

# Experiments, Simulations and Magnets for the ISIS Ring

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Short Talk for Discussion  
Beam Dynamics Meets Magnets

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- ISIS Facility
- Working Point Studies
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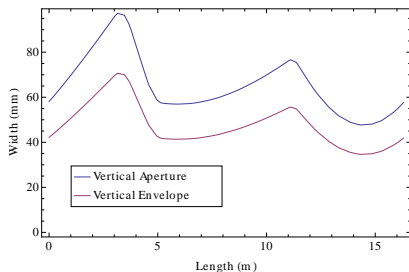
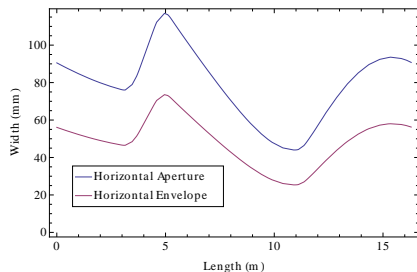
# ISIS Facility





# ISIS Optics

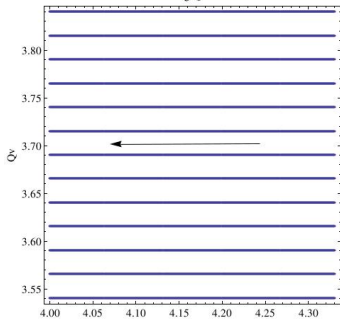
- 3 main quadrupoles and two trim quadrupoles in each straight
- Large tune split,  $Q_H = 4.31$ ,  $Q_V = 3.83$
- Tune is optimised empirically through cycle with trim quads
- Tapering profiled vacuum vessels and RF shields



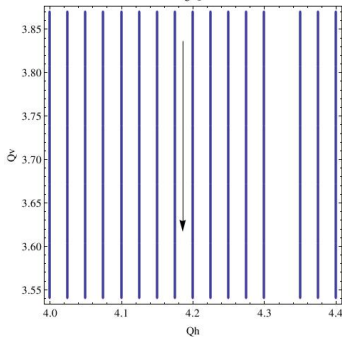
# Working Point Studies

- Goal to explore low intensity beam behaviour
- Storage ring mode - no AC magnet or RF
- Q set constant in one plane
- In the other plane Q ramped between two values
- Plots show differential of intensity along lines
- Q was ramped in both directions to see the difference
- Each measurement was repeated 3 times, and averaged

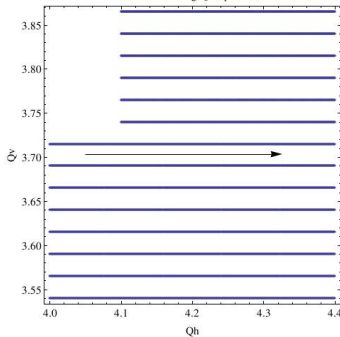
Scanning Qh Down

 $Q_h$   
 $\leftarrow$ 


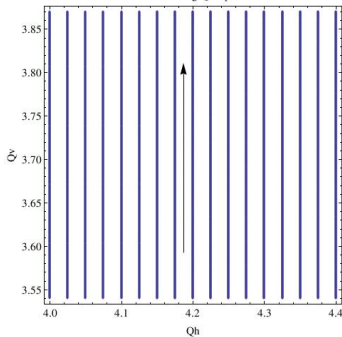
Scanning Qv Down

 $Q_v$   
 $\downarrow$ 


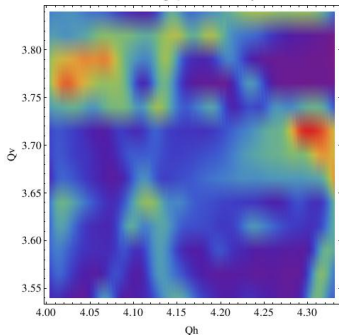
Scanning Qh Up

 $Q_h$   
 $\rightarrow$ 


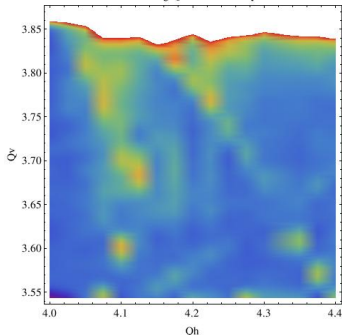
Scanning Qv Up

 $Q_v$   
 $\uparrow$ 


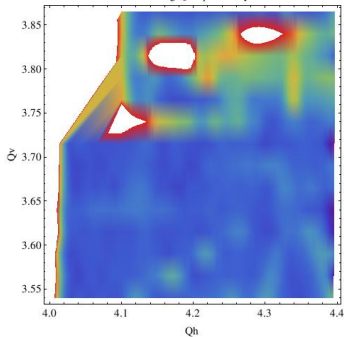
Scanning Qh Down Intensity

 $Q_h$   
 $\leftarrow$ 


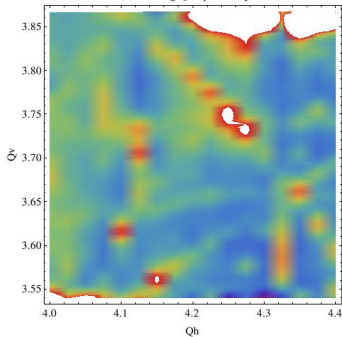
Scanning Qv Down Intensity

 $Q_v$   
 $\downarrow$ 


Scanning Qh Up Intensity

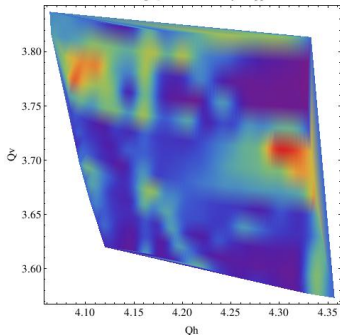
 $Q_h$   
 $\rightarrow$ 


Scanning Qv Up Intensity

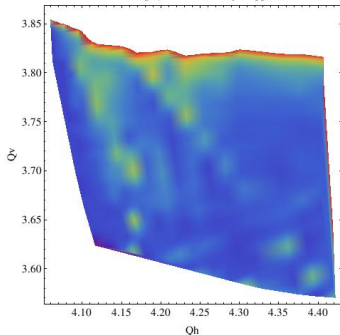
 $Q_v$   
 $\uparrow$ 




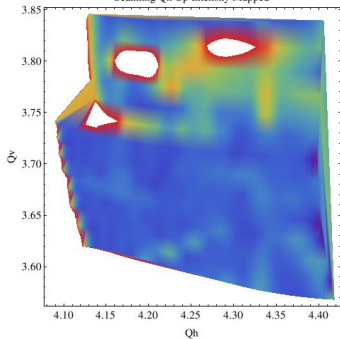
Scanning Qh Down Intensity Mapped

 $Q_h$   
 $\leftarrow$ 


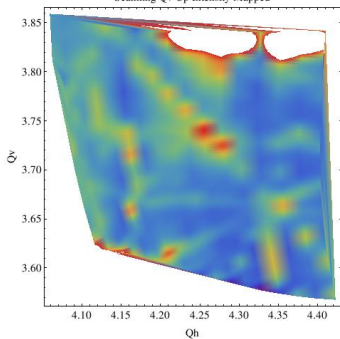
Scanning Qv Down Intensity Mapped

 $Q_v$   
 $\downarrow$ 


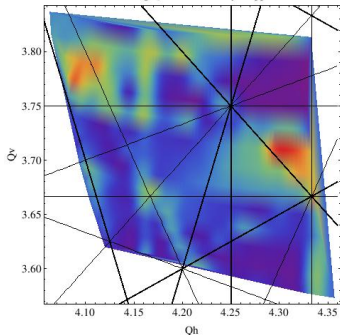
Scanning Qh Up Intensity Mapped

 $Q_h$   
 $\rightarrow$ 


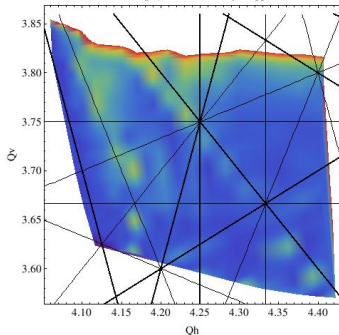
Scanning Qv Up Intensity Mapped

 $Q_v$   
 $\uparrow$ 


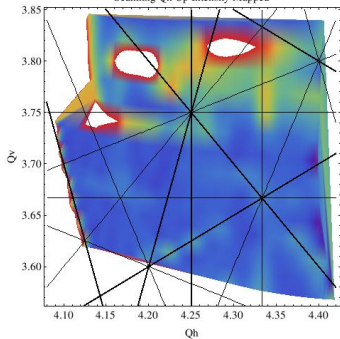
Scanning Qh Down Intensity Mapped

 $Q_h$   
 $\leftarrow$ 


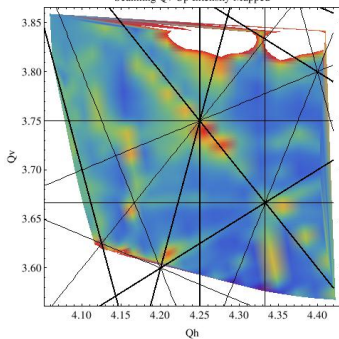
Scanning Qv Down Intensity Mapped

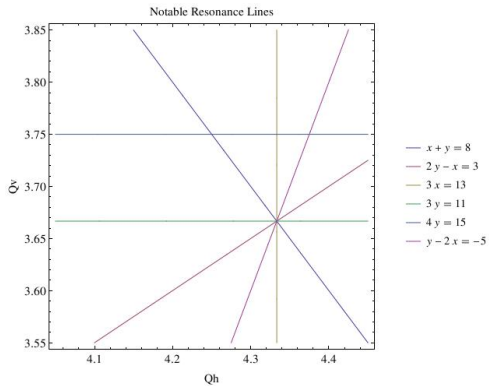
 $Q_v$   
 $\downarrow$ 


Scanning Qh Up Intensity Mapped

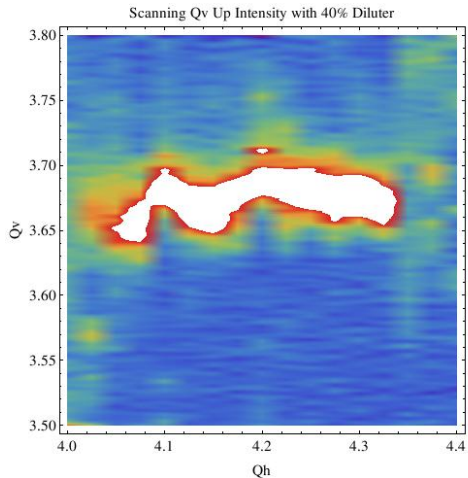
 $Q_h$   
 $\rightarrow$ 


Scanning Qv Up Intensity Mapped

 $Q_v$   
 $\uparrow$ 


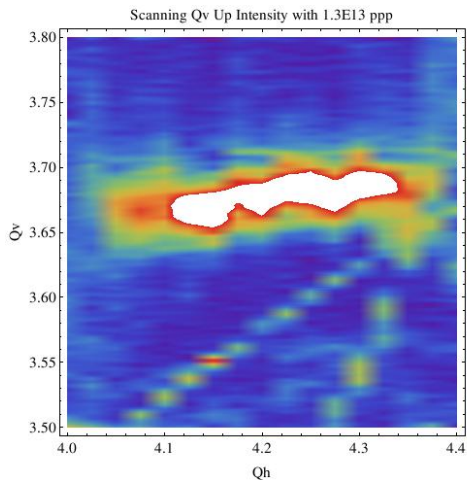


# 40 % Diluter



$Q_v$   
↑

# Diluter out $1.3 \times 10^{13}$ ppp Injected



$Q_v$   
↑

# Observations

- There are some important resonance lines at low intensity
- These deserve further investigation as they reveal machine defects
- May play a role in operational beam dynamics
- Strongly affected by space charge
- Knowledge of such resonances vital for high intensity research
- Can be included in simulation studies of the machine

# Simulations

- There are several major simulation projects underway
- 2D transverse and 1D longitudinal tools are well developed
- 2.5D code combining these, including injection is being benchmarked
- To be used for machine studies along with other codes (ORBIT)
- Next field maps from magnet models
- Lots of the dynamics becomes easier - dispersion and chromaticity
- Simulations will be more computationally demanding
- Continued access to HPC resources very important

# Magnet Modelling and Measurements at ISIS

- **Background**

50 Hz machine, magnets 30 years old

Updating capacity to simulate, measure and build new magnets

- **Motivation**

Build operational spares, new magnets for upgrades

Improve knowledge of existing magnets and simulation models

- **Plan**

Detailed modelling and measurement of ISIS TS2 kicker (T Mouille)

Built and measured new trim quadrupoles

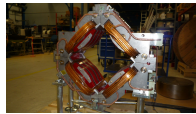
Model and measure ISIS ring lattice magnets - and build more spares

First quadrupoles, then dipoles; DC then AC

Magnet test and measurement facility is in the pipe-line



ISIS TS2 Kicker



ISIS Trim Quadrupole