

THE SCIENTIFIC “METHOD”

- “Ask a scientist what he conceives the scientific method to be, and he will adopt an expression that is at once solemn and shifty-eyed: solemn, because he feels he ought to declare a position; shifty-eyed, because he is wondering how to conceal the fact that he has no opinion to declare.”
- Peter Medawar, Zoologist, 1969

PARKES SURVEY FOR DIM AND DARK GALAXIES 1997-2005



HI SELECTED GALS with Sloan



THE DETECTIVE'S EQUATION

$$O(H | E_1, E_2, \dots, E_N) = W(E_1 | H) \times W(E_2 | H) \\ \times W(E_3 | H) \times \dots \times O(H)$$

$$\text{where } W(E | H) = \frac{P(E | H)}{P(E | \bar{H})}$$

INFERENCE TABLE; Murder in the Library

that point. Thus for the murder in the library (5:1) the detective produced an IT on her hypothesis that '*The leading lady is the murderer*' as follows:

INFERENCE TABLE: MURDER IN THE LIBRARY

Clue (E)	O(H)	W(E H)	O(H E)
Prior	1/6		
Motive	1/6	2	1/3
Opportunity	1/3	4	4/3
Footprint	4/3	1/44	1/33

INFERENCE TABLE 1

Hidden Galaxies

CORRECTED INFERENCE TABLE (8:1): HIDDEN GALAXIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Clue	Date	$W(E H)$	$O(H E)$	Q	\sqrt{Q}	$2^{\pm\sqrt{Q}/2}$	(4)/(7)	
Prior			1					
1	1975	2^4	2^4	4	2	$2^{\pm 1}$	2^3	Doubt.
2	1978	2^{-3}	2^1	7	3	$2^{\pm 2}$	2^{-1}	“ “
3	1983	2^2	2^3	9		$2^{\pm 2}$	2^1	“ “
4	1984	2^2	2^5	11			2^3	“ “
5	1985	2^2	2^7	13			2^5	Optim.
6	1987	2	2^8	14	4	$2^{\pm 2}$	2^6	Belief
7	1987	2^3	2^{11}	17			2^9	Belief
8	1990	2^2	2^{13}	19			2^{11}	Convic.
9	1993	2^2	2^{15}	21	5	$2^{\pm 3}$	2^{12}	“ “.
10	1994	2^3	2^{18}	24			2^{15}	“ “
11	1995	2	2^{19}	25			2^{16}	“ “

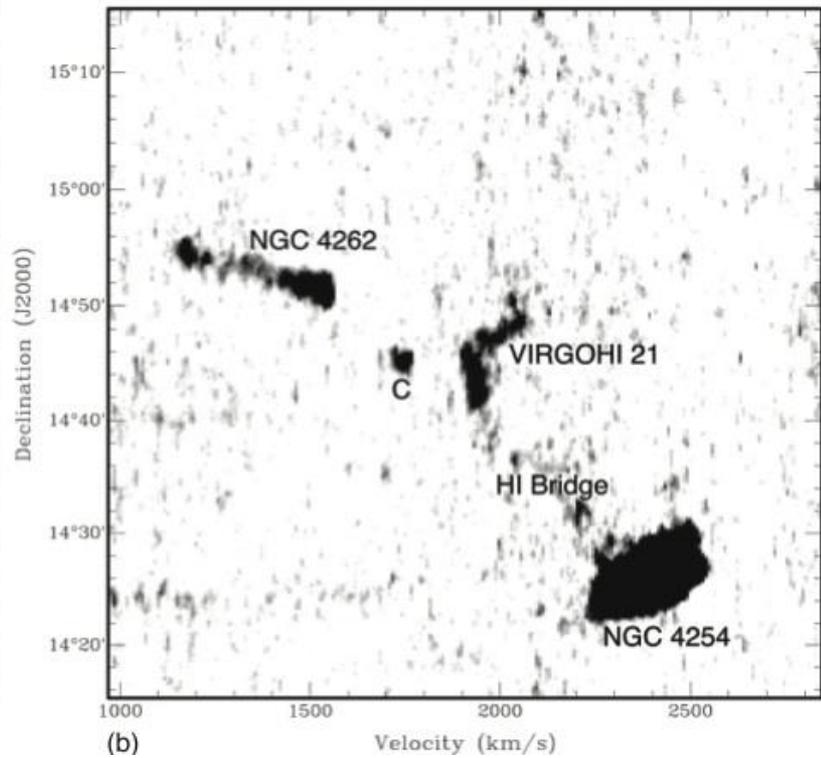
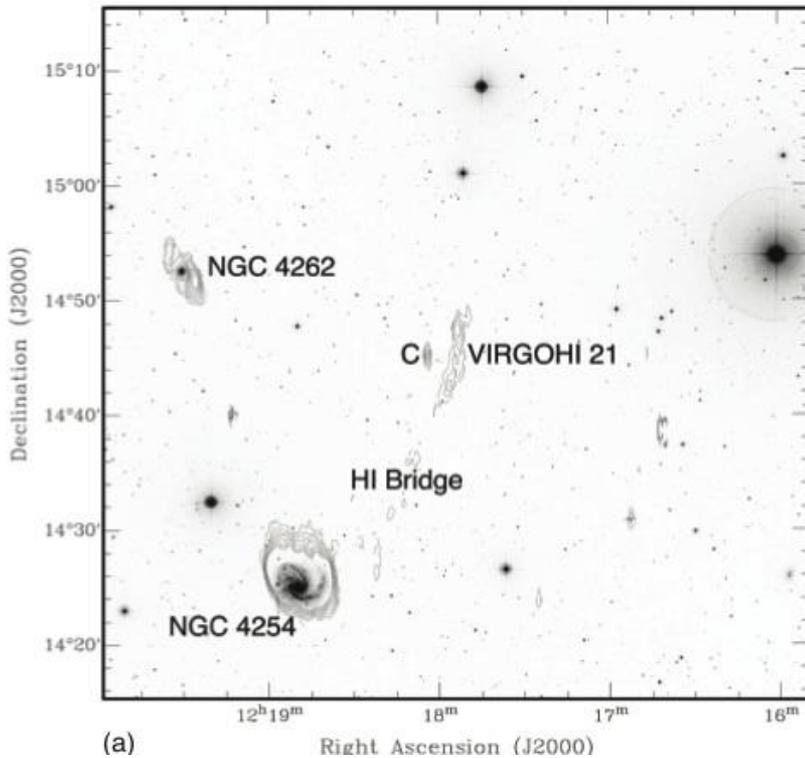
INFERENCE TABLE 2

Hidden Galaxies

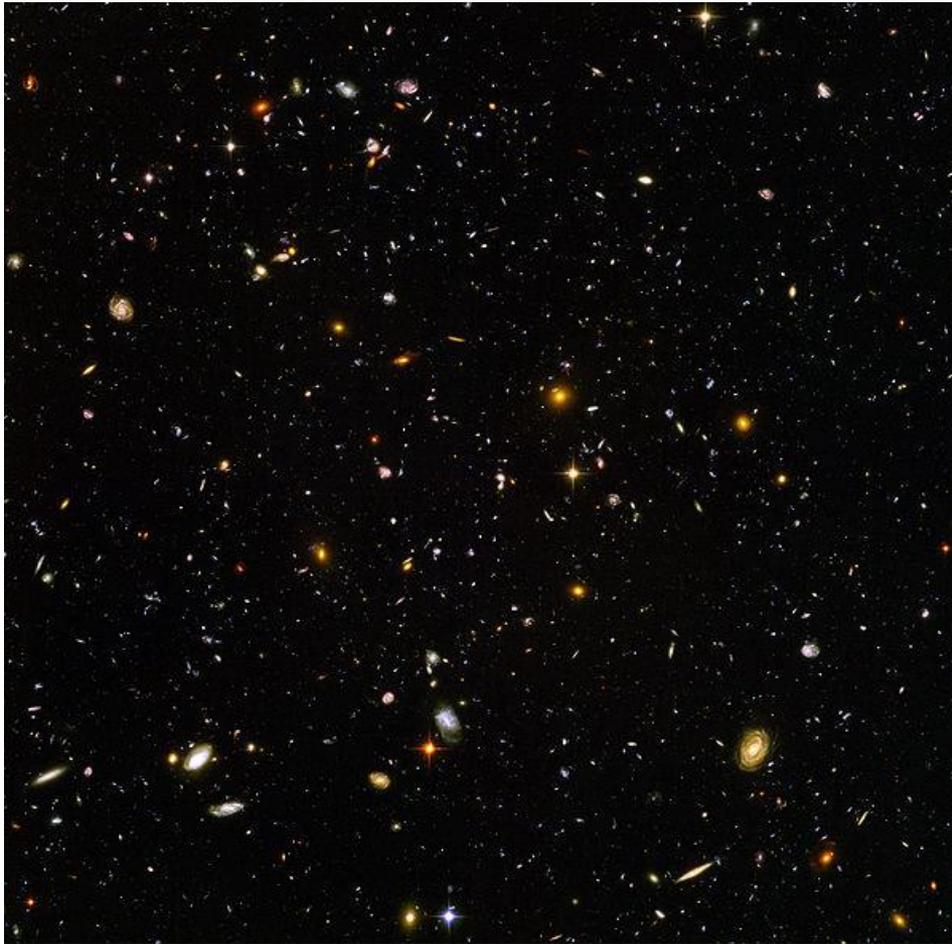
12*	1995	2^{-4}	2^{15}	29			2^{12}	“ “
13	1997	2	2^{16}	30			2^{13}	“ “
14*	1997	2^{-4}	2^{12}	34	6	$2^{\pm 6}$	2^9	Belief
15	1998	2^2	2^{14}	36	6		2^{11}	Convic.
16	1999	2^{-2}	2^{12}	38			2^9	Belief
17	2000	2^4	2^{16}	42			2^{13}	Convict
18	2002	2^{-1}	2^{15}	43	7	$2^{\pm 4}$	2^{11}	Belief
19	2002	2^{-2}	2^{13}	45			2^9	“ “
20*	2005	2^{-5}	2^8	50			2^4	Optimis
21	2005	2^2	2^{10}	52			2^6	Belief
22	2005	2^2	2^{12}	54			2^8	“ “
23	2009	2	2^{13}	55			2^9	“ “
24	2010	2^4	2^{17}	59	8		2^{13}	Convic.
25	2012	2^{4+5}	2^{26}	68			2^{22}	“ “
26	2012	2^2	2^{28}	70			2^{24}	“ “

Psst! A completely Dark Galaxy.

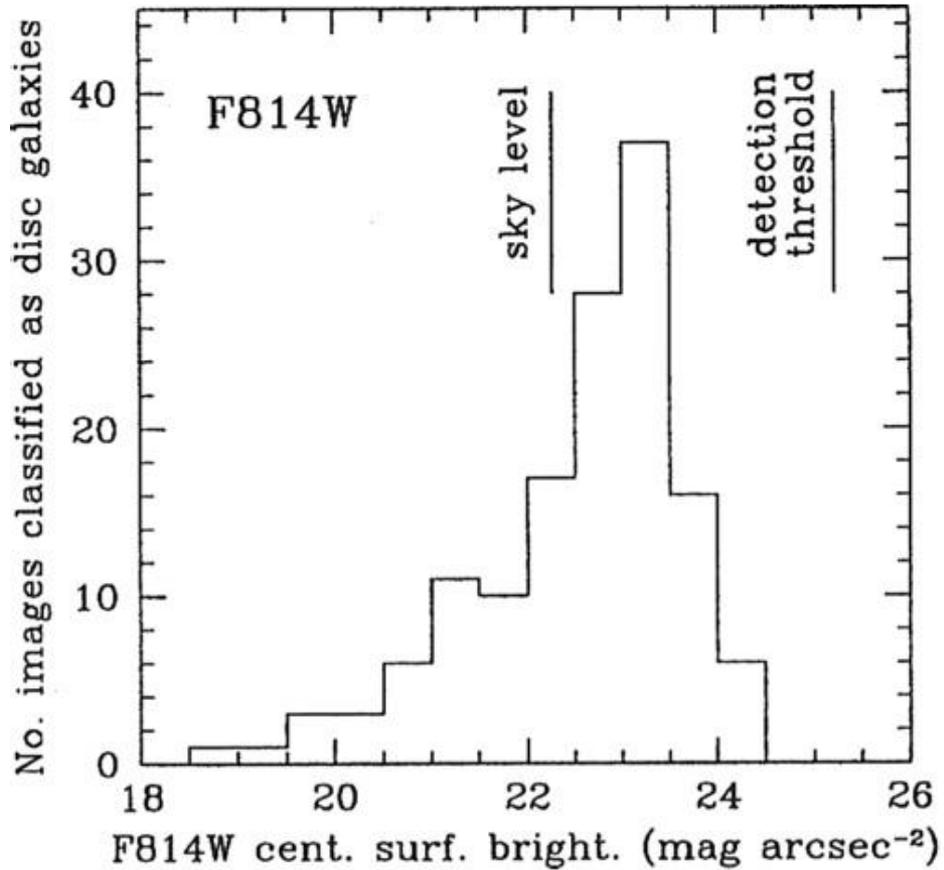
Minchin et al, ApJ., 2007



SOMETHING ultra WEIRD IN HUDF?
Can you see it?

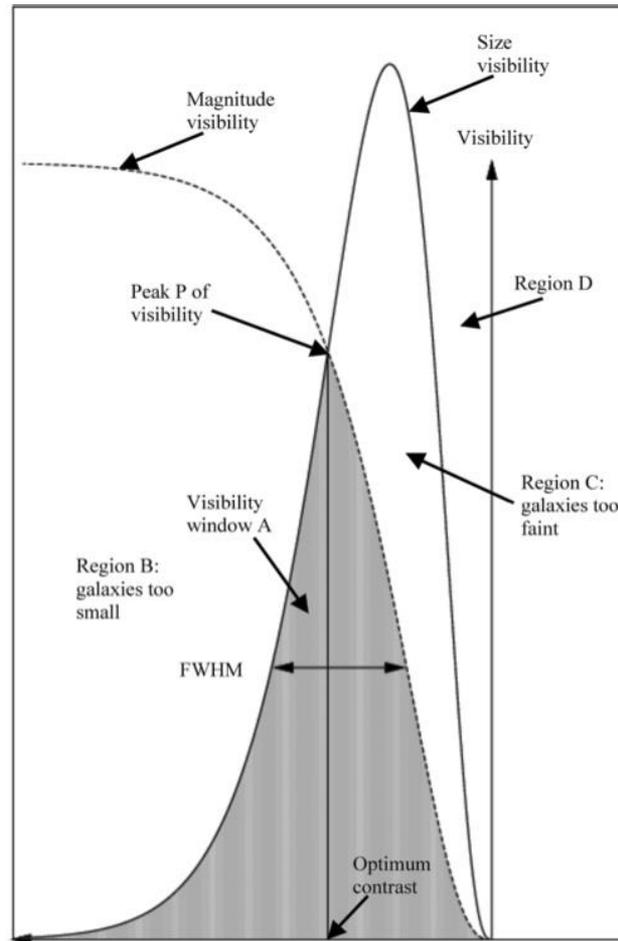


SBs of disc gals in HDF



VISIBILITY OF GALAXIES

Disney & Lang , 2012, MNRAS



ORIGIN DETECTIVE'S EQUATION

The Detective's Eqn:

$$O(H \mid E_1, E_2, \dots, E_N) = W(E_1 \mid H) \times \dots \times O(H)$$

with only one clue E_1 becomes

$$O(H \mid E_1) = W(E_1 \mid H) \times O(H)$$

which is Bayes' Theorem in unfamiliar

Odds Form. Unconvincing: like ladder with only one rung.

FIRST EXPLANATION OF HOW INDUCTION CAN WORK IN SCIENCE

- “There are in (Optics) demonstrations which do not produce the same kind of certain Laws as Geometry – which is based on fixed and incontestable Principles. Here we first assume the Principles, make predictions from them, and look to see if those predictions are verified by experiment. There is no other way to proceed. We obtain thereby a degree of probability which very often is scarcely less than direct proof. And when there is a great number of such verified predictions, particularly if some of them are brand new, then it seems to me there ought to be a very strong confirmation of my ideas.” HUYGHENS, ‘TREATISE ON OPTICS’, Preface 1690.

INFERENCE TABLE

Big Bang Cosmology 2005

INFERENCE TABLE FOR BIG BANG HYPOTHESIS

#	Clue	W(E H)	O(H E,..)	
	Prior	1	1	
1	Nothing older than expans. age	2^2	2^2	A
2	Earlier hot dense state	2^6	2^8	B
3	U should but does not decelerate	2^{-1}	2^7	C
4	U should be but is not anisotropic	2^{-6}	2	D
5	Gals don't dim w redshift but shd.	2^{-3}	2^{-2}	E
6	B Bang could prod. Light elements	2^4	2^2	F
7	B Bang predicts structure peaks	2^4	2^6	G
8	B Bang can't produce galaxies	2^{-6}	$2^0 = 1$	H
9	But CDM variant can	2^4	2^4	I
10	But gals don't resemble CDM ones	2^{-4}	1	J
11	'Inflation' may expln. no anisotropy	2	2	K
12	Recent accelng expansn not explnd.	2^{-4}	2^{-3}	L

Conclusions

- 1 The DETECTIVE'S EQN. [DE] can do your Scientific Inference, especially with conflicting evidence. Can lead to INDUCTIVE CERTAINTY. { Bayes' Theorem is not convincing bec multiplicative nature left out}. (Huyghens 1690)
- 2 If necessary use Subjective Weights, weak clues, rough (binary) values, experience & judgment.
- 3 You don't need Statistics [much of which is wrong; Howson and Urbach, 1990]. The DE will do it for you.
- 4 Universe is probably stuffed with Dim and Dark galaxies.
- 5 The DE is the algorithm of Common Sense and provides a neat explanation of Ockham's Razor, which is a bit of a mystery otherwise.
- 6 Are you sure about The Big Bang?