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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

$$x = 7816.082584pc \quad (1)$$
$$y = 240.023507pc \quad (2)$$
$$z = 16640.055966pc \quad (3)$$
$$vx = -37.456858km/s \quad (4)$$
$$vy = -151.794112km/s \quad (5)$$
$$vz = -21.609662km/s \quad (6)$$

- $M_{Pal5}(t = -4Gyr) = 31090\, M_\odot$
- $M_{Pal5}(t = today) = 13150\, M_\odot$
- $d_{Sun} = 23190\, pc$

3.1 The potential

The functional form of the potential components is as follows:

Flattened NFW halo:

$$\Phi_{Halo}(R, z) = -\frac{GM}{\sqrt{R^2 + \frac{z^2}{q_z^2}}} \ln\left(1 + \frac{\sqrt{R^2 + \frac{z^2}{q_z^2}}}{R_{Halo}}\right) \quad (7)$$
$$M_{Halo} = 1.81194 \times 10^{12}\, \mathrm{M}_\odot \quad (8)$$
$$R_{Halo} = 32260\, pc \quad (9)$$
$$q_z = 0.8140 \quad (10)$$

Jaffe bulge:

$$\Phi_{Bulge} = -\frac{GM_{Bulge}}{b_{bulge}} \ln\frac{R}{R + b_{bulge}} \quad (11)$$
$$M_{Bulge} = 3.4 \times 10^{10}\, \mathrm{M}_\odot \quad (12)$$
$$b_{Bulge} = 700.0\, \mathrm{pc} \quad (13)$$

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Miyamoto-Nagai disk:

$$\Phi_{Disk} = -\frac{GM_{Disk}}{\sqrt{R^2 + \left(a_{Disk} + \sqrt{z^2 + b_{Disk}^2}\right)^2}} \tag{14}$$

$$M_{Disk} = 1.0 \times 10^{11}\, M_\odot \tag{15}$$

$$a_{Disk} = 6500\, pc \tag{16}$$

$$b_{Disk} = 260\, pc \tag{17}$$

- $V_C(R_{Sun}) = 249.01\, km/s$
- $V_C(R_{Pal5}) = 247.84\, km/s$
- $V_C(R_{Halo}) = 251.99\, km/s$
- $a(R_{Sun}, 0, 0) = 7.95\, pc/Myr^2$
- $a(R_{Pal5}) = a(7816pc, 240pc, 16640pc) = 3.51\, pc/Myr^2$
- $a(R_{Halo}, 0, 0) = 2.06\, pc/Myr^2$

4 THE METHODS

Quite interesting text about the methods.

4.1 Ana Bonaca

4.2 Nathan Deg

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

5 RESULTS

Many interesting results.

5.1 Ana Bonaca

For Ana's results see Fig. 1

5.2 Nathan Deg

This subsection is dedicated to Nathan.

6 CONCLUSIONS

Oh man, all these conclusions!

ACKNOWLEDGEMENTS

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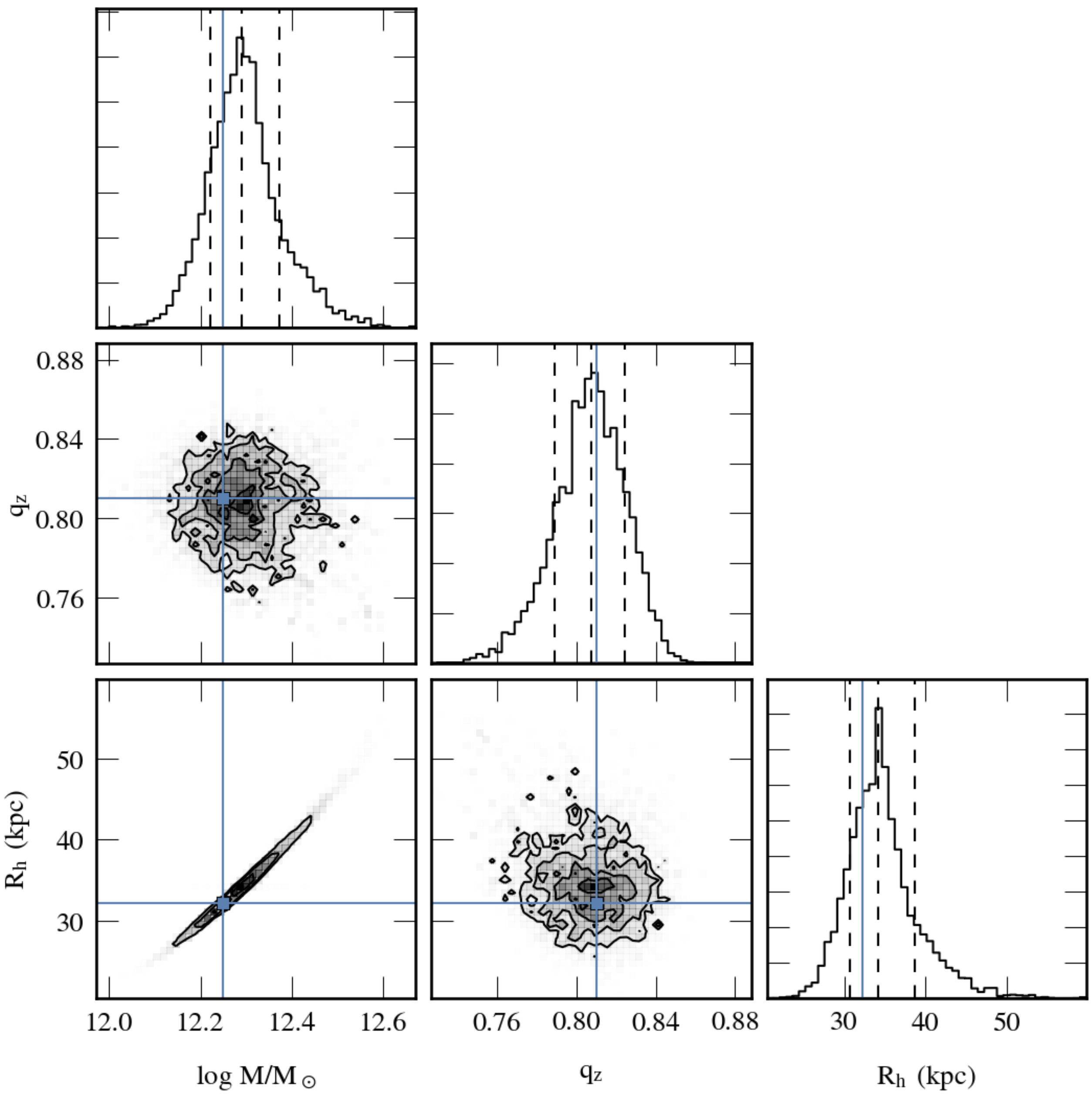
0.88
0.84
0.80
0.76
q_z
50
40
30
R_h (kpc)
12.0
12.2
12.4
12.6
0.76
0.80
0.84
0.88
30
40
50
log $M/M_\odot$
q_z
R_h (kpc)

Figure 1. ...