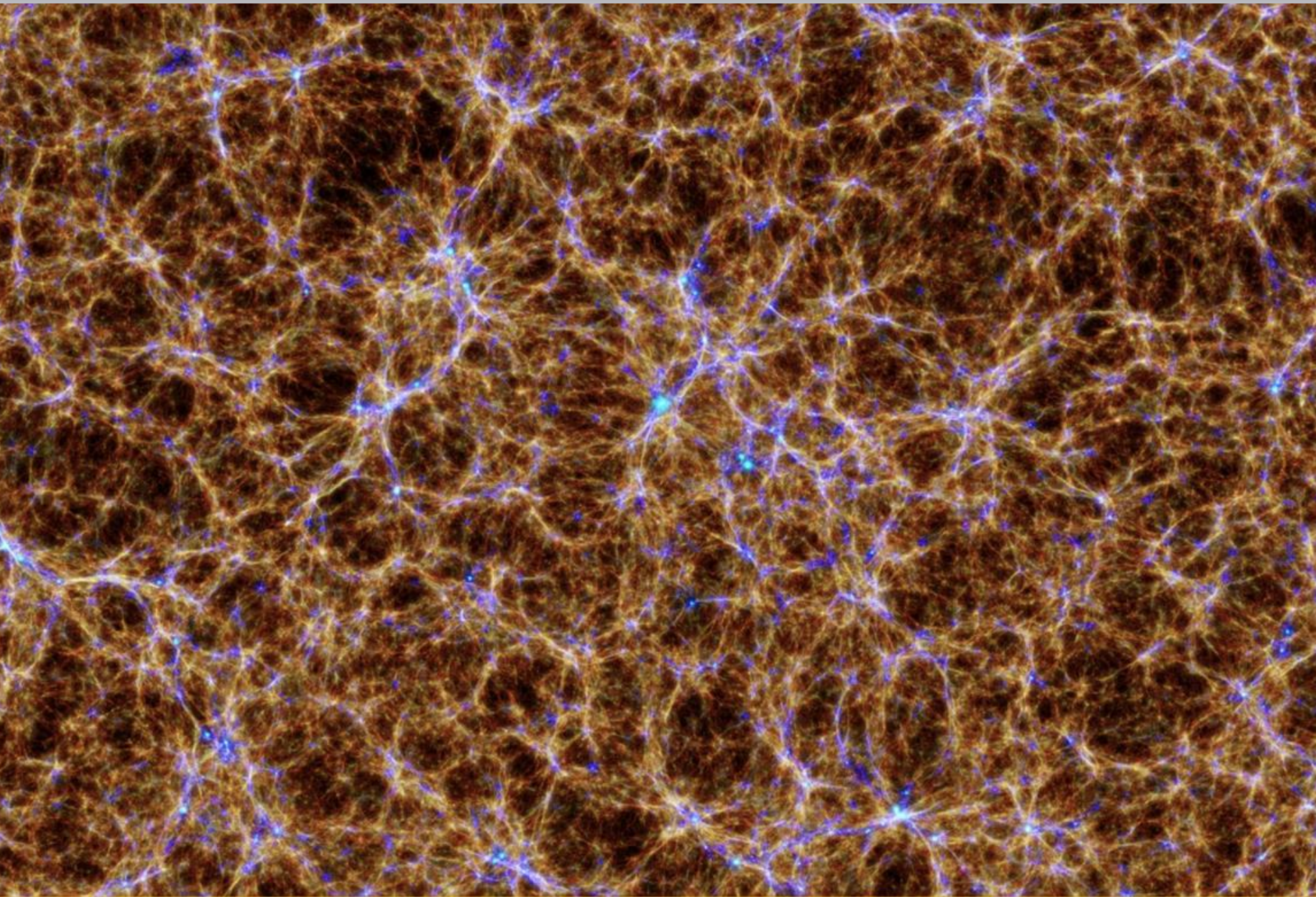
The background of the slide is a visualization of the cosmic web, showing a complex network of filaments and nodes of matter in the universe. The filaments are colored in shades of orange, yellow, and blue, set against a dark brown background.

**What does it mean to understand
galaxy evolution ?**

**A naive, biased and simplistic
view from an „outsider“ to
trigger some discussion ...**

Listening at your own risk !

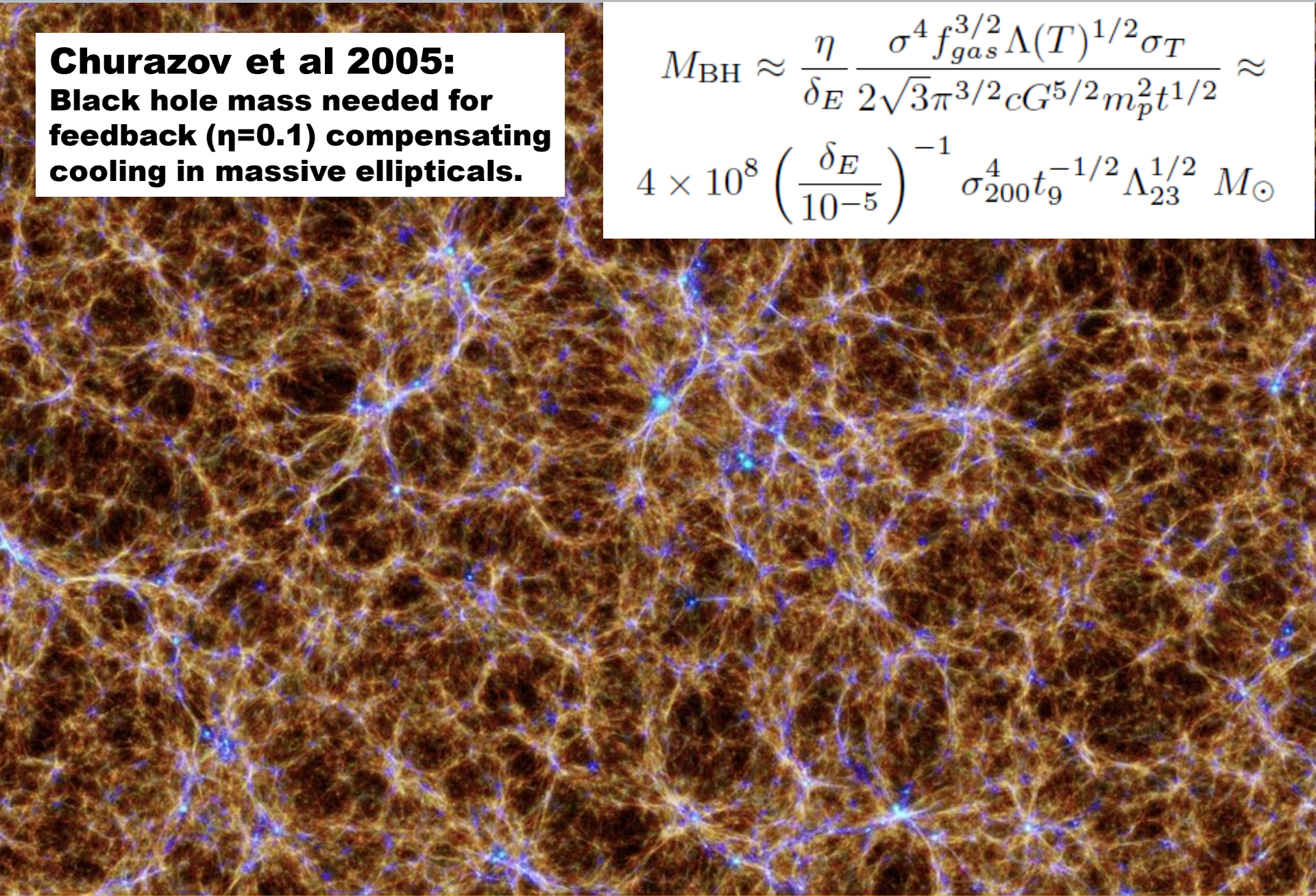
Chapter I: Do simple models help ?



Chapter I: Do simple models help ?

Churazov et al 2005:
Black hole mass needed for
feedback ($\eta=0.1$) compensating
cooling in massive ellipticals.

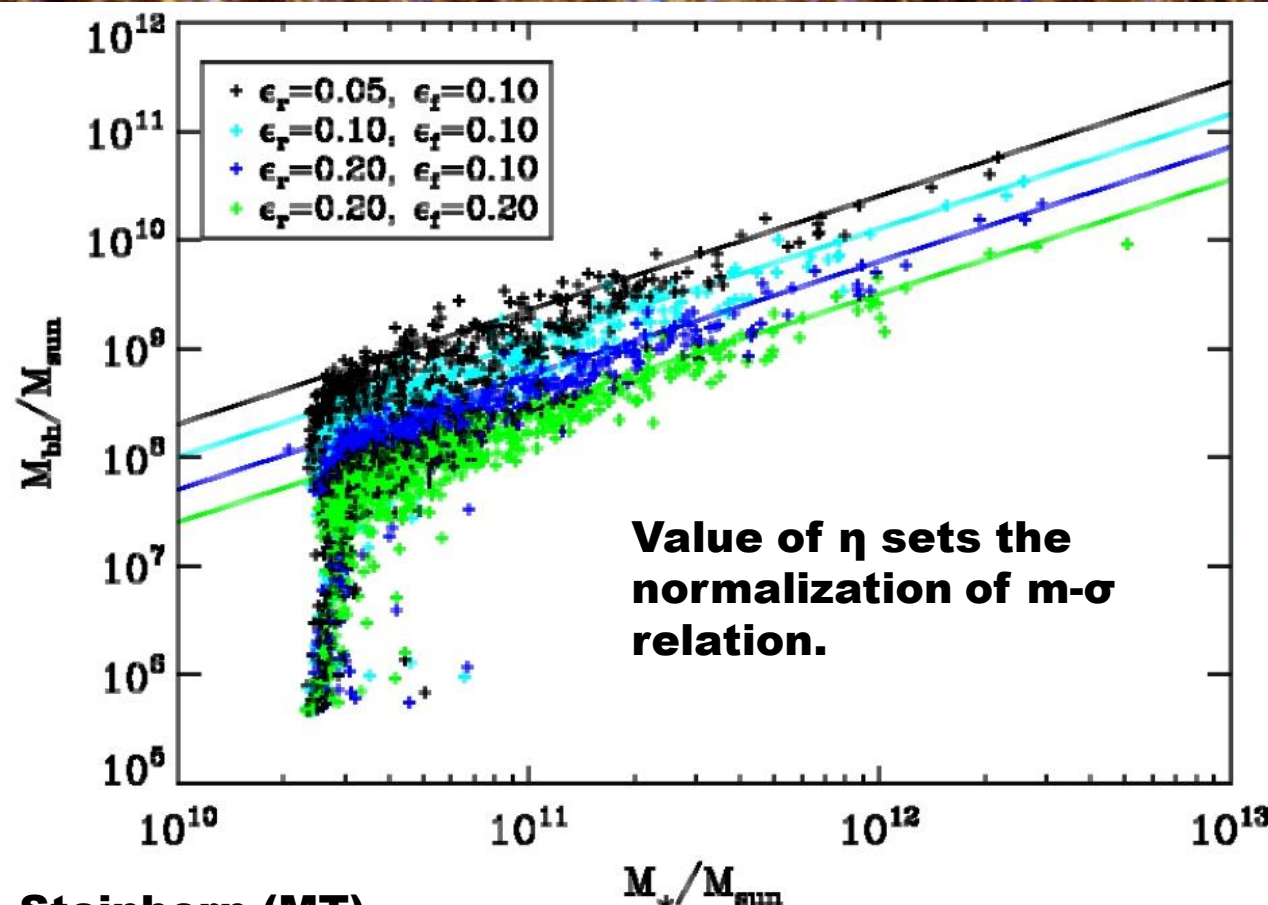
$$M_{\text{BH}} \approx \frac{\eta}{\delta_E} \frac{\sigma^4 f_{\text{gas}}^{3/2} \Lambda(T)^{1/2} \sigma_T}{2\sqrt{3}\pi^{3/2} c G^{5/2} m_p^2 t^{1/2}} \approx$$
$$4 \times 10^8 \left(\frac{\delta_E}{10^{-5}} \right)^{-1} \sigma_{200}^4 t_9^{-1/2} \Lambda_{23}^{1/2} M_\odot$$



Chapter I: Do simple models help ?

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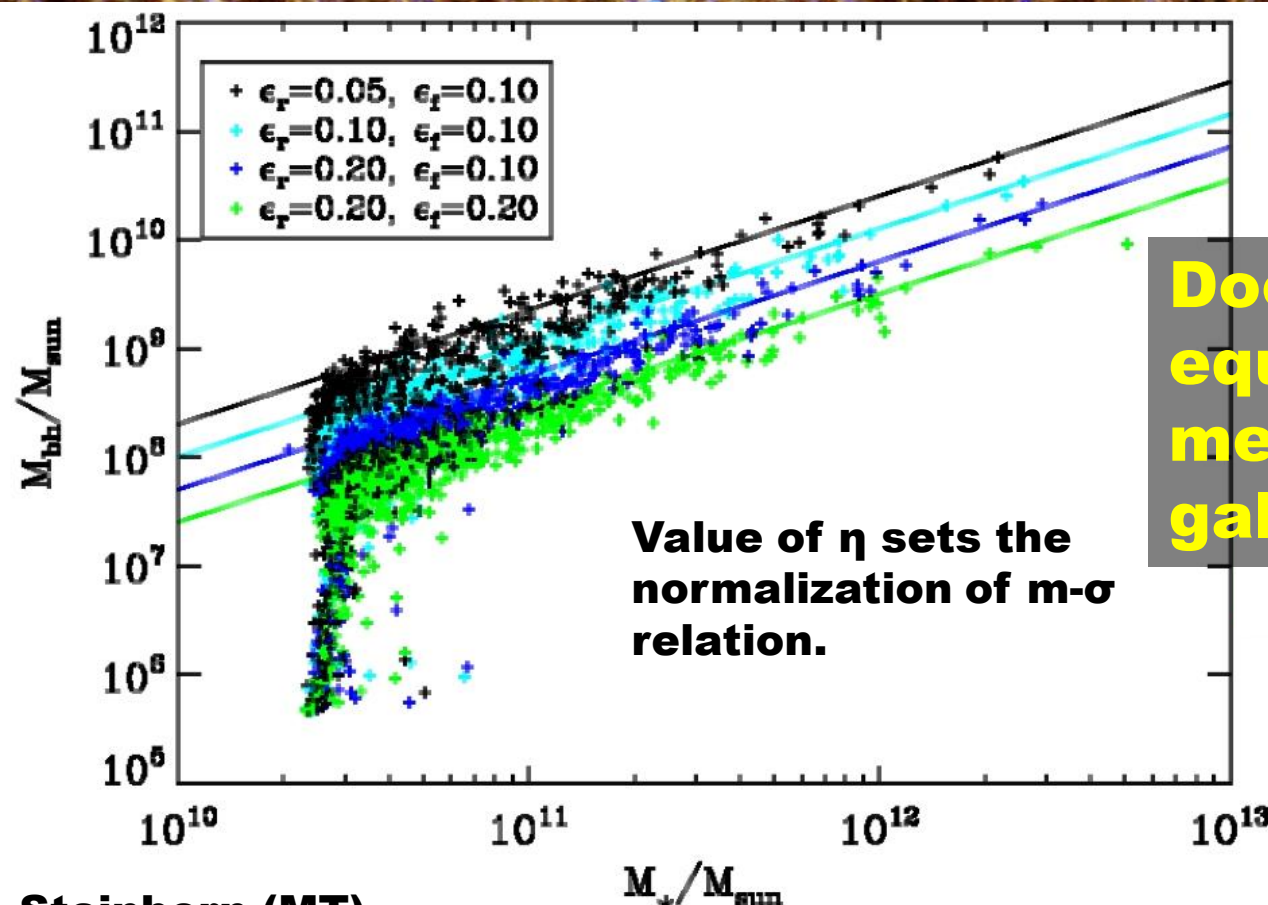


Steinborn (MT)

Chapter I: Do simple models help ?

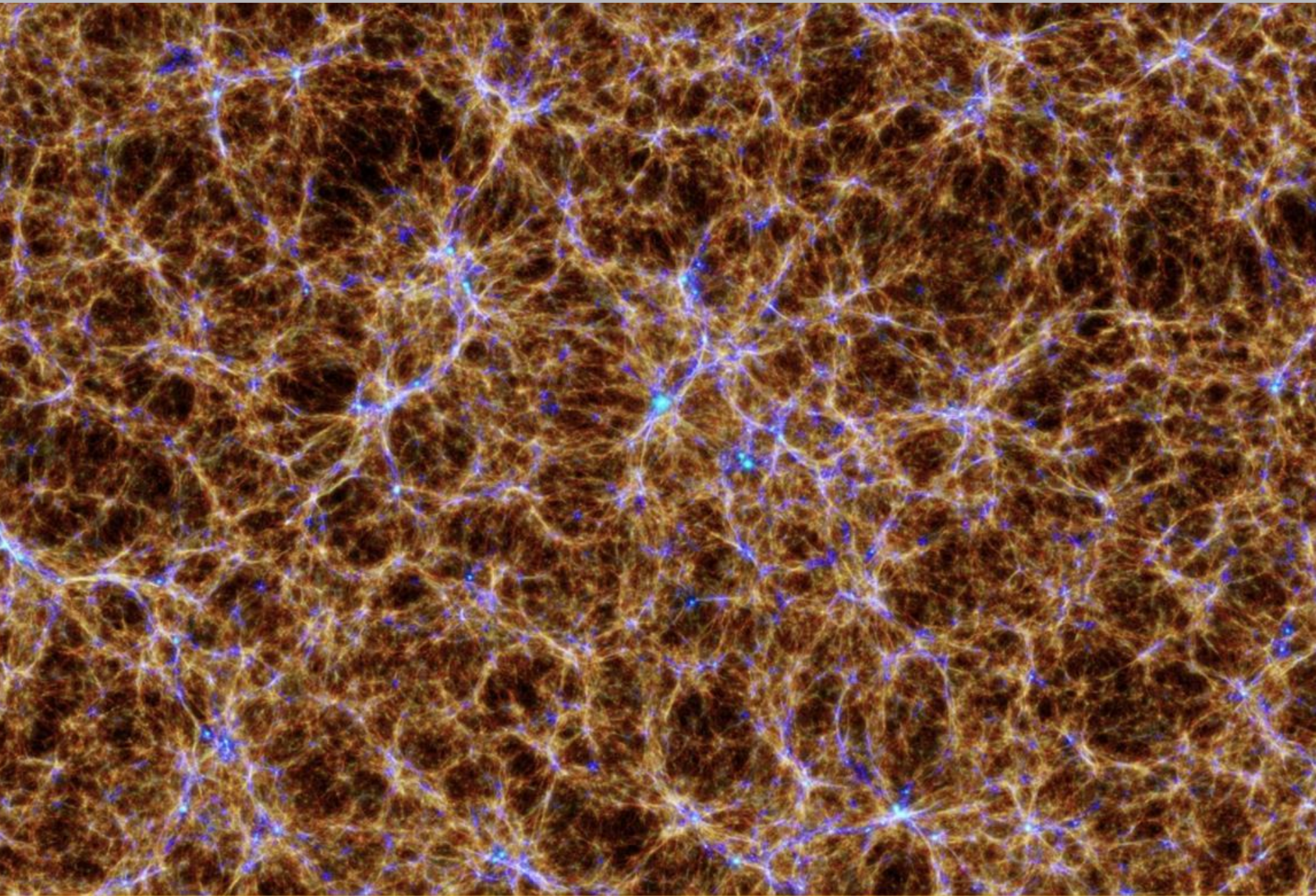
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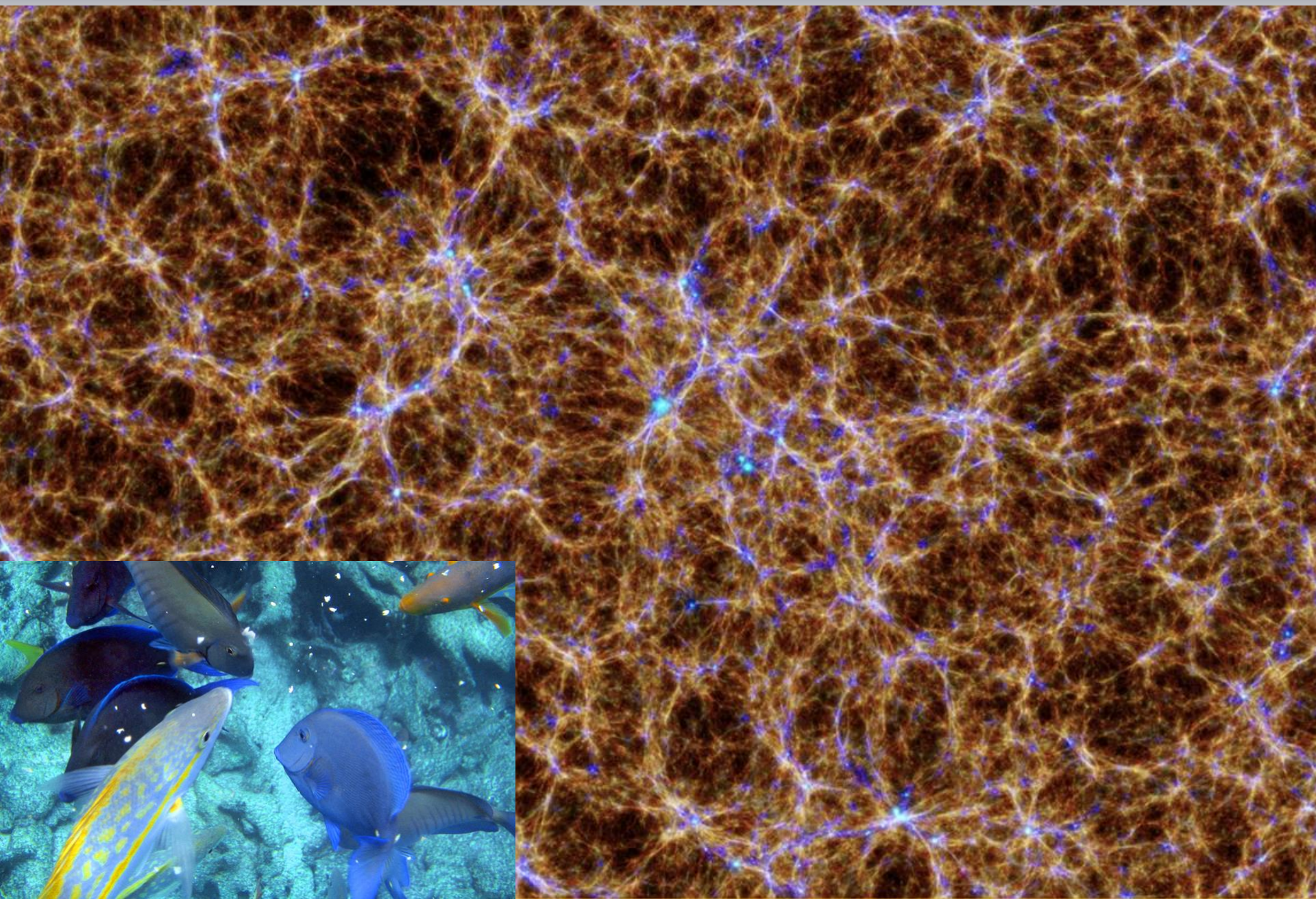


**Does understanding
equilibrium states
mean understanding
galaxy formation ?**

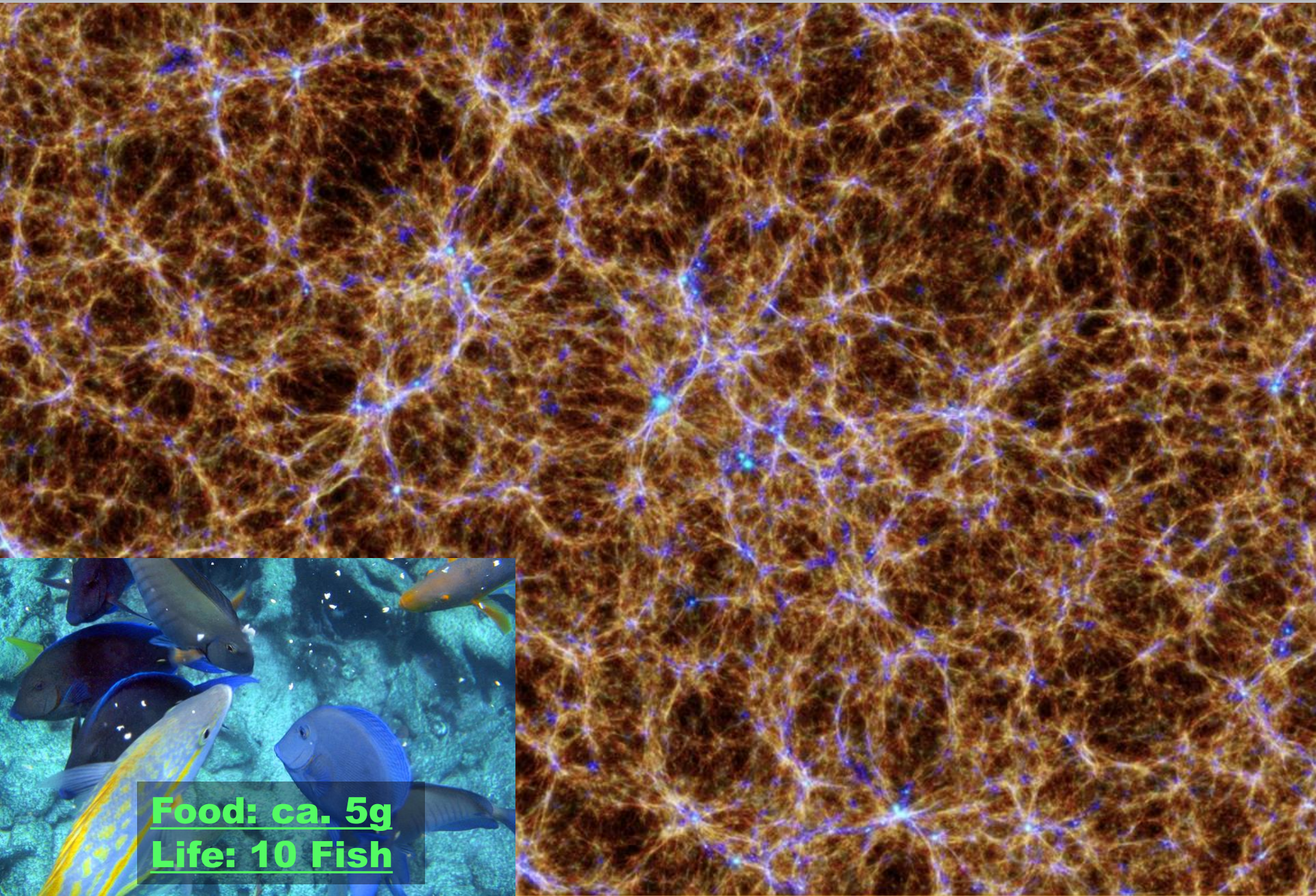
Chapter II: Galaxies are not numbers !



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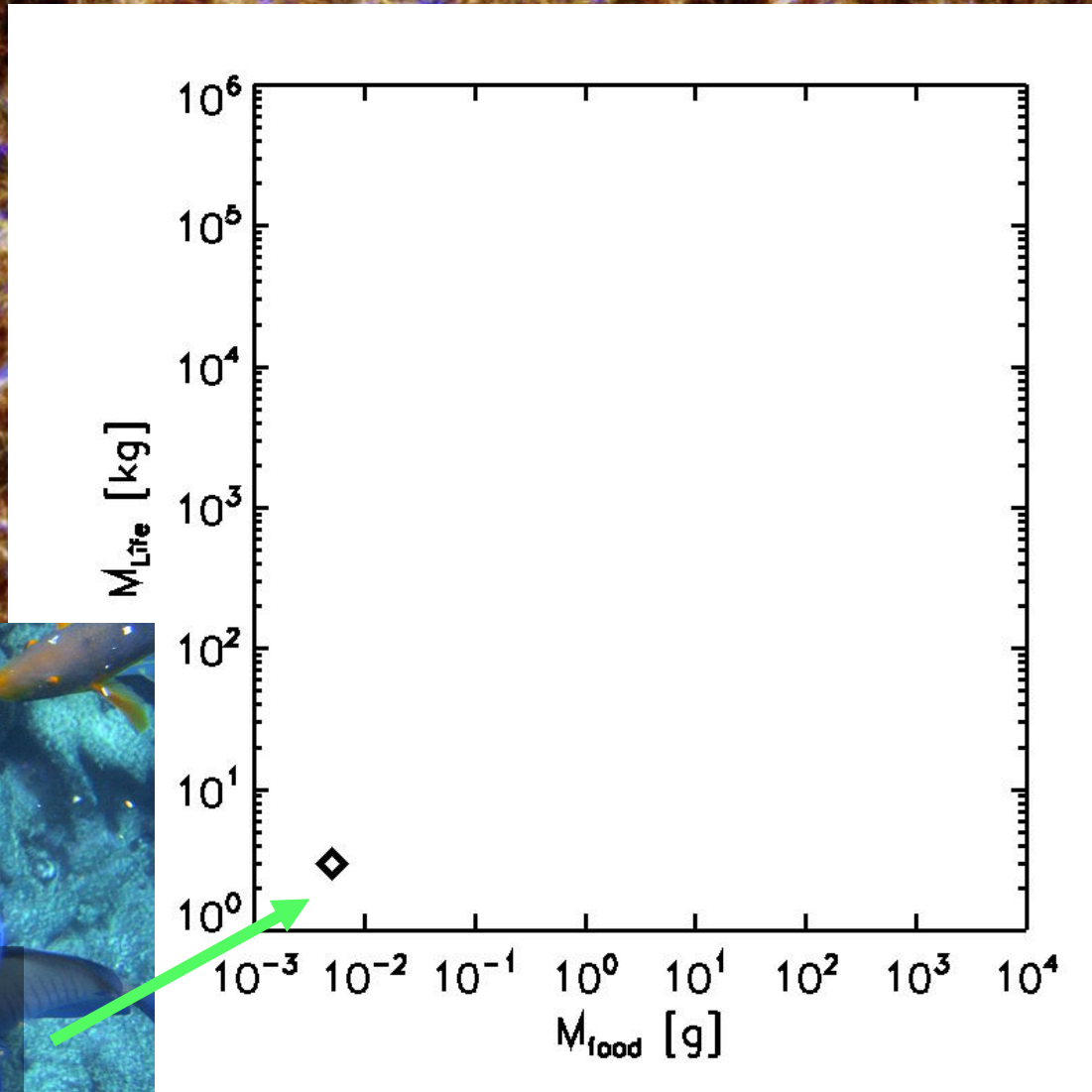
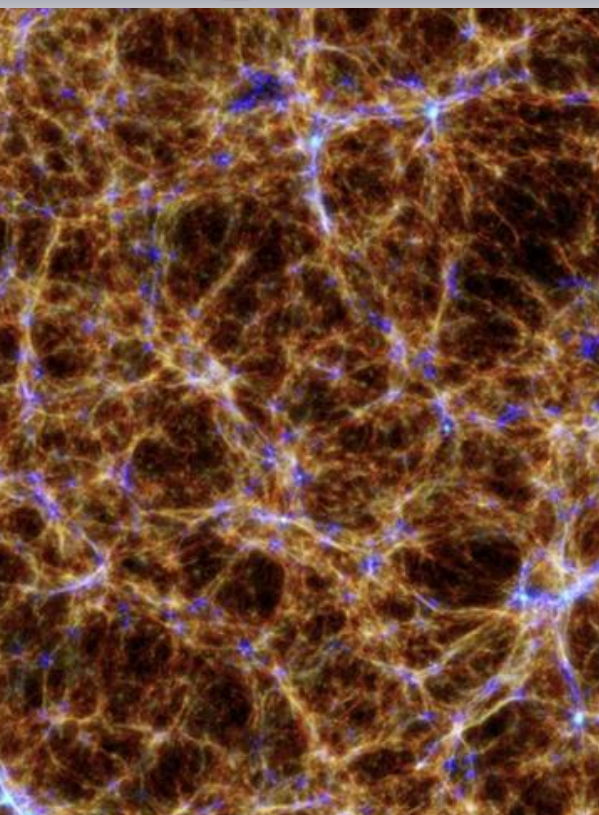


Chapter II: Galaxies are not numbers !



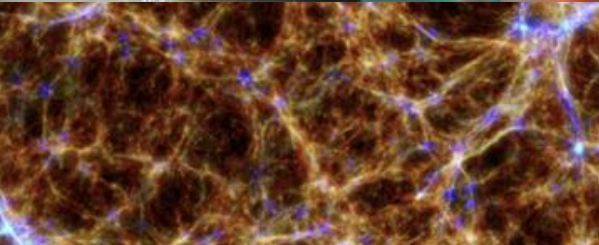
Food: ca. 5g
Life: 10 Fish

Chapter II: Galaxies are not numbers !



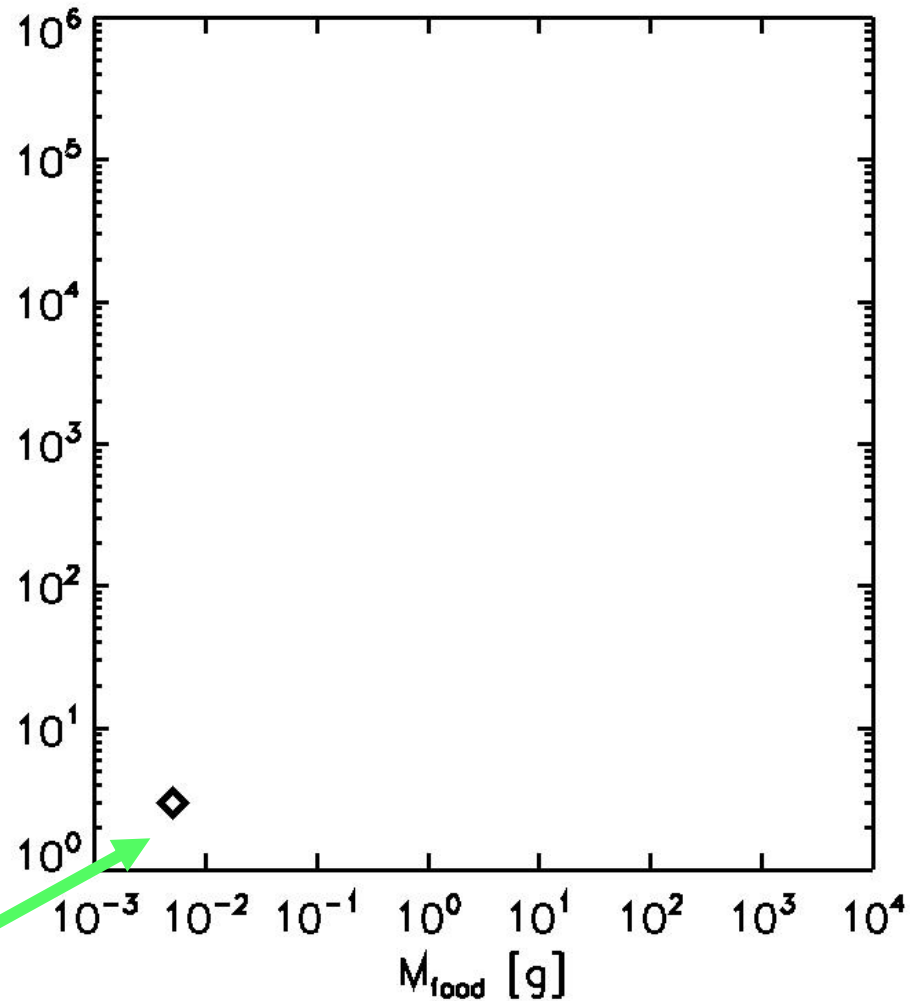
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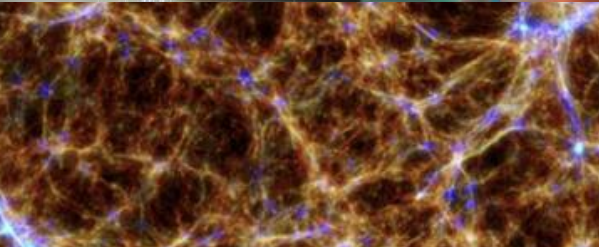
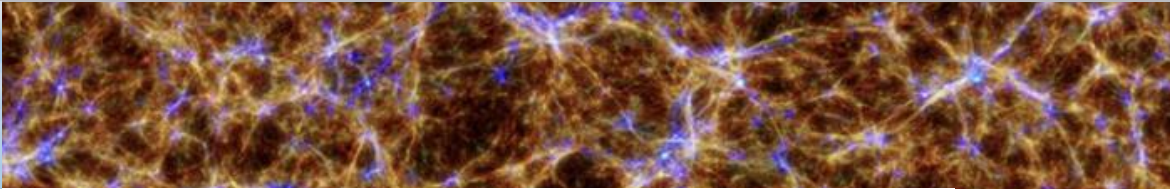
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$M_{\text{Life}} [\text{kg}]$



Chapter II: Galaxies are not numbers !

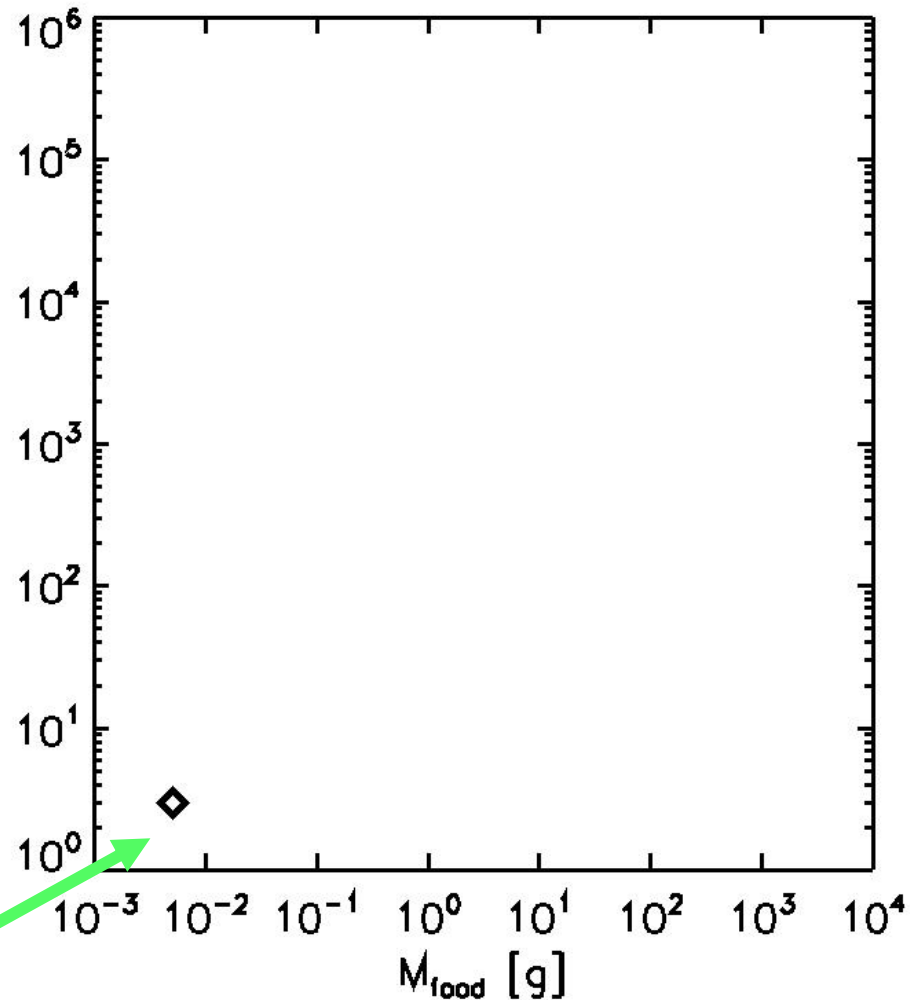
Food: ca. 20kg
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M_{Life} [kg]



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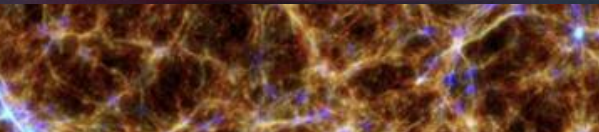


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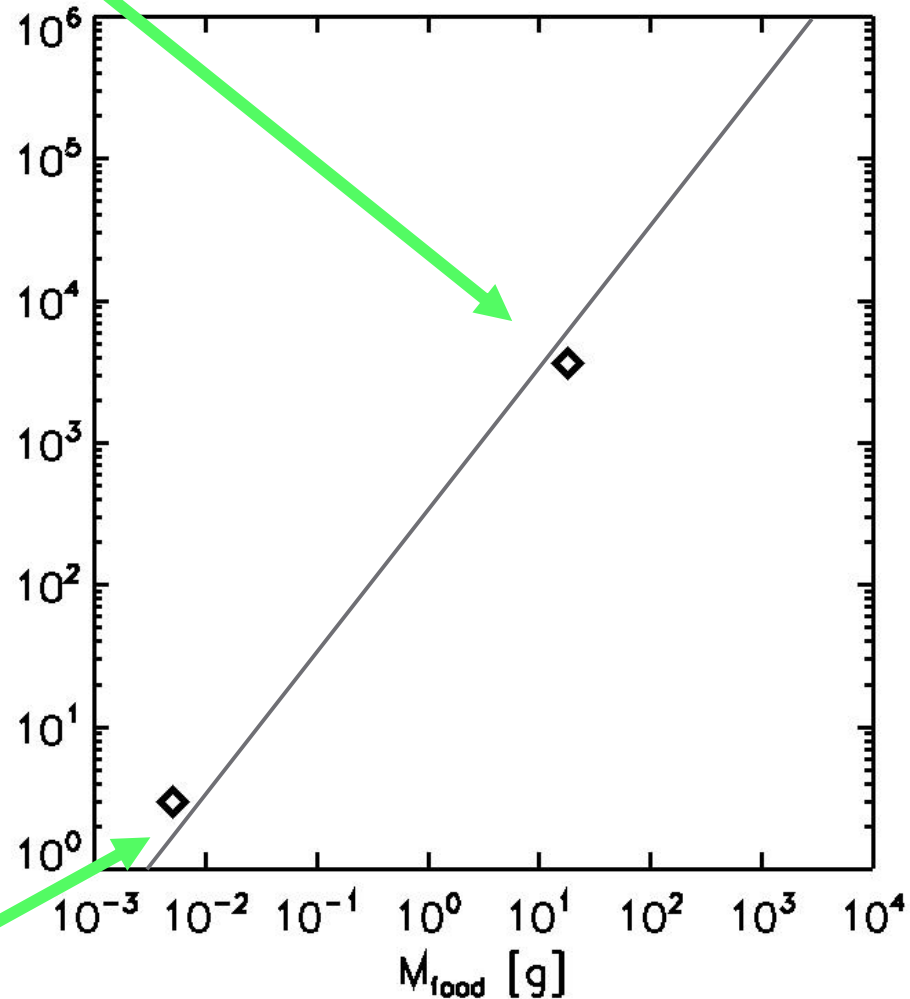


CAPACIDAD 13 PERSONAS 910 KG



Food: ca. 5g
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$M_{\text{Life}} \text{ [kg]}$

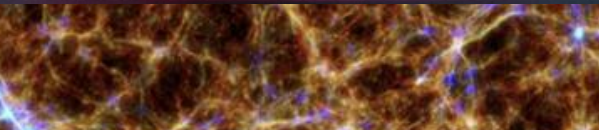


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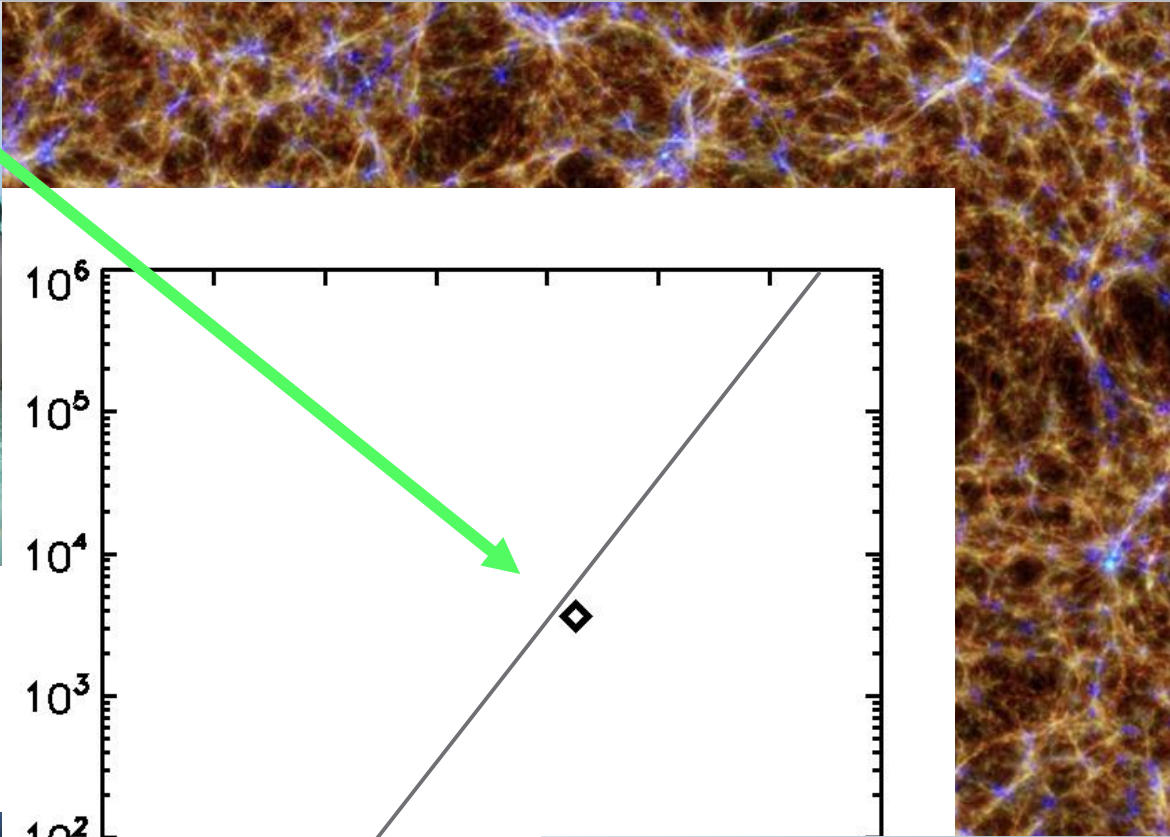
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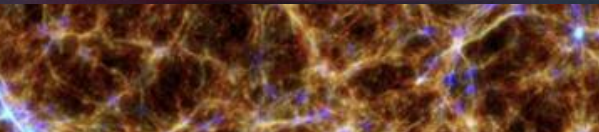


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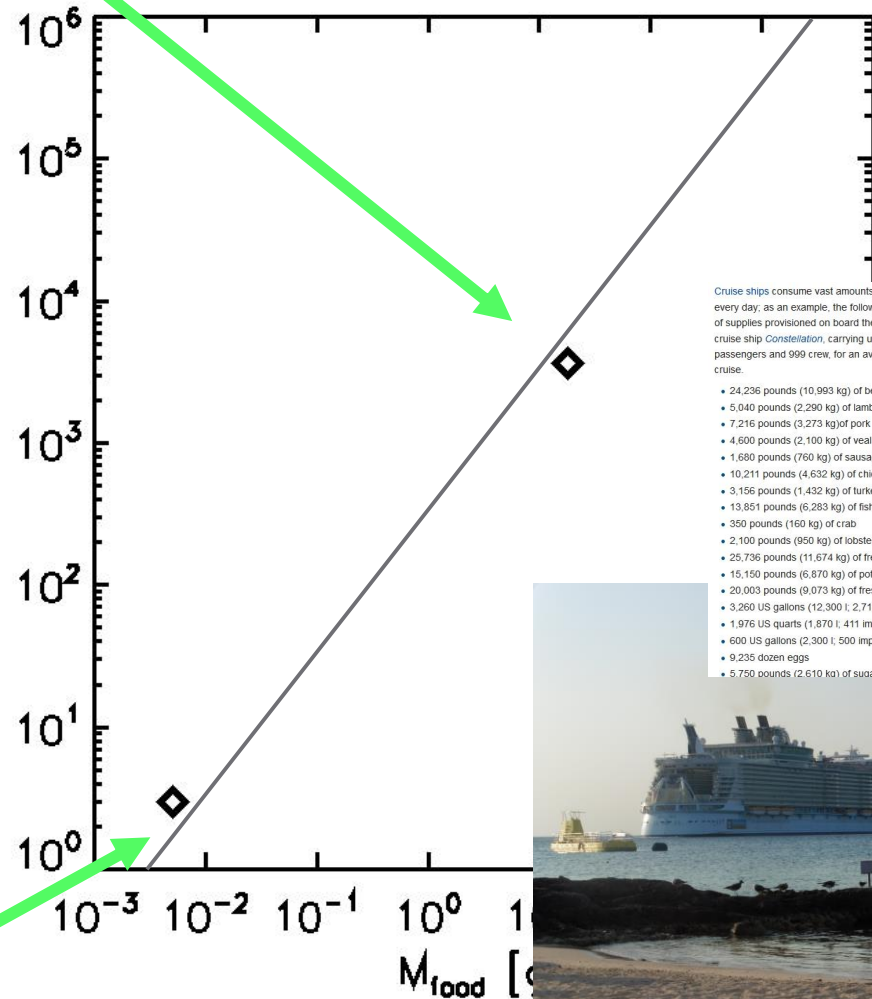


CAPACIDAD 13 PERSONAS 910 KG



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Cruise ships consume vast amounts of food every day, as an example, the following is a list of supplies provisioned on board the Celebrity cruise ship Constellation, carrying up to 1,950 passengers and 999 crew, for an average 7 day cruise.

- 24,236 pounds (10,993 kg) of beef
- 5,040 pounds (2,290 kg) of lamb
- 7,216 pounds (3,273 kg) of pork
- 4,600 pounds (2,100 kg) of veal
- 1,680 pounds (760 kg) of sausage
- 10,211 pounds (4,632 kg) of chicken
- 3,156 pounds (1,432 kg) of turkey
- 13,851 pounds (6,283 kg) of fish
- 350 pounds (160 kg) of crab
- 2,100 pounds (950 kg) of lobster
- 25,736 pounds (11,674 kg) of fresh vegetables
- 15,150 pounds (6,870 kg) of potatoes
- 20,003 pounds (9,073 kg) of fresh fruit
- 3,260 US gallons (12,300 l; 2,710 imp gal) of milk
- 1,976 US quarts (1,870 l; 411 imp gal) of cream
- 600 US gallons (2,300 l; 500 imp gal) of ice cream
- 9,235 dozen eggs
- 5,750 pounds (2,610 kg) of sugar



Workers load a Cruise Ship in Charlotte Amalie, USVI

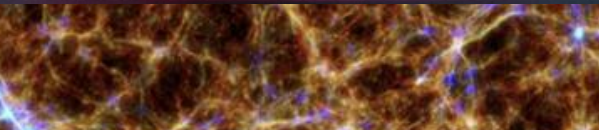


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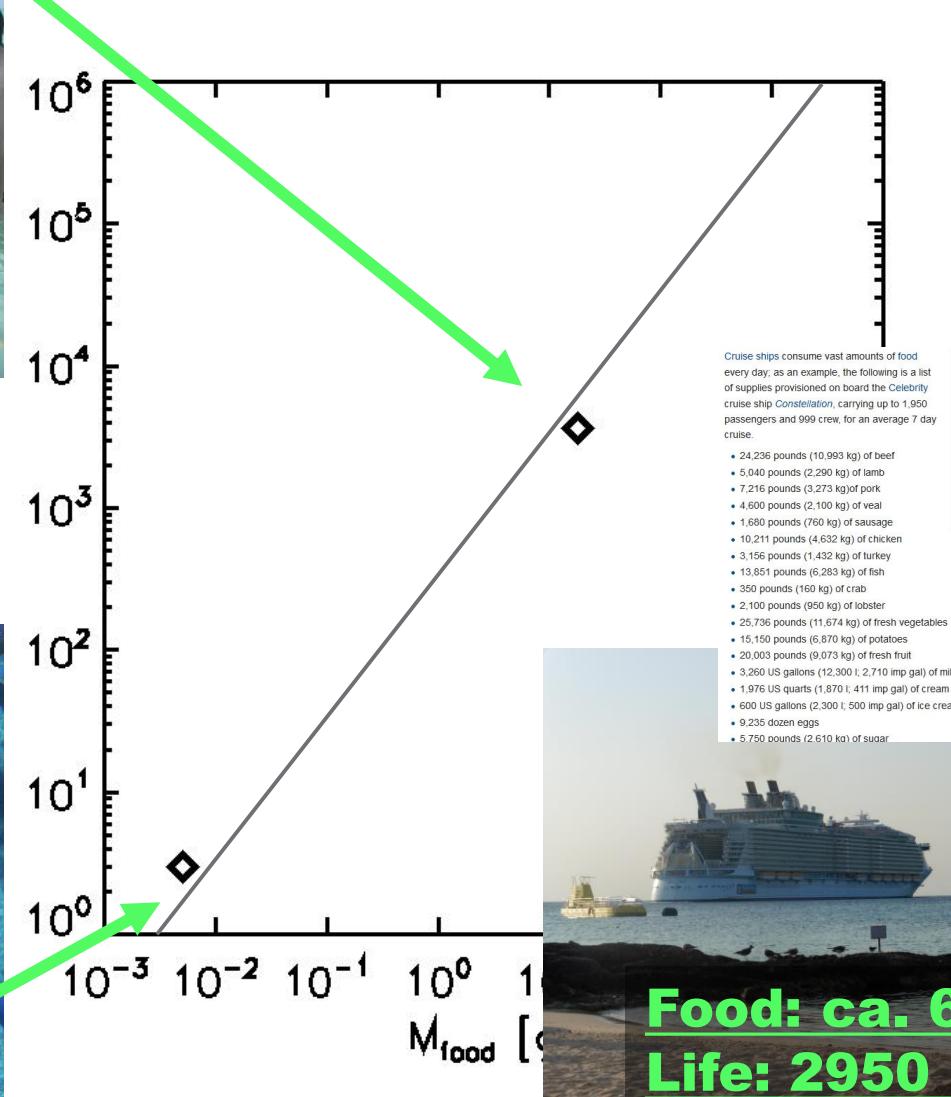
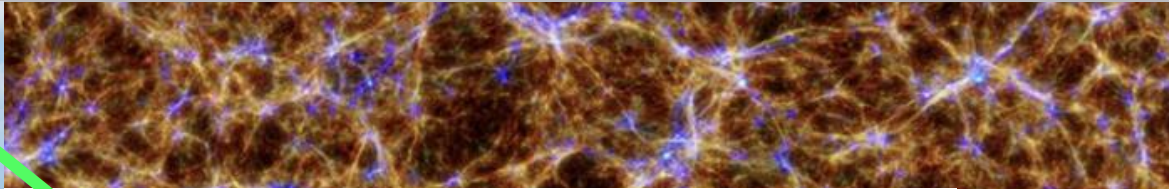
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CAPACIDAD 13 PERSONAS 910 KG



Food: ca. 5g
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7 days,
3 meals
2 snacks



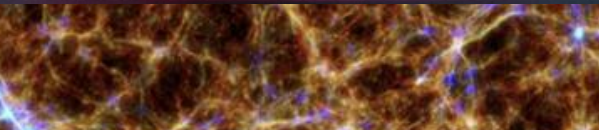
Food: ca. 66tons
Life: 2950 people

Chapter II: Galaxies are not numbers !

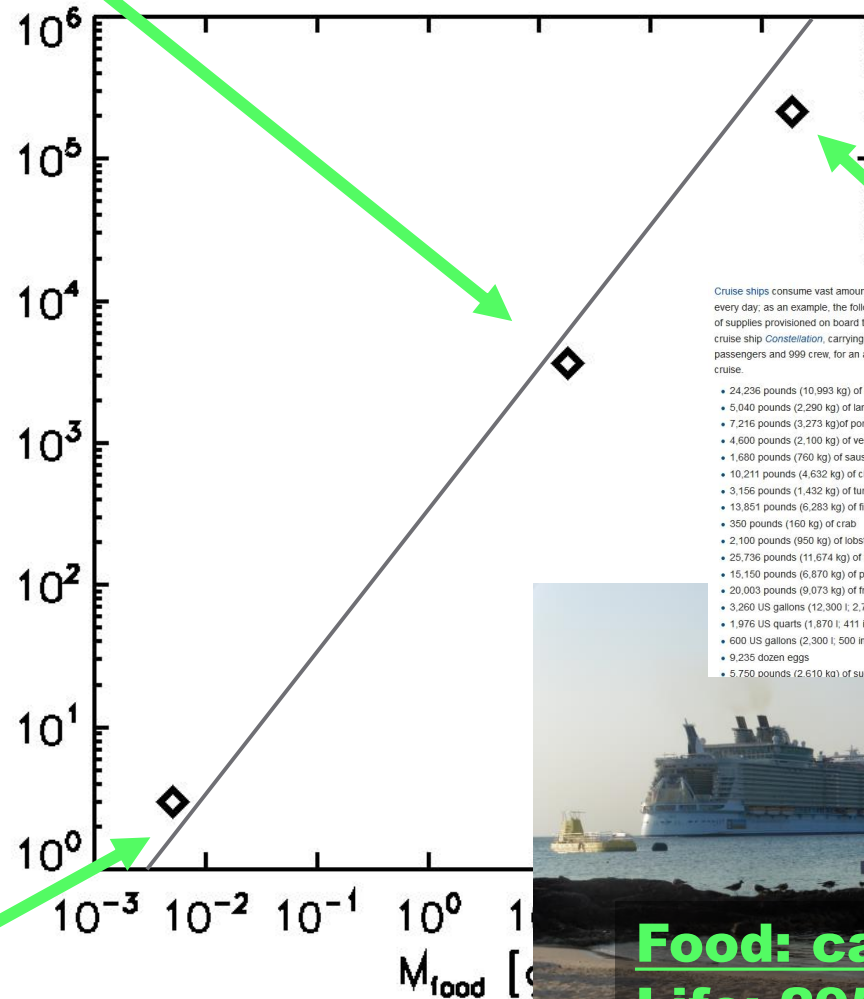
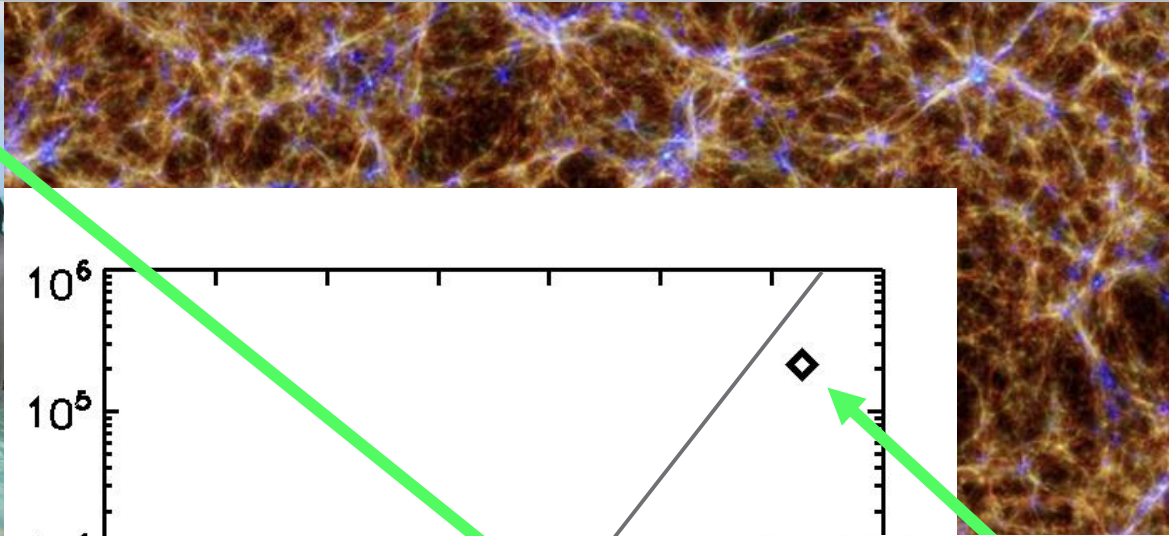
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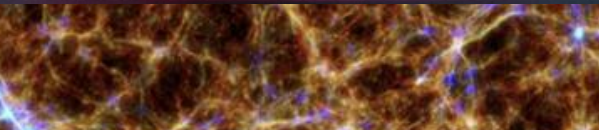
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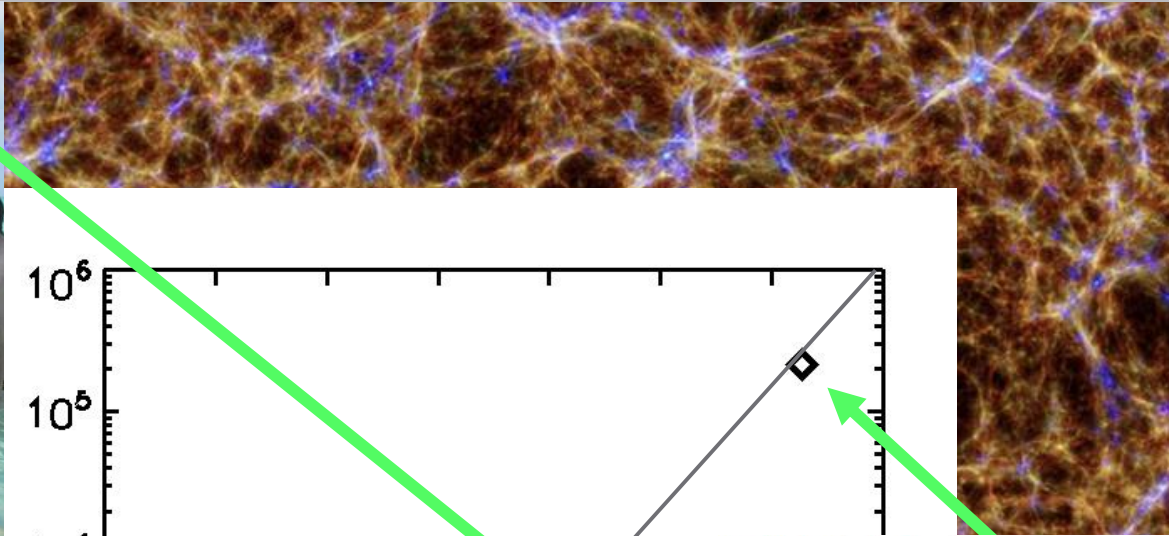
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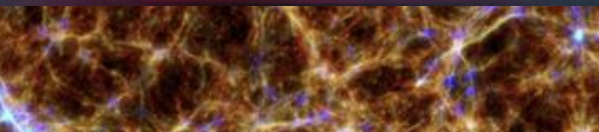
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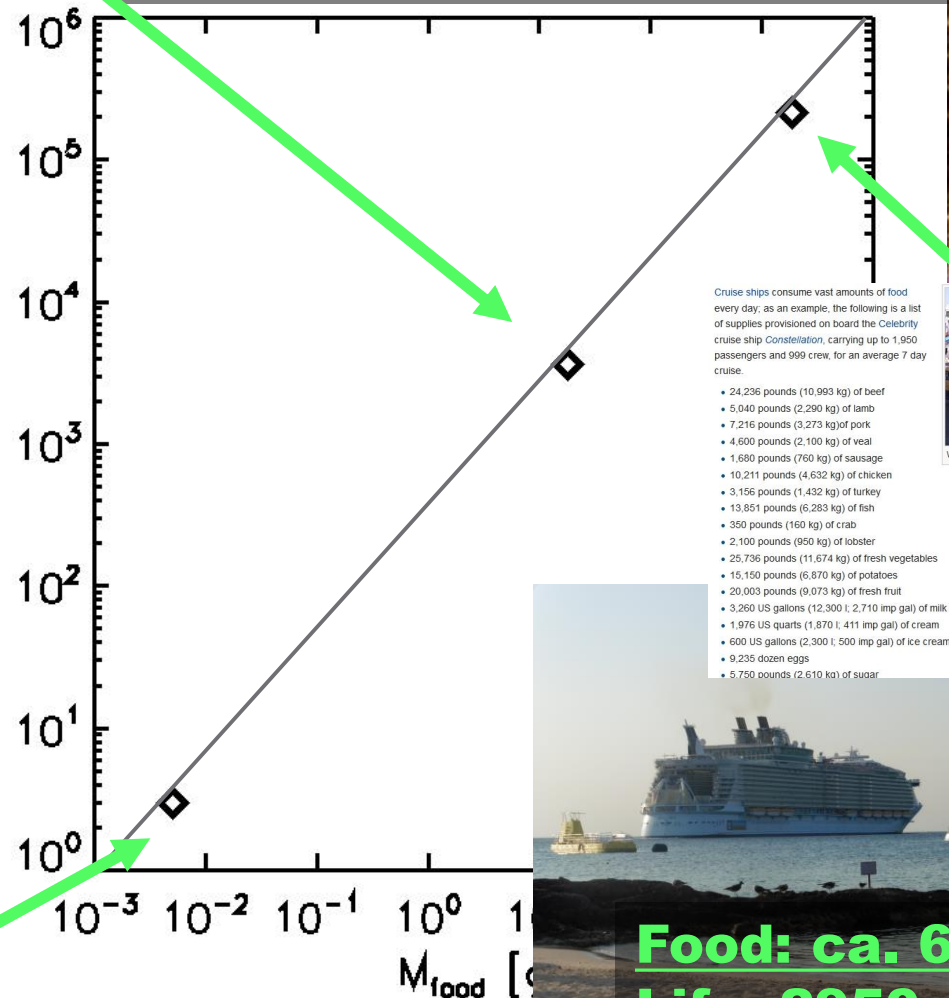


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Do fundamental scaling relations help to understand galaxy formation physics ?



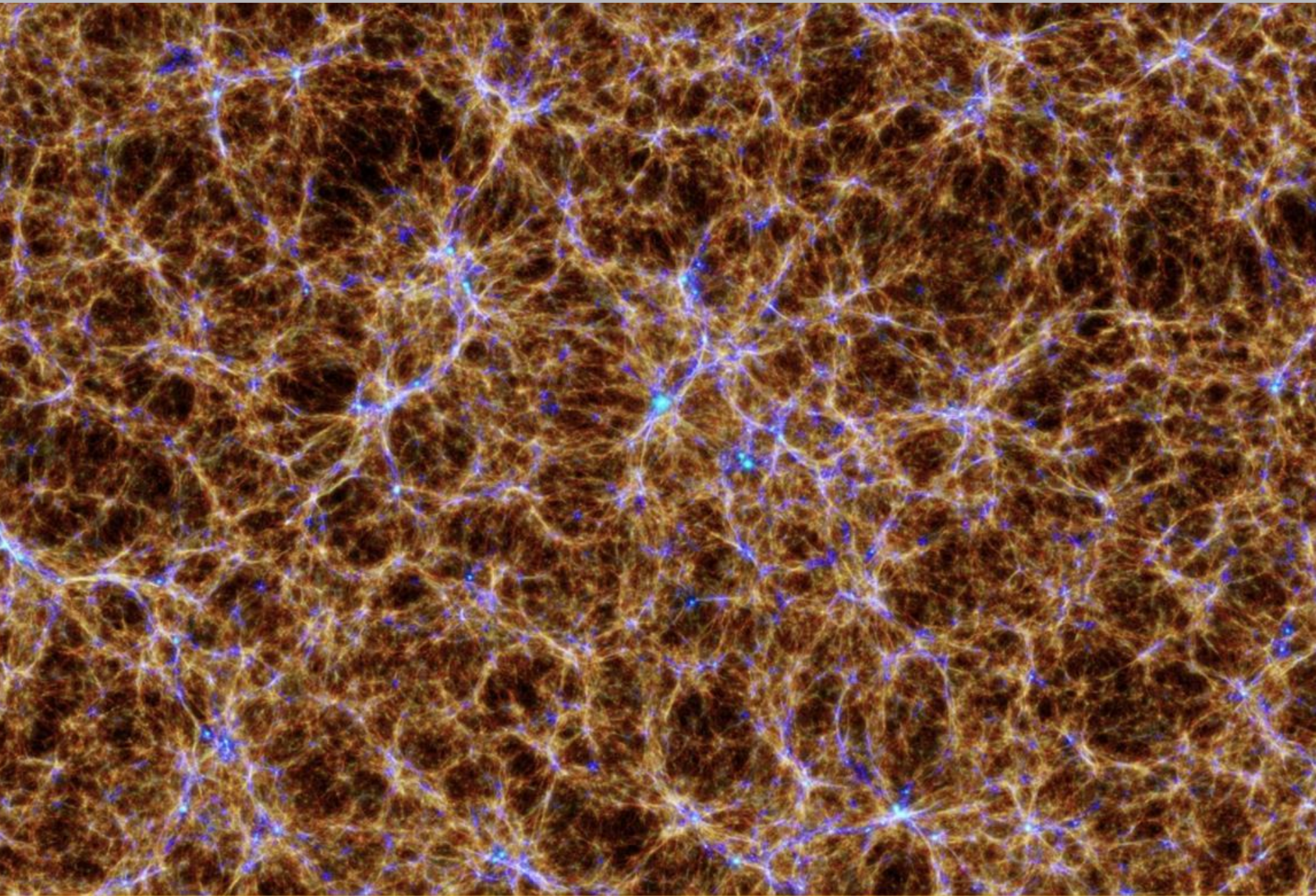
Workers load a Cruise Ship in Charlotte Amalie, USVI

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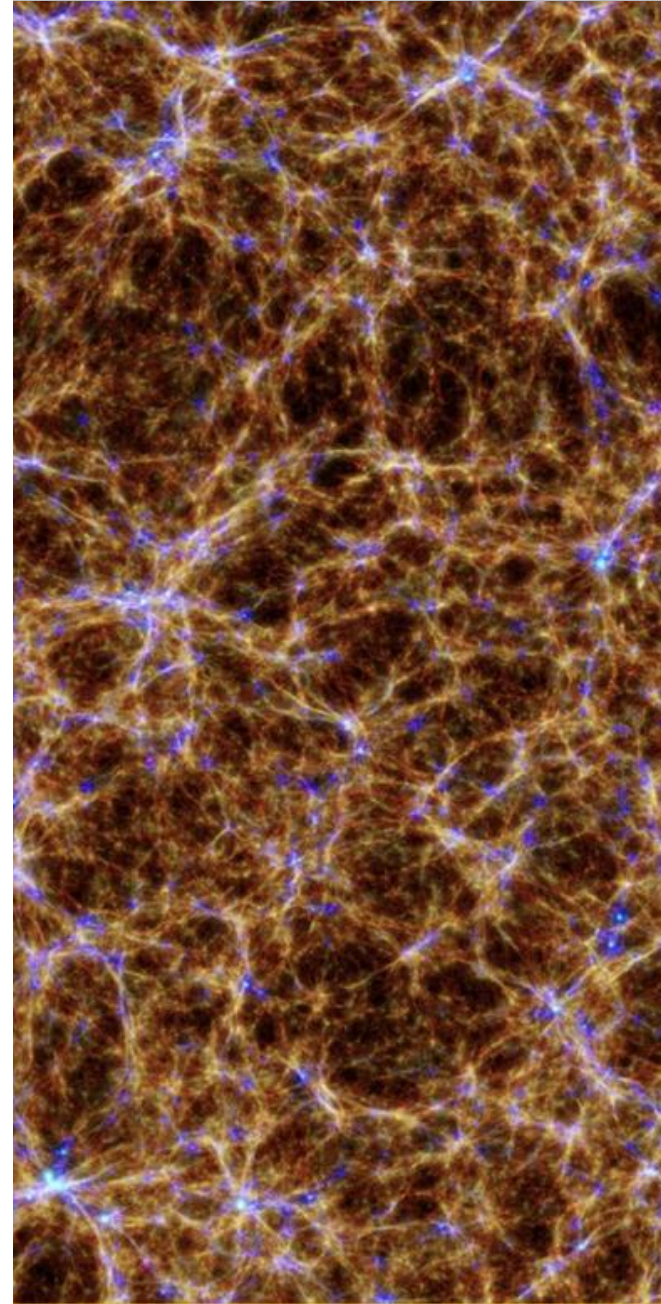
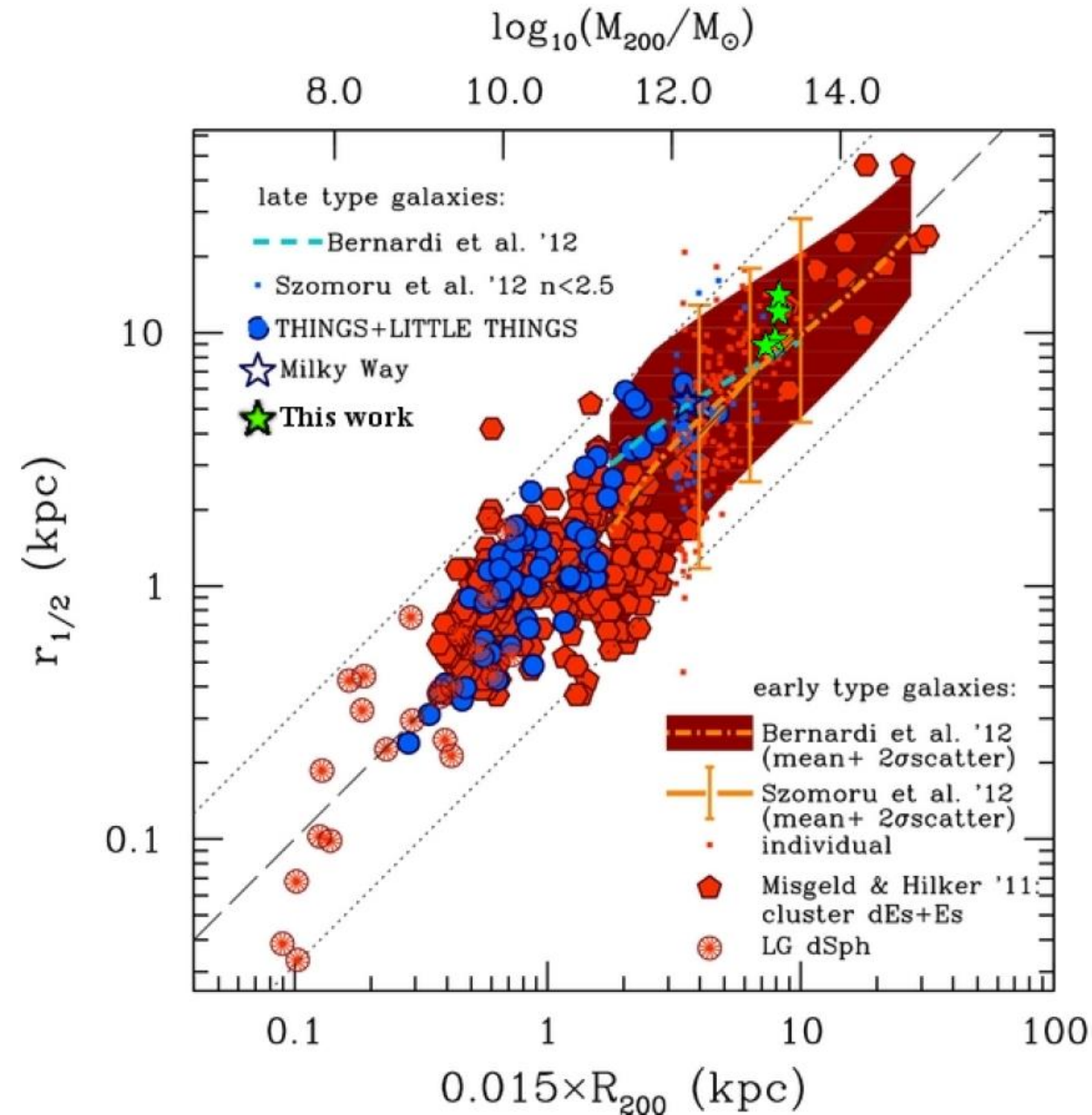


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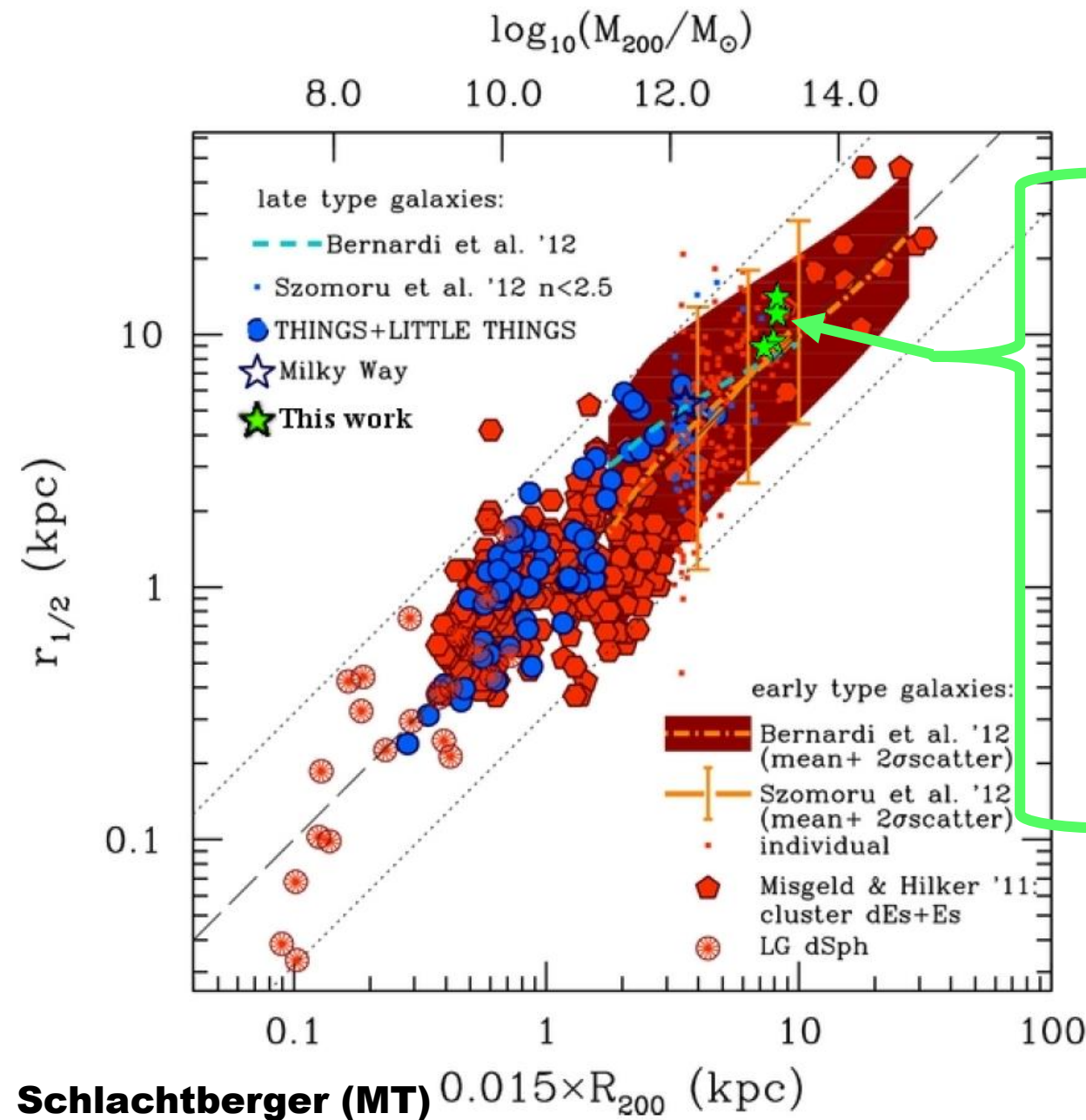
Chapter III: Physics is in the scatter ?



Chapter III: Physics is in the scatter ?



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Zoom-in Simulations of 4 isolated ETGs:

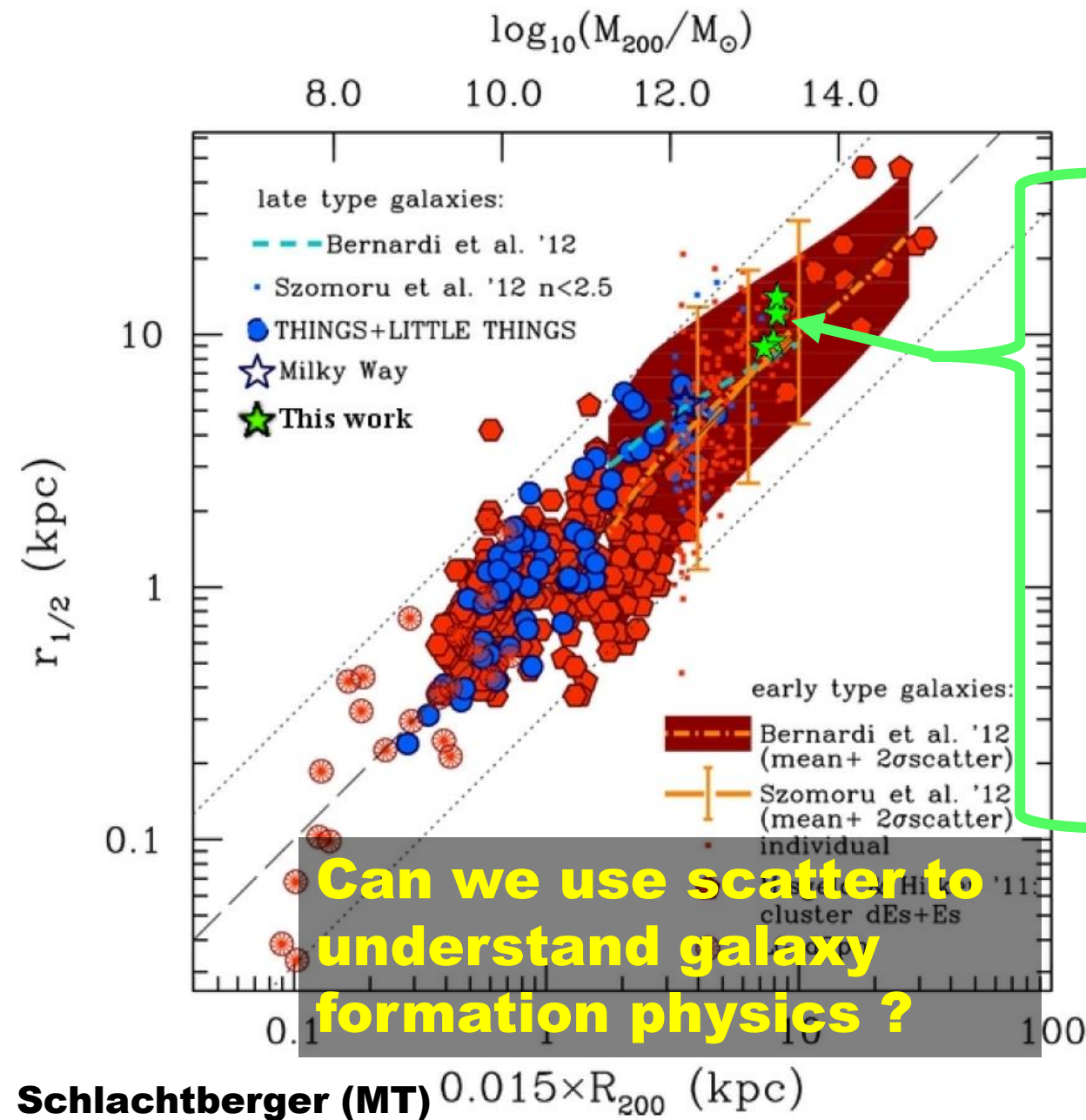
one forms by major merger of two LTGs

one forms by major merger of two ETGs

one is already an ETG at high redshift and grows through smooth accretion

One forms through multiple minor merger events

Chapter III: Physics is in the scatter ?



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Chapter I: Do simple models help ?

Does understanding equilibrium states mean understanding galaxy formation ?

Chapter II: Galaxies are not numbers !

Do fundamental scaling relations help to understand galaxy formation physics ?

Chapter III: Physics is in the scatter ?

Can we use scatter to understand galaxy formation physics ?