

The study of **galaxy spin-filament alignments** to unravel the **evolution of galaxies and their components**

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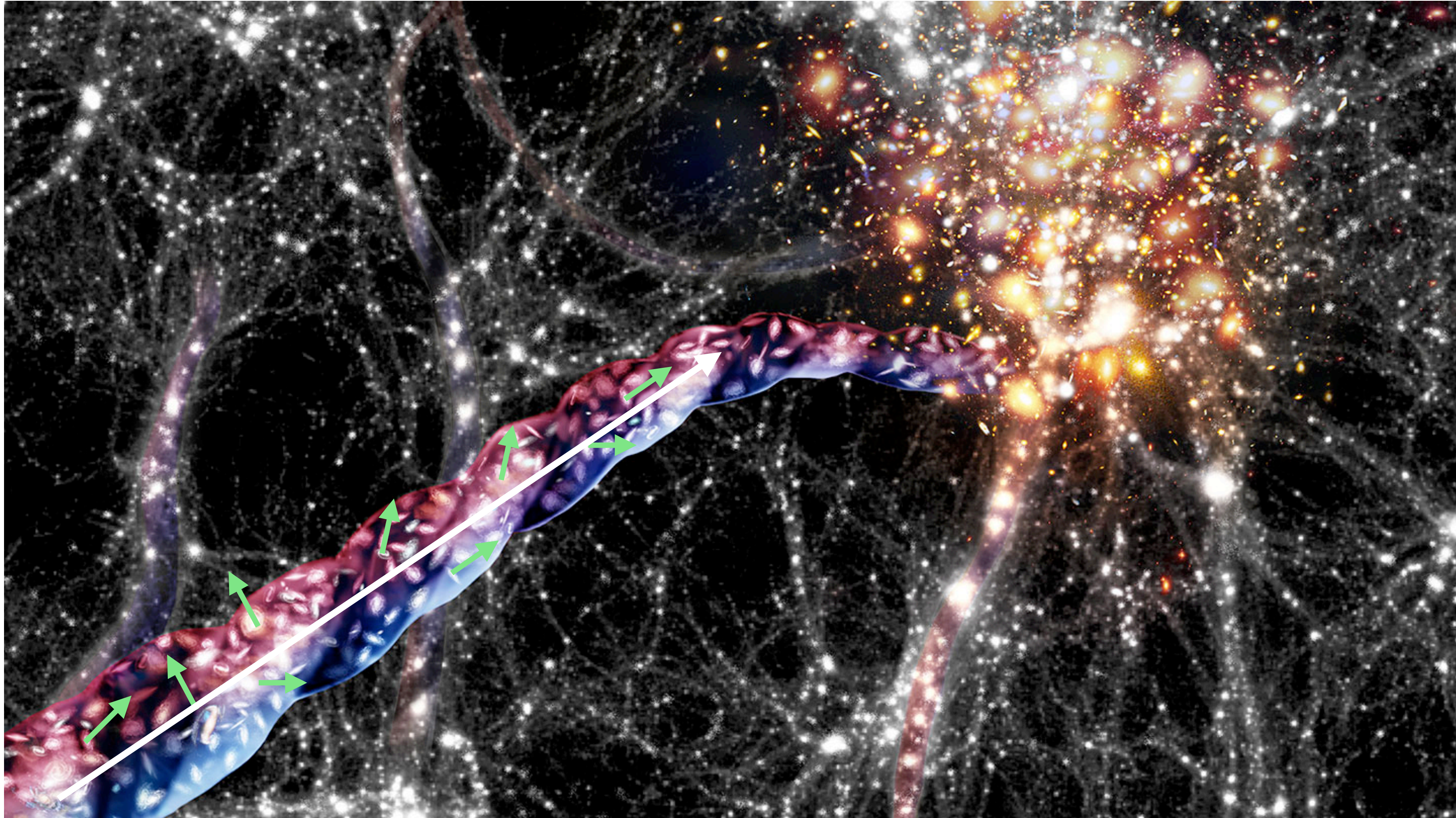
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Motivation

How do galaxies build up their spin in the cosmic web?

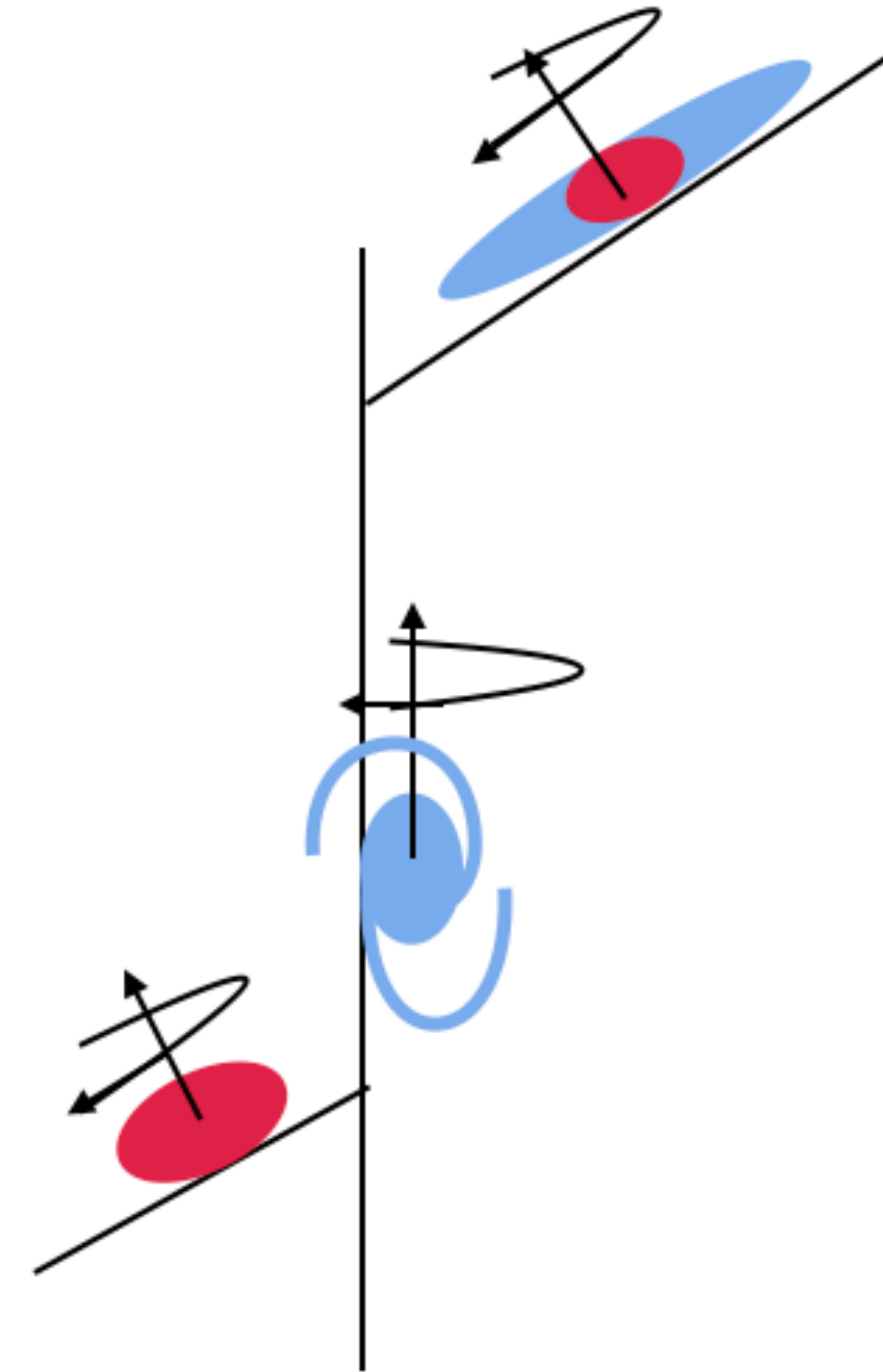


Spin-filament alignments in the observations

What is the **primary galaxy parameter** of correlation with spin-filament alignments?

What can we tell about separate spin-filament alignments for **bulges and discs**?

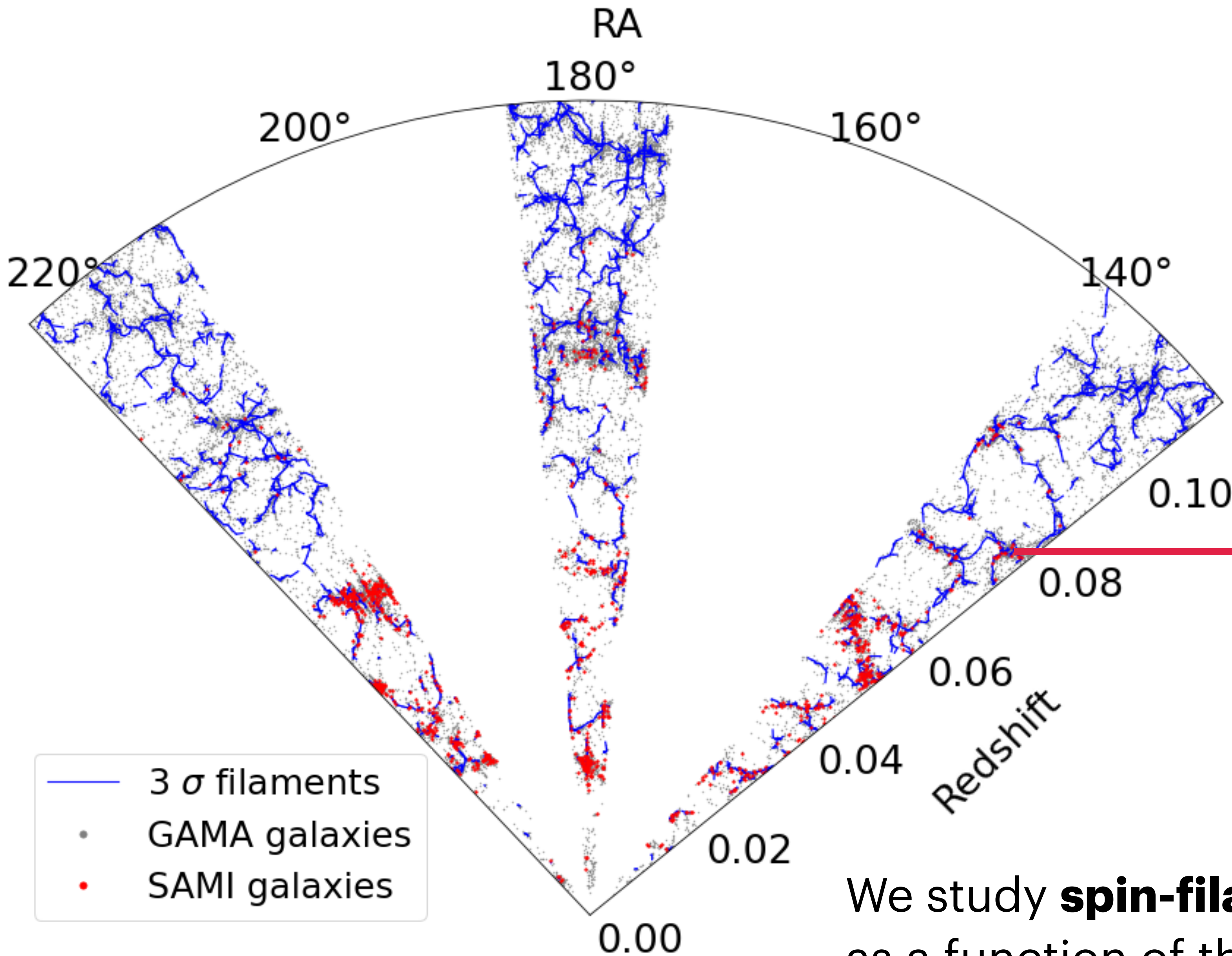
Do we see differences for spins from **stars versus ionised gas**?



Insights on the formation of
galaxies,
bulges and discs

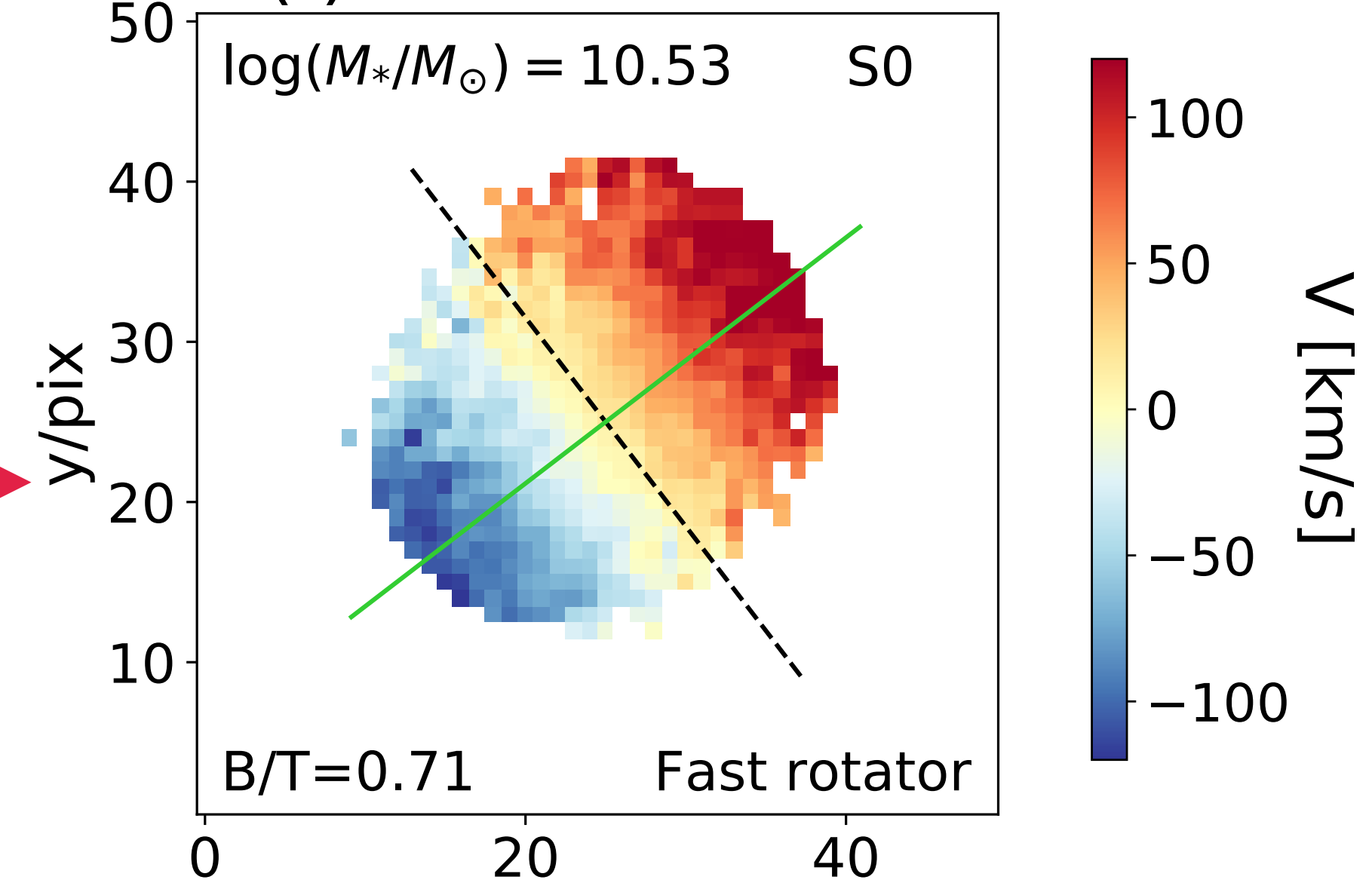
SAMI galaxies in GAMA filaments

GAMA: 98.5% complete
Filaments: Disperse
SAMI: IFU data



- 3 σ filaments
- GAMA galaxies
- SAMI galaxies

(f) SAMI ID:16317



We study **spin-filament alignments of 1121 galaxies** as a function of their properties.

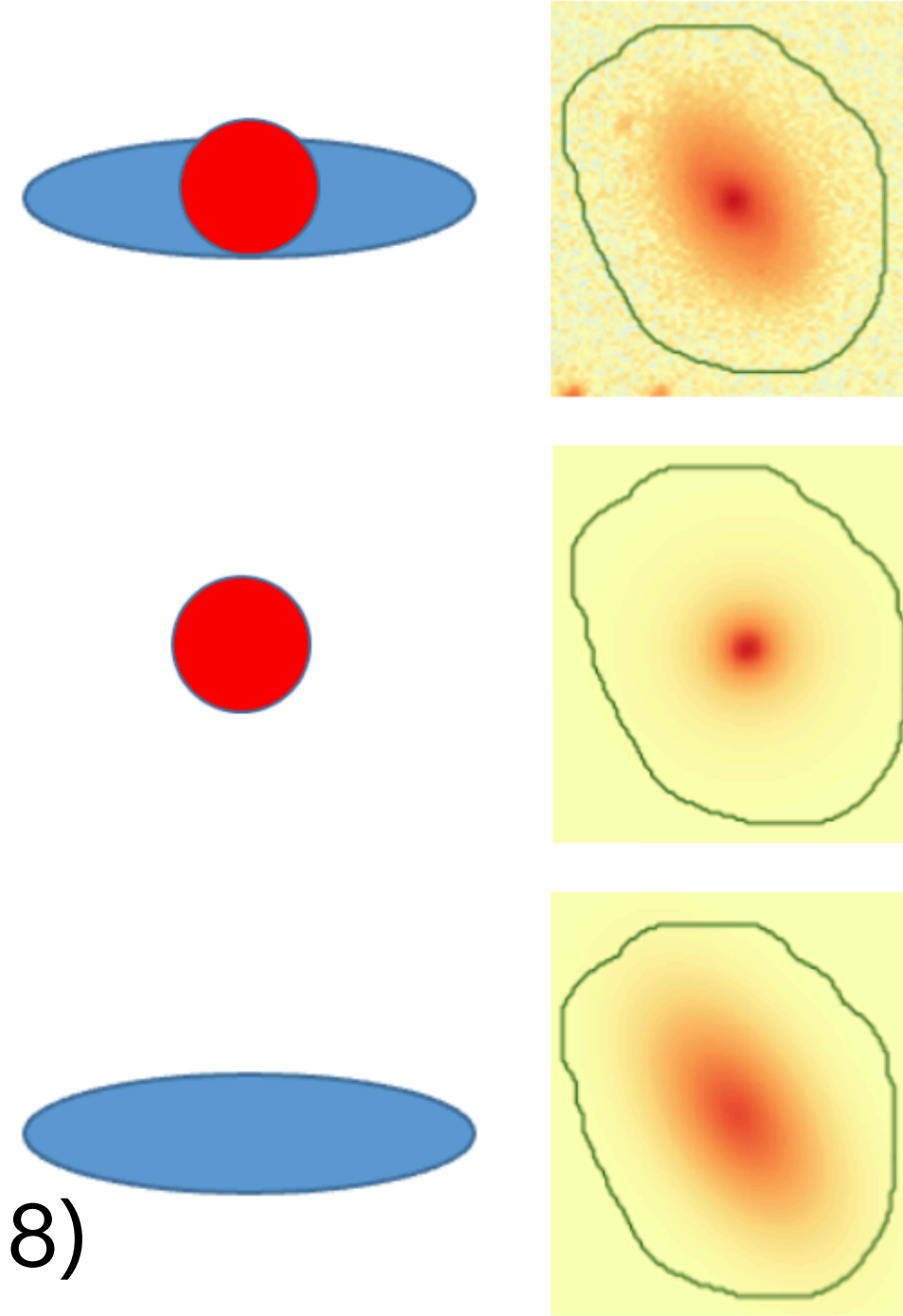
2D bulge/disc decompositions

Bulge/disc
photometric
decomposition

(Barsanti et al. 2021,
Casura et al. 2022)

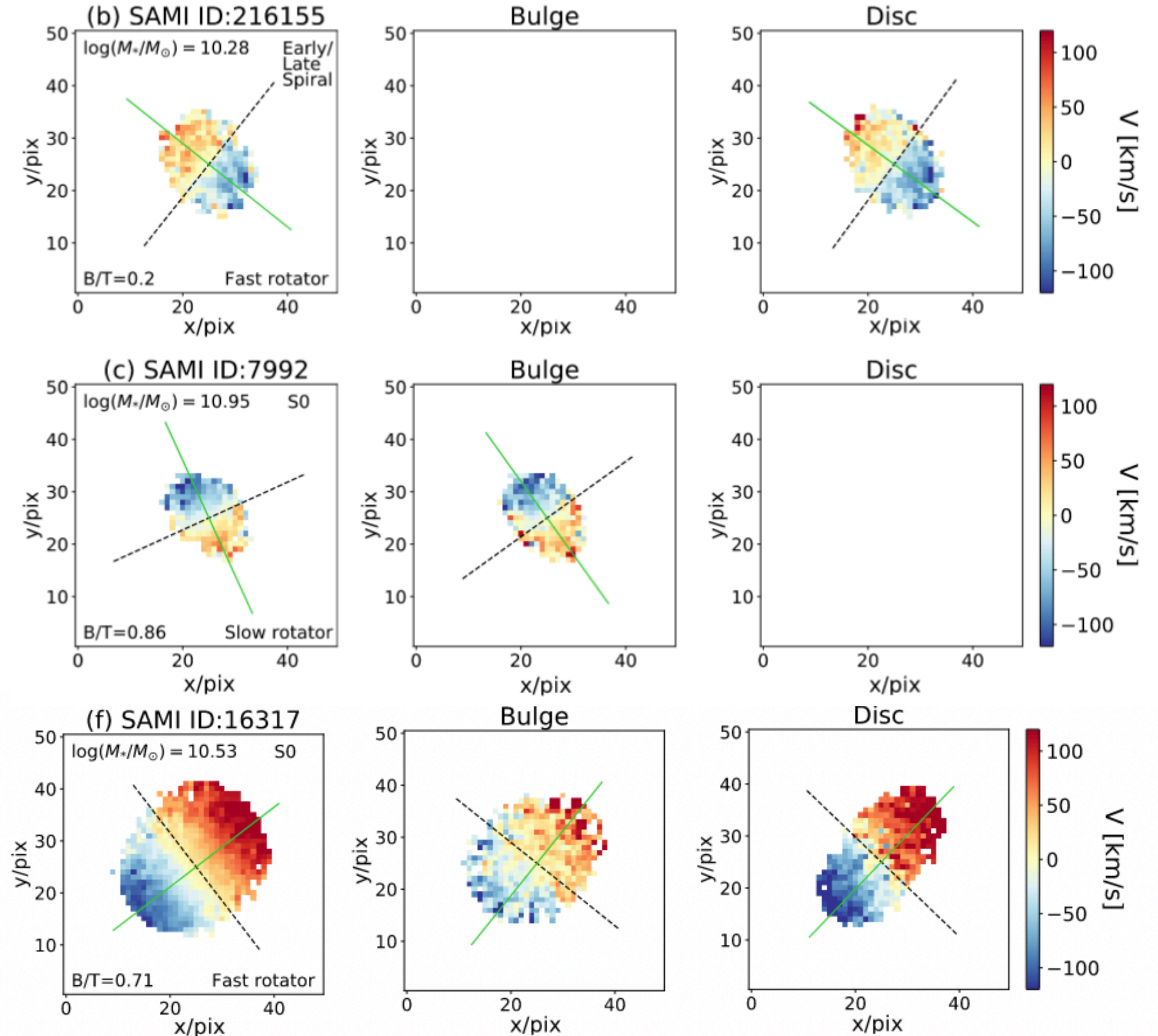
ProFound and ProFit

(Robotham et al. 2017, 2018)



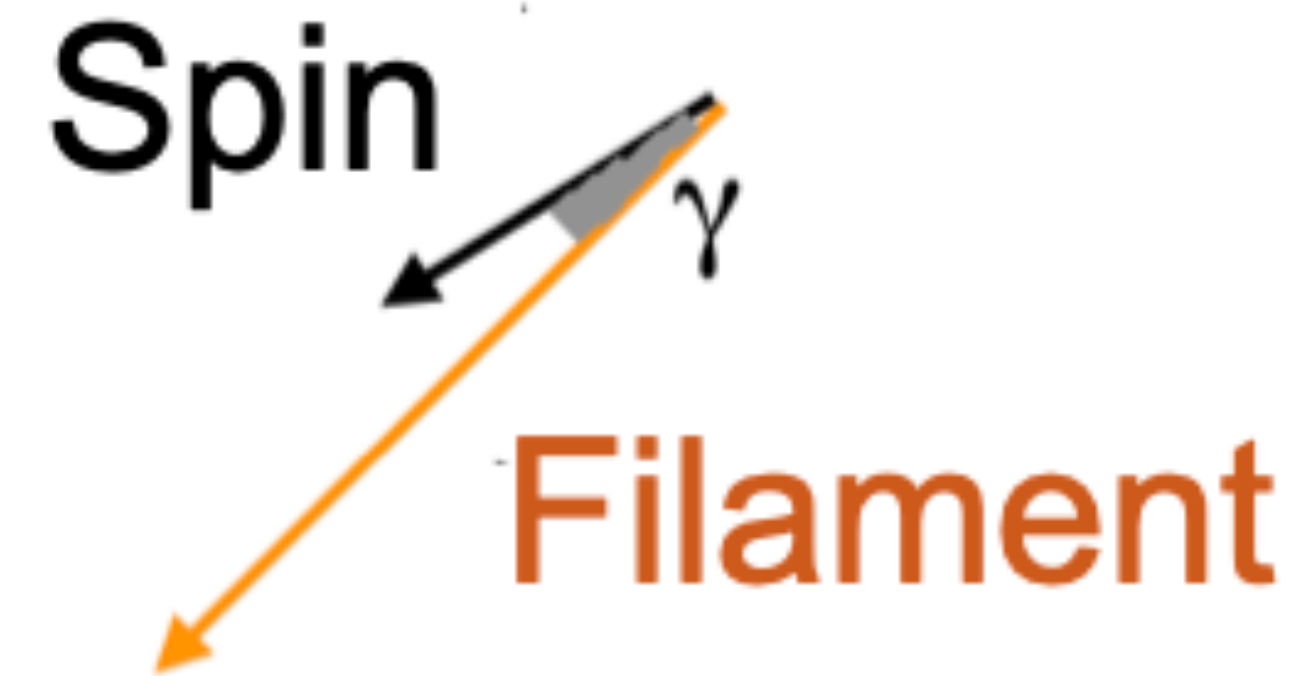
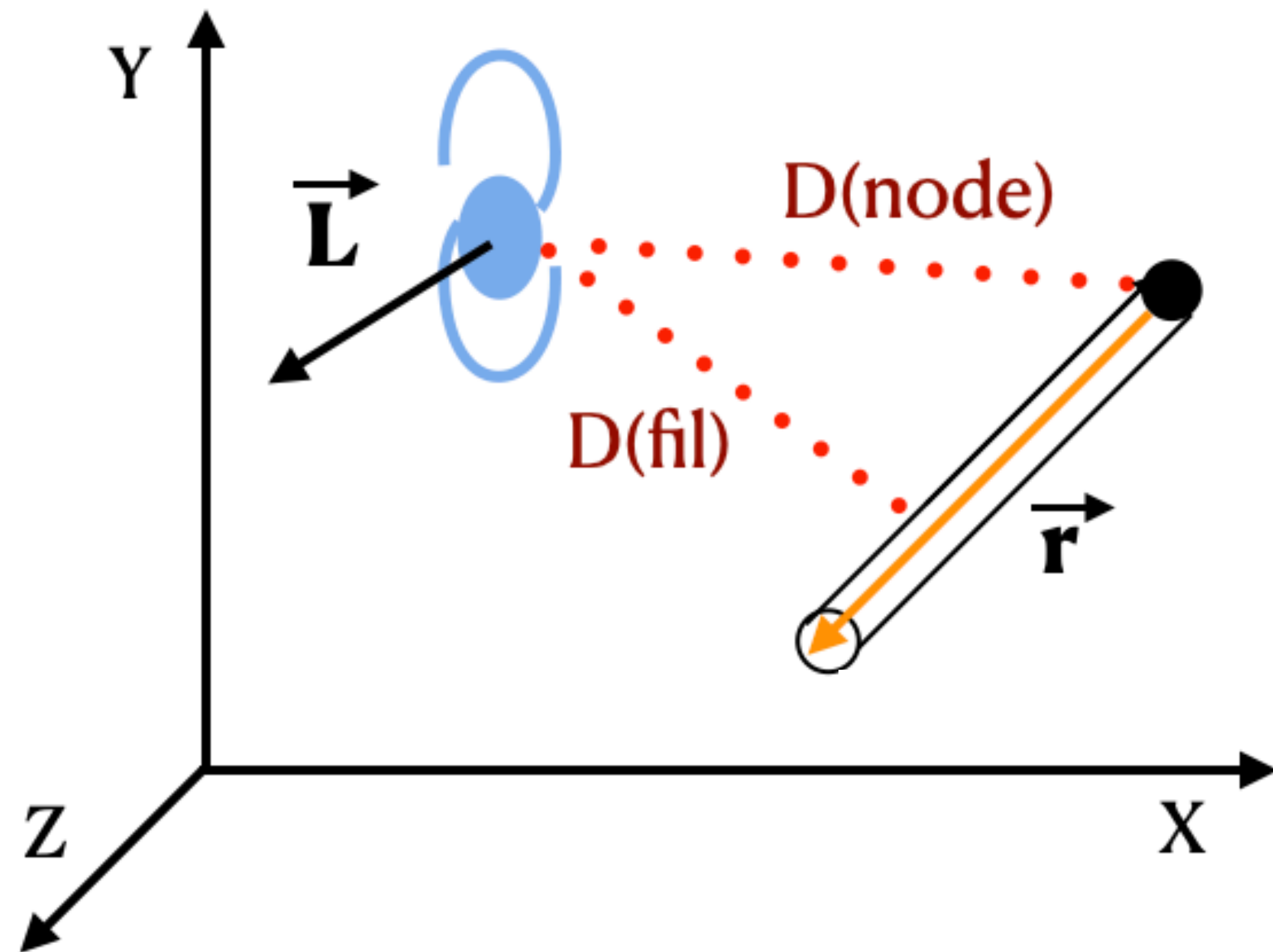
Bulge/disc
kinematic
decomposition

(Oh, Colless, Barsanti et al. 2020)



Galaxy spin-filament angle

We assign each SAMI galaxy to the closest cosmic filament



3D angle

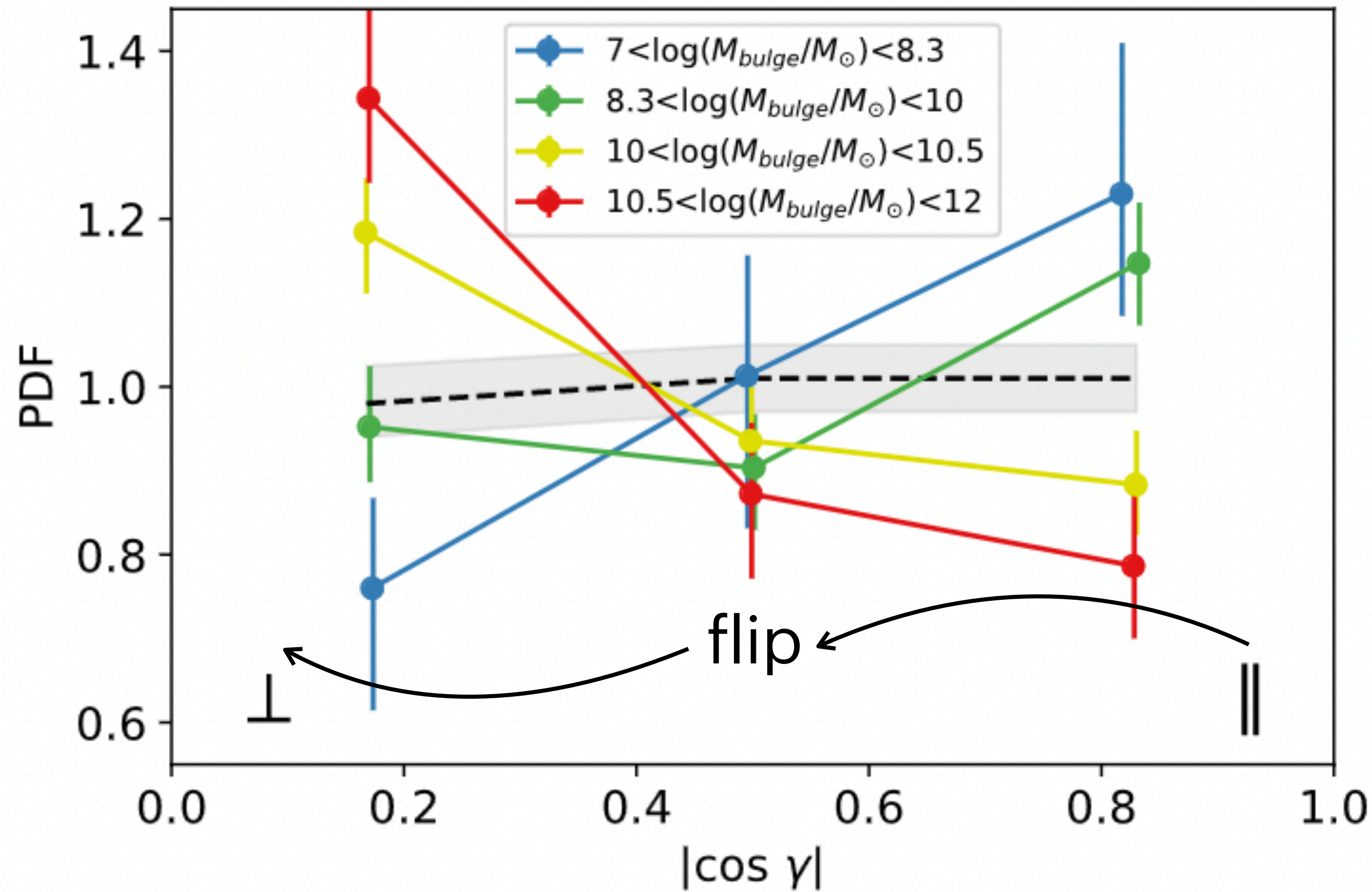
$$\cos(\gamma) = \left(\frac{\mathbf{L} \cdot \mathbf{r}}{|\mathbf{L}| |\mathbf{r}|} \right)$$

$$\left\{ \begin{array}{l} |\cos(\gamma)| = 0 \rightarrow \perp \text{ alignment} \\ |\cos(\gamma)| = 1 \rightarrow \parallel \text{ alignment} \end{array} \right.$$

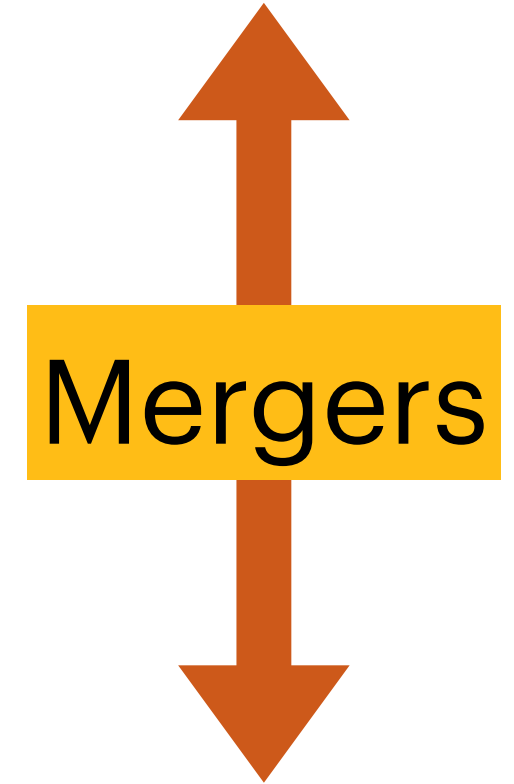
Bulge Mass is the primary parameter

Barsanti, Colless, Welker et al., 2022

No correlation residuals left for the other parameters



Growth of the bulge

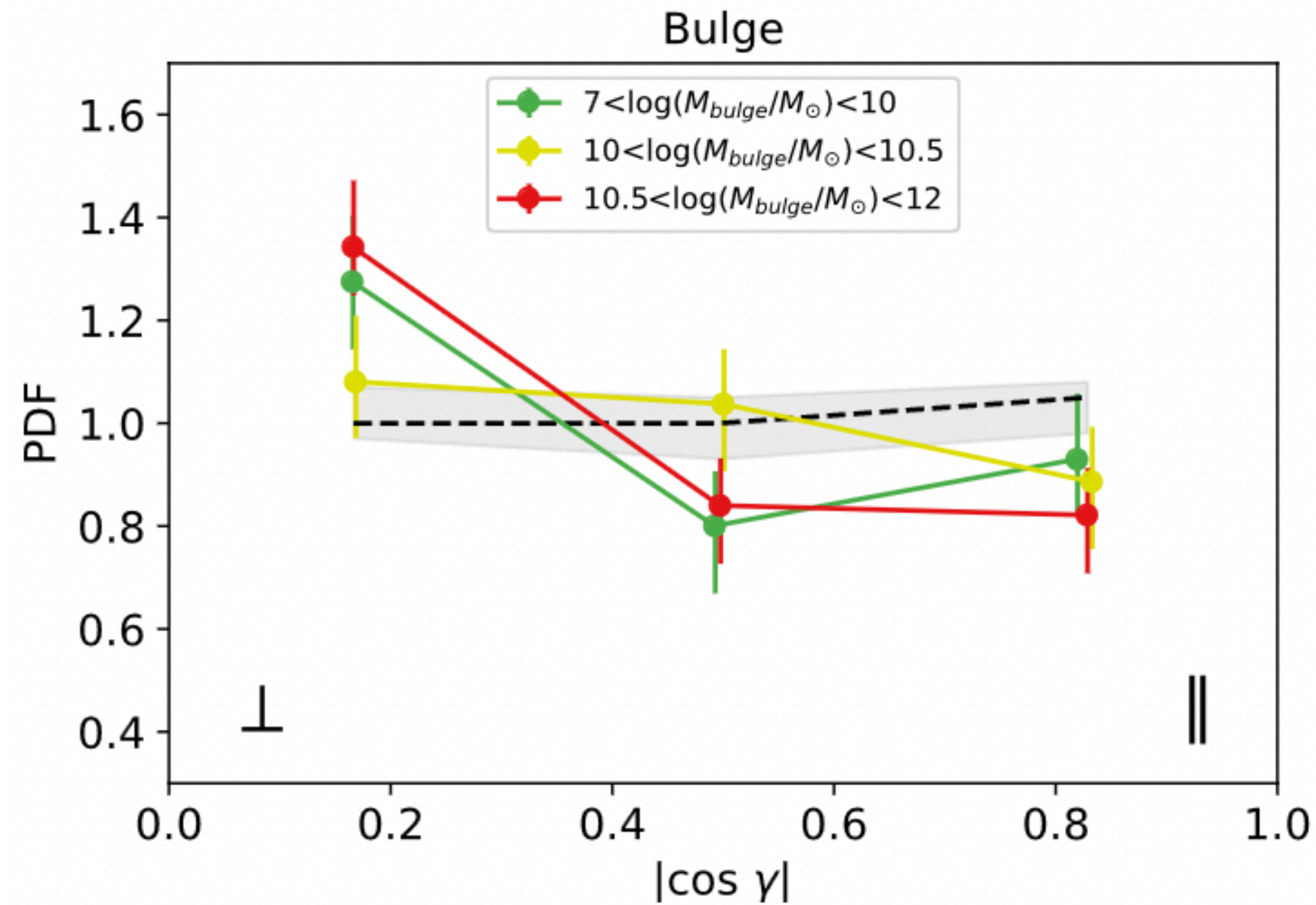


flipping of spin-filament alignments

Galaxies with high bulge mass \longrightarrow \perp alignment
Galaxies with low bulge mass \longrightarrow \parallel alignment

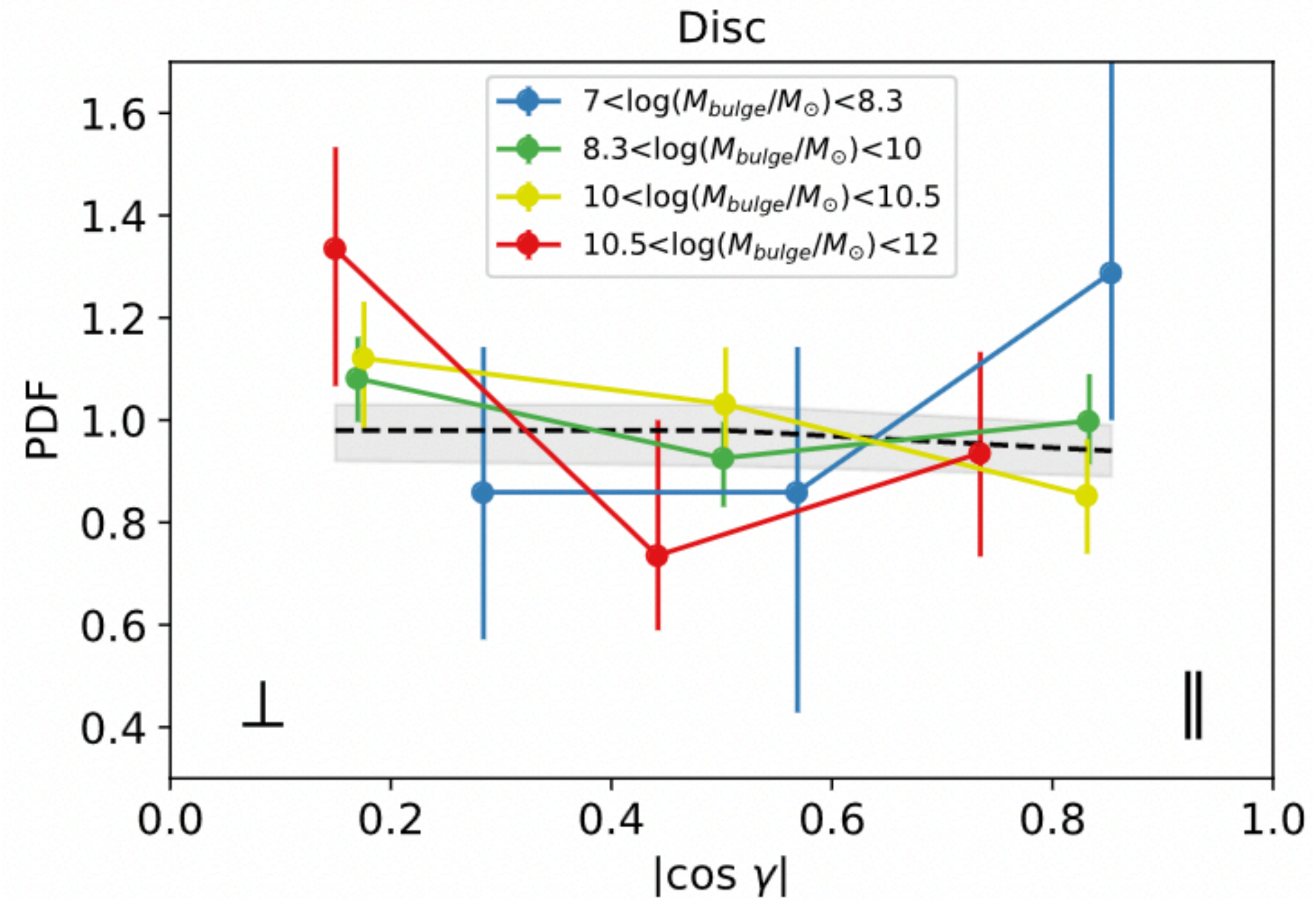
Significant tendencies
K-S test: p-values < 0.05

Bulge/disc spin-filament alignments



Bulges \longrightarrow \perp alignment

Mergers



Discs
high bulge mass \longrightarrow \perp alignment
low bulge mass \longrightarrow \parallel alignment

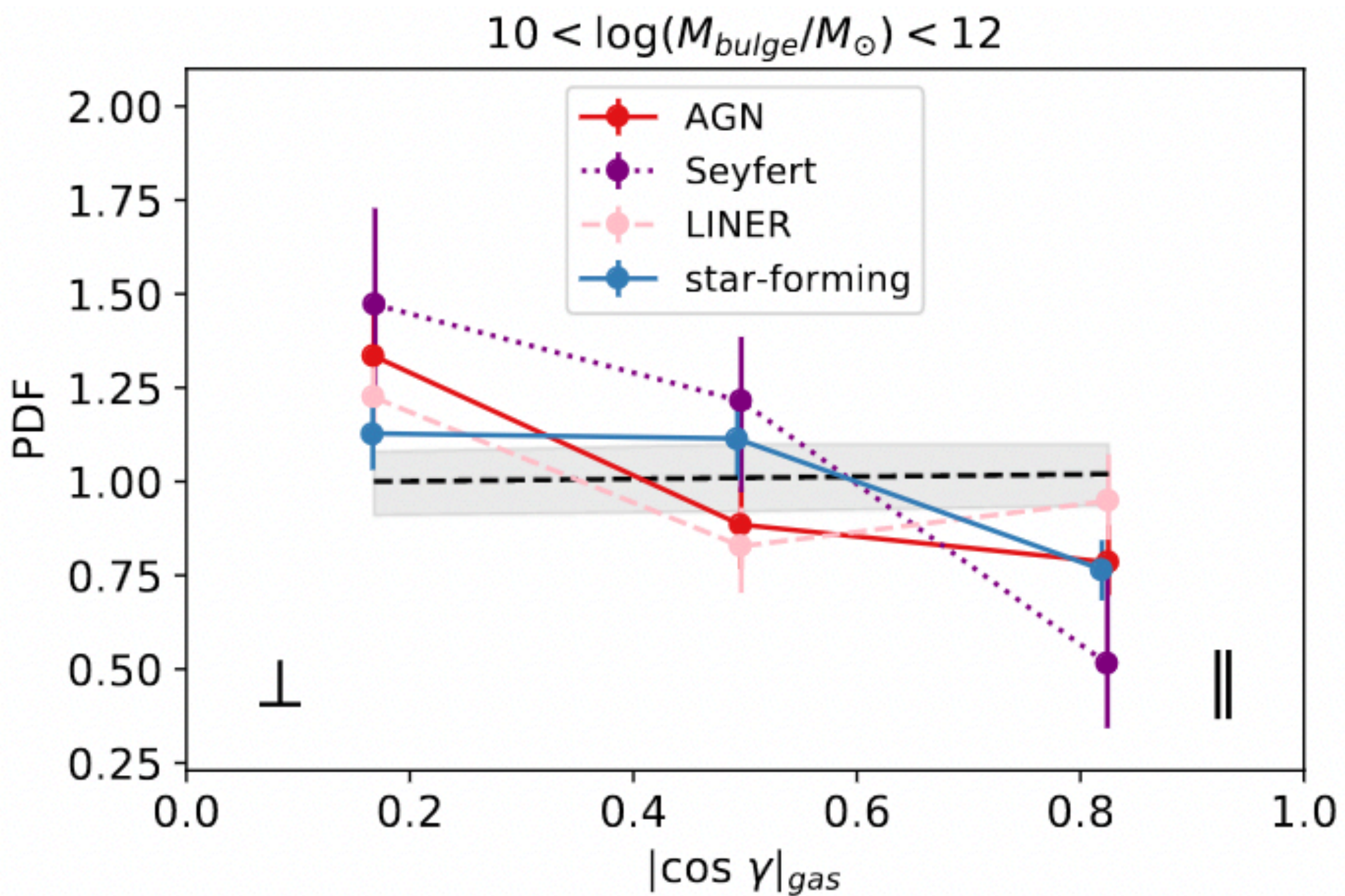
Multiple channels of formation

What is the role of black hole activity in spin-filament alignments?

Barsanti, Colless, d'Eugenio et al., 2023

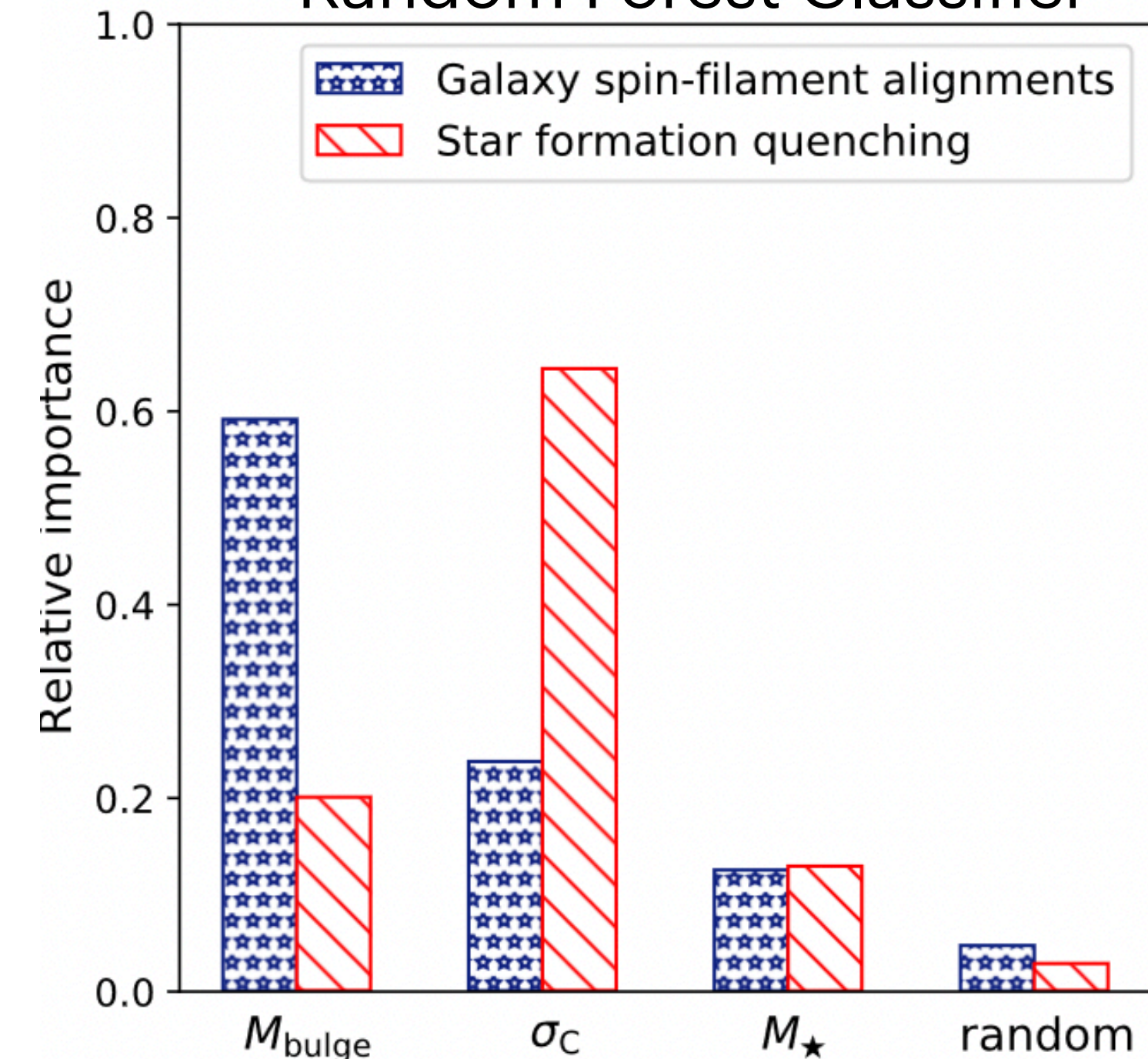
Instantaneous AGN

Integrated AGN



\perp Seyfert galaxies

Random Forest Classifier



M_{bulge} is the most predictive parameter for **galaxy spin-filament alignments**

σ_c is the most predictive parameter for **secular star formation quenching**

Link between ionised gas spin-filament alignments and instantaneous BH activity