The Eris Simulation

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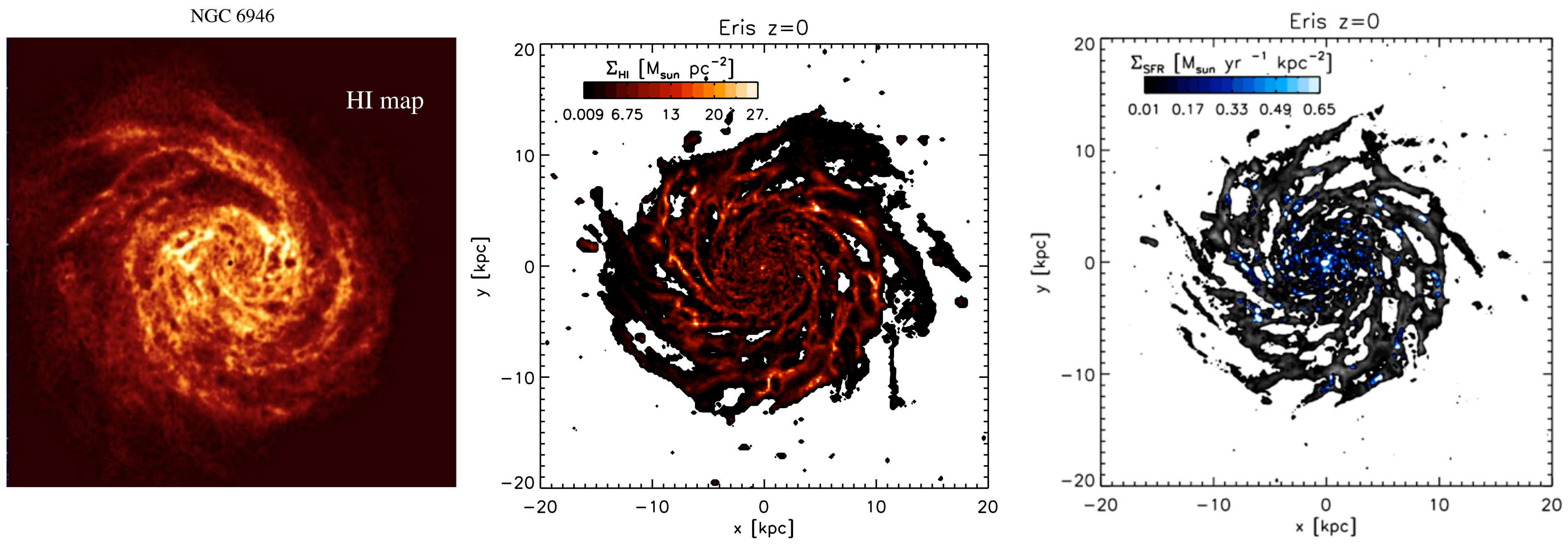
The Basics

	M_{vir} [$10^{12}M_{sun}$]	V_{sun} [km/s]	M* [$10^{10}M_{sun}$]	f_b	B/D	R_d [kpc]	M_i	SFR [M_{sun} yr^{-1}]
Eris	0.79	206	3.9	0.12	0.35	2.5	-21.7	1.1
MW	1±0.2	221±18	4.9-5.5	?	0.33	2.3±0.6	?	0.68-1.45

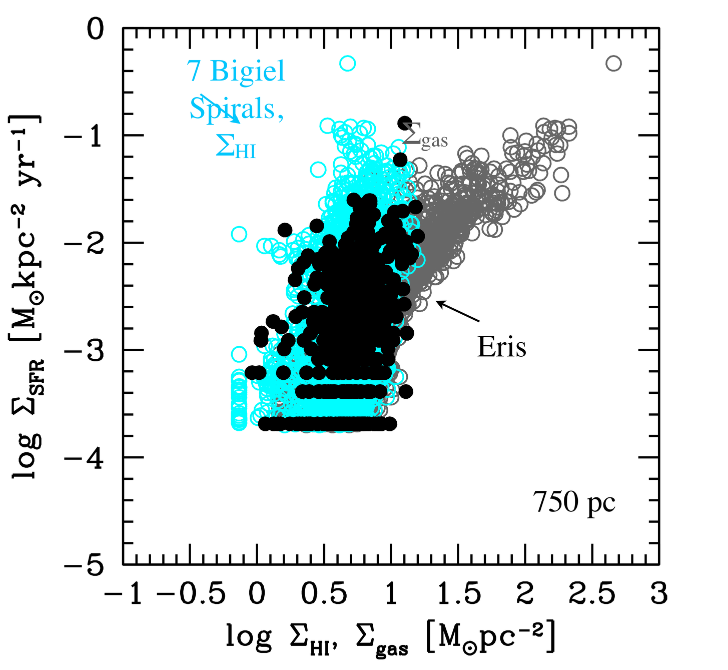
✳ The highest-resolution cosmological simulation of the formation of a late-type spiral galaxy to date.
✳Sampled using the "zoom-in" technique, high resolution at the center, coarse dark matter distribution outside.
✳ Gasoline: *N*-body + SPH code that allows for a large dynamic range due to its Lagrangian nature.
✳ Eris contains a total of 18 M particles within the virial radius: 3 M in gas, 7 M in dark, 8.6 M in stars
✳ Physics: Star formation, heating by an UV background, SNe type Ia and type II feedback (blast-wave) and enrichment, cooling. No AGN.
✳ Eris was run on the the NASA Pleiades and Swiss National supercomputers consuming roughly 1.6 million cpu-hours (9 months including overhead) from z=90 to z=0.

Cold Gas Distribution and Star Formation



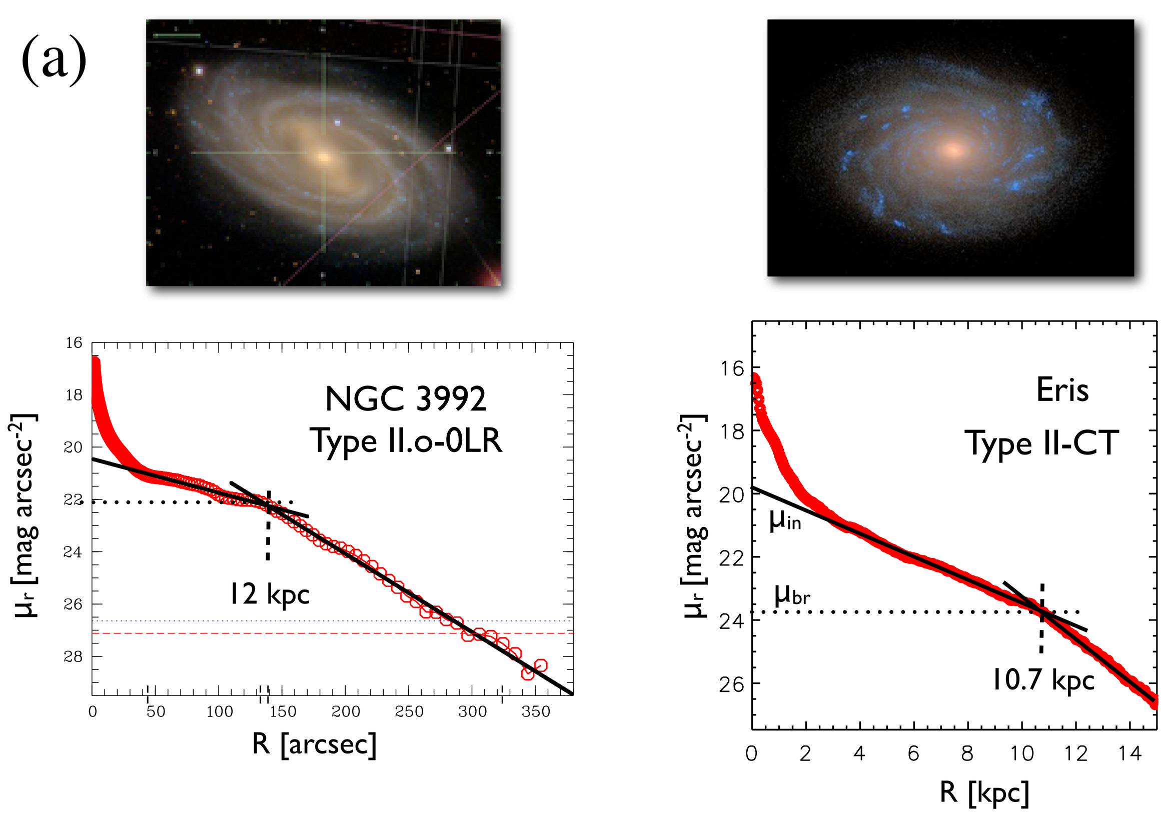
HI disks observed in nearby face-on spirals extend further than the stellar disk have a distribution of holes with mean diameter ~1 kpc. Boomsma et al. 2008.

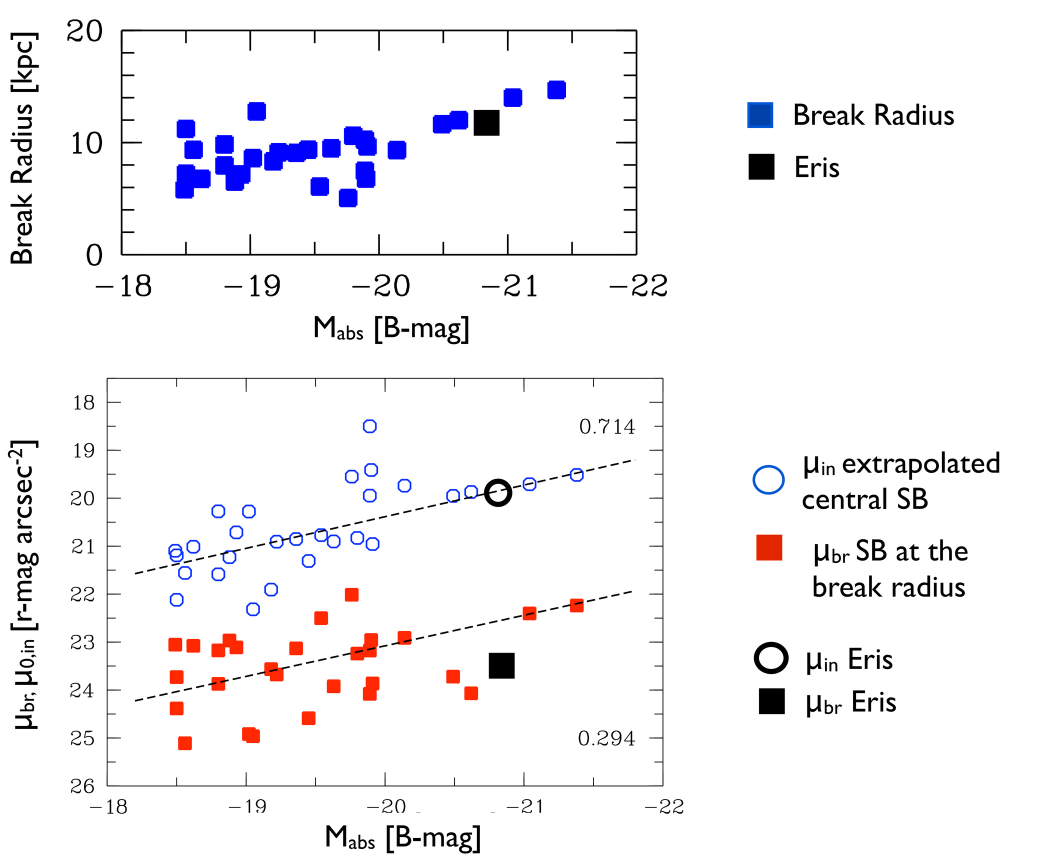
Observations of the Kennicutt-Smith relation in nearby spirals shows that there is a strong correlation between molcular hydrogen surface density and star formation, and no correlation between Σ_{SFR} and Σ_{HI}. Although thre is no H2 physics in our simulations in fact we match the observed Σ_{SFR}-Σ_{HI} data.

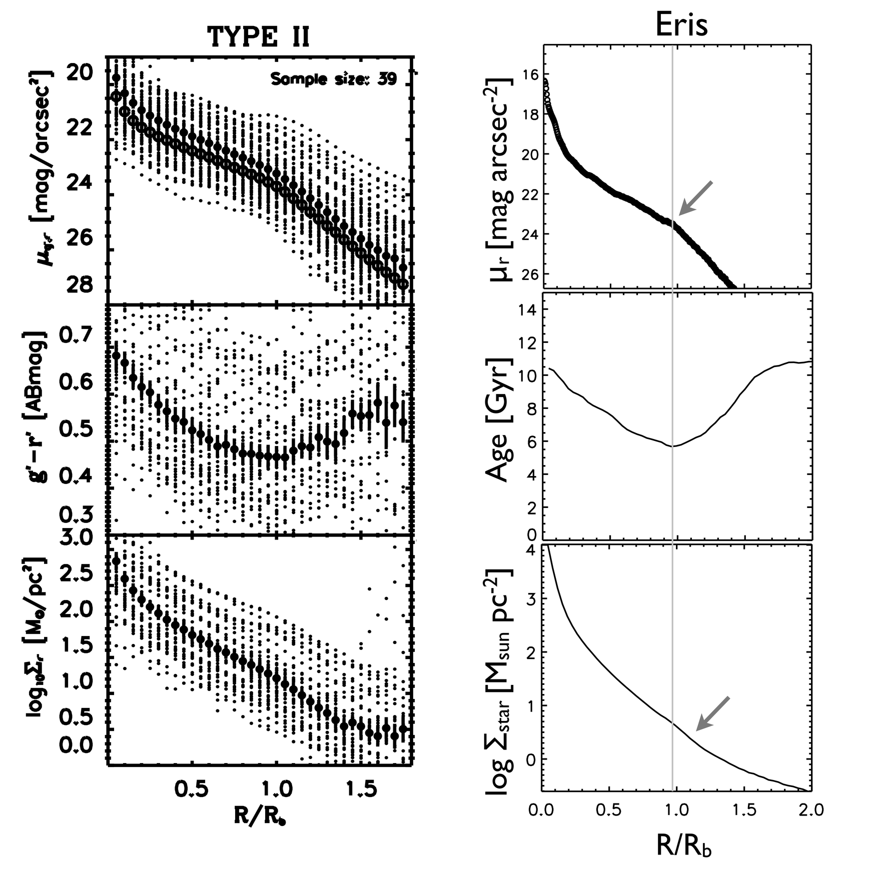


Higher simulations of even higher resolution (in which the high densities of star-forming regions are resolved) are needed to match the molecular K-S relation.

Galactic Disk

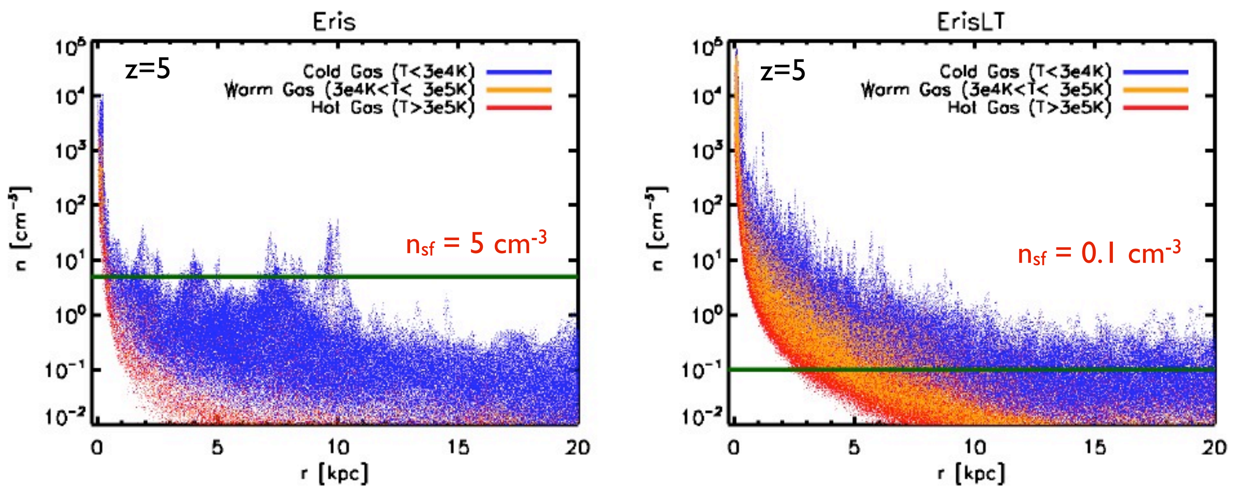






(a) As the mayority of nearby spirals, Eris shows a downward surface profile break, so it would be classified as a Type II-CT (classical break). (b) The break radius r_b, the surface brightness at r_b, and the extrapolated inner surface brightness, all agree with observations. (c) Since the break in surface brigness is sharper than the break in surface stellar density, a possible explanation for these breaks is the changing properties of the stellar populations at r_b (e.g. Roskar et al. 2008). Indeed, the age of the stars dips at the position of the break. Observational data was taken from Pohlen & Trujillo 2006 and Bakos, Trujillo, & Pohlen 2008.

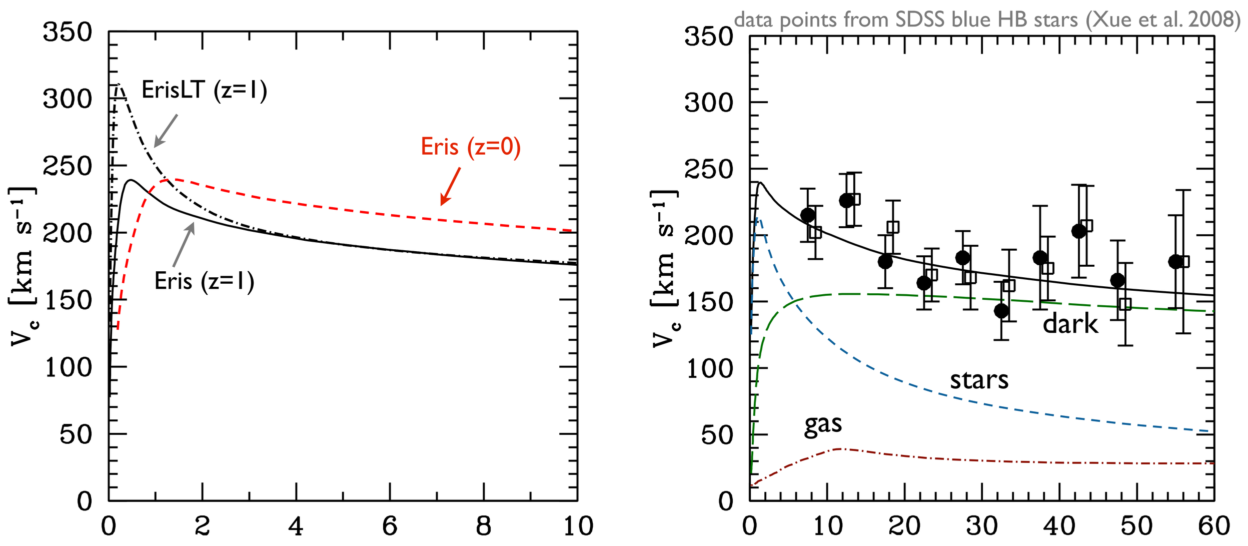
High vs. Low Star Formation Threshold

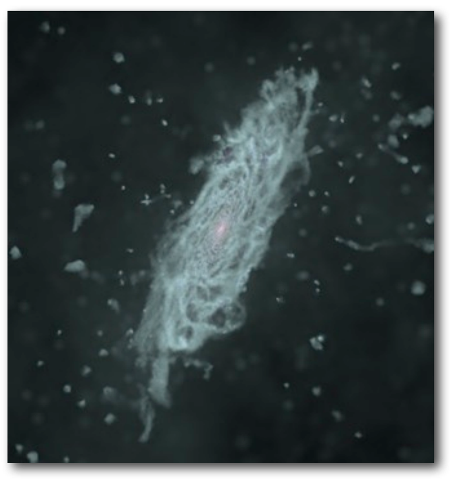


The key to the formation of a massive, extended disk with a small classical bulge (B/D=0.35) is the threshold for star formation. Using a high threshold (HT) allows for the formation of an inhomogeneous ISM: feedback is more efficienty because it acts mostly on the highest-density regions, and removes preferentially low-angular momentum matetrial.

Rotation Curve

The rotation curve of Eris at z=0 is not highly peaked at the center, and falls slowly at large radii, in agreement with observations. We are on the right track to solving the mass concentration problem!





References

Guedes, J., et al 2011 ApJ, accepted
Bakos, Pohlen, & Trujillo 2008
Broosma et al. 2008
Pohlen & Trujillo 2006