Stellar encounters and protoplanetary disks

Lu, Li et al. 2022 Nature Astronomy

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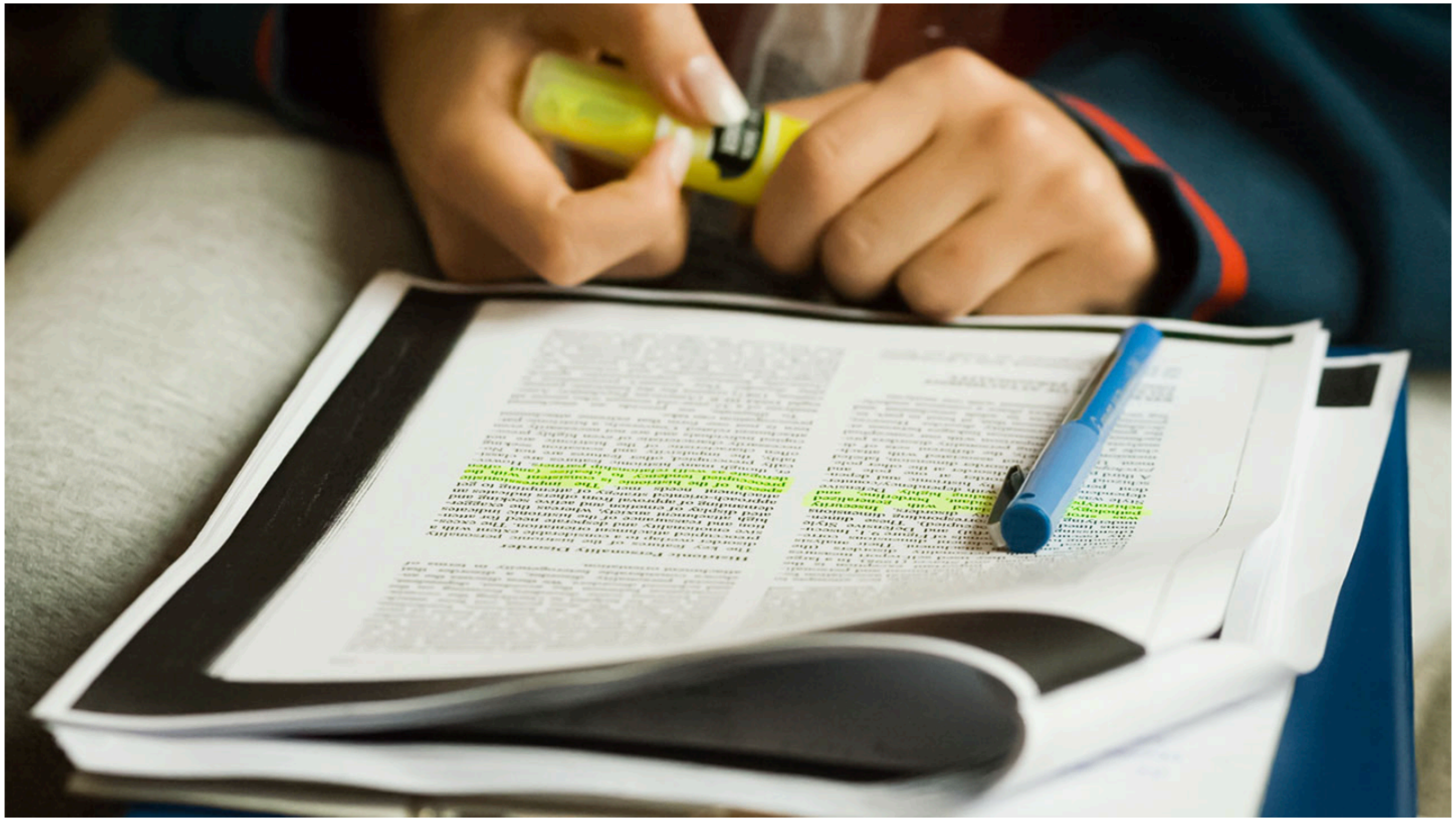
21 MAR 2016 • BY ELISABETH PAIN



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Why Most Published Research Findings Are False

1 language

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Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

It can be proven that most claimed research findings are false.

The PDF of the paper

"**Why Most Published Research Findings Are False**" is a 2005 essay written by John Ioannidis, a professor at the Stanford School of Medicine, and published in *PLOS Medicine*.[1] It is considered foundational to the field of metascience.

In the paper, Ioannidis argued that a large number, if not the majority, of published medical research papers contain results that cannot be replicated. In simple terms, the essay states that scientists use hypothesis testing to determine whether scientific discoveries are significant. "Significance" is formalized in terms of probability, and one formalized calculation ("*P value*") is reported in the scientific literature as a screening mechanism. Ioannidis posited assumptions about the way people perform and report these tests; then he constructed a statistical model which indicates that most published findings are false positive results.

Argument [edit]

Suppose that in a given scientific field there is a known baseline probability that a result is true, denoted by $\mathbb{P}(\text{True})$. When a study is conducted, the probability that a positive result is obtained is $\mathbb{P}(+)$. Given these two factors, we want to compute the conditional probability $\mathbb{P}(\text{True} \mid +)$, which is known as the positive predictive value (PPV). Bayes' theorem allows us to compute the PPV as:

$$\mathbb{P}(\text{True} \mid +) = \frac{(1-\beta)\mathbb{P}(\text{True})}{(1-\beta)\mathbb{P}(\text{True}) + \alpha\left[1-\mathbb{P}(\text{True})\right]}$$

where α is the type I error rate (false positives) and β is the type II error rate (false negatives); the statistical power is $1-\beta$. It is customary in most scientific research to desire $\alpha = 0.05$ and $\beta = 0.2$. If we assume $\mathbb{P}(\text{True}) = 0.1$ for a given scientific field, then we may compute the PPV for different values of α and β:

12557 citations

Why Most Published Research Findings Are False

1 language

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"**Why Most Published Research Findings Are False**" is a 2005 essay written by John Ioannidis, a professor at the Stanford School of Medicine, and published in *PLOS Medicine*.[1] It is considered foundational to the field of metascience.

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Argument [edit]

Suppose that in a given scientific field there is a known baseline probability that a result is true, denoted by

...ry in most
...PPV for different

...citations

Metascience

Article Talk

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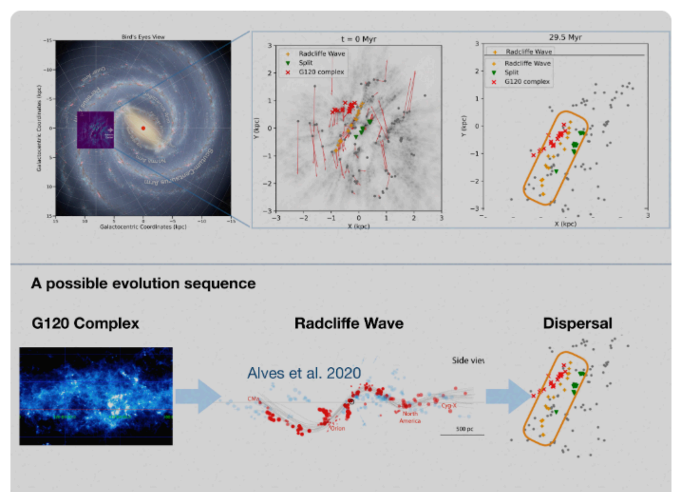
For the journal, see Metascience (journal).
Not to be confused with Science studies, or with the obsolete synonym 'Meta-science' for the Philosophy of science.

Metascience (also known as **meta-research**) is the use of scientific methodology to study science itself. Metascience seeks to increase the quality of scientific research while reducing inefficiency. It is also known

Guang-Xing Li, Associate Professor of Astrophysics, Yunnan University

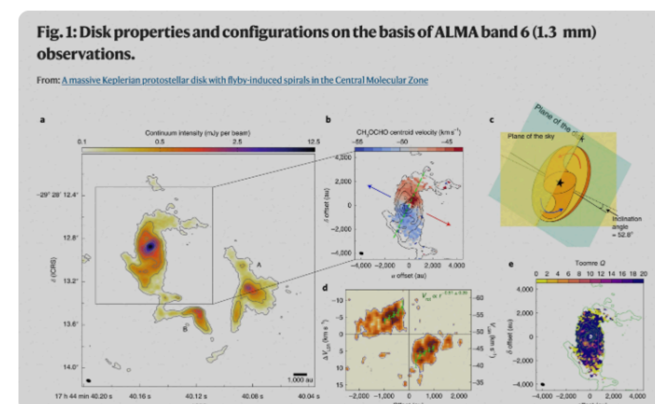
I am a theoretical astrophysicist with close ties to observations, specializing on the dynamics of the interstellar medium and star formation, and my general interests include the evolution of galaxy disks, galaxy centers, and the evolution of protostellar and protoplanetary disks. Check out my CV and publications, Research ID Profile.

Highlights



Gaia predicts the future of the Milky Way Interstellar Medium

In Weather Forecast of the Milky Way: Shear and Stellar feedback determine the lives of Galactic-scale filaments we trace the evolution of the molecular ISM using a sample of Young Stellar Objects (YSO) association --molecular cloud complex (YSO-MC complex). See Here for more details.



Flyby-induced spirals structures in massive protoplanetary disks

In A massive Keplerian protostellar disk with flyby-induced spirals in the Central Molecular Zone, Lu, Li et al. Nature Astronomy we report the discovery of a first case of of flyby-induced formaiton of spiral structures in a massive protoplanetary disk.

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FEEDBACK

Scale-free gravitational collapse as the origin of ρ ~ r^{-2} density profile - a possible role of turbulence in regulating gravitational collapse

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Li, Guang-Xing

Astrophysical systems, such as clumps that form star clusters share a density profile that is close to $\rho \sim r^{-2}$. We prove analytically this density profile is the result of the scale-free nature of the gravitational collapse. Therefore, it should emerge in many different situations as long as gravity is dominating the evolution for a period that is comparable or longer than the free-fall time, and this does not necessarily imply an isothermal model, as many have previously believed. To describe the collapse process, we construct a model called the turbulence-regulated gravitational collapse model, where turbulence is sustained by accretion and dissipates in roughly a crossing time. We demonstrate that a $\rho \sim r^{-2}$ profile emerges due to the scale-free nature the system. In this particular case, the rate of gravitational collapse is regulated by the rate at which turbulence dissipates the kinetic energy such that the infall speed can be 20-50 per cent of the free-fall speed (which also depends on the interpretation of the crossing time based on simulations of driven turbulence). These predictions are consistent with existing observations, which suggests that these clumps are in the stage of turbulence-regulated gravitational collapse. Our analysis provides a unified description of gravitational collapse in different environments.

Publication:	Monthly Notices of the Royal Astronomical Society, Volume 477, Issue 4, p.4951-4956
Pub Date:	July 2018
DOI:	10.1093/mnras/sty657 10.48550/arXiv.1803.03273
arXiv:	arXiv:1803.03273
Bibcode:	2018MNRAS.477.4951L

Volume 6 Issue 7, July 2022

A flyby-impacted massive protostellar disk

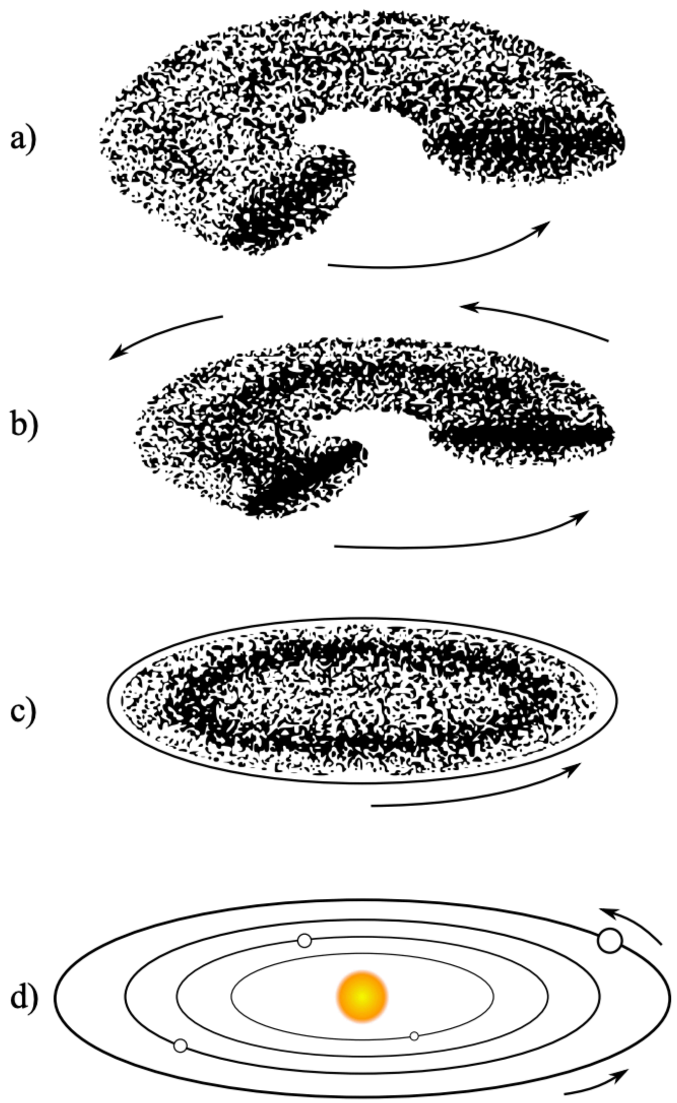
ALMA observations of a massive protostar near the Galactic Centre reveal a large disk with two embedded spirals. A combined analytical and numerical analysis suggests that the spirals were formed by a close flyby. The study concludes that massive stars can form in a similar way as low-mass stars: through disk-mediated accretion subject to flybys.

See Lu et al.

Image: Image courtesy of Xing Lu. Cover Design: Bethany Vukomanovic

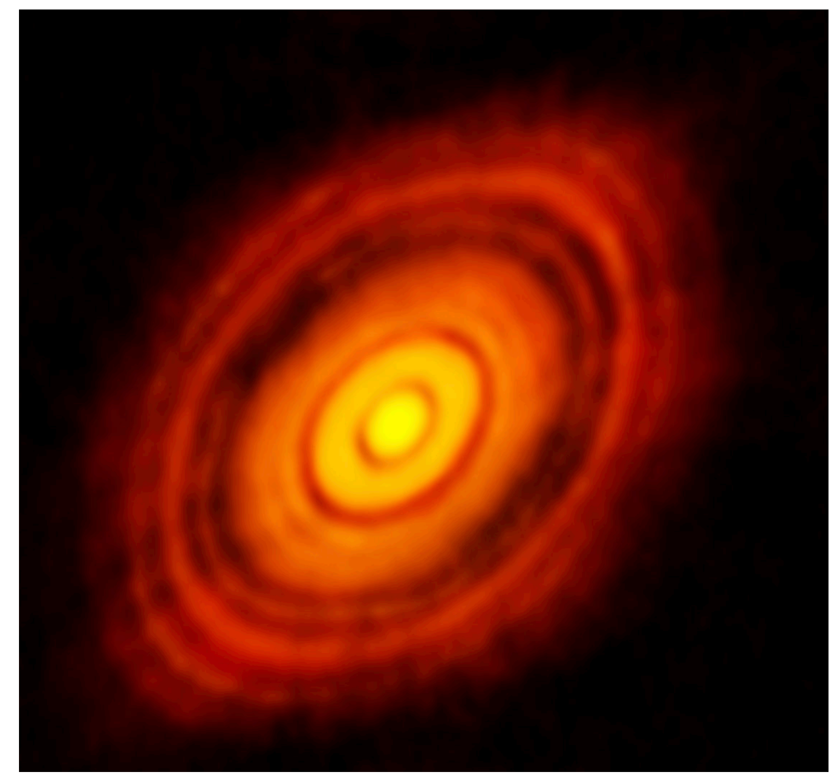
Nebula Hypothesis

Isolated

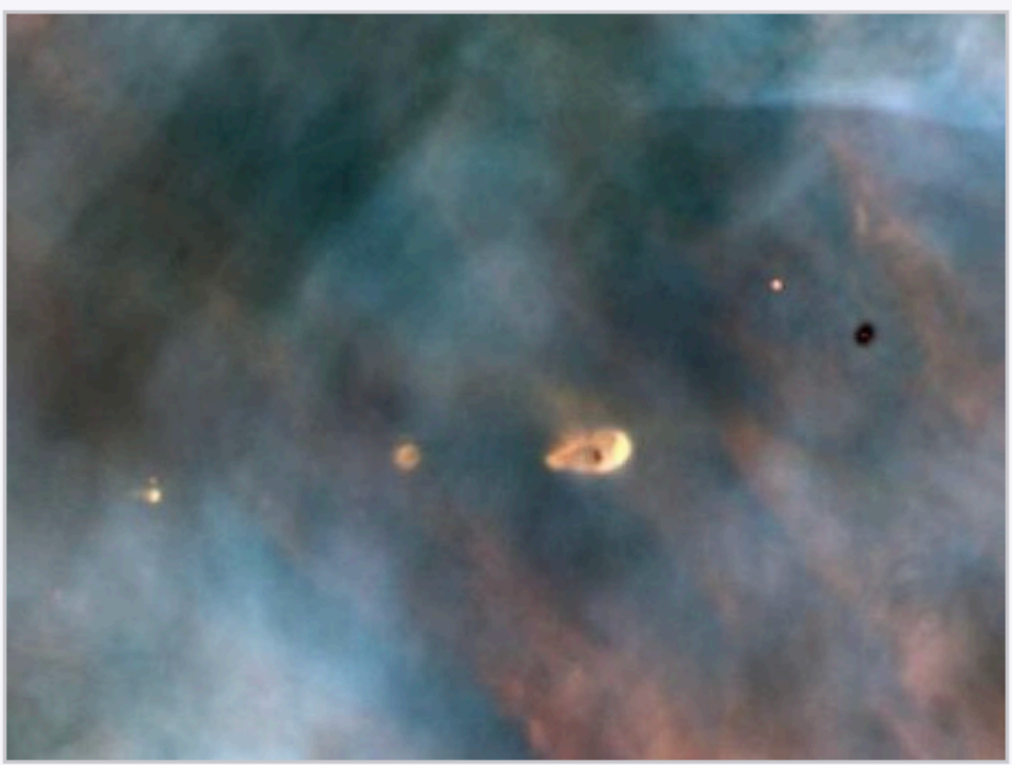


Proposal by P.S. Laplace

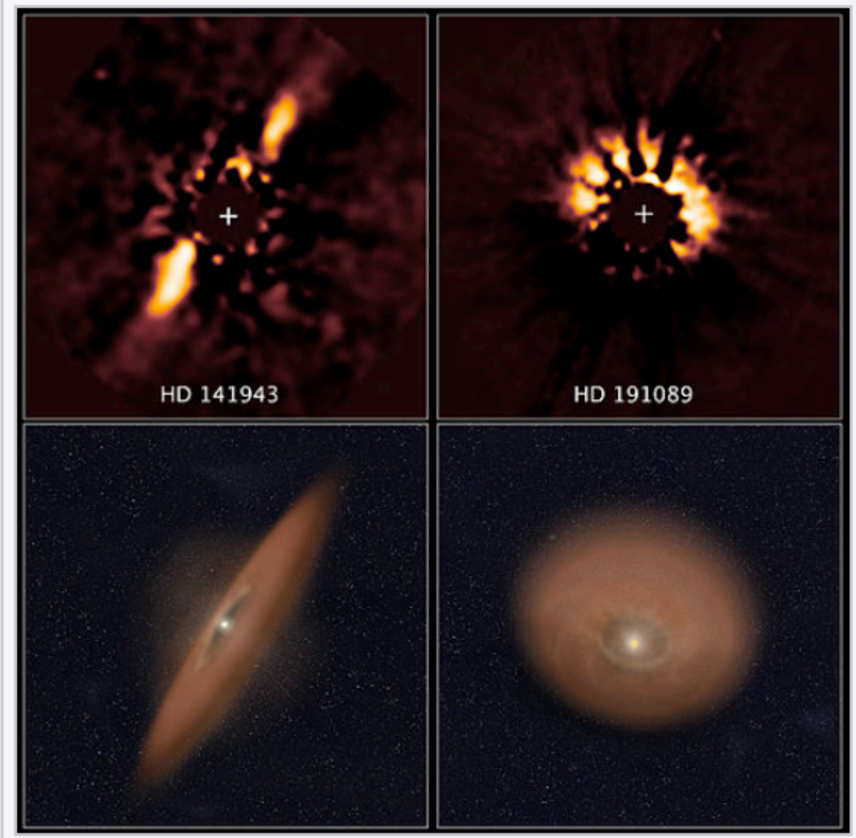
ALMA image of HL Tau disk



Protoplanetary disks

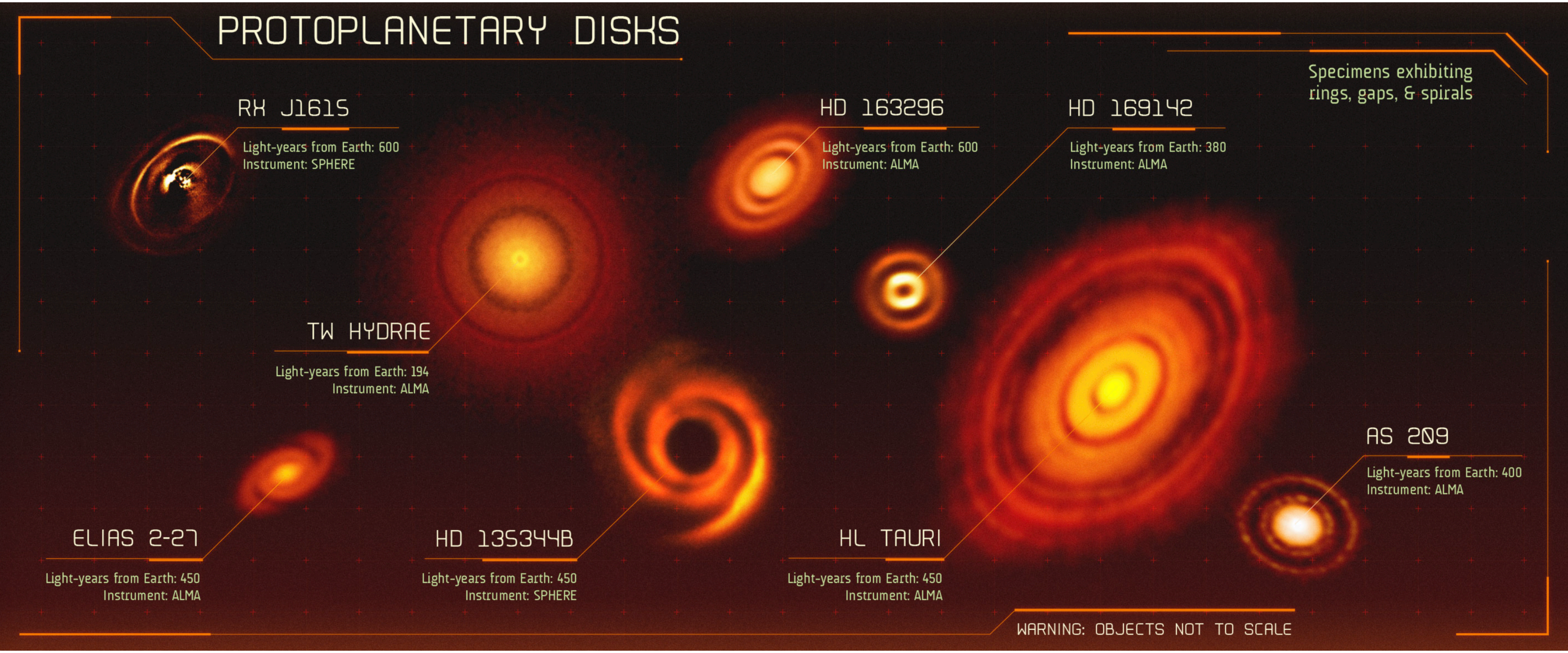


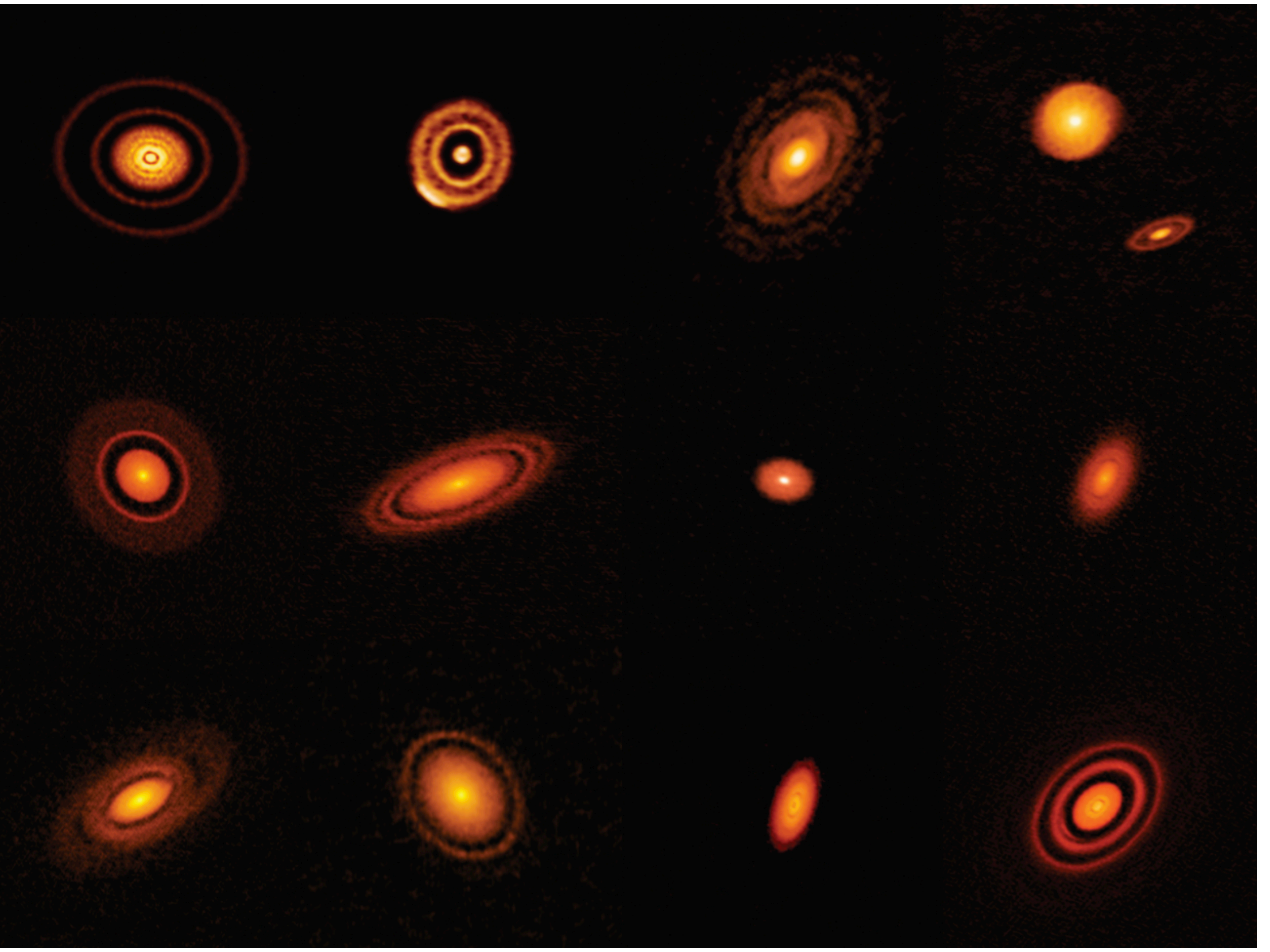
A protoplanetary disk forming in the Orion Nebula



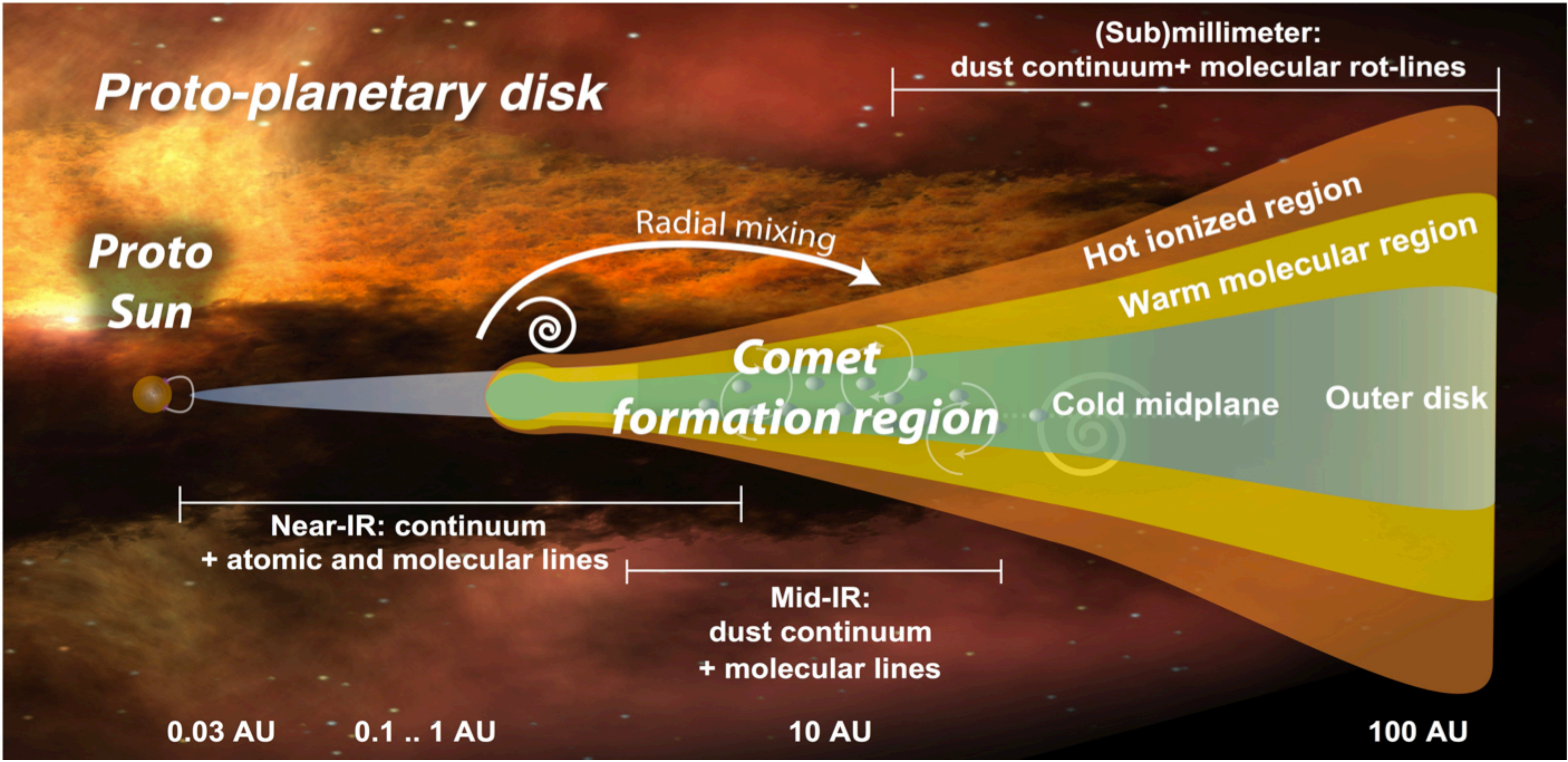
Debris disks detected in HST archival images of young stars, HD 141943 and HD 191089, using improved imaging processes (24 April 2014).[48]

Protoplanetary disks





disks are complex

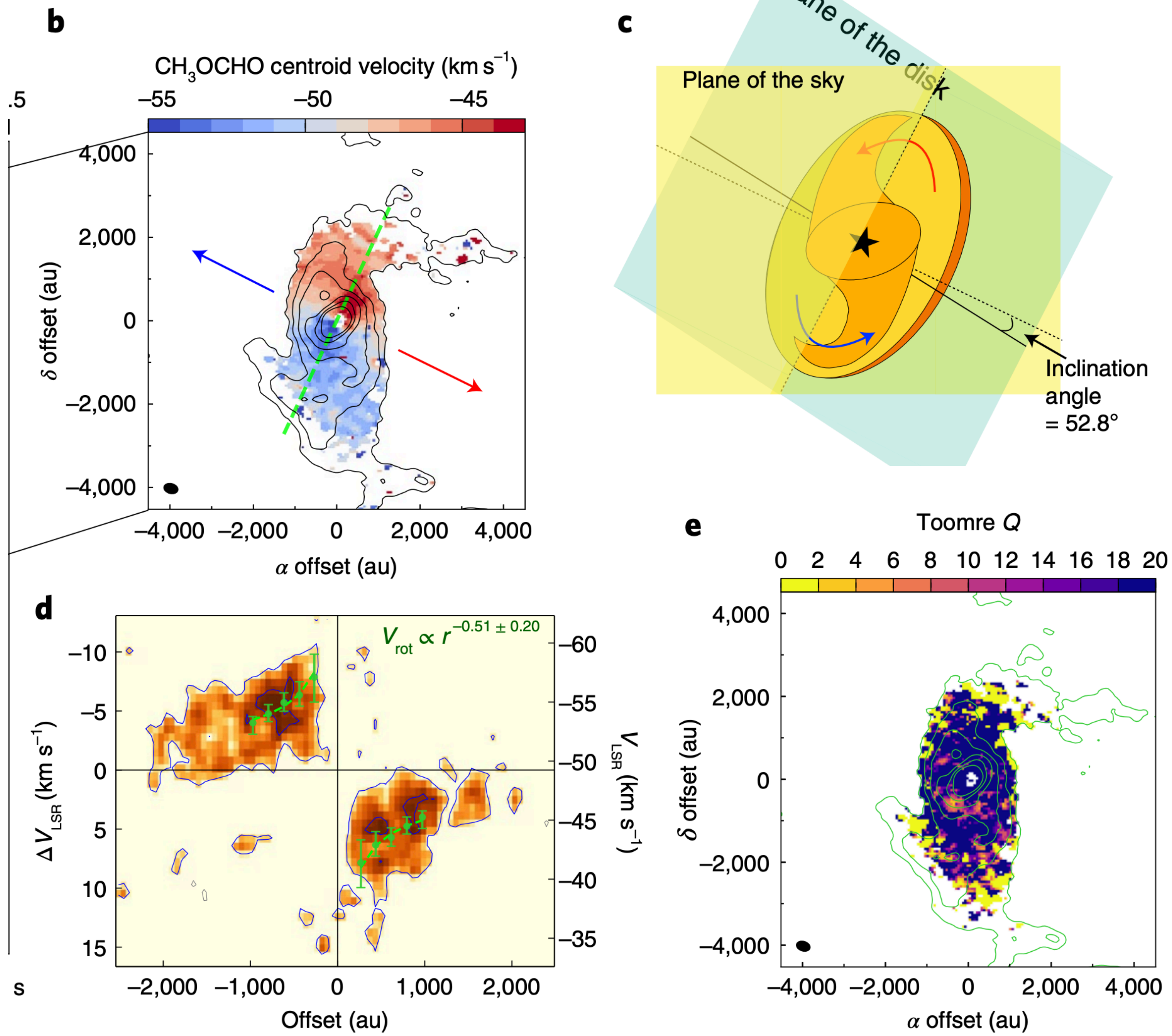


protoplanetary disk with
spiral arms

Star formation in the CMZ

Velocity map

Velocity



Surface density

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Galaxy have spiral arms

Galaxy have spiral arms

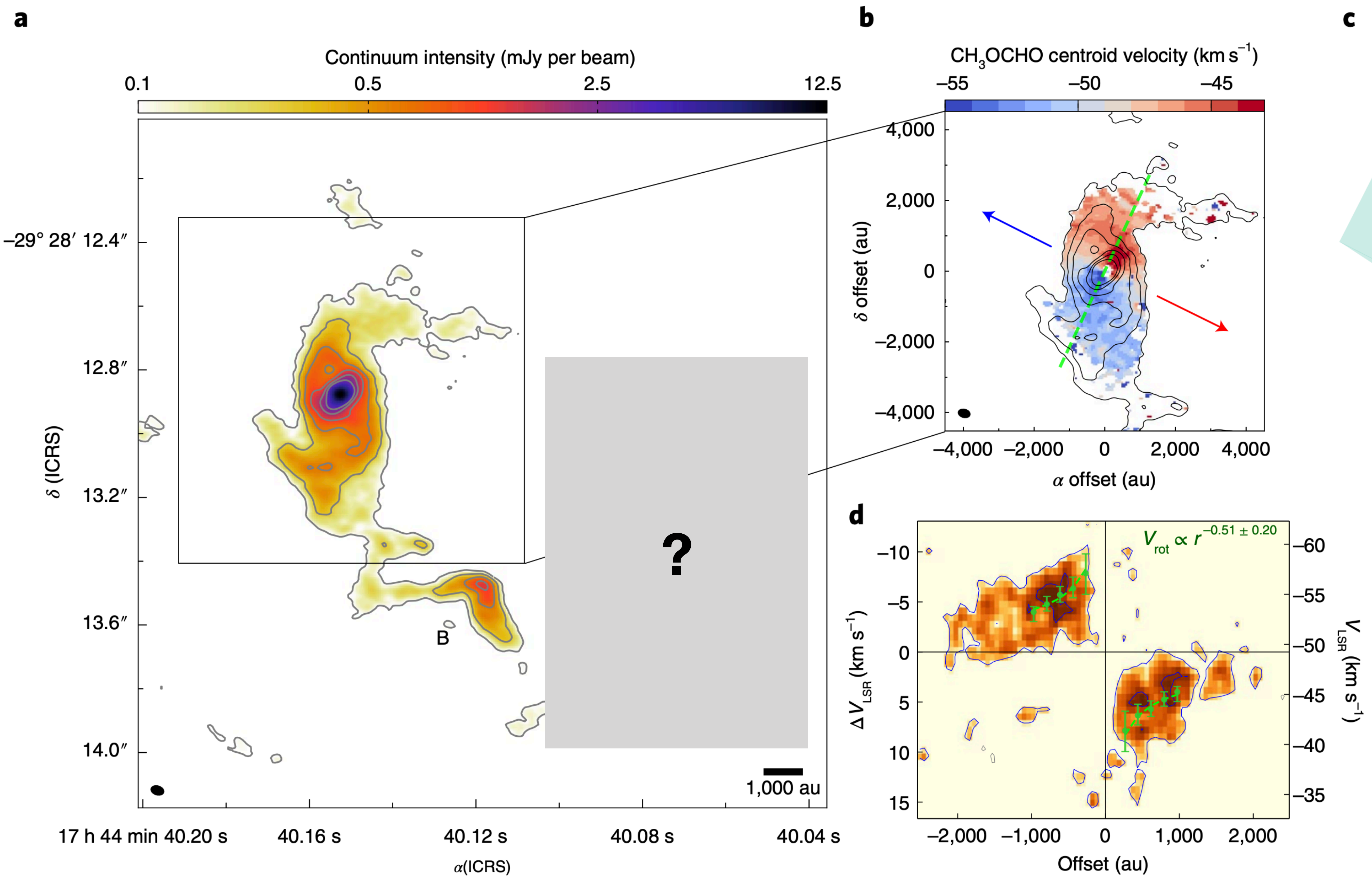
Figure

Caption

Figure 1.5: Numerical simulation by Toomre & Toomre (1972), showing the formation of a tidal arm as a result between a galaxy-galaxy interaction.

This figure was uploaded by Rafael Ruggiero

Zoom out: The disk is not isolated



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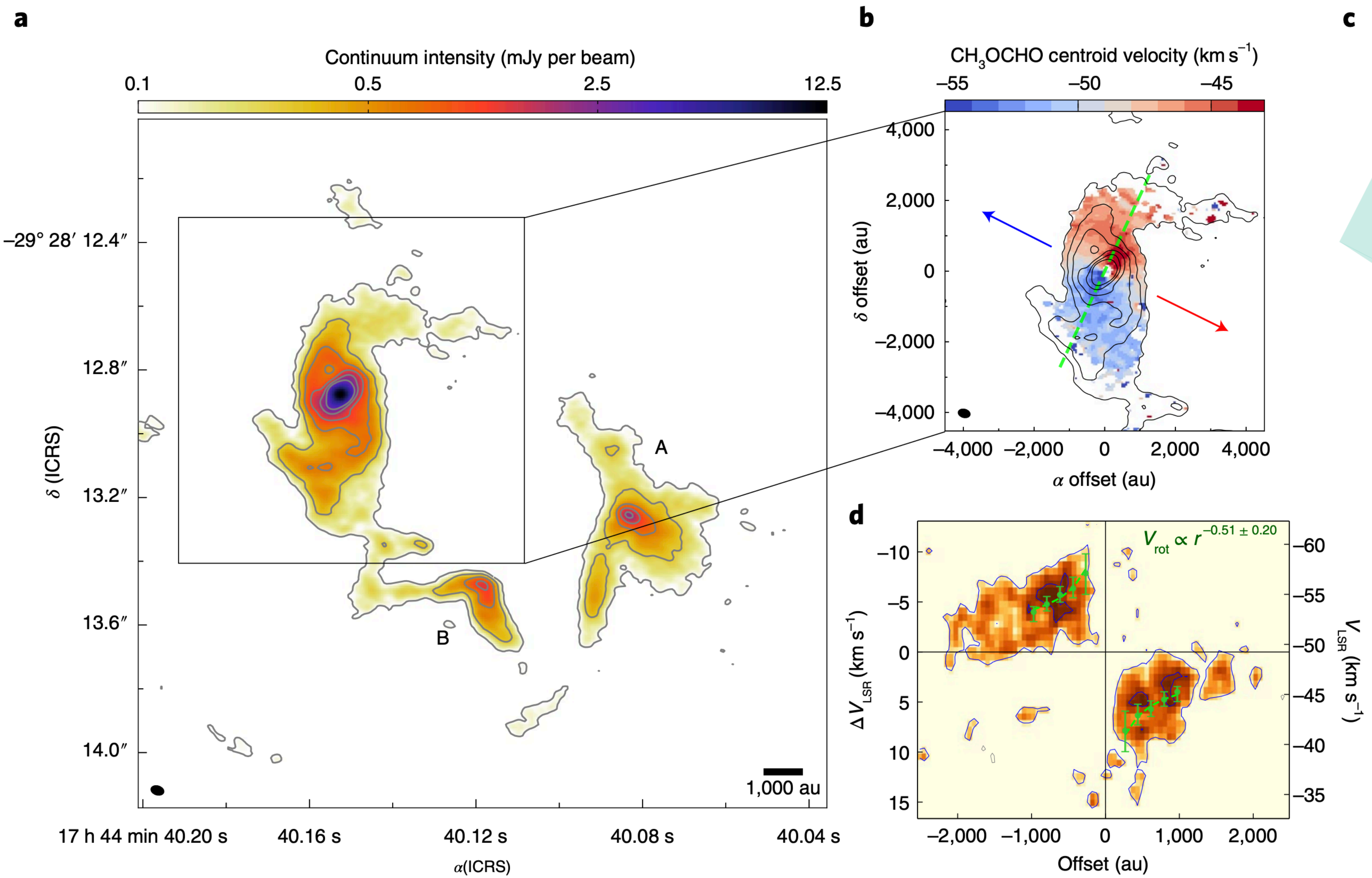
Zoom out: The disk is not isolated



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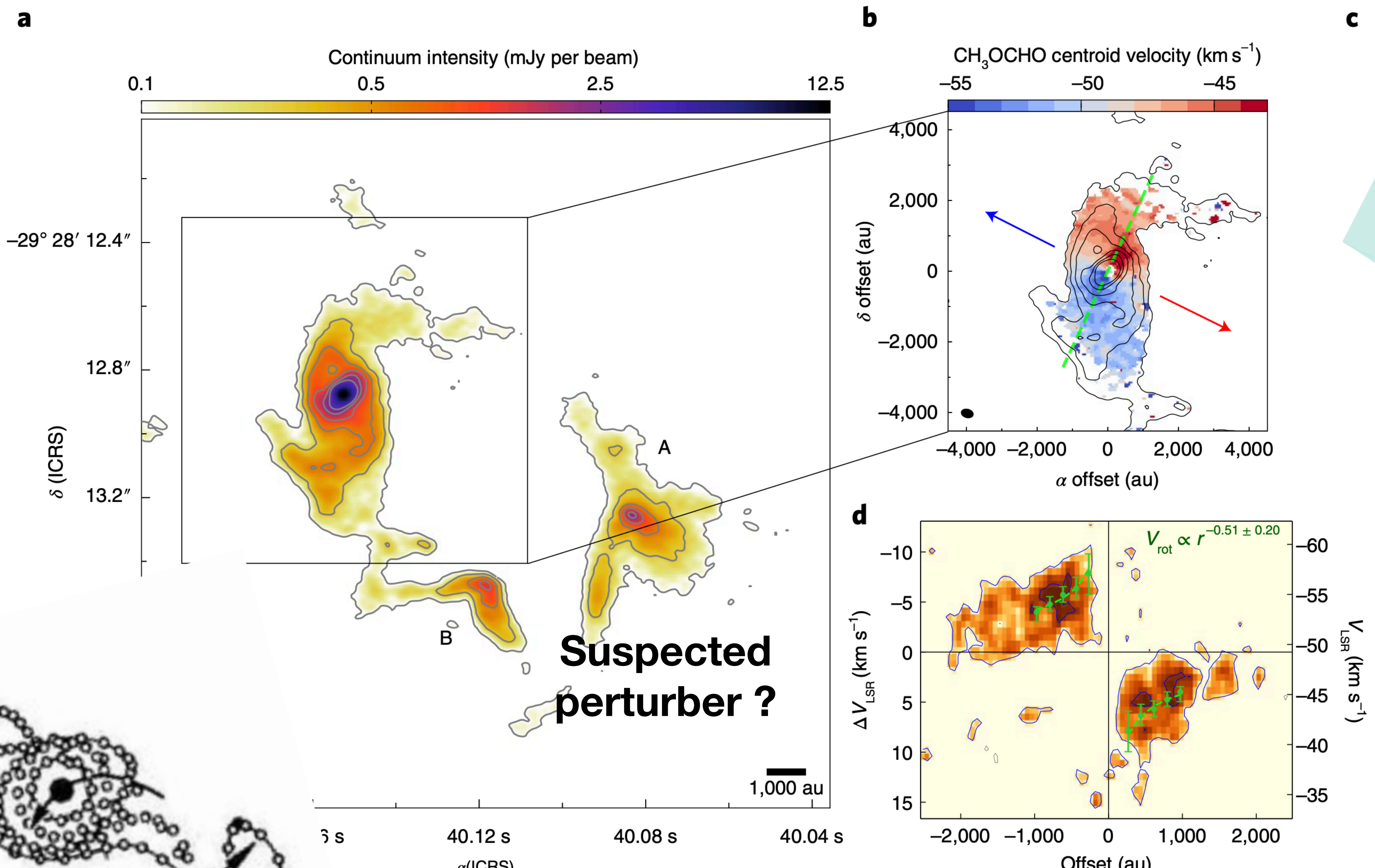
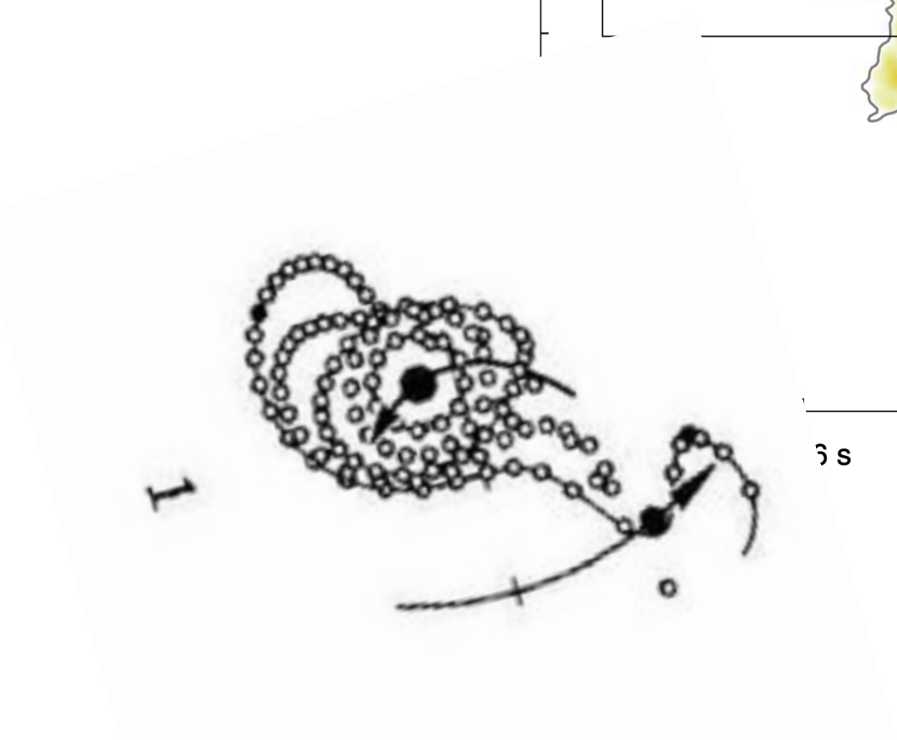
Zoom out: The disk is not isolated





Suspected perturber ?

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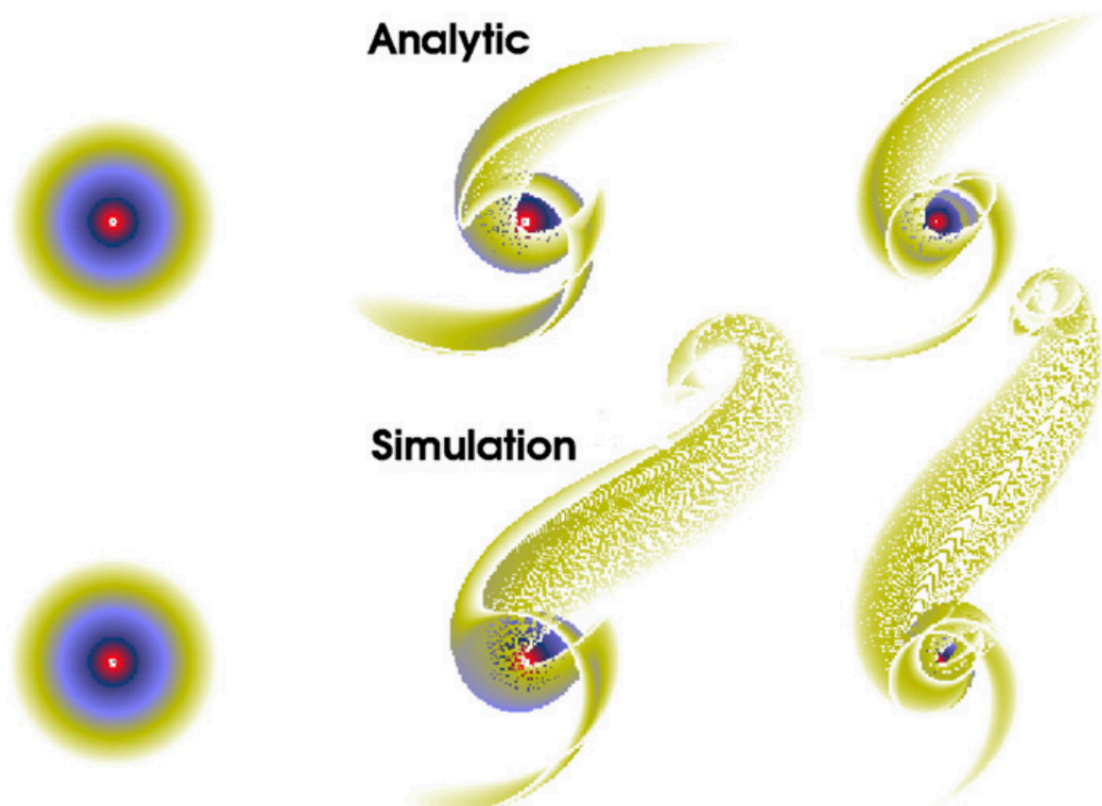
Flyby-induced spirals

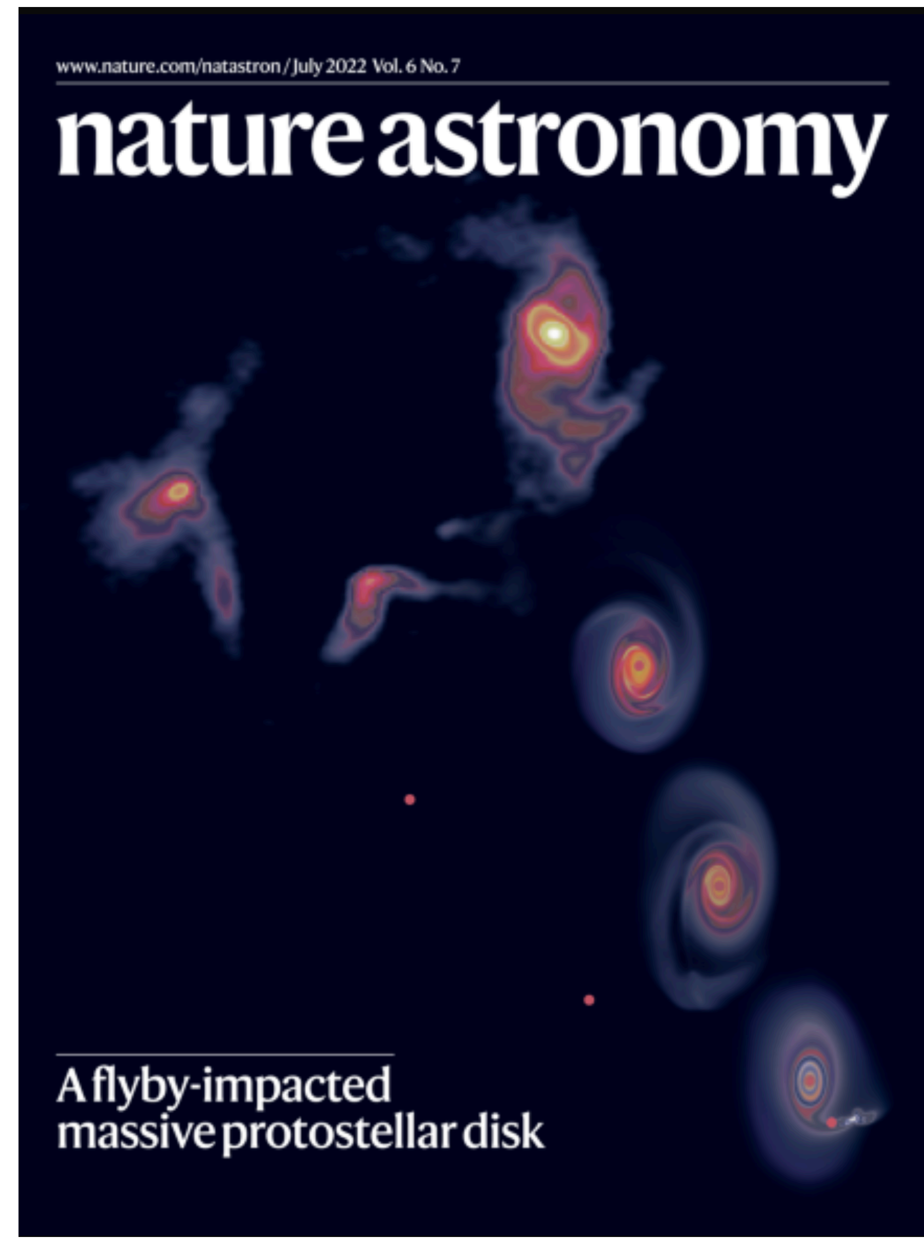
Scanning the parameter space (D'Onghia, E. et 2010)



$$\Delta v_x = 2GM_{pert}\frac{r\cos\phi_0}{b^2V_{sl}}\left[\alpha K_1(\alpha) + \alpha^2\Big(K_0(\alpha) \pm K_1(\alpha)\Big)\right]$$

Find the parameters and simulations

Simulation using Phantom code



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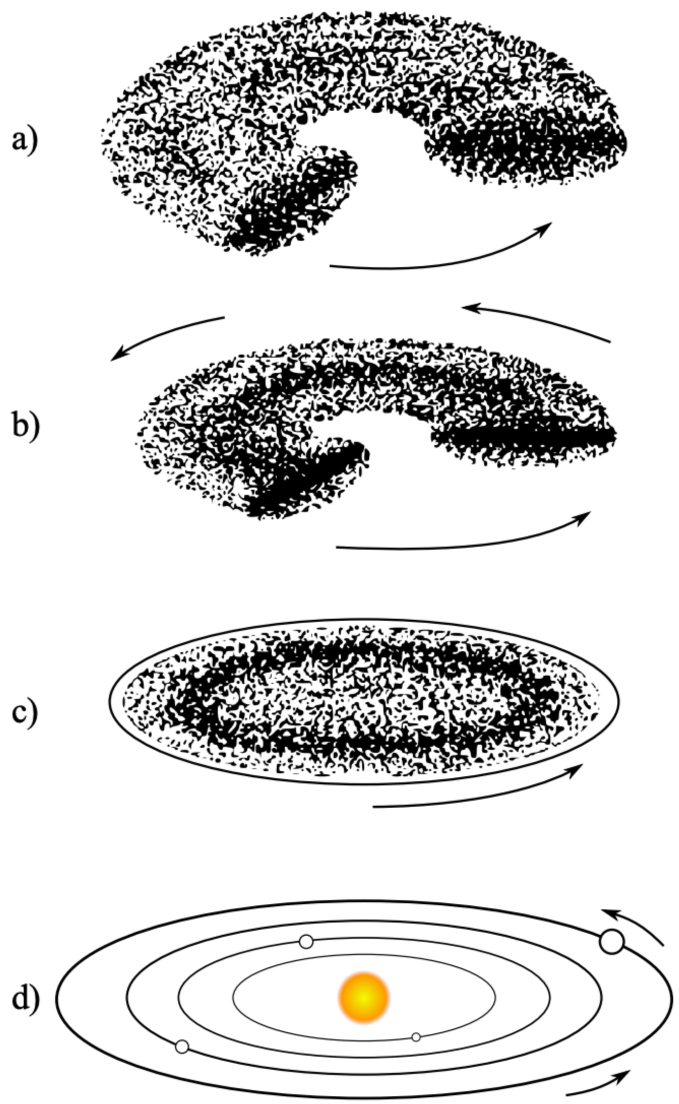
Isolated

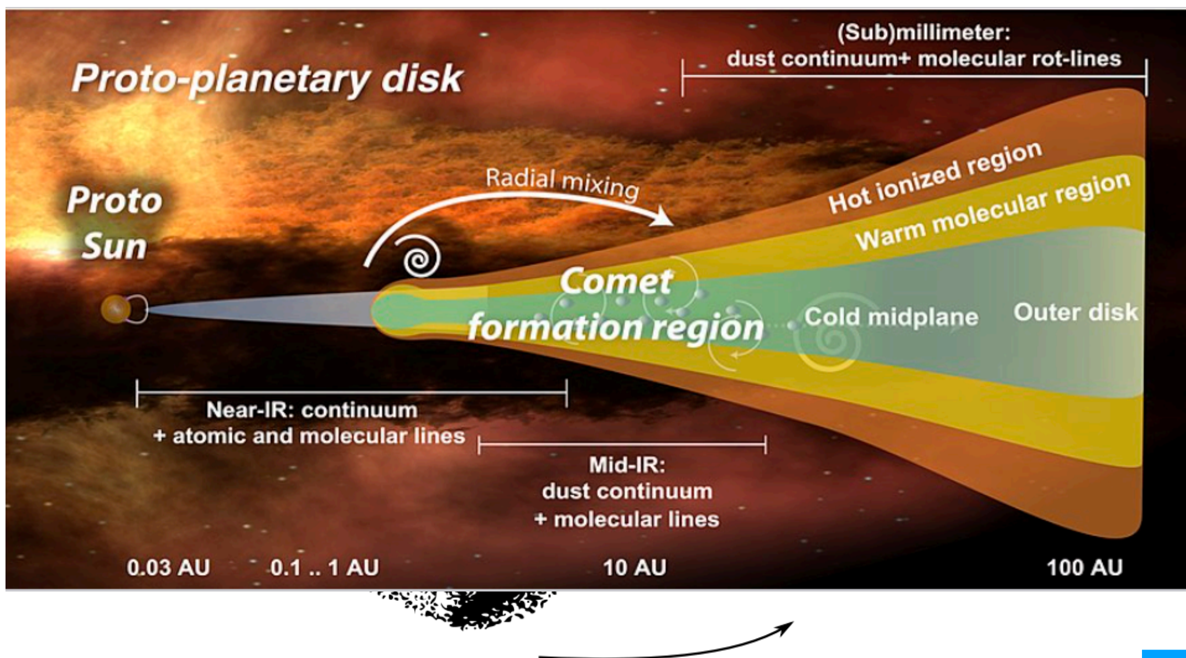


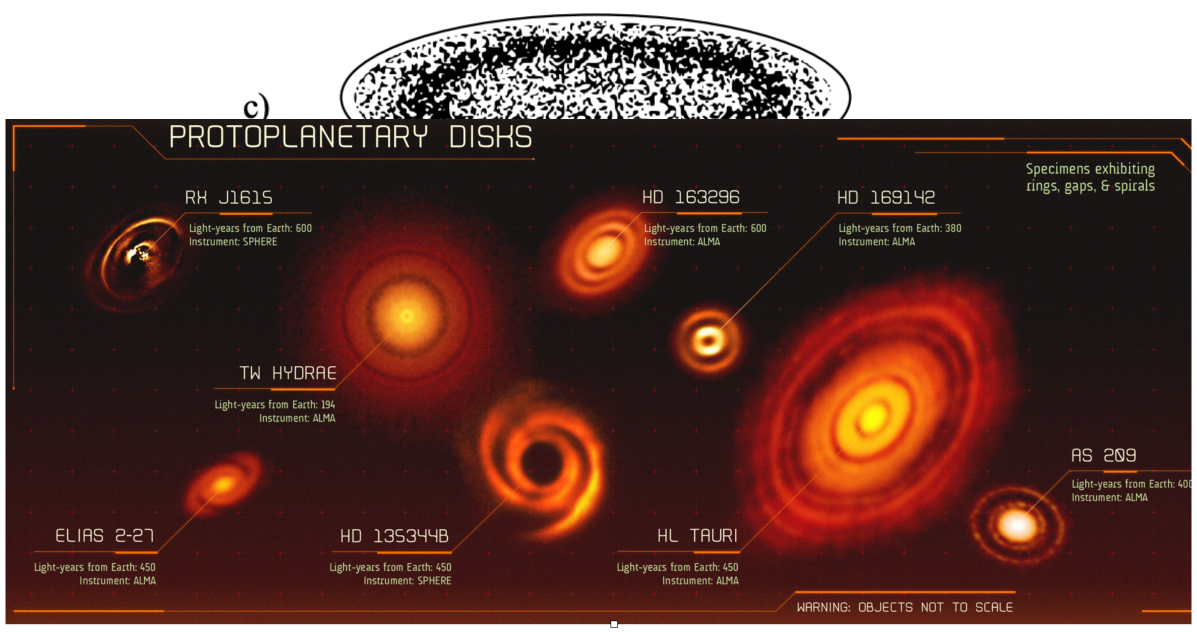
Nebula hypothesis

Perturbed

Proposed by many theoretical studies,
e.g. Pfalzner et al. Cuello et al.

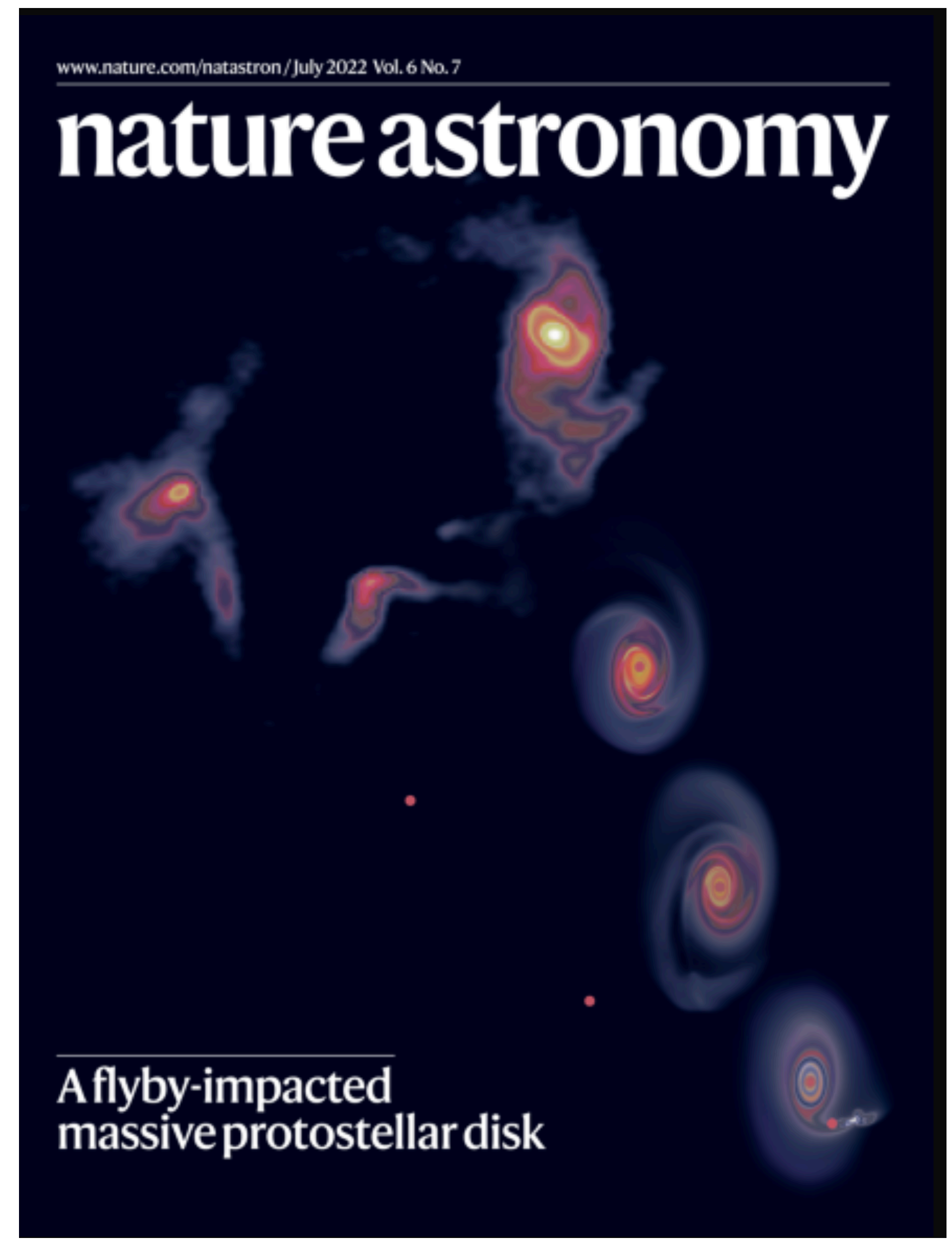
Isolated





1000+ papers

Perturbed



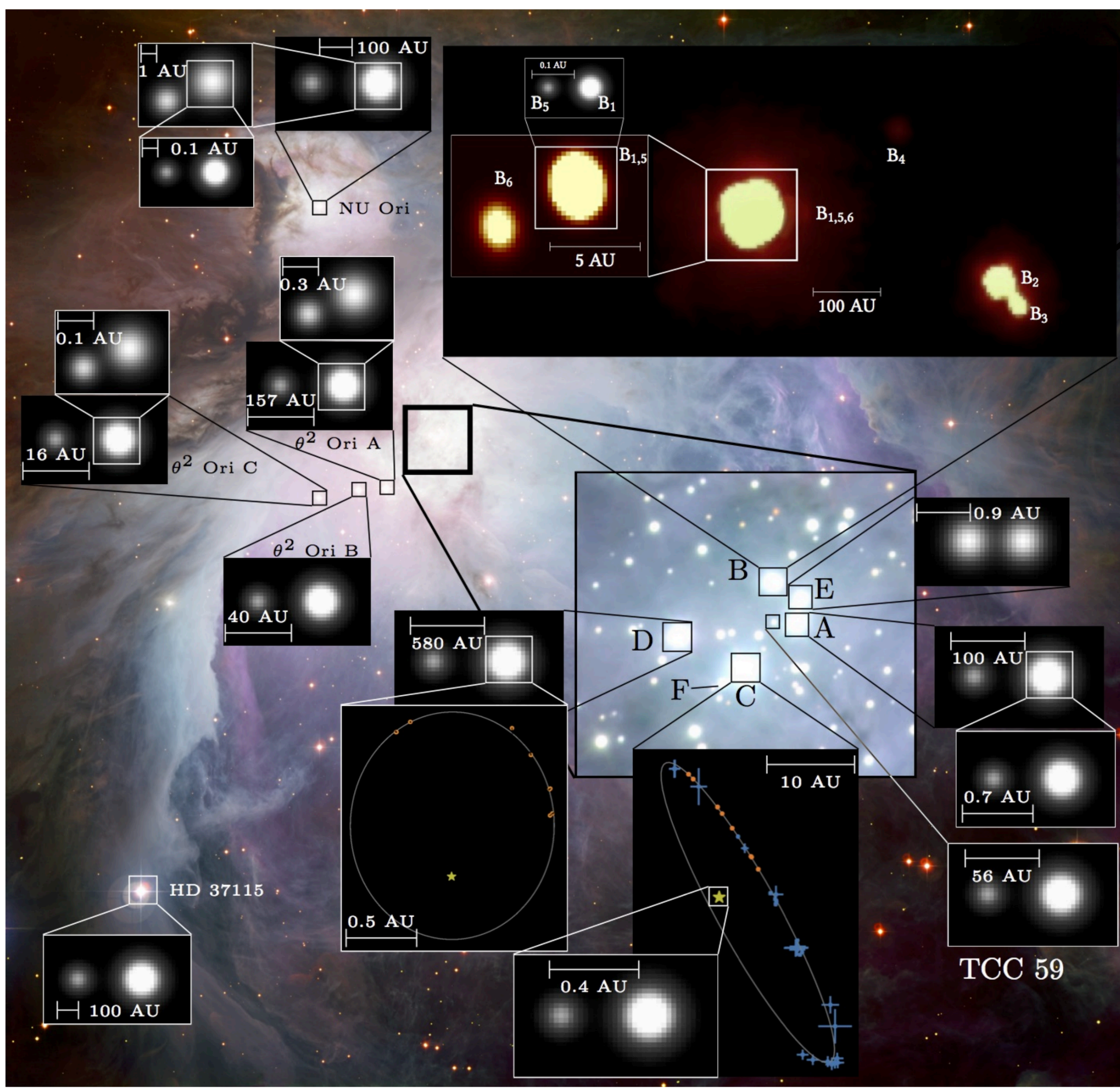
Proposed by many theoretical studies, e.g. Pfalzner et al. Cuello et al.

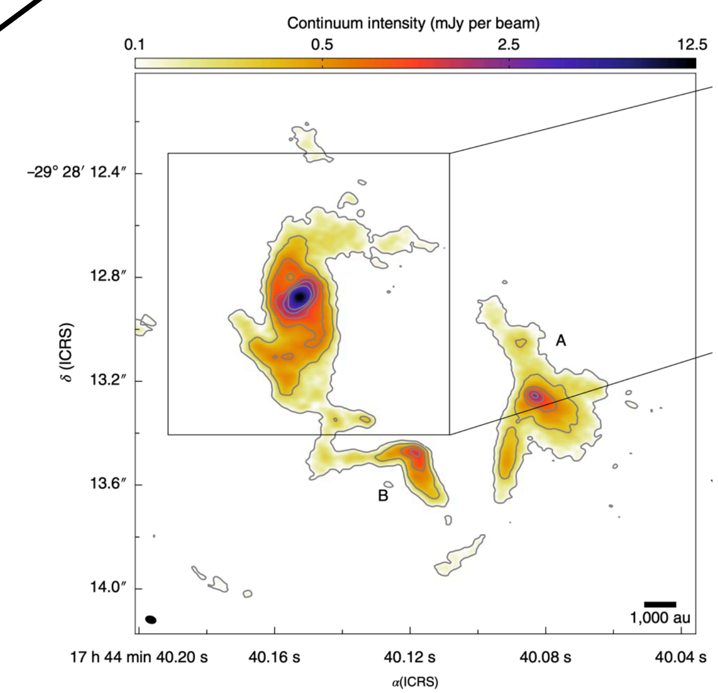
Stellar encounters are *relevant*

Reason 1: Planetary systems are Enormous (compared to stars)

Reason 2: Stars are born in hierarchies

Sometime ago





Remove of gas
Formation of jupiter
some binaries

Karl et al, 2018, Gravity collaboration

Lu, Li et al. 2022 Nature Astronomy