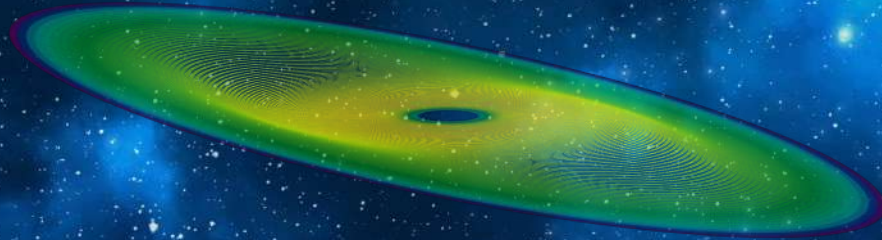


Warping through the Galaxy

Carolin („Lina“) Kimmig
PhD with Kees Dullemond, ITA Heidelberg



Formation and Evolution of Planetary Systems
a conference dedicated to the scientific legacy of Willy Kley

August 3rd, 2022

Structure



1. Motivation: asymmetrical features

2. Warped disks

- Formation
- 1D model
- Evolution

3. Current PhD project(s)

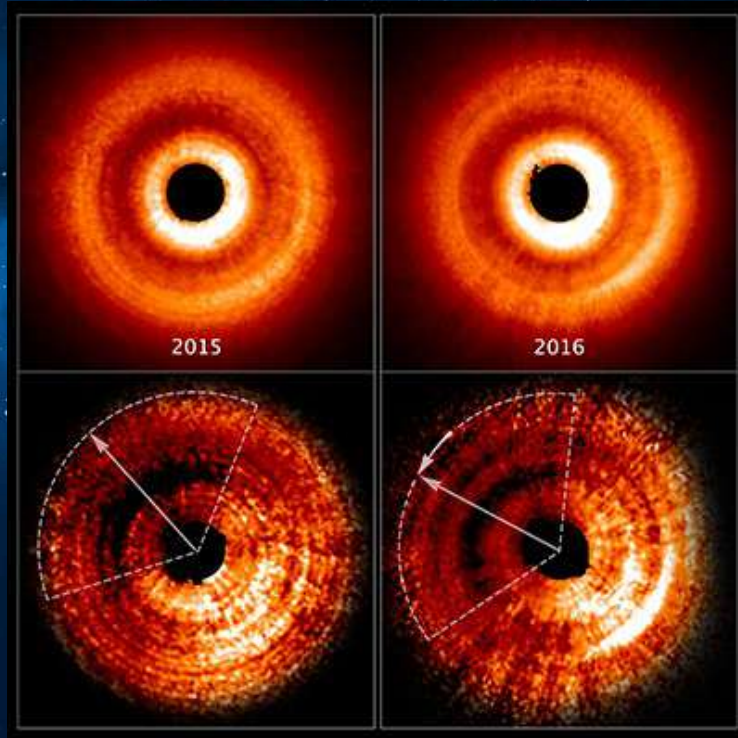
Asymmetrical features in protoplanetary disks

Structure

- 1 Motivation
- 2 Warped disks
 - Formation
 - 1D model
 - Evolution
- 3 PhD project(s)
- 4 Summary

TW Hydra

NASA, ESA, and J. Debes (STScI)

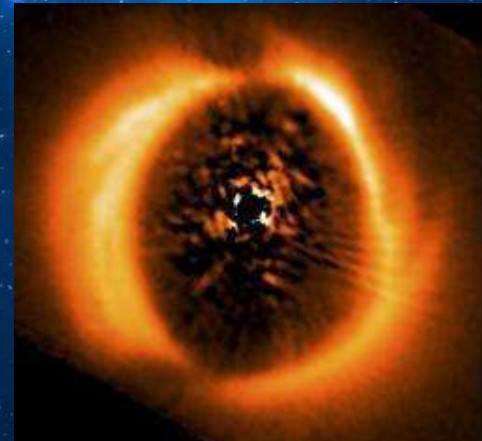


HD 142527

S. Marino et al.

HD 135344B

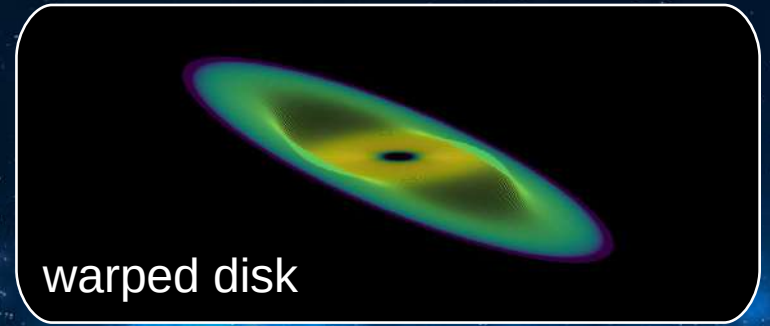
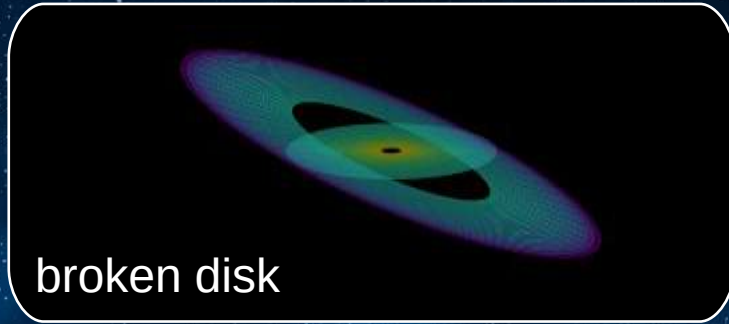
ESO, T. Stolker et al.



Misaligned disks

Structure

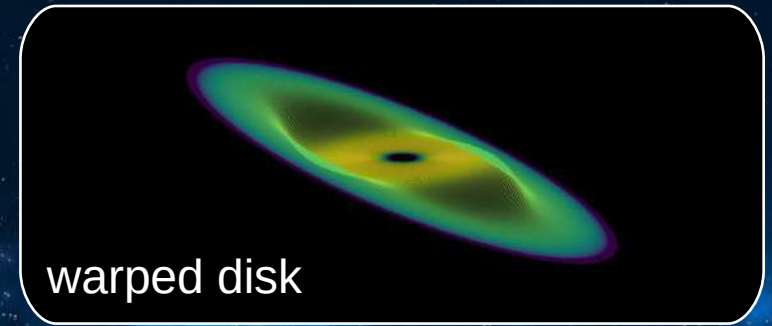
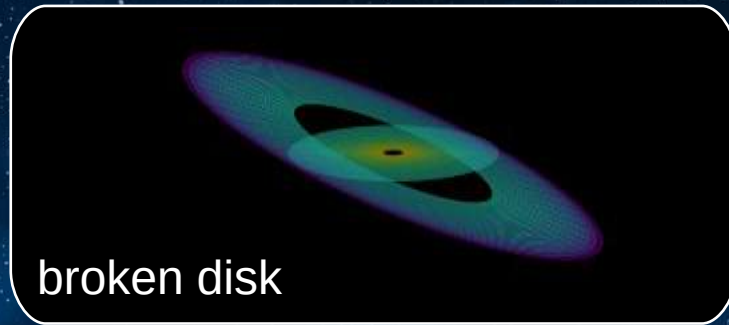
- 1 Motivation
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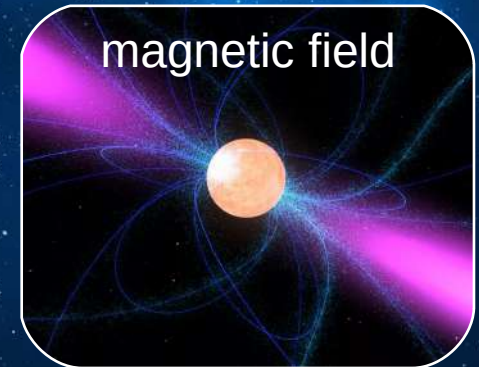
Misaligned disks – formation

Structure

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misalignment is the key!



How does a warped disk evolve?

Structure

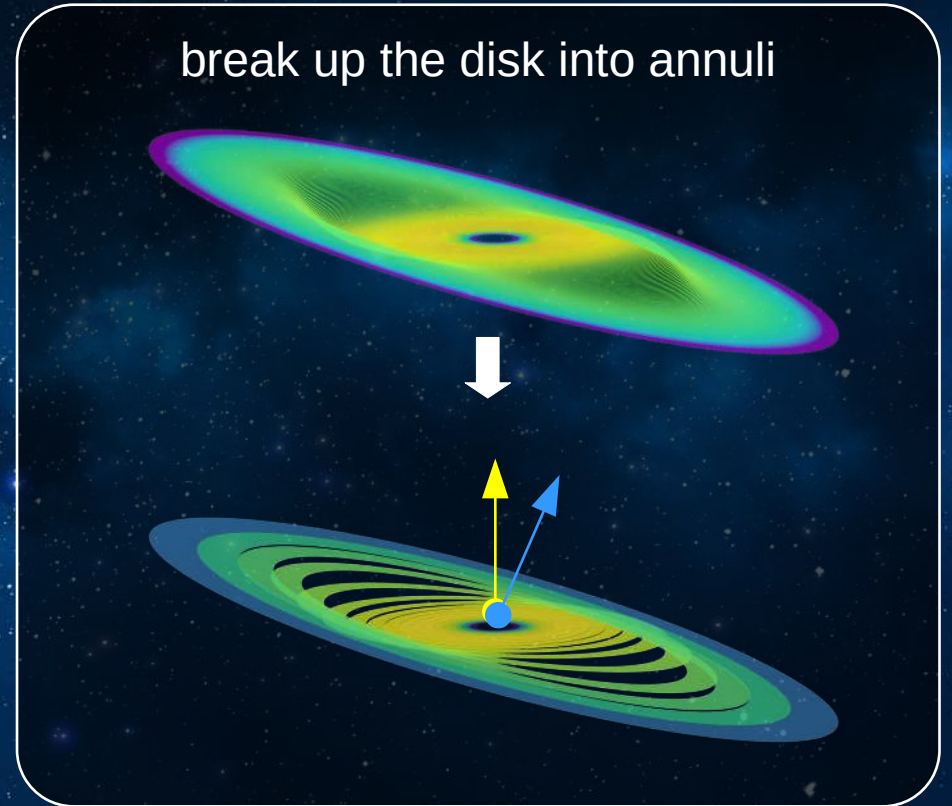
- 1 Motivation
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1 dimension for
a 3D object
???

1-dimensional model

break up the disk into annuli



How does a warped disk evolve?

Structure

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1 dimension for
a 3D object
???

1-dimensional model

dwarpy

disk warps in python



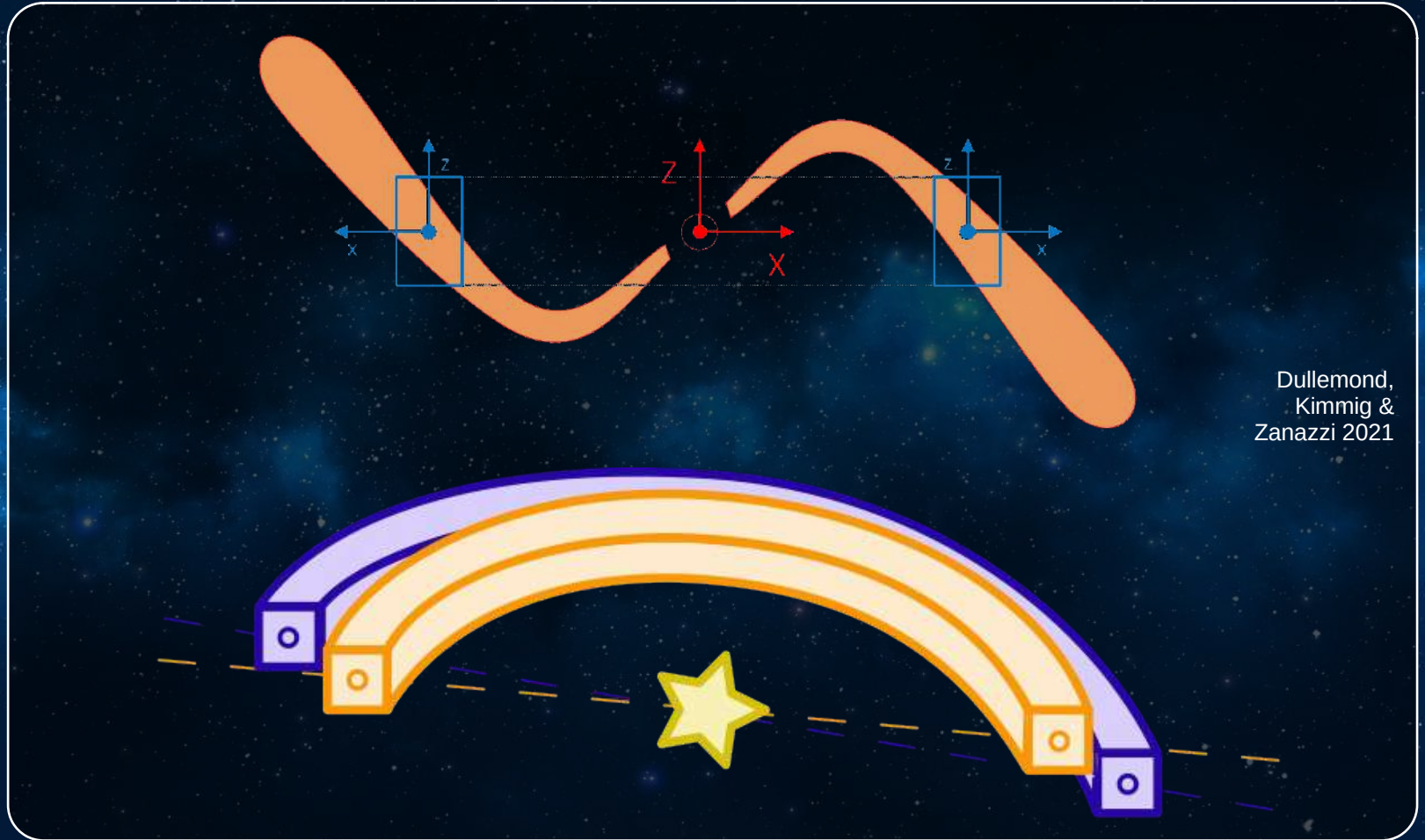
other ring codes by
J. Pringle,
R. Nealon,
D. Price,
G. Ogilvie...

Image Credit: HourglassHero

Why does a warped disk evolve?

Structure

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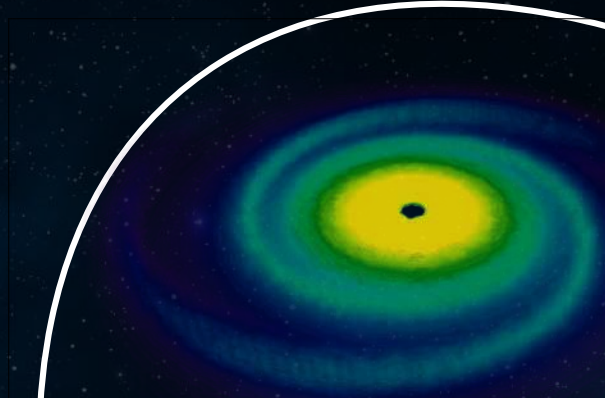


Dullemond,
Kimmig &
Zanazzi 2021

Outlook: Inclined flyby scenario – FARGO3D

Structure

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Spirals and warps caused by flyby

- How long-lived are spirals?
- How strong is the warp?
 - Rebecca Nealon et al. 2020 (SPH)
- Investigate the kinematics

collab. with Philipp Weber (University of Santiago, Chile)

Summary

Structure

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- Warped disks are important in the investigation of **non-axisymmetric** features in PPDs
- Dwarpy can be a **powerful tool** to simulate warped disks
- Using RADMC-3D, we are planning to investigate the **shadow evolution** and **kinematics** of warped disks
- We are modeling an inclined **flyby scenario** using FARGO3D





Thank you!

Questions?

contact me anytime
c.kimmig@stud.uni-heidelberg.de

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