The Gaia Challenge - recovering the galactic potential using a Palomar 5-like stream

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ABSTRACT
Kick-ass abstract

Key words: globular clusters — galactic dynamics

1 INTRODUCTION

Very introductory text.

2 THE WORKSHOPS

Very interesting text about the Gaia Challenge workshops.

3 THE PALOMAR 5 CHALLENGE

This is a very interesting text about the Challenge.

We ran a direct N-body simulation of a Palomar 5-like globular cluster, which dissolved in a static background potential (see below). The model initially consisted of 65,356 particles and was evolved for 4 Gyr using the publicly available code Nbody6.

The Challenge can be found on the wiki page of the Gaia Challenge workshop[1], and we invite everybody to download the Challenge and contribute. The columns are described in the header of the file. They give Cartesian coordinates and observables for positions and velocities of all particles. All numbers are either in pc and km/s, or degree and mas/yr, respectively.

The Cartesian coordinates are given in the Galactic rest frame. The observables were derived assuming a solar Galactocentric distance of 8.33 kpc and a LSR motion of 239.5 km/s (Gillessen et al. 2009). In addition, the solar reflex motion was assumed to be $(11.1, 12.24, 7.25)$ km/s (Schönrich, Binney, & Dehnen 2010).

The present-day position of Palomar 5 is $RA = 229.022083$ deg, $Dec = -0.111389$ deg or $l = 0.852059$ deg,

$b = 45.859989$ deg, respectively. The present-day Cartesian coordinates of the progenitor are

$$
\begin{align}
x &= 7816.082584 pc \tag{1}\\
y &= 240.023507 pc \tag{2}\\
z &= 16640.055966 pc \tag{3}\\
vx &= -37.456858 km/s \tag{4}\\
vy &= -151.794112 km/s \tag{5}\\
vz &= -21.609662 km/s \tag{6}
\end{align}
$$

3.1 The potential

- $M_{Halo} = 1.81194 \times 10^{12} \, M_\odot$
- $R_{Halo} = 32260 \, pc$
- $q_z = 0.8140$
- $M_{Pal5}(t = -4Gyr) = 31090 \, M_\odot$
- $M_{Pal5}(t = today) = 13150 \, M_\odot$
- $d_{Sun} = 23190 \, pc$
- $V_C(R_{Sun}) = 249.01 \, km/s$
- $V_C(R_{Pal5}) = 247.84 \, km/s$
- $V_C(R_{Halo}) = 251.99 \, km/s$
- $a(R_{Sun}, 0, 0) = 7.44 \, pc/Myr^2$
- $a(R_{Pal5}) = a(7816pc, 240pc, 16640pc) = 3.34 \, pc/Myr^2$
- $a(R_{Halo}, 0, 0) = 1.97 \, pc/Myr^2$

The functional form of the potential components is as follows:

Flattened NFW halo:

$$
\Phi_{Halo}(R, z) = -\frac{GM}{\sqrt{R^2 + \frac{z^2}{q_z^2}}} \ln\left(1 + \frac{\sqrt{R^2 + \frac{z^2}{q_z^2}}}{R_{Halo}}\right) \tag{7}
$$

Jaffe bulge:

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$$\Phi_{Bulge} \quad = \quad -\frac{GM_{Bulge}}{b_{bulge}} \ln \frac{R}{R + b_{bulge}} \tag{8}$$

$$M_{Bulge} \quad = \quad 3.4 \times 10^{10} \, \mathrm{M_\odot} \tag{9}$$

$$b_{Bulge} \quad = \quad 700.0 \, \mathrm{pc} \tag{10}$$

Miyamoto-Nagai disk:

$$\Phi_{Disk} \quad = \quad -\frac{GM_{Disk}}{\sqrt{R^2 + \left(a_{Disk} + \sqrt{z^2 + b_{Disk}^2}\right)^2}} \tag{11}$$

$$M_{Disk} \quad = \quad 1.0 \times 10^{11} \, M_\odot \tag{12}$$

$$a_{Disk} \quad = \quad 6500 \, pc \tag{13}$$

$$b_{Disk} \quad = \quad 260 \, pc \tag{14}$$

4 THE METHODS

Quite interesting text about the methods.

4.1 Nathan Deg

Nathan's method is described in Deg & Widrow (2013).

5 RESULTS

Many interesting results.

5.1 Nathan Deg

This subsection is dedicated to Nathan.

6 CONCLUSIONS

Oh man, all these conclusions!

REFERENCES

Deg N., Widrow L., 2013, MNRAS, 428, 912
Gillessen S., Eisenhauer F., Trippe S., Alexander T., Genzel R., Martins F., Ott T., 2009, ApJ, 692, 1075 3
Schönrich R., Binney J., Dehnen W., 2010, MNRAS, 403, 1829 3

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