Muon e-learning development at ISIS

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ISIS

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Criteria for effective online learning

- Multimedia promotes deep and meaningful learning
- Monitoring, feedback and reviews increases understanding and transfer
- Chunking
- Promote active learning in materials
- Problem based learning (PBL) is an excellent way of incorporating active learning

Criteria for effective online learning

- Contrasts and context need to be provided
- Reconceptualising knowledge
- “ARCS motivational model to ensure that learning is enjoyable, meaningful and fit for purpose”
- ARCS ten worst short falls
- Consider cognitive learning disabilities
- Multitasking hinders learning

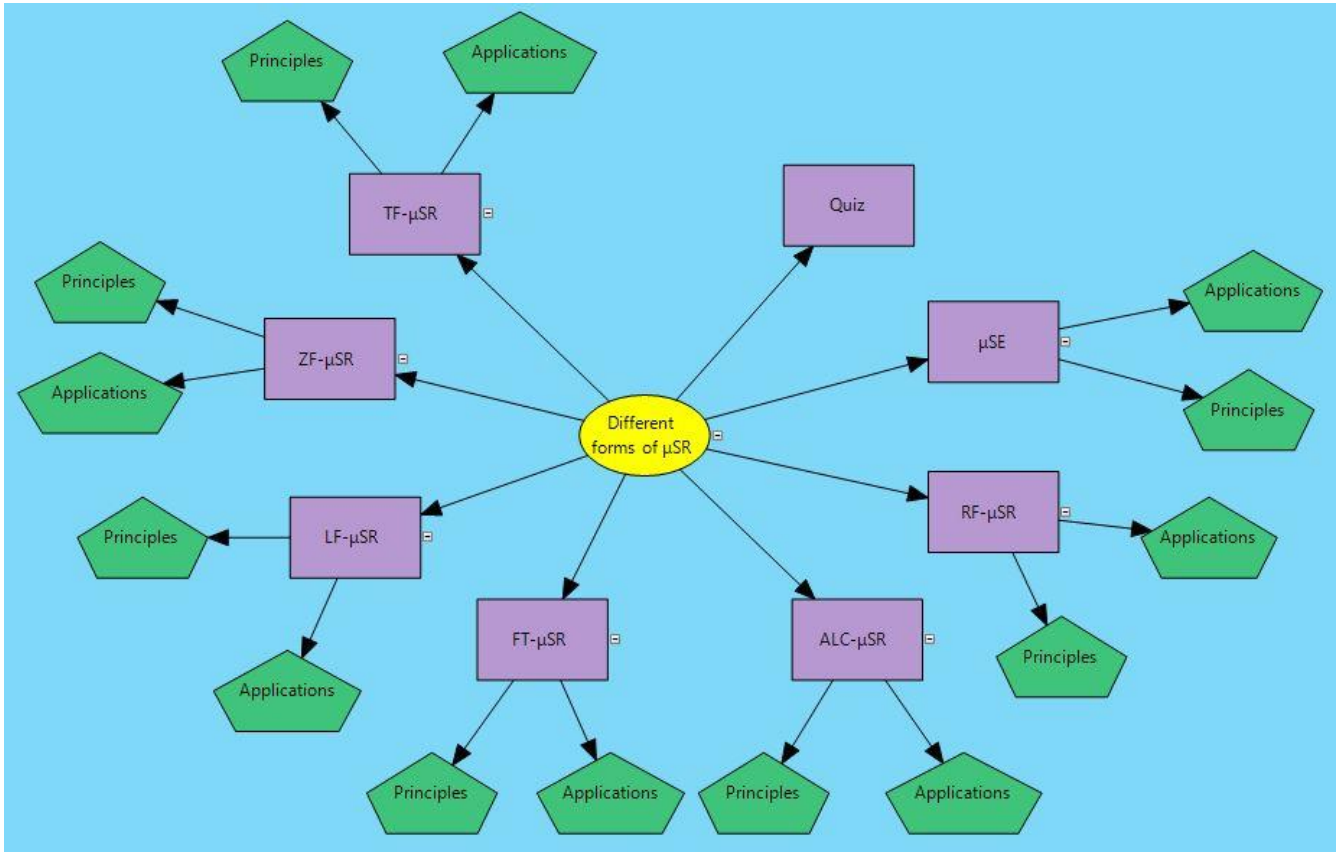
Refining existing materials

- Small edits using feedback
- Small updates based upon changes to the new version of Mantid
- Added tutorial covering how to use an algorithm within Mantid

Different Types of μSR – Motives

- Used and reviewed the previous student's materials after watching videos of the previous school
- There are seven different variations of μSR
- Why?
- What are the differences?
- What are the different applications?

Different Types of μSR – Planning



Different Types of μSR

- Builds upon the first lecture of the Muon Training School
- Covers a topic discussed quite briefly
- Gives students more of a background
- Helps students get the most out of the lectures

Different Types of μSR – Examples

μSR

Preview | Edit | Reports | Grade essays

Muon implantation

Muons enter and stop inside samples; they do not scatter from, diffract or reflect off. Once entering the sample the muons implant themselves amongst its original atoms, see Fig. 1. When inside a sample muons can act as probing particles and gain information. The information coming from the muons is in the form of their spin polarisation and is measured as a function of time after implantation. This is measured using their decay into positrons, which are emitted asymmetrically relative to the spin polarisation. When inside a material, muon spin polarisation changes according to the processes going on inside, changing the measured signal.

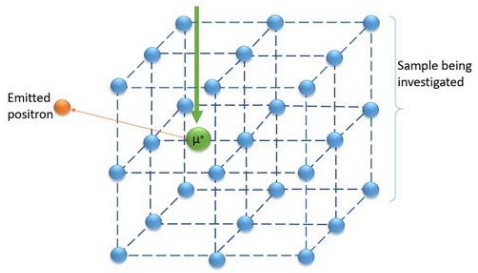


Fig. 1: Muon implantation in a sample.

In most cases muons implant into samples without loss of spin-polarisation. Implantation of muons can cause ionisation of at
scattering of electrons within a sample. Muons rarely replace an atom in the sample. They usually stop at interstitial sites of
or addition sites of molecules.

Principles of TF-μSR

TF-μSR is Transverse Field μSR. This means that an external magnetic field is applied perpendicular to the muon's spins, causing the muons to precess. The frequency with which muon spin precesses about the transverse field is proportional to field size.

μ precession

In TF- μSR muon precession is measured as a cone, rather than a plane; and the muon polarisation traces out of the base of this cone instead of being relative to the plane (see Fig. 1).

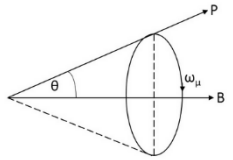


Fig. 1: Precession of a muon in a transverse applied field.

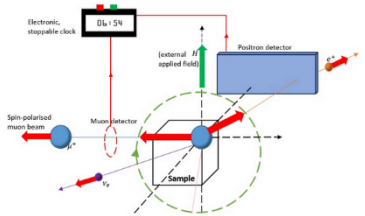
Where, P= muon polarisation.

B = internal field.

ω_μ = precession frequency.

θ = angle between the magnetic field and initial muon spin-polarisation.

Experimental set-up



Applications of TF-μSR

TF-μ SR has many applications. The most commor

Other uses include: gaining information of muon re
magnetic susceptibility and the sites where muons

Superconductors

In a Type II superconductor there are two distinct magnetic phases, which are illustrated in Fig. 1.

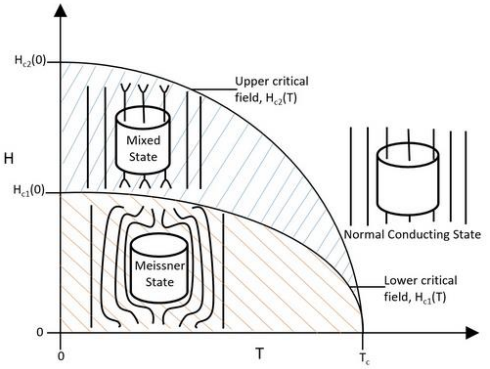
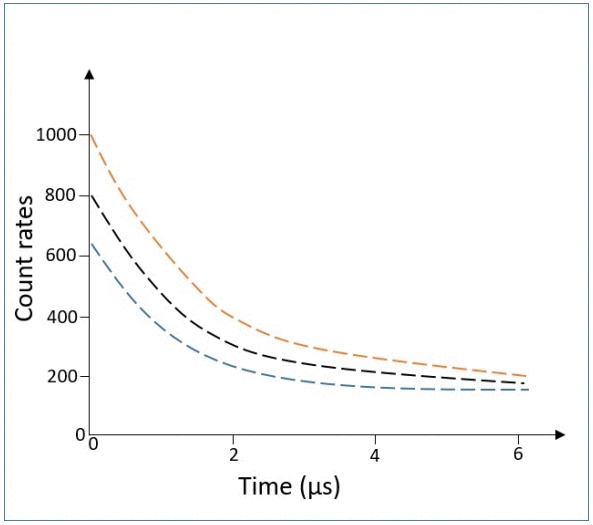


Fig. 1: A phase diagram showing the magnetic phases in a Type II superconductor.

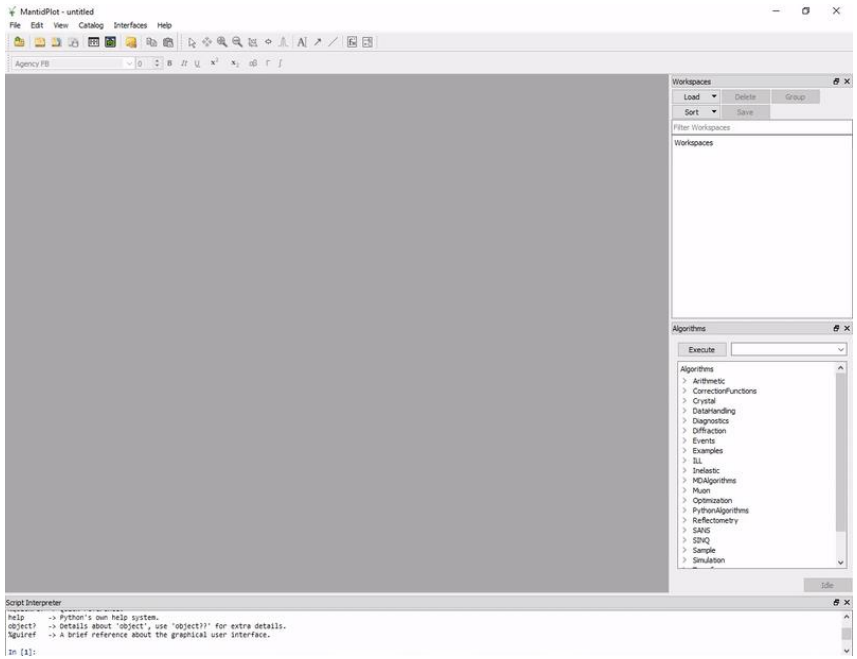


Using Muesr within the Muon Training School

- Python script created by Roberto De Renzi
- Made for Jupyter Notebooks but implemented using Mantid
- Working in conjunction with WP10
- Student feedback
- Assess user-friendliness and success of script

Introducing Muesr using e-neutrons

- Used Mantid script repository
- Tutorial GIF on e-neutrons to shows students how to install
- Workshop session in the Muon Training School
  - Students to used the script in Mantid
  - Tried out simple examples of using the program
  - Gave feedback on process
- Could add more instructional material to e-neutrons



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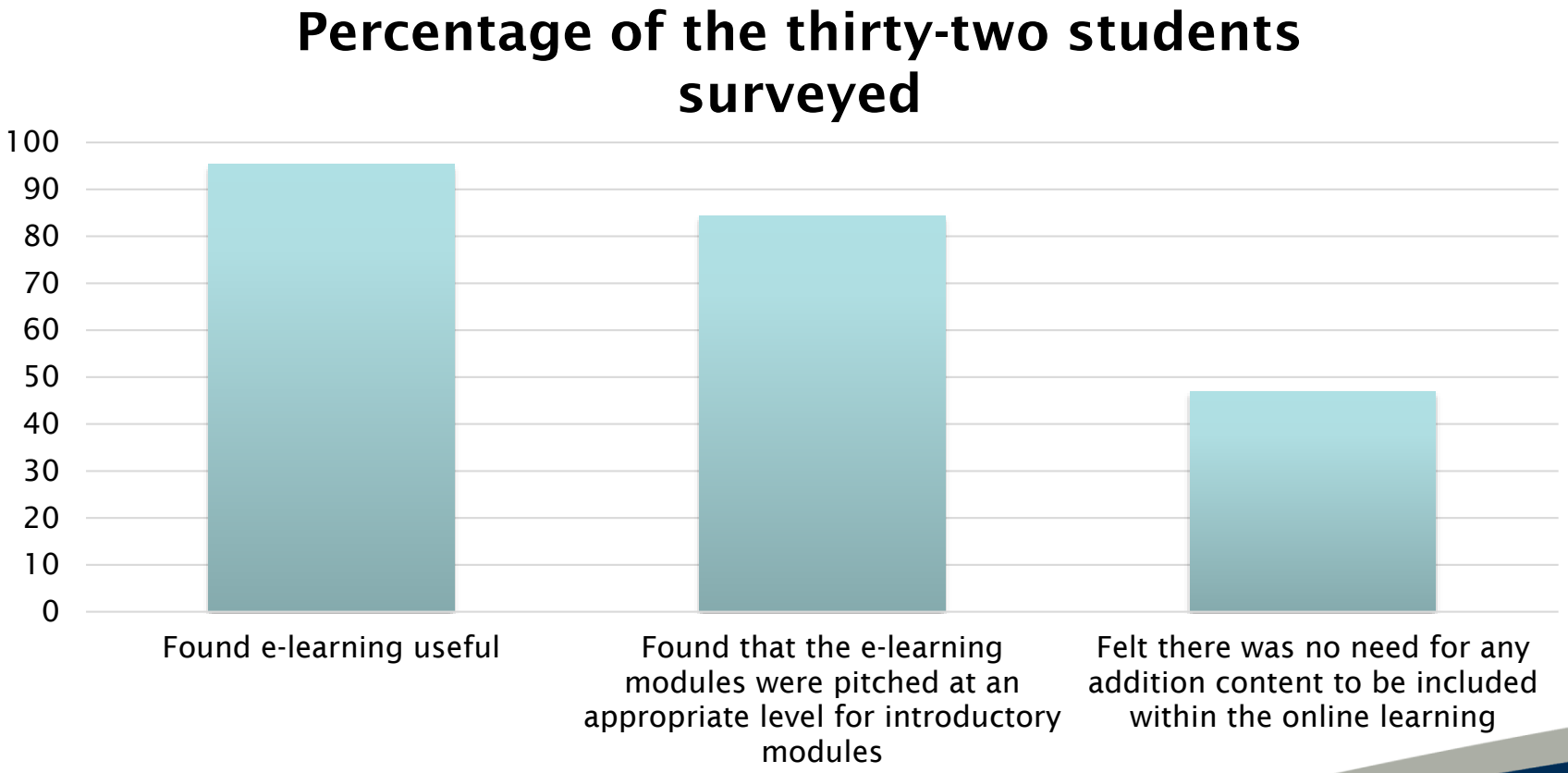
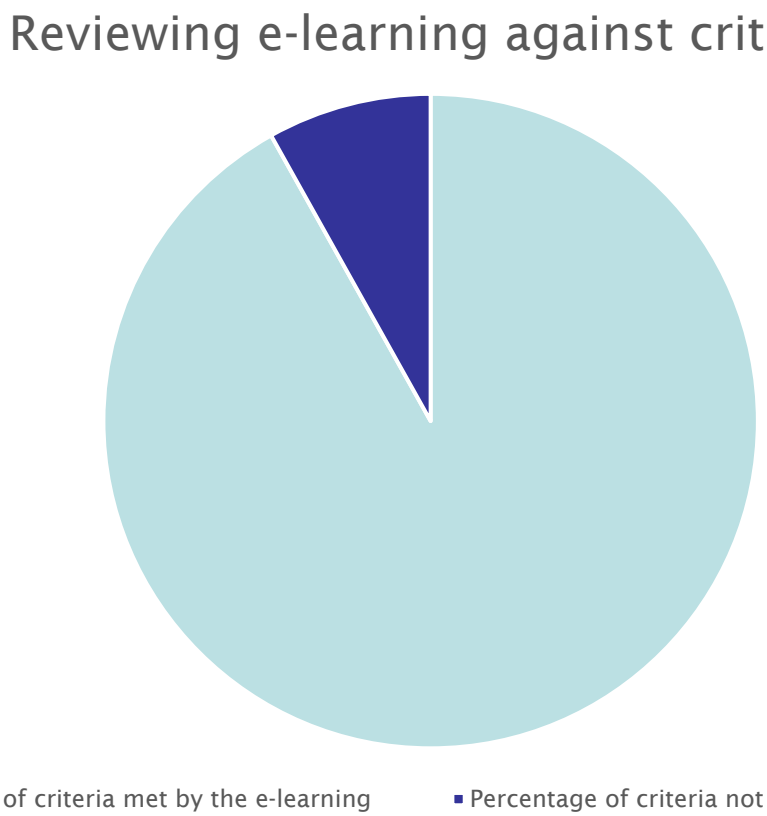
Student feedback from questionnaire



Informal student feedback

- Not all the students did the online learning
- Many students did the e-learning after starting the Muon Training School
- The Muon Training School illustrated the importance of some of the online modules

Evaluation of materials against criteria



- 10% of criteria not fulfilled by project so far
- Points unfulfilled:

- Inclusion of mp4 files
- Inclusion of audio files
- Tailoring the course to each student's individual learning needs

Blended learning for muons

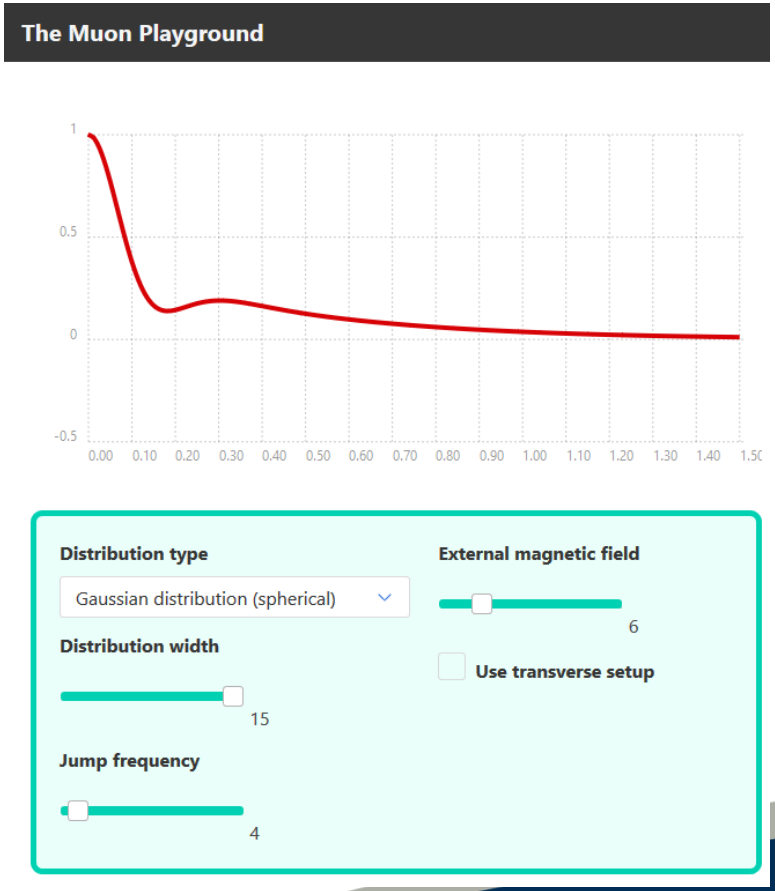
- All the material produced is aimed to complement muon training school
- Training school now relies on online pre-school materials
- Vast majority of system users for muons have been muon training school participants
  - Biggest group actively engaged with training
  - Pre-school learning
  - Post-school reinforcement
- SwednESS course was big exception in using materials without practical work

- Stand-alone users have used lecture videos in reasonable numbers
- Some pre-experiment use by new/field-changing facility users
- Feedback scores rank:

1. Hands-on practical sessions
2. 'Best' and most widely relevant lectures
3. Online learning materials

Future plans at ISIS – 1

- Interpreting muon data is the biggest challenge for students
- Starting on topic-specific introductions to data analysis
  - First will be ionic diffusion
  - Themed data analysis activities from training school provide materials to adapt
- New muon relaxation app made by collaborator in STFC
  - Full MC simulation beyond our resources
  - JavaScript based calculations for simple models/field distributions
  - Should be easy to extend to cover most training school level examples



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Future plans at ISIS – 2

- New student starts on 2nd July (SINE2020 supported)
- Feedback from muon training school showed students want what we are planning to make

ISIS Neutrons

- Interest from QENS for data analysis workbook
- Oxford School for Neutron Scattering
  - Pre-school material
  - Distributing more content afterwards
- ISIS Neutron Training Course
  - Pre-school competency checks

Conclusions

- Students greatly appreciate the muon online materials
- Now vital to maximising learning on training school
- Students still view hands-on training as more important
- Student requests and our delivery plan are well-aligned
- Interfaced with WP10 for muon site finding code
- Moving on to the most instructive parts of the training: Interpreting the data and approaching data analysis
- Will soon have raw materials for tailored learning
- Trying to increase participation from ISIS neutron groups and training activities