

Mads Bertelsen, ESS DMSC

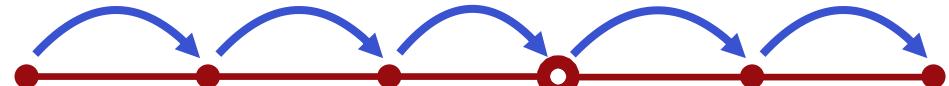
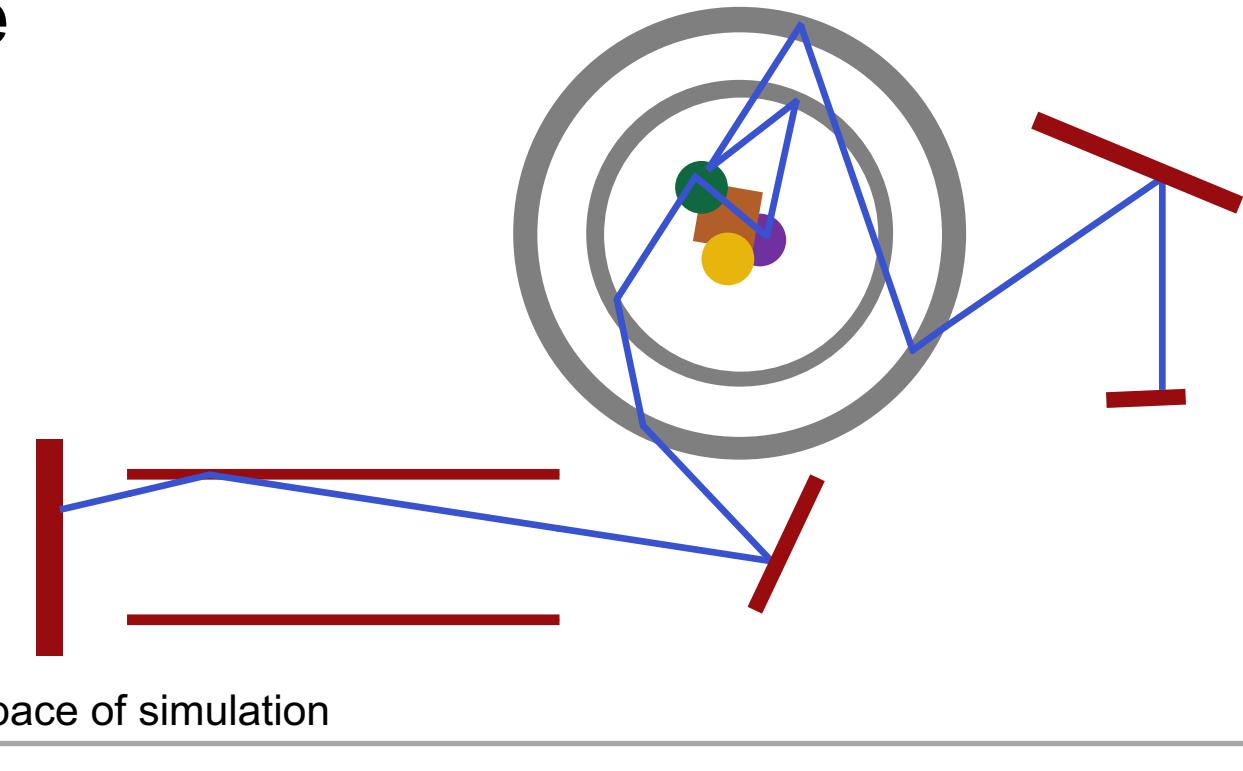
McStas Union components

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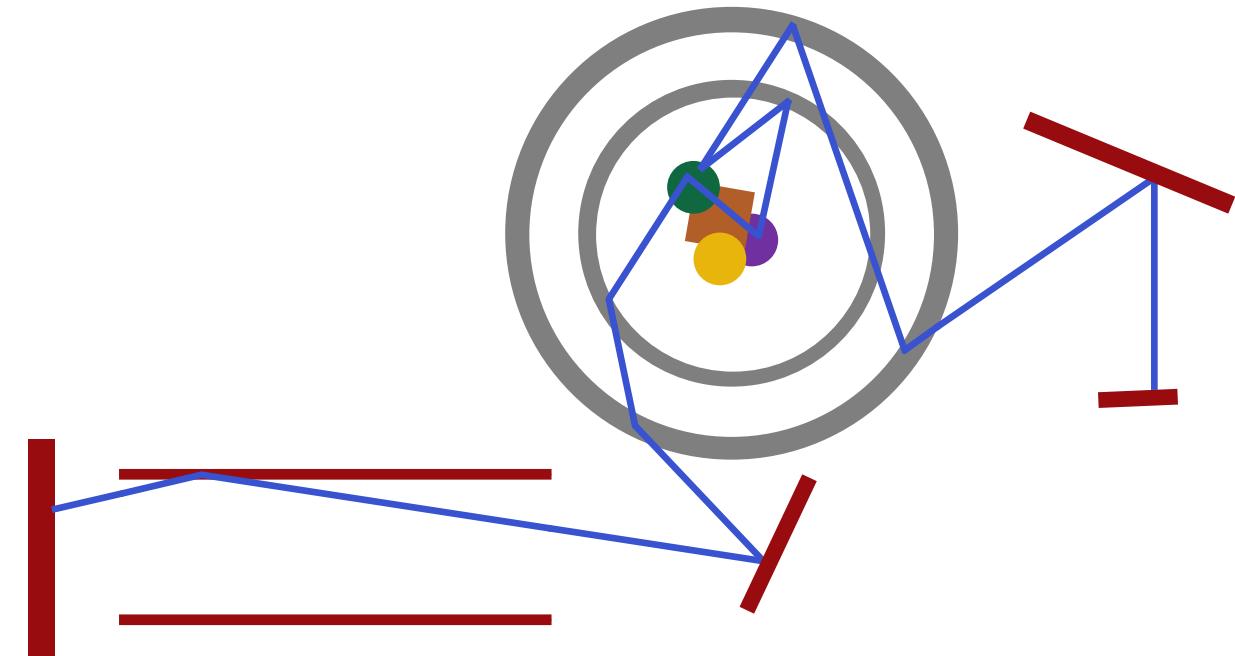
Union in instrument file

- Only the Union_master component affect the rays



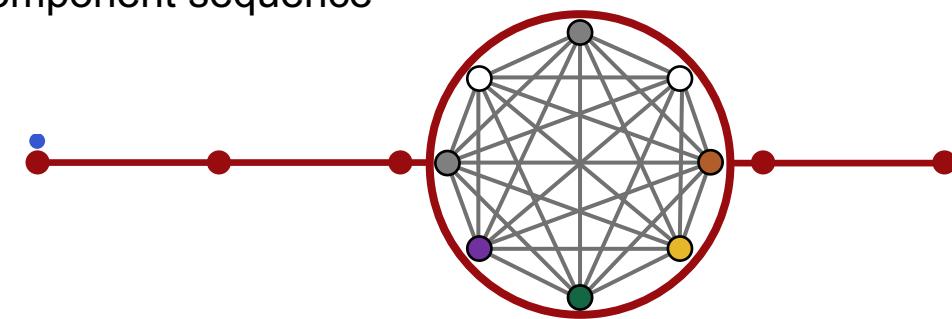
Union in instrument file

- Only the Union_master component affect the rays
- In the Union_master there is propagation in a network instead of sequential



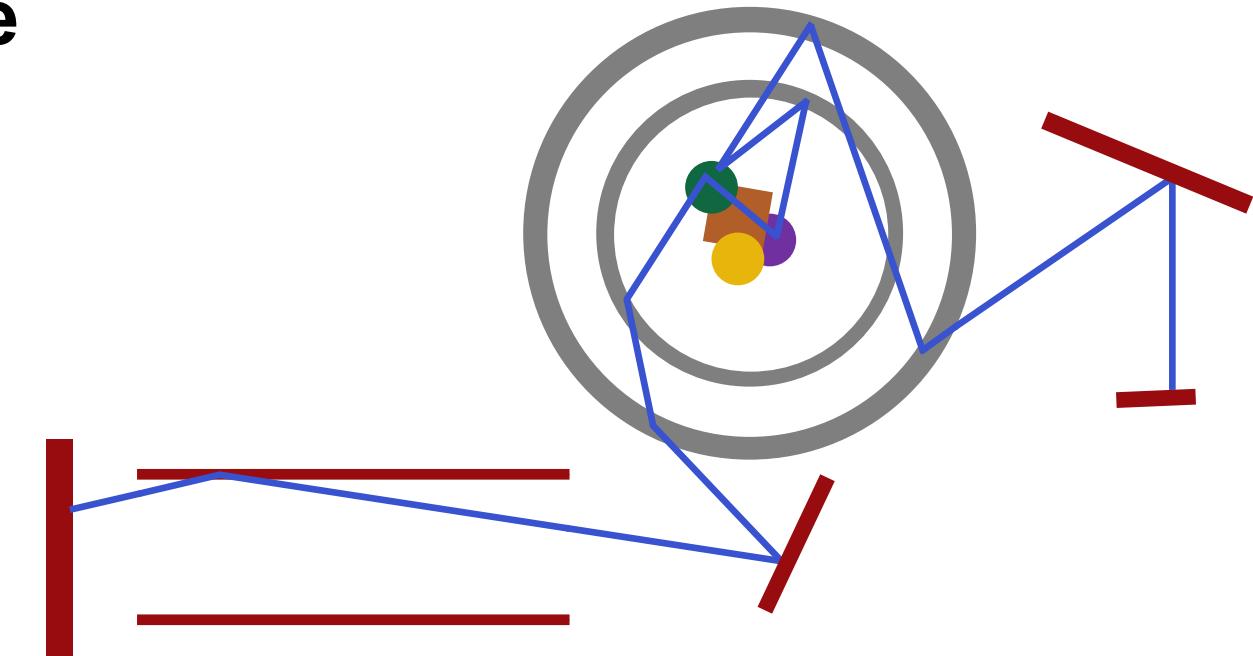
3D space of simulation

Instrument component sequence



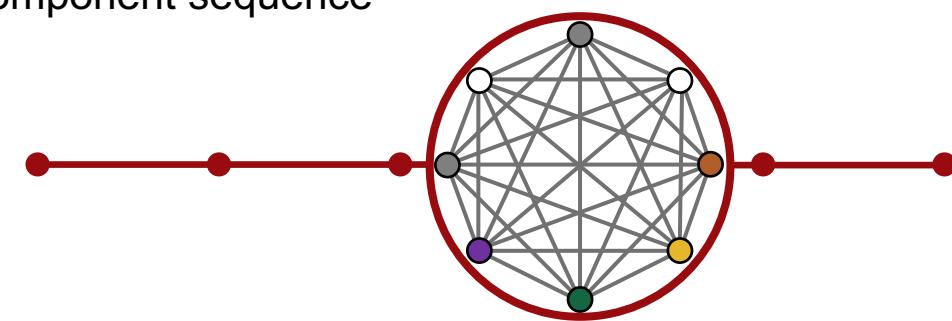
Union in instrument file

- Only the Union_master component affect the rays
- In the Union_master there is propagation in a network instead of sequential
- The network complexity is reduced by geometrical analysis before raytracing



3D space of simulation

Instrument component sequence



Union ray histories

中
國
散
裂
中
子
源

Top 5 most common histories. Shows the index of volumes entered (VX), and the processes (PX)

```

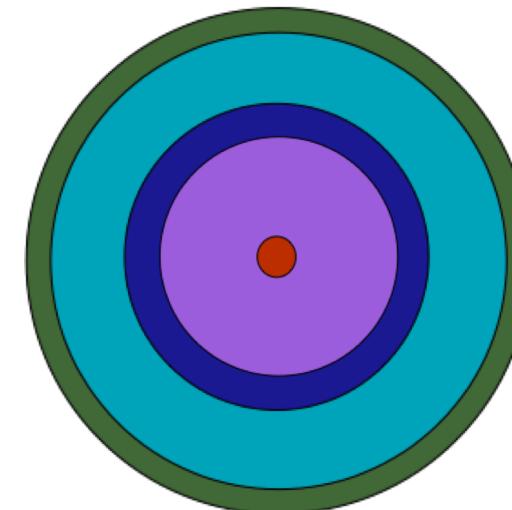
313073 N I=5.09E+02 V0 -> V1 -> V2 -> V3 -> V4 -> V5 -> V4 -> V3 -> V2 -> V1 -> V0
24844 N I=3.57E+01 V0 -> V1 -> V2 -> V3 -> V4 -> V5 -> P1 -> V4 -> V3 -> V2 -> V1 -> V0
13679 N I=2.22E+01 V0 -> V1 -> V2 -> V3 -> V4 -> V3 -> V2 -> V1 -> V0
9510 N I=1.85E+01 V0 -> V1 -> V2 -> V3 -> V4 -> V6 -> V4 -> V3 -> V2 -> V1 -> V0
159655 N I=1.41E+01 V0 -> V1 -> P1 -> V0

```

P1 Is scattering process 1

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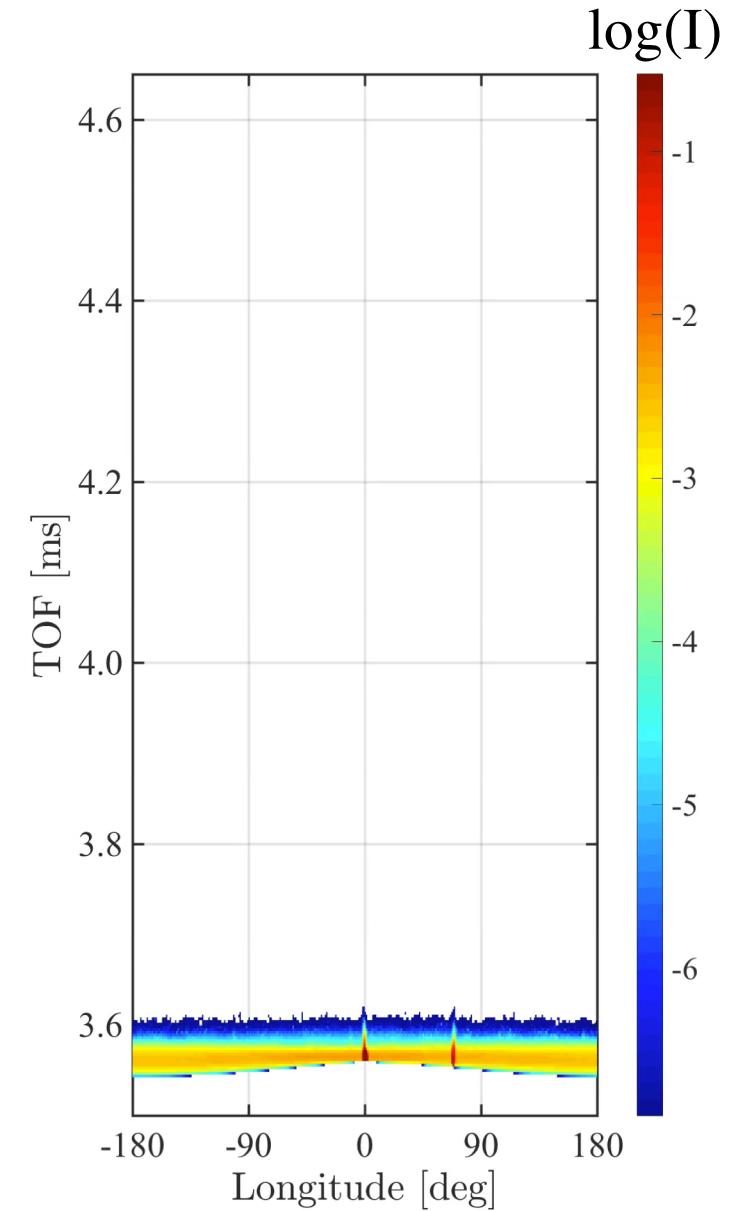
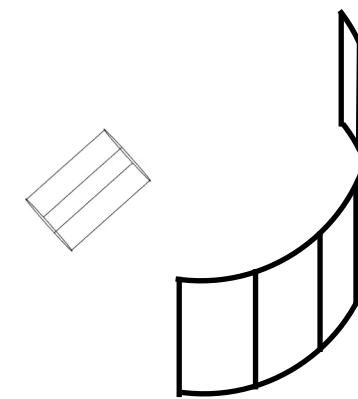


V0 Surrounding vacuum
V1 Outer cryostat wall
V2 Outer cryostat vacuum
V3 Inner cryostat wall
V4 Inner cryostat vacuum
V5 Sample

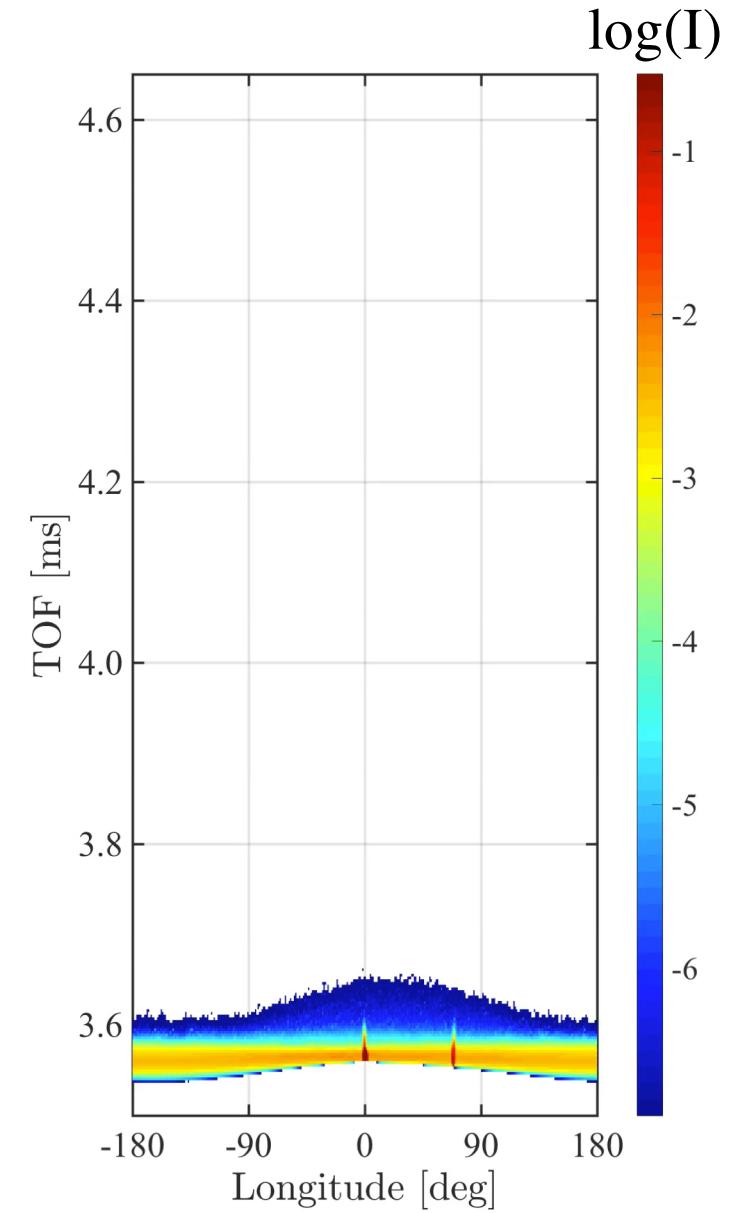
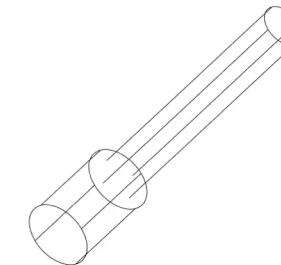
Building a sample



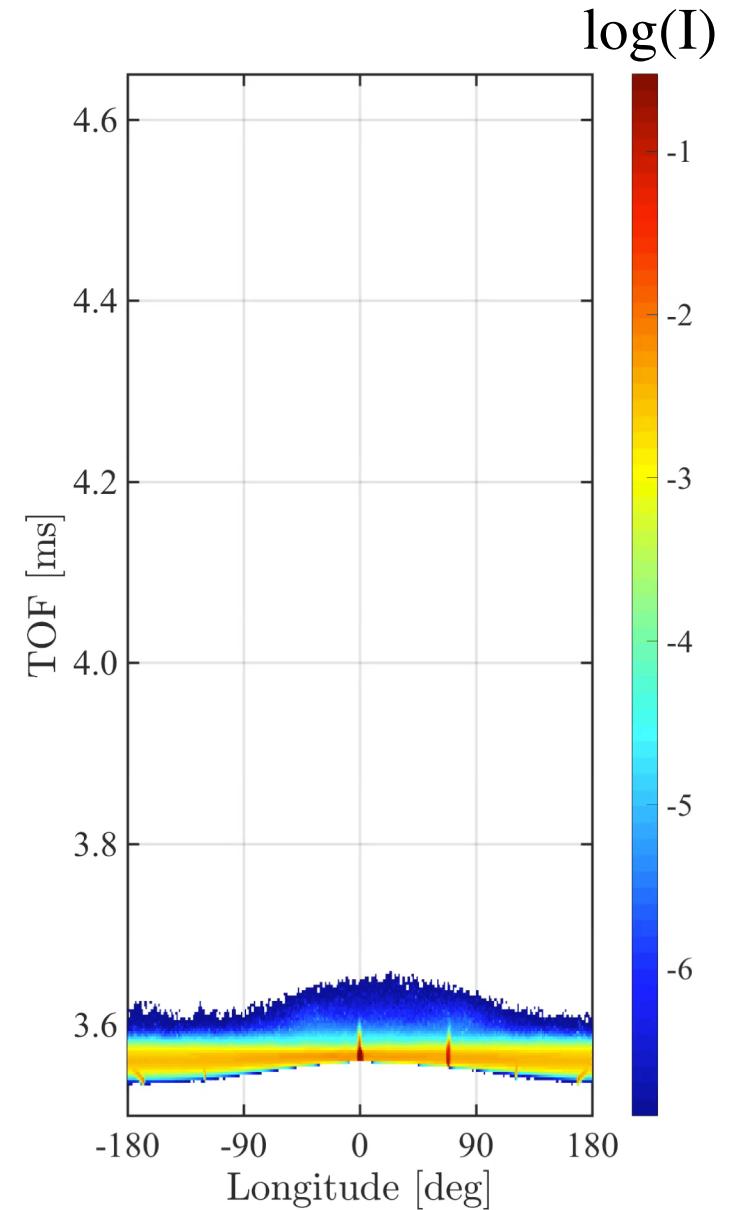
5 meV beam

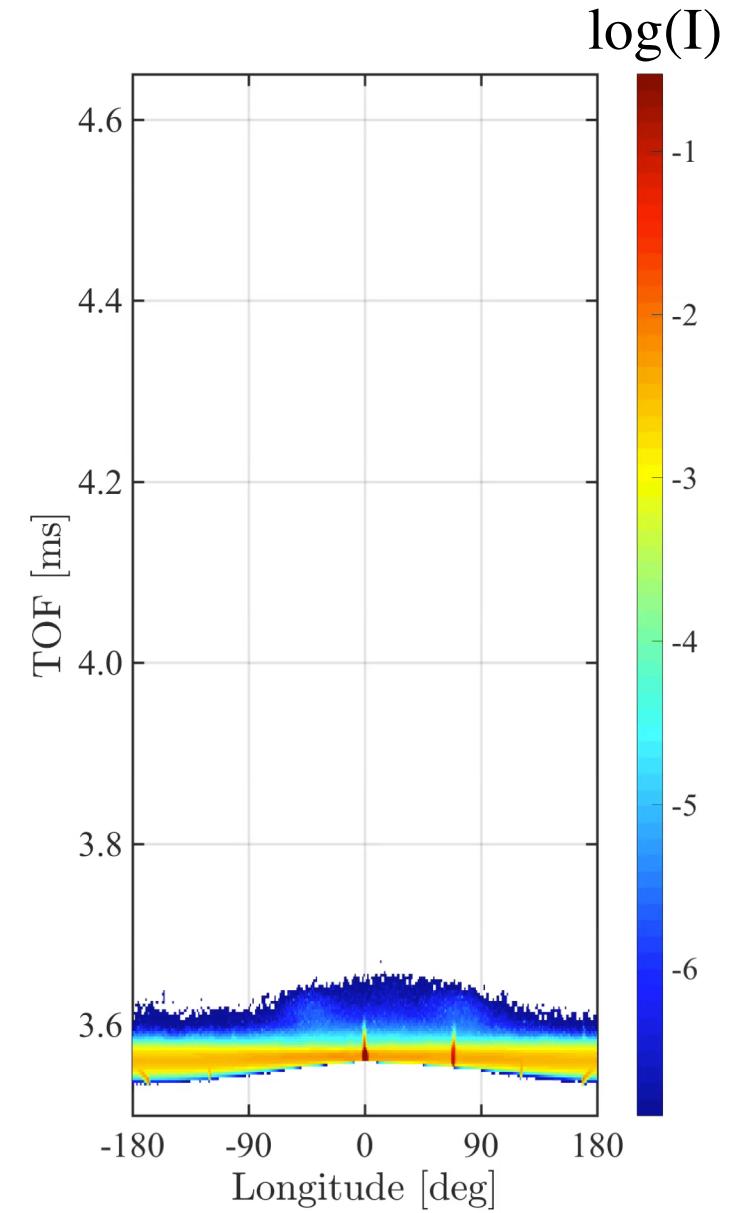
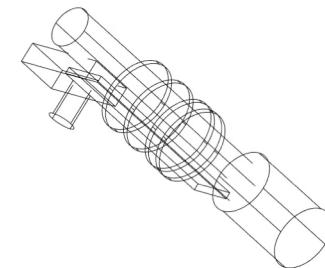
Building a sample



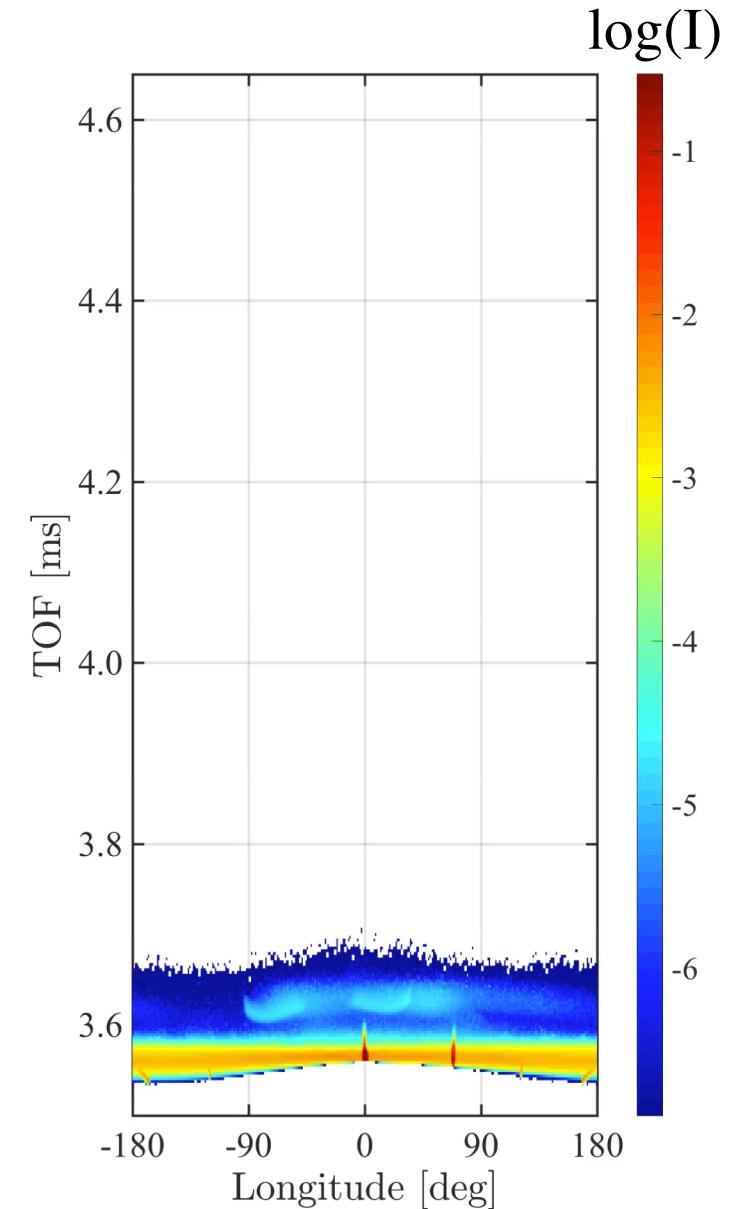
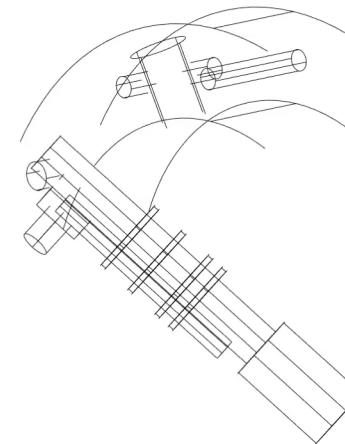
Building a sample



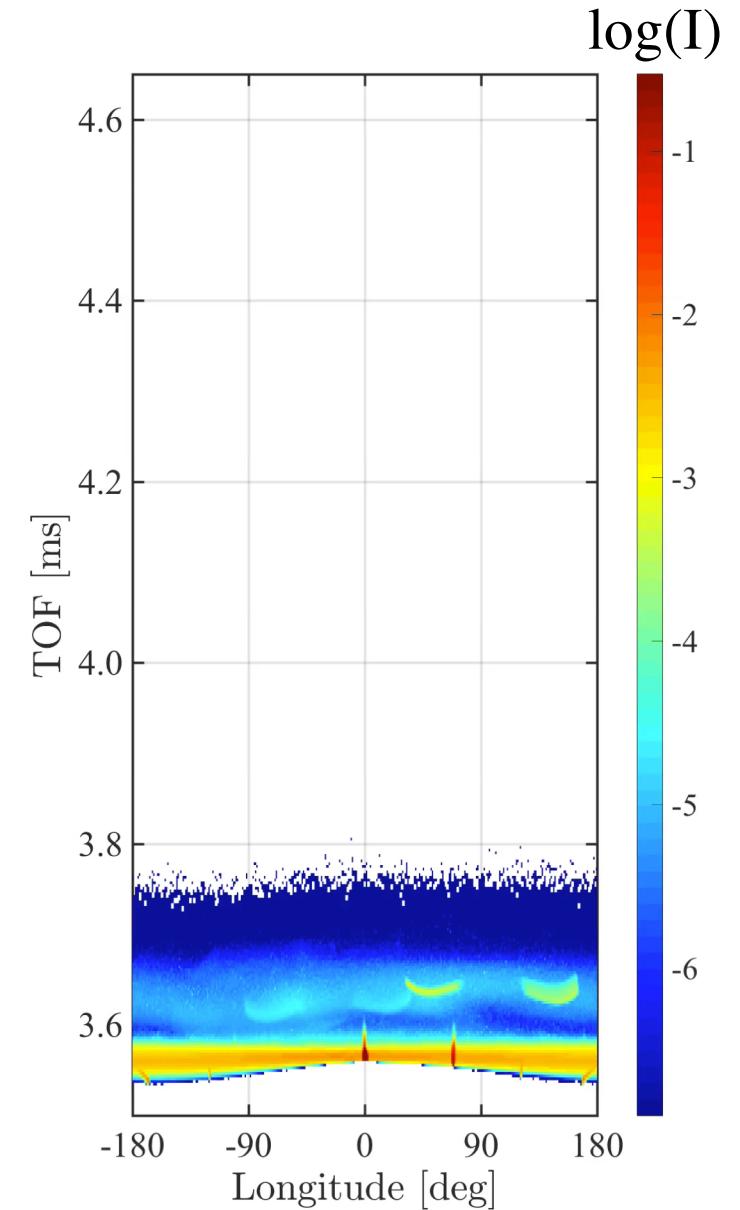
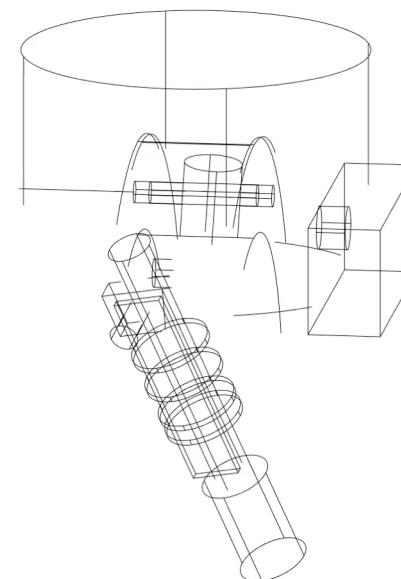
Building a sample



Building a sample



Building a sample

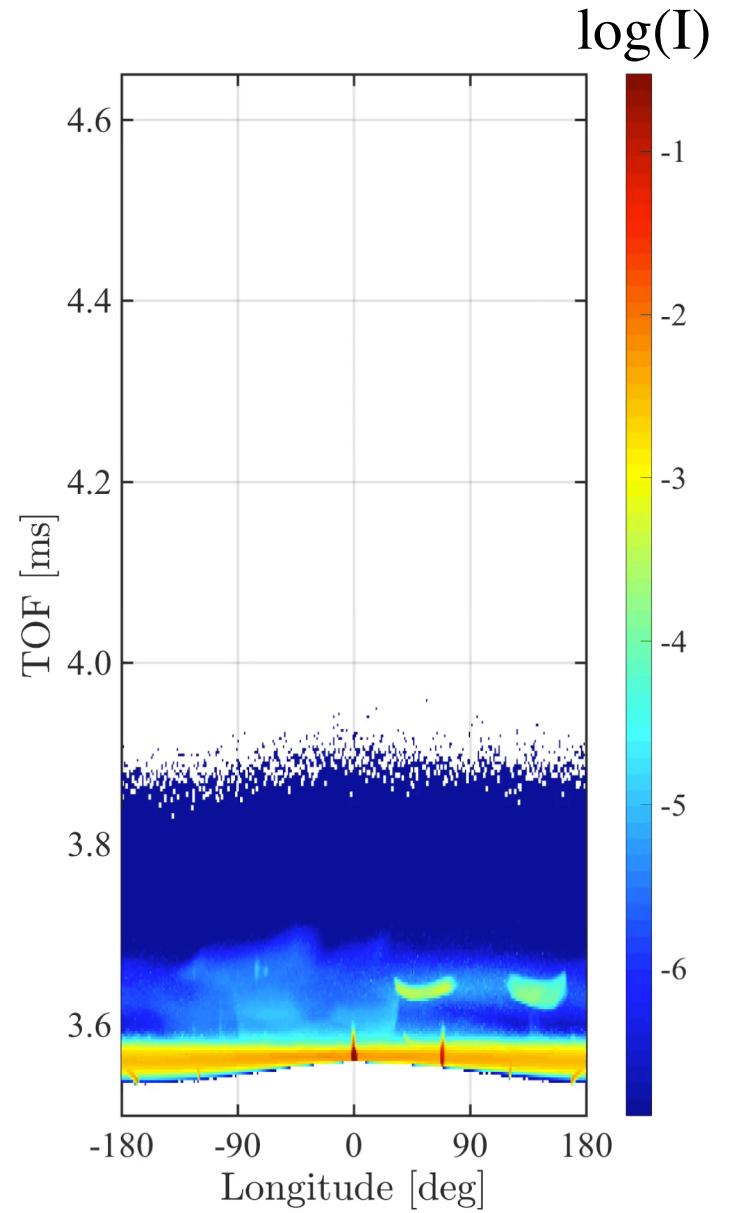
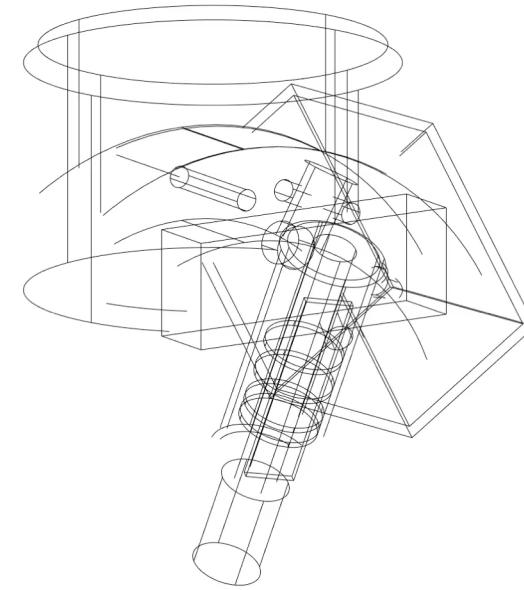


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Building a sample

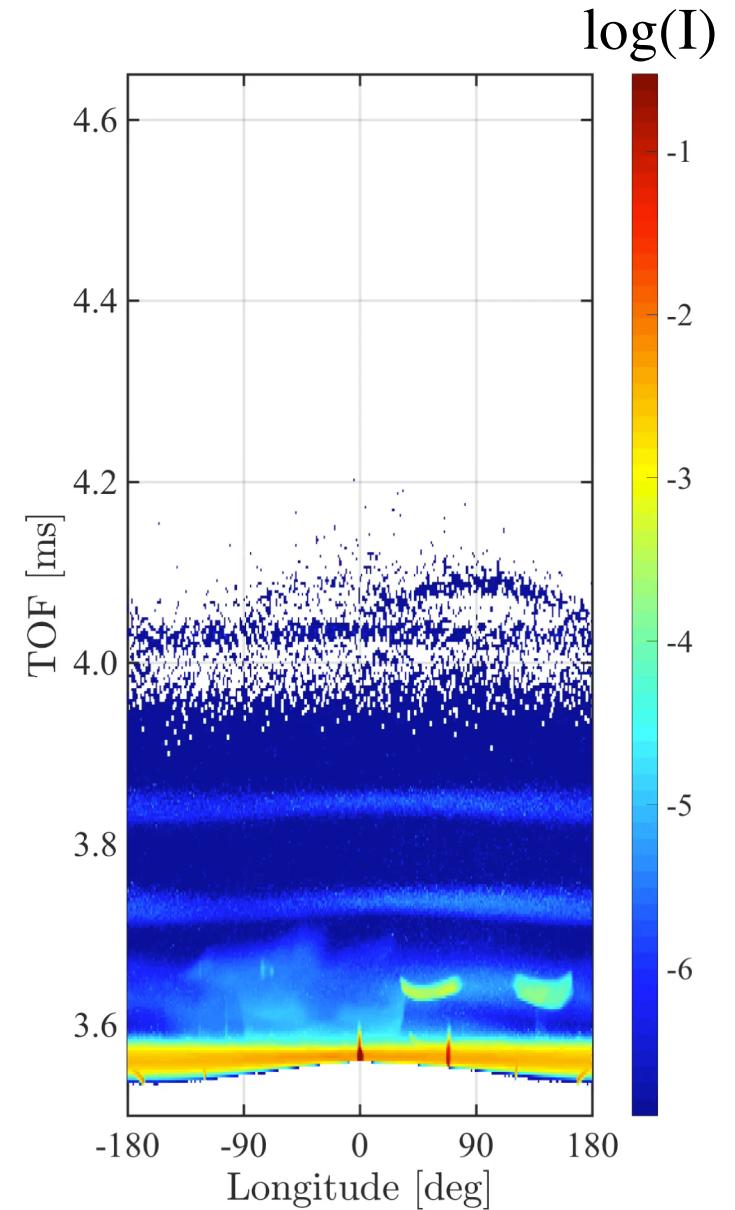
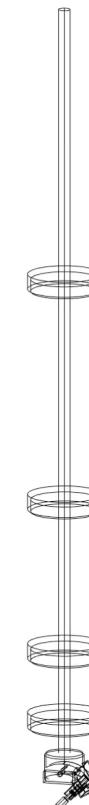


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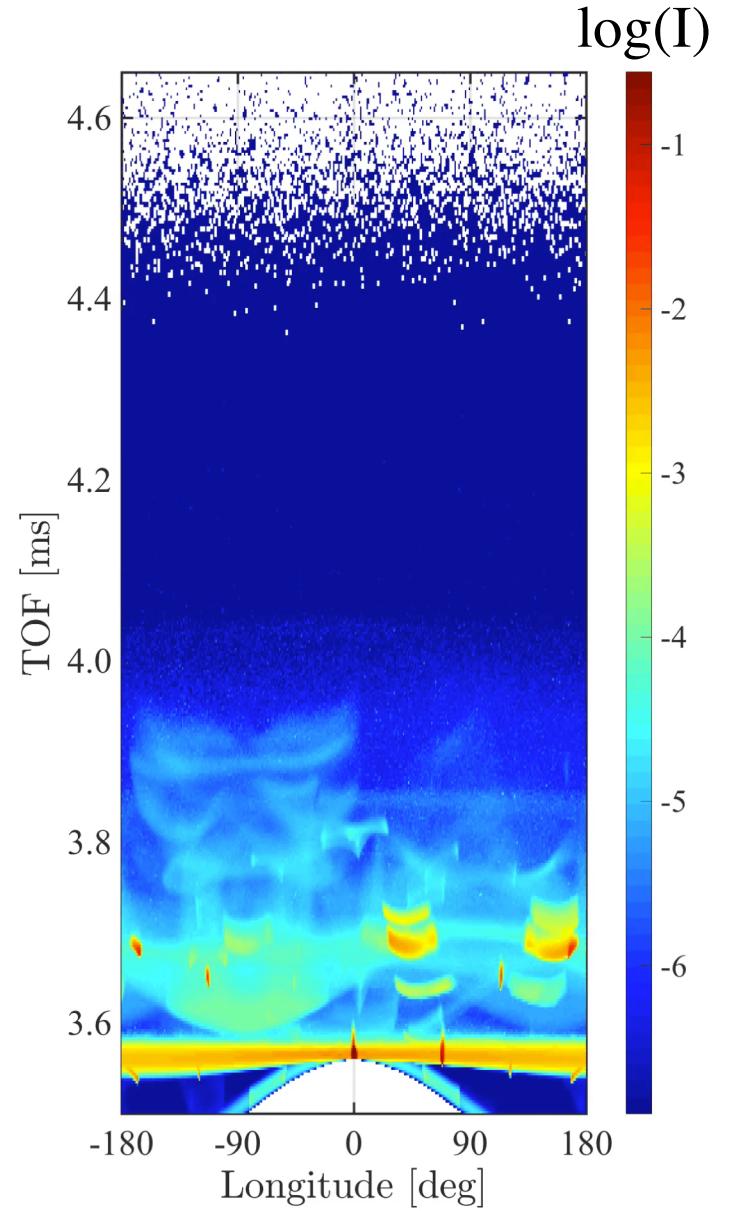
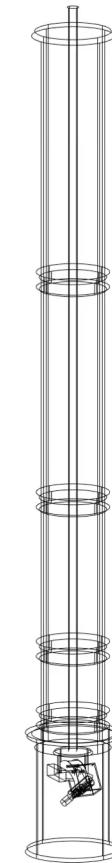
Building a sample



Building a sample



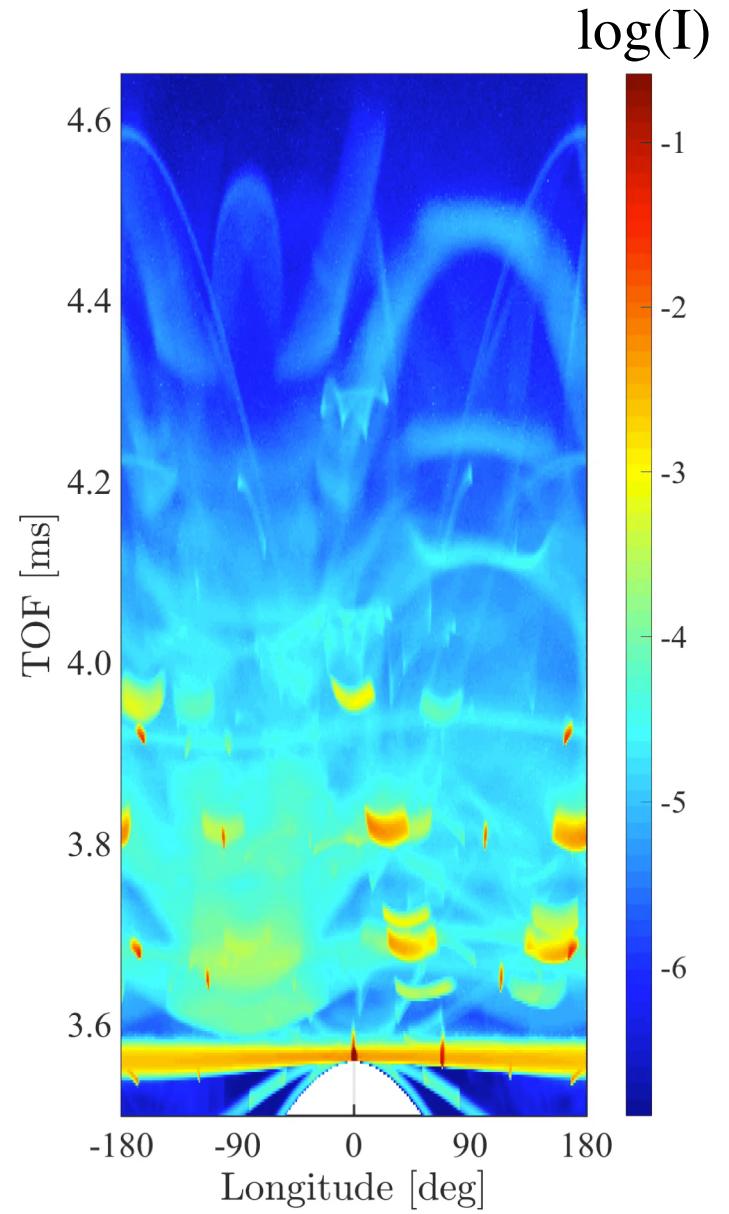
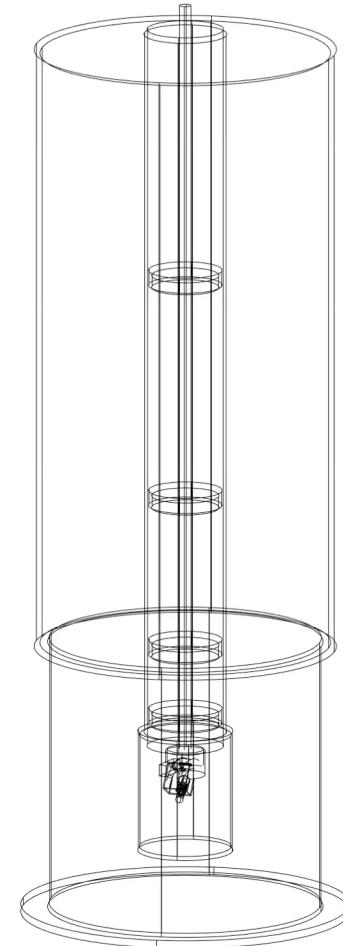
Image from NIST webpage



Building a sample



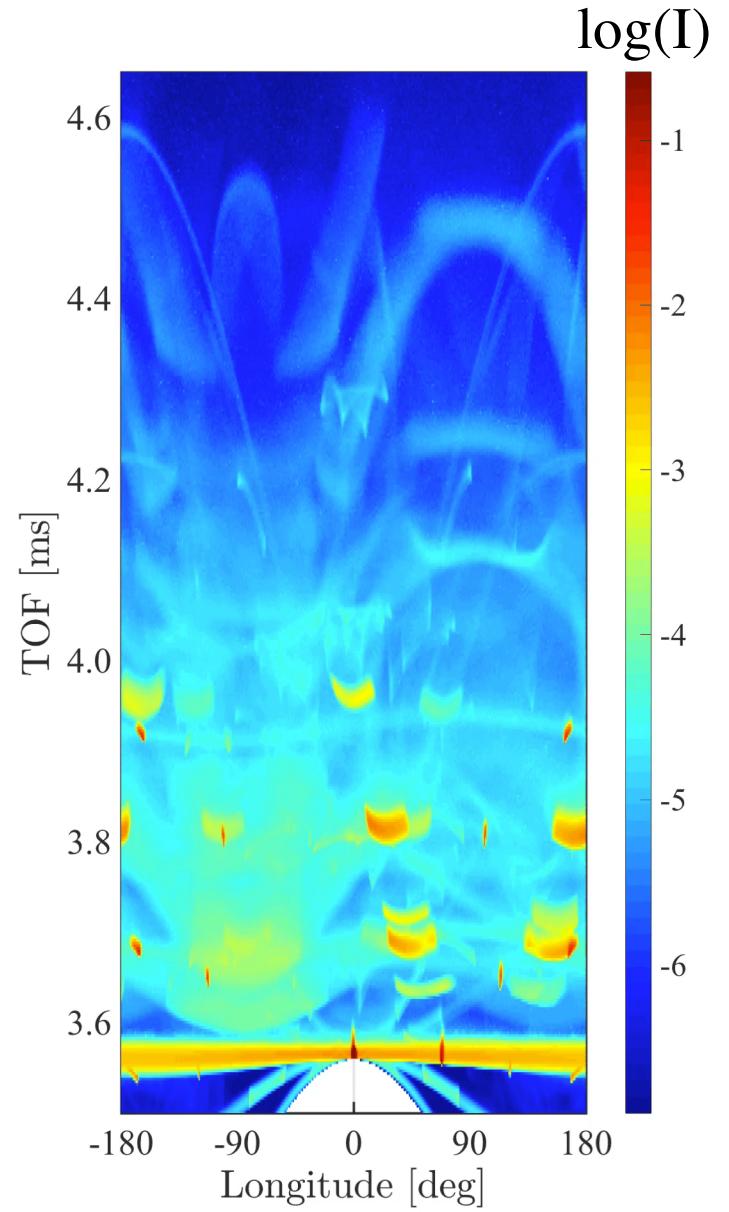
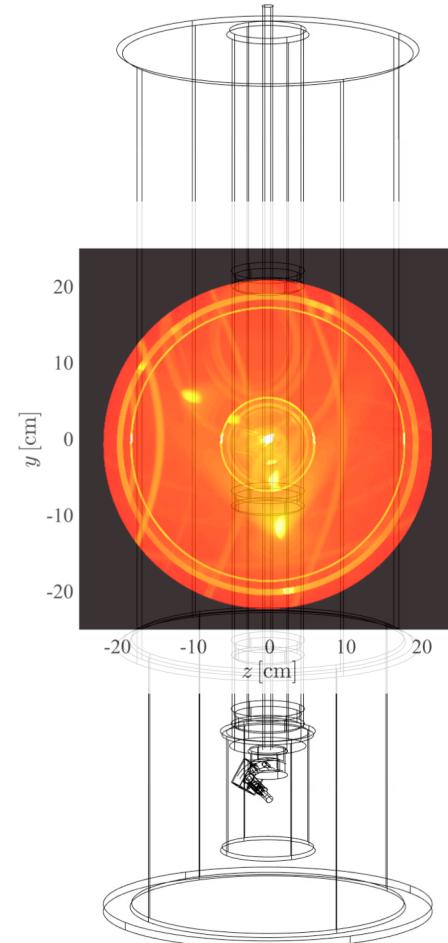
Image from NIST webpage



Building a sample



Image from NIST webpage

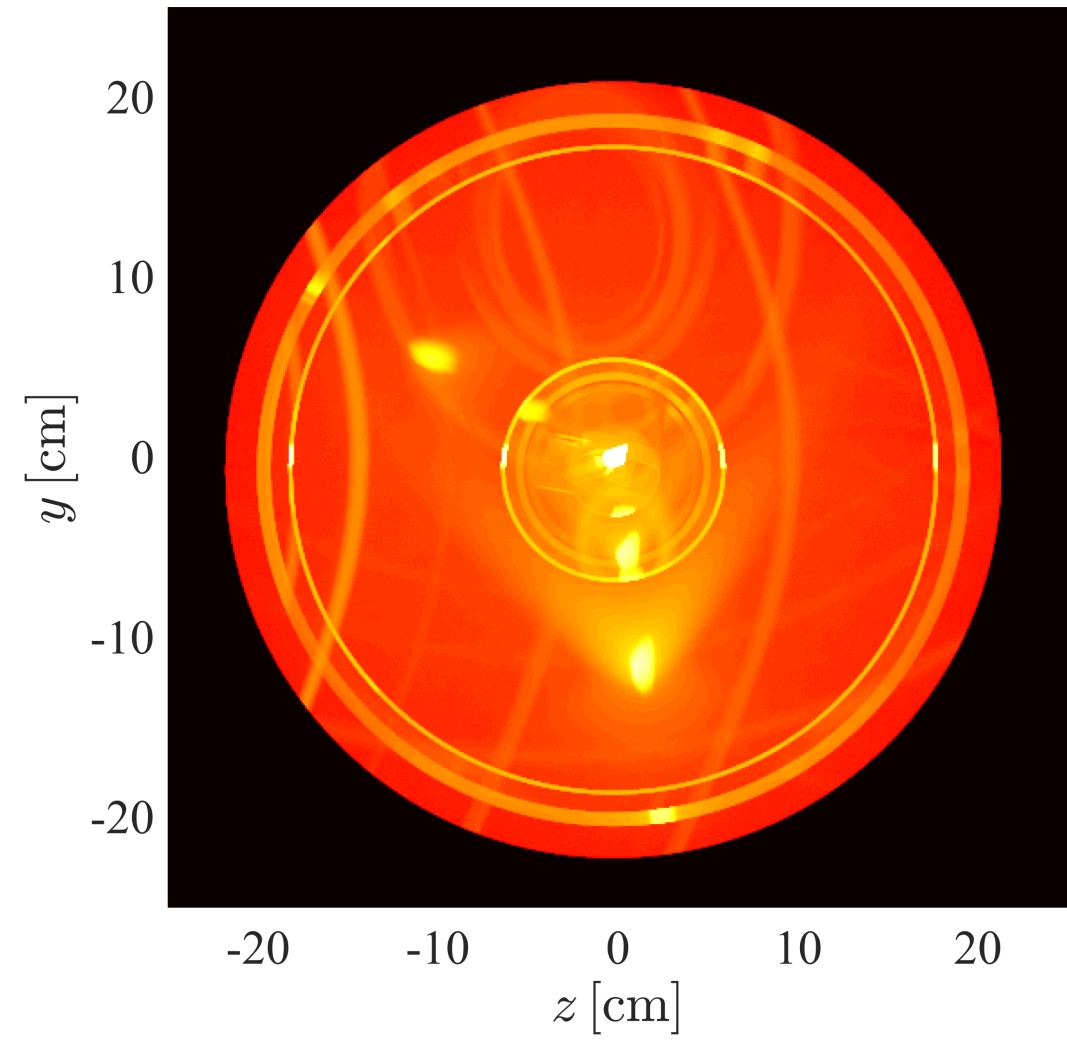


Union loggers

- Record information during scattering
- Here spatial distribution of scattered intensity from above

COMPONENT scattering_zx = Union_logger_2D_space(
D_direction_1="z",D1_min=-0.25,D1_max=0.25,n1=300,
D_direction_2="x",D2_min=-0.25,D2_max=0.25,n2=300,
filename="scattering_zx.dat")
AT (0,0,0) RELATIVE sample_position

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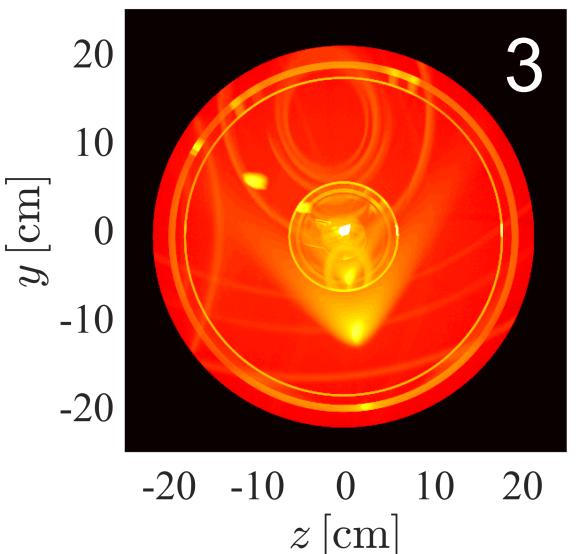
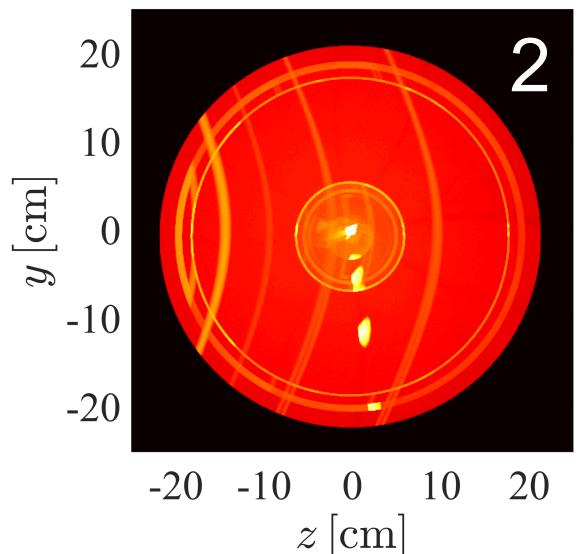
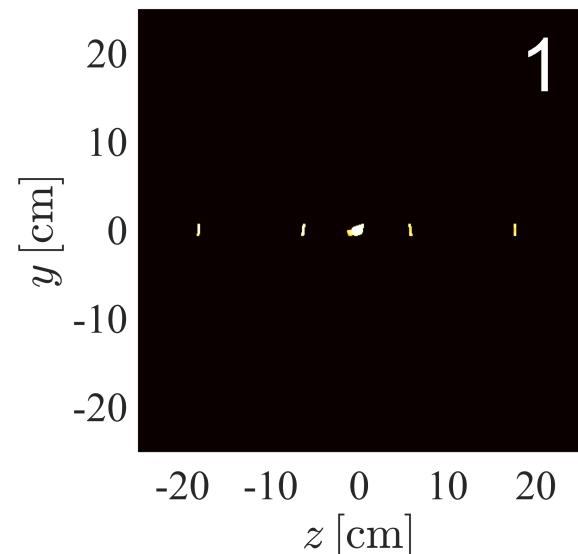
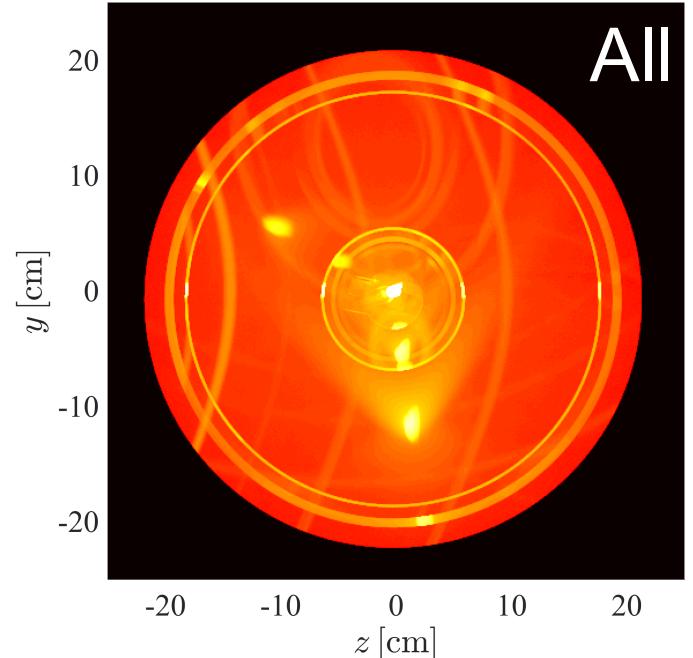


Union loggers

- Can select to view just a specific order of scattering in the system

```
COMPONENT scattering_zx_1 = Union_logger_2D_space(
    D_direction_1="z",D1_min=-0.25,D1_max=0.25,n1=300,
    D_direction_2="x",D2_min=-0.25,D2_max=0.25,n2=300,
    filename="scattering_zx.dat",order_total=1)
```

AT (0,0,0) RELATIVE sample_position

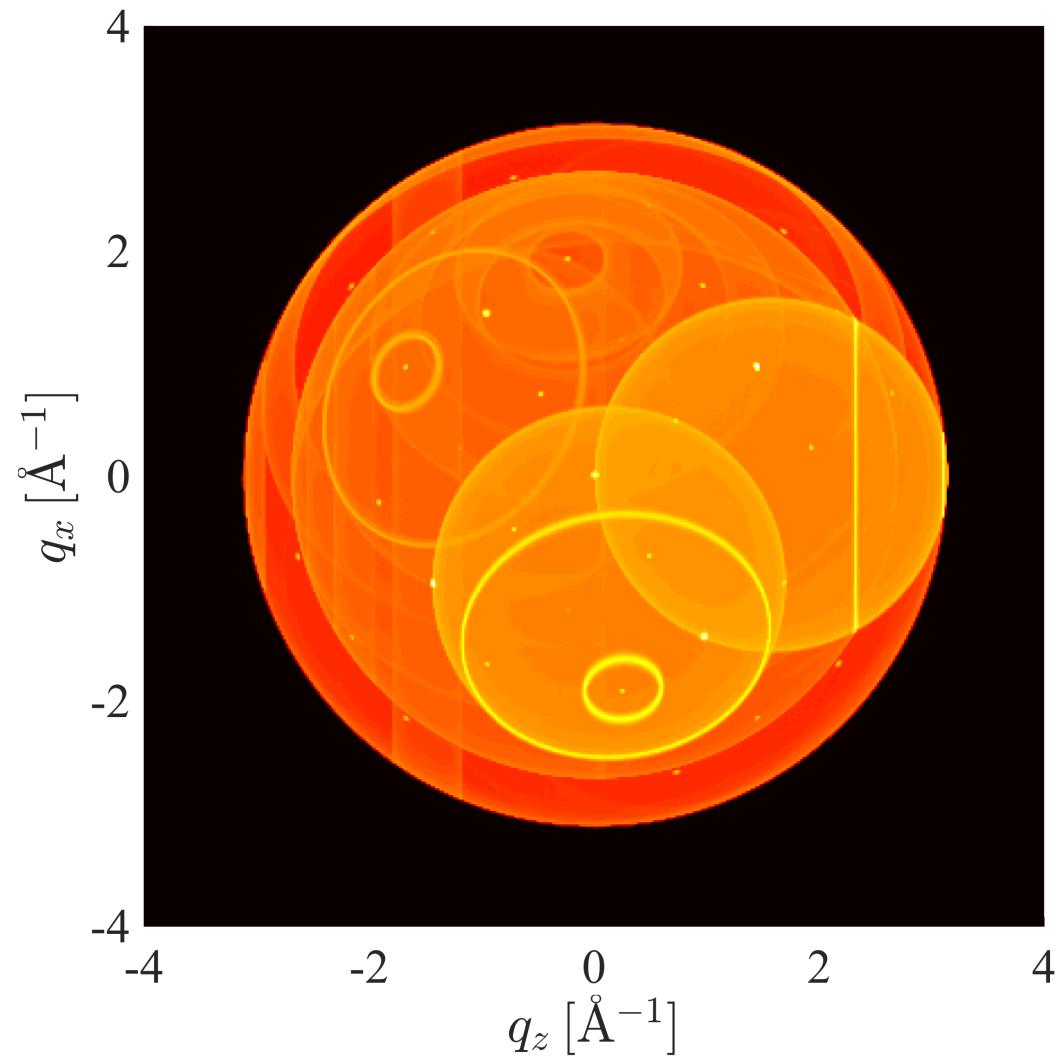


Union loggers

- Here the scattering vector is recorded

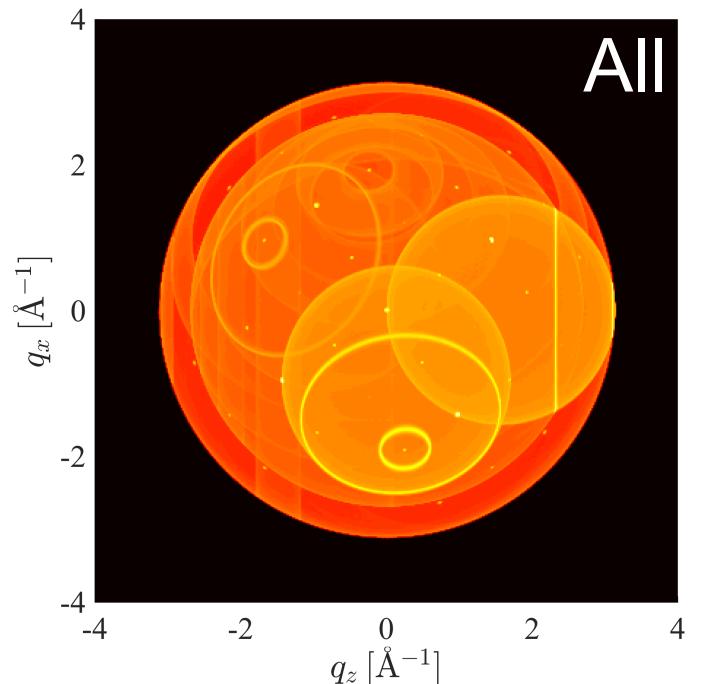
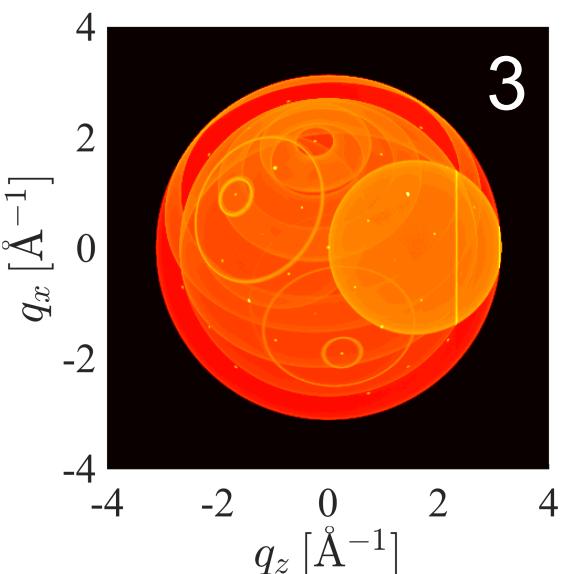
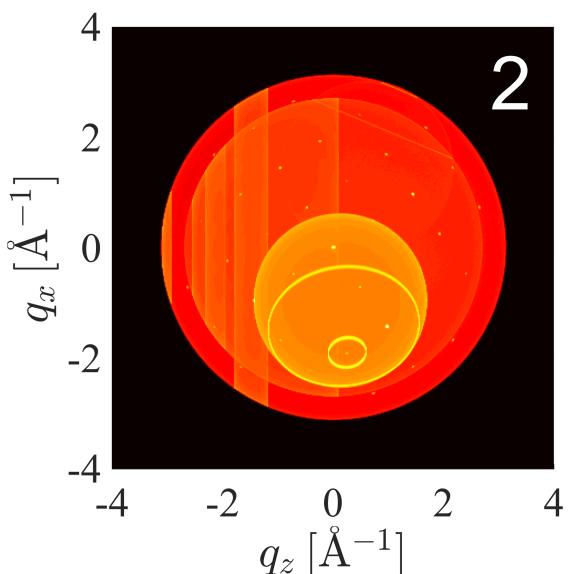
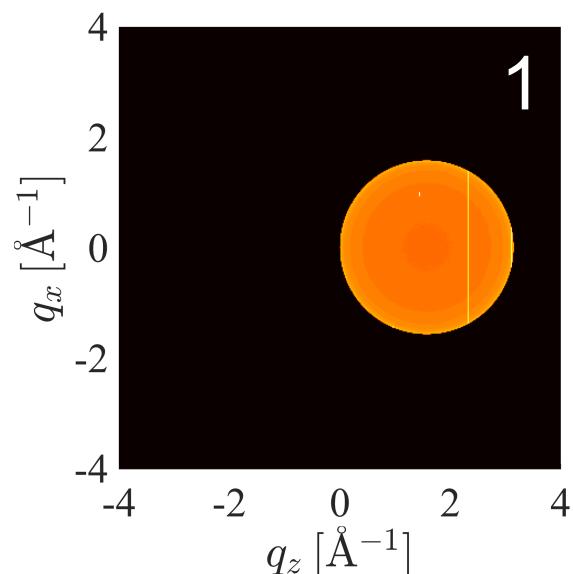
```
COMPONENT scattering_zx_Q = Union_logger_2DQ(  
    Q_direction_1="z",Q1_min=-4,Q1_max=4,n1=300,  
    Q_direction_2="x",Q2_min=-4,Q2_max=4,n2=300,  
    filename="scattering_zx_Q.dat")
```

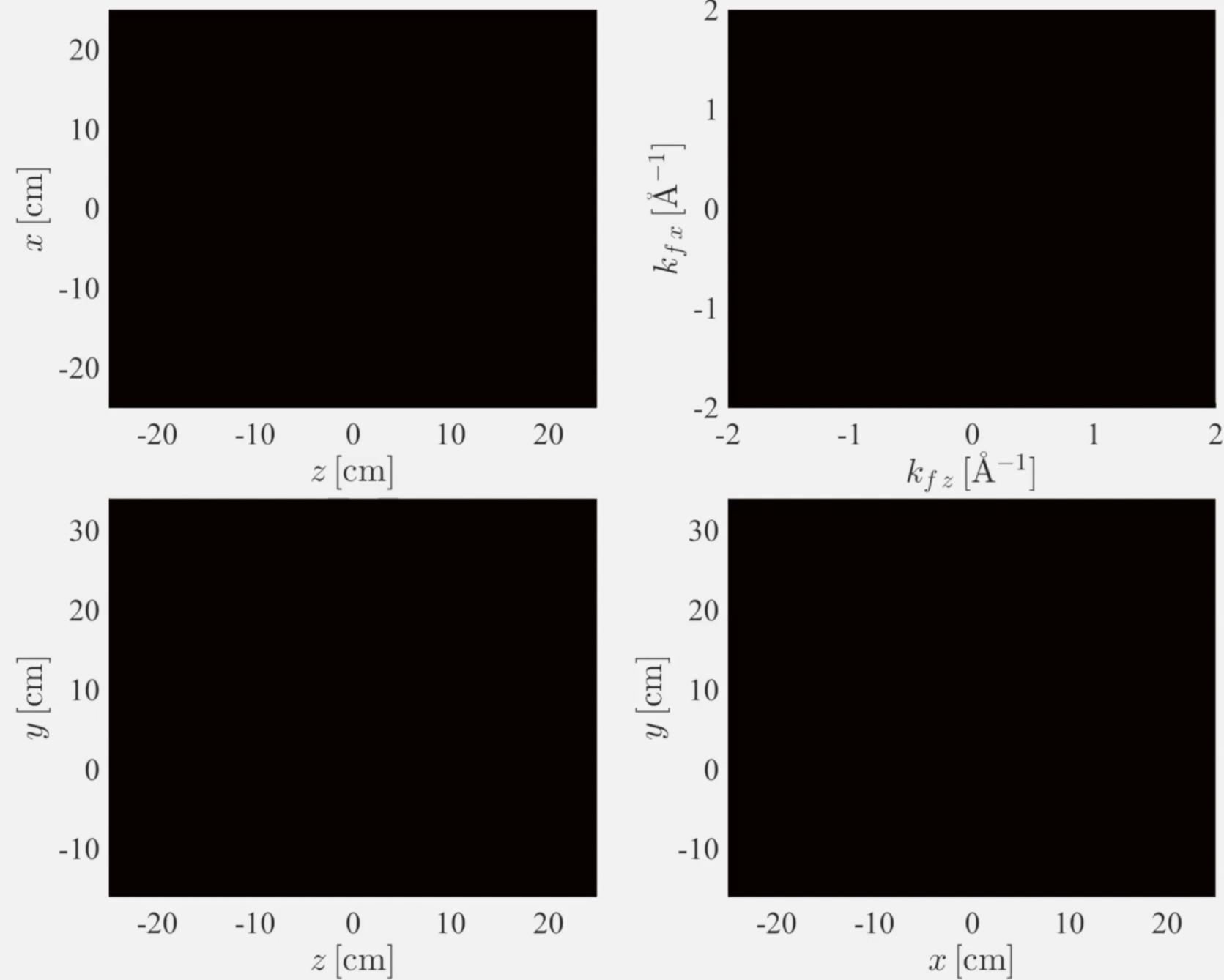
AT (0,0,0) RELATIVE sample_position



Union loggers

- Can select to view just a specific order of scattering in the system





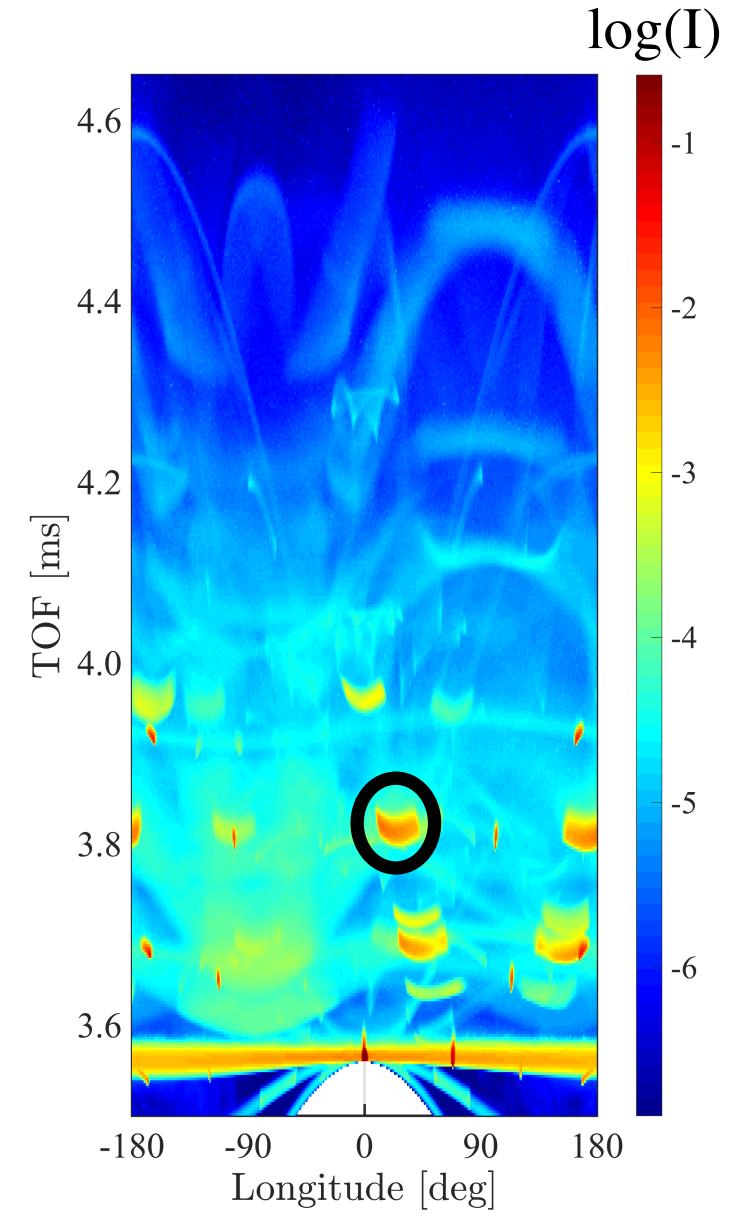
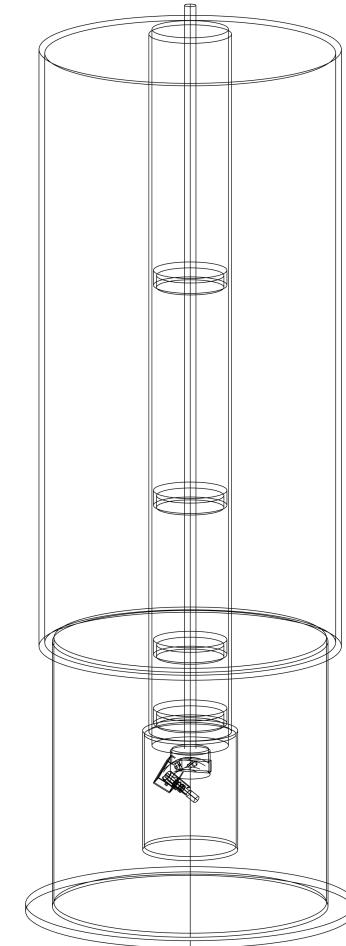
Union loggers – Use mcdoc

Contributed components

Name
Union_logger_2D_kf
Union_logger_2D_space
Union_logger_2D_kf_time
Union_logger_1D
Union_logger_3D_space
Union_logger_2DQ
Union_logger_2D_space_time

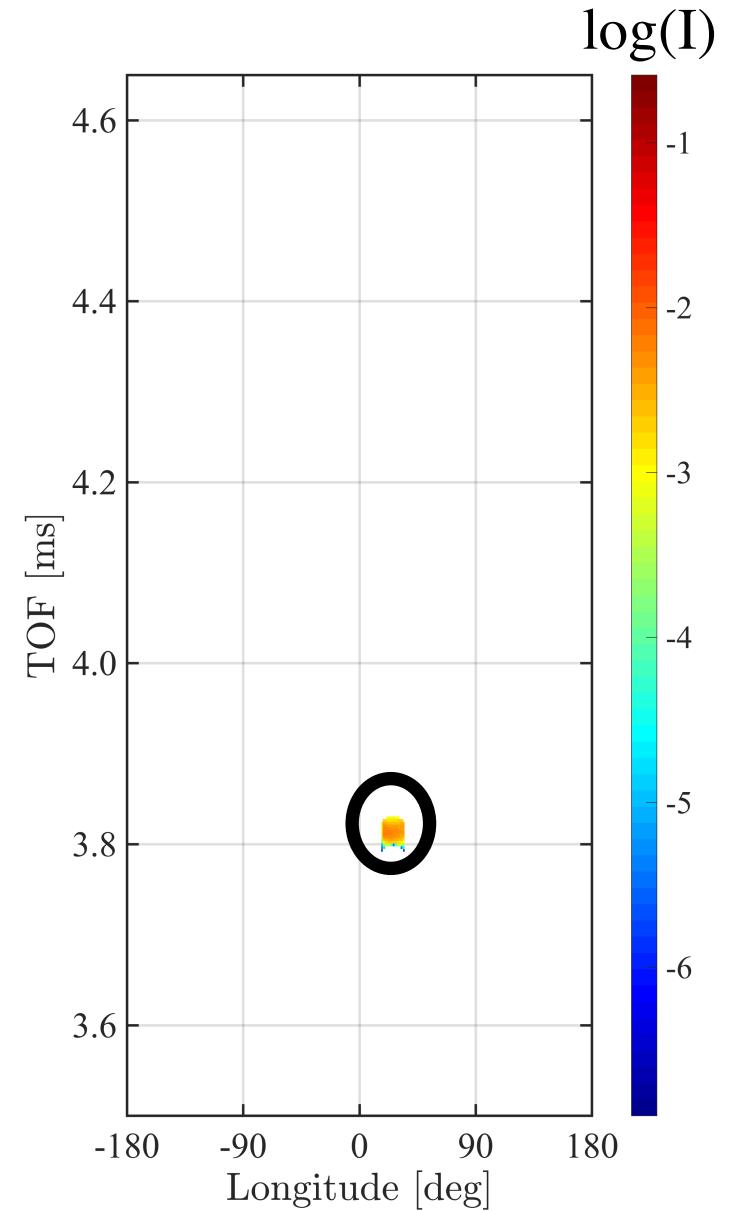
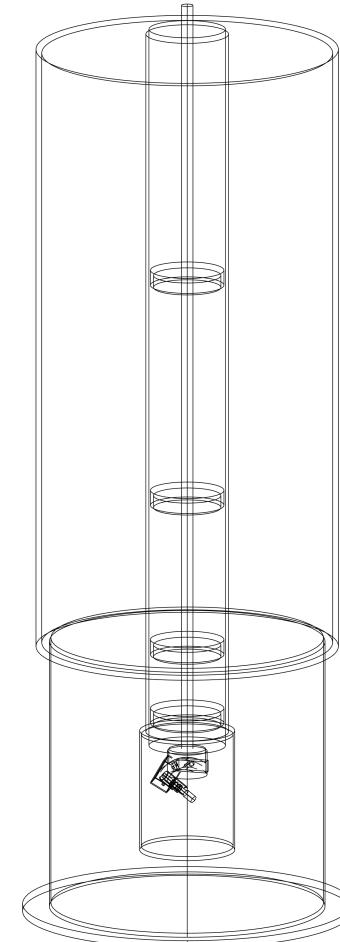
Union conditionals

- Wish to understand how individual background features arose



Union conditionals

- Wish to understand how individual background features arose
- Select subset of output to be recorded in loggers using Union conditionals



Union conditionals

- Can limit the events that are recorded to the logger using conditionals
- Here only rays that contribute to the chosen background problem is seen
- Spatial distribution of scattered intensity
- They modify an existing Logger

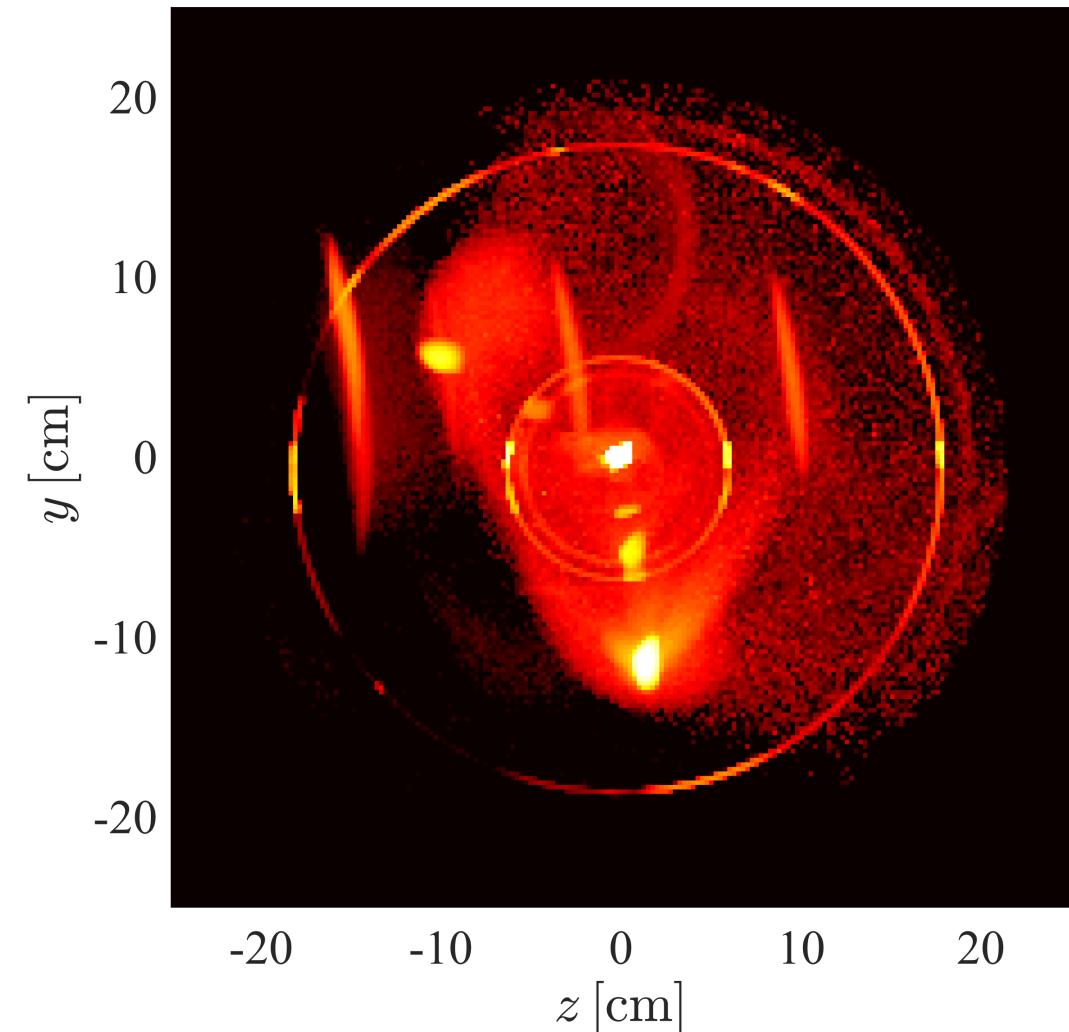
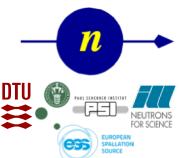
COMPONENT conditional = Union_conditional_PSD(

2019 CSNS target_loggers=" scattering_zx",

McStas xwidth=0.01,yheight=0.01

School time_min=1.2E-3, time_max=1.5E-3)

McStas AT (0,0,1) RELATIVE sample_position

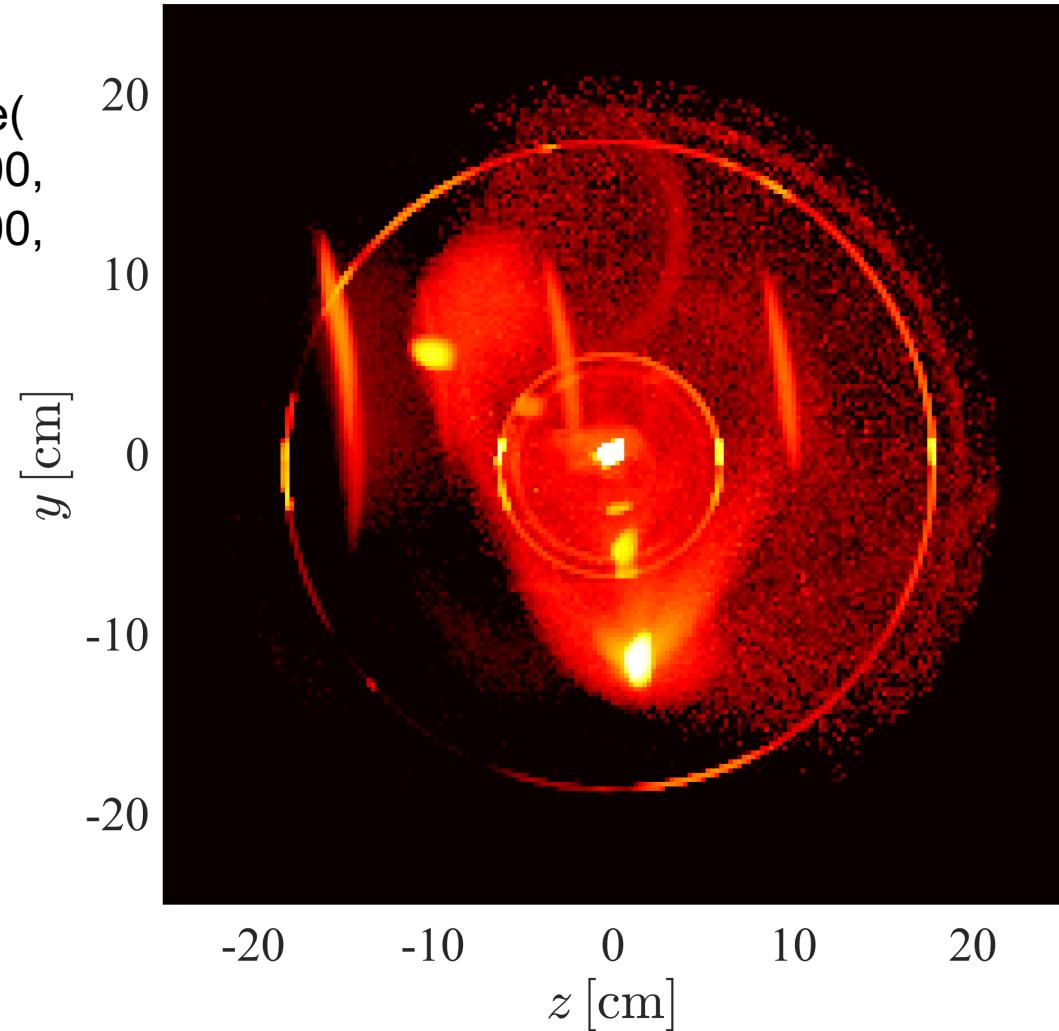


Union conditionals

```
COMPONENT scattering_zx = Union_logger_2D_space(
    D_direction_1="z",D1_min=-0.25,D1_max=0.25,n1=300,
    D_direction_2="x",D2_min=-0.25,D2_max=0.25,n2=300,
    filename="scattering_zx.dat")
AT (0,0,0) RELATIVE sample_position
```

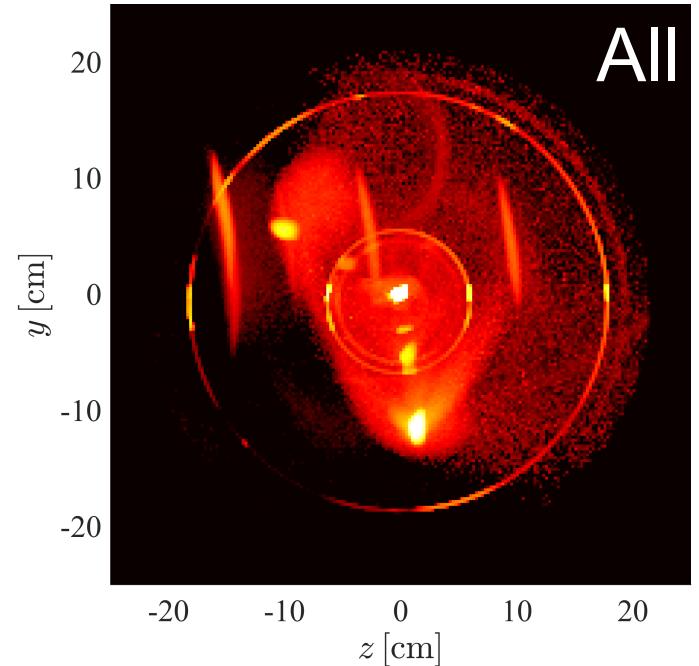
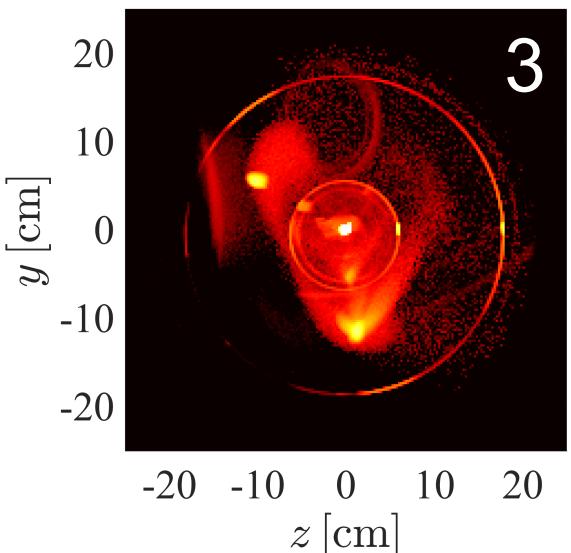
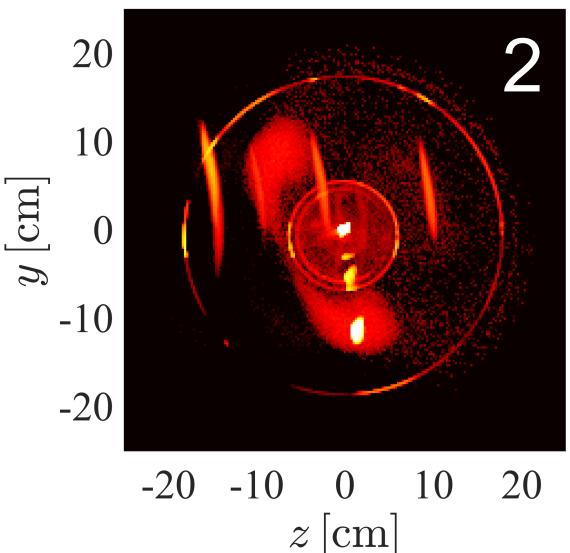
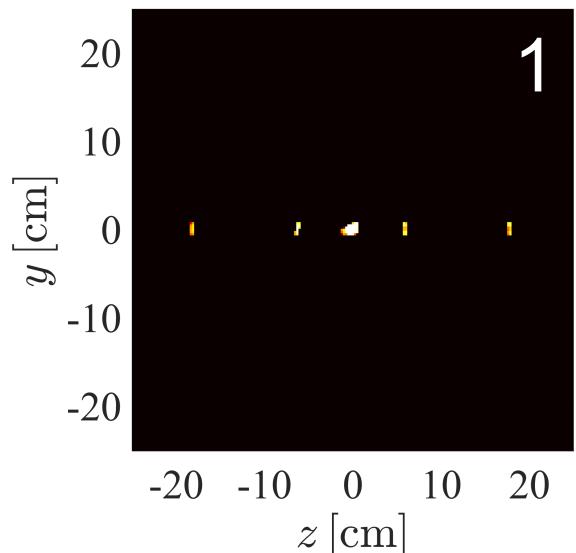
```
COMPONENT conditional = Union_conditional_PSD(
    target_loggers=" scattering_zx",
    xwidth=0.01,yheight=0.01
    time_min=1.2E-3, time_max=1.5E-3)
AT (0,0,1) RELATIVE sample_position
```

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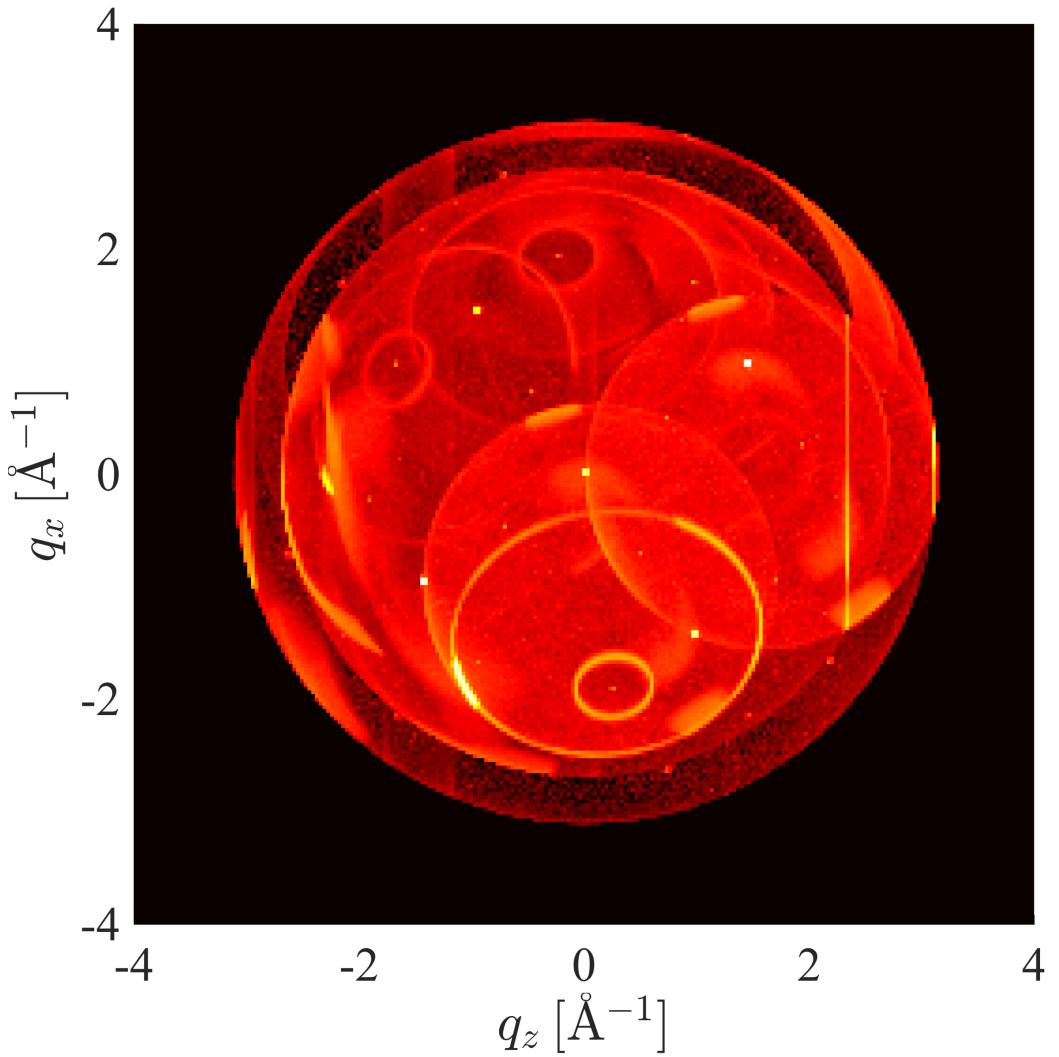
Union conditionals

- The different scattering orders makes it easier to draw conclusions



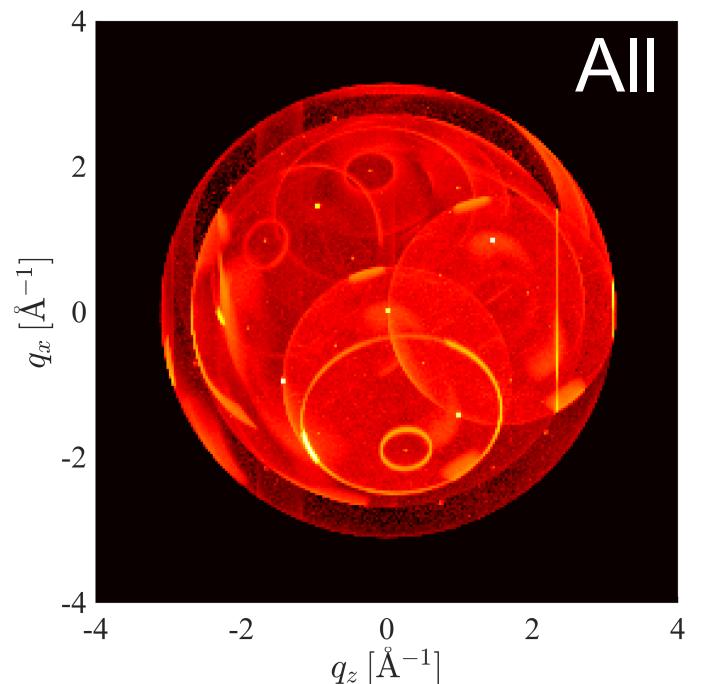
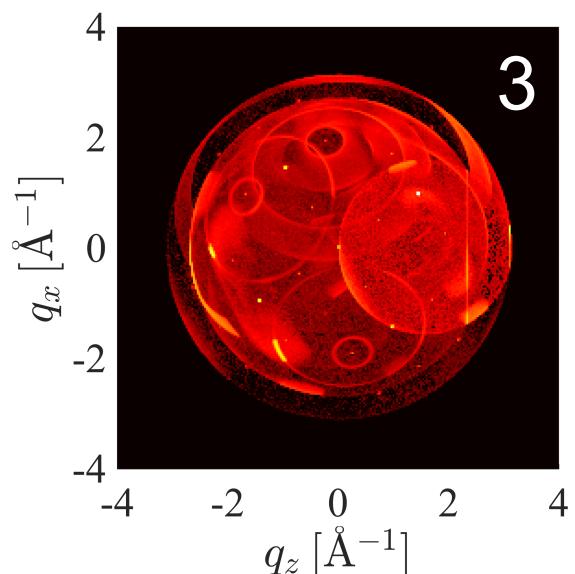
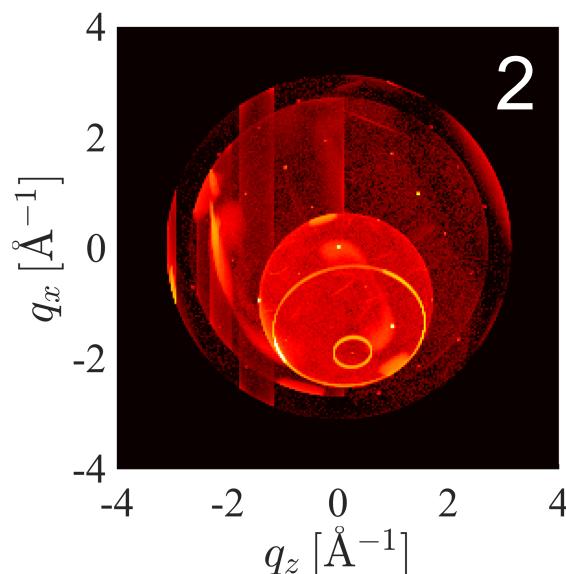
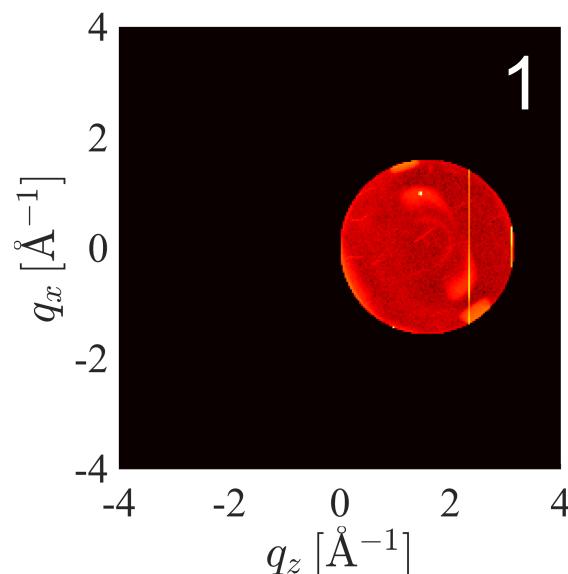
Union conditionals

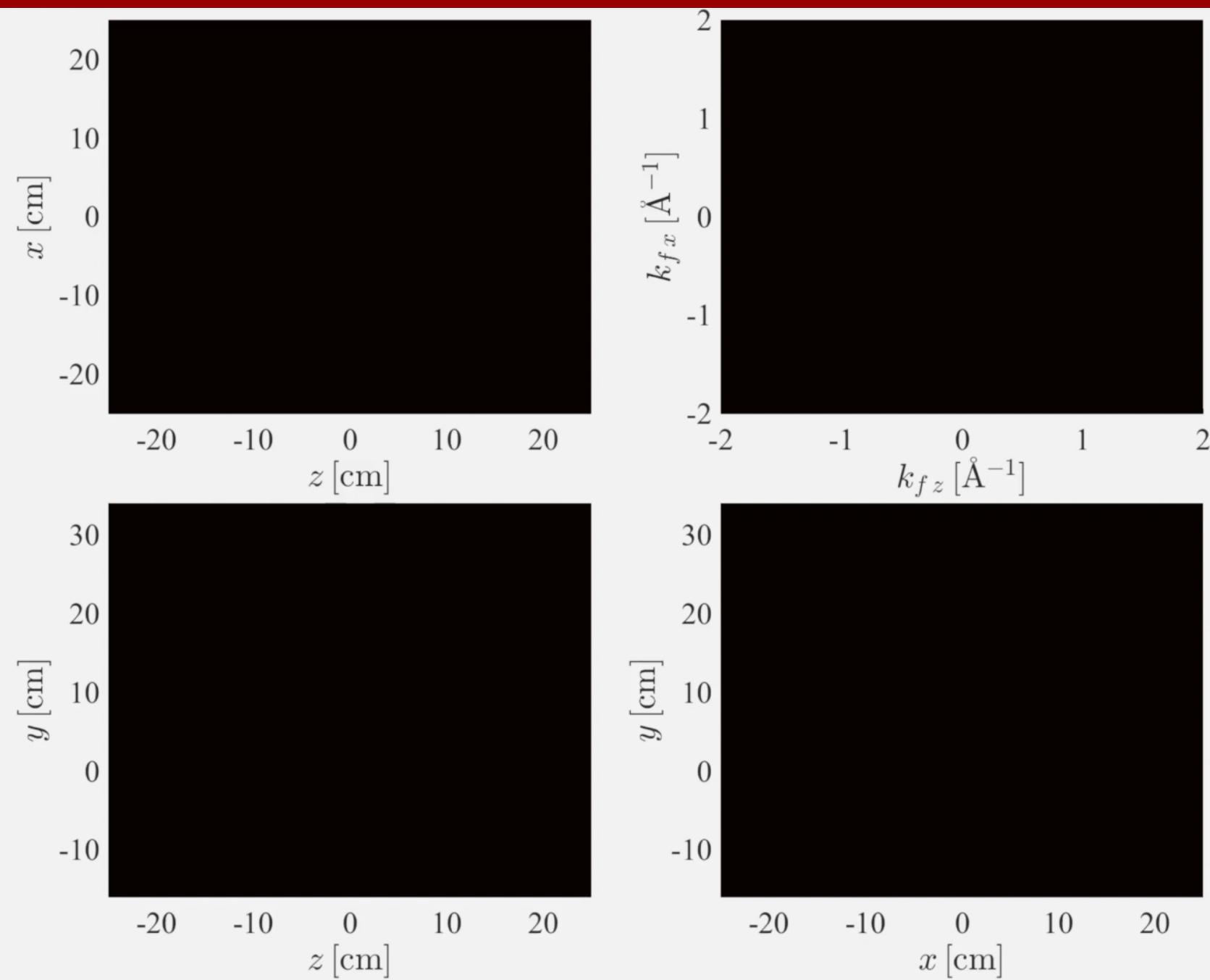
- Scattering vectors of rays that contribute to the chosen background problem



Union conditionals

- Easier to see scattering orders





Conclusion

- Use Union components for complex geometries or for modular physics
- Performs full multiple scattering simulation
- Slower than typical McStas simulations, but still runs well on a laptop
- Strong visualization tools
- Easier to contribute physics

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Exercise

- Add loggers to your instrument file from the last session
- A solution file is available on github for inspiration
 - mcdoc Union_logger
 - Mcdoc Union_conditional
- One last demonstration talk after the exercise

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