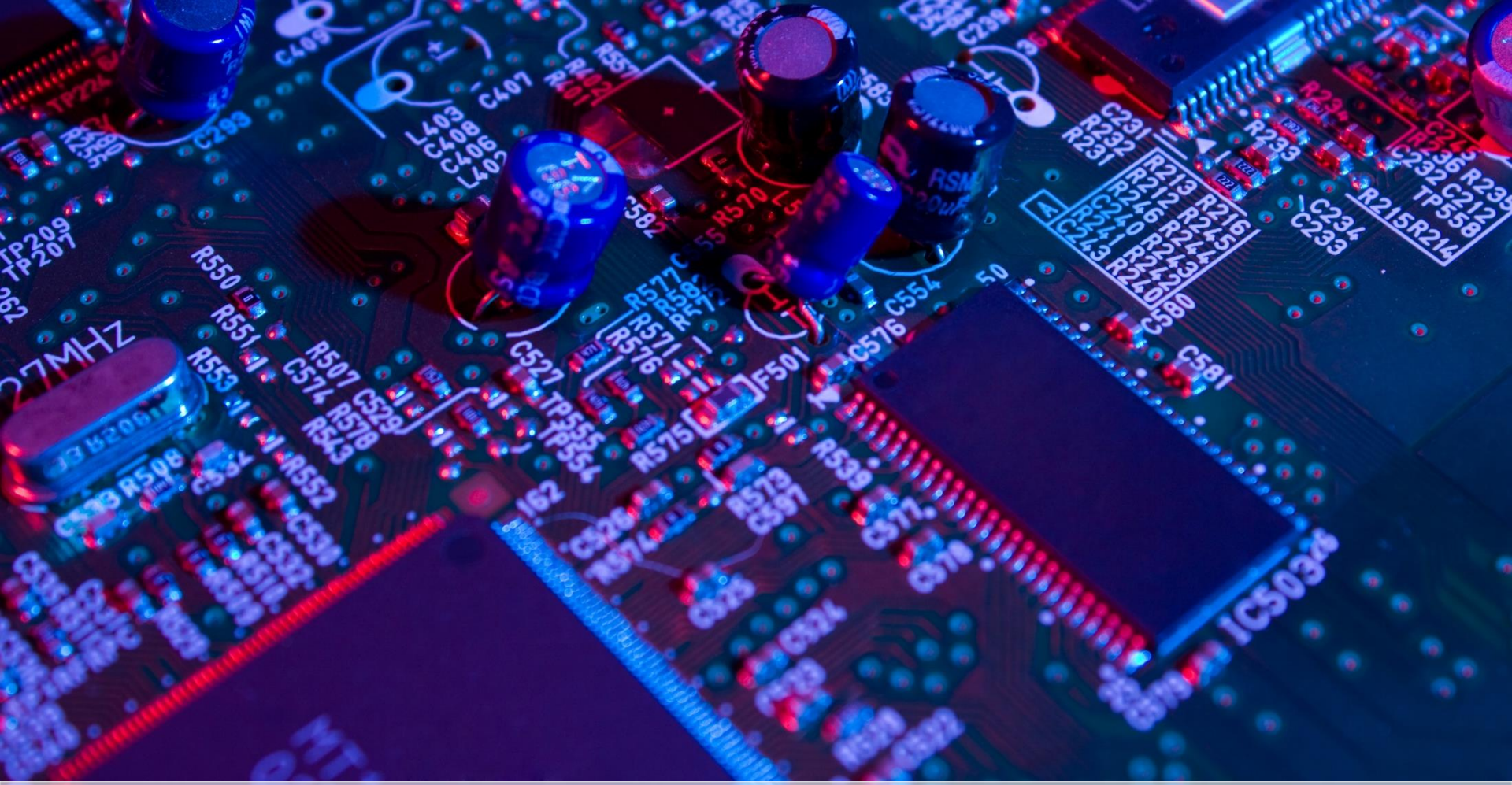

When the Chips Are Down....

Christopher Frost

ISIS Facility

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A problem has been detected and windows has been shut down to prevent damage to your computer.

The problem seems to be caused by the following file: SPCMDCON.SYS

PAGE_FAULT_IN_NONPAGED_AREA

If this is the first time you've seen this Stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

Technical information:

*** STOP: 0x00000050 (0xFD3094C2,0x00000001,0xFBFE7617,0x00000000)

*** SPCMDCON.SYS - Address FBFE7617 base at FBFE5000, DateStamp 3d6dd67c

Schaerbeek, Belgium: May 18th 2003, 22:30

4096 (2^{12}) votes added to an electronic voting machine

4096

0 0 0 0 0 1 0 0 0 1 1 0 0 1 1 0 1

"worried about the influence of Martians on these elections…. unless the cosmic rays affect our lists in a positive way!"

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SUN Microsystems - 2000

- Flagship Enterprise systems had problem in ‘cache’ memory

Cisco Systems - 2003

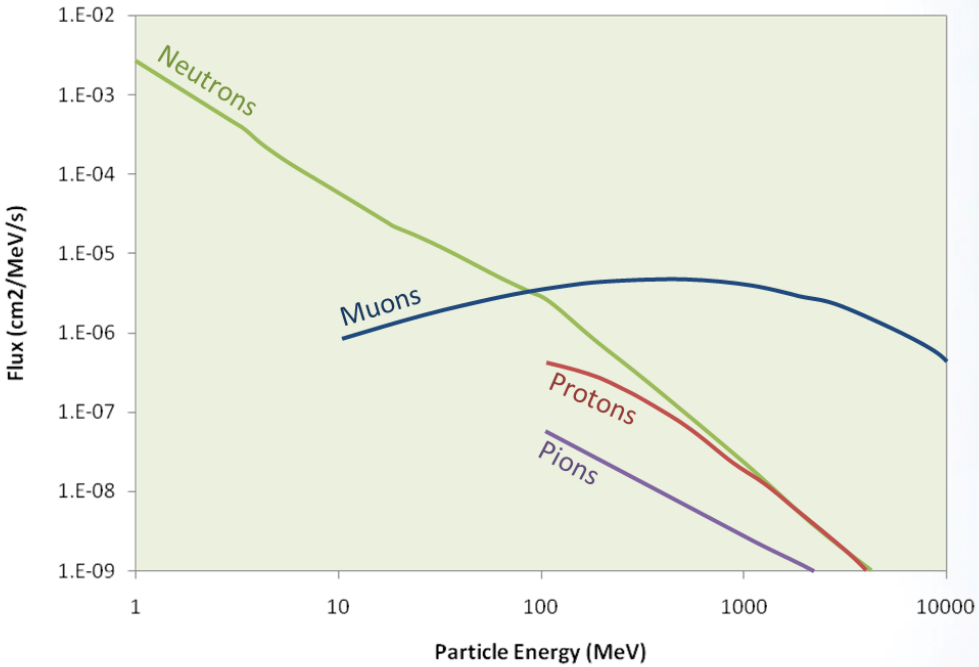
- High end 12000 series router line cards suffered failures

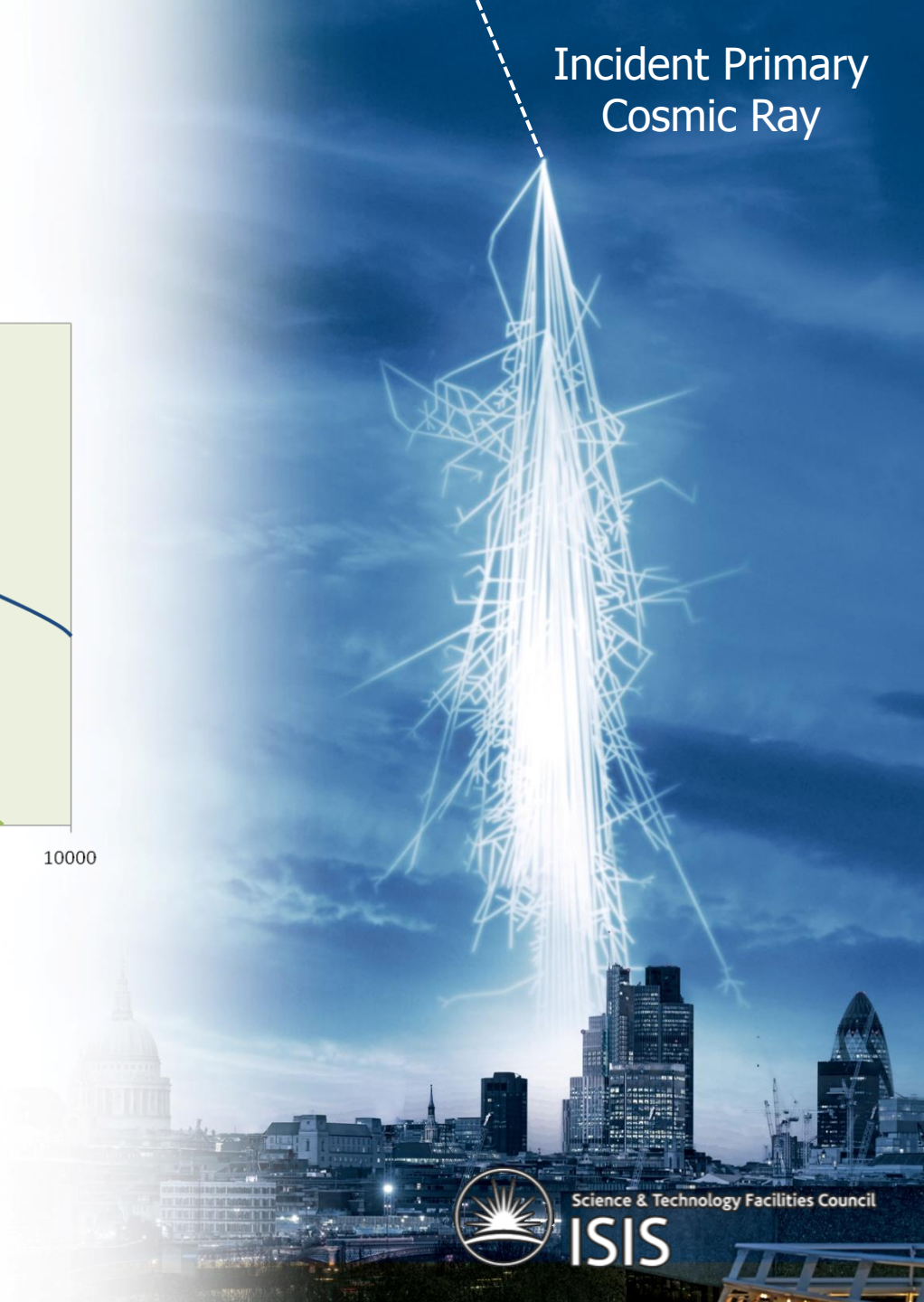
Cypress Semiconductor Corporation - 2001

- $1bn factory ground to halt every month due to single bit-flip in network

Sources: Daniel Lyons “Sun Screen”, Forbes magazine Nov 2000: Cisco 12000 Single Event Upset Failures Overview and Work Around; www.cisoc.com: James F. Ziegler and Helmut Pucher, SER-History, Trends and Challenges, Cypress 2004

Images courtesy of Shutterstock and Cisco Systems





Reproduced from J.F.Ziegler et al IBM. J. Res. Develop. 40, 1996, p23

Neutron Radiation from Cosmic Rays

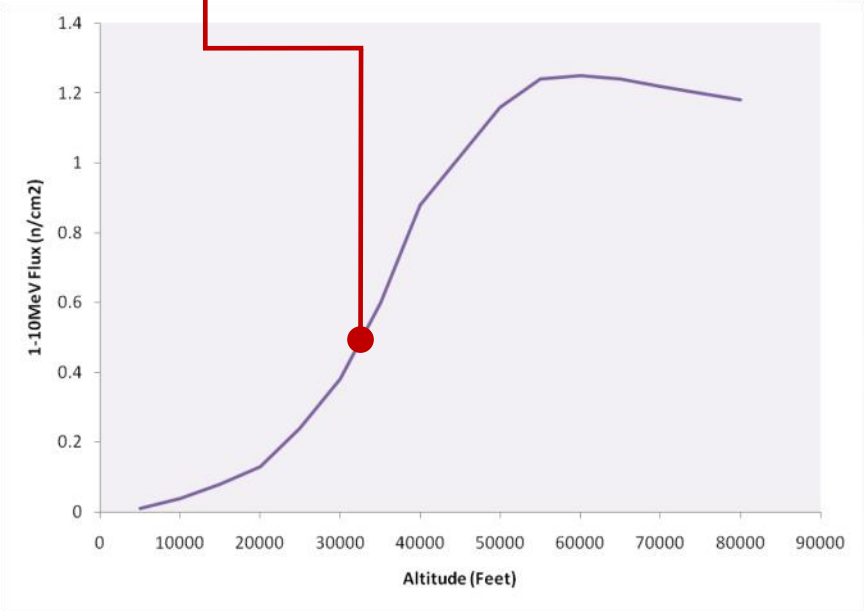
~ once a minute

E Normand and TJ Baker IEEE Trans Nucl Sci 40, 1484, (1993)

Neutron Radiation from Cosmic Rays

~ 300 a minute

More neutrons at 35,000 feet



E Normand and TJ Baker IEEE Trans Nucl Sci 40, 1484, (1993)

Neutron Radiation from Cosmic Rays

~ 300 a minute

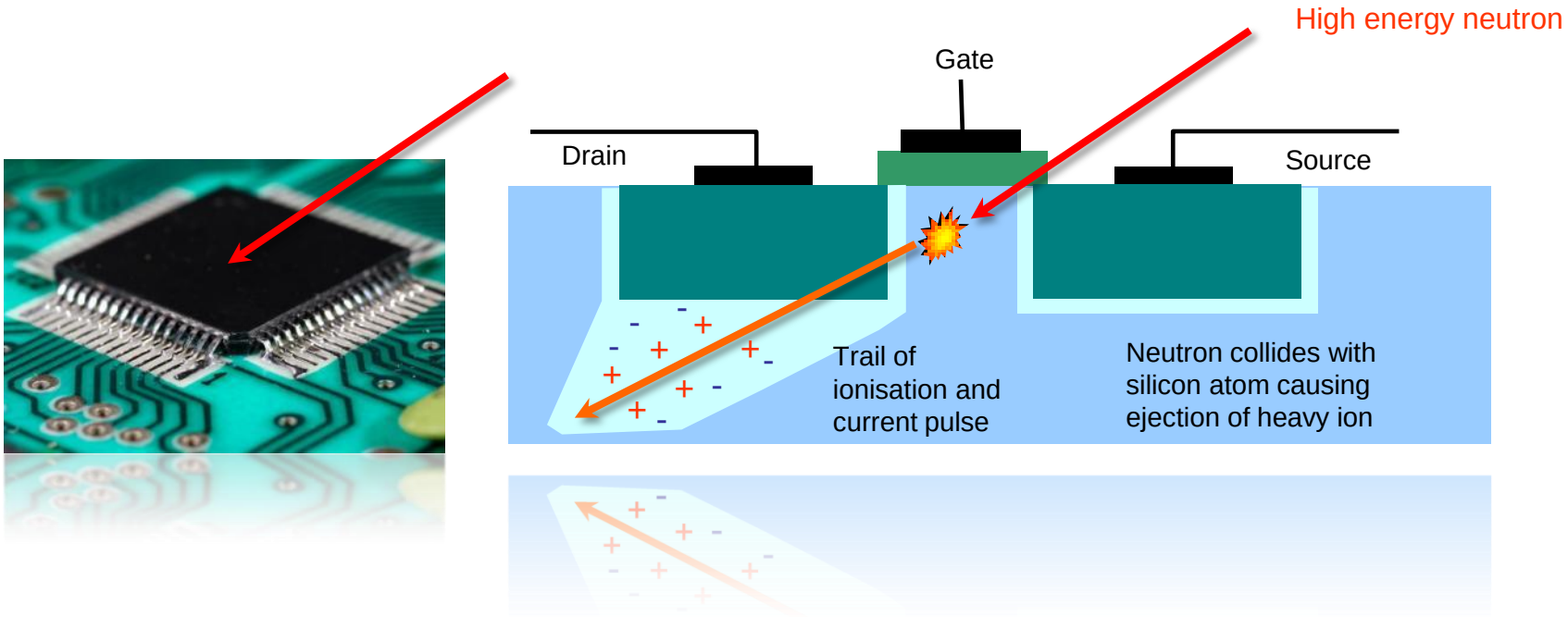
More neutrons at 35,000 feet

The dominant reliability issue in aircraft avionics

Becoming a dominant reliability issue in all advanced electronics

E Normand and TJ Baker IEEE Trans Nucl Sci 40, 1484, (1993)

A Single Event Effect (SEE) is when a highly energetic particle present in the environment, strikes sensitive regions of an electronic device disrupting its correct operation



A Single Event Effect (SEE) is when a highly energetic particle present in the environment, strikes sensitive regions of an electronic device disrupting its correct operation

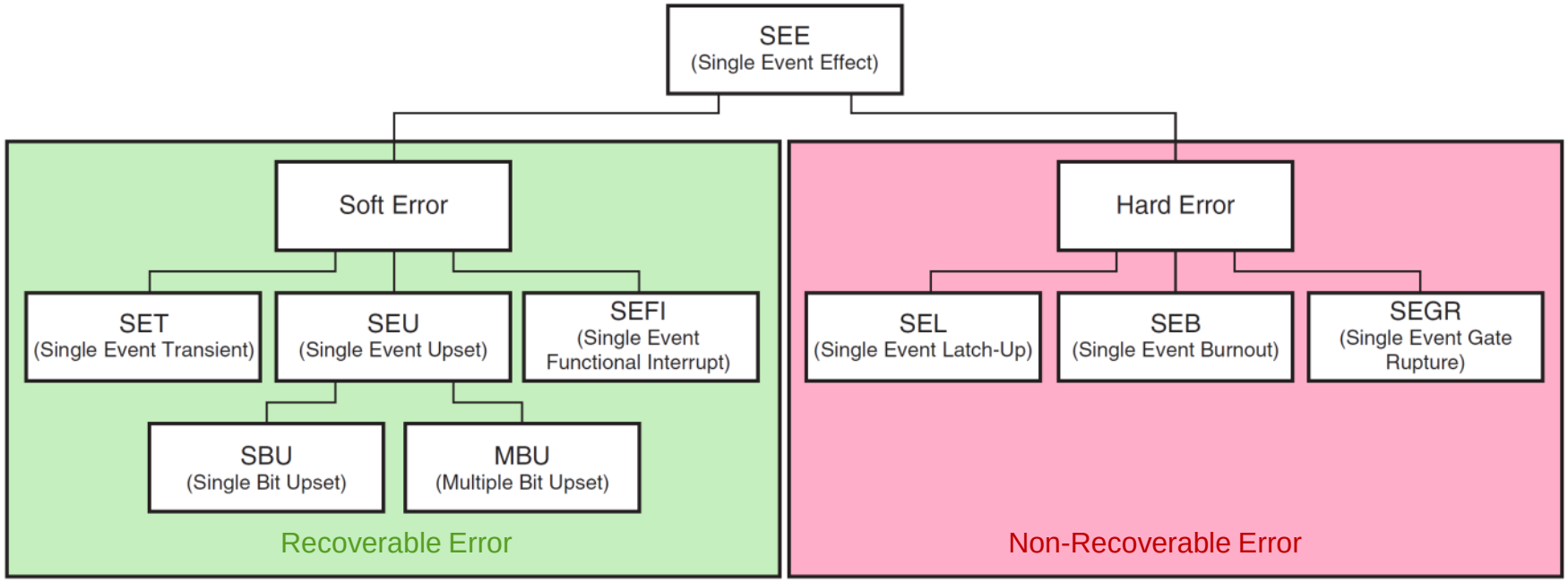


Diagram Courtesy: Xilinx

‘Real-world Incident’

7th October 2008 at 04:40:26
Flight Qantas QF72 – Singapore to Perth

ATSB TRANSPORT SAFETY REPORT Aviation Occurrence Investigation
AO-2008-070
Final (Table 26 ;p 150)

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ATSB TRANSPORT SAFETY REPORT Aviation Occurrence Investigation AO-2008-070
Final

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Blackpool Rollercoaster has a 213 ft drop

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“It identified a number of specific lessons for the manufacturers of new, complex, safety-critical systems...”

The Chief Commissioner of the ATSB, Mr Martin Dolan
Media Report 19 December 2011

ATSB TRANSPORT SAFETY REPORT Aviation Occurrence Investigation AO-2008-070
Final

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There were significant logistical difficulties in obtaining access to appropriate test facilities and developing test software and procedures.....

ATSB TRANSPORT SAFETY REPORT Aviation Occurrence Investigation AO-2008-070
Final

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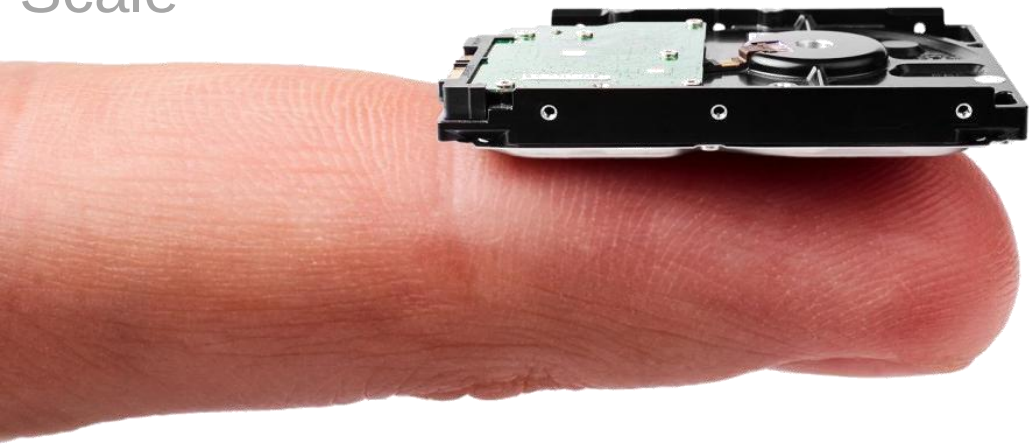
Functionality

Scale



Martin Cooper
Invented mobile phone and made the first call in 1973

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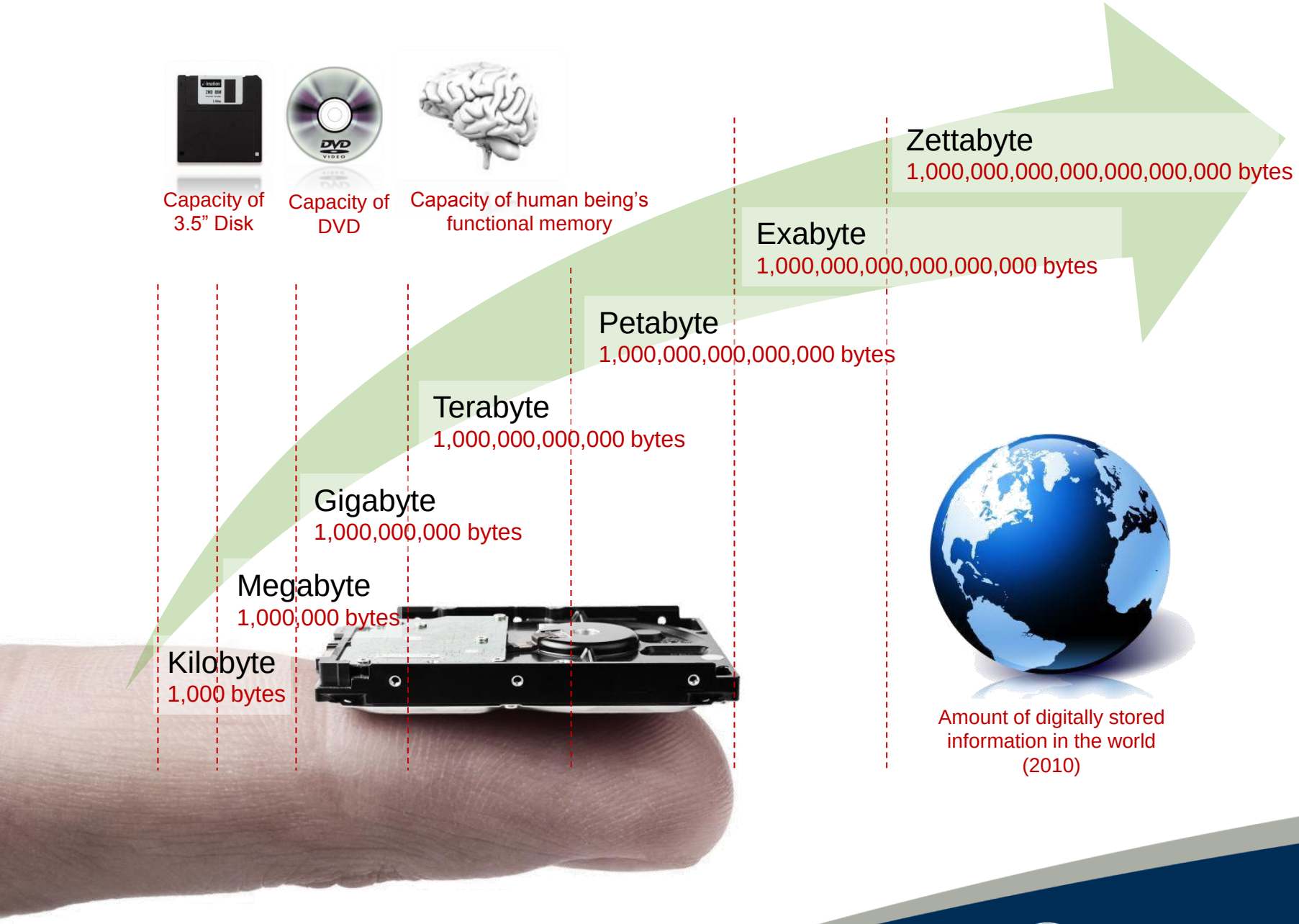
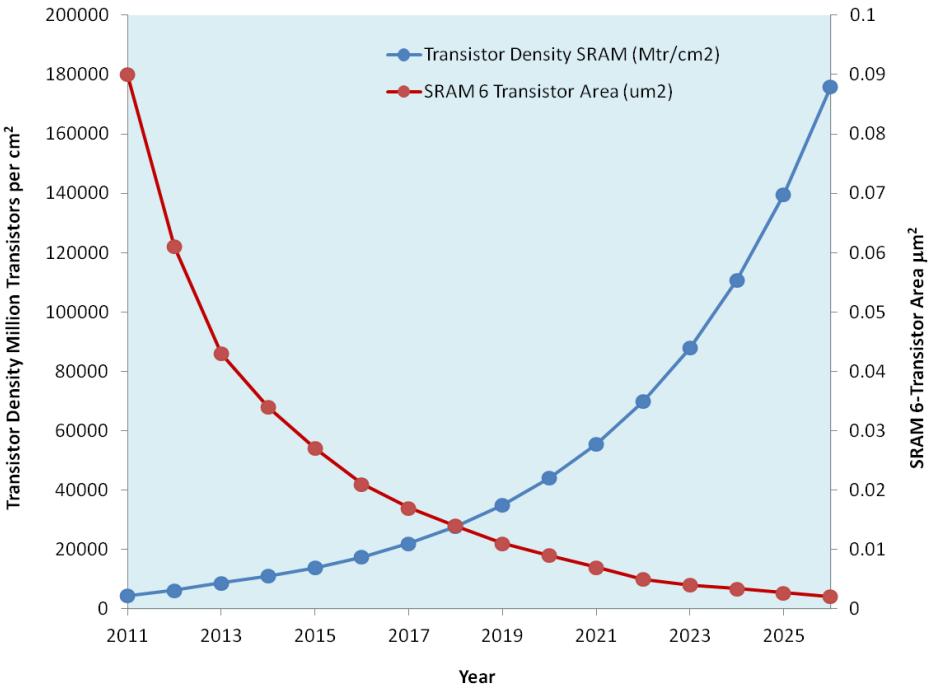
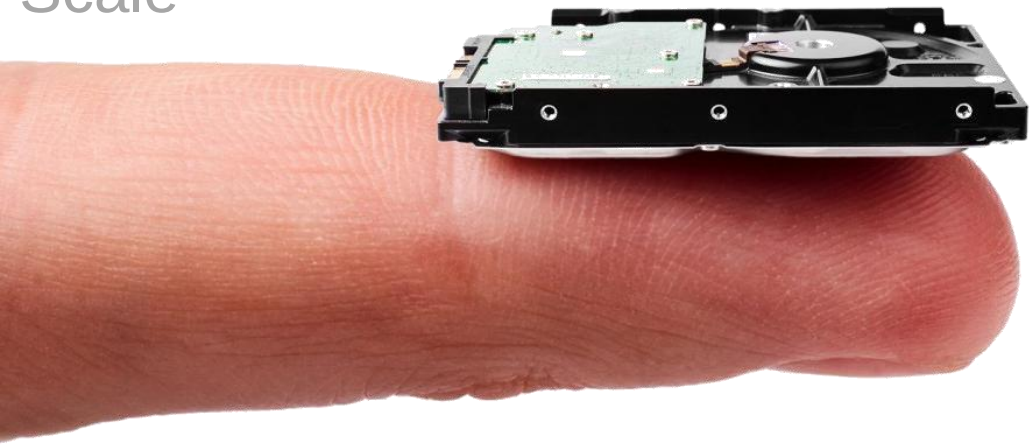


Source: Cisco

Functionality



Scale



Reproduced from data in ITRS Roadmap 2011

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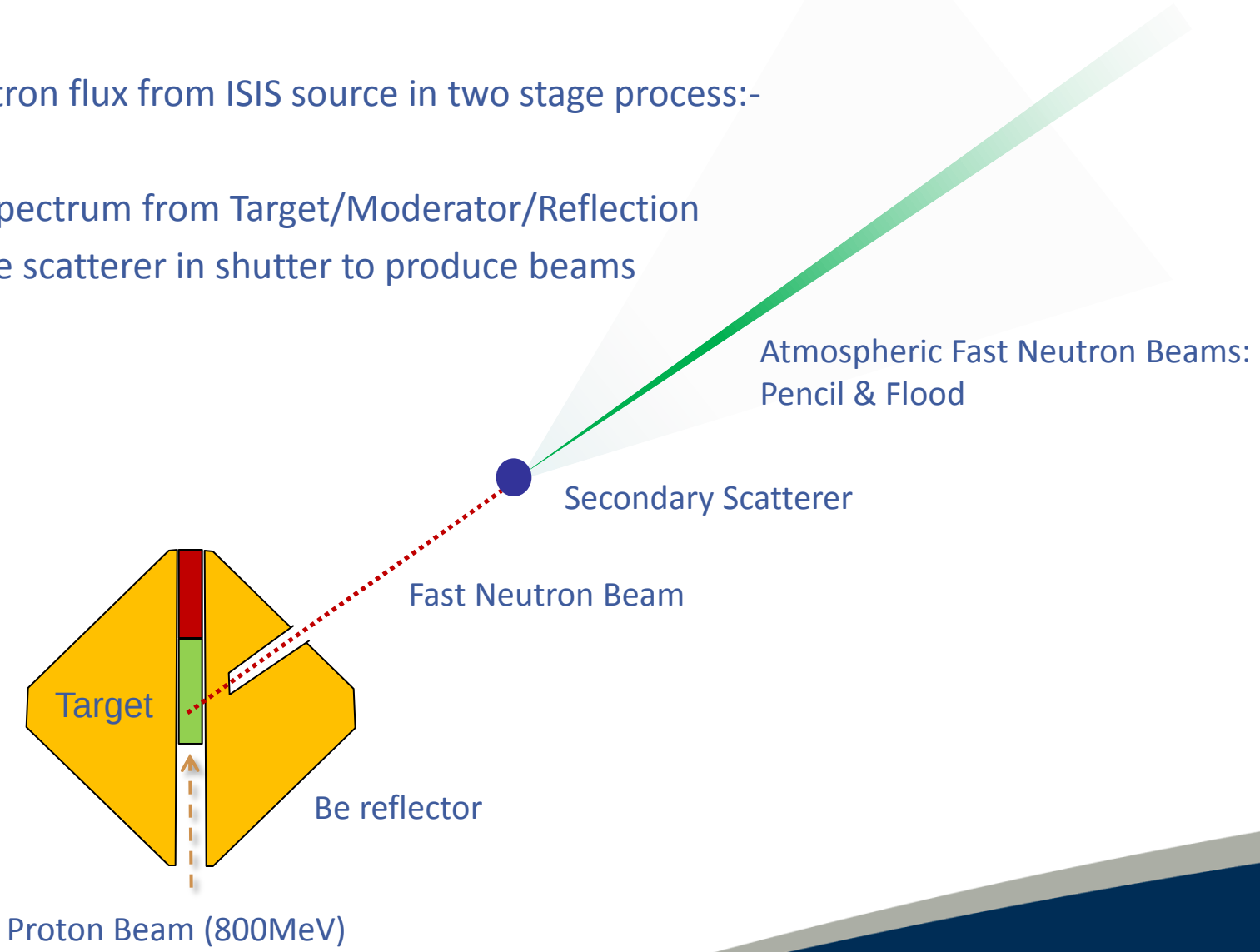
ISIS Neutron Source
Rutherford Appleton Lab

Basic Principle

Use fast neutron flux from ISIS source in two stage process:-

- Harden spectrum from Target/Moderator/Reflection
- Illuminate scatterer in shutter to produce beams



Primary Beam Specification
An energy bandwidth of 0-800MeV
The fast neutron flux (>1MeV) should match the QinetiQ QARM model for the atmospheric neutron spectrum
The integrated flux above (10MeV) should be of the order of 1×10^6 n/cm^2/s
The thermal neutron flux should be of the same order 1×10^6 n/cm2/s and removable via filters
A highly collimated beam up to as large area beam as possible (currently of order 25cm×25cm)
The gamma-ray flux be less than 1krad/day, but ISIS should aim for <1krad/week
Variable collimation below a certain size (25cm×25cm) to down to a size of ~2x2cm^2
A 'flood' beam with 2-3 sizes up to a maximum of 100cm×100cmwith flux of the order of 1×10^4 n/cm2/s
Ability to change to flux by two orders of magnitude (ideally 10^5 – 10^7 n/cm2/s integrated flux above 10MeV for the collimated beam and 10^3 – 10^5 n/cm2/s for the flood room)

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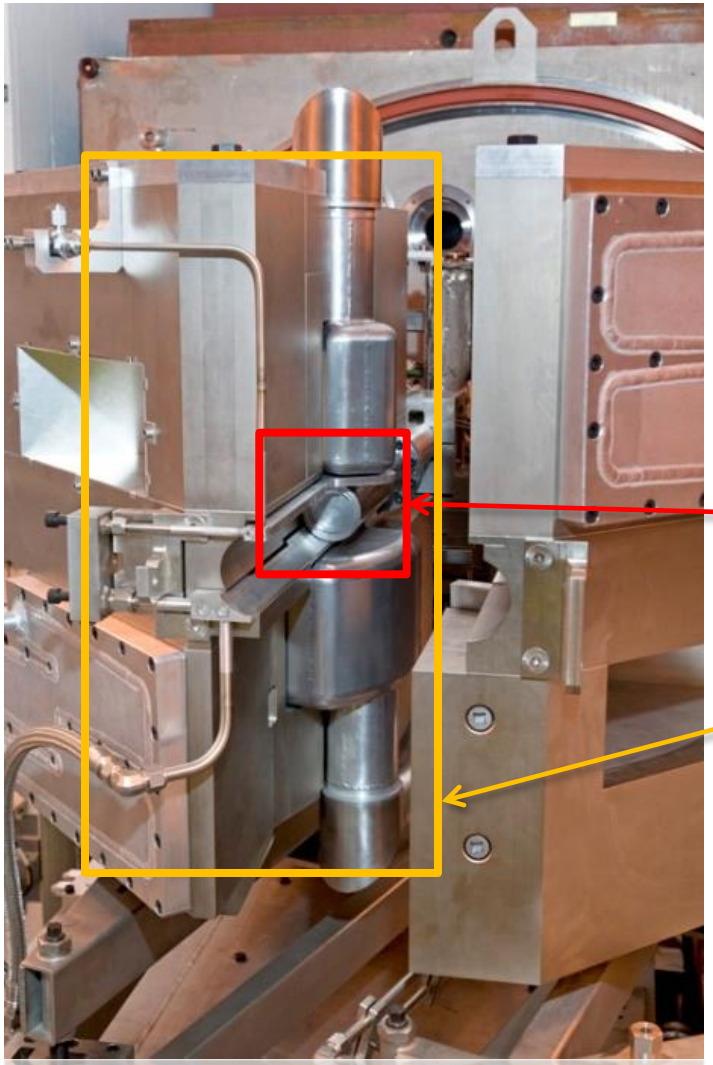
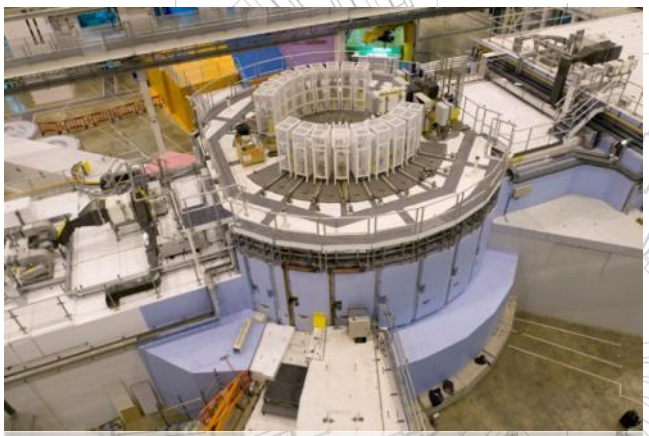
ISIS Second Target Station: Fast Neutrons





Target

Be reflector

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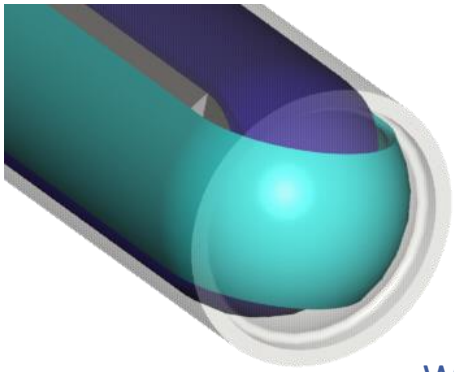
ISIS Second Target Station: Fast Neutrons

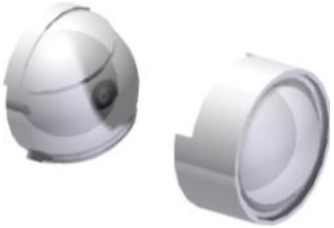
- ChipIr is more sensitive to target/moderator/reflector changes



Water flow across front face

New design

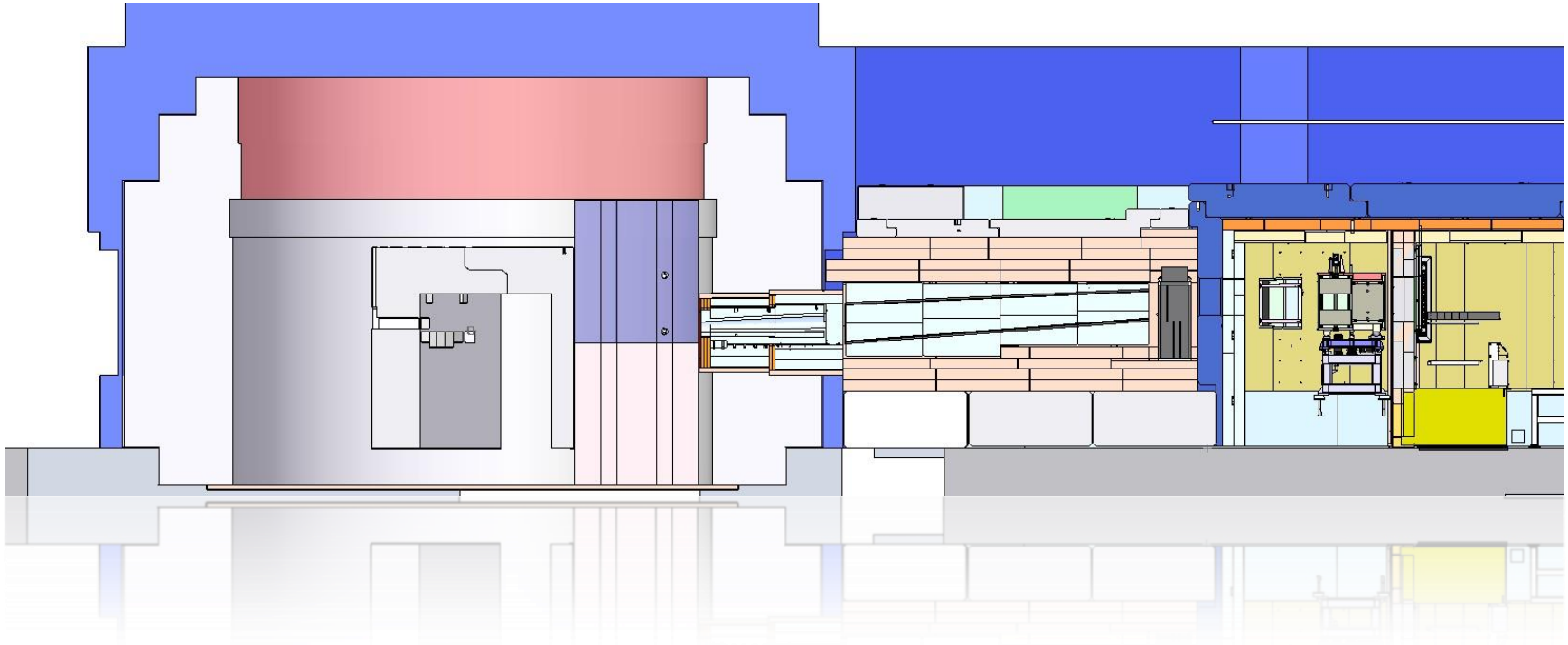
which increases cooling on front face



Tantalum end cap and water flow guide

ISIS Second Target Station: Fast Neutrons

- Target/moderator/reflector illuminated shutter/insert/front end
- Flux and spectrum optimised using Comblayer (Stuart Ansell) [MCNPX]



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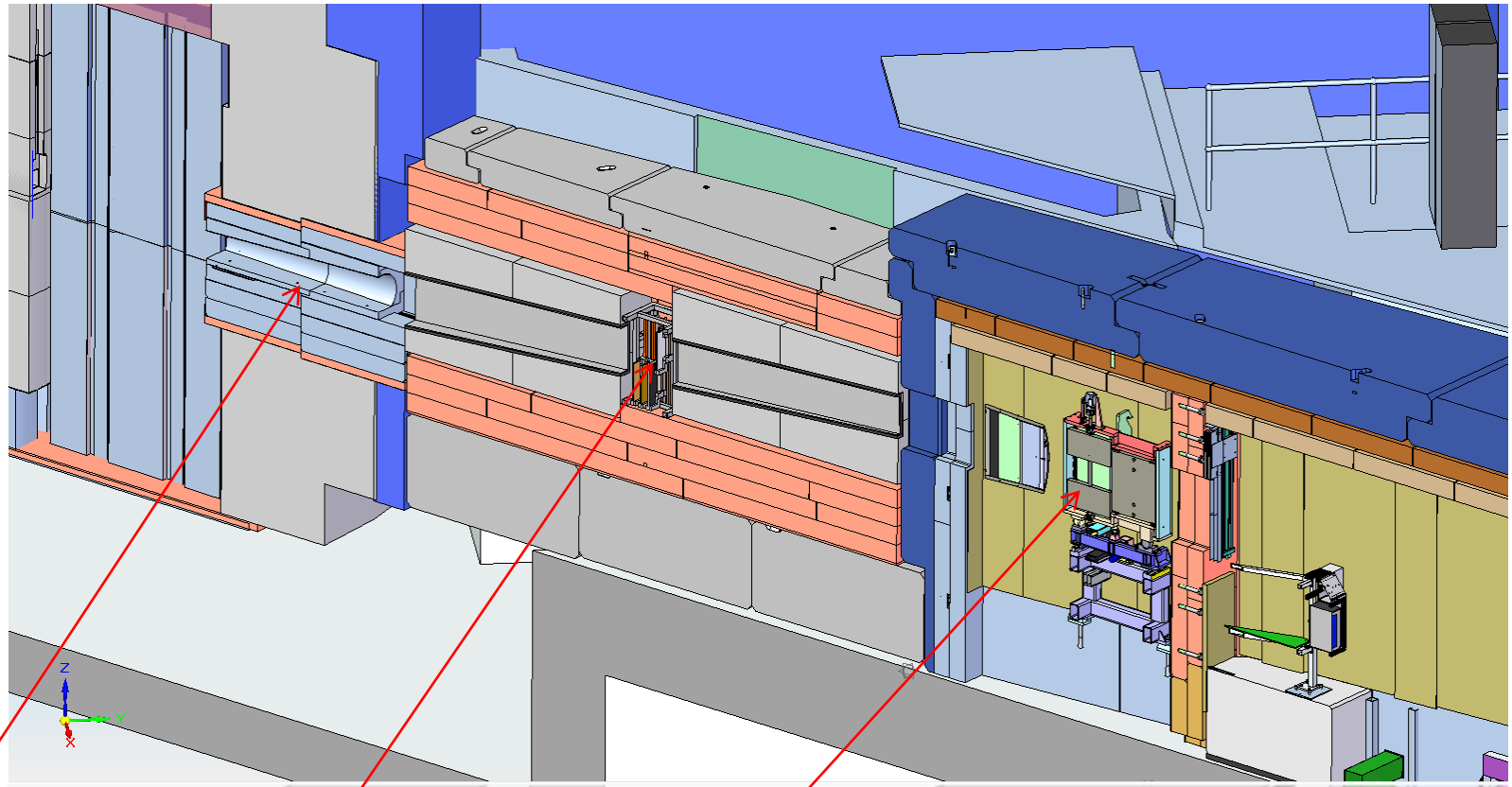
ISIS Second Target Station: Fast Neutrons

- Shutter and Front End are illuminated by the fast neutrons



Inset

Filter Set

Collimator

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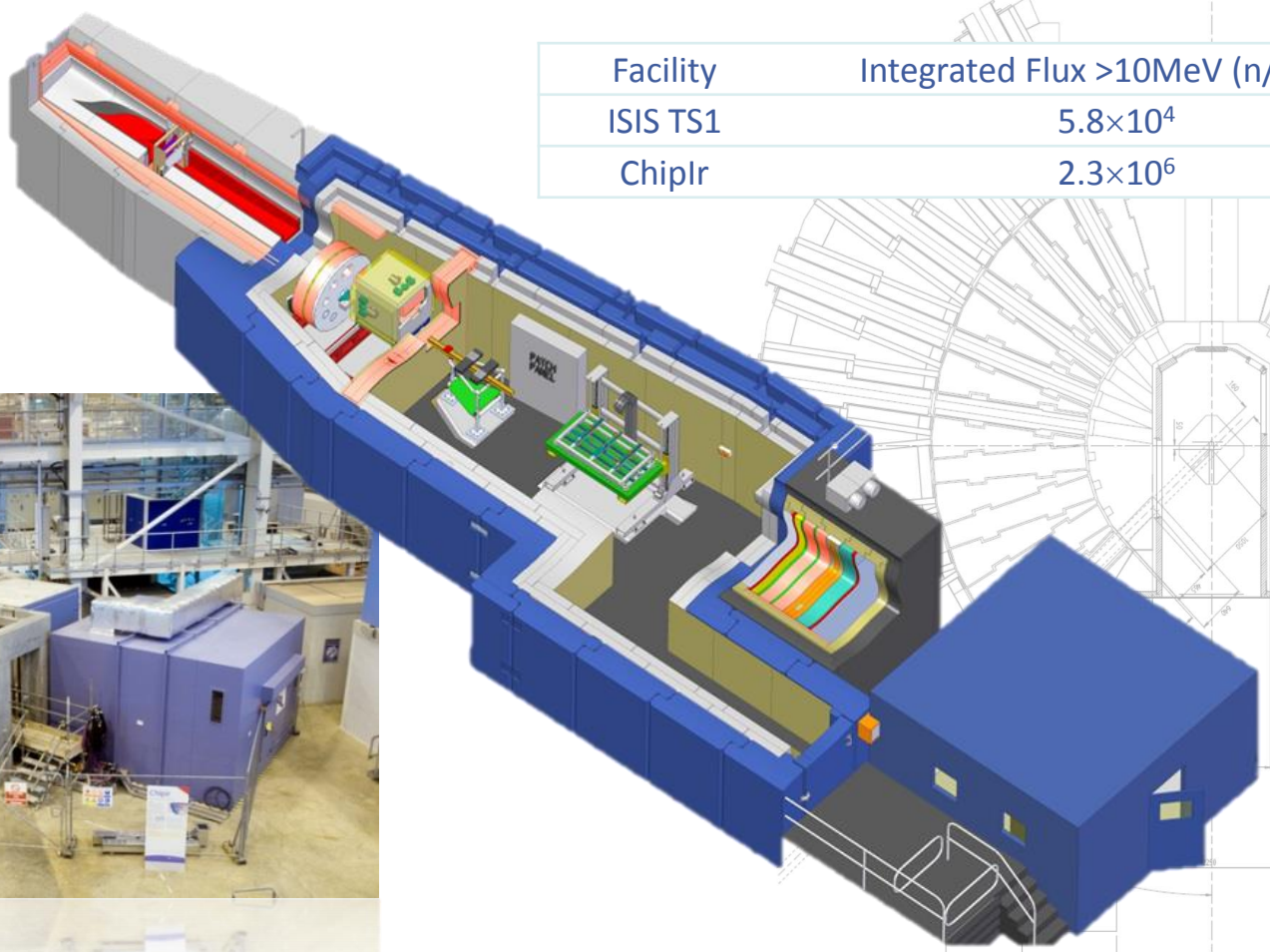
Facility	Integrated Flux >10MeV (n/cm^2/s)
ISIS TS1	5.8×10^4
ChipIr	2.3×10^6



Beam	Size
Collimated	Continuously variable 250mm×250mm to 1mm×1mm
Flood	Fixed sizes 1000m×1000mm 500mm×500mm

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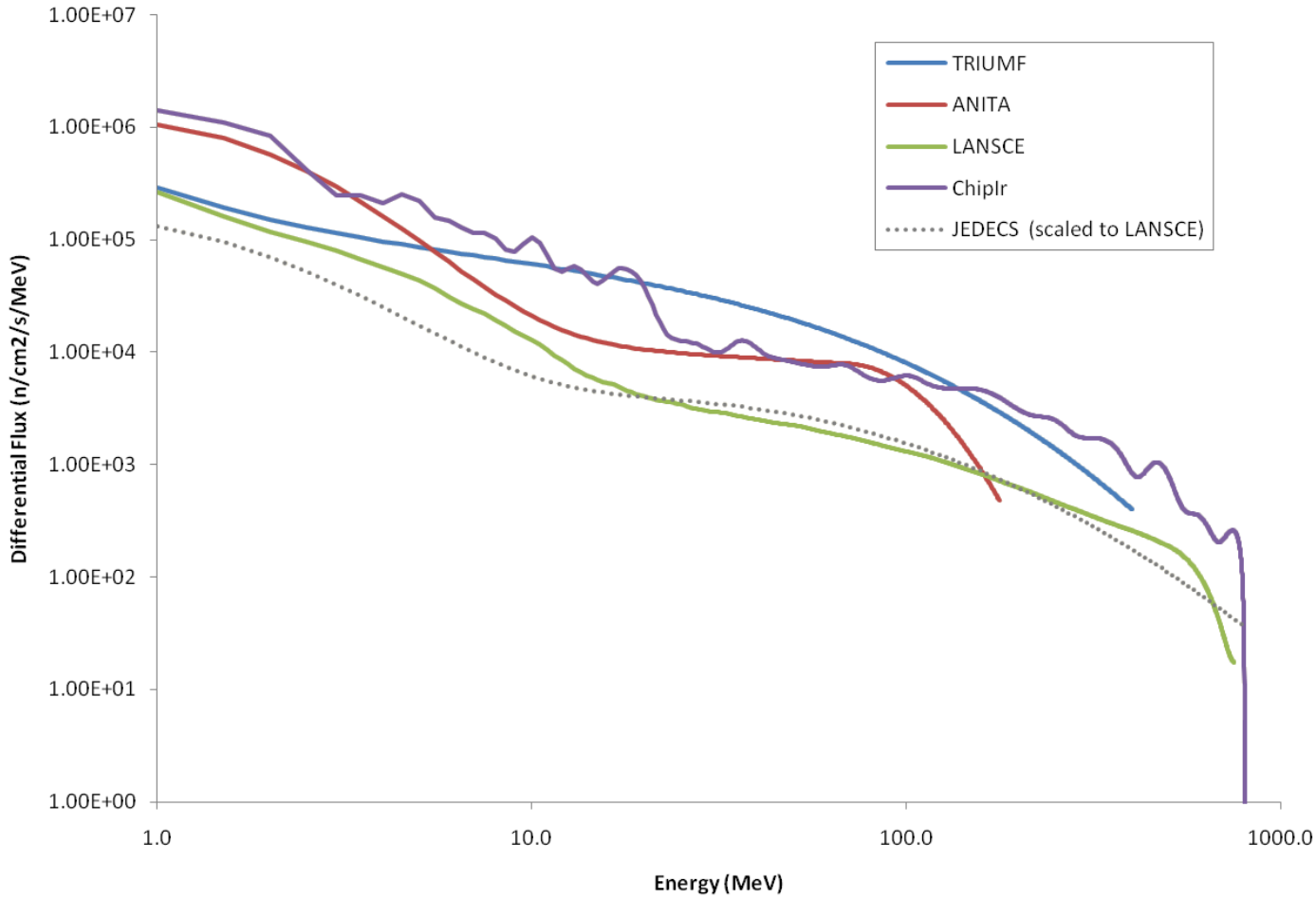

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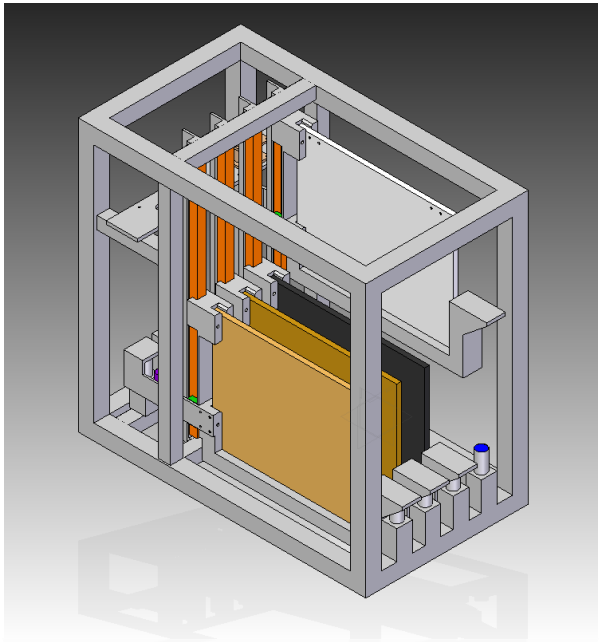
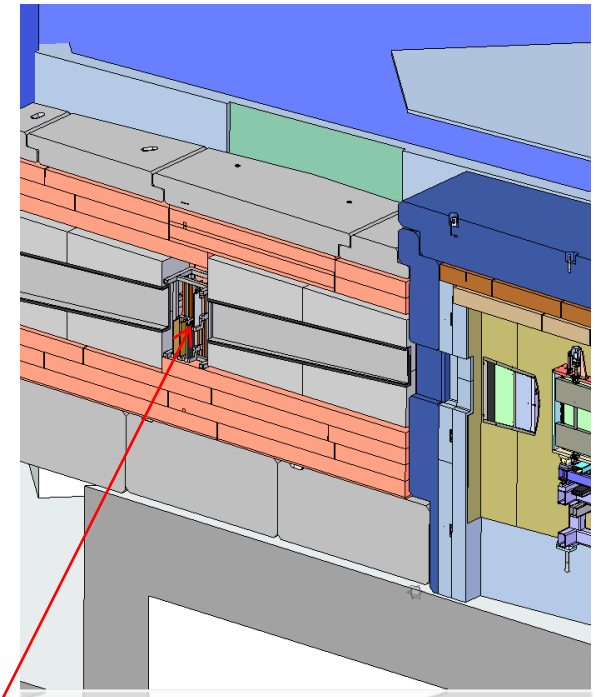
ISIS Second Target Station: Fast Neutrons

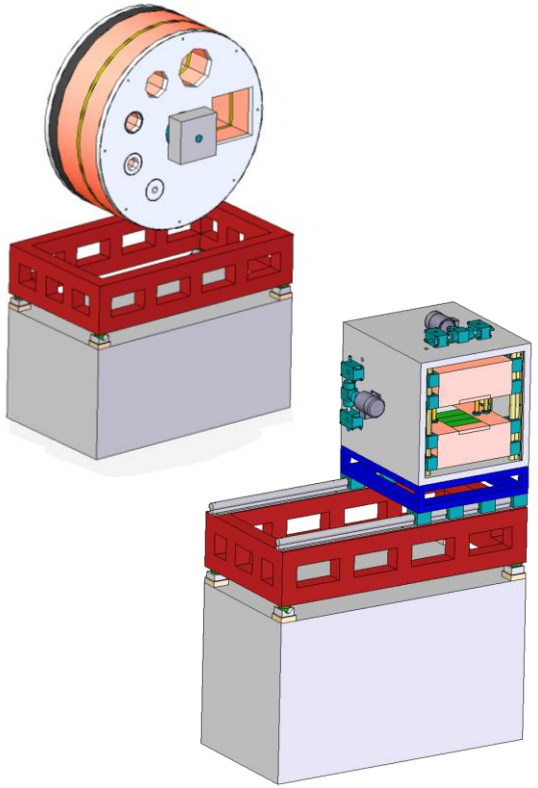
- Filters allow modification of the beam

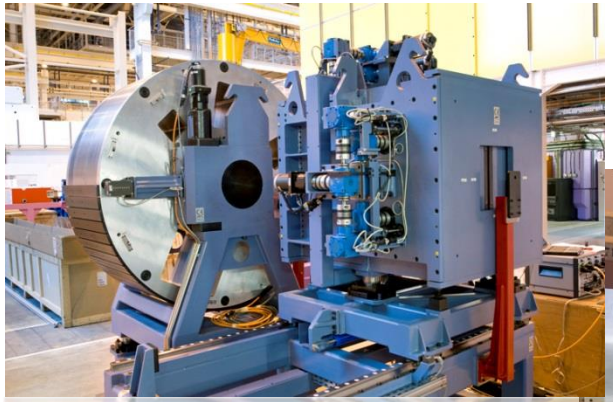


4 x Automatic Filter



Filters in Situ





Beam	Size
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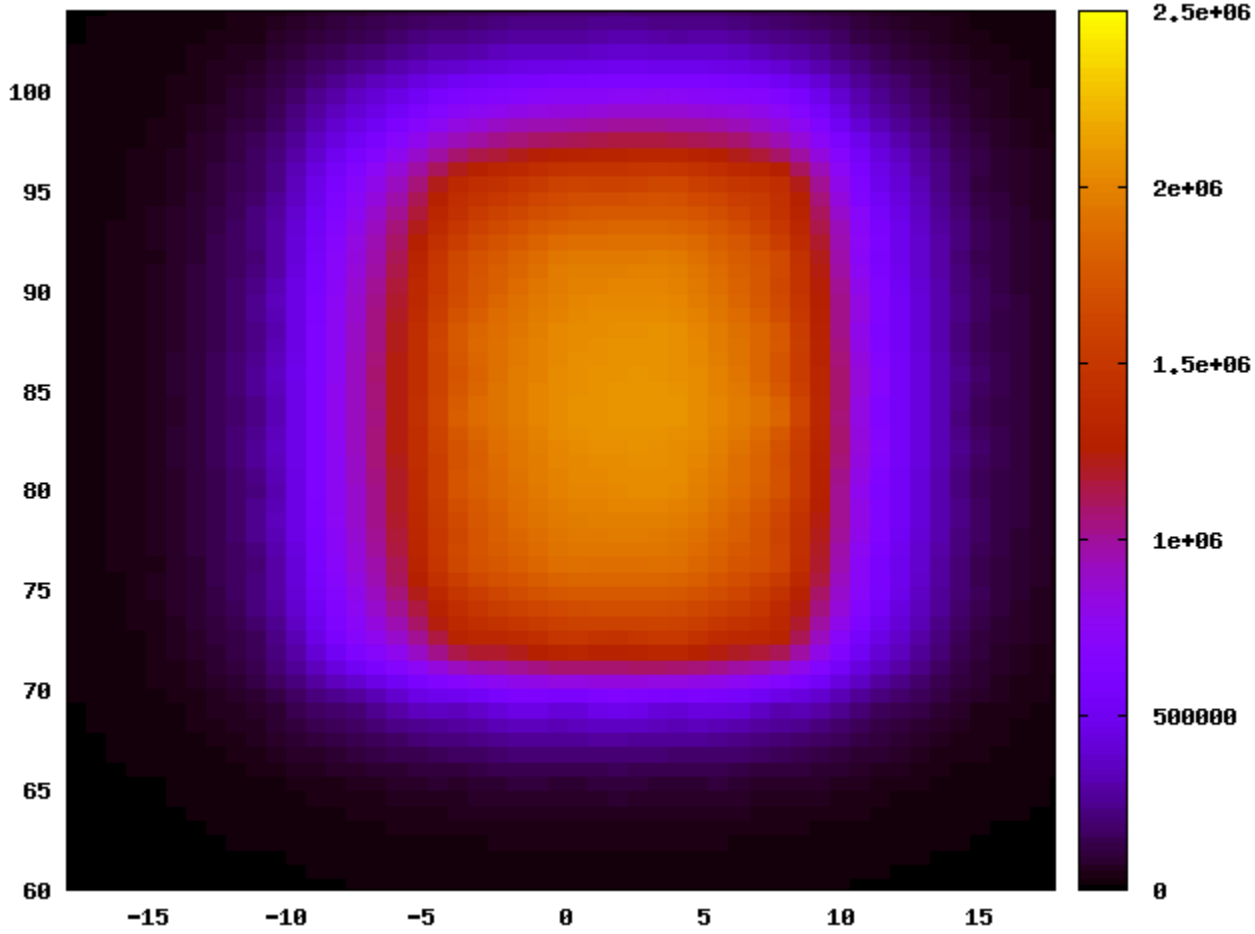

17cm by 25cm beam

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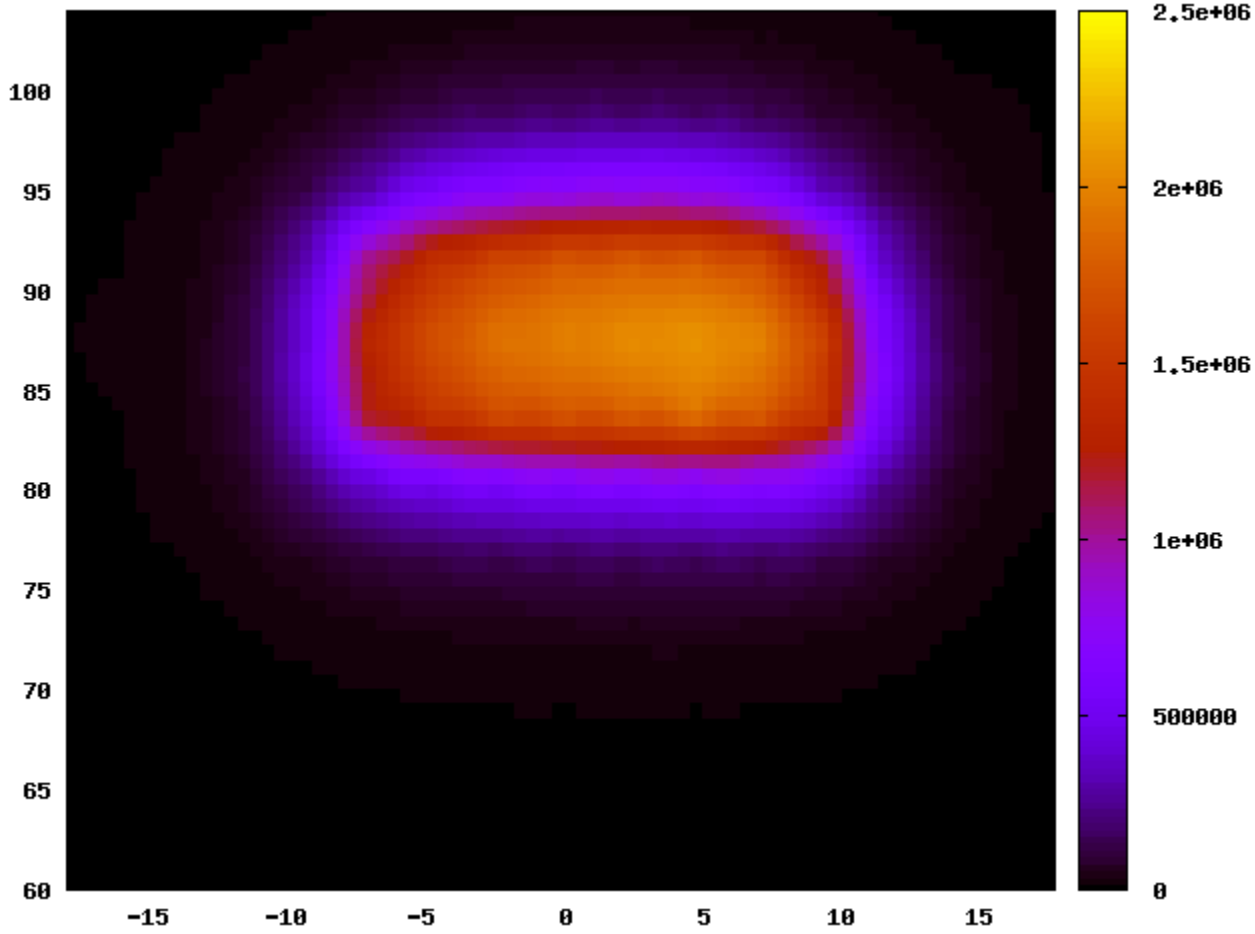

17cm by 12cm beam

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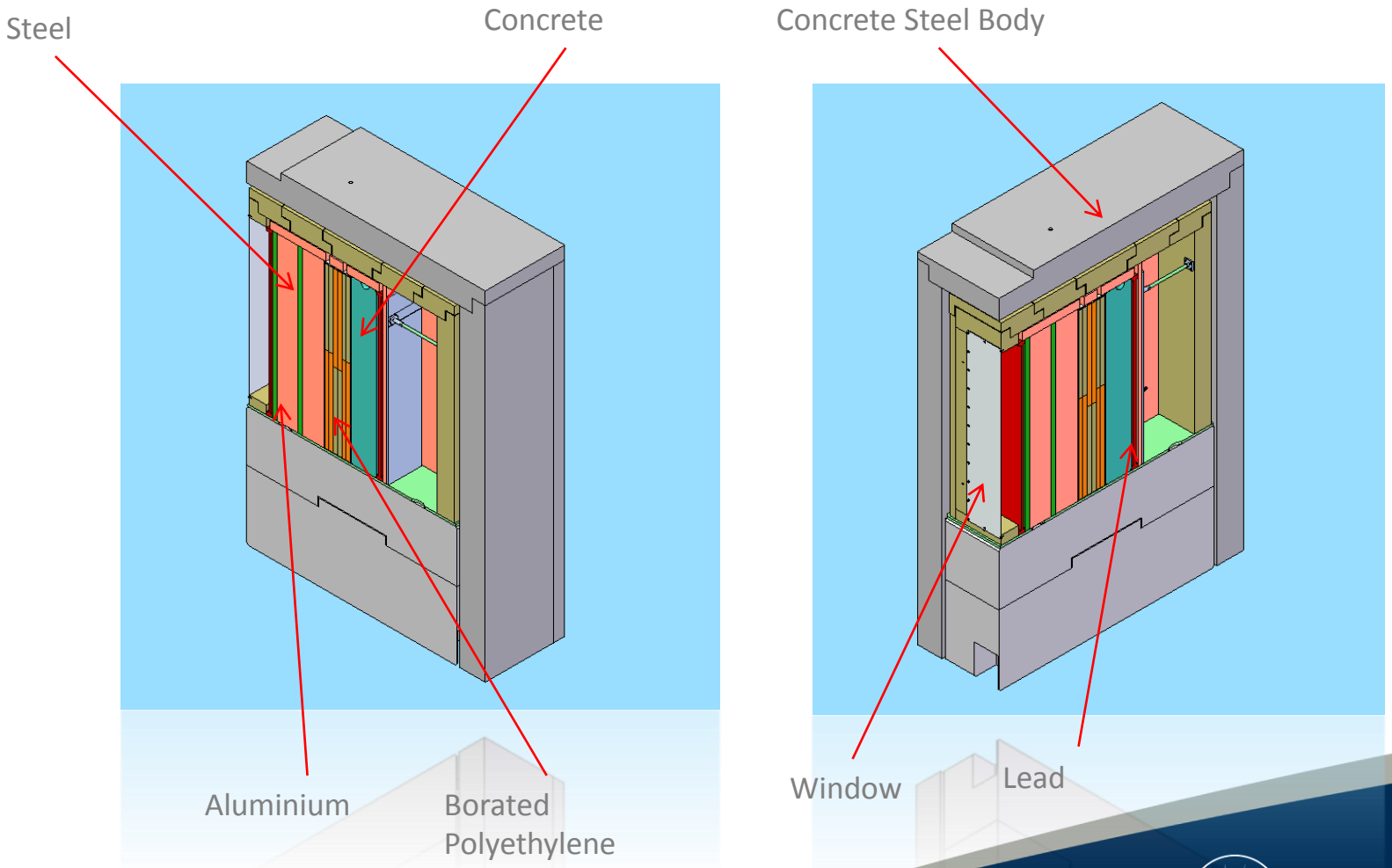
ISIS Second Target Station: Fast Neutrons

- Beamstop aims to reduce background in the blockhouse



ISIS Second Target Station: Fast Neutrons

- Blockhouse: Low background in Hall

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ISIS Second Target Station: Fast Neutrons

- Blockhouse: DUT positions/Collimator/Beamstop

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Under Construction

December 2013

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“There are also efforts to improve radiation testing; for example, a facility to simulate effects of neutrons on aircraft systems has recently been developed as part of the ISIS facility for neutron science at the STFC Rutherford Appleton Laboratory”

- RAL Space and Lloyds of London

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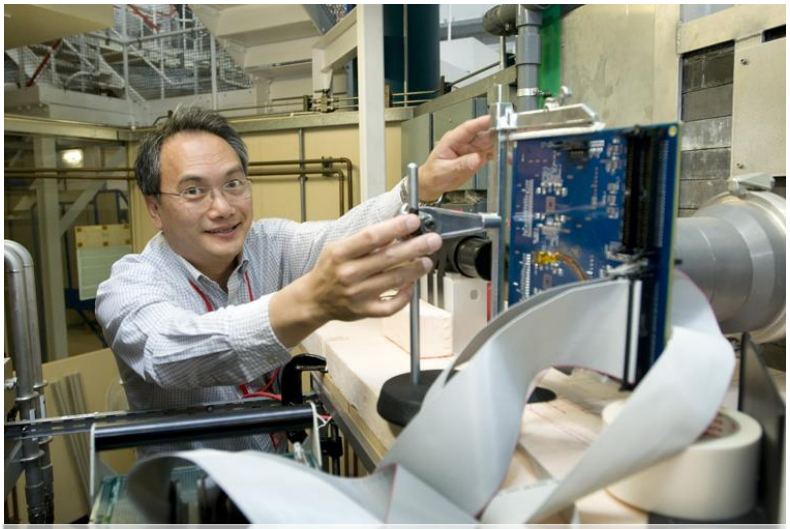
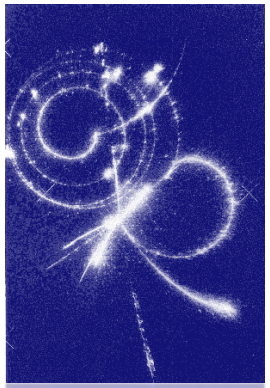


Dr Nelson Tam of Marvell Semiconductor



Muons– First seen in cosmic rays

"The micro-electronics industry is on the verge of architectural shift as devices get to below 20 nm. It was predicted in 1979 that there will be a watershed moment when such devices become susceptible to muon ionisation, and we believe current technologies are approaching this threshold."

- Prof. Bhuva from Vanderbilt University

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