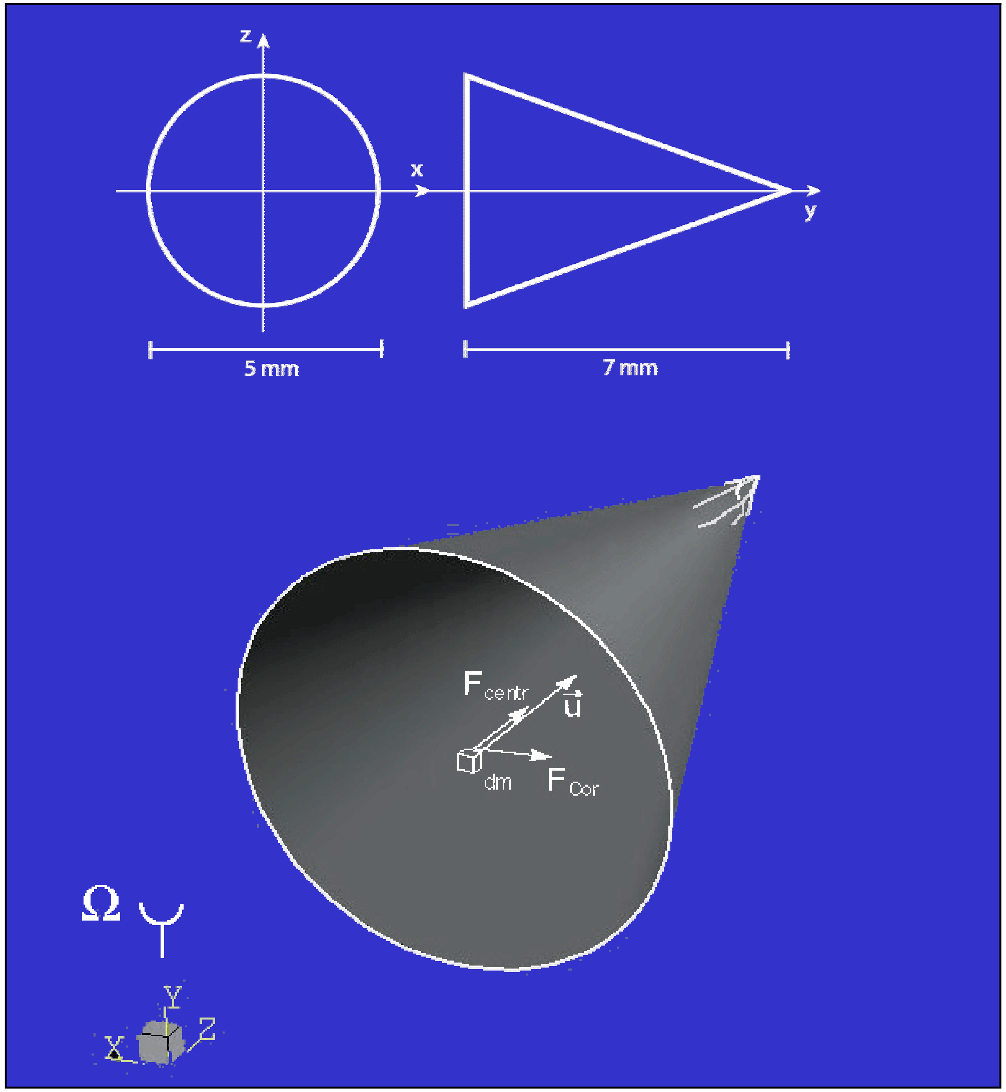
SuperConvection - How does it work ?

Centrifugal Effects

- Convection
- Coriolis effect
- Centrifugal forces

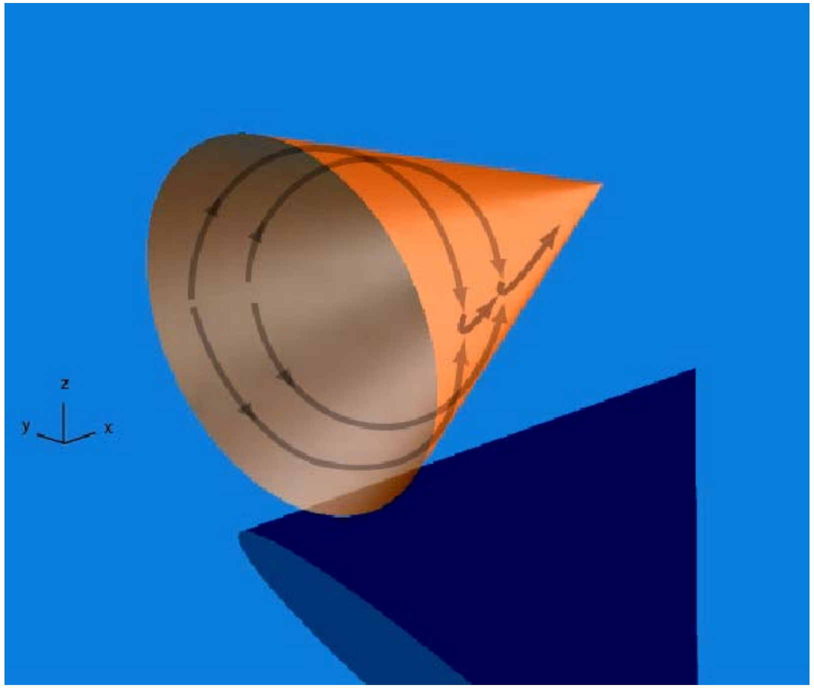


SuperConvection Flows

<u>Example (no heat transfer limitations)</u>

Rotation:	10000 RPM
Radius:	10 cm
ΔT:	75 °C (cooling)

Gives velocity of **1.6 m/s** in the boundary layer

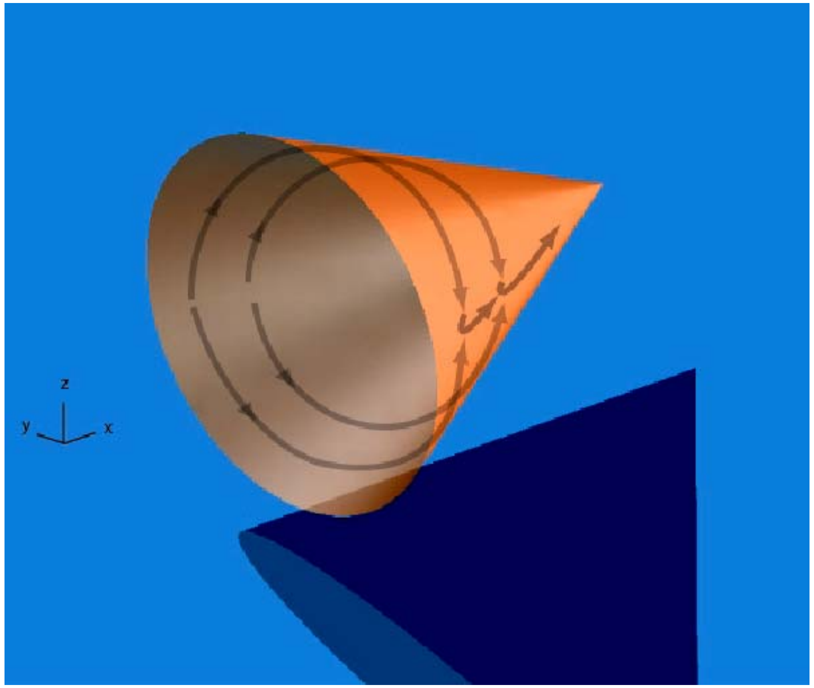


SuperConvection Flows

<u>Example (no heat transfer limitations)</u>

Rotation:	10000 RPM
Radius:	10 cm
ΔT:	75 °C (cooling)
V:	50 µl

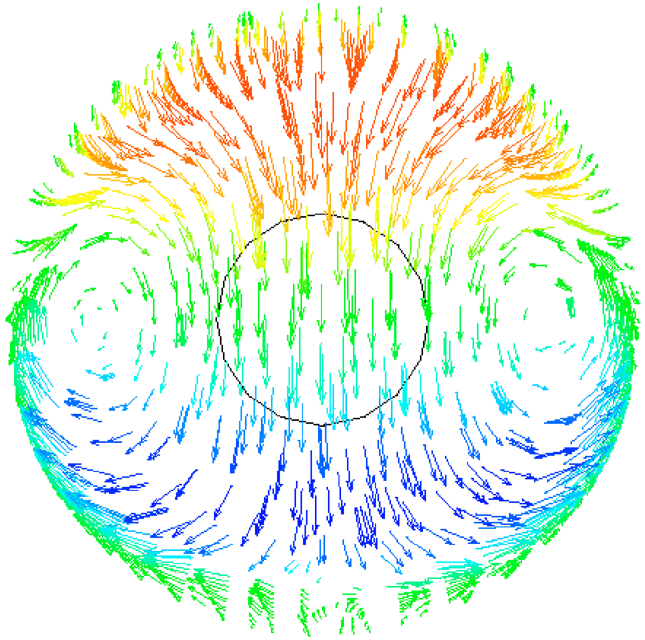
Reach homogenization in the order of **0.1** sec



Cooling at > 5000 RPM (3000 xg)

- Fluid velocities mm/sec (0 RPM)

  $\rightarrow$ cm – dm/ sec (m/sec)
- Increased velocity in the boundary layers
- Velocity scales linear with RPM
- Depends/limited by the tube material (heat transfer)
- Flow is laminar
- Increased mean cooling rate
- Improved temperature homogeneity
- Distinct flow pattern



SuperConvection features

Extremely Rapid Mass Transport

Rapid thermal homogenization

Increased number of molecular collisions

SuperConvection features

Rapid thermal homogenization

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Rapid ramping

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Rapid and high-quality PCR

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Increased number of molecular collisions

↓

Enhanced kinetics

↓

Rapid isothermal reaction steps

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Implications for PCR and Cycle Sequencing

PCR also in large reaction volumes

Dilution of inhibitors

High sensitivity in diagnostic/forensic PCR

Enhanced kinetics

Increased product formation

Shorter elongation /termination steps