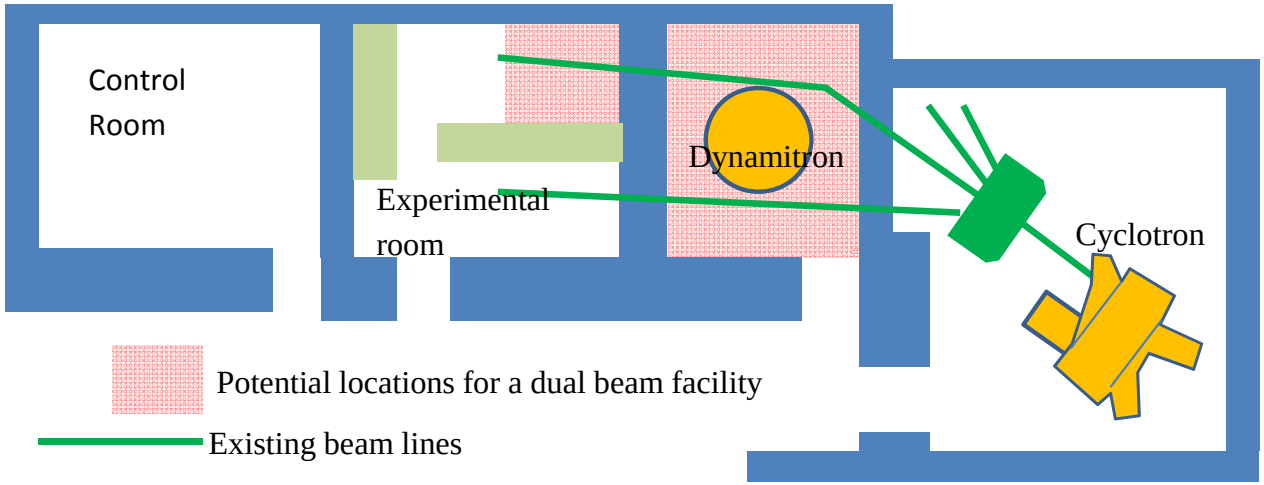
Materials Irradiation at University of Birmingham

Martin Freer
M.Freer@bham.ac.uk
12 Dec 2014

Cyclotron MC40 – p, d, 3He, 4He

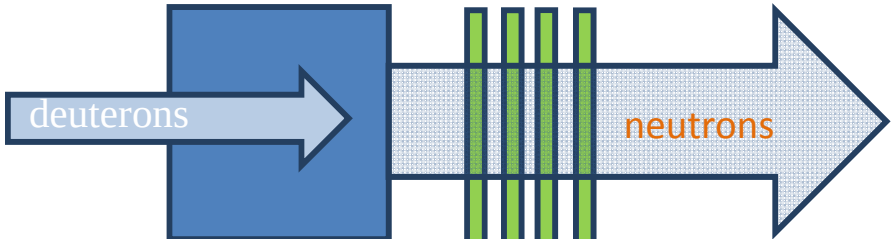
The MC40 cyclotron possesses the capability to deliver (with variable energy) of protons and ^{4}He up to 40 MeV, deuterons of 20 MeV and ^{3}He up to 53 MeV. These have ranges in iron of 2900 microns, 270 microns, 530 microns and 535 microns, respectively, with intensities of up to 20 microAmps.

Present materials irradiation programme:
RPV steels
Zirconium alloys
Si Carbides



Layout of Birmingham Accelerator Complex

The programme would involve the irradiation of a range of materials for nuclear applications, but including zirconium alloys, steels, ceramics, ODS steels……. We expect to be able to deliver 0.1 dpa/day.



Schematic of the neutron production and sample irradiation

Present

Proton beam 1 mA

Lithium target – epithermal neutron flux

Future

Deuteron beam 15 mA

Lithium target ~3×10^{13} neutrons per second via the Li(d,n) reaction.

This flux of ~3×10^{13} neutrons would be spread over a region of 5 cm diameter.

For the present spectrum and intensity it would be possible to reach dpa's of 1 mili dpa (10^{-3} dpa) for a week long exposure

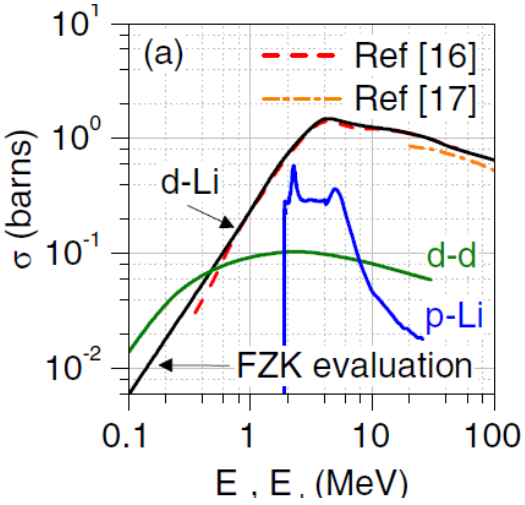


Fig 1. Neutron production cross sections as a function of energy, from [1].

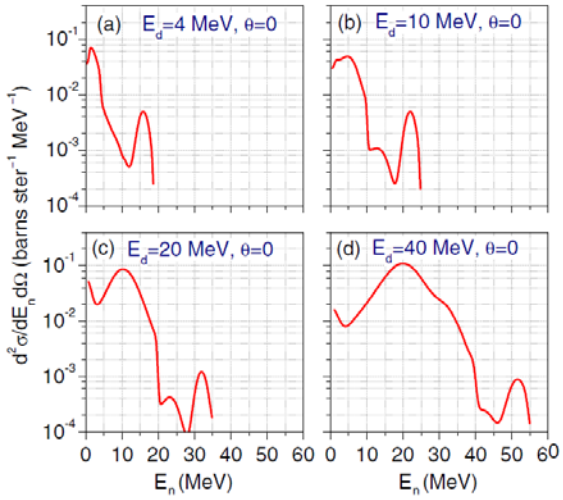
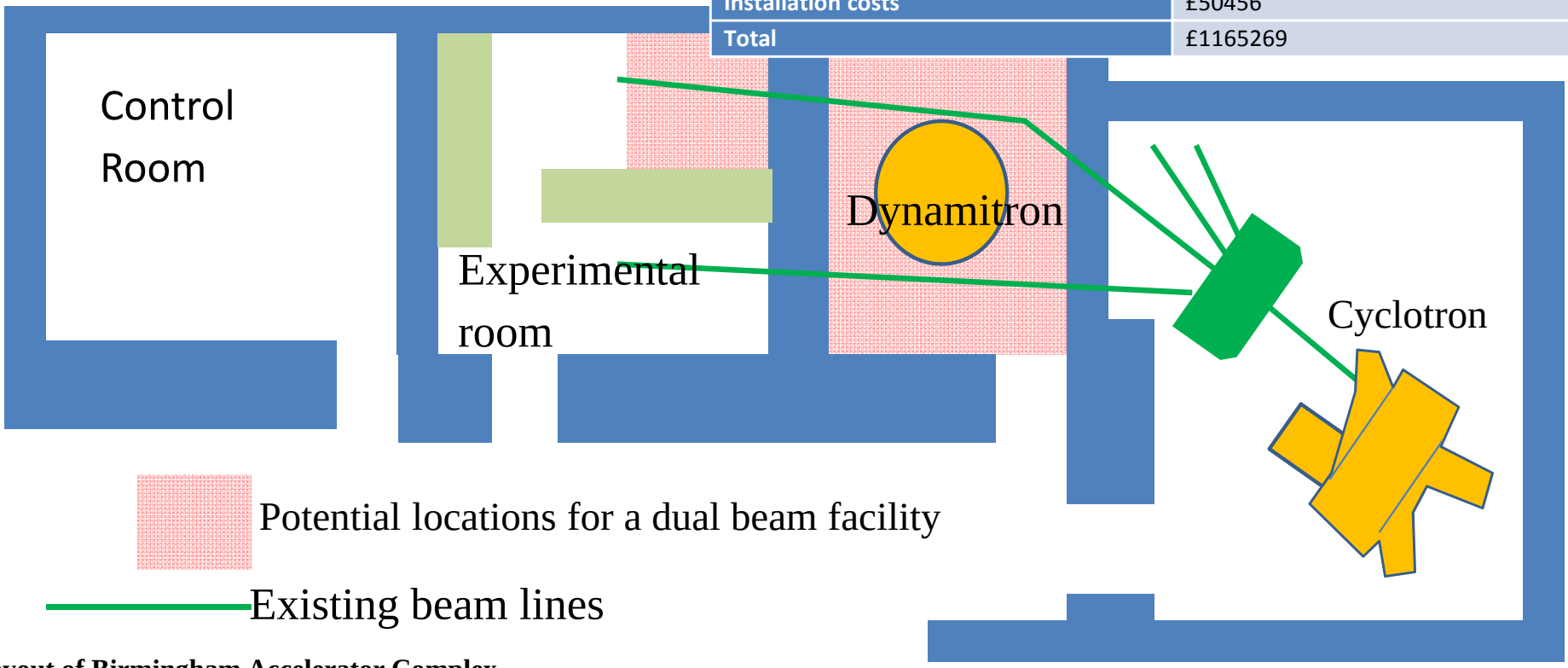


Fig 2. Neutron energy distributions at zero degrees. The 4 MeV plot illustrates the distribution that would be generated with the present facility, from [2].

Dual Beam facility Including FIB

Costs for upgrade

Chiller etc for target cooling	£35000
New terminal and source assembly	£446875
New beam tube	£108875
150 KW oscillator	£170625
New PLC control system	£231563
Water cooling upgrade	£121875
Installation costs	£50456
Total	£1165269



Layout of Birmingham Accelerator Complex

We expect to be able to deliver 0.1 dpa/day for the Cyclotron and up to 1 dpa/day for the Dynamitron (for lower depths).