# DISCOVERY OF AN ULTRA-FAINT DWARF GALAXY IN THE INTRACLUSTER FIELD OF THE VIRGO CENTER, A FOSSIL OF THE FIRST GALAXIES?

*In Sung Jang & Myung Gyoon Lee*

*Astronomy Program, Department of Physics and Astronomy, Seoul National University, Gwanak-gu, Seoul 151-742, Korea*

Dipartimento di Fisica e Astronomia "Galileo Galilei"

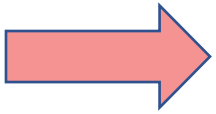
**Patrizia Bussatori**

17 July 2020

# Introduction

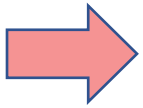
**UFDs are the faintest among the known galaxies in the observed universe.**

- $M_V > -8$
- $r_{eff} < 300\ pc$



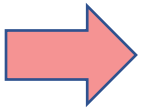
*UFDs are fainter and smaller than classical dwarf spheroidal galaxies (dSphs)*

**STELLAR MASS** => $10^6\ M_\odot$
**DYNAMICAL MASS** comparable to those of dSphs



*They are dominated by DARK MATTER*

**METAL POOR POPULATION** => [Fe/H] < -2
**AGE** OF 12 Gyr



*UFDs are strong candidates for the fossil remnants of the first galaxies*

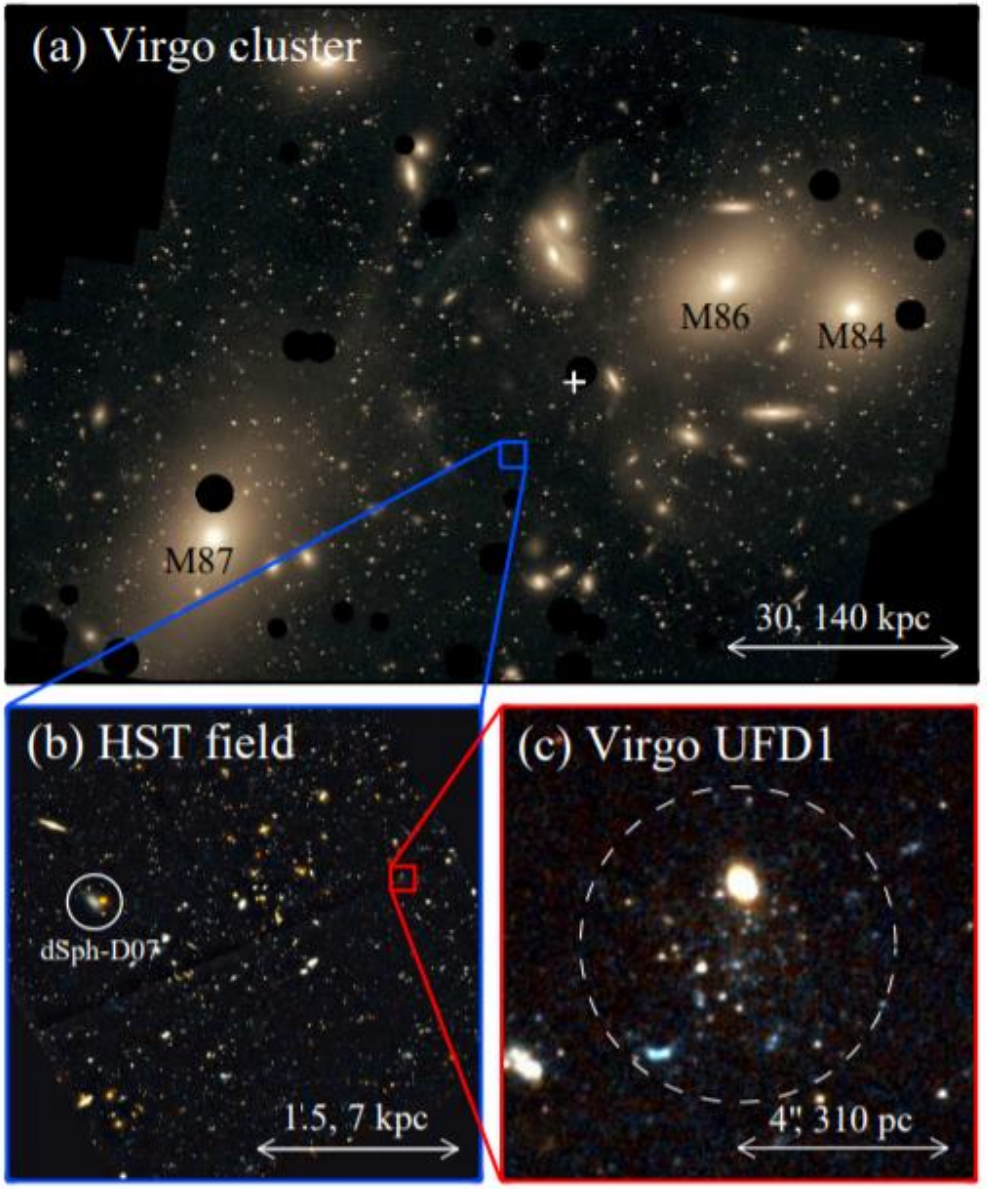
# Data

(a) Deep color image of the Virgo core by Mihos et al. (2005).

(b) dSph-D07 is marked by white circle, and the new Virgo UFD1 is indicated by red square.

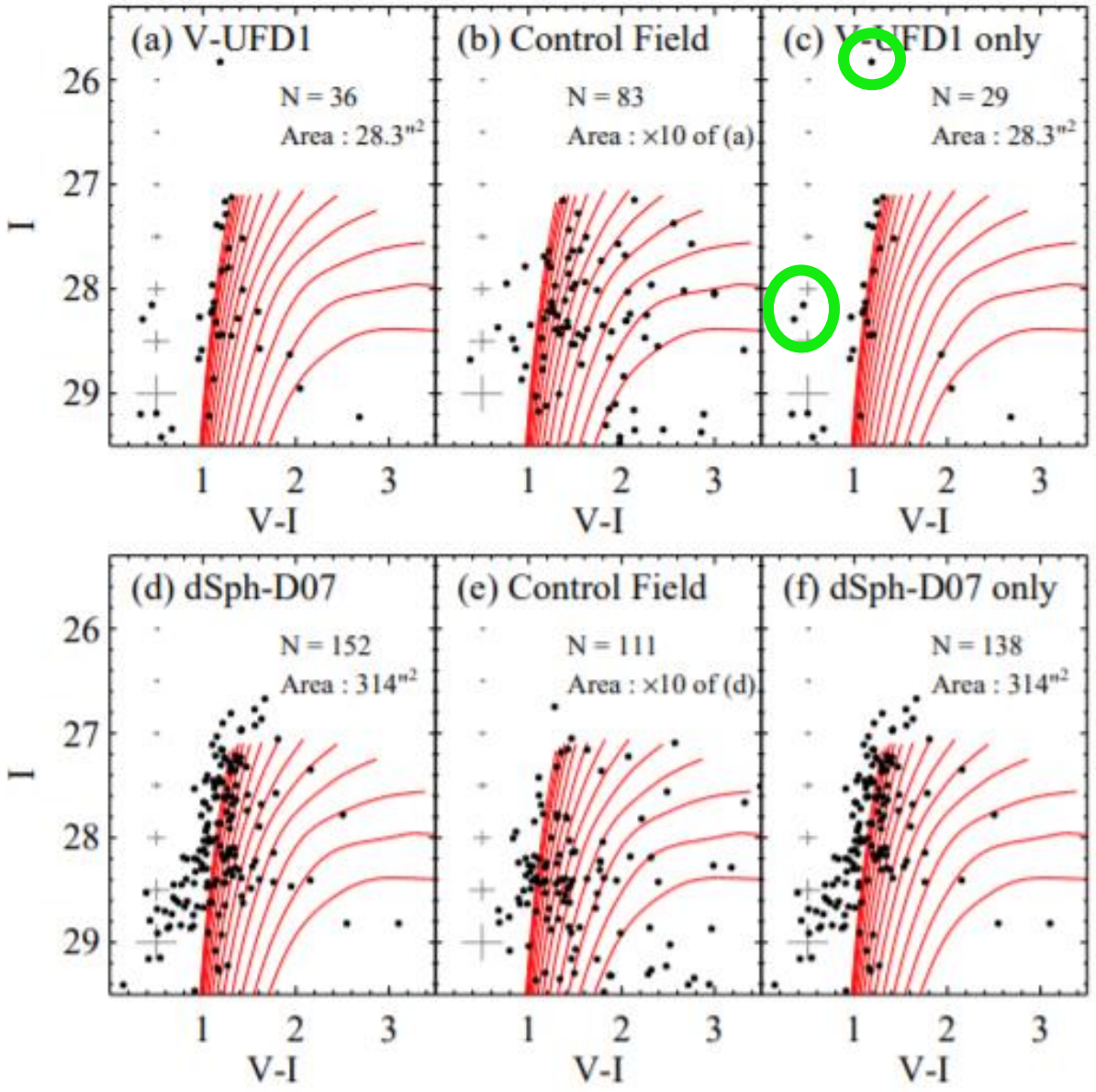
(c) A 10″ × 10″ section of the HST field of Virgo UFD1.

**DISCOVERY OF A NEW UFD!**



# Result

## Color-Magnitude Diagram of the Resolved Stars



## DISTANCE

- TRGB magnitude: $\mathbf{I_{TRGB} = 27.14 \pm 0.04}$

  => $\mathbf{(m-M)_0 = 31.22 \pm 0.04}$ based on TRGB calibration

- Visual isochrones fitting the *I-(V-I)* CMD of 12 Gyr

  => $\mathbf{(m-M)_0 = 31.08 \pm 0.05}$

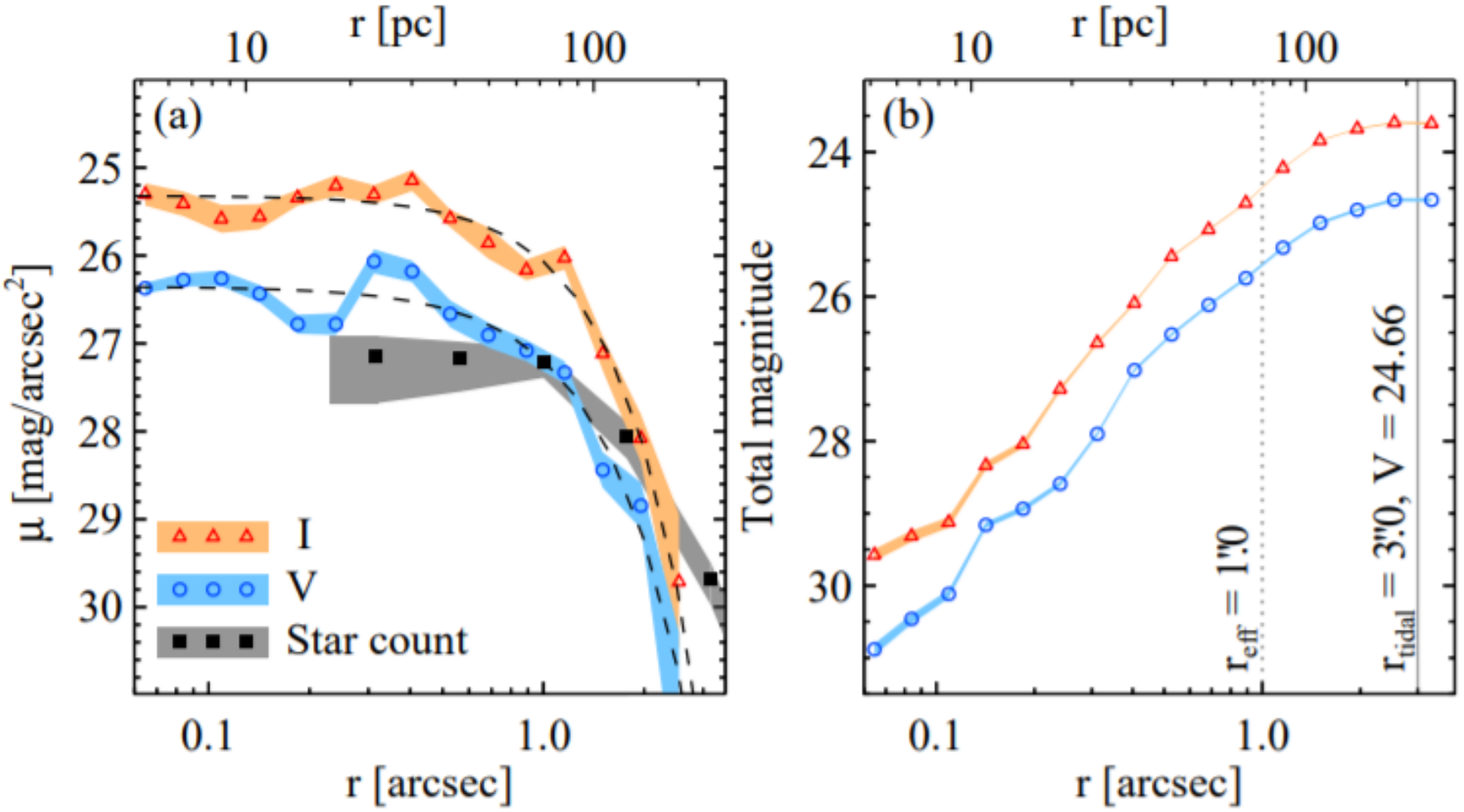
  => 0.1 mag smaller than TRGB method but consistent

## METALLICITY

Comparing the *V−I* color of the red giants and the isochrones they estimate **[Fe/H] = −2.4 ± 0.4**

# Result

## Basic Parameters of Virgo UFD1




Radial profiles of the V (open circles) and I-band (triangles) surface brightness (a) and integrated magnitudes (b) of Virgo UFD1 .

# Result

## Basic Parameters of Virgo UFD1

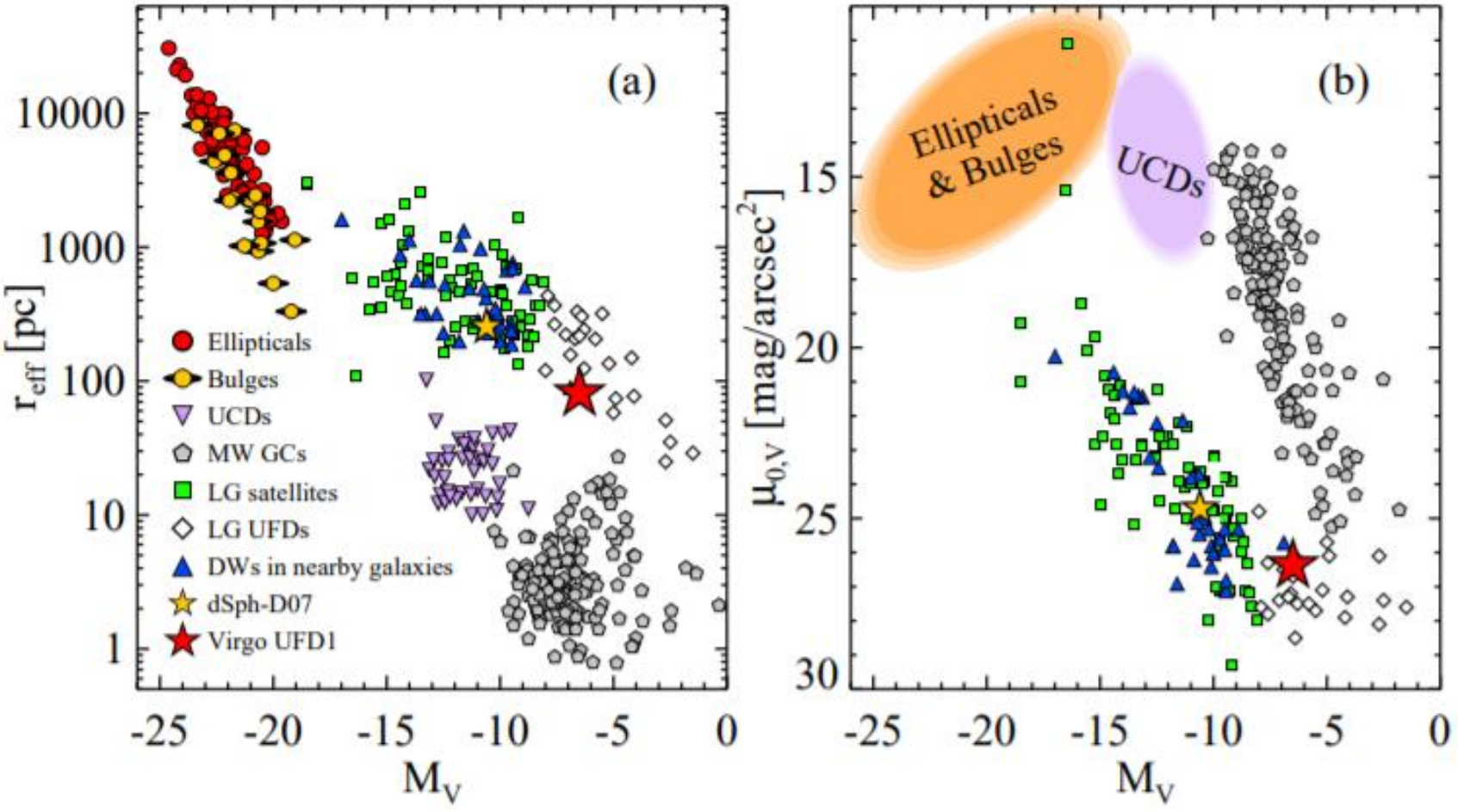
TABLE 1
BASIC PARAMETERS OF VIRGO UFD1

| Parameter | Value[a] |
|---|---|
| R.A.(2000) | $12^h28^m06.^s061$ |
| Dec(2000) | $12°33'47.''61$ |
| Type | UFD |
| Distance, $(m-M)_0$ | $31.08 \pm 0.05$ (16.4 $\pm$ 0.4 Mpc) |
| Total magnitude, $V^T$ | $24.66 \pm 0.08$ |
| Total color, $V^T - I^T$ | $1.06 \pm 0.10$ |
| Ellipticity, $e = (a-b)/a$ | $0.1 \pm 0.1$ |
| Absolute magnitude, $M_V$ | $-6.5 \pm 0.2$ |
| Position angle | $130° \pm 10°$ |
| Core radius ($r_{\rm core}$), $V, I$ | $1.''5 \pm 0.''1$, $1.''5 \pm 0.''1$ |
| Tidal radius ($r_{\rm tidal}$), $V, I$ | $3.''0 \pm 0.''3$, $3.''1 \pm 0.''3$ |
| Sersic Index (n), $V, I$ | $0.56 \pm 0.06$, $0.52 \pm 0.05$ |
| Effective radius ($r_{\rm eff}$), $V, I$ | $1.''02 \pm 0.''09$, $1.''01 \pm 0.''09$ |
| Central surface brightness | $26.37 \pm 0.05$, $25.34 \pm 0.04$ |

[a] Derived in this study

# Discussion and conclusion

## Comparison with Other Dwarf Galaxies




(a) Effective radius vs. absolute V total magnitude of the Virgo UFD1 in comparison with those for other stellar systems. (b) The V -band central surface brightness vss absolute V total magnitude of Virgo UFD1.

# Discussion and conclusion

## Fossils of the First Galaxies?

**OLD AGE (>10 Gyr based on narrow RGB and no AGB stars)**

**LOW METALLICITY ([Fe/H] = −2.4 ± 0.4)**

**SPATIAL LOCATION IN THE INTRACLUTSER FIELD**

**Virgo UFD1 may be a fossil remnant of the first galaxies**

*Are UFDs the Missing Satellite Dwarfs?*