ABRA

Accelerated Beams for Research and Applications

A National Cyclotron Facility

Prof. Tzany Kokalova Wheldon
University of Birmingham

Context

– “Suitcase physicist” syndrome

– Complementary to radioactive beam programme, AGATA, FAIR

– Support the Early R&D programme for applications of PPAN science

– Longer beam-times and priority for UK NP community measurements

– Feasibility studies and support for international PAC proposals → increase success rate in leading UK experiments

– Blue sky ideas and test measurements

– Training of PhD students and Early Career Researchers.

Current status

Currently the only UK (high) energy beams for research are from the Birmingham Cyclotron Facility.

Research limited to ~6-hours per day between isotope production activities.

Beams *p*, *d*, ^{3}He, ^{4}He & ≤40 μA.

Increasingly over booked.

MC40 was first installed in 1988 (36 years old → 50 years in 2038). Time to plan for replacement/expansion.

Physics Case

Proposed new UK cyclotron facility predominantly for stable beams:

– nuclear astrophysics;

– nuclear structure;

– dual beam with neutron facility.

– *novel medical isotope research;*

– *nuclear data;*

– *detector development and testing for international projects;*

– *radiation hardness testing, e.g. for space and accelerator applications;*

– *fusion studies;*

– *training of PhD students and ECRs*

Proposed beamlines at a K≥70 multi-beam cyclotron

Charged-particle studies, e.g. for astrophysics

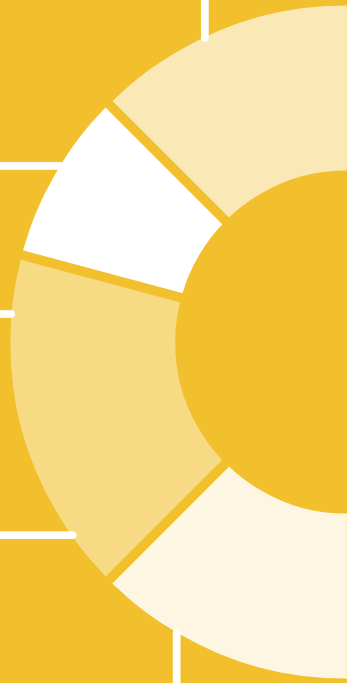
Gamma spectroscopy/structure station

Long flight-path neutron spectroscopy area / **DUAL BEAM** with HF-ADNeF

(Production on MC40)

Medical isotope research / radiotherapy research

National Physical Laboratory / UKAEA
UKSA/ other industrial partners



WHY Birmingham?

– Existing Infrastructure and technical staff and expertise

– University Support

– Safety and regulation existing

– Built HF-ADNeF on time + budget

– Long history and experience of cyclotrons in Birmingham

– 4/10 Medical Radionuclide Innovation Programme grants

– Radiobiology research group

– Cost effective – we have the Jyäskylä prototype ECR source

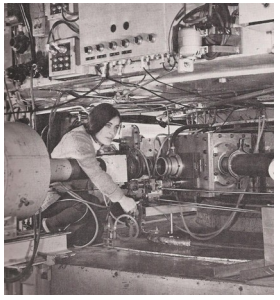
– Geographical position: central

– STEP Fusion reactor site planned for Midlands

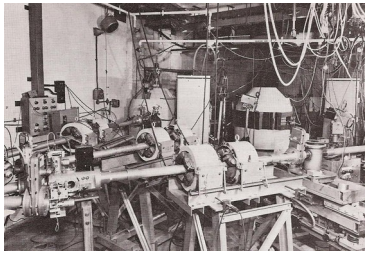
– Strong research partnership with NPL on radioisotopes/radiochemistry and standards etc.

– Strong links with QE hospital (largest in Europe)

Birmingham Accelerators



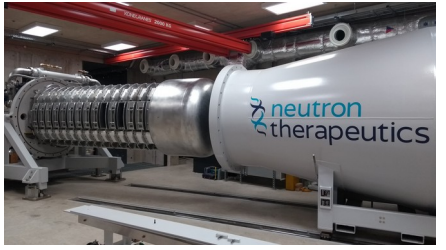
Nuffield Cyclotron
1948-1999



Radial Ridge Cyclotron
1960-2002

Dynamitron
1970-2020

MC40 Cyclotron
2001-present
at Birmingham



HF-ADNeF
2001-present
at Birmingham

Stakeholders

Academic

UKRI – STFC, EPSRC, MRC…

PPAN Communities

NP, PP, APP

– Detectors research/testing

– ECFA (European Committee for Future Accelerators):

UK-DRDT3 Detector R&D

– Space research

Industry

NPL

UKAEA

AWE

NNL

UKSA

Rolls Royce

Nuclear Medicine companies

Overview & Budget (very preliminary)

Cyclotron *K* = 70	Costings	Timeline
Multi-beam ≥10 MeV/u Ion-source for H → U Estimated extraction: Alphas ~50-100 µA ^{1}H ~1000 µA ^{2}H ~ 500 µA	Machine €35M (provisional quote) Building £10-15M (based on use of an existing building and expertise at B'ham)	4-5 years for machine build & delivery 1 year installation and commissioning In parallel: end-station design and build

Open for everyone to shape the physics case and thus the facility capabilities, including beamlines, end-stations/detection.

THANK YOU