Wave Forcing in a Rotating Cylindrical Flow

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Background

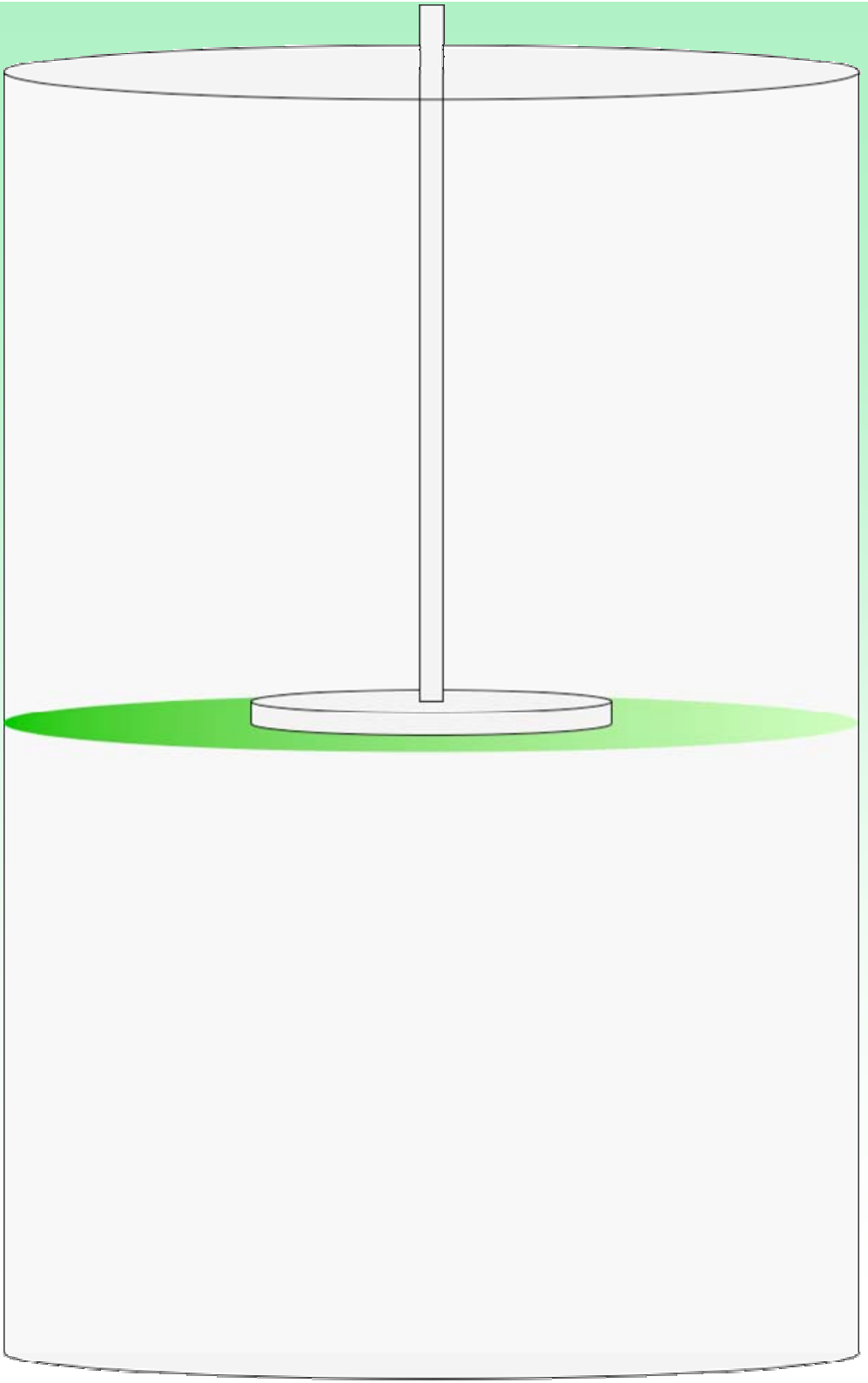
- Inertial waves are present in rotating fluid flows
- Past work: over-reflection from a sheared region of fluid as driving force in spherical Couette geometry
- Hide and Titman (1967): detached shear layers in a cylinder-disk system
- **We examine fluid flow in and near the boundary layer of the disk**

Experimental Setup

- Rossby number: -1
  - Ω_o = 1 Hz
  - Ω_i = 0 Hz
- Ekman number: 6.87×10^{-5}

$Ro = (\Omega_i - \Omega_o)/\Omega_o$

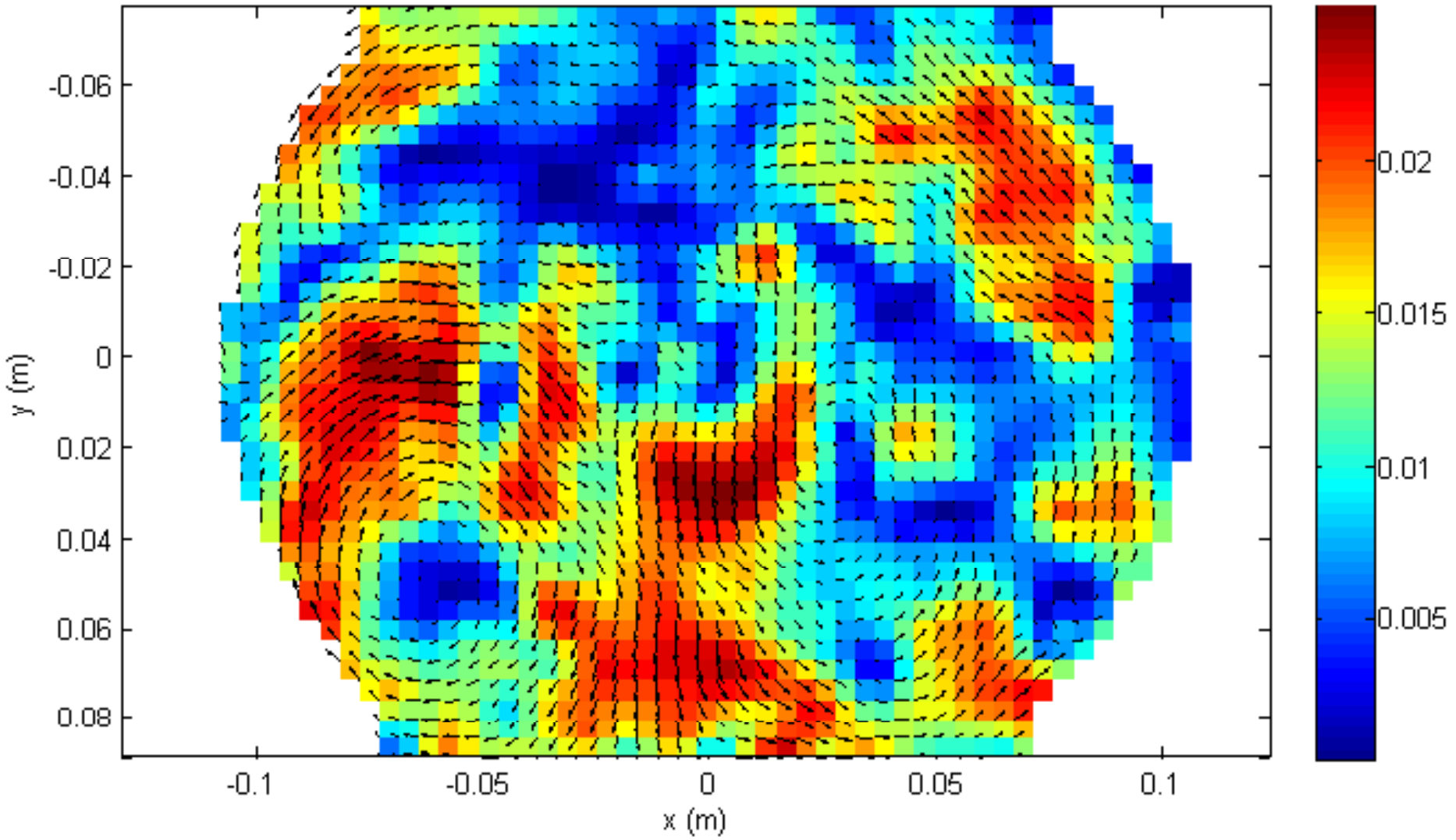
$E = \nu/(\Omega_o L^2)$



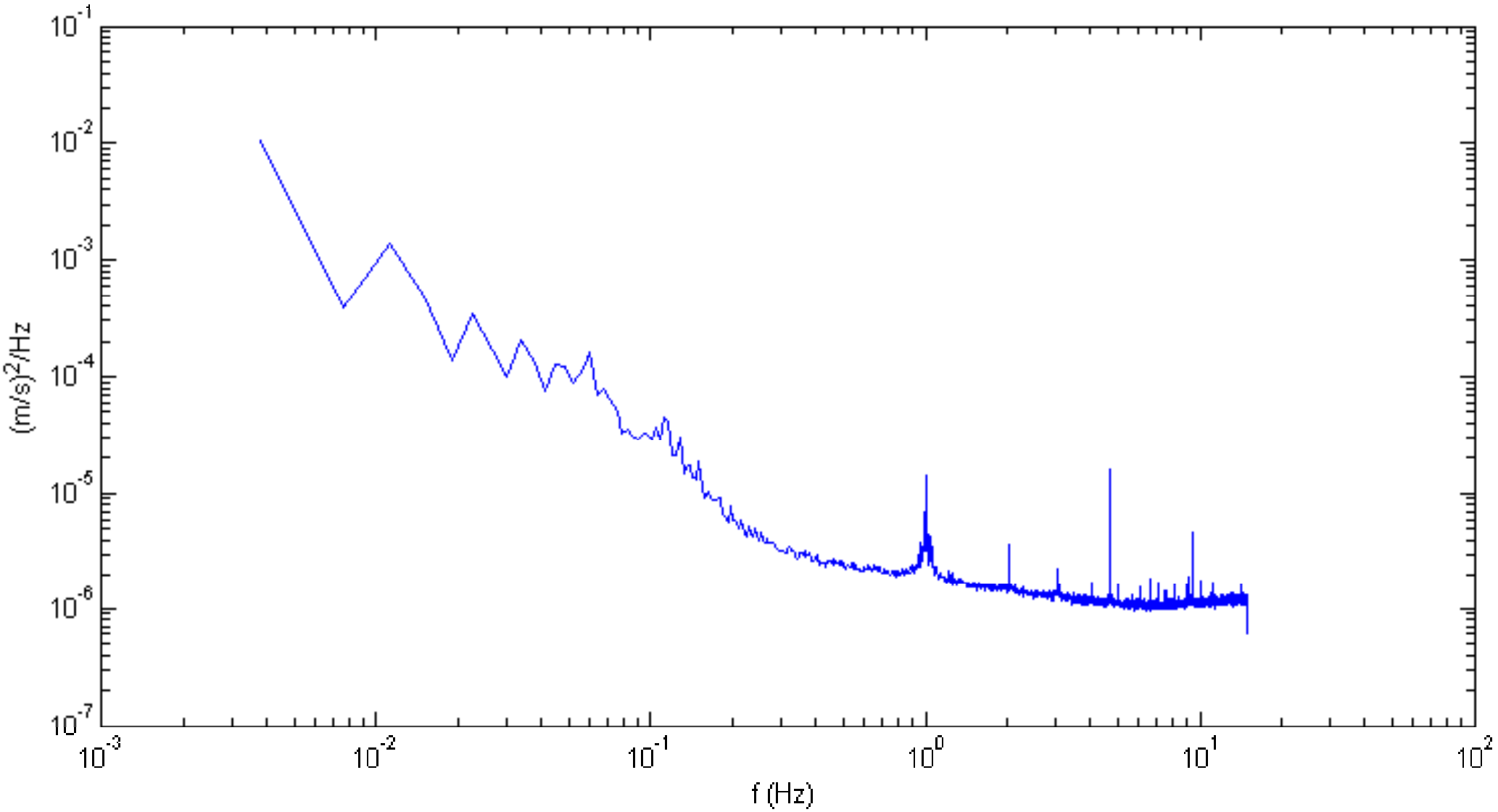
Particle Image Velocimetry

QuickTime™ and a
Motion JPEG OpenDML decompressor
are needed to see this picture.

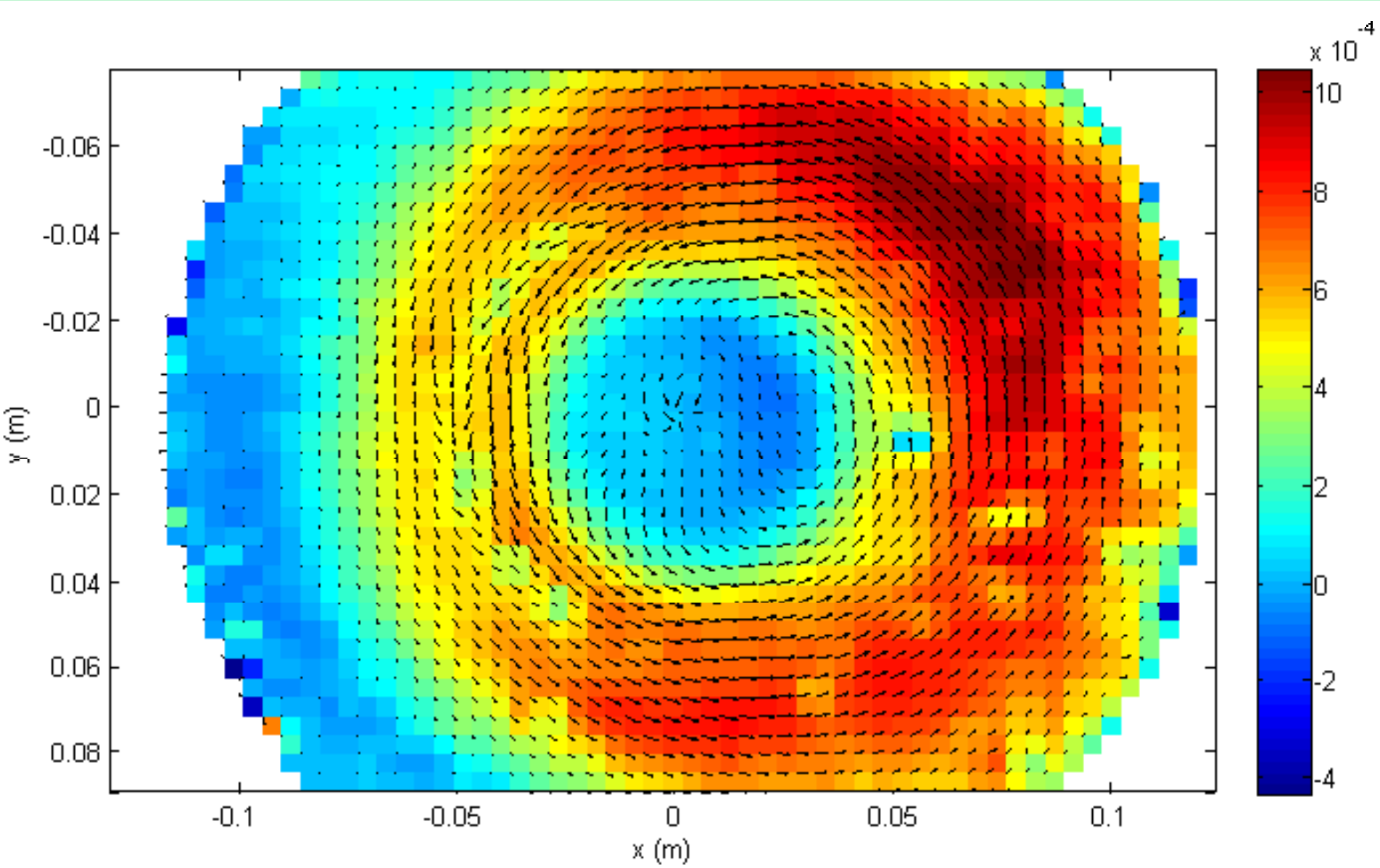
Radial Jets


-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
y (m)
-0.1
-0.05
0
0.05
0.1
x (m)
0.02
0.015
0.01
0.005

Turbulent Power Spectrum



Mean Angular Momentum



Conclusions

- Unclear what forces large-scale waves
- Large traveling vortex—interacting with disk edge, affecting angular momentum transfer?
- Disk oscillations, topographical effects dominate system
- Does over-reflection play a role?

Future Work

- Optimize data analysis
- Refine experiment to minimize error
- Lower Ekman number: increase speed, temperature
- Lower Rossby number: counter-rotate