

CORRIENTES ESTELARES

Aquellos ríos de estrellas en la Galaxia y el Universo local

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La Charla de los Viernes en el Planetario UNLP

El grupo DOTS



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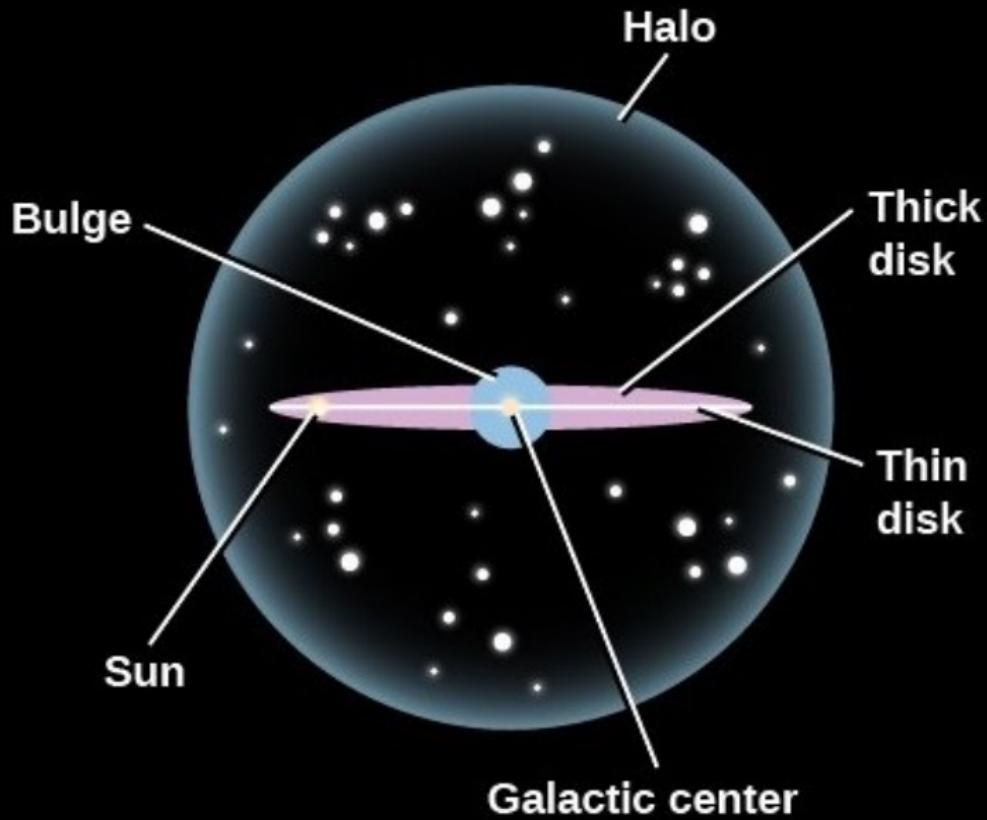
Martín Mestre

Una galaxia de disco típica

Messier 81 (HST)



Modelo simplificado de la Galaxia



Se empiezan a encontrar subestructuras: Arcturus stream

276

O. J. EGGEN

1971PASP...83..271E

stars in the other old disk population groups (cf. Eggen 1971c), the period is probably 80 to 90 days.

III. Kinematics

If we adopt $(U', V')_0$ with respect to the local standard of rest, of $(+10, -16)$ km/sec (Eggen 1970a), the Arcturus group has $V' = -100$ km/sec with respect to that standard. The parameters of the orbits of the group stars, based on the galactic potential field discussed by Eggen, Lynden-Bell, and Sandage (1962) are listed in Table III. The group stars, U' between -20 and -60 km/sec, are now at apogalactium, R_{\max} between 10.1 and 10.4 kpc, in orbits with $e = (R_{\max} - R_{\min})/(R_{\max} + R_{\min}) = 0.45$.

TABLE III
ORBITAL PARAMETERS FOR STARS WITH
 $V' = -100$ KM/SEC AND THE LISTED VALUES OF U'

| U' (km/sec) | $R(\text{Max})$ Kpc | $R(\text{Min})$ | e |
|------------------|------------------------|-----------------|-------|
| + 40 | 10.10 | 3.87 | 0.445 |
| + 20 | 10.08 | 3.90 | 0.44 |
| ± 0 | 10.08 | 3.90 | 0.44 |
| - 20 | 10.08 | 3.90 | 0.44 |
| - 40 | 10.10 | 3.87 | 0.445 |
| - 60 | 10.40 | 3.84 | 0.46 |
| - 80 | 10.90 | 3.80 | 0.485 |
| -100 | 11.10 | 3.73 | 0.495 |

The values of U and Y for the members of the

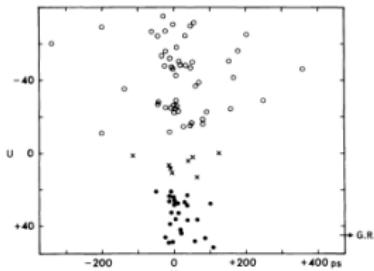
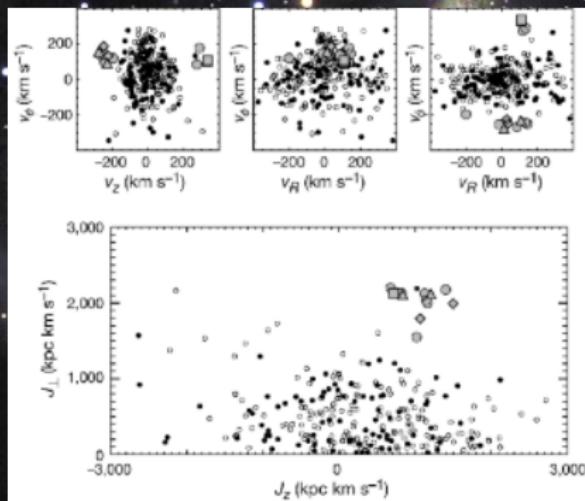


FIG. 5.—The correlation between the U vectors of the space motion and Y , the distance from the sun in the direction of galactic rotation, for members of the Arcturus group in Table I (open circles). Stars in Table IV are shown as crosses and the filled circles are members of the η Cephei group.

The η Cephei group members (Eggen 1971b) have values of U between $+20$ and $+50$ km/sec and $V(-97 \text{ km/sec})$ is only about 10 percent less than that for the Arcturus group stars. The U vectors of η Cephei group members are shown as filled circles in Figure 5. The trigonometric parallax of Arcturus is too well established to allow a change from -119 to -97 km/sec and the value of $V = -97$ km/sec for η Cep is based on a trigonometric parallax of $0''.071$ (weight 52) whereas $V = -116$ km/sec would require a value of $0''.027$. Although the difference in the V velocity of the two groups is small, it

Helmi stream

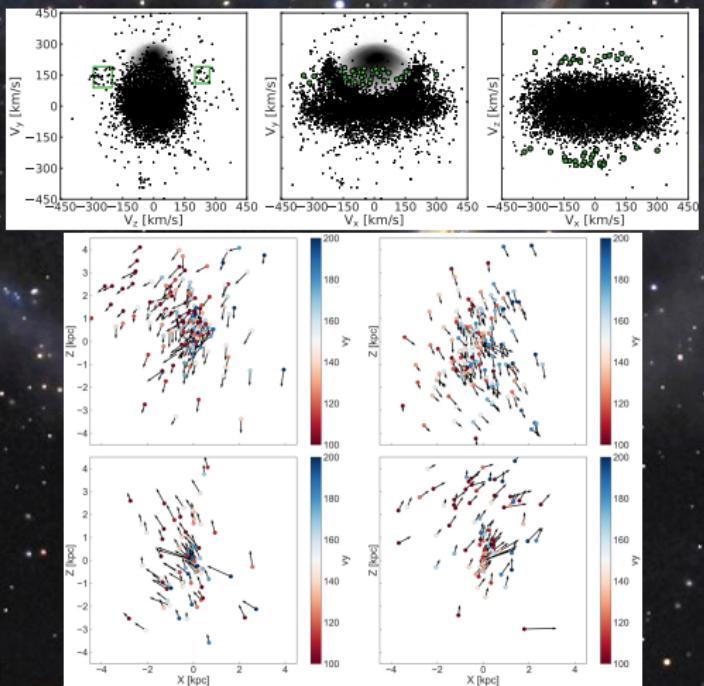
• Satélite Hipparcos
Miembros detectados: 13 estrellas



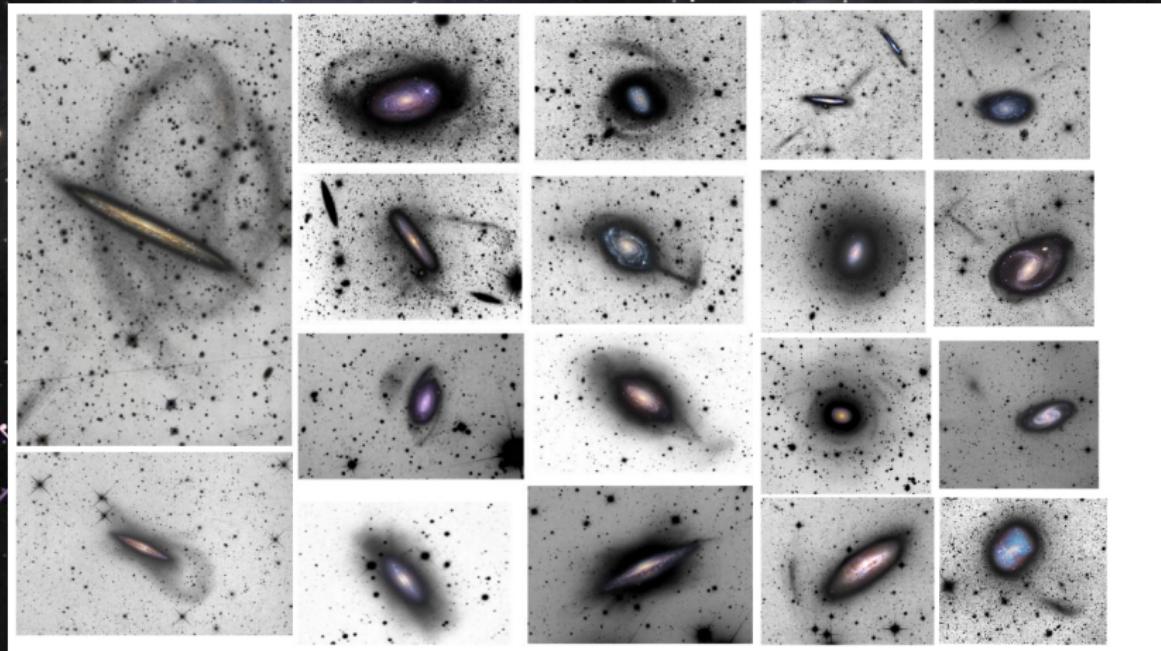
Helmi stream

Satélite Gaia

Nuevos miembros detectados: ~ 600 estrellas



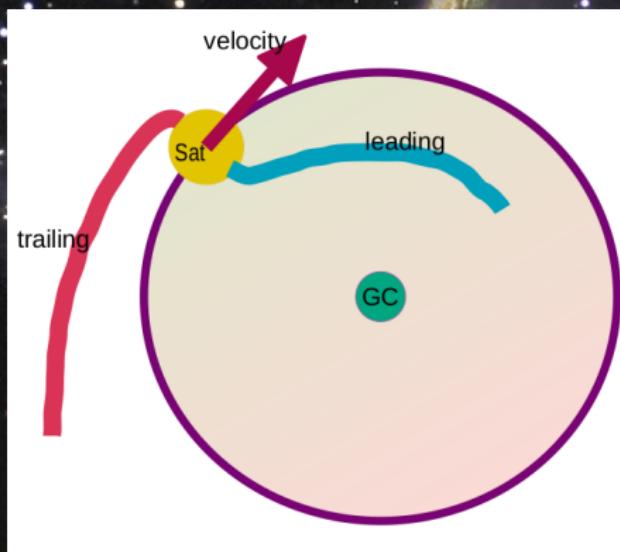
Corriente estelares en el Universo local



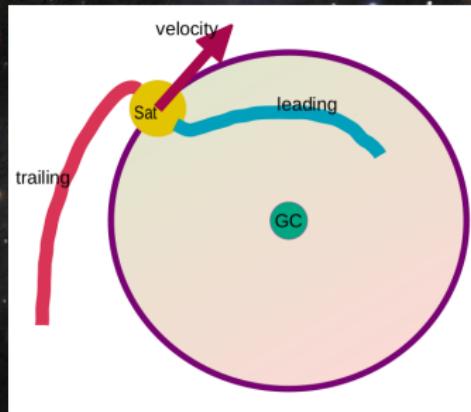
Qué es una corriente estelar?

Es el sistema que se forma cuando un sistema auto-gravitante de estrellas (cúmulo globular o galaxia enana) es desarmada por las fuerzas gravitatorias de marea producidas por la galaxia anfitriona.

Generalmente un par de brazos de marea son formados, uno que va hacia adelante y otro hacia atrás del progenitor.

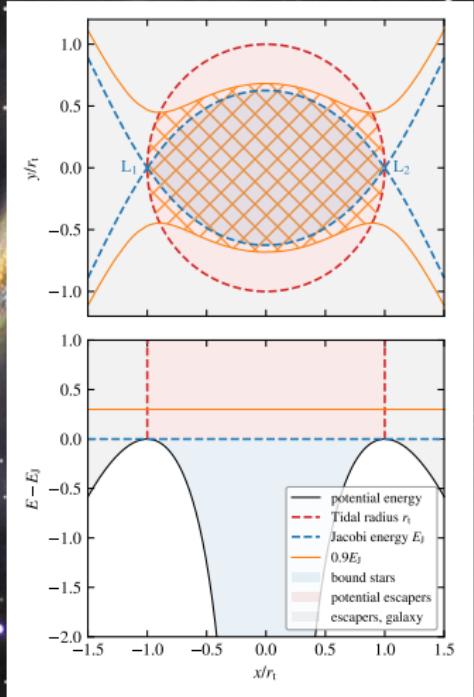


El radio de marea



Para órbitas circulares en un potencial con simetría esférica:

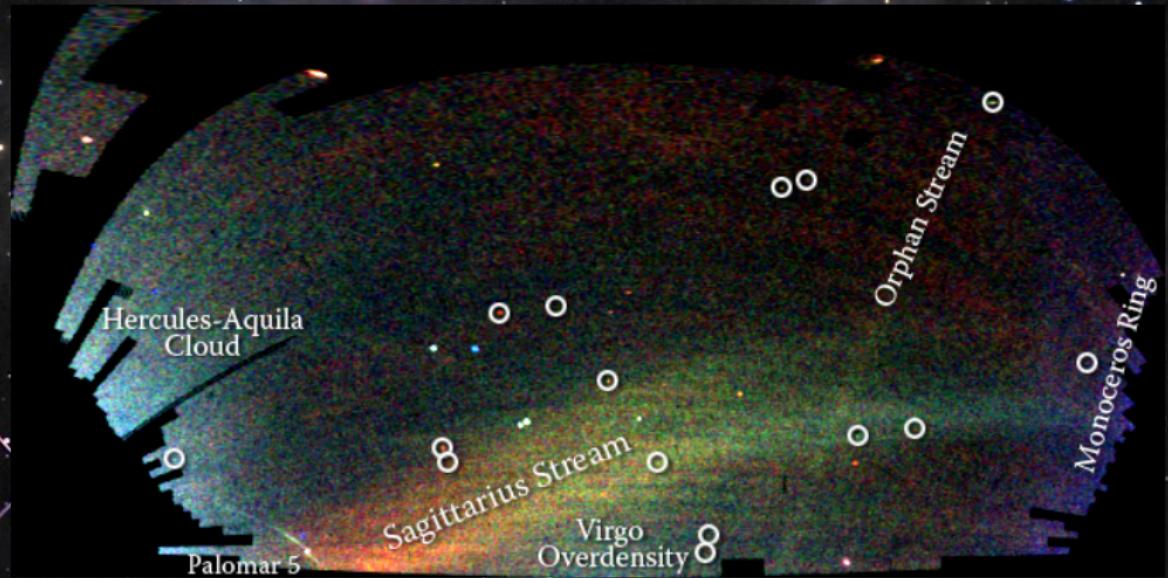
$$r_t \approx \left(\frac{Gm}{\Omega^2 - \frac{\partial^2 \Phi}{\partial R^2}} \right)^{1/3}$$



Simulación de corriente estelar genérica

Animación: 1_GlobularClusterStreamInMWwithSubHalos.mp4

El campo de corrientes estelares

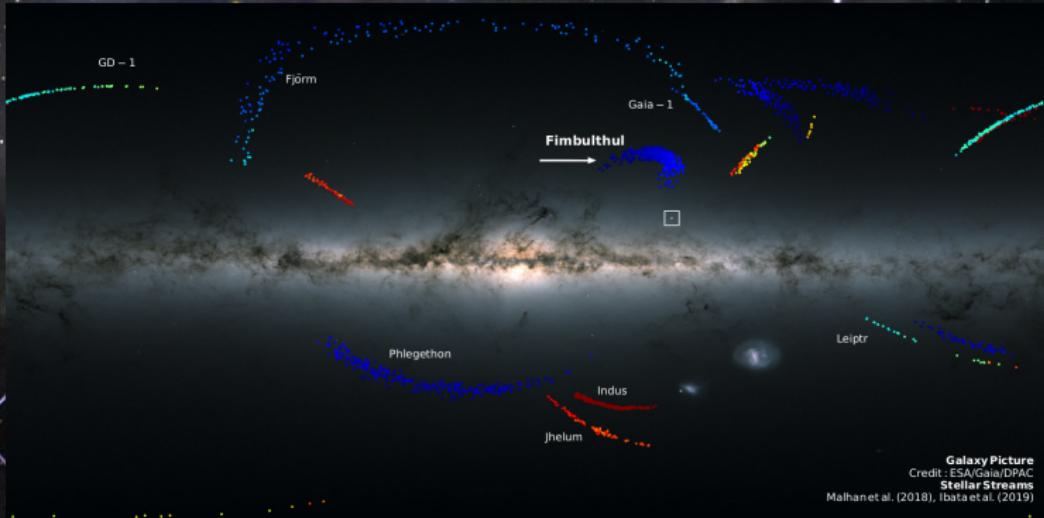


Blokurov V. et al. 2006

Simulación de corriente estelar de Sagitario

Animación: 2_FormationSagittariusStreamWithLMC.mp4

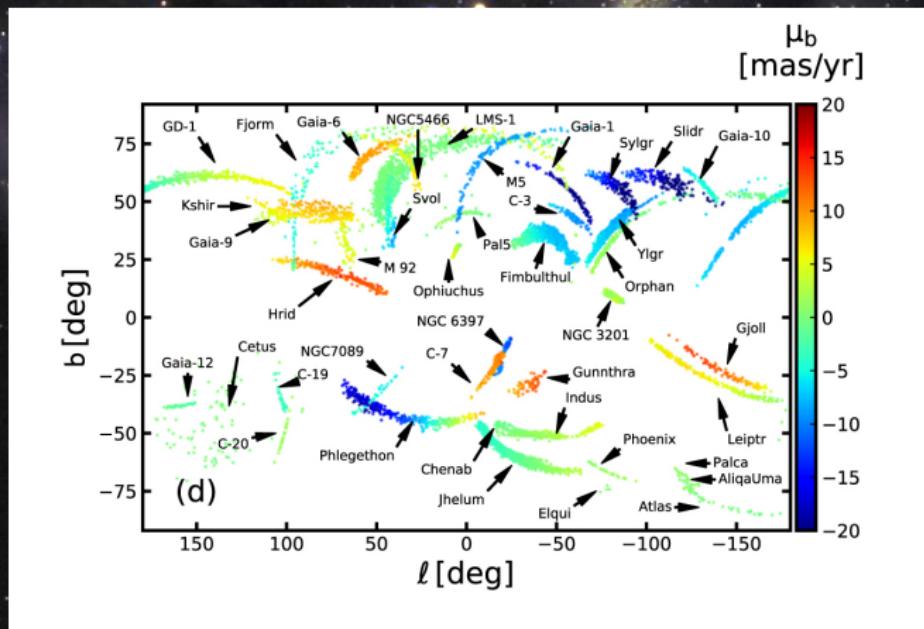
La era de Gaia



Corrientes estelares en la Galaxia

Atlas de las fusiones en la Vía Láctea (Malhan et al. 2022)

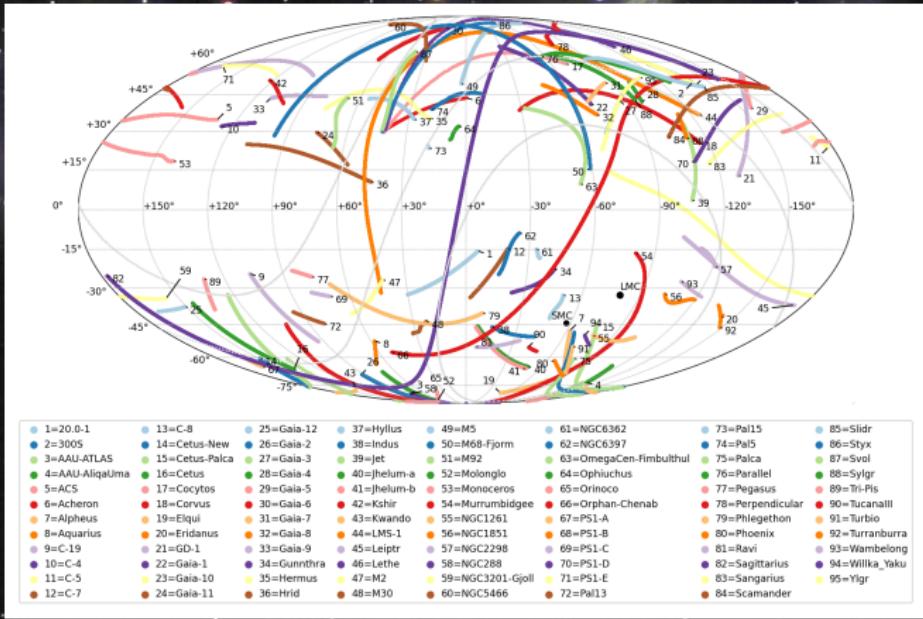
41 corrientes comprendiendo un total de 9192 estrellas de Gaia EDR3



Corrientes estelares en la Galaxia

Código Galstreams en Python (Cecilia Mateu 2022)

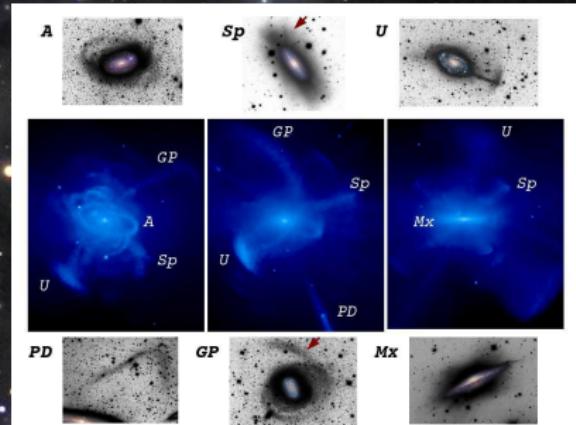
95 corrientes con trayectorias 5D/6D disponibles



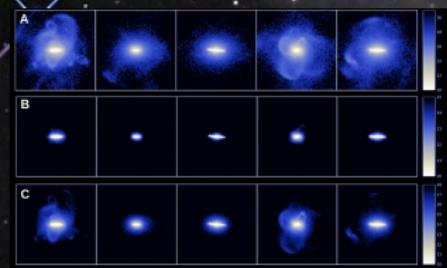
Corrientes estelares en la computadora

Efectos de marea:

- Círculos máximos
- Plumas
- Caparazones
- Paraguas
- Nubes gigantes



Martínez-Delgado D. et al. 2010, Johnston et al. 2008

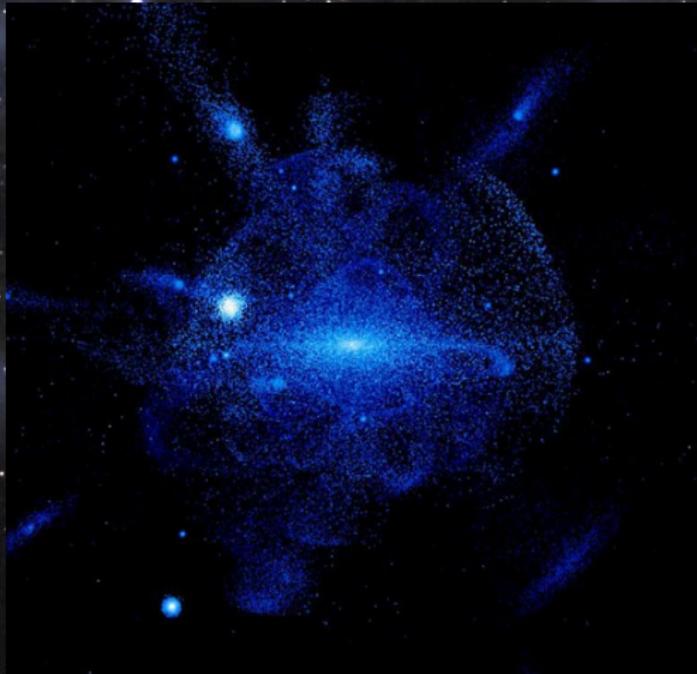


Martínez-Delgado D. 2018

Corrientes alrededor de galaxia tipo VL para diferentes valores del límite de brillo superficial detectable (mag/arcsec²):

- $\mu_A = 31$
- $\mu_B = 25$
- $\mu_C = 28$

Corrientes simuladas en la computadora

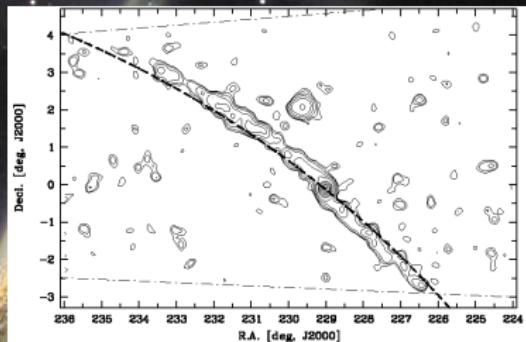
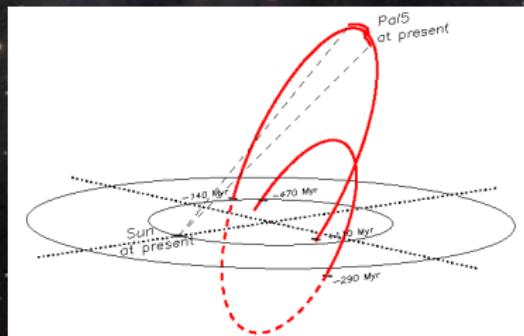


Consistente con un Universo jerárquico formado por sucesivas fusiones de galaxias

Corriente Palomar 5

(Odenkirchen 2000+)

Una corriente estelar que transita por el halo y la barra



$$d_{CG} \approx 16 \text{ kpc}$$

$$d_\odot \approx 20 \text{ kpc}$$

$$\text{longitud} \approx 20^\circ / 7 \text{ kpc}$$

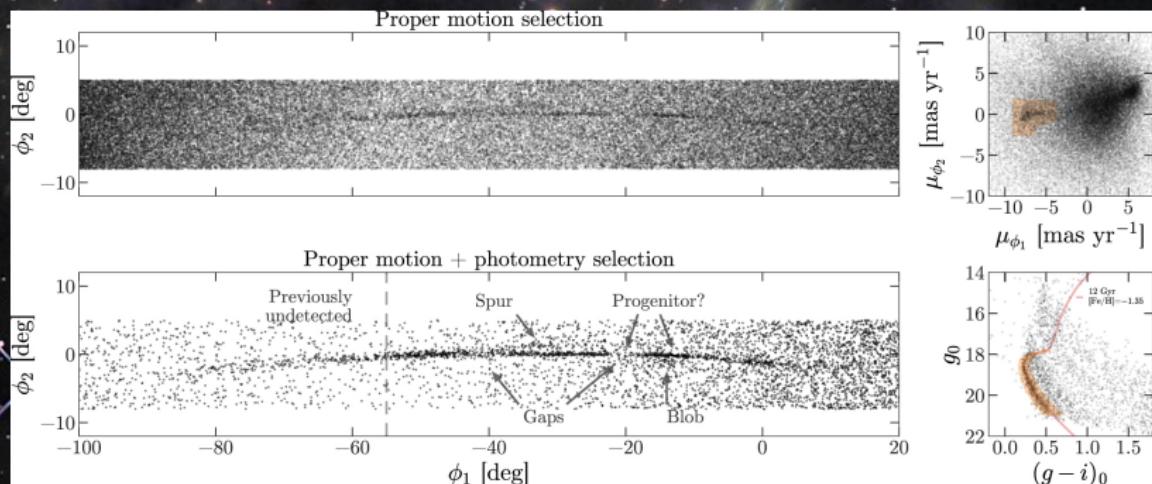
$$\text{ancho} \approx 120 \text{ pc}$$

Corriente estelar GD-1

(Grillmair & Dionatos 2006)

Una corriente estelar "fría"

(Price-Whelan & Bonaca 2018)

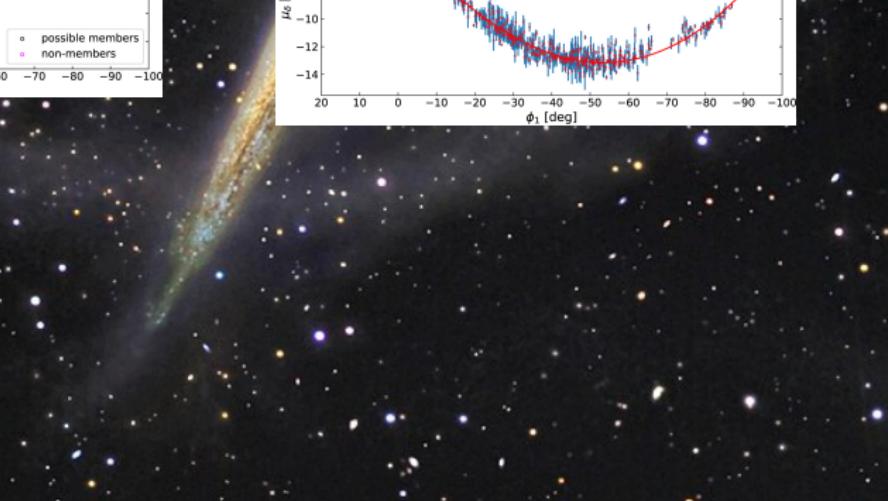
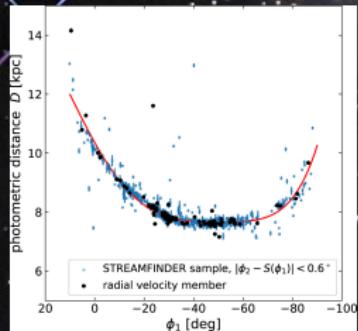
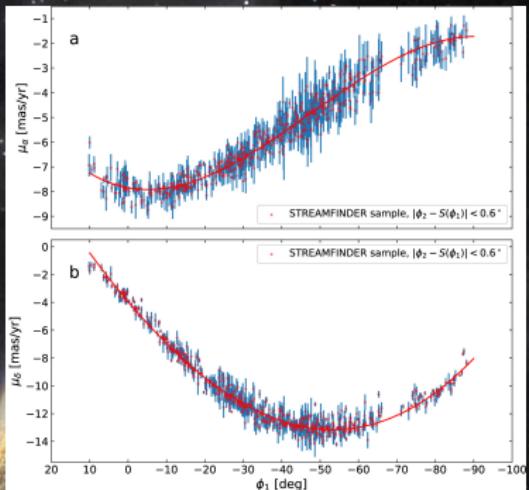
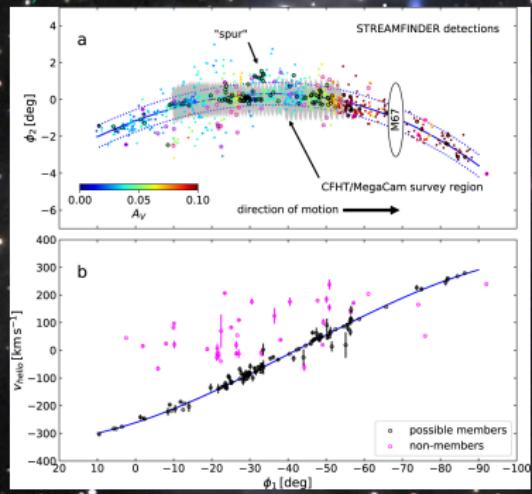


$d_\odot \approx 10$ kpc
length $\approx 100^\circ / 10$ kpc

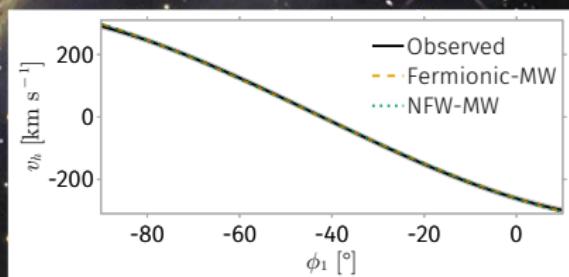
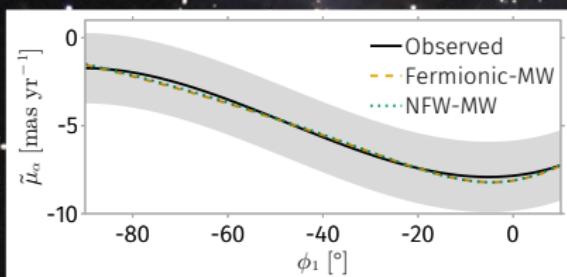
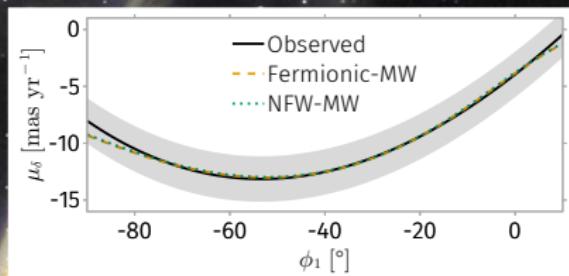
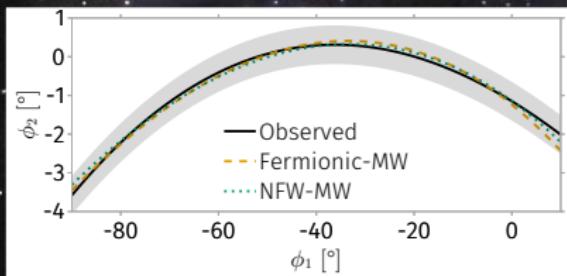
width $\approx 12^\circ / 30$ pc

Observables de la corriente GD-1

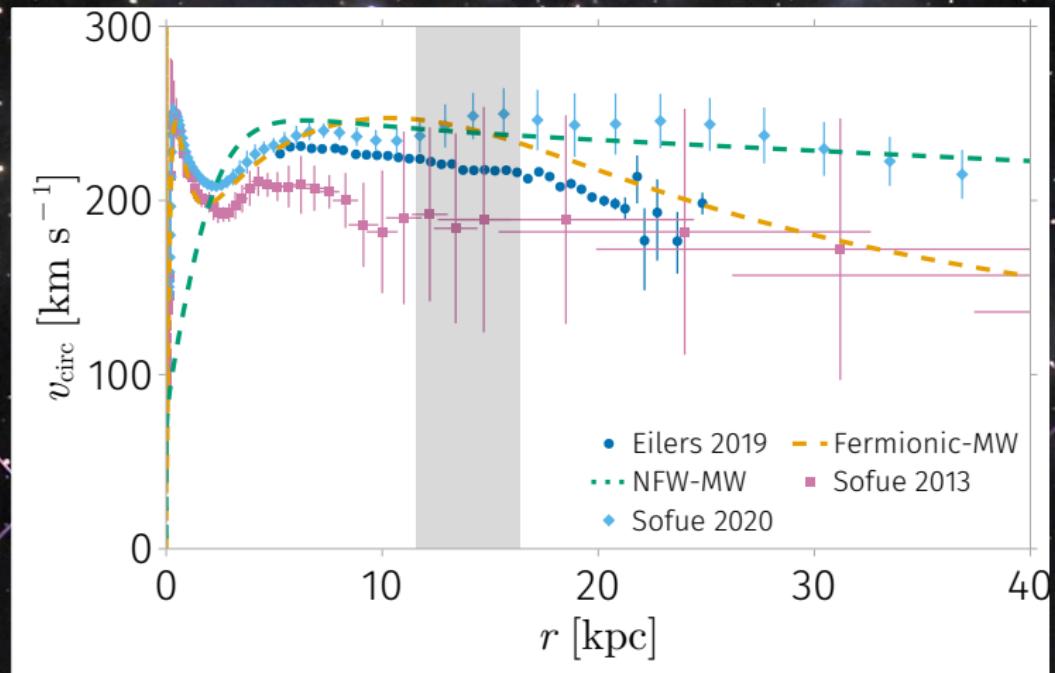
(Ibata+20)



Resultado de ajuste de potencial gravitatorio



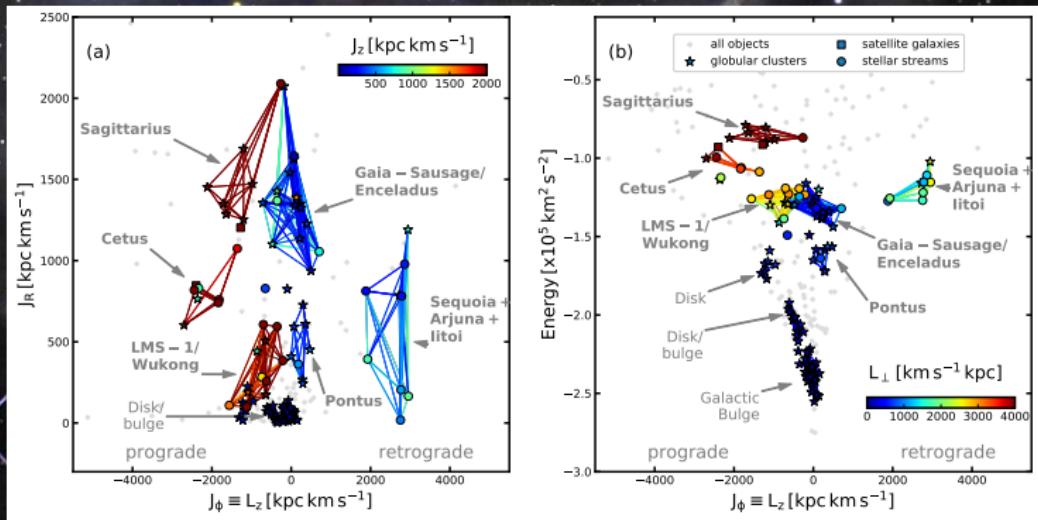
Curva de rotación Galáctica



42 corriente estelares

Animación: 3_42StellarStreams.mp4

Atlas global de las fusiones en la Vía Láctea



Corrientes estelares y cúmulos globulares agrupados en espacio Energía-Momento angular

Atlas global de las fusiones en la Vía Láctea

Animación: 4_AtlasOfStreams.mp4

Fusión de dos galaxias de disco

Animación 360°: GalaxyCollision

¡Muchas gracias!



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