

Code and Data Sharing for Advanced Radiotherapy

Andrea Gutierrez, **Tony Price**, Costanza Panaino, Martin Turner,
and Hywel Owen

MCMA17

17th October 2017



UNIVERSITY OF
BIRMINGHAM



Science & Technology
Facilities Council



Got to menti.com

Enter code 92 51 49

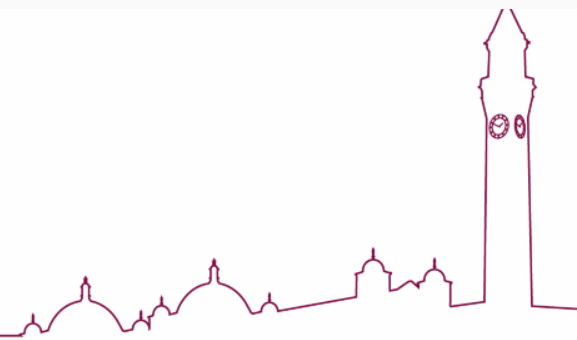
Please enter the code

Submit

The code is found on the screen in front of you

or

Find nearby presentations



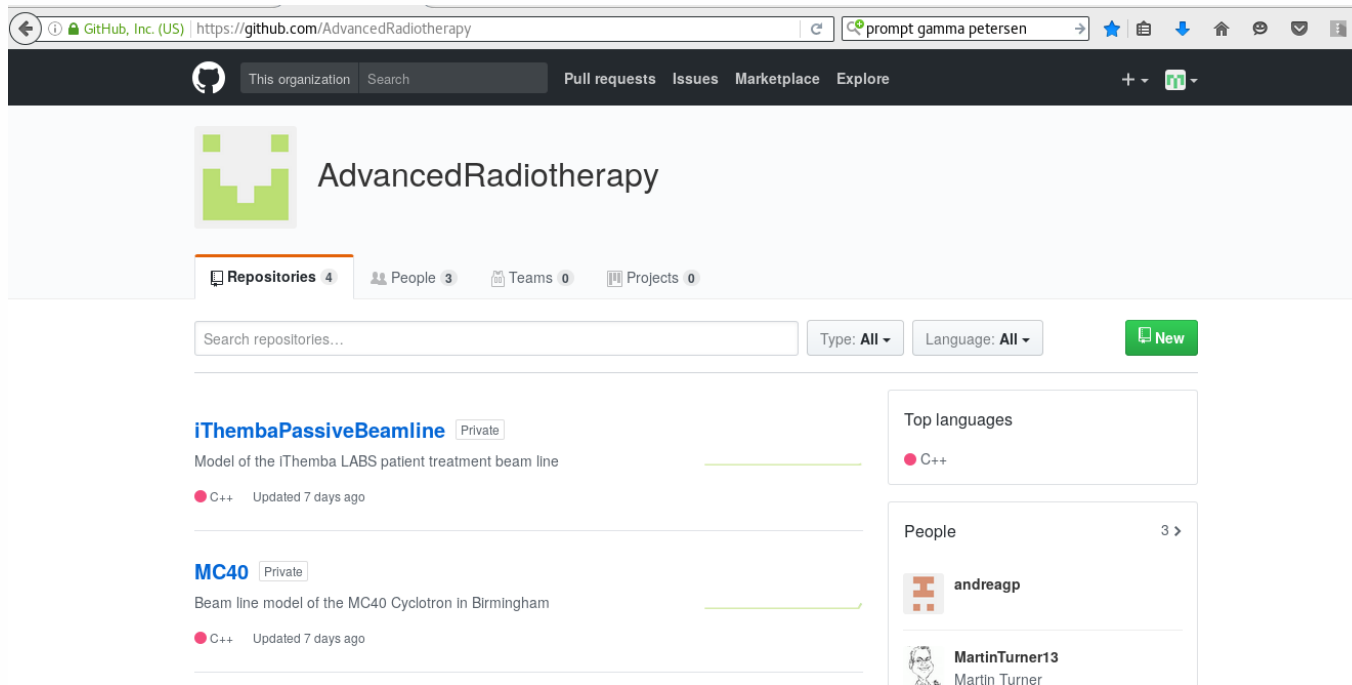
Project Overview

- Project funded in the UK by STFC Global Challenges Network+ Advanced Radiotherapy
- **Aims:**
 - To enable non MC experts to use MC code and facilitate the use of MC in a clinical environment
 - To save users time by providing models of beam lines and experimental facilities which have been validated by expert users of the facility
 - Pure Geant4, FLUKA, TOPAS, GATE...
 - Provide data to verify any code we provide is working on your system



Project Overview

- Host code and data on UCL github
 - Currently set to private, will change soon
 - Pull requests will be possible but no push
 - Instructions on how to run simulations and expected results in README.md files



The screenshot shows the GitHub organization page for 'AdvancedRadiotherapy'. The browser address bar displays 'https://github.com/AdvancedRadiotherapy'. The organization's profile includes a green and white logo and the name 'AdvancedRadiotherapy'. Below the profile, there are navigation tabs for 'Repositories 4', 'People 3', 'Teams 0', and 'Projects 0'. A search bar is present with the text 'Search repositories...'. To the right of the search bar are filters for 'Type: All' and 'Language: All', along with a green 'New' button. The main content area lists two repositories:

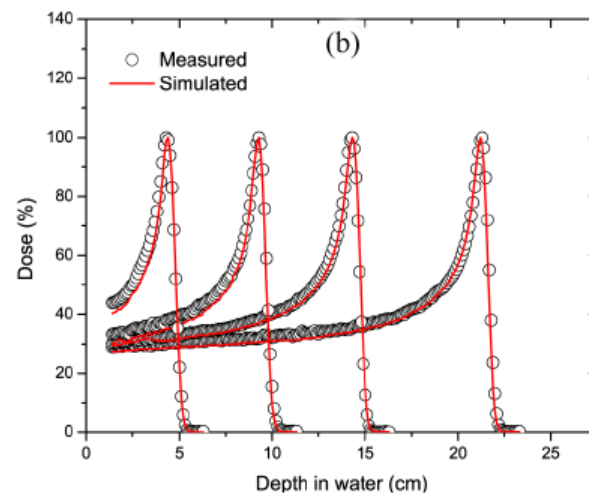
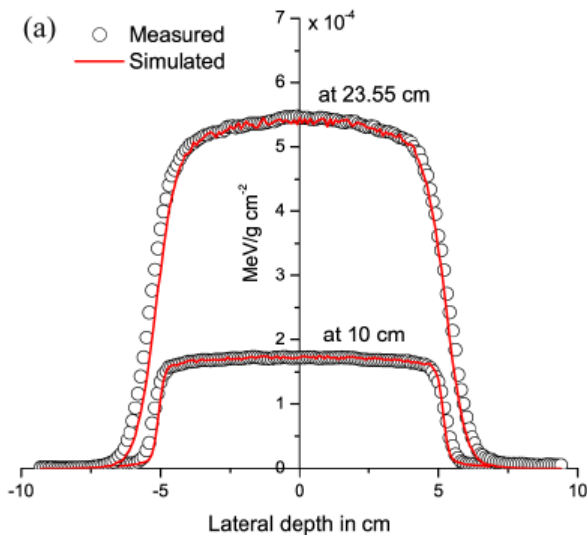
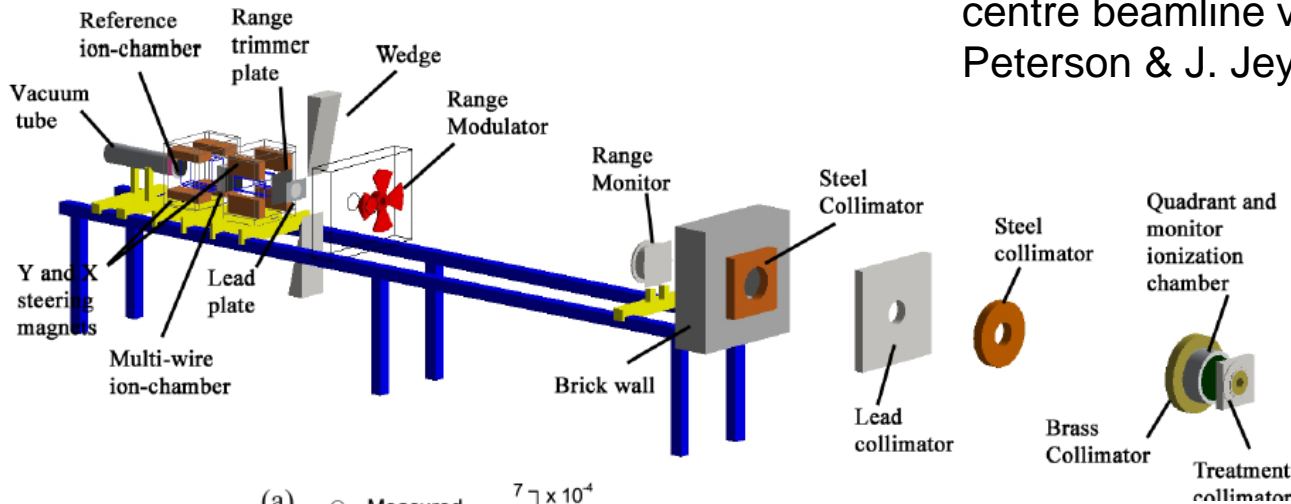
- iThembaPassiveBeamline** (Private): Model of the iThemba LABS patient treatment beam line. Updated 7 days ago. Language: C++.
- MC40** (Private): Beam line model of the MC40 Cyclotron in Birmingham. Updated 7 days ago. Language: C++.

On the right side, there are two sidebars: 'Top languages' showing C++ and 'People' showing 3 members, including 'andreagp' and 'MartinTurner13' (Martin Turner).

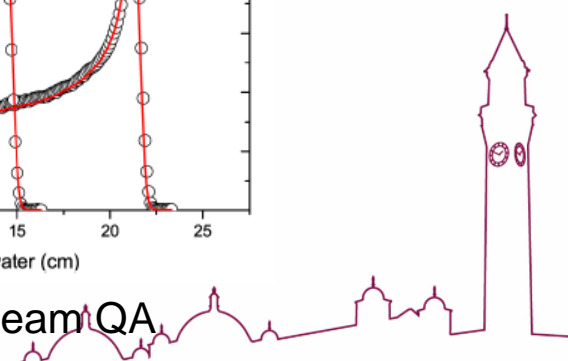


Case Study 1: iThemba Beam line and proton CT

Geant4 implementation of iThemba proton centre beamline validated by experts (S. Peterson & J. Jeyasugithan) at UCT

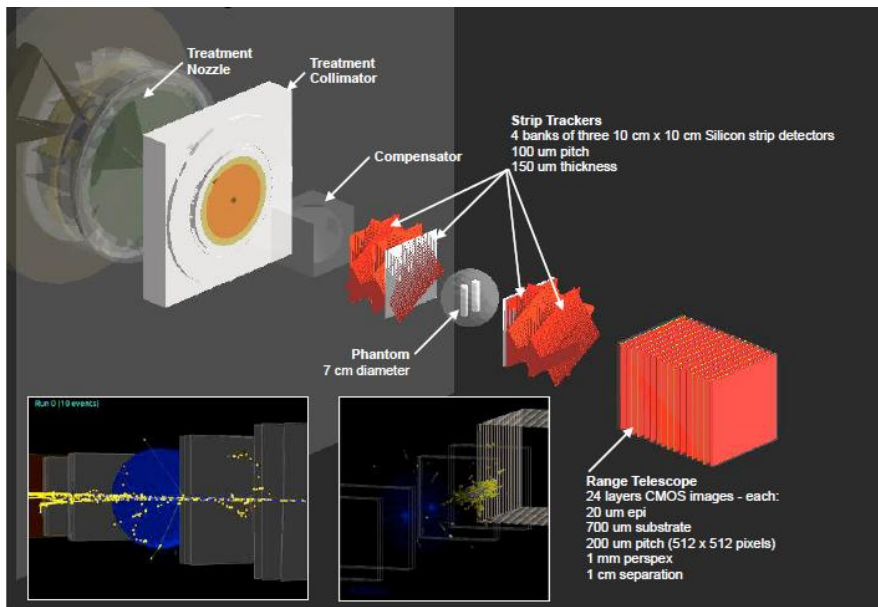


Small ionisation chamber in water tank for beam QA

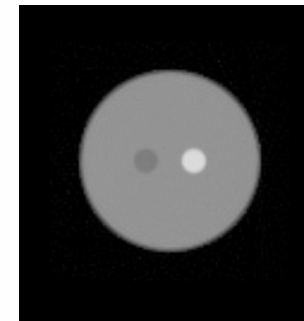
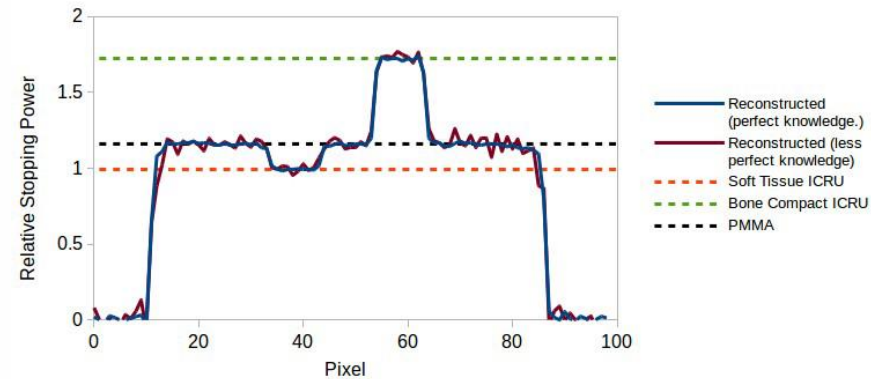


Case Study 1: iThemba Beam line and proton CT

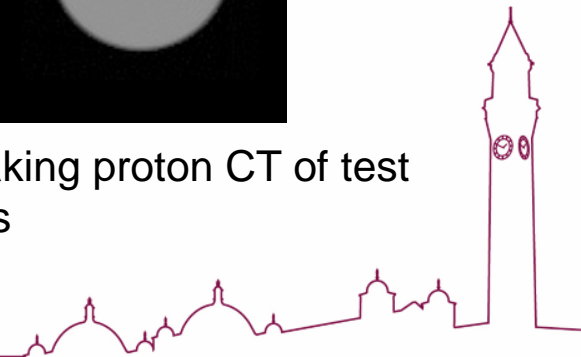
Donated to PRAVDA to help optimise proton CT which would be tested at iThemba LABS



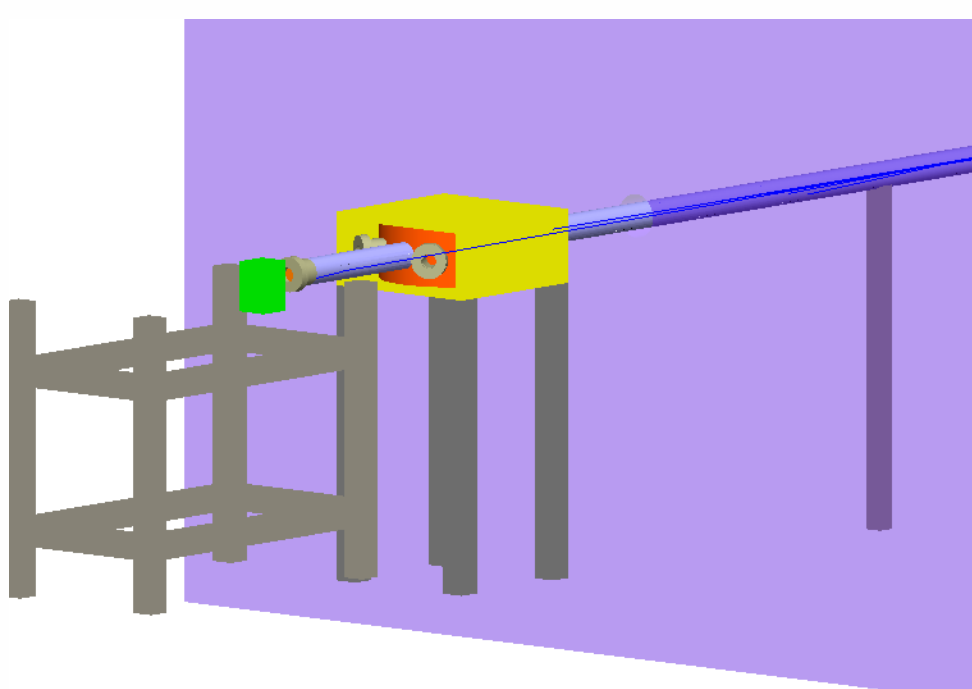
Members of PRAVDA could focus on just simulating their device...



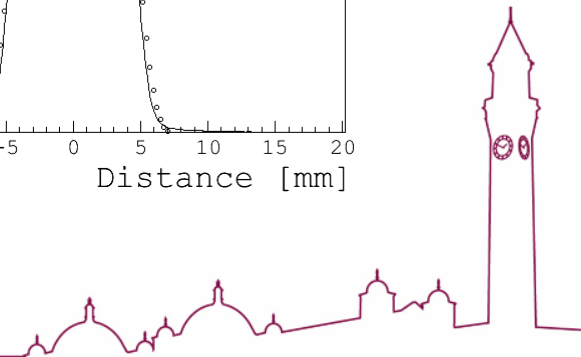
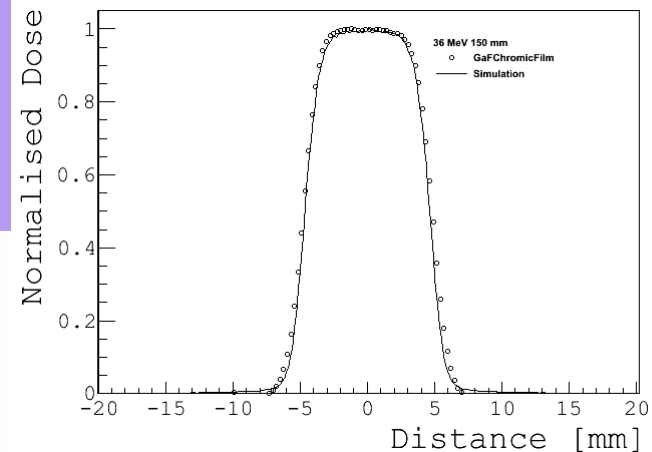
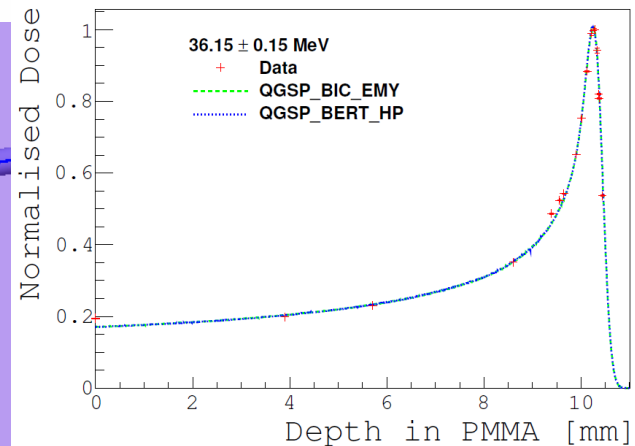
.. and making proton CT of test phantoms



Case Study 2: Birmingham MC40 Medical Beam line



Geometry fully implemented and beam parameters for 29 MeV and 36 MeV beams optimised. See poster or talk to me for more details



Case Study 2: Birmingham MC40 Medical Beam line

AdvancedRadiotherapy / MC40 Private

Watch 0 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

Beam line model of the MC40 Cyclotron in Birmingham Edit

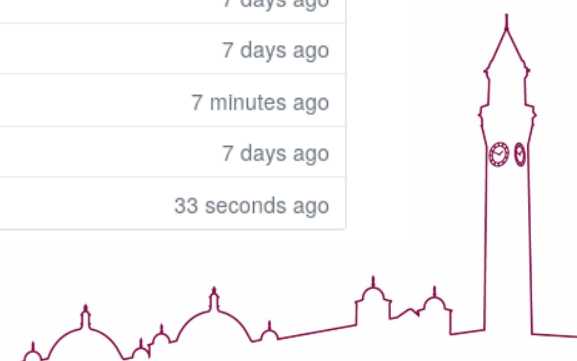
Add topics

8 commits 1 branch 0 releases 0 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

Tony Price added fit36MeVBraggPeak.py for analysis Latest commit 71457a7 34 seconds ago

include	removed unnecessary backup files in src and include	7 days ago
macros	Updated the README.md file	7 minutes ago
rootfiles	added example rootfile output	5 minutes ago
src	removed unnecessary backup files in src and include	7 days ago
GNUmakefile	added required files	7 days ago
README.md	Updated the README.md file	7 minutes ago
bhamBeamline.cc	added required files	7 days ago
fit36MeVBraggPeak.py	added fit36MeVBraggPeak.py for analysis	33 seconds ago



Case Study 2: Birmingham MC40 Medical Beam line

MC40 Cyclotron Model

Validated with Geant4.10.1 on Ubuntu 12.04. Tested and working on CentOS7 and SLC6 with Geant4.10.2.p03

Also requires ROOT (<https://root.cern.ch>)

To build:

1. source relevant thisroot.sh and geant4make.sh
2. change to /bhamBeamLine
3. type 'make'

To run a Bragg peak to test against validation data type

```
'bhamBeamLine macros/braggpeak.mac'
```

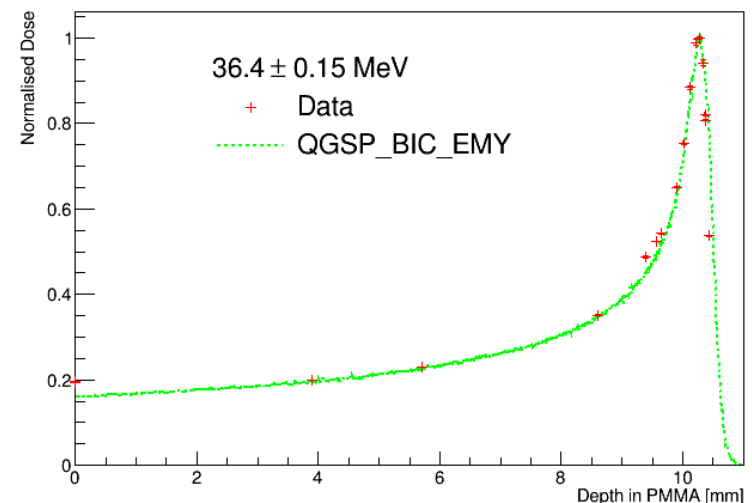
This will simulate 10k primaries and output a file called rootfiles/braggpeak.root

To analyse the data simply run

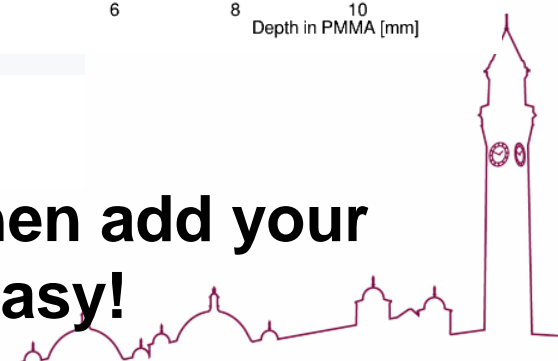
```
'python fit36MeVBraggPeak.py'
```

This will scale the Bragg Peak to data obtained with Ionisation chambers

Dose deposited as a function of depth in PMMA



Once results are replicated you can then add your experiment to the beamline! Easy!



Case Study 3 – Clatterbridge Cancer Centre

- Many experiments performed at CCC in the UK in the build up to NHS proton facilities opening
- Many users therefore need to model the beamline to accurately simulate their experiments
- Currently many users are (have) modelling the beamline...
 - UCL
 - NPL
 - Manchester University
 - Royal Berkshire Hospital
- We want to add a single validated model for all to use!



Case Study 4 – STFC Global Challenged Network+ Advanced Radiotherapy Phantom



Physical and software phantoms for proton therapy

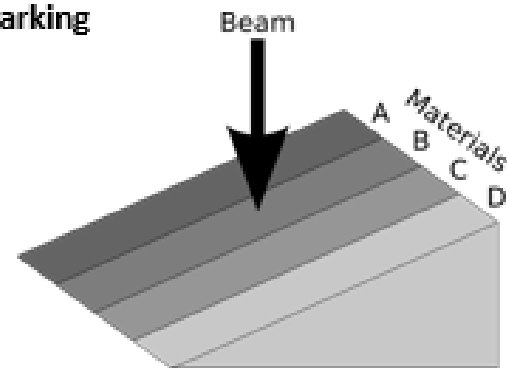
- Need to verify Monte Carlo simulations not only in water but also in additional materials:
 - Dose distributions simulated in the water used for the tuning will always fit measurements in water
 - Need additional benchmarking in non-water materials

Aim: Standard phantom design for MC benchmarking

Slide borrowed from Carla's talk yesterday

Proposed to host such a phantom in a single place for all users

We intend on making available to all users via github when ready



Picture courtesy: Adam Aitkenhead

WE NEED YOU



**Increased exposure
for your work**

Increased citations

**Decrease time
wasted by others**

**Contact us and
donate now!**

t.price@bham.ac.uk

