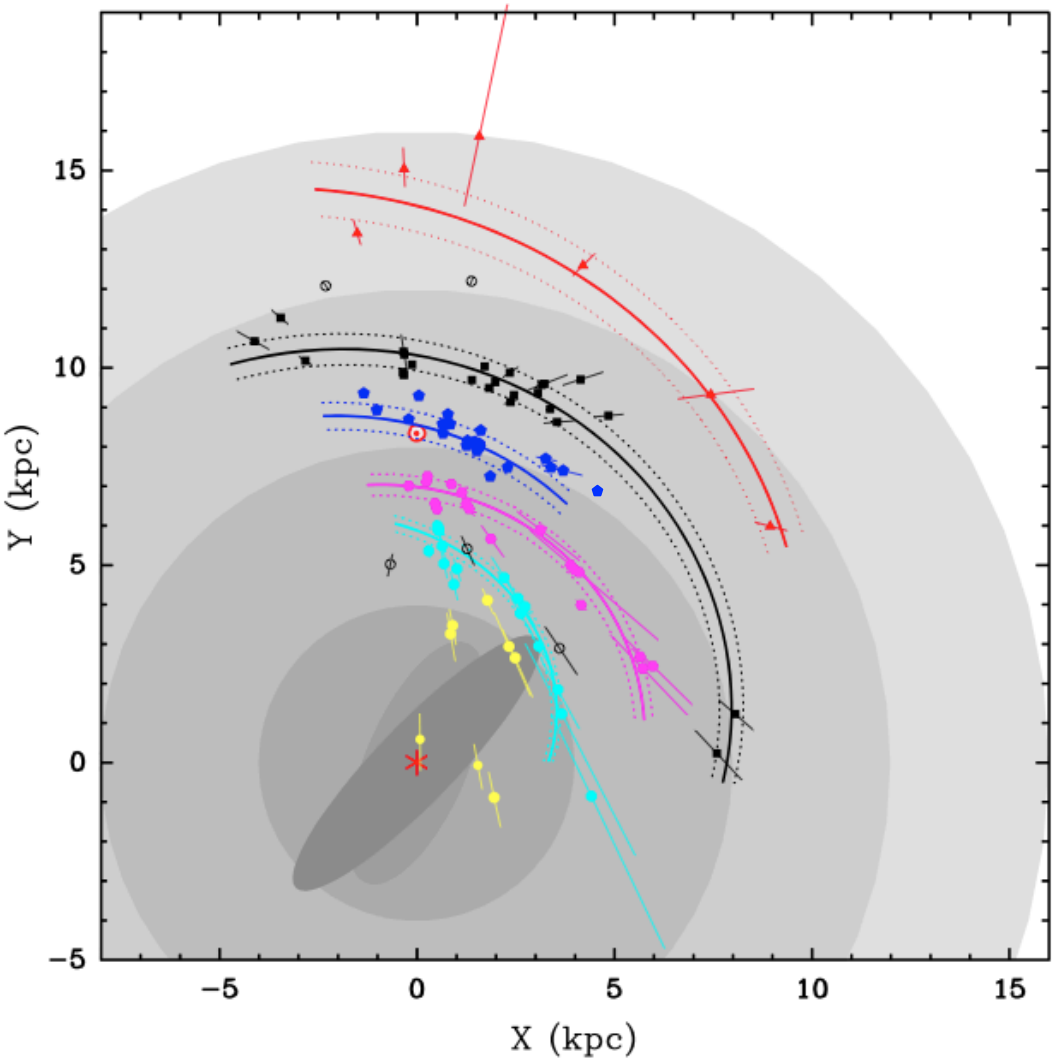
Tomography of the Galactic spiral arms with SKA: Synergy with current VERA projects

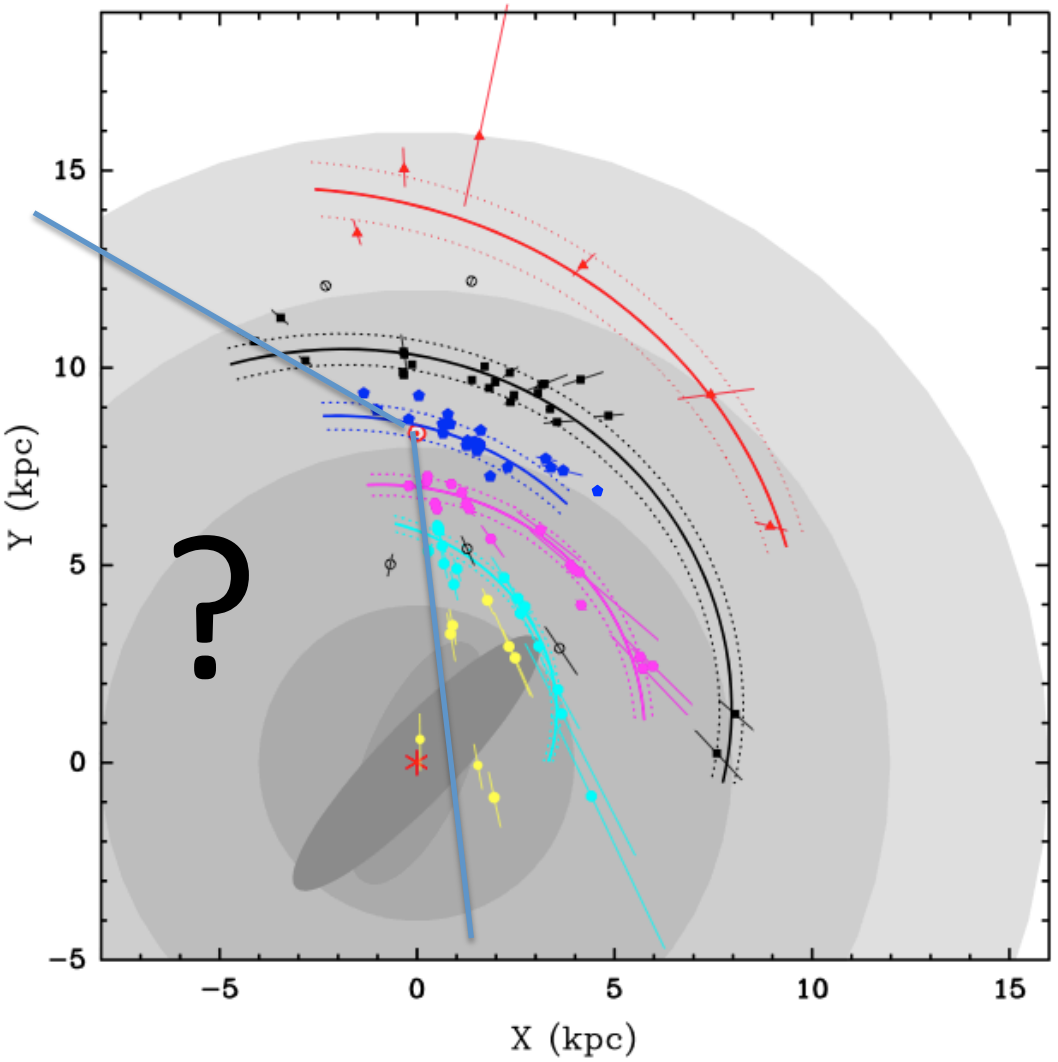
Ross Burns, D2 Kagoshima-U

What did we learn from VERA + VLBA mapping of the Galaxy?



- Good progress in the Galactic structure
  Spiral Arms (MSFRs) – Reid
  Bar – Matsumoto
  Fundamental parameters – Honma, Reid and Honma
- Gap in the Perseus Arm
- Outer Galaxy structure and rotation (ORC – Sakai, Nakanishi)
- Local Arm joins Perseus Arm?
- 4 Arm model -> DW

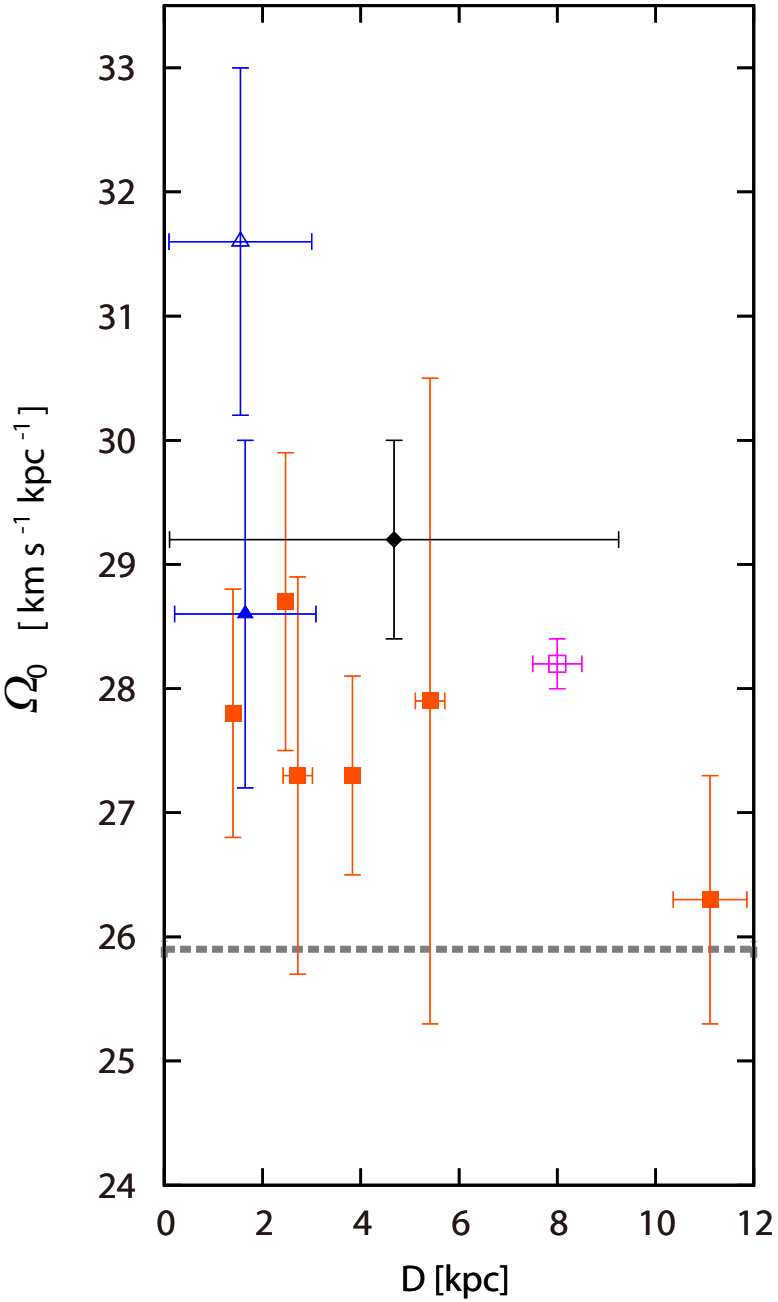
Mapping the Southern Galaxy: Opportunities

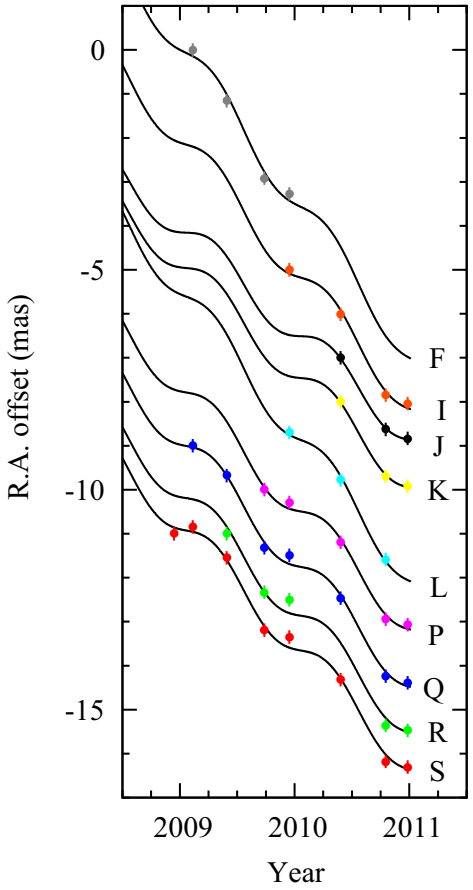


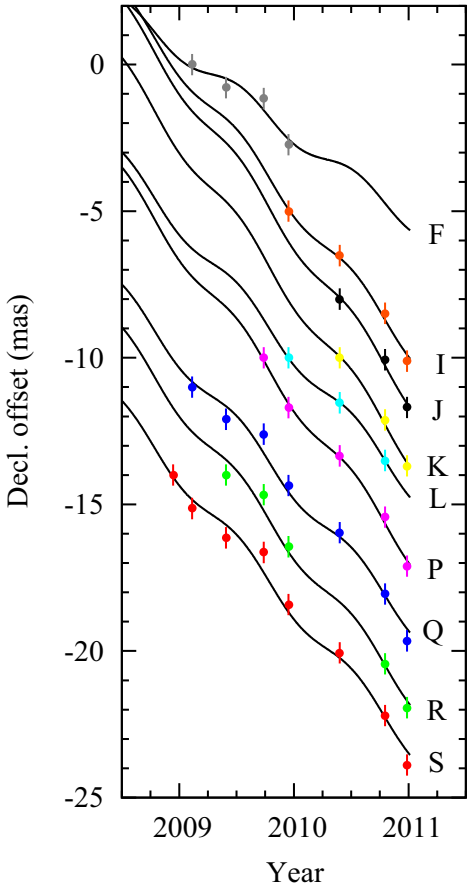
- Full Structure
  - how many arms?
  - relations?
- Density wave theory
- Outer Galaxy
- Bigger sample -> Ω_0, Θ_0, R_0
- Galactic center
- Bar

IRAS 20143+3634

Galactic Constants

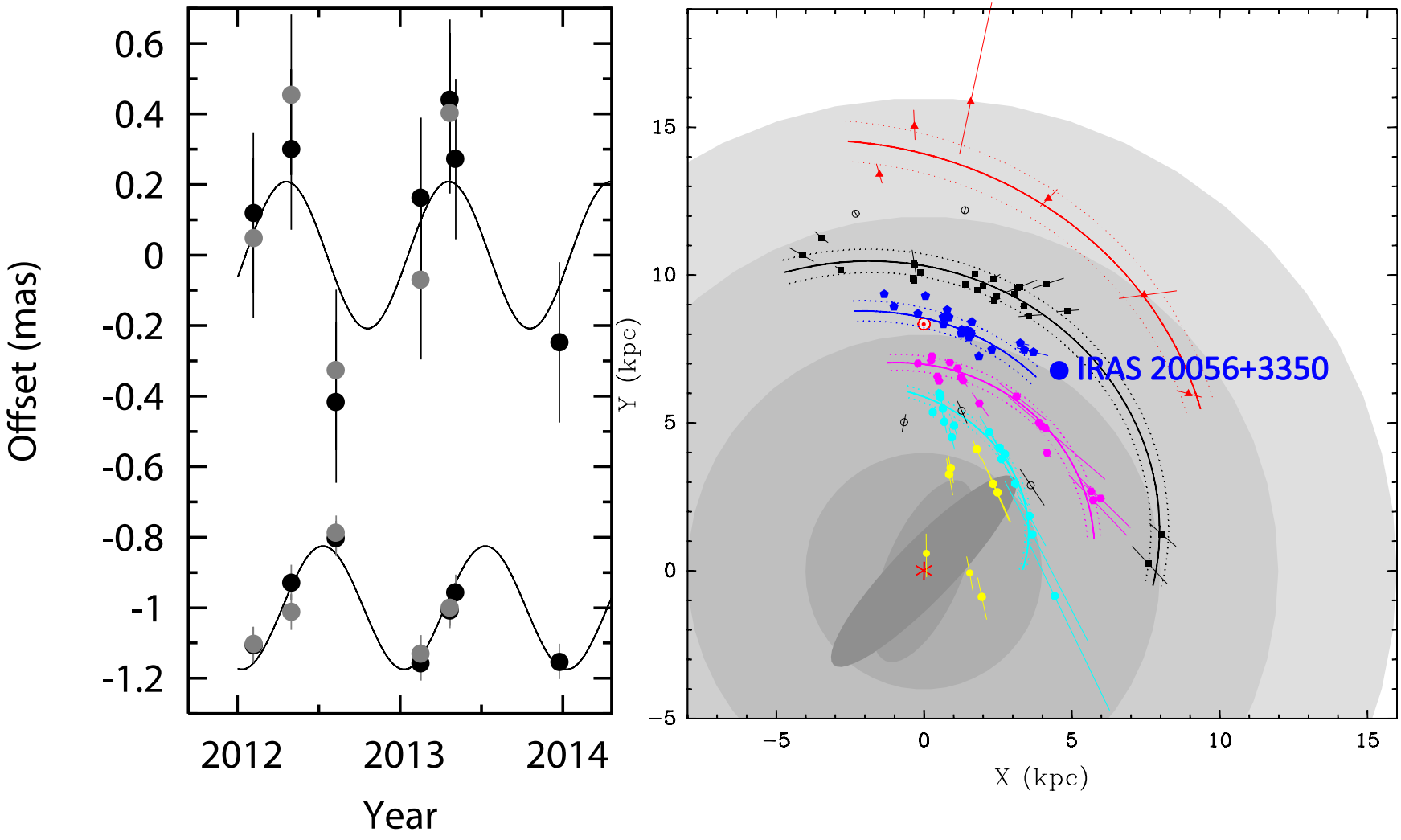


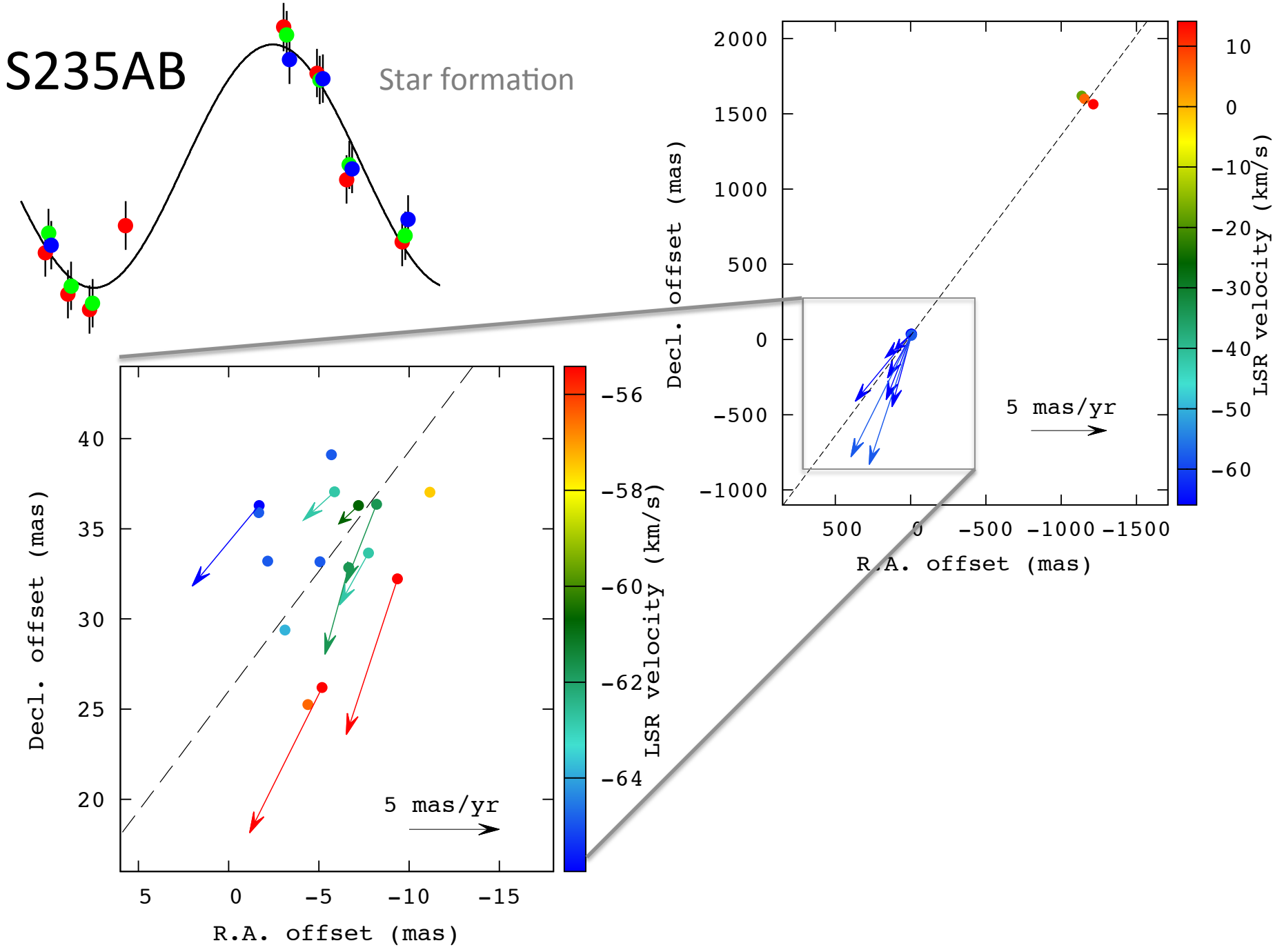




IRAS 20056+3350

Galactic Structure

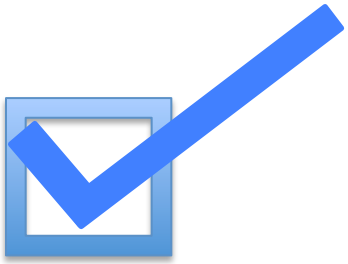



S235AB
Star formation
Decl. offset (mas)
R.A. offset (mas)
LSR velocity (km/s)
5 mas/yr
40
35
30
25
20
5
0
-5
-10
-15
-56
-58
-60
-62
-64
2000
1500
1000
500
0
-500
-1000
500
0
-500
-1000
-1500
10
0
-10
-20
-30
-40
-50
-60

We have the chance to solve many of the unanswered questions about the Galaxy, using Southern sky SKA-VLBI

SKA-VLBI synergy with current VERA projects

ORC – Increase sample size
SFR – Internal motions of masers
MIRA – large sample for P-L relation
GC – Better visibility of the G.Center

Discuss synergy with VERA 

Discuss new ideas 

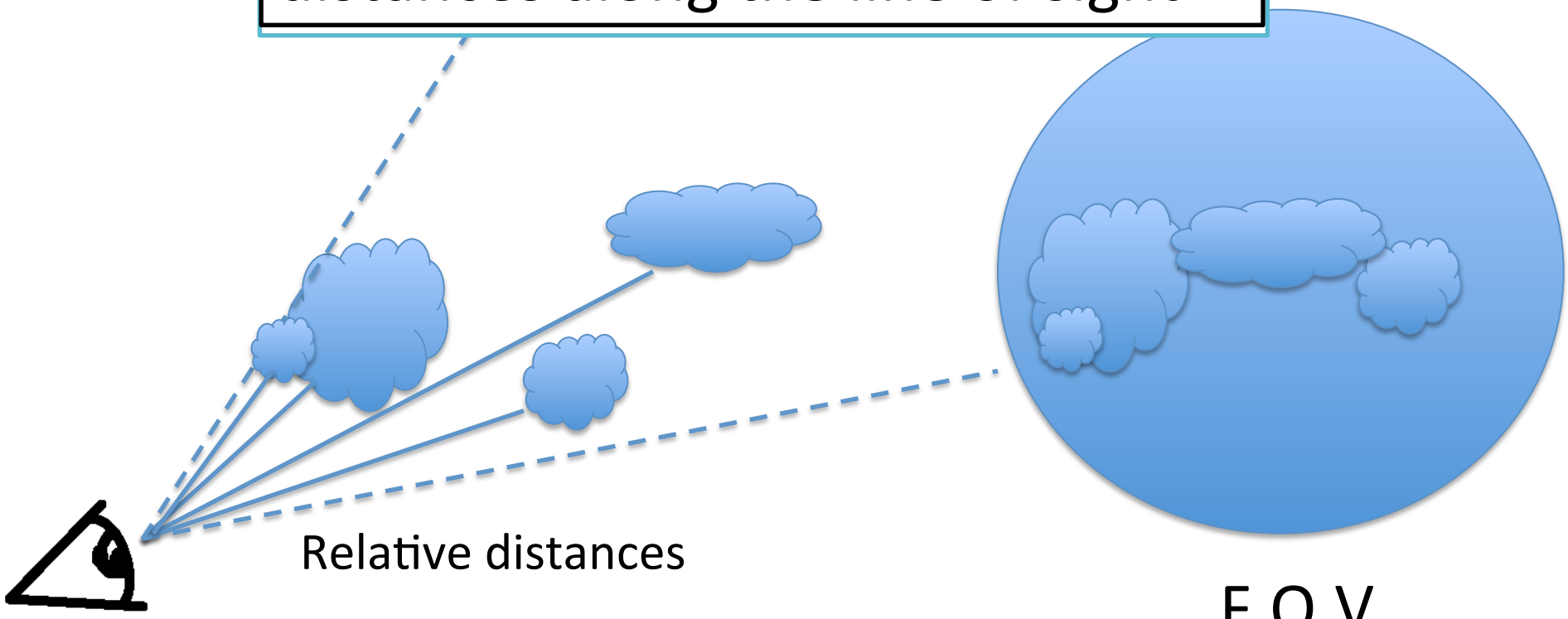
Big (more complete) samples allow us to study new stuff

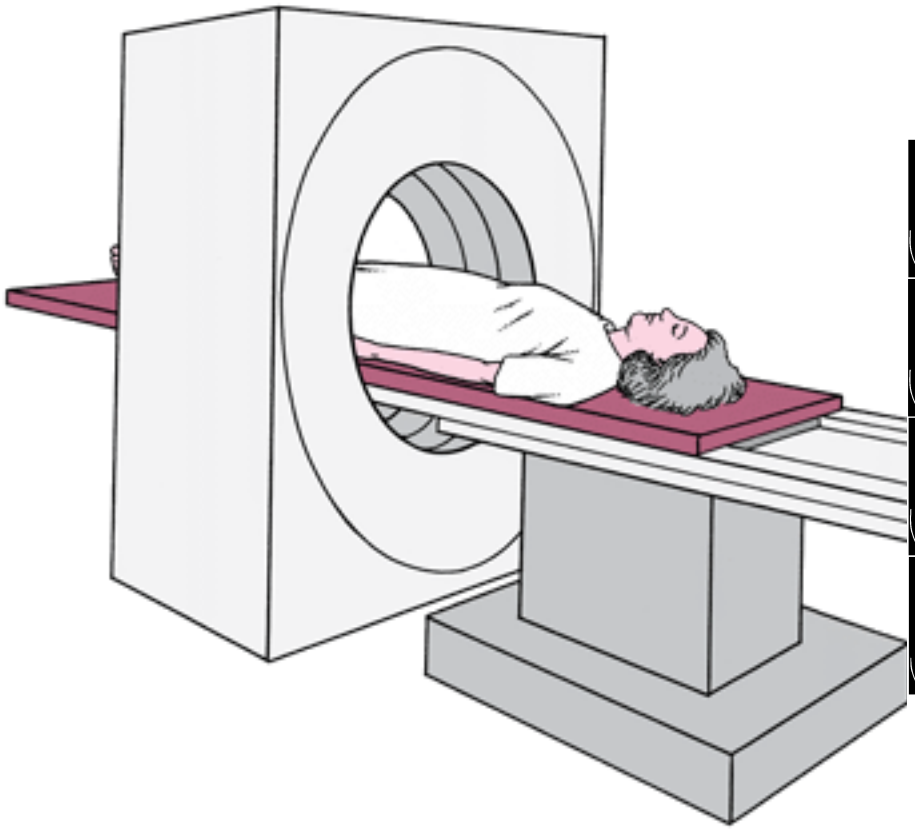
(Tomography of the Spiral Arms)

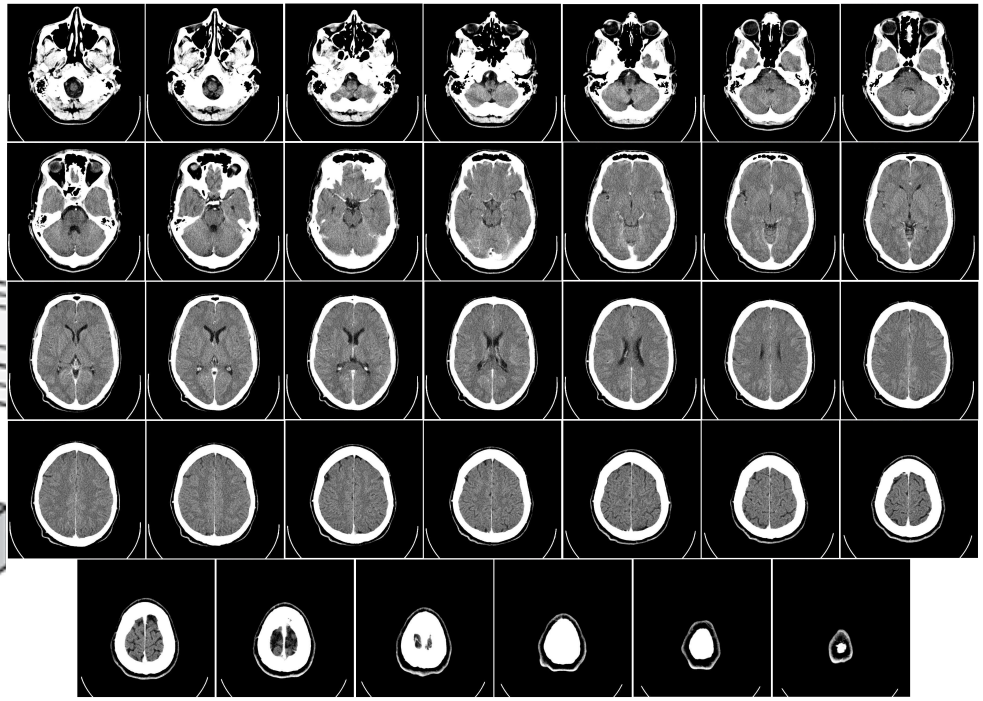
#1

What is meant by `tomography'?

Reveal 3D structure using distances along the line of sight







#2

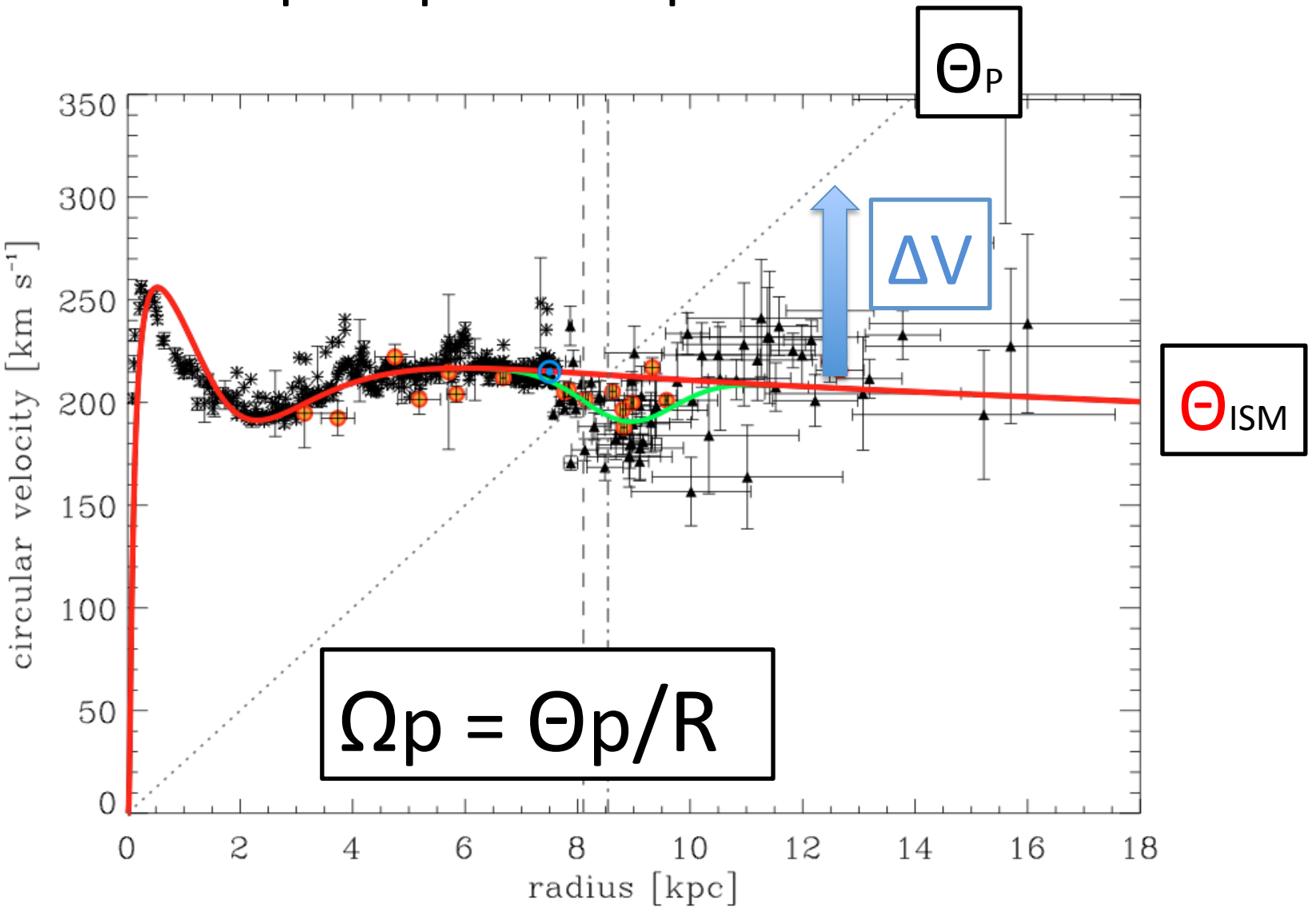
Tomography of Spiral Arms

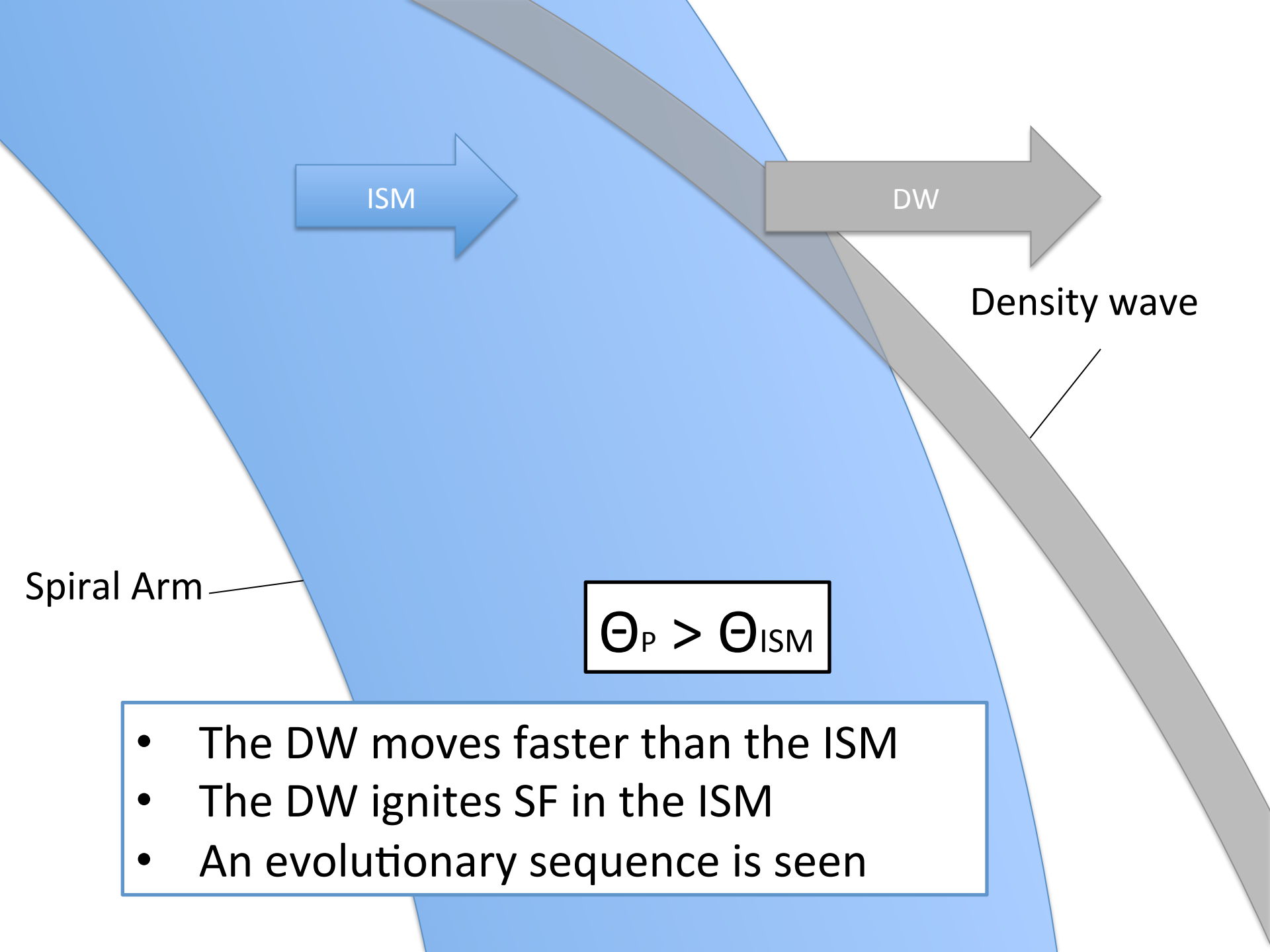
Influence of the density wave

And calculating the pattern speed

#2

The Spiral pattern speed

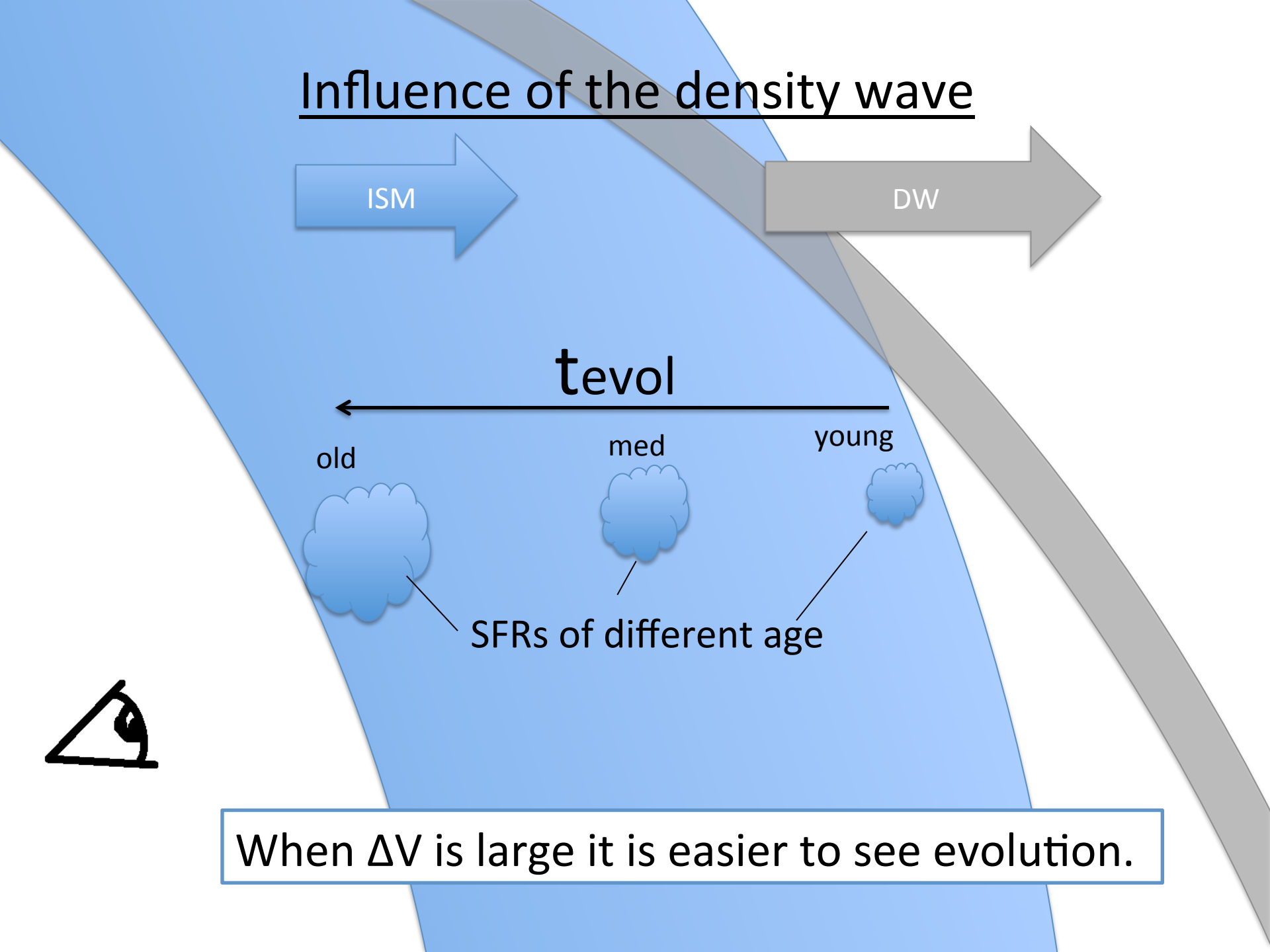




- The DW moves faster than the ISM
- The DW ignites SF in the ISM
- An evolutionary sequence is seen

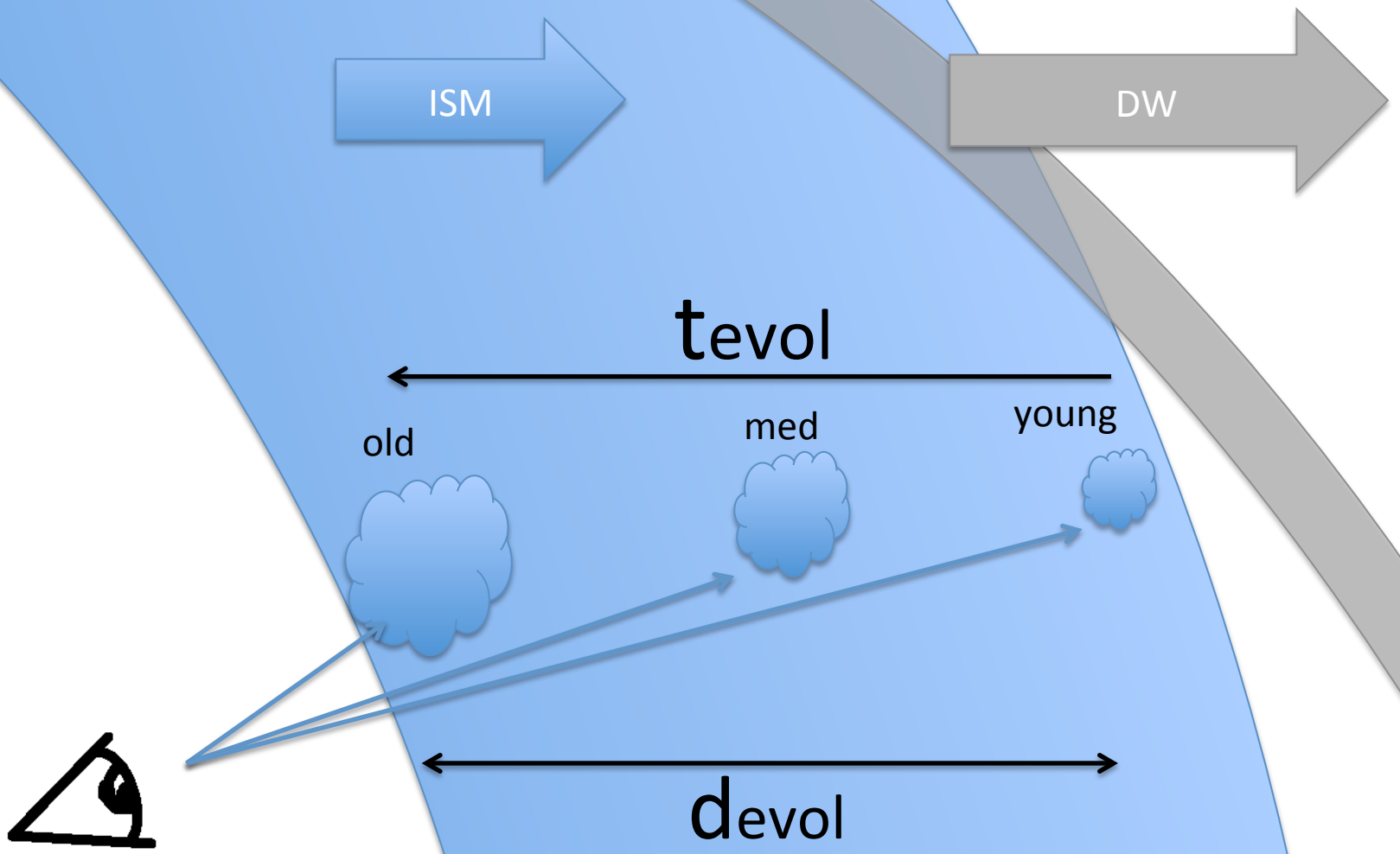

Density wave people
ISM

Influence of the density wave



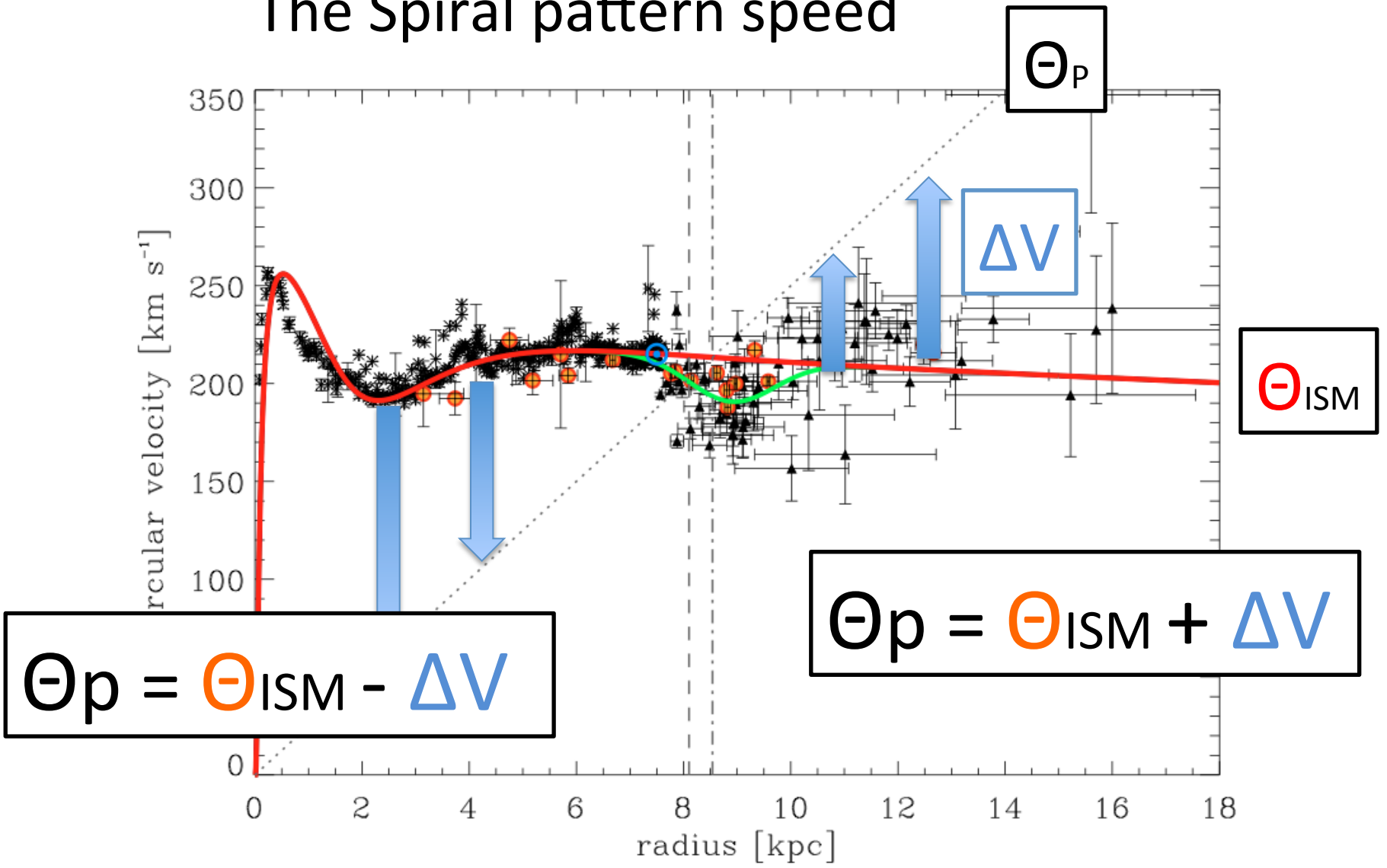
When ΔV is large it is easier to see evolution.

Influence of the density wave



$$\Delta V = d_{evol} / t_{evol}$$

Influence of the density wave:
The Spiral pattern speed



Is it feasible?

1) Need accurate distance (1 - 2%), therefore D < 3 kpc

2) ΔV must be detectable:

$$\Delta V = (\Theta - \Omega_p) \geq \frac{20pc}{10^6 yrs}$$

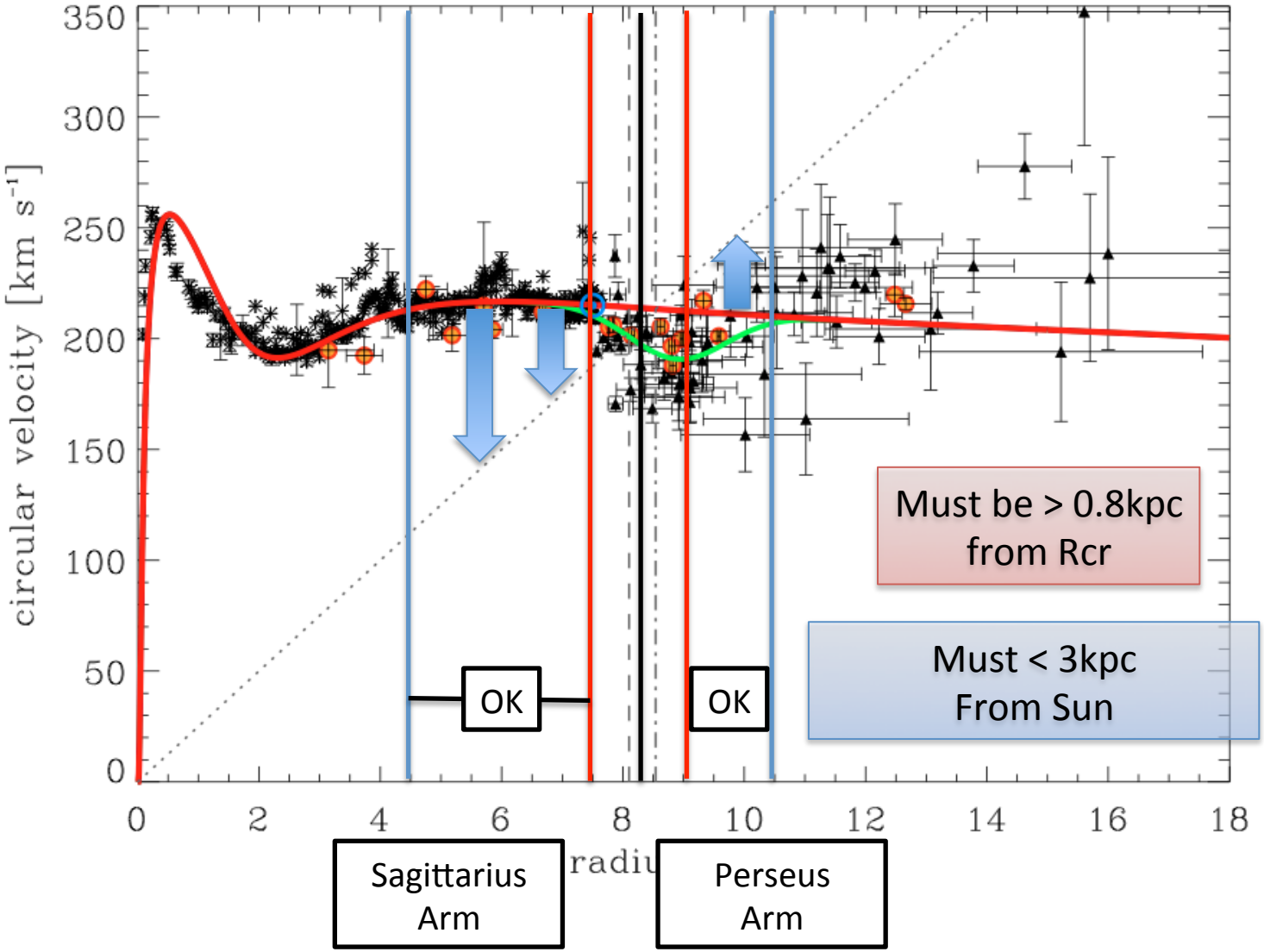
which gives

$$\Delta V = (\Theta - \Omega_p) \geq 20 \text{ km s}^{-1}$$

$$\frac{\Theta - \Omega_p}{\Omega_p} \simeq \frac{20km/s}{25km/s/kpc} = 0.8 \text{ kpc}$$

i.e. Must be more than 0.8 kpc from Rcr

Is it feasible?



More questions we can answer

Is the pattern REALLY a rigid body?

What is the influence of the Bar?

Is the pattern speed the same for all Arms?

Thank you for listening!