Theoretical Astrophysics

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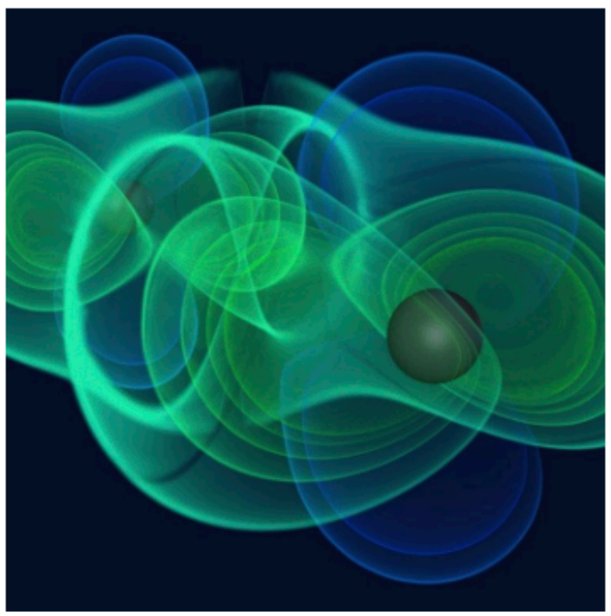
Astrophysical Dynamics

Astrophysical Magnetohydrodynamics

Protoplanetary Disks & Planet Formation

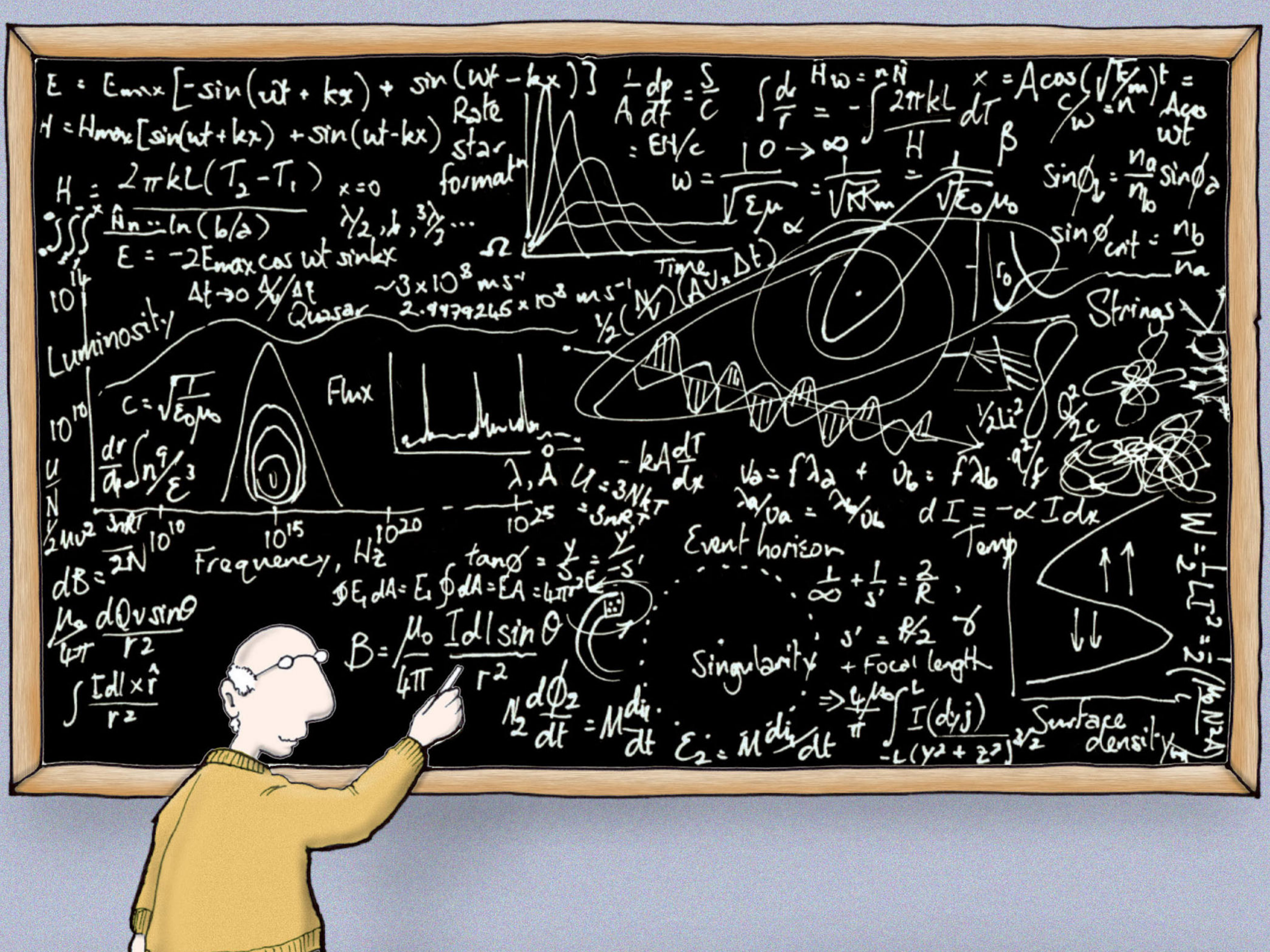
Tidal Disruptions Events



Gravitational Wave Astrophysics

In a nutshell, we care to understand the dynamics of various astrophysical systems and how we can use observations to learn about the physical properties of planets, stars, and black holes.

How?



Rate
star
Luminosity
Quasar
Flux
Strings
Event horizon
Singularity
+ Focal length
Frequency, Hz
Temp
Surface
density

Equations for a Magnetized Fluid

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \boldsymbol{v}) = 0$$

continuity

$$\frac{\partial \boldsymbol{v}}{\partial t} + (\boldsymbol{v} \cdot \nabla)\, \boldsymbol{v} = -\nabla \Phi - \frac{\nabla P}{\rho} + \frac{1}{\rho} \boldsymbol{J} \times \boldsymbol{B}$$

momentum

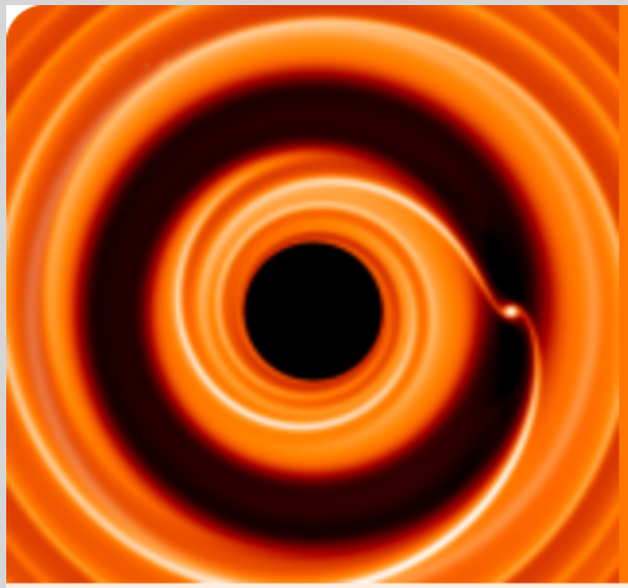
$$\frac{\partial \boldsymbol{B}}{\partial t} + (\boldsymbol{v} \cdot \nabla)\, \boldsymbol{B} = (\boldsymbol{B} \cdot \nabla)\, \boldsymbol{v} - \boldsymbol{B}\, (\nabla \cdot \boldsymbol{v})$$

induction

$$\frac{\partial e}{\partial t} + \nabla \cdot (e \boldsymbol{v}) = -P\, (\nabla \cdot \boldsymbol{v})$$

energy

State-of-the-art Numerical Codes

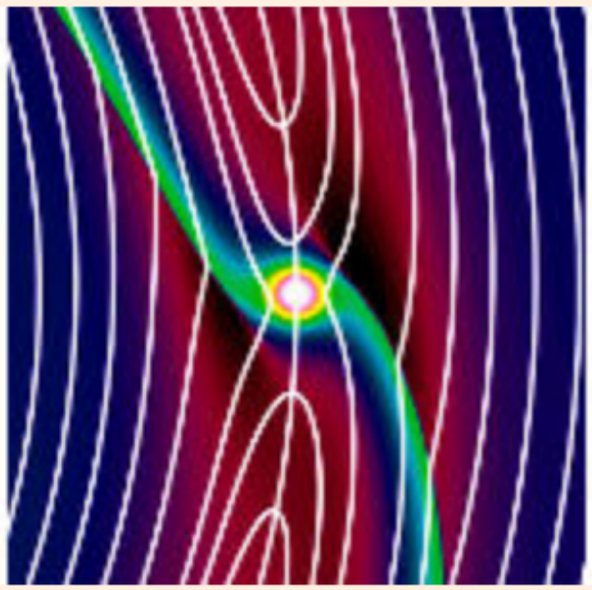


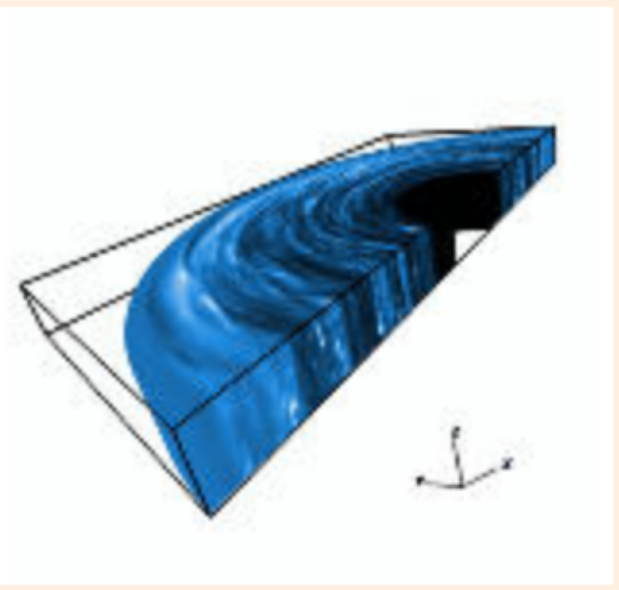
FARGO3D

Benitez-Llambay & Masset (2016) FARGO3D is a very optimized code to study protoplanetary disks. **http://fargo.in2p3.fr/**

Pablo Benitez-Llambay

A versatile HD/MHD code that runs on clusters of CPUs or GPUs, with special emphasis on protoplanetary disks.



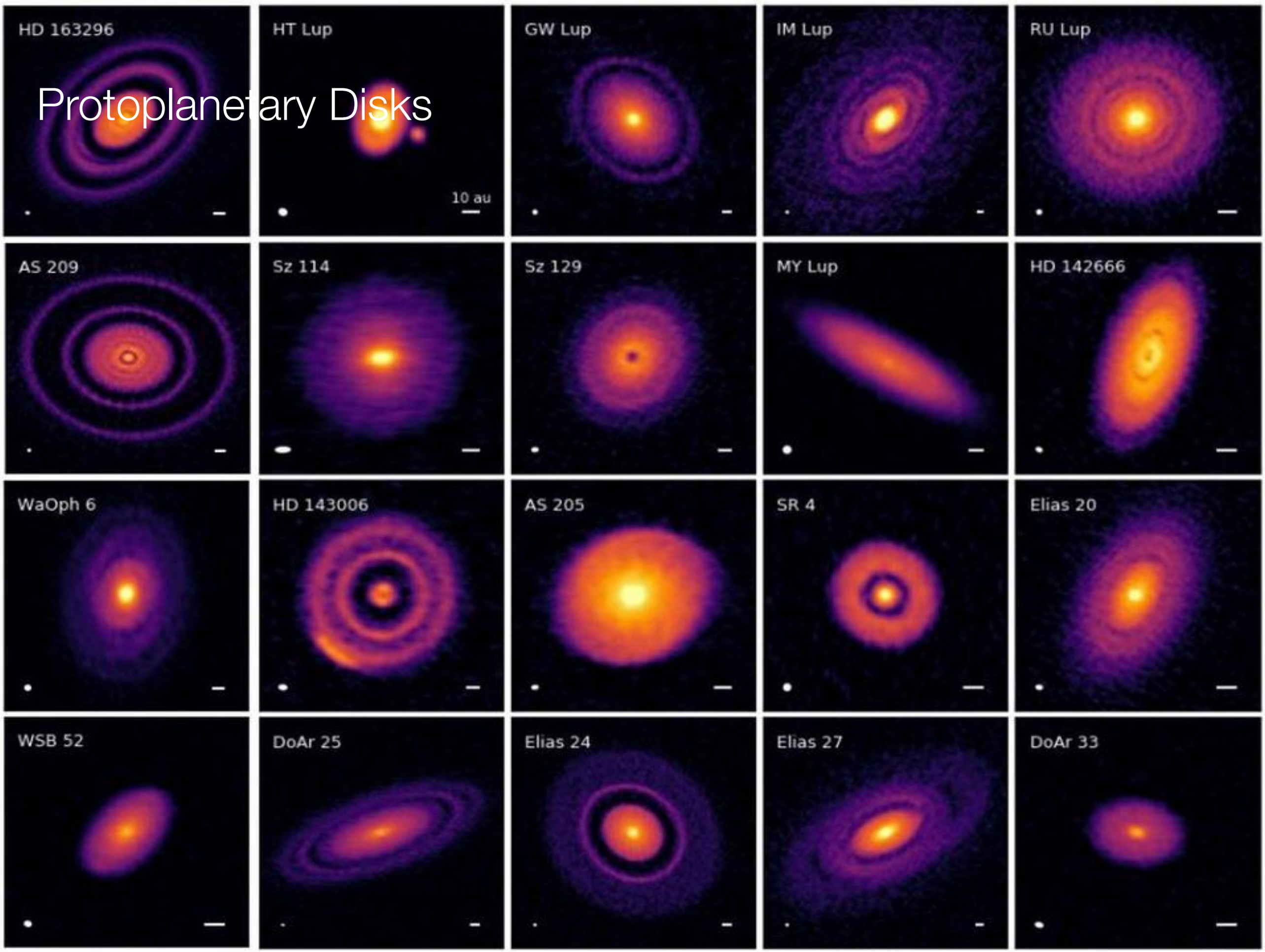


Supercomputers

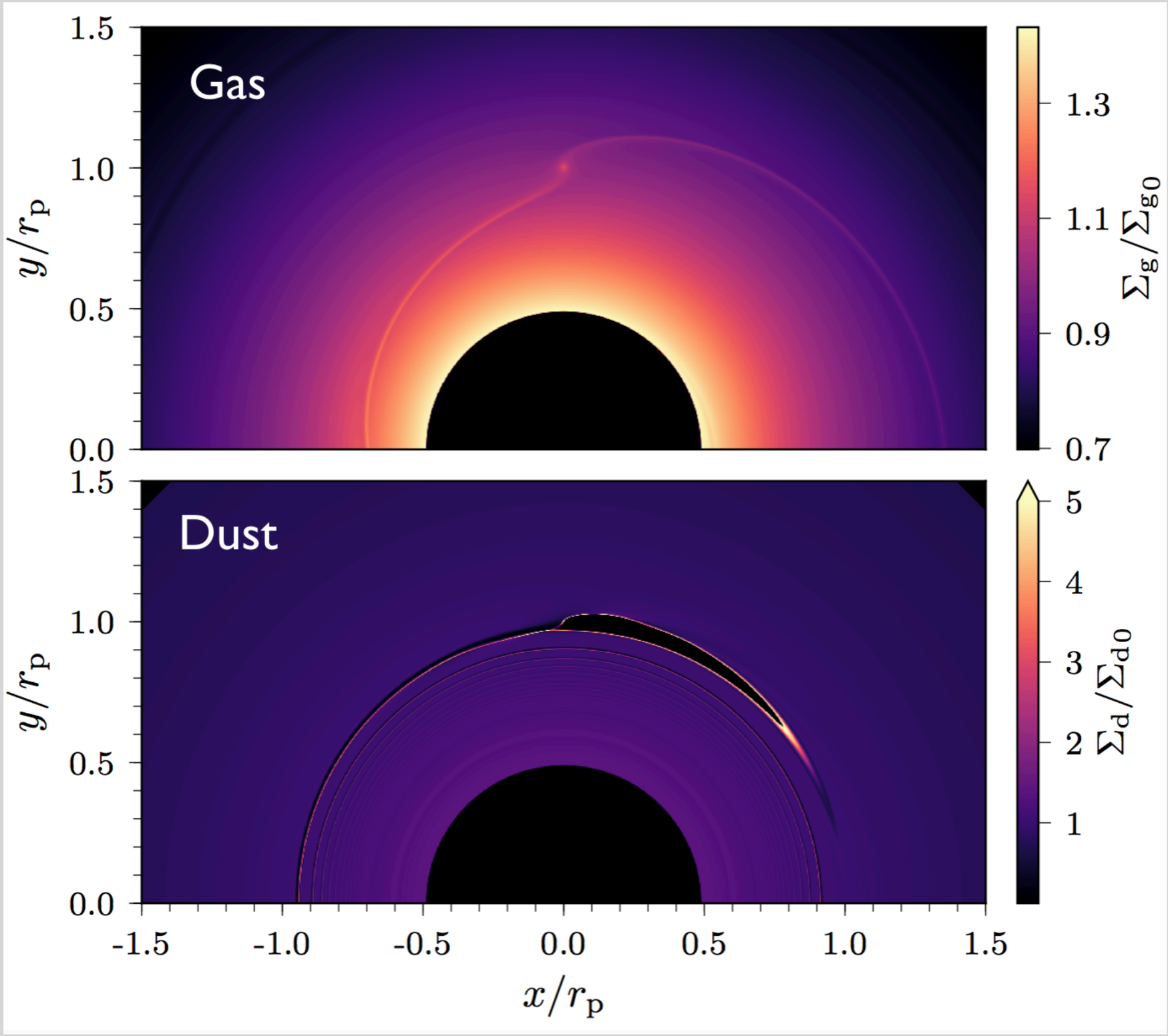
Some Examples of Recents Projects on Protoplanetary Disks

ALMA

Protoplanetary Disks



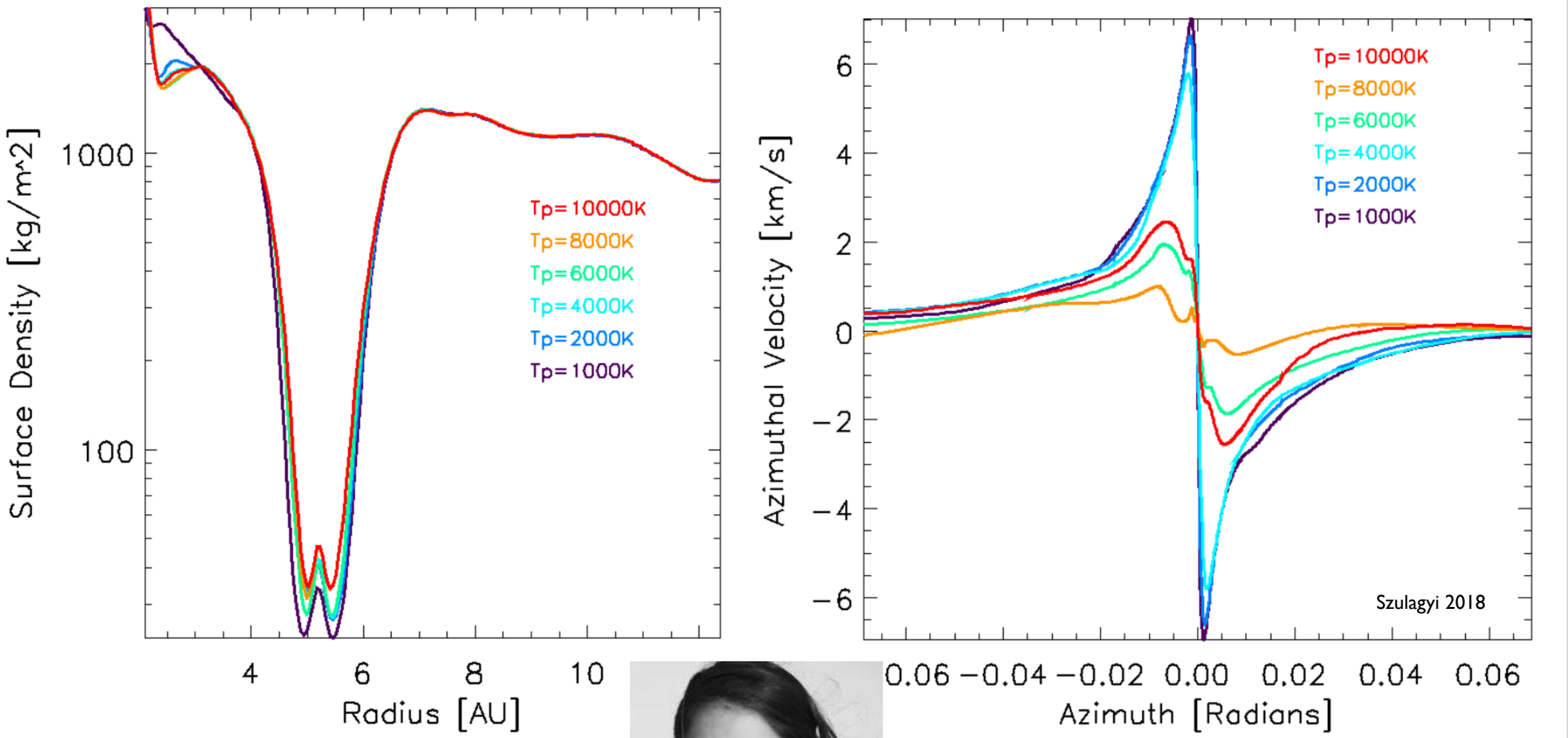
Dust & Planetary Migration



Pablo Benitez-Llambay

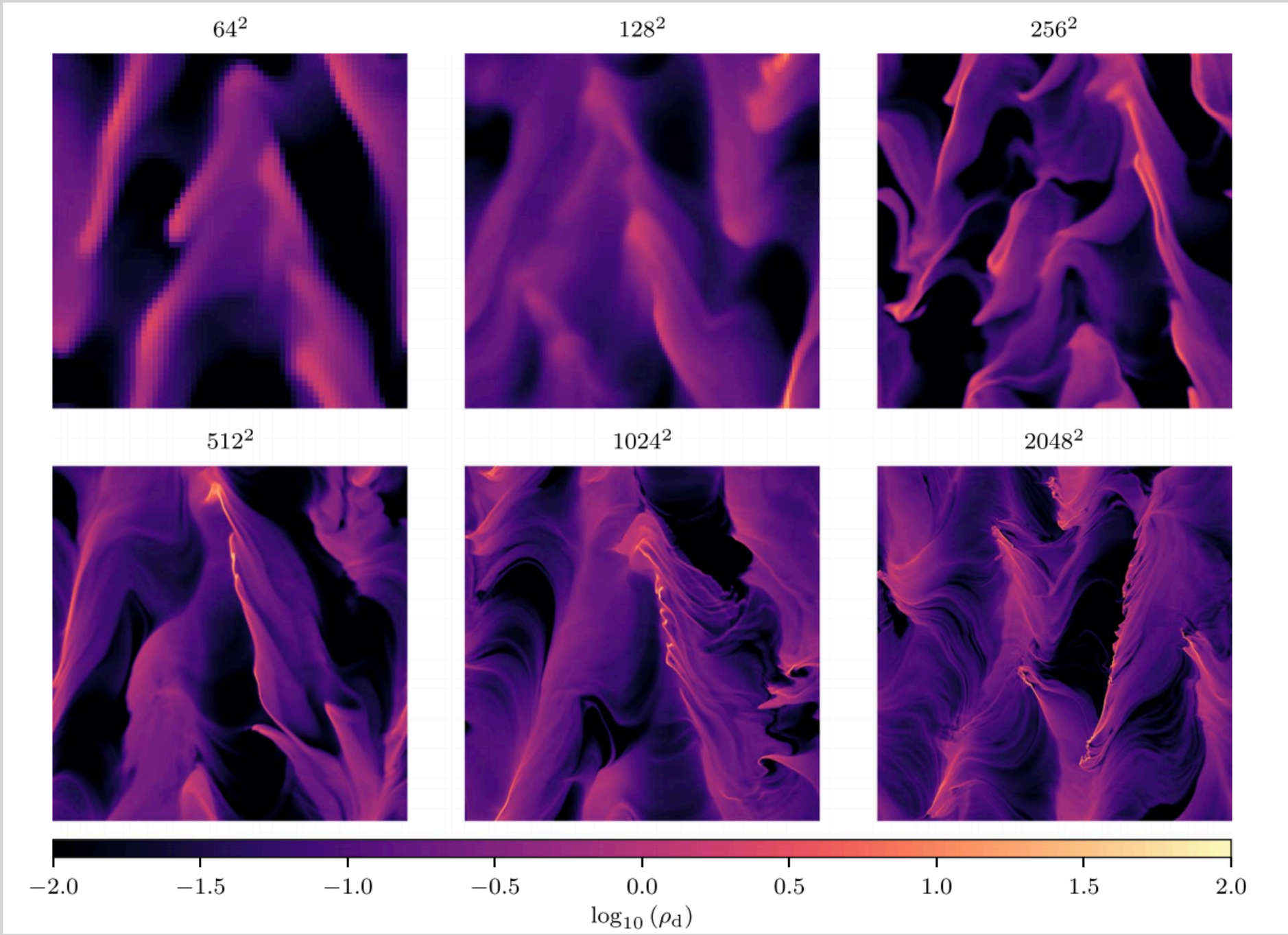
Benitez-Llambay & MEP 2018

Structure of Disks and Gaps



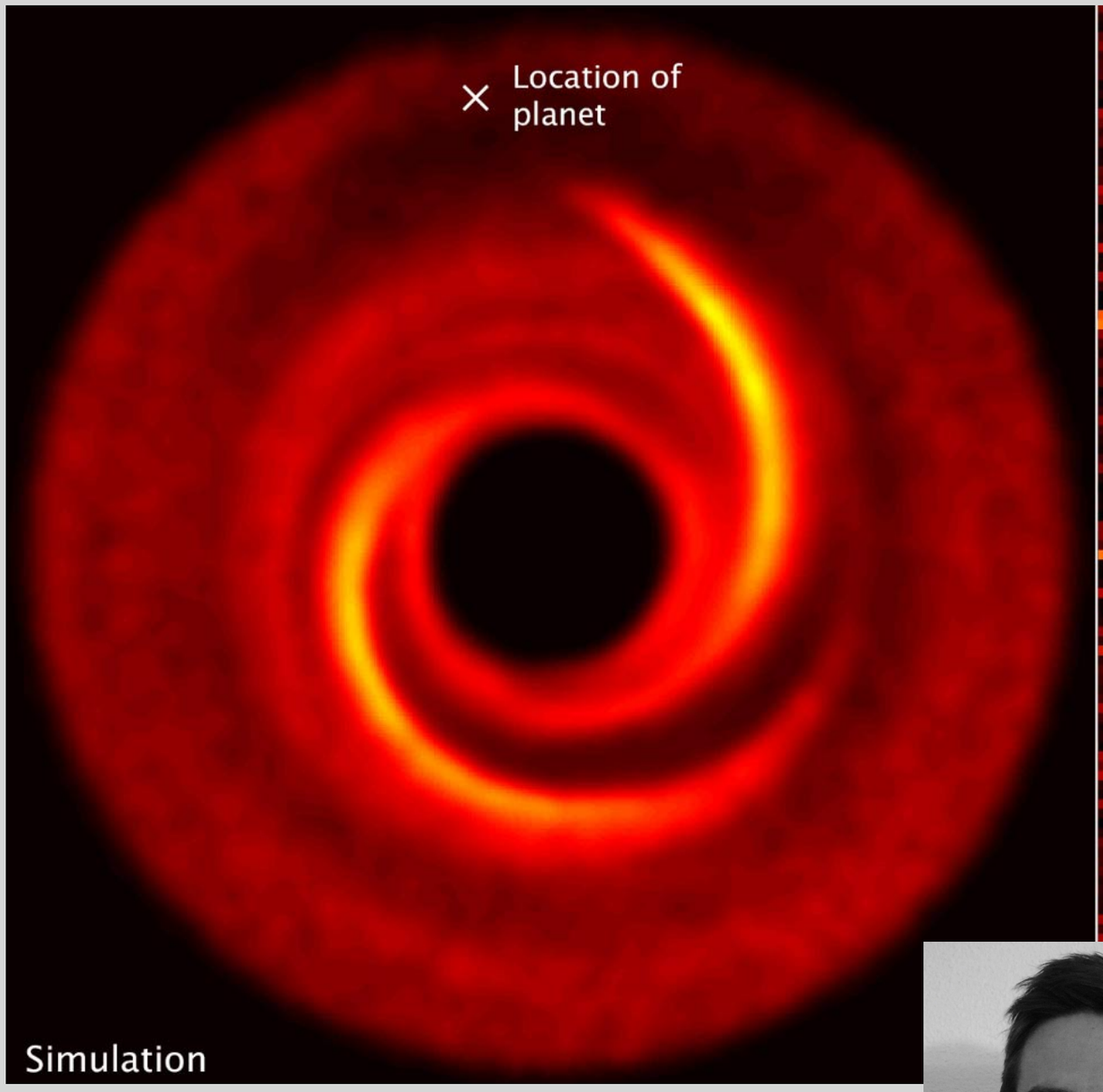
Ximena Ramos

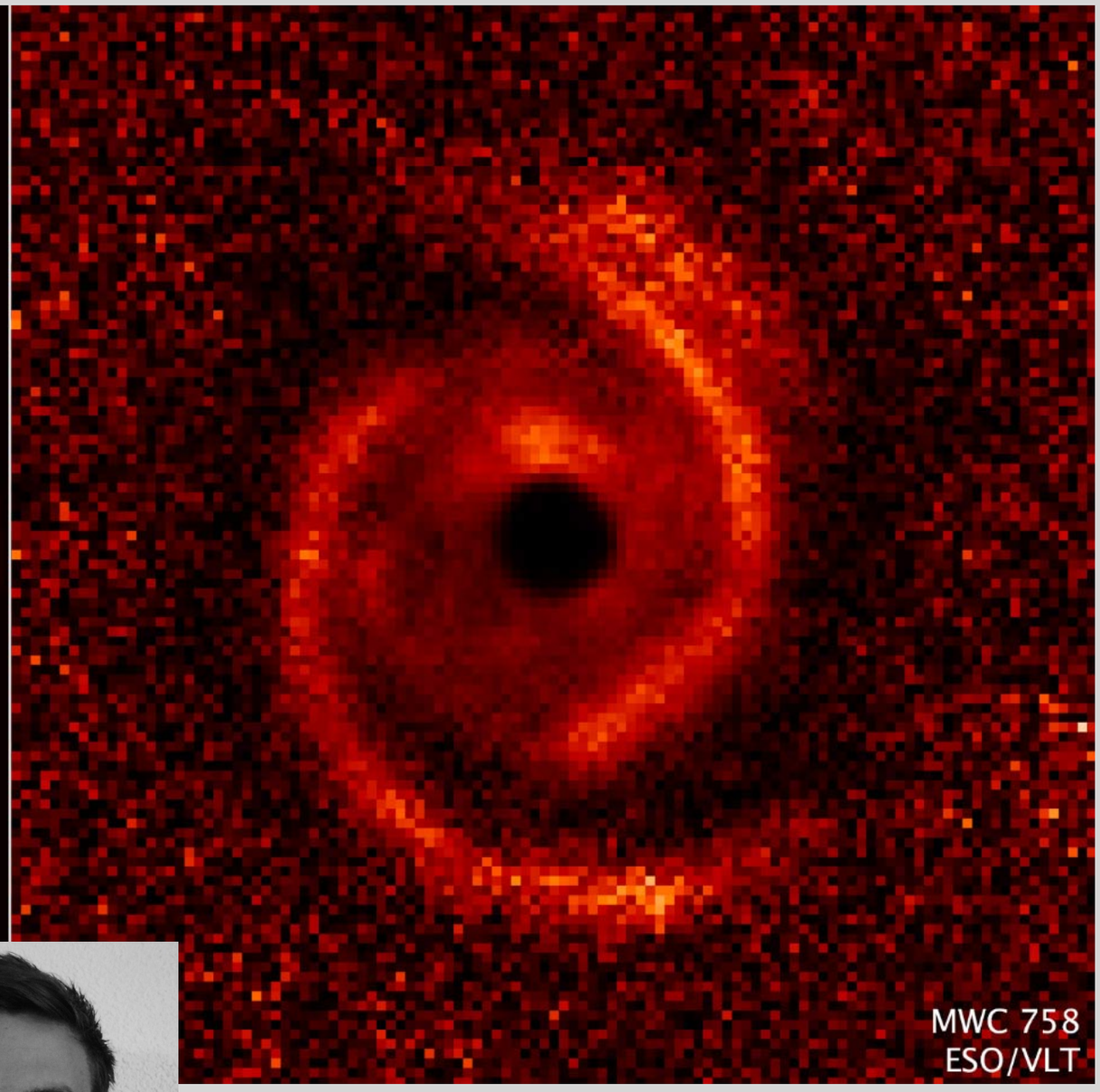
Key Processes in Planet Formation



Leonardo Krapp

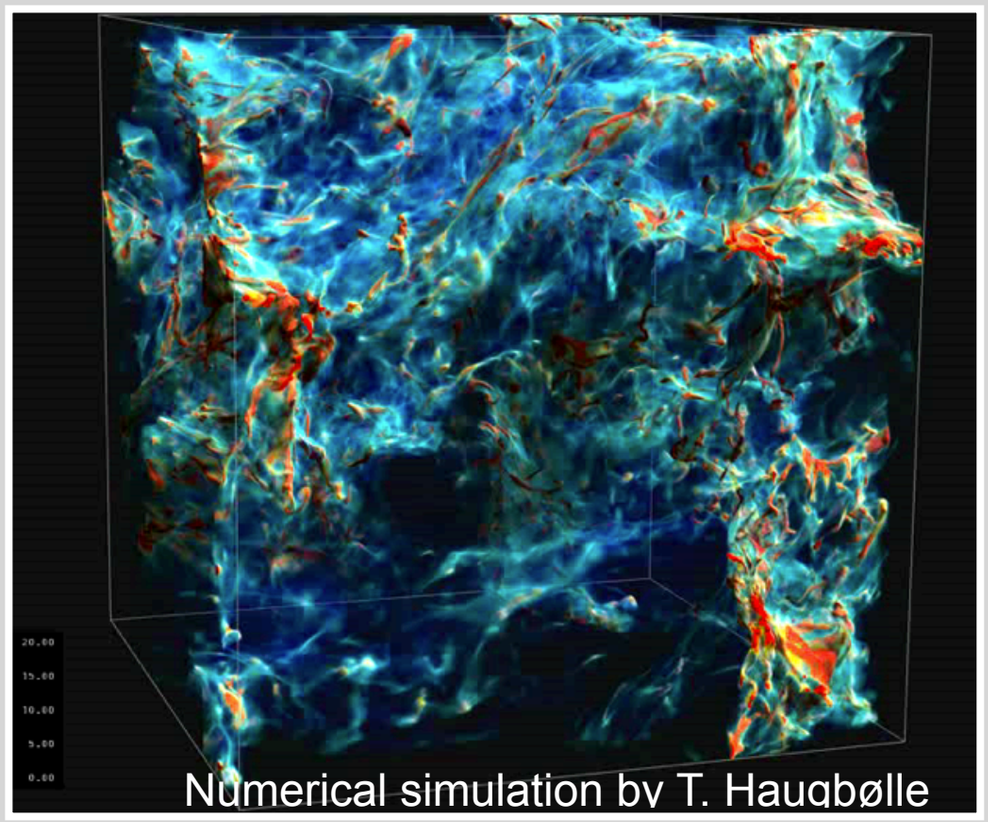
Self-Gravitating Disks

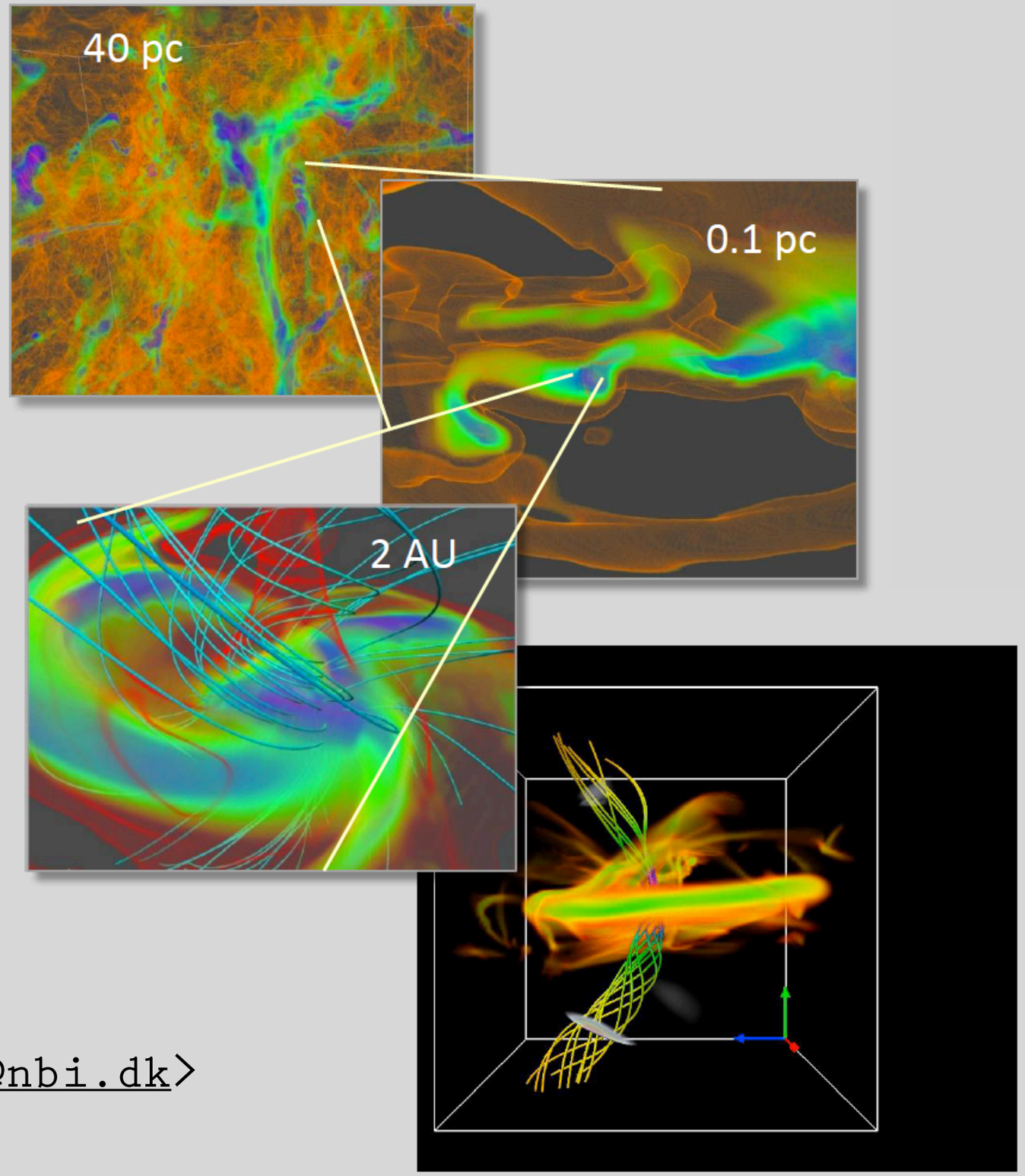




Christopher Andersen

Interstellar Medium & Star Formation





Troels Haugbølle

Troels Haugboelle <haugboel@nbi.dk>
Aake Nordlund <aake@nbi.dk>

What You Can Learn

- Fundamental Physics
  Fluid Dynamics + N-body Dynamics
  Magnetohydrodynamics
  Radiative Processes

- Numerical Skills
  From writing your own scripts to running state-of-the-art numerical codes on thousands of processors

- Learn to think
  How to use these building blocks for future projects

Choose Something...

- Interesting
  So you will be motivated and get others excited

- Useful
  So you can build on this for future projects

- Fun
  So you will enjoy working on it!

GOOD LUCK !

Relevant Webpages

- https://sites.google.com/view/nbia-astrophysics
- https://sites.google.com/view/nbiagwastro
- http://www.astrophysics.nbi.ku.dk

You are always welcome to email us or stop by!