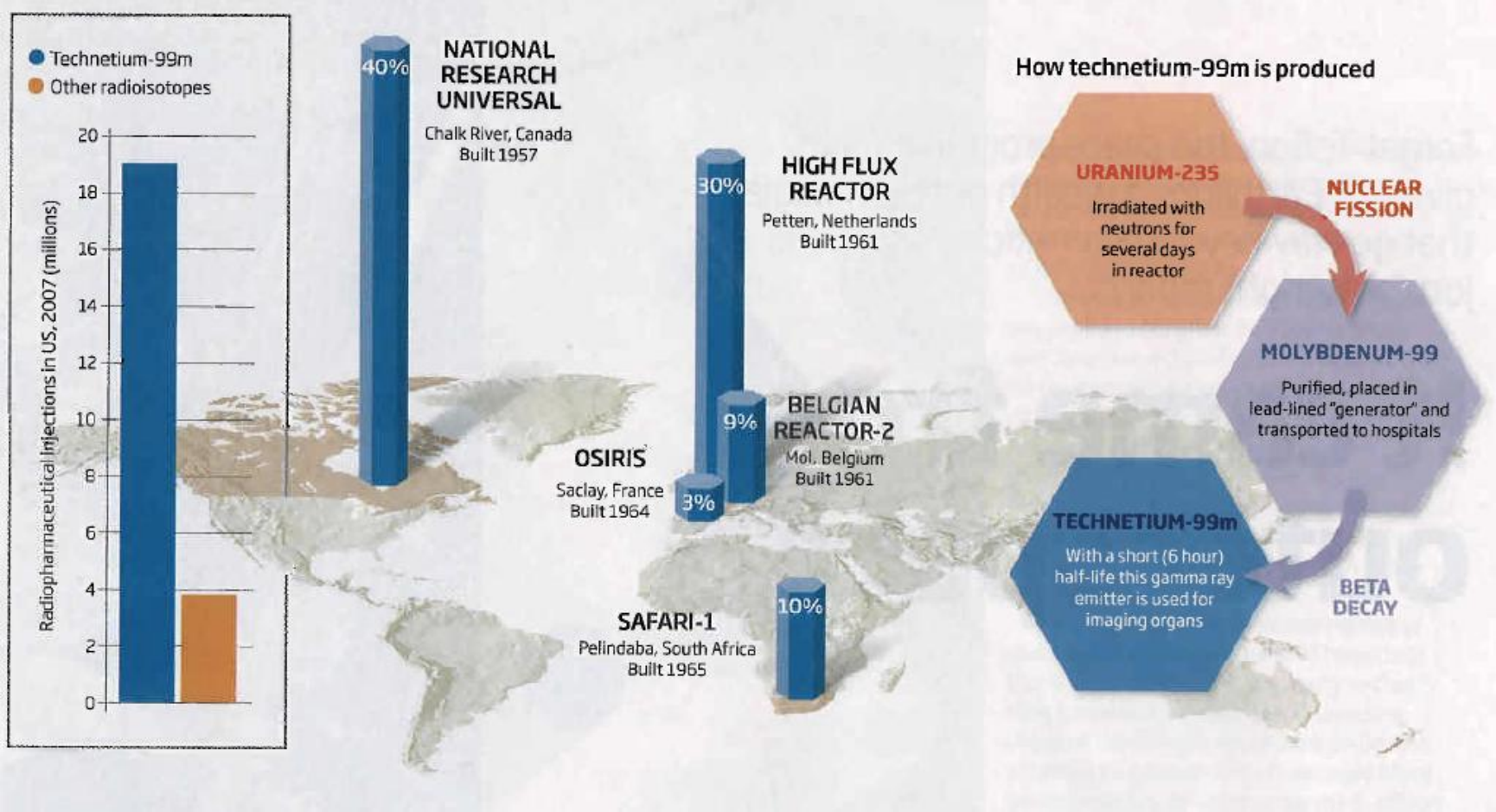
SPECT
take up and function capability



PET CT
combination capability

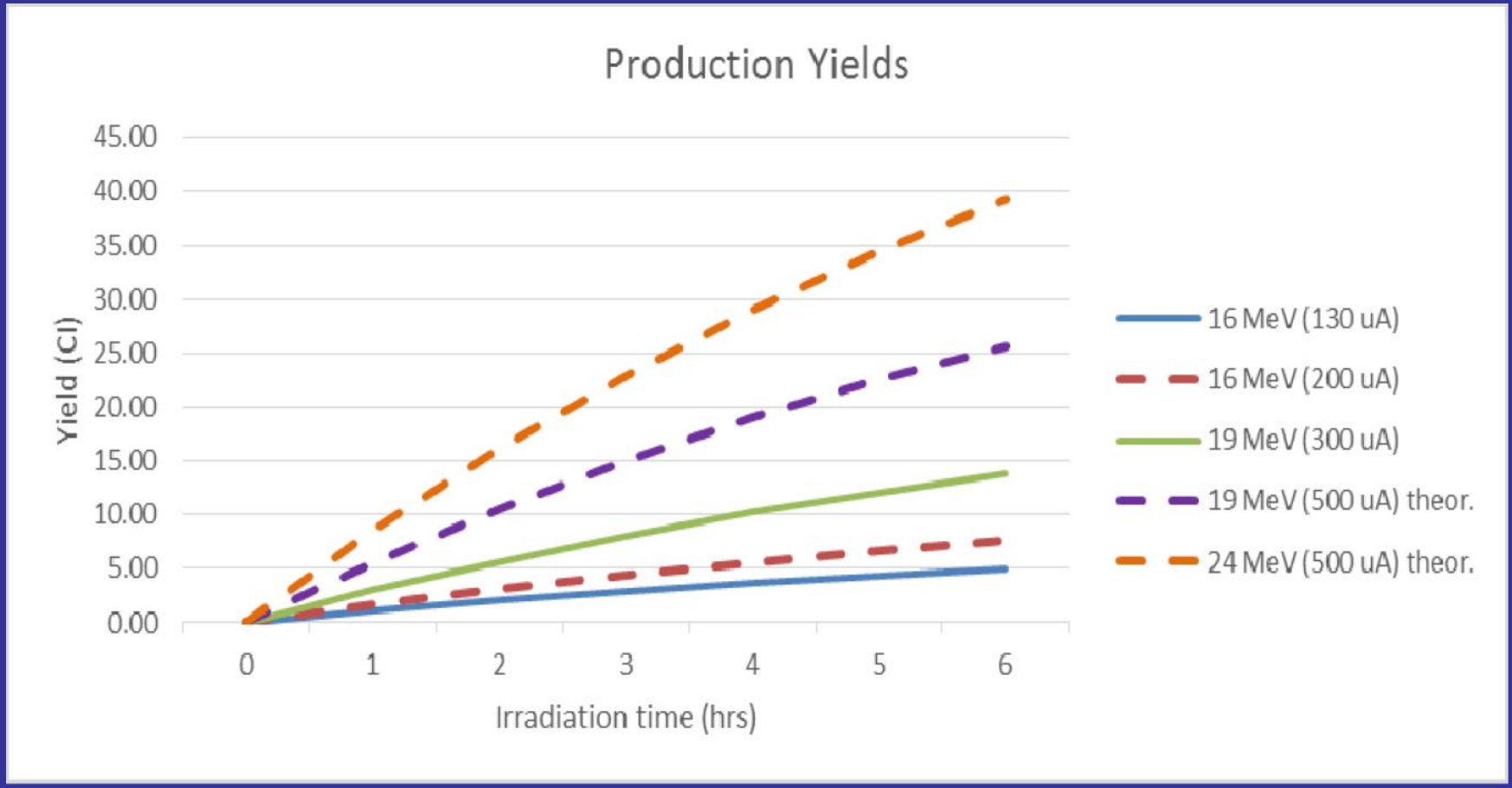


The Aging Fleet

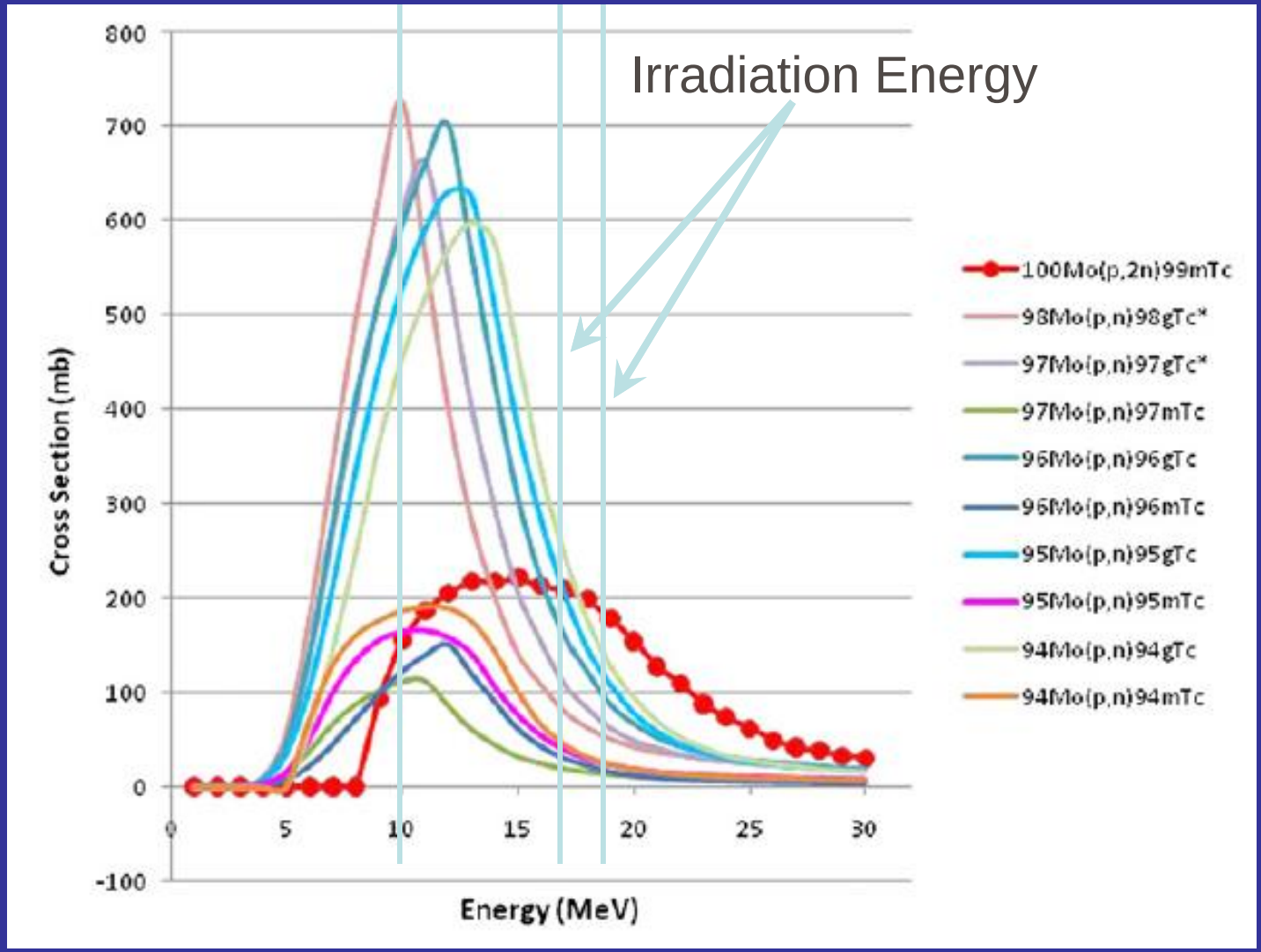


Cyclotron production of ^{99m}Tc

Yield Comparison: Energy, Current Considerations



Side Reactions: $^{94\text{-}97}$Mo(p,n)



A. Celler, X. Hou, F. Bénard, T. Ruth, Phys. Med. Biol. 2011, 56, 5469

Cyclotron and Radiochemistry Developments

- Production cyclotron considerations:
  - Containment
  - Supply chain geography
  - Multiple targets for combined run production
- Radiochemistry issues:
  - Targeted tracers and new indications
  - Reduced preparation Chelators
  - Extended range of Pharmacy ‘Kits’

Summary

- Nuclear Medicine is rapidly developing
- Reactor and Cyclotron created isotopes will be needed
- Getting closer to targeted diagnostic agents with precision therapeutic agents
- Half live determines the PET configuration
- Developments are High energy / Integrated shielding /Multiple targets for Isotopes production

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Thankyou