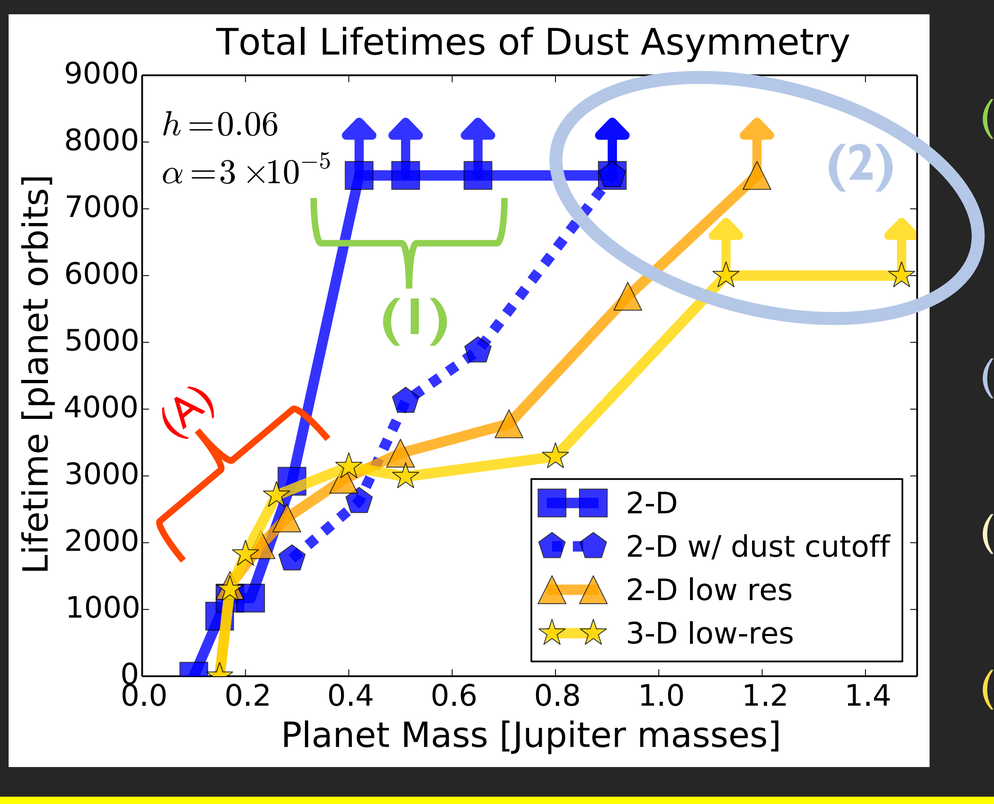
New ways to create longer-lived dust asymmetries

(1) Re-triggered Vortices
(2) High-mass planets
(3) Planet Migration
(4) VSI

MH+ 23 on arXiv



How it happens!! (MH+ 23)

(1) With high enough resolution (29 / h), high-mass planets re-trigger vortices early. These new elongated vortices develop **compact cores** that ***may not decay in the dust*** even after the gas vortex is gone.
(2) Even though Jupiter-mass planets still induce elongated vortices, they're compact enough that they ***do not decay in the gas***.
(3) The vortex's dust asymmetry can survive indefinitely because it is ***left behind*** when the planet migrates inwards.
(4) The VSI can seed the RWI with ***compact vortices*** that do not decay.

Context

Our previous work (MH+ 17, 19, 21) found that ***incorporating the planet's growth*** into simulations shortens the lifetimes of a vortex's dust asymmetry.

That's because the resulting vortices are elongated instead of compact.

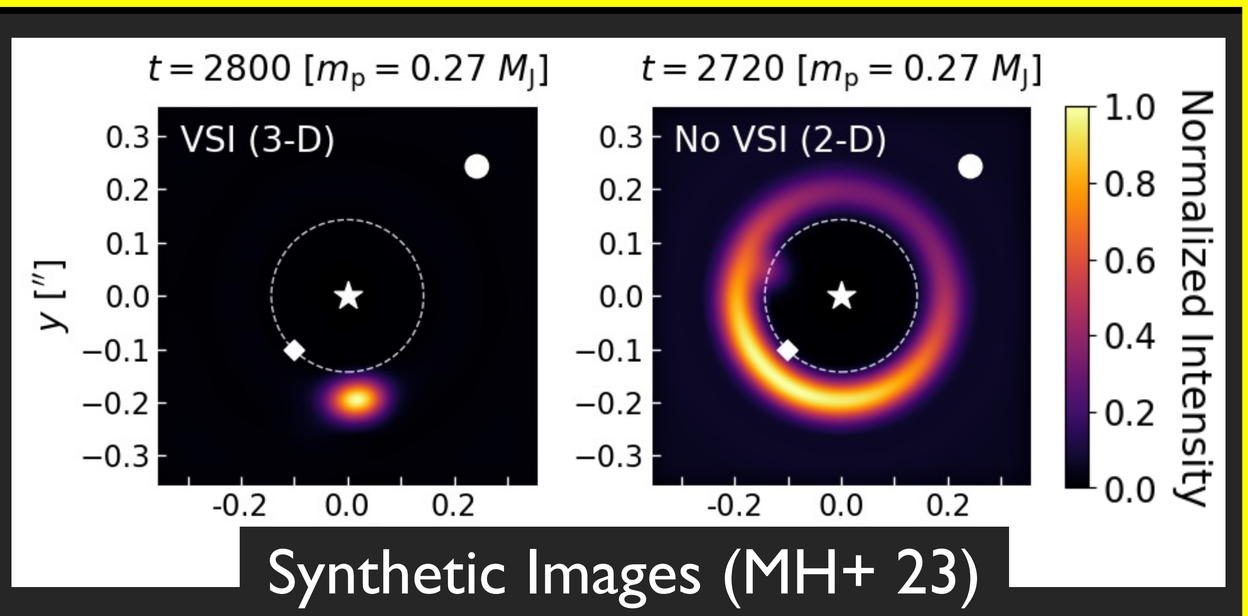
Only low-mass planets can produce long-lived dust asymmetries by re-triggering vortices (MH+ 21).

Doesn't work! (MH+ 23)

(A) Low-mass planets still re-trigger long-lived vortices in high-mass discs, ***but not in low-mass discs***.
(B) With high enough vertical resolution in 3-D, the dust clumps produced by ***dust feedback*** no longer survive indefinitely.

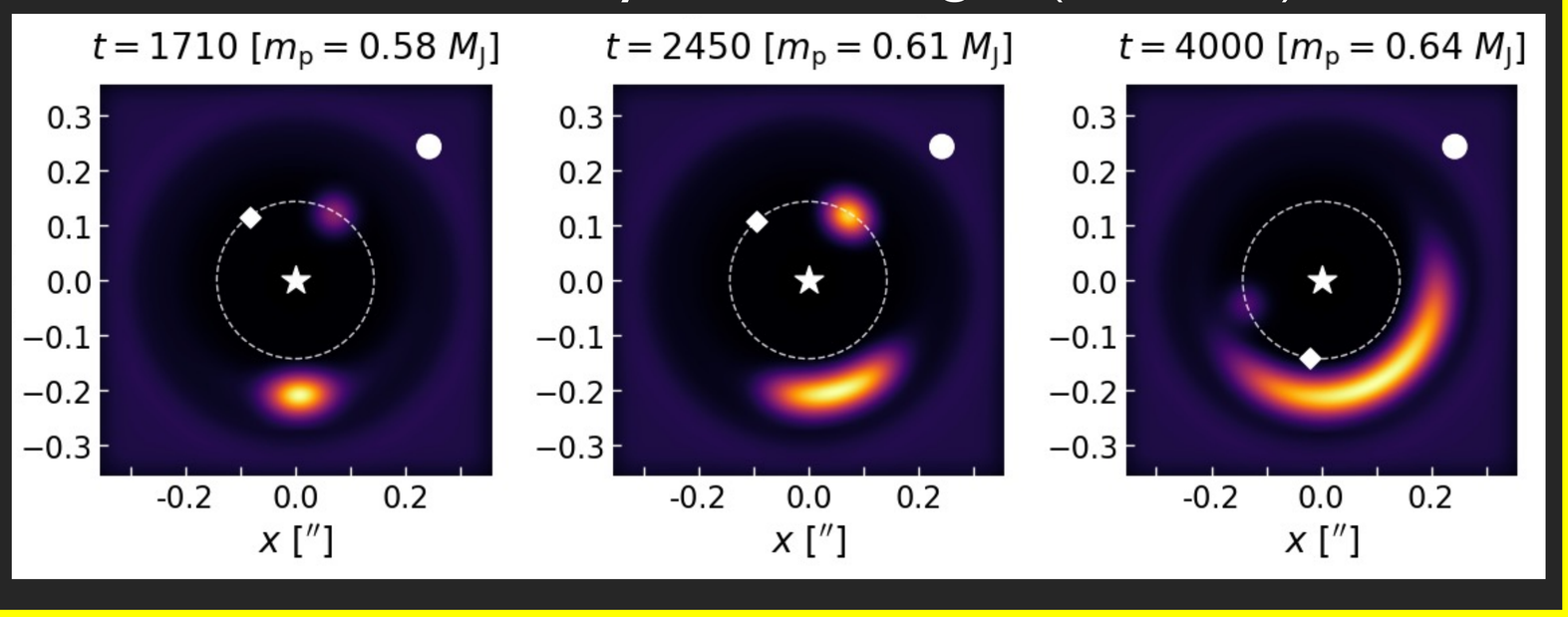
We found four new ways to make **planet-induced vortices** *survive longer* in simulations, which contradicts **how rare** asymmetries are in mm-dust images of protoplanetary discs.

With a low-mass planet, planet-induced vortices are much more **compact with active VSI** than with no VSI.

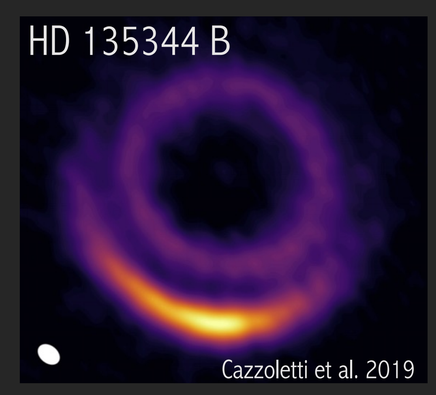


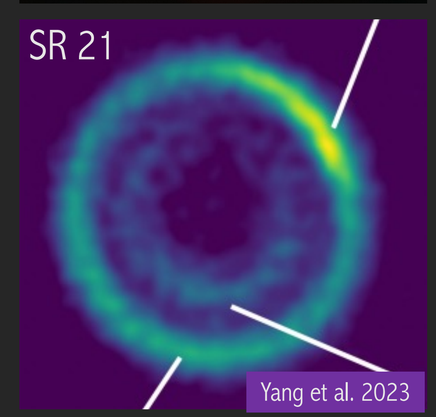
Synthetic Images (MH+ 23)

Once the last **re-triggered vortex** decays in the gas, its compact core slowly decays towards a ring.



Planet-induced Vortex Candidates (at gap edges)





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Hydro simulations done w/ FARGO3D

MH+ 23 = How to form compact & other longer-lived planet-induced vortices: VSI, planet migration, or re-triggers, but not feedback

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