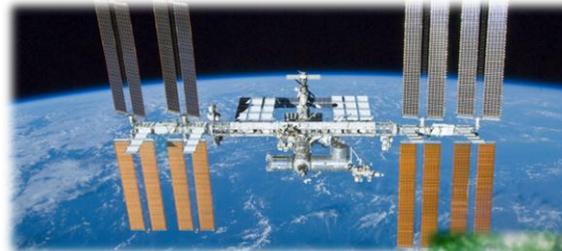


# Microgravity Fluids for Biology Workshop

## ASGSR Workshop III

### Contributors:

DeVon Griffin, NASA GRC  
Fred Kohl, NASA GRC  
Gioia Massa, NASA KSC  
Brian J. Motil, NASA GRC  
Patricia Parsons-Wingerter, NASA GRC  
Charles Quincy, NASA KSC  
Kevin Sato, Lockheed Martin/ARC  
Bhim Singh, NASA GRC  
Jeff Smith, NASA ARC  
Raymond Wheeler, NASA KSC

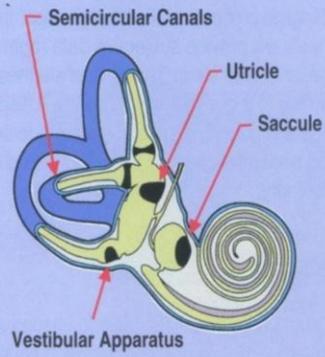


# Introduction

- Last year (at first ASGSR meeting) we kicked off/brainstormed ideas to foster collaboration between Fluid Physics and Space Biology.
- Developed a draft White Paper – organized to identify fluids-related knowledge/technical gaps currently facing space biology research.
- Will present overview today and invite the broader community to comment/respond.
- This is not a new concept - our goal is to reenergize both disciplines – challenge them to work together within their current budget/program limitations as well as advocate for new work if warranted.
- Fits into Open Source approach.

# Multiscale Fluid-Structural-Interaction Physiological Models

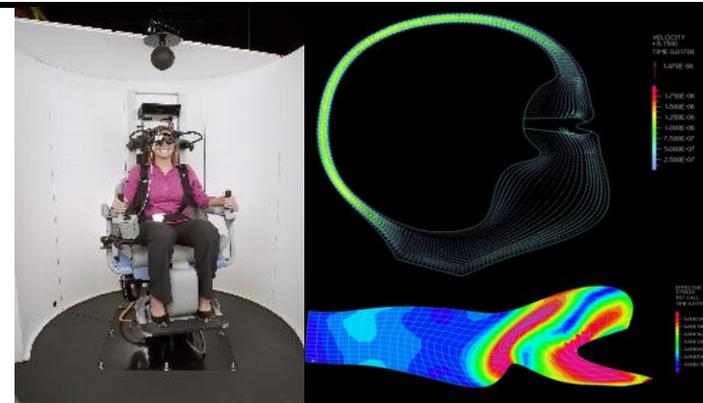
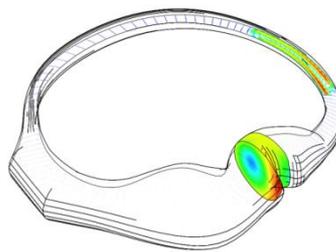
## Fluid- Structural Vestibular Model



Inner Ear

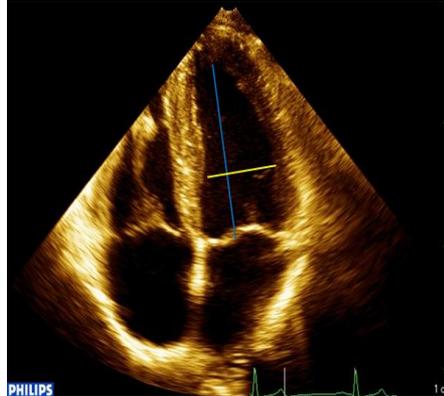
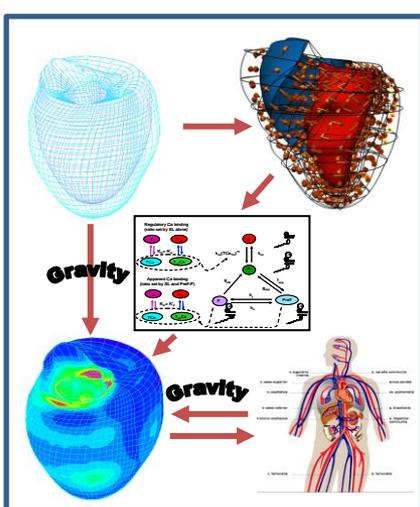


$\mu$ G Caloric Stimulation Test

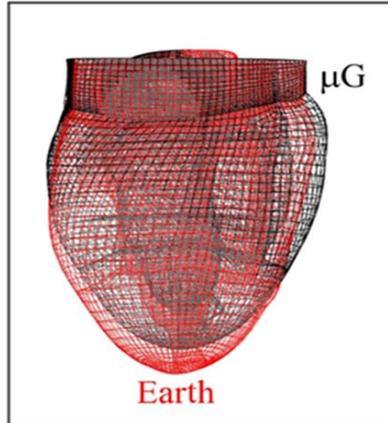


Rotational Chair Test

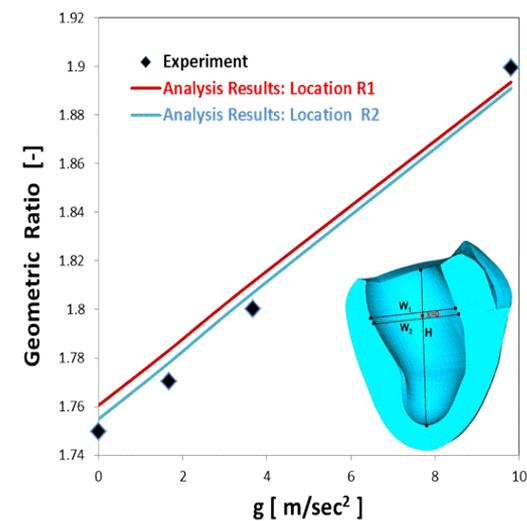
## Integrated Multiscale Cardiovascular Model



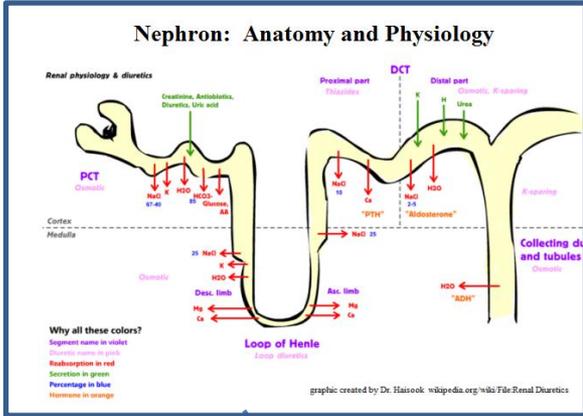
Ultrasound Measurement of  $\mu$ G Cardiac Shape



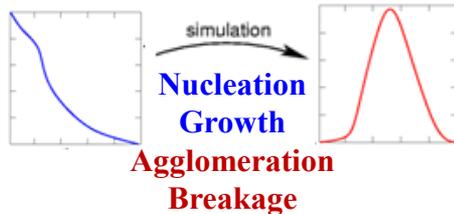
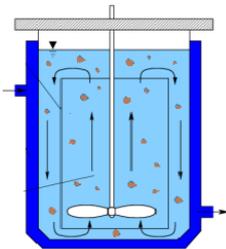
FE Predicted Cardiac Shape Change in  $\mu$ G



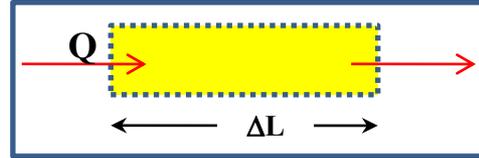
# CFD Coupled to Population Balance Model of Nephron as a Continuous Crystallizer



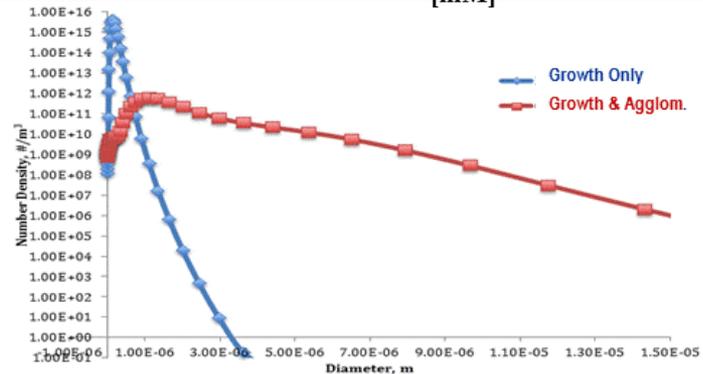
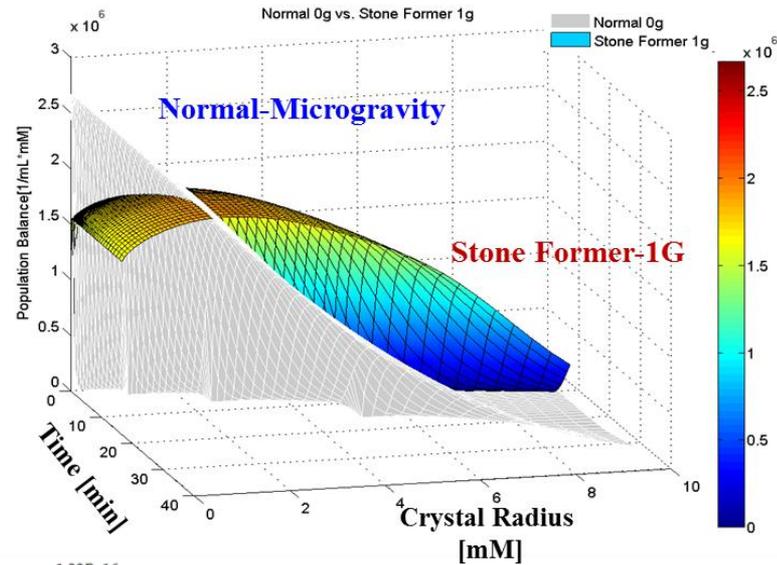
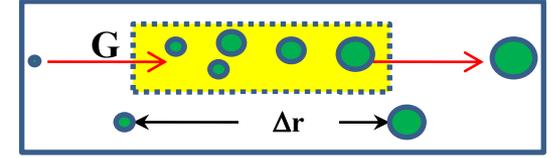
## Continuous Crystallizing Reactor



## Physical Flow CV (Nephron)



## Imaginary Growth CV



# Next Steps

- Incorporate comments & suggestions – by November 30th.
- Prioritize risks and finalize white paper – by early next year.
- Identify areas of collaboration and match skills – on going.

**Provide to presenters today or email to:**

**[Brian.J.Motil@nasa.gov](mailto:Brian.J.Motil@nasa.gov)**

***Please sign and provide email address***

# Presentations

- *Current and Future Issues for Plant Systems*

Gioia Massa & Charles Quincy, NASA KSC

- *Microgravity Fluids Issues for Animal Systems*

Jeffrey D. Smith, NASA ARC

- *Microgravity Fluids Issues for Cell Biology and Microbiology*

Jeffrey D. Smith, NASA ARC

- *Microgravity Issues for Bioregenerative Life Support Technologies*

Raymond M. Wheeler, NASA KSC