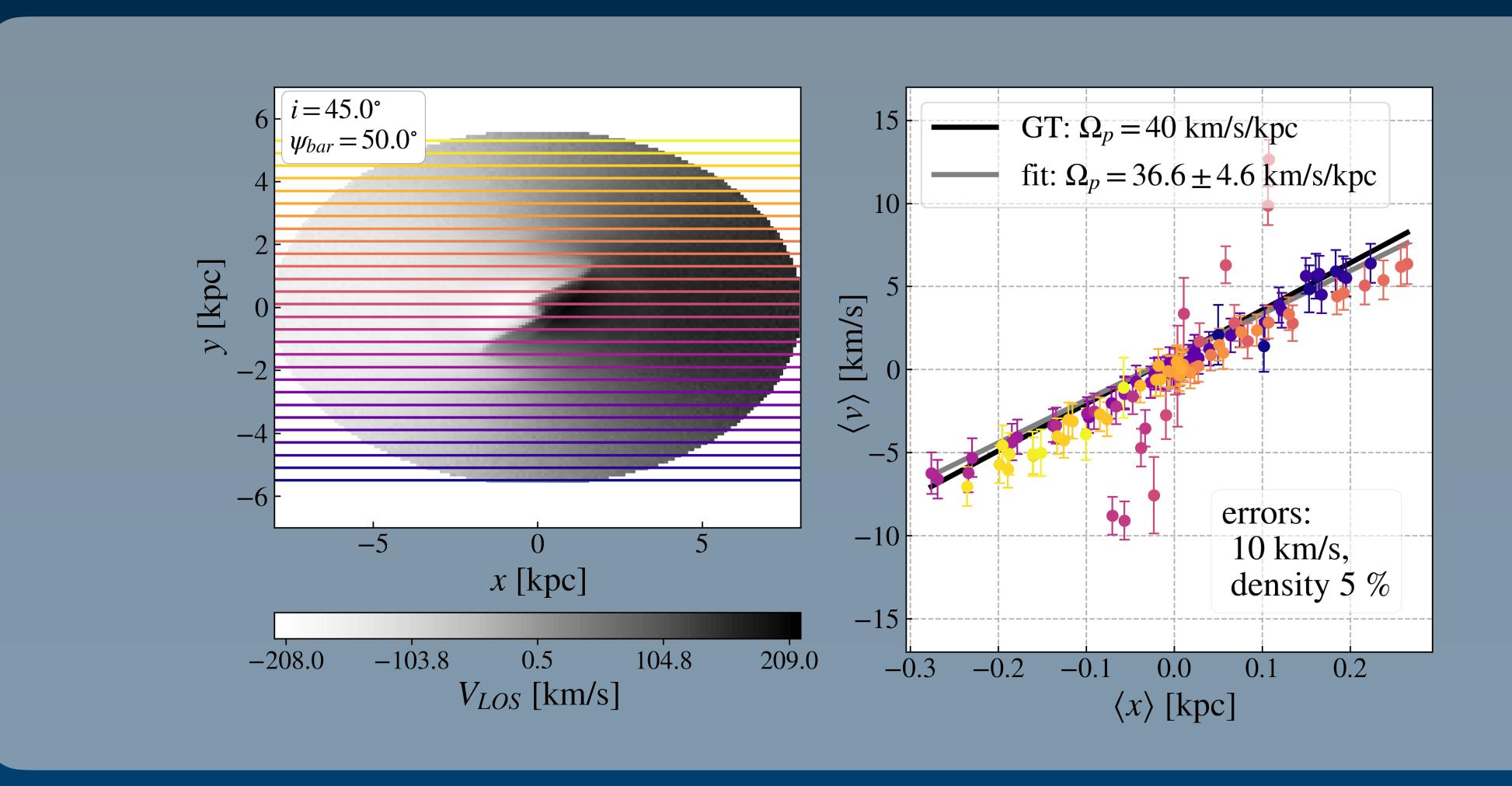
## On the Tremaine-Weinberg method:

can we trust gas tracers to measure pattern speeds?

14:02



#### The Tremaine-Weinberg method

the TWM helps measure the pattern speed  $\Omega_P$  of galaxies calculating  $\langle v \rangle$  and  $\langle x \rangle$  in slits (horizontal lines on the left panel) using the formula:

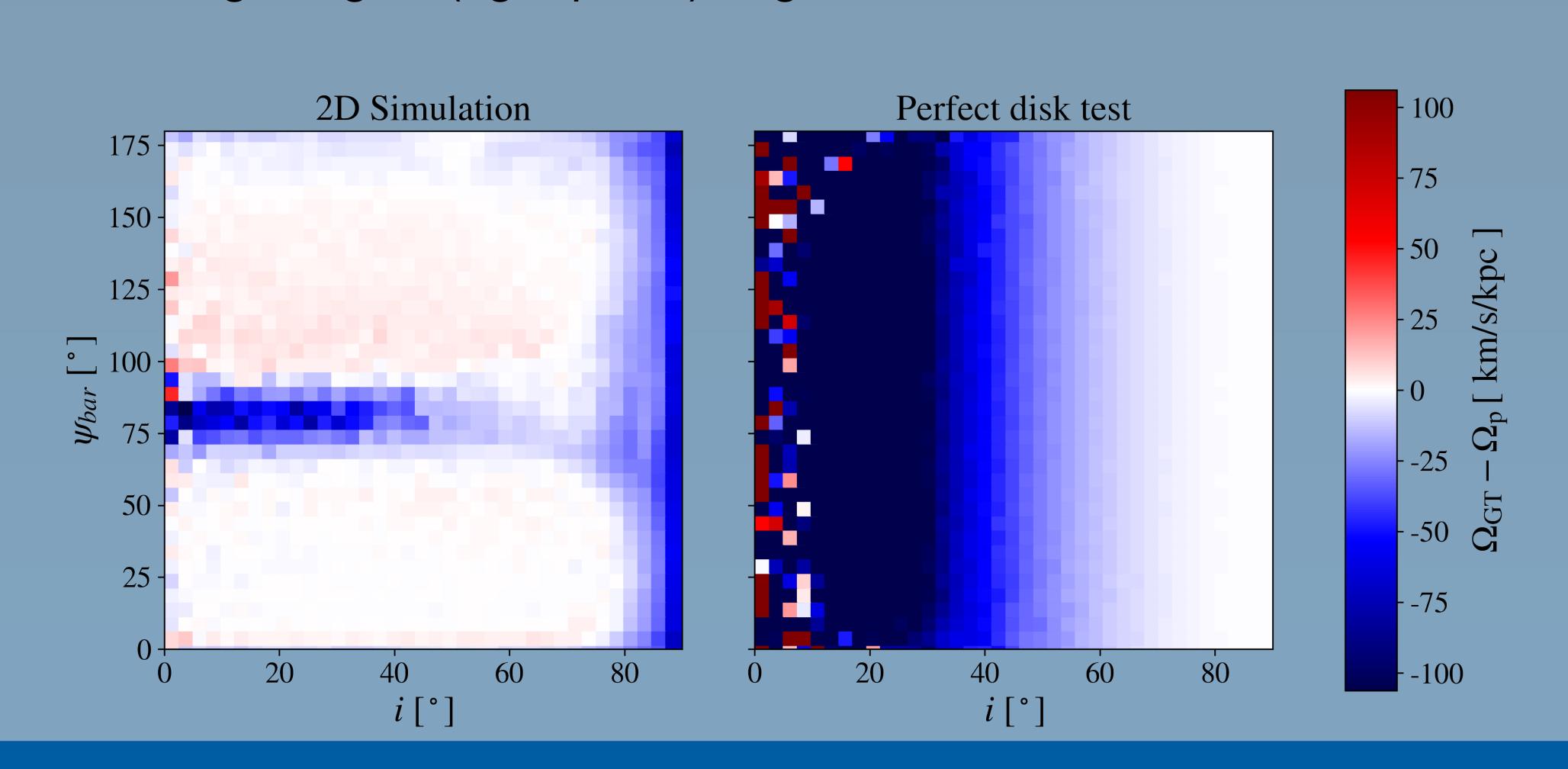
$$\Omega_{\mathsf{P}} \sin(i) = \frac{\int_{-\infty}^{\infty} h(y) \int_{-\infty}^{\infty} v_{\mathsf{LOS}}(x, y) \Sigma(x, y) \, \mathrm{d}x \, \mathrm{d}y}{\int_{-\infty}^{\infty} h(y) \int_{-\infty}^{\infty} \Sigma(x, y) x \, \mathrm{d}x \, \mathrm{d}y} = \frac{\langle v \rangle}{\langle x \rangle}$$

 $\psi_{
m bar}$  is the angle between galaxy major axis and the bar; i is inclination.

#### Applying the TWM to 2D simulations

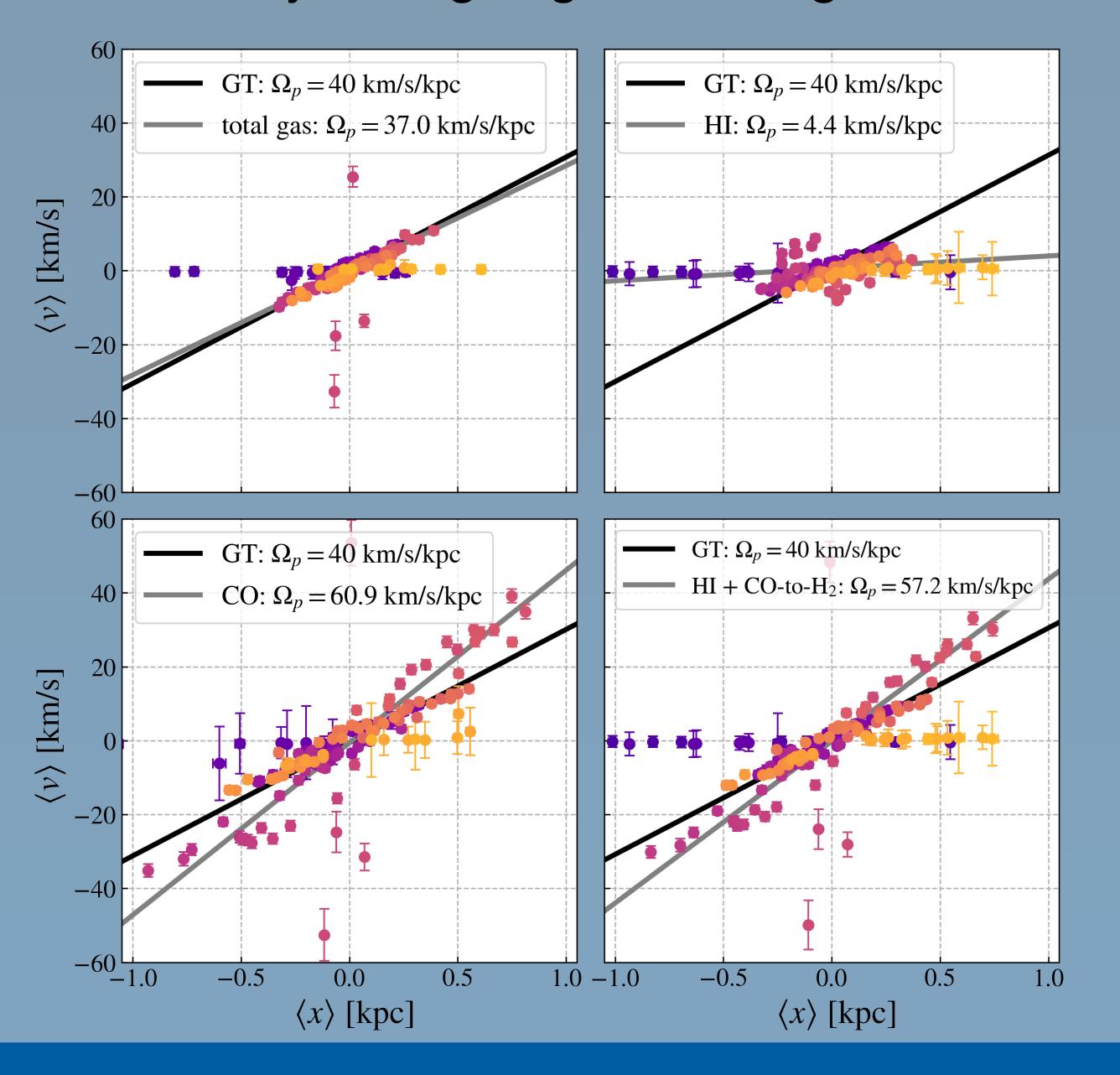
Applying method to 2D simulation (left panel) allows us to study  $\psi_{\text{bar}}$  limitations.

We applied the TWM to galaxy disk without any pattern and still got signal (right panel). It gives us the inclination limits.



#### Applying the TWM to 3D simulations

For different gas tracers we can measure different pattern speeds, and only total gas gives the right answer.



not really





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### Takeaways:

- 1.  $i \in [5^{\circ}; 45^{\circ}]$
- 2.  $|\psi_{\text{bar}}| < 30^{\circ}$
- 3. try to avoid gas tracers

check out more details and interactive plots! <a href="https://olgaborodina.github.io/EAS.html">https://olgaborodina.github.io/EAS.html</a>



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