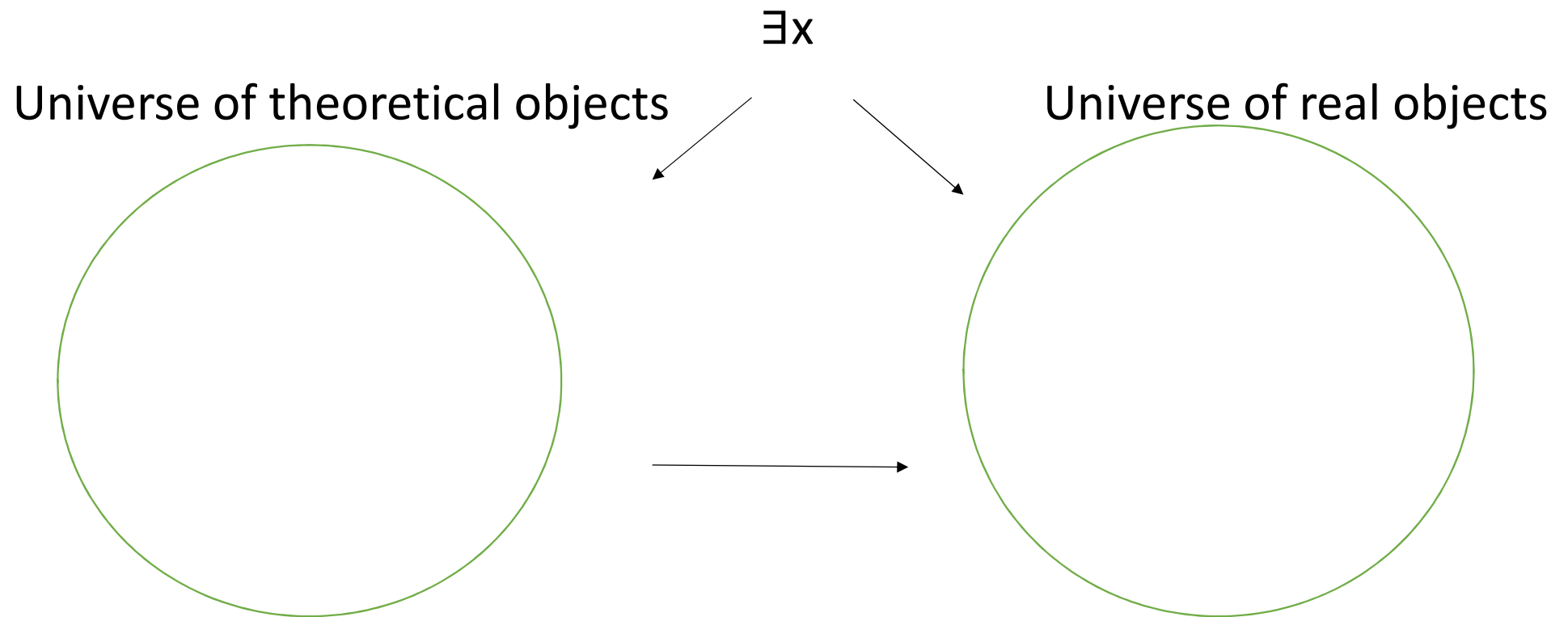


# Dark Matter as a Hypothetical Object: The Application of Methodological Tools to Contemporary Cosmology

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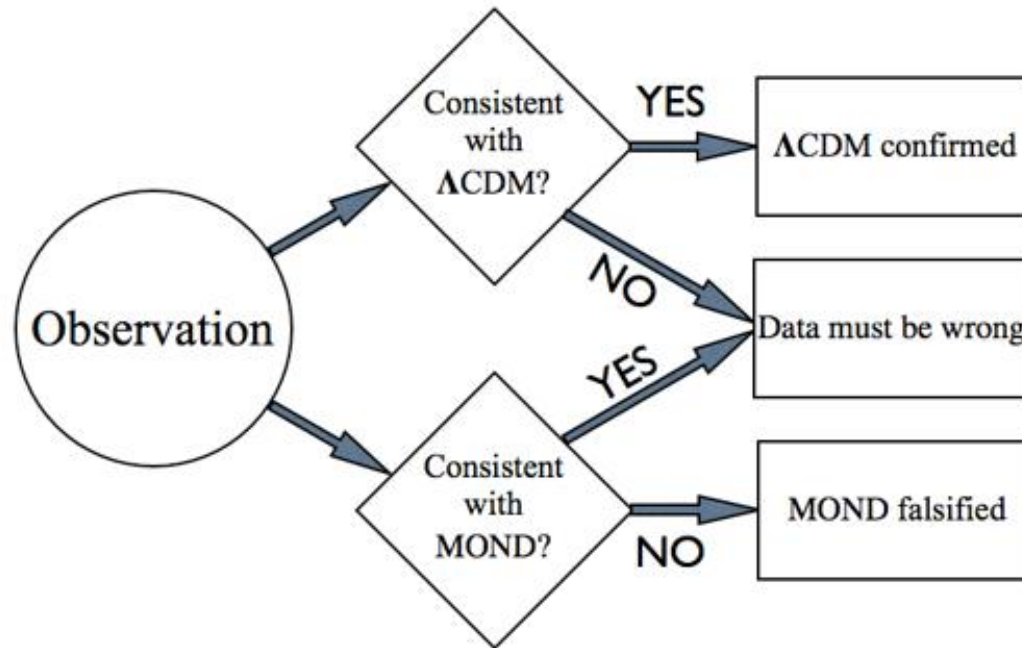
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# Hypothetical objects



See Lazutkina, A. (2017). "Theoretical terms of contemporary cosmology as intellectual artifacts" in Franz, J. & Berr, K. (eds.) *Welt der Artefakte*. Berlin: Frank & Timme. 63-70.

A simple flowchart for the interpretation of any astronomical observation



This flowchart was made “tongue-in-cheek” by Stacy McGaugh, but as a description of the current situation in cosmology it is true enough

# Theory of Truthlikeness

- Science approximates reality: previous theories are replaced by new theories, which are closer to the truth (more *truthlike*)
- Idea introduced by Karl Popper; a leading approach (the *likeness approach*) based on work of Ilkka Niiniluoto
- Truthlikeness can be measured in relation to a concrete cognitive problem
- Assumption: our observations are true

- $d(x, y) = |x - y|$
- Truthlikeness =  $1 / (1 + d(x, y))$

	$V_{1/2}$ obs	$V_{1/2}$ MOND	$V_{1/2}$ $\Lambda$ CDM	Truthlikeness MOND	Truthlikeness $\Lambda$ CDM
<b>Fornax</b>	20.1	20.8	25.5	0.59	0.16
<b>Carina</b>	11.3	9.9	13.8	0.42	0.29
<b>Leo I</b>	15.8	15.9	16.2	0.9	0.71
<b>Leo II</b>	11.3	11.6	12.8	0.77	0.4
<b>Sculptor</b>	15.8	14.9	15.7	0.53	0.9
<b>Draco</b>	15.6	15.1	14.7	0.67	0.53
<b>Sextans</b>	13.5	11.8	18.2	0.37	0.18
<b>Ursa Minor</b>	16.3	15.4	16.6	0.53	0.77

# Principle of correspondence

- Generalization and refinement of Niels Bohr's idea
- E.K. Voishvillo :
  - The old theory is not a special case of the new one, it becomes false in the light on new theory
  - The statements of the old theory are reformulated by adding new conditions, thereby narrowing the scope of its application, and deleting implied false part from it
  - ***Modified version*** of the old theory is a special case of the new theory

# Principle of correspondence

Newton's law

$$\forall x \forall v \forall m \forall t \forall f ((V(v, x, t) \& M(m, x) \& F(f, x, t)) \rightarrow F = d(mv)/dt)$$

MOND:

$$\forall x \forall v \forall m \forall t \forall f ((V(v, x, t) \& M(m, x) \& F(f, x, t)) \rightarrow F = m\mu(a/a_0)a)$$



Newtonian law with the condition **D** becomes a special a case of MOND

- **D**:  $\mu(a/a_0) \approx 1$

$$\forall x \forall v \forall m \forall t \forall f ((V(v, x, t) \& M(m, x) \& F(f, x, t) \& D) \rightarrow F = d(mv)/dt)$$

- Alexander, S. G. et al. (2017). “MOND Calculations of Bulk Dispersions and Radial Dispersion Profiles of Milky Way and Andromeda Dwarf Spheroidal Galaxies.” *Astrophysical Journal* 835: 233–246.
- Fattahi, A. et al. (2016). “The cold dark matter content of Galactic dwarf spheroidals: no cores, no failures, no problem.”  
<<https://arxiv.org/abs/1607.06479>>.