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A SPECTROSCOPIC SURVEY OF SUPERTHIN GALAXIES*

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ABSTRACT

We present spectroscopic observations of superthin galaxies. Superthin galaxies have the thinnest stellar disks among disk galaxies. A sample of 138 superthins was observed in visible light with the 3.5 m telescope at Apache Point Observatory in New Mexico to obtain the rotation curves of the ionized gas in the galaxies. The sample represents the largest survey of superthin galaxies so far and provides a database to investigate the kinematic and dynamic properties of this special type of extragalactic objects. Here we present the rotation curves of our sample objects.

Keywords: Extragalactic Astronomy (506), Galaxy Spectroscopy (2171), Galaxy Kinematics (602), Galaxy Rotation Curves (619), Galaxy Dynamics (591), Dark Matter (353)

INTRODUCTION

Superthin galaxies are the thinnest disk galaxies. Several studies have been conducted over many years because of the unusual appearance of this galaxy types, especially from an edge-on perspective, see Goad & Roberts (1979), Karachentsev et al. (1993), Kautsch (2009). The superthin galaxy types are defined to have a very thin stellar disks, and over the time the definition slightly changed because of differences of defining the extension of galaxies (major/minor axes versus scalelength/scaleheight) and the color filter used to image the objects. We use a modern definition to select the target galaxies developed by Bizyaev et al. (2017). In this definition superthins have a scalelength-to-scaleheight ratio of their stellar disk larger than nine ($h/z \geq 9$) in the SDSS r band.

Superthins are part of the flat, aka simple disk, galaxy class, which is mostly part of Sd Hubble class; and the objects have low surface brightnesses (Karachentsev et al. (1993), Karachentsev et al. (1999), Makarov et al. (2001), Mitronova et al. (2005), Kautsch et al. (2006), Kautsch (2009), Bizyaev et al. (2014), Bizyaev et al. (2017)). About 5% of Sd galaxies are superthins (Kautsch et al. (2006), Bizyaev et al. (2017)). Only very few superthin galaxies have

Superthin galaxies

- Как правило, нет балджа.
- Стабилизация диска массивным темным гало

Here we report the first results of our long-term spectroscopic survey and present the rotation curves of the objects. 138 target objects.

- Dual Imaging Spectrograph on the 3.5 m telescope of the Apache Point Observatory

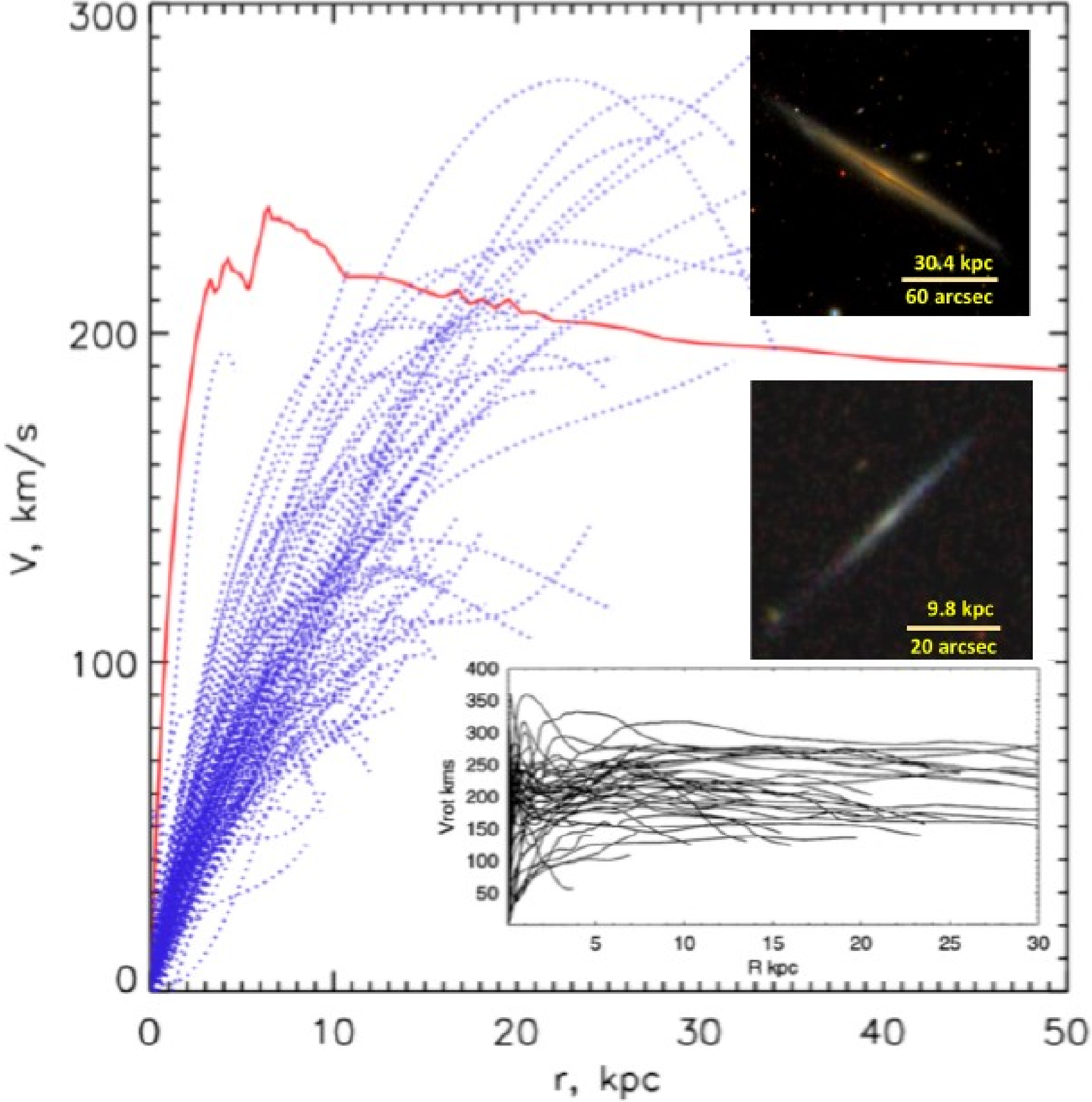

Figure 1. The main figure shows the rotation curves of our 138 galaxies in blue dotted curves. The solid red curve demonstrates the Milky Way rotation curve. The inlays show representative superthins of a red (upper) and a blue (lower) type, respectively. The horizontal bar in each panel represents the scale in kpc at the distance of the galaxy and the apparent size in arcsec. The bottom inlay shows rotation curves of normal regular disk galaxies from Sofue et al. (1999) for comparison.

REFERENCES

Superthins appear in two distinct populations with dierent properties based on their (r-i) color (Bizyaev et al, 2017). The most extreme superthins are blue, have the thinnest disks and lowest surface brightnesses, while the red ones are physically larger (in scalelengths and scaleheights) and are brighter.

Our preliminary model results tend to support the idea that a dominant dark halo suppresses dynamical heating and therefore prevents disk thickening and bulge formation. However, further calculations are necessary to confirm whether or not a dark halo is solely responsible for squishing the stellar disk in superthin galaxies.

Мои комментарии

- Это важное и интересное продолжение давно начатой работы.
- Особенности темного гало могут заключаться либо в его аномально большой массе, либо в аномально низкой концентрации к центру. Пока нет прямых указаний ни на то, ни на другое. Хотя хотелось бы проверить.
- Малая толщина дисков может быть объяснена не особенностями гало, а низкой плотностью диска, не испытавшего динамического нагрева, при «нормальном» во всех отношениях гало.

The Shape of the Rotation Curves of Edge-on Galaxies

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Astronomy letter, 29, 437, 2003

$$V_s(x) = \frac{\int\limits_{-y_0}^{y_0} S(r)\exp(-\tau(x,y))V_\varphi(r)\frac{x}{\sqrt{x^2+y^2}}dy}{\int\limits_{-y_0}^{y_0} S(r)\exp(-\tau(x,y))dy}, \quad (4)$$

where the quantity $\tau(x, y)$, which characterizes the optical depth per unit length in the disk plane, is determined by the dust distribution function $f_{\rm dust}(x, y)$:

$$\tau = \int\limits_{y_0}^{y} f_{\rm dust}(x,\xi)\,d\xi. \quad (5)$$

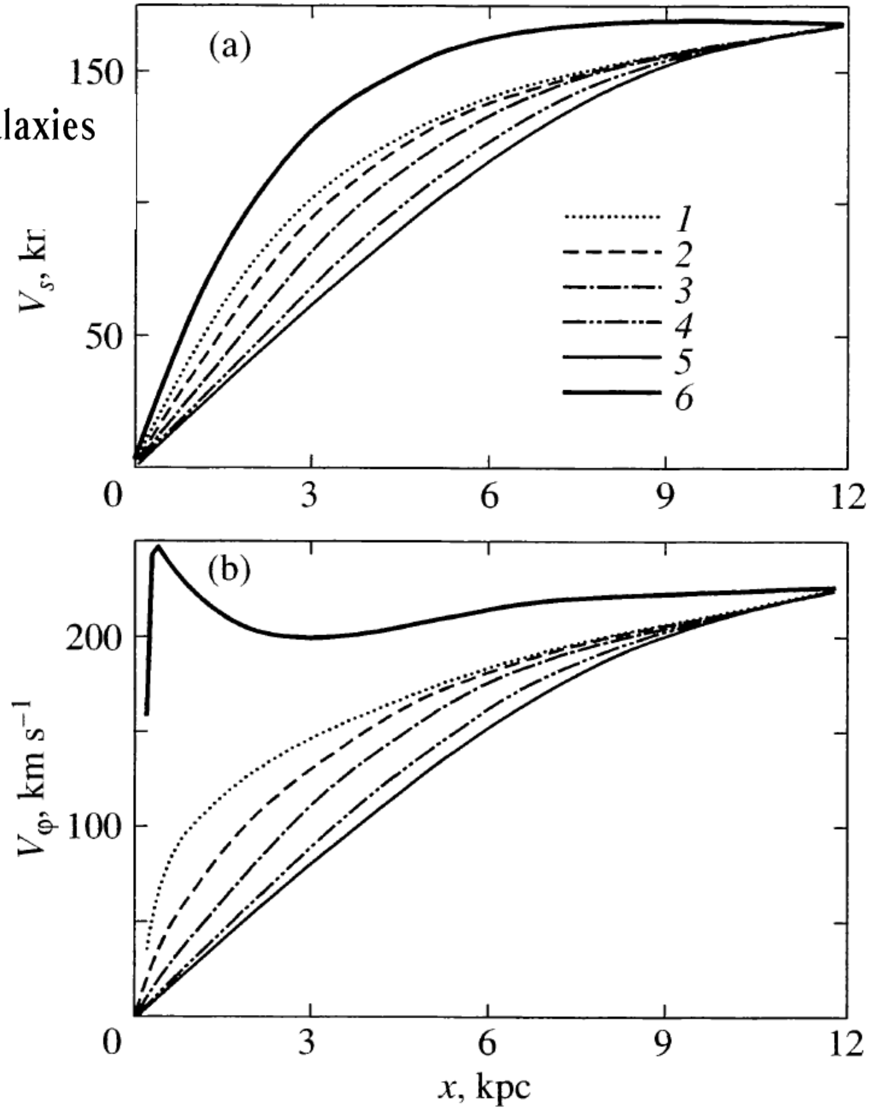

Fig. 5. The absorption-corrected line-of-sight velocity distributions $V_s(x)$ for the radial scale length of the dust distribution $L = L_{\rm d} = 3$ kpc. (a) The dependences $V_\varphi(r)$ (a bulgeless model) and $V_s(x)$ for various optical depths at $r = 3$ kpc: (*1*) $\tau_0 = 0$, (*2*) 0.37, (*3*) 0.73, (*4*) 1.46, and (*5*) 2.2 kpc^{-1}. (b) The same for the rotation curve of the third type (see Fig. 2b).