



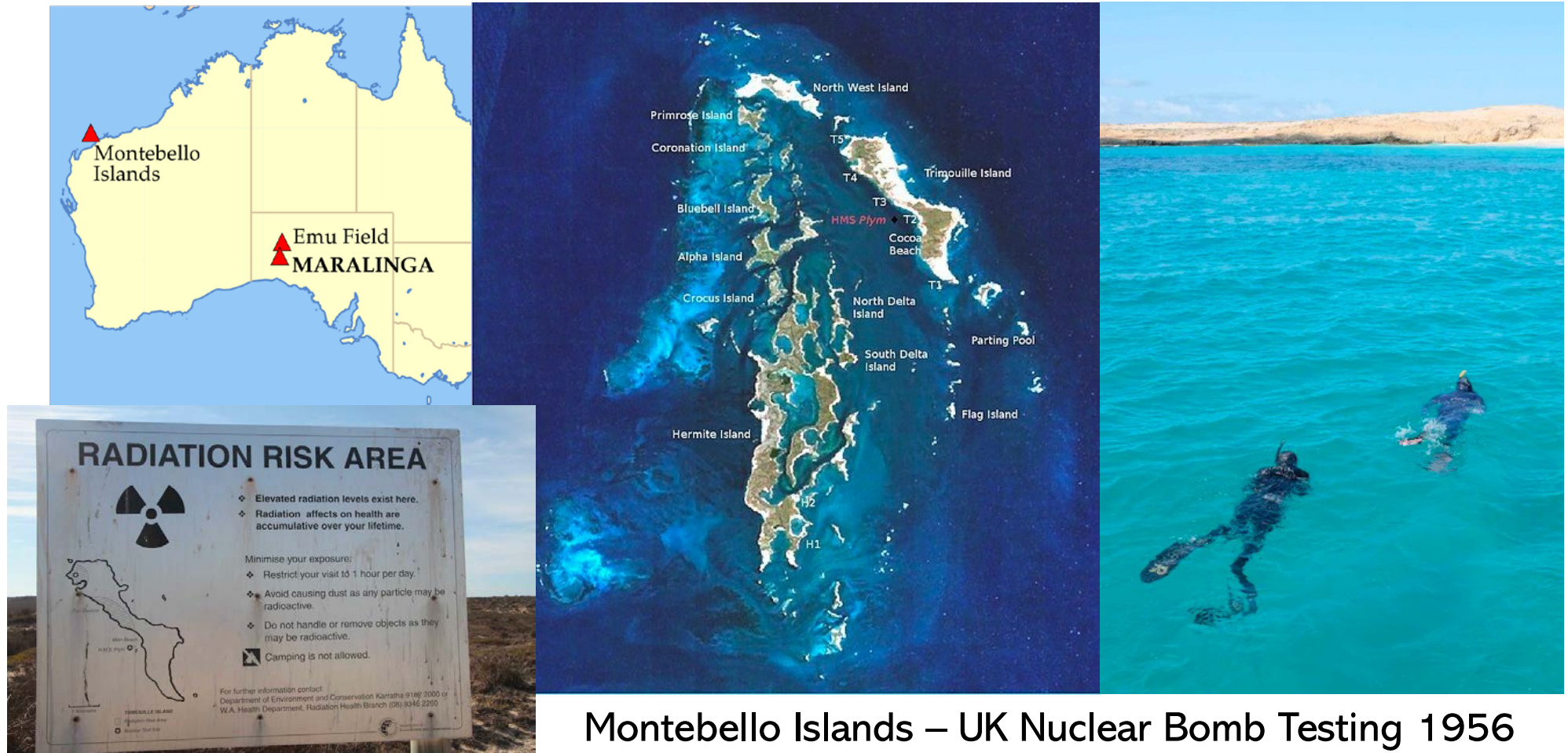
Curtin University

## **A WA View of Nuclear Science – A changing landscape?**

Curtin University | Nuclear Science | December 2022

CURTIN CONFIDENTIAL

Like SA, WA had an early taste of nuclear science.....



Montebello Islands – UK Nuclear Bomb Testing 1956

Like most Australian Federal and State Governments, there was a fear to mention nuclear, but one decision changed that.....and another potential failure might further accelerate this change!



Yesterday



Today

## WA Government created a capability analysis and capacity plan for subs



- Collins Class Submarines are home based in WA at Fleet Base West
- WA developed a capability analysis and capacity building plan as a state response to the task of acquiring a nuclear-powered submarine capability
- It was driven by the assumption that regardless of timeframe, Australia must set about developing an operational and sustainment capability immediately
- The (pathway) plan is set around six pillars of consideration ranging from issues of governance and strategic alignment, to safety and security, through to supply chain and industry

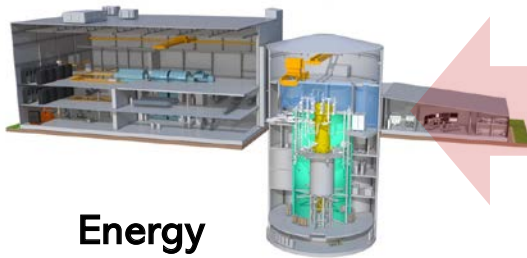
See: Minister Papalia's address to SIA 11<sup>th</sup> Biennial Conference 2022  
Canberra, 7 Nov - 9 Nov, 2022

# It has also regenerated the conversation on Nuclear Physics Science Markets in WA...

Resources  
Technology  
University  
Trailblazer



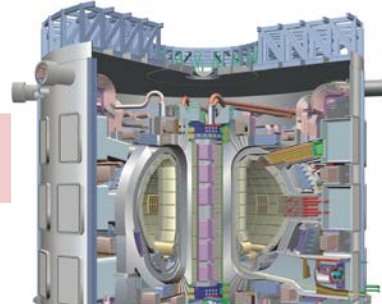
**Mining**



**Energy**



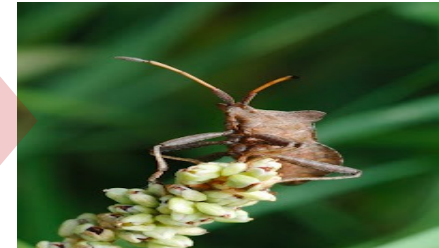
**Defence**



- Nuclear Science**
- Uranium Mining
- Computational
- Quantum Physics
- Mineralogy Testing & Mapping
- Energy Systems
- Nuclear Systems
- Sustainment & Safety
- Nuclear Medicine
- Radioisotopes
- Skills & Education
- Science & Innovation



**Medical Diagnoses & Treatment (UWA)**




**Agriculture**



**Criminal Investigations**

# UWA Medical Physics Learning, Teaching and Research Programs



UWA MEDICAL PHYSICS GROUP

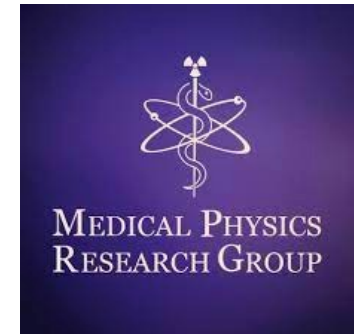
Home About Study People Research Careers Application Blog Contacts

A variety of opportunities are available at UWA for students who are interested in learning about Medical Physics.

**Course accreditation** This course is accredited by the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM).

 Australasian College of Physical Scientists & Engineers in Medicine

Medical Physics at UWA

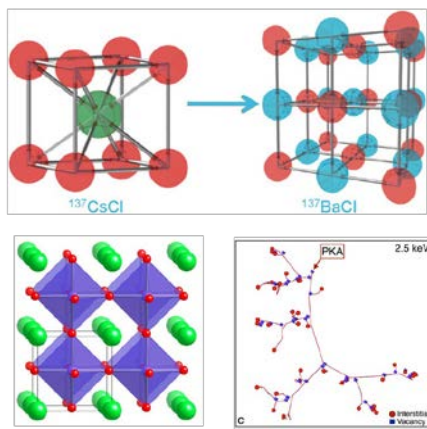


The Medical Physics Research Group at UWA conducts basic and translational research into radiation therapy, radiation biology, tumour modelling, molecular radiotherapy, radiation safety, clinical medicine and health technologies, which will lead to new applications of physics, engineering, biology and medicine for diagnostic and treatment of diseases.

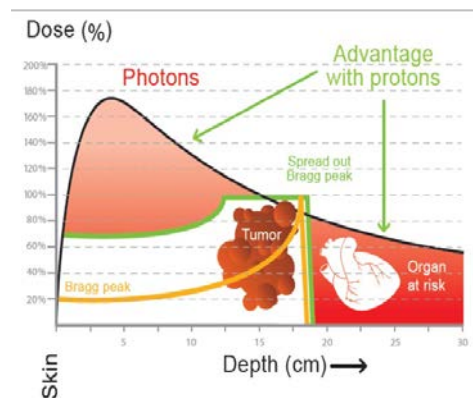
# Curtin University Nuclear Physics Research Programs (Examples)



When Atoms Collide



Atomistic Computer Simulations



Proton Therapy

(Minimal radiation exposure of healthy organs)



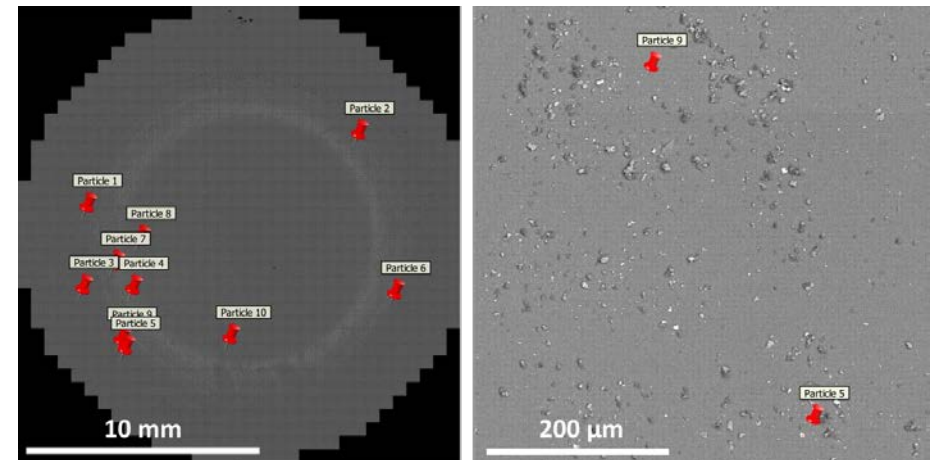
Atom Probe Tomography

*“We know that certain problems deserve solving, even if we don’t know what applications the solutions will have. It’s also a feedback mechanism. When people know the solution they then wonder where it can be applied. That’s why we work together with everybody.”*

**Prof. Igor Bray, Curtin University, Project Leader.**

## Development of advanced microanalytical methods for IAEA Nuclear safeguards

Nuclear Safeguards are activities by which the IAEA can verify that a State is living up to its international commitments not to use nuclear programmes for nuclear-weapons purposes.



IAEA environmental sampling of nuclear materials



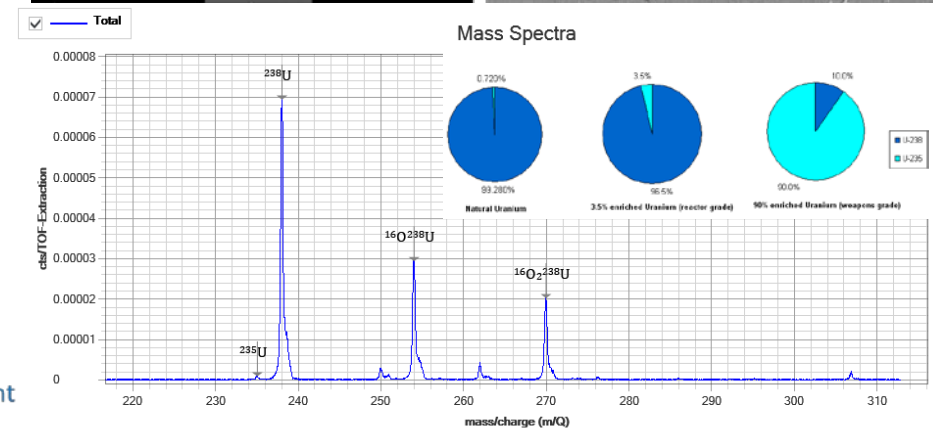
Automated Search



Confirm and Characterise



Precision Isotopic Measurement



Innovative combination of automated mineralogy and imaging mass-spectrometry for the rapid search and characterisation of microscale uranium particles from IAEA environmental samples



### Nuclear & Particle Physics Course

This unit provides an introduction to contemporary nuclear and particle physics for non-specialists. The unit starts with a historical introduction and some qualitative formalities. Then we consider the size and shape of nuclei, the masses of nuclei, nuclear instability, alpha decay, nuclear collisions and reactions including fission and fusion, and nuclear models. The second half of the unit is devoted to particles and their interactions. We consider the strong interaction of hadrons and the quark model, the electromagnetic interaction, the weak interaction including beta decay, give a summary of the standard model and discuss what is beyond the standard model. The unit concludes by considering nuclear and particle astrophysics.

#### What you'll learn

- Use the strong link between physics and mathematics in the context of Nuclear and Radiation Physics,GC1
- Apply of Nuclear and Radiation Physics principles to explain the causes of relevant interactions and phenomena, devise strategies to investigate these and test the possible solutions
- Apply a robust problem solving technique suited to multi-stage problems involving nuclear and radiation physics
- Plan experiments and use equipment to perform nuclear and ionizing radiation physics measurements and write detailed reports with due care to uncertainties and OHS issues

We also have school outreach, summer scholarship, as well as Undergrad, Masters and PhD programs.



A strong team led by **John Curtin Distinguished Professor Igor Bray**, Head of Physics and Astronomy, and the Theoretical Physics Group.

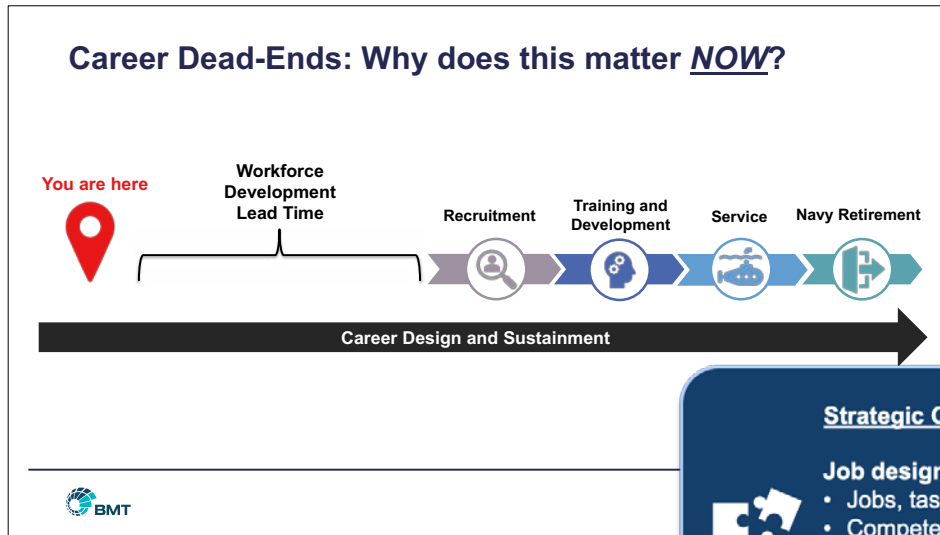
The team Includes:

- **Prof Nigel Marks**, a materials scientist, who is a regular commentator on nuclear energy
- **Alisher Kadyrov**, PhD in Nuclear Physics, and teaches Nuclear Physics at 3d year
- **Dmitry Fursa**, PhD in Nuclear Physics, also has experience teaching Nuclear Physics

# Drivers for building a future nuclear workforce (for SSNs)



- Strategic career mapping & understanding the required disciplines will be a key driver for growing nuclear capability & capacity in the right areas
- This includes horizontal market movement of like-minded skillsets
- Attracting talent and driving retention for the Nuclear Industry, Applications and Sciences market



#### Strategic Career Design Levers

- Job design**
  - Jobs, tasks & responsibilities
  - Competencies & qualifications
  - Career pathways & promotion opportunities
- Organisational Systems**
  - Recruitment strategies (e.g., Opportunities for life)
  - Training systems
  - HR strategies, policies and practices
  - Culture and leadership
- Macro Factors**
  - Legislation (e.g., OHS, IAEA safety standards)
  - Industry/professional bodies (e.g., Career transition partnerships)
  - Education systems

#### Our Research: Future of Work Institute (FOWI)

- Scheme of Complement Design**
  - Design input, adopted by stakeholders
  - Evidence for human-oriented systems design
- Fatigue Modelling**
  - Purpose built open-source BMM software
  - Sovereign capability ensured with private functions
- Technological and Systems Analysis**
  - Evaluating technological & mission changes on human work requirements
- Sustainability and Workforce Planning**
  - What do future workers expect?
  - Who is the future submariner?
  - What work & system conditions need to be met for retention?

**Crew endurance over time**

Short-term Operational Functioning 'over a watch' → Mid-term Mission Endurance 'over a mission' → Long-term Sustainability 'over a career'

**IMPACT PRINCIPLES**

1. Research-driven, actionable recommendations, targeted to stakeholder groups
2. Design input & assurance
3. Targeted research methods

**METHODS**

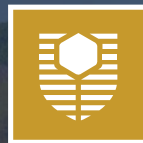
- Field Studies: Alongside & at-sea trials
- Lab Studies: Experiments
- Scenario Walkthroughs: Interviews/Focus Groups, Workshops
- Virtual Simulations: Training simulators, Bio-mathematical modelling

Partners: Australian Commonwealth Government, Naval Group, DST, FOWI, Curtin University

## The role of nuclear science from mining to nuclear subs – WA can be a strong partner in the evolution of Australia’s Nuclear Science ecosystem!

- WA can and will have a significant role to play in the evolution of Australia’s nuclear science ecosystem
- WA has the Universities with the requisite background and foundation in key nuclear science disciplines, both from a learning and teaching, and research/research infrastructure perspective
- WA has significant infrastructure and aligned markets, that are foundational to accelerate the evolution of Australia’s nuclear science ecosystem
- WA has a (pathway) plan set around six pillars of consideration ranging from issues of governance and strategic alignment, to safety and security, through to supply chain and industry - this can be expanded to all market disciplines
- Building capability and capacity early will be key, where WA can have a major role in growing our baseline nuclear science ecosystem





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