

The background of the slide is a night sky featuring the Milky Way galaxy, which is visible as a bright, multi-colored band of stars and dust stretching across the upper half of the frame. Below the sky, the silhouettes of several astronomical observatories are visible on a dark, rocky hill. The observatories have complex, multi-tiered structures with some open telescope apertures. The overall scene is dark, with the primary light source being the stars and the Milky Way.

Открытие чёрной дыры в ультракомпактной карликовой галактике

Афанасьев А. В.
ГАИШ МГУ

A 3.5-million Solar Masses Black Hole in the Centre of the Ultracompact Dwarf Galaxy Fornax UCD3

Anton V. Afanasiev,^{1,2*} Igor V. Chilingarian,^{3,1} Steffen Mieske,⁴ Karina T. Voggel,⁵ Arianna Picotti,⁶ Michael Hilker⁷, Anil Seth,⁵ Nadine Neumayer,⁶ Matthias Frank,⁷ Aaron J. Romanowsky,^{8,9} George Hau,⁴ Holger Baumgardt,¹⁰ Christopher Ahn,⁵ Jay Strader,¹¹ Mark den Brok,^{12,13} Richard McDermid,¹⁴ Lee Spitler,¹⁵ Jean Brodie⁹ and Jonelle L. Walsh¹⁶.

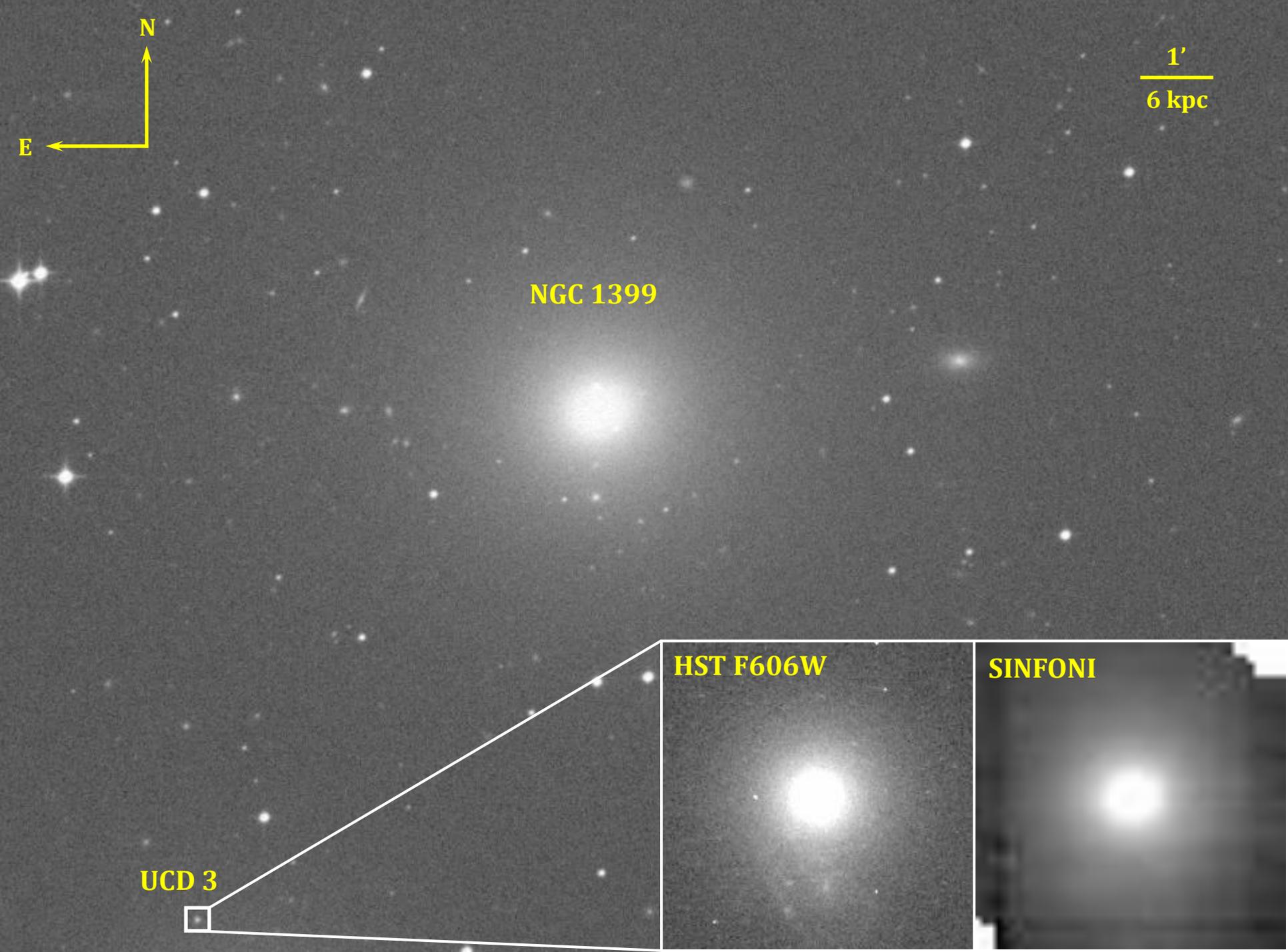
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ABSTRACT

The origin of ultracompact dwarfs (UCDs), a class of compact stellar systems discovered two decades ago, still remains a matter of debate. Recent discoveries of central supermassive black holes in UCDs likely inherited from their massive progenitor galaxies provide support for the tidal stripping hypothesis. At the same time, on statistical grounds, some massive UCDs might be representatives of the high luminosity tail of the globular cluster luminosity function. Here we present a detection of a $3.3^{+1.4}_{-1.2} \times 10^6 M_{\odot}$ black hole (1σ uncertainty) in the centre of the UCD3 galaxy in the Fornax cluster, that corresponds to 4 per cent of its stellar mass. We performed isotropic Jeans dynamical modelling of UCD3 using internal kinematics derived from adaptive optics assisted observations with the SINFONI spectrograph and seeing limited data collected with the FLAMES spectrograph at the ESO VLT. We rule out the zero black hole mass at the 3σ confidence level when adopting a mass-to-light ratio inferred from stellar populations. This is the fourth supermassive black hole found in a UCD and the first one in the Fornax cluster. Similarly to other known UCDs that harbour black holes, UCD3 hosts metal rich stars enhanced in α -elements that supports the tidal stripping of a massive progenitor as its likely formation scenario. We estimate that up to 80 per cent of luminous UCDs in galaxy clusters host central black holes. This fraction should be lower for UCDs in groups, because their progenitors are more likely to be dwarf galaxies, which do not tend to host central black holes.

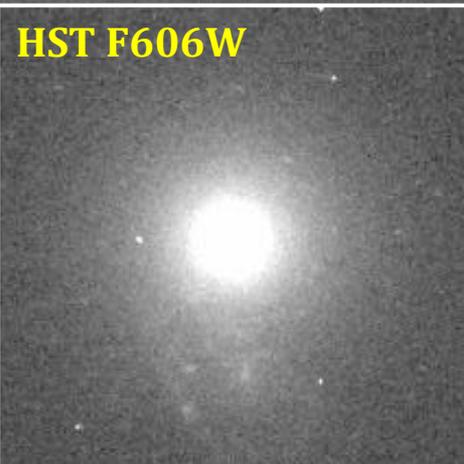
Структура работы:

1. Введение
2. Ультракомпактные карлики
3. Получение спектроскопических данных для галактики Fornax-UCD3
4. Джинсовское динамическое моделирование
5. Результаты
6. Выводы



NGC 1399

UCD 3

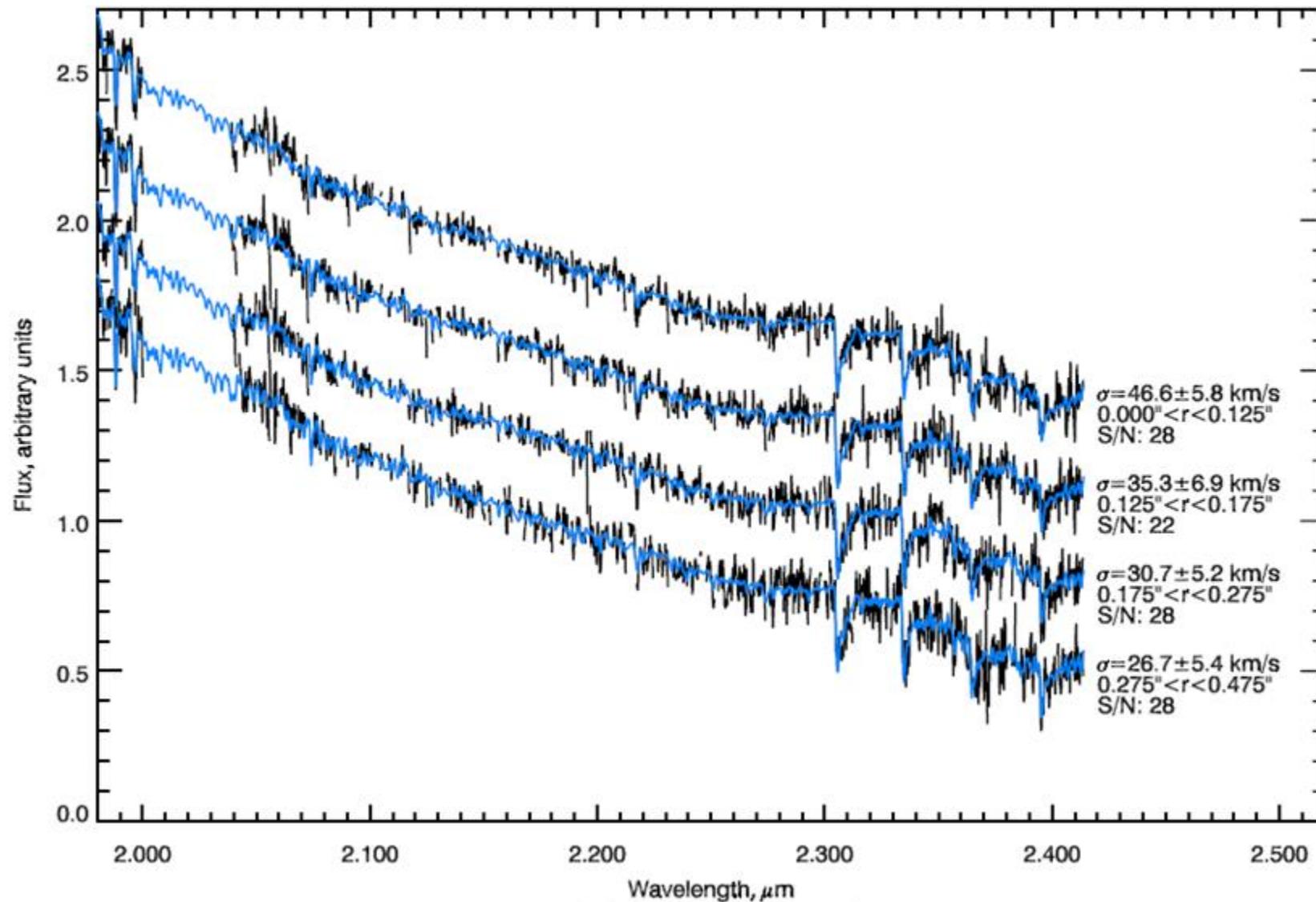


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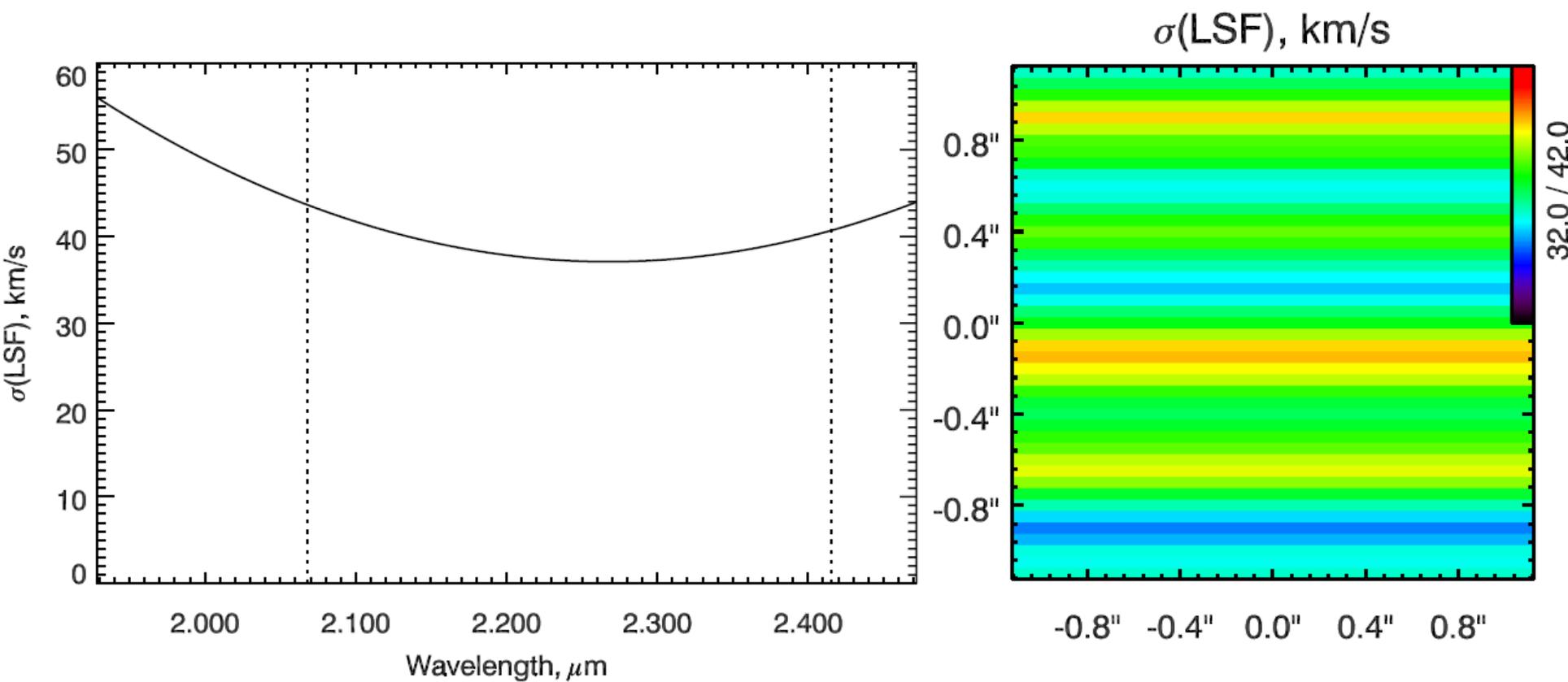


SINFONI

Получение данных



Получение данных



Джинсовское моделирование

Уравнения Джинса:

$$\frac{\overline{\rho v_R^2} - \overline{\rho v_\phi^2}}{R} + \frac{\partial(\overline{\rho v_R^2})}{\partial R} + \frac{\partial(\overline{\rho v_R v_z})}{\partial z} = -\rho \frac{\partial \Phi}{\partial R}$$

$$\frac{\overline{\rho v_R v_z}}{R} + \frac{\partial(\overline{\rho v_z^2})}{\partial z} + \frac{\partial(\overline{\rho v_R v_z})}{\partial R} = -\rho \frac{\partial \Phi}{\partial z},$$

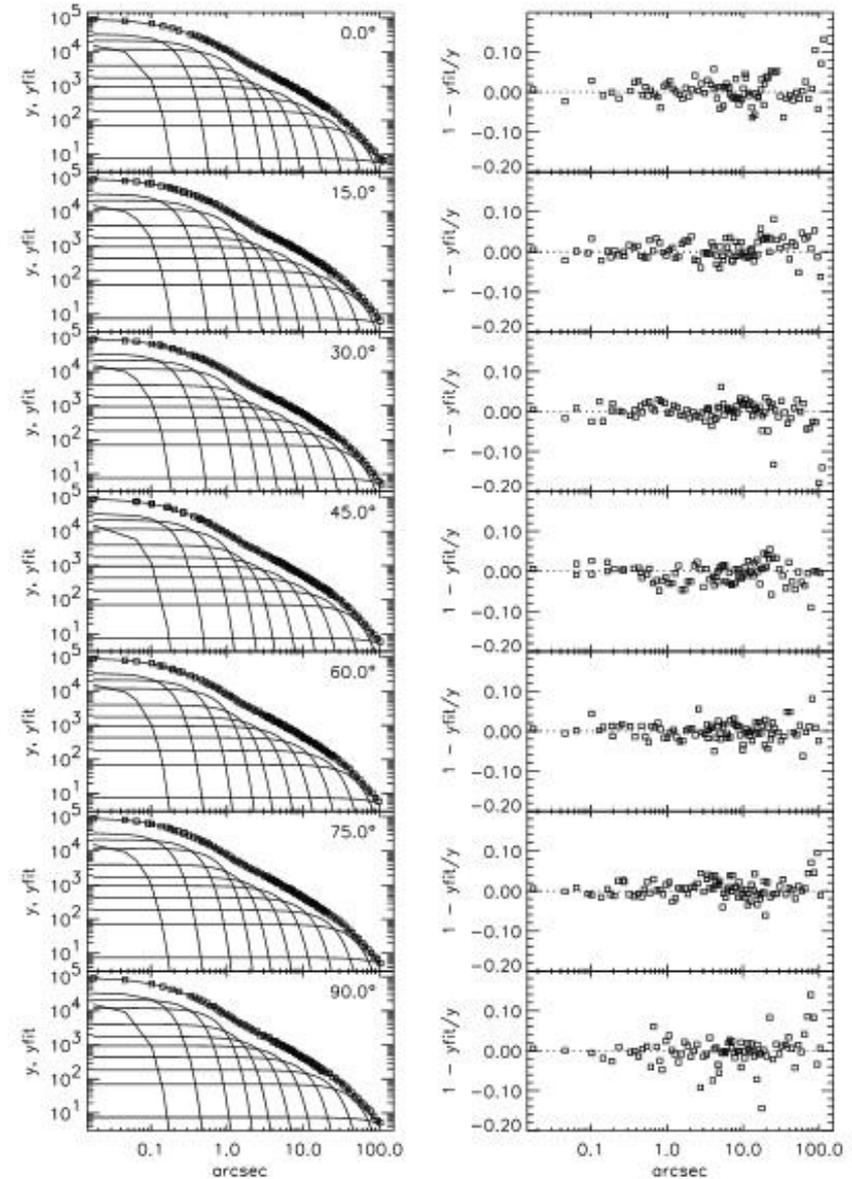
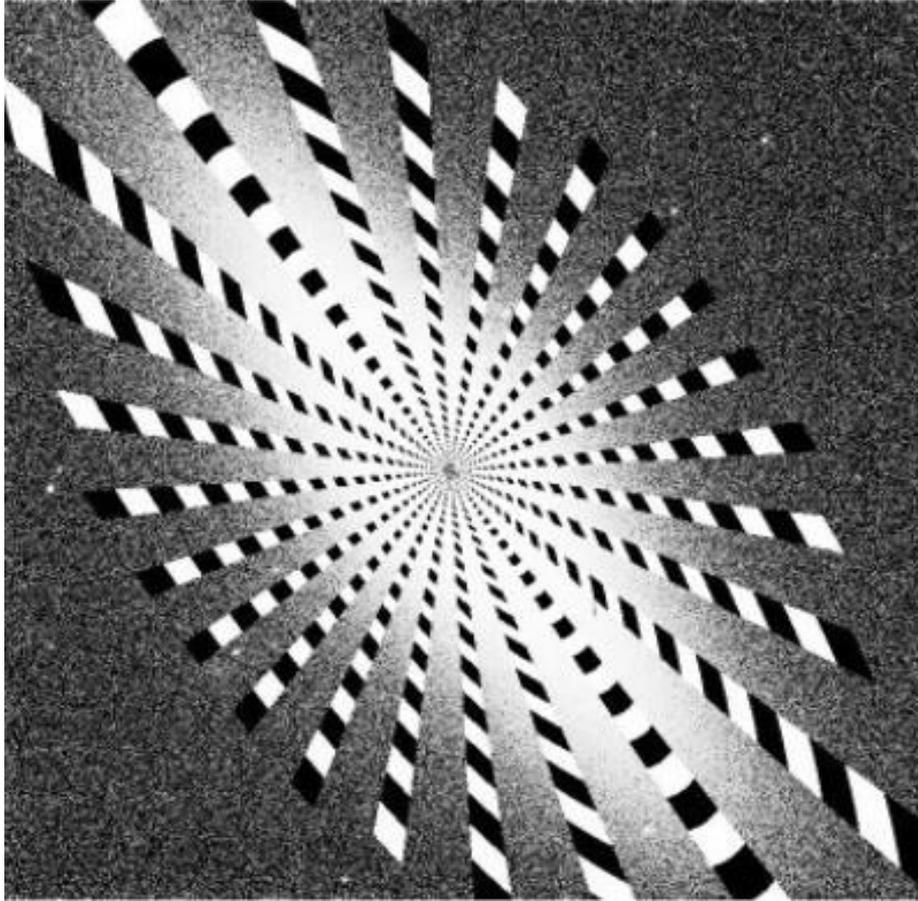
где ρ – плотность звёзд, Φ – потенциал.

Обычно из наблюдений известно ρ (фотометрия).

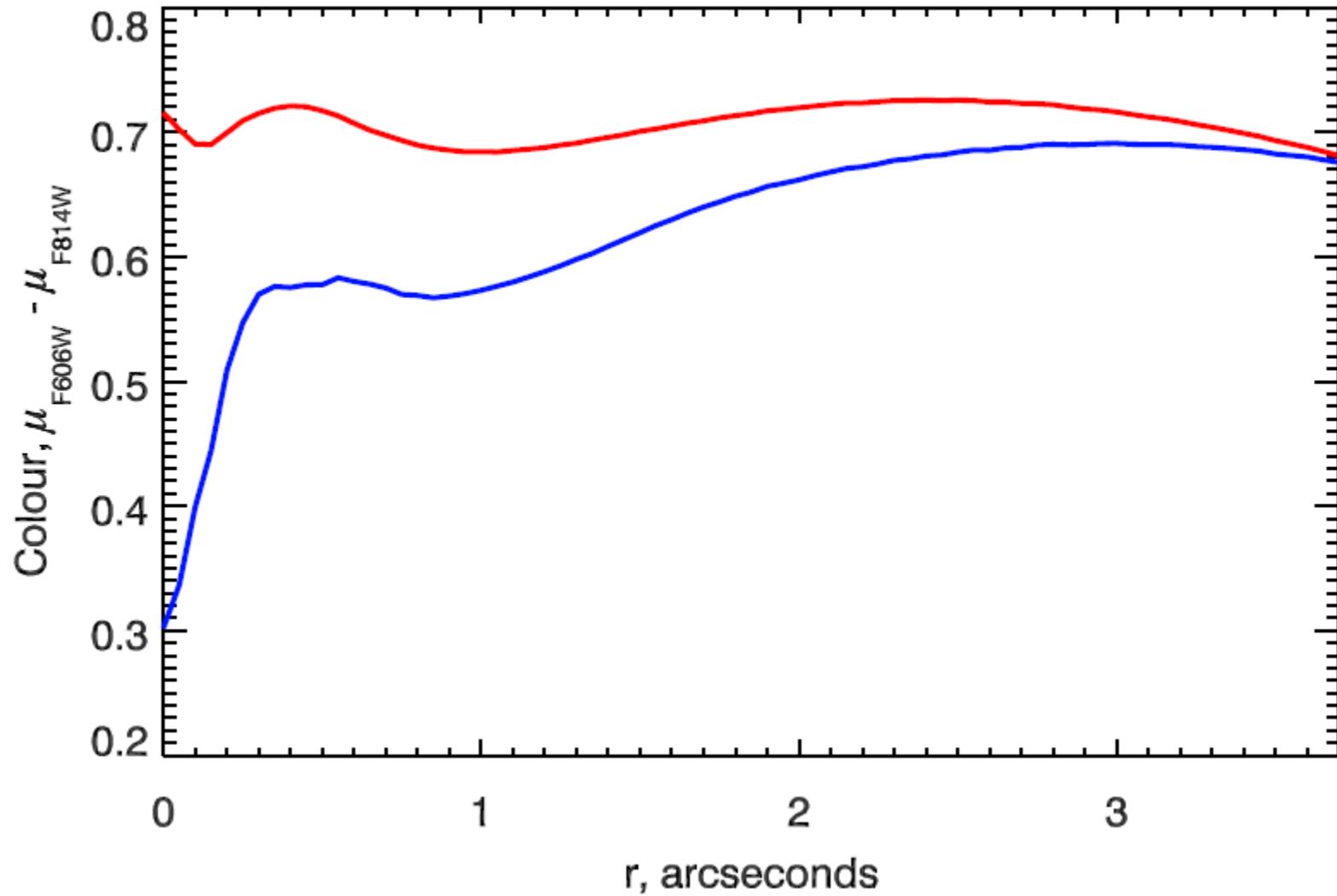
Φ зависит от модельных параметров.

Моделирование позволяет получить распределение v и σ .

Multi Gaussian Expansion (MGE)

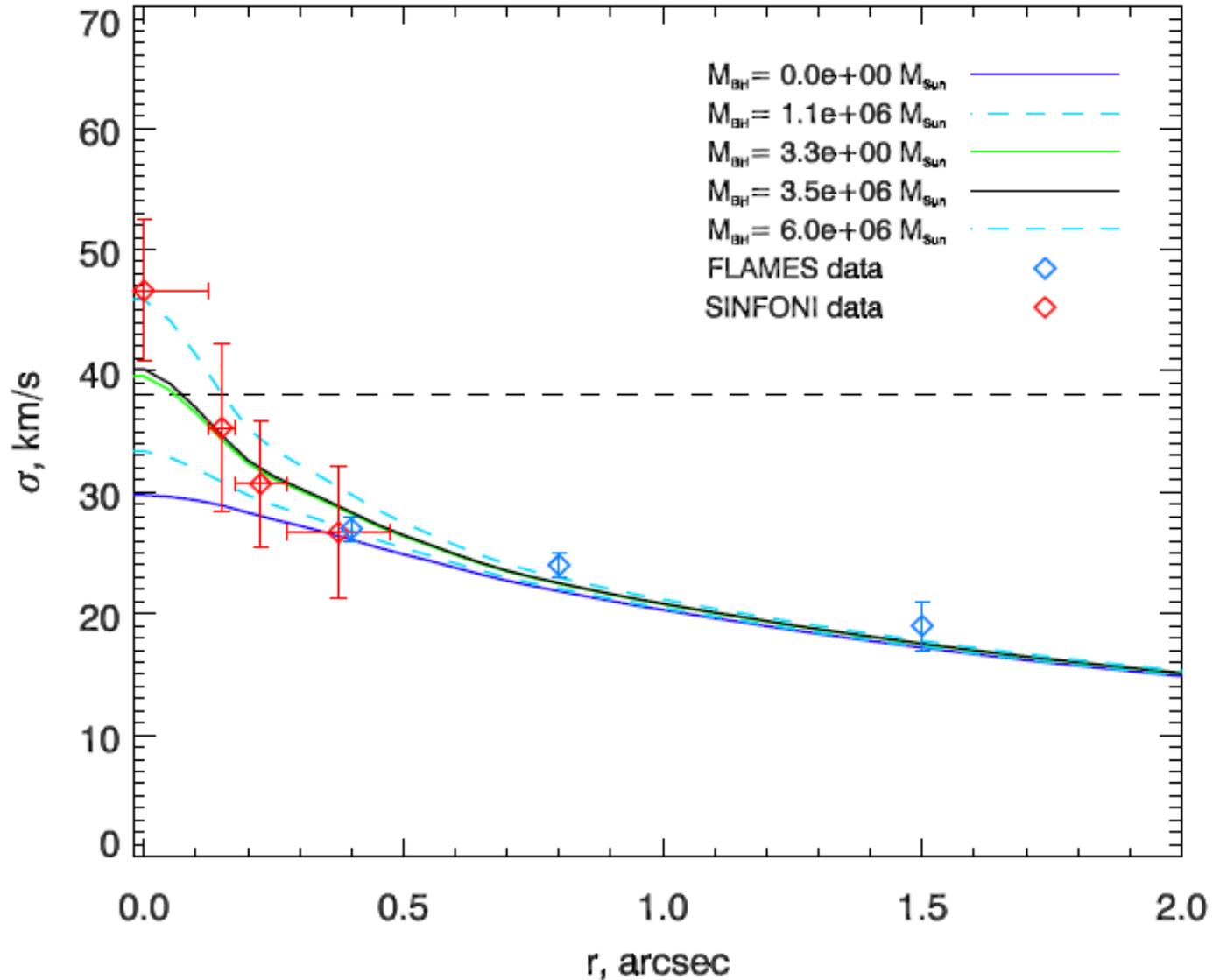


Учёт профиля цвета



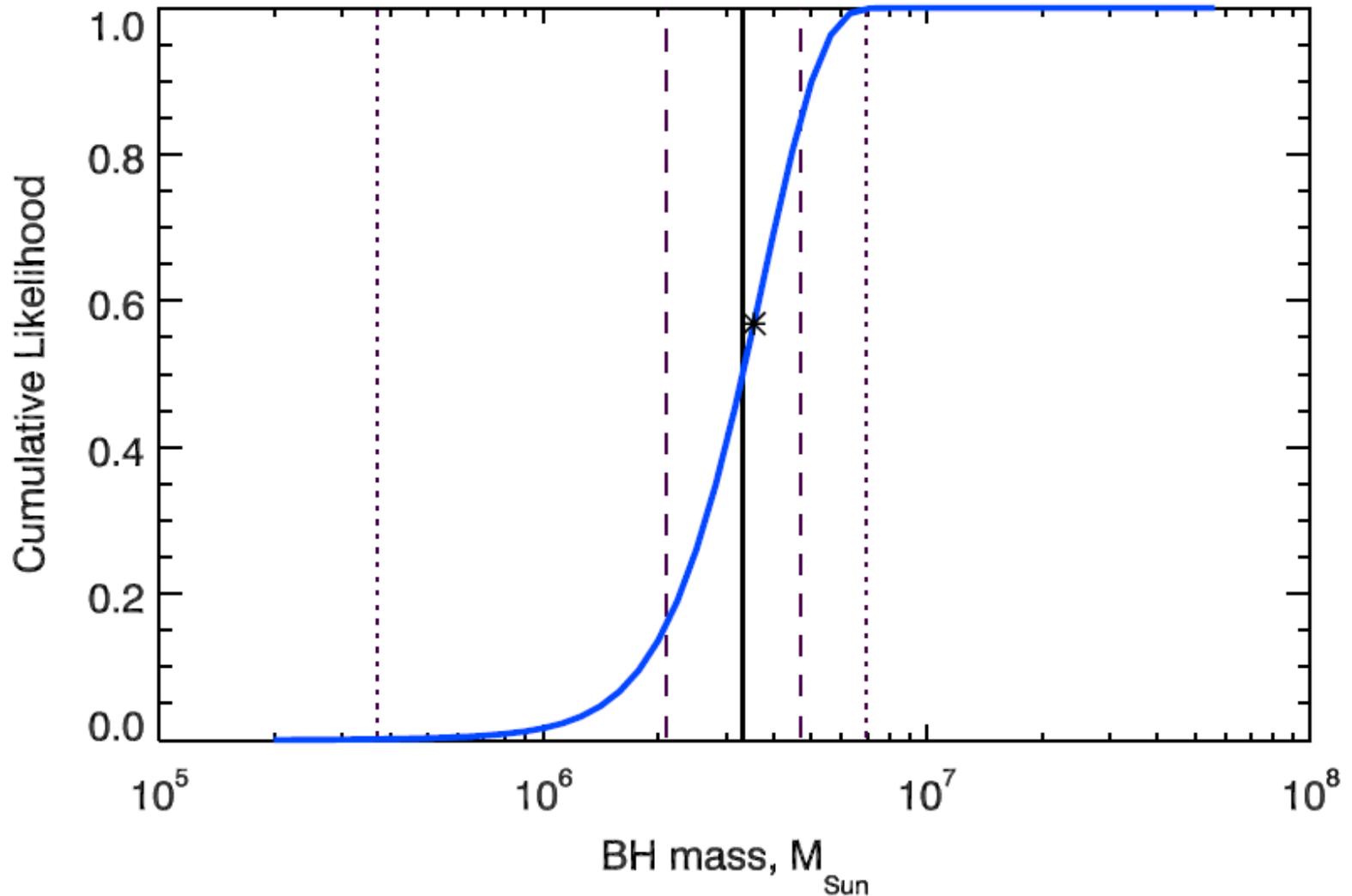
Результаты динамического моделирования

UCD3, $\beta = 0.00$

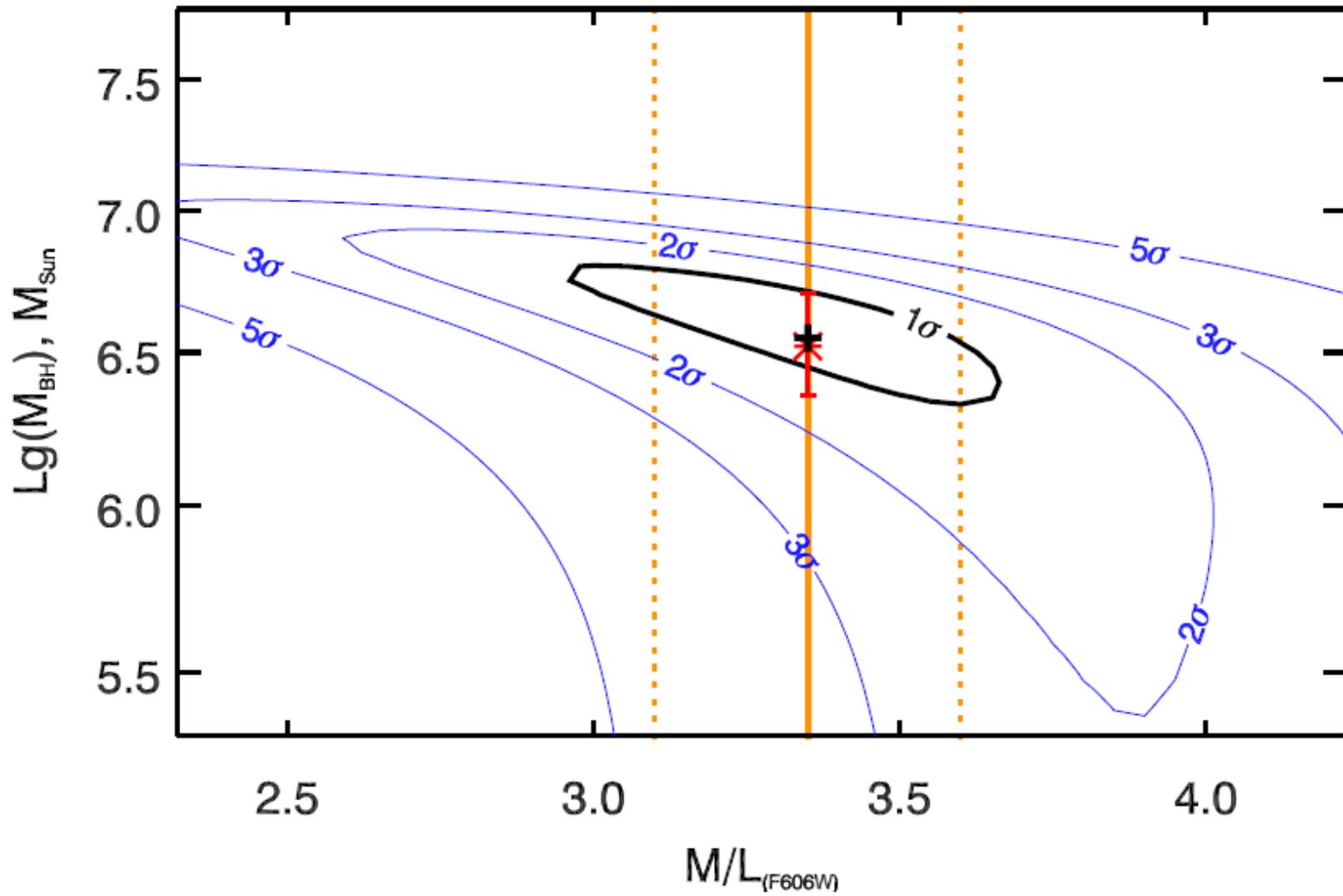


Определение M_{BH}

Cumulative likelihood function

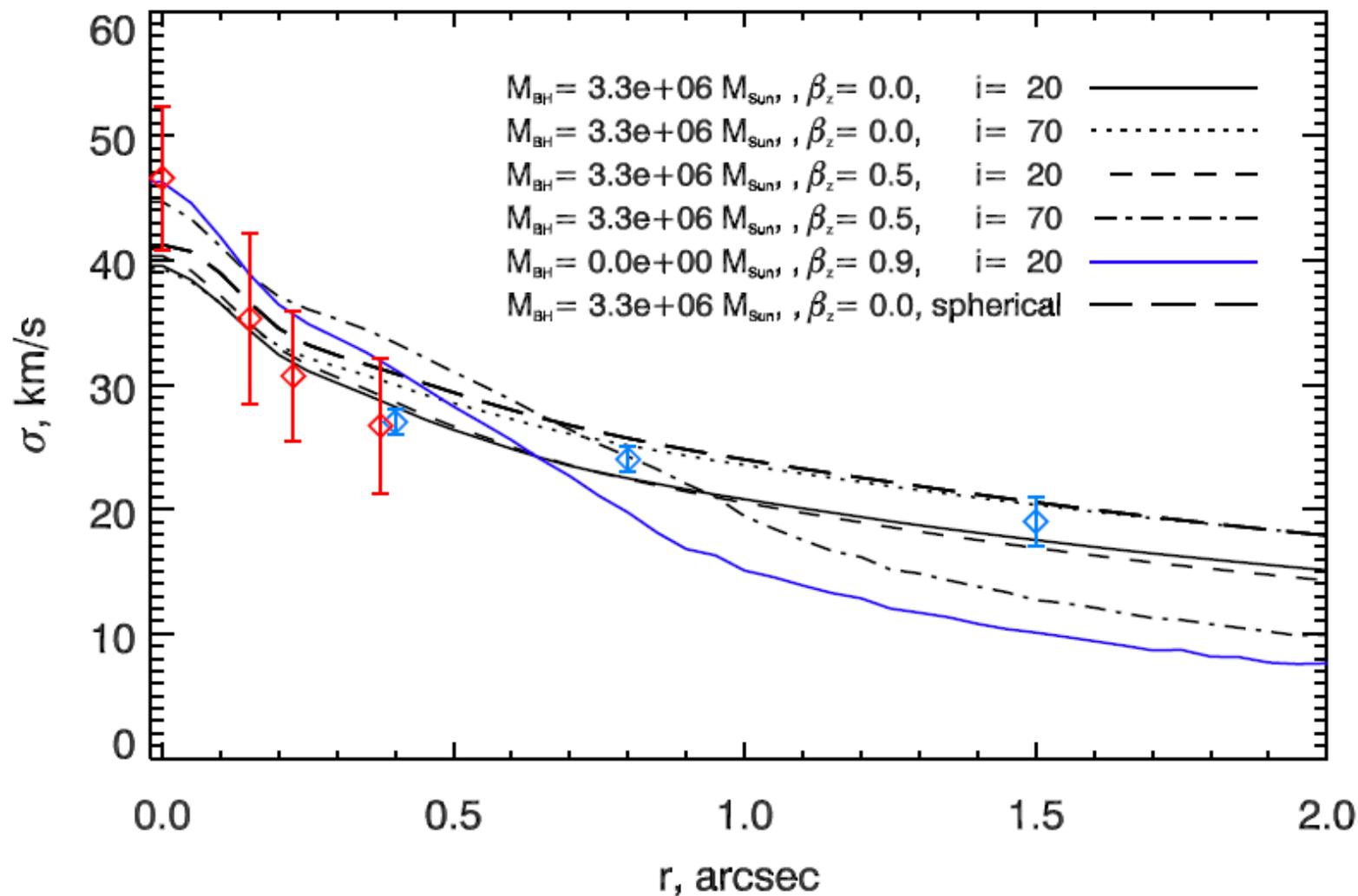


Карта χ^2



Возможное влияние анизотропии

UCD3 anisotropy test



Выводы:

1. В Fornax-UCD3 обнаружена чёрная дыра, составляющая 4% её массы.
2. Подтверждается приливное происхождение большинства UCD
3. α -обогащение – *надёжный* маркер присутствия SMBH
4. До 80% UCD в скоплениях могут иметь сверхмассивные чёрные дыры

Спасибо за внимание!