ON A FREQUENCY PATTERN ESTIMATE FROM AN ENTROPY-BASED METHOD

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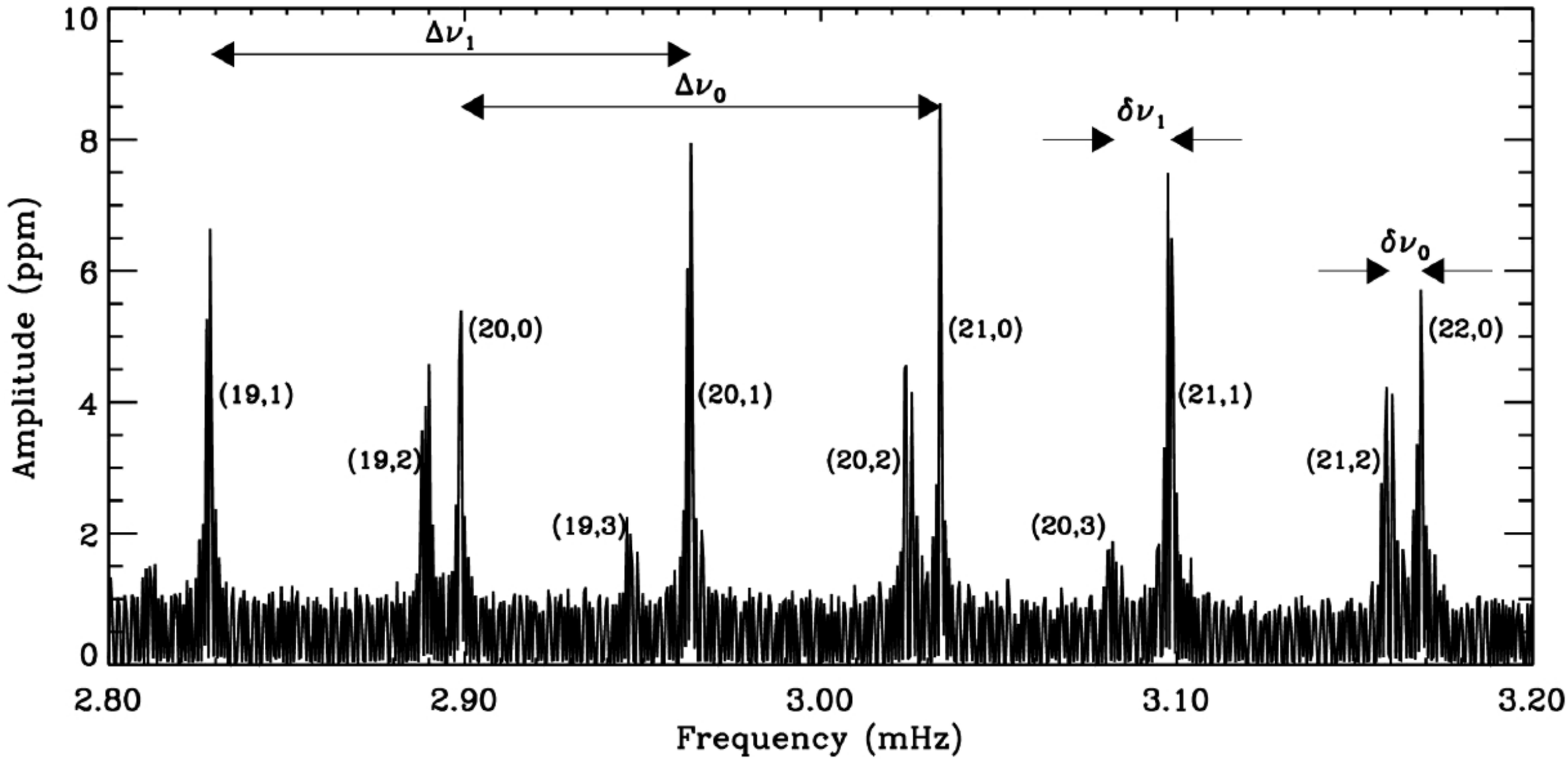
PRELIMINARY…

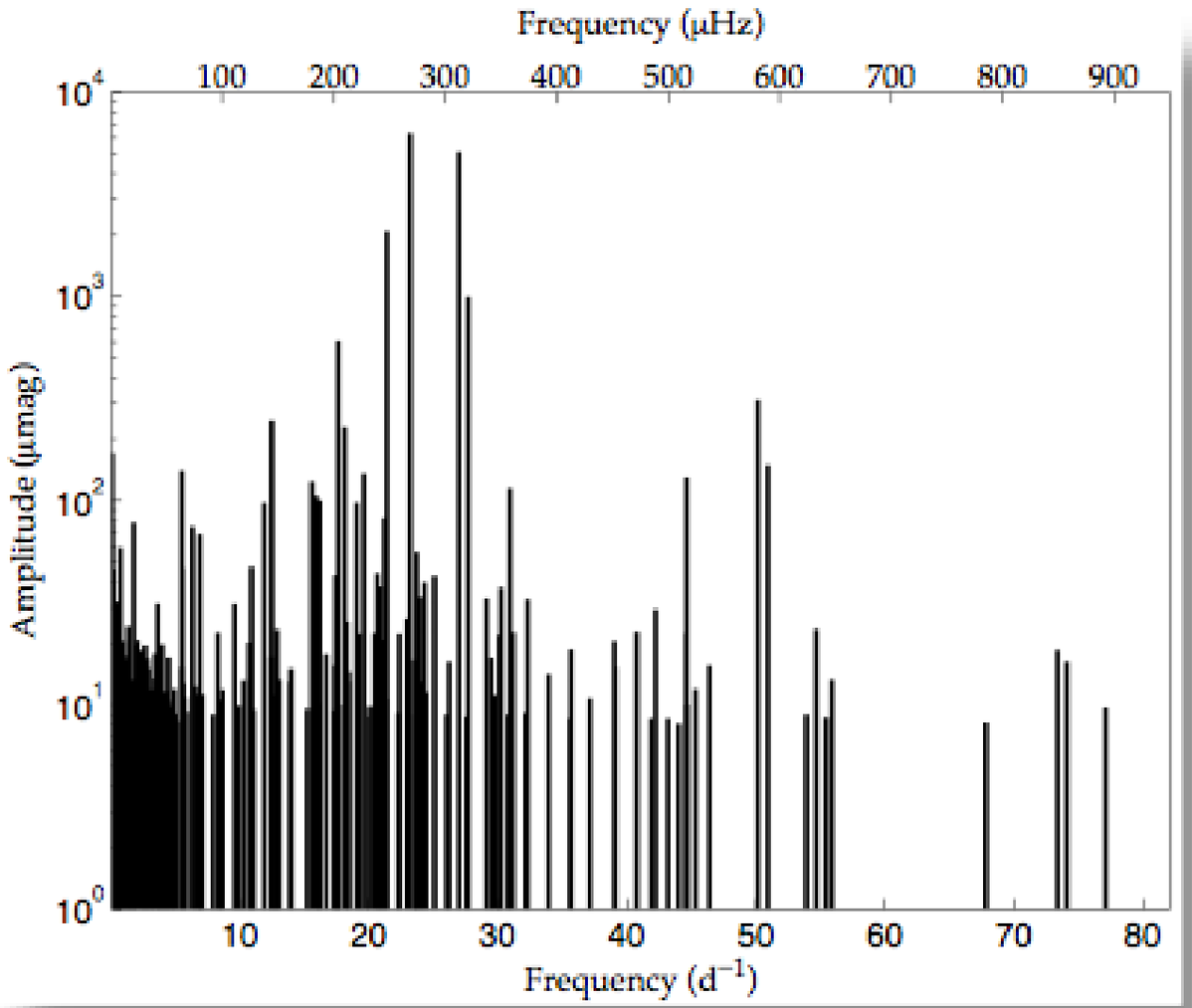
THE SUN AND SOLAR LIKE STARS

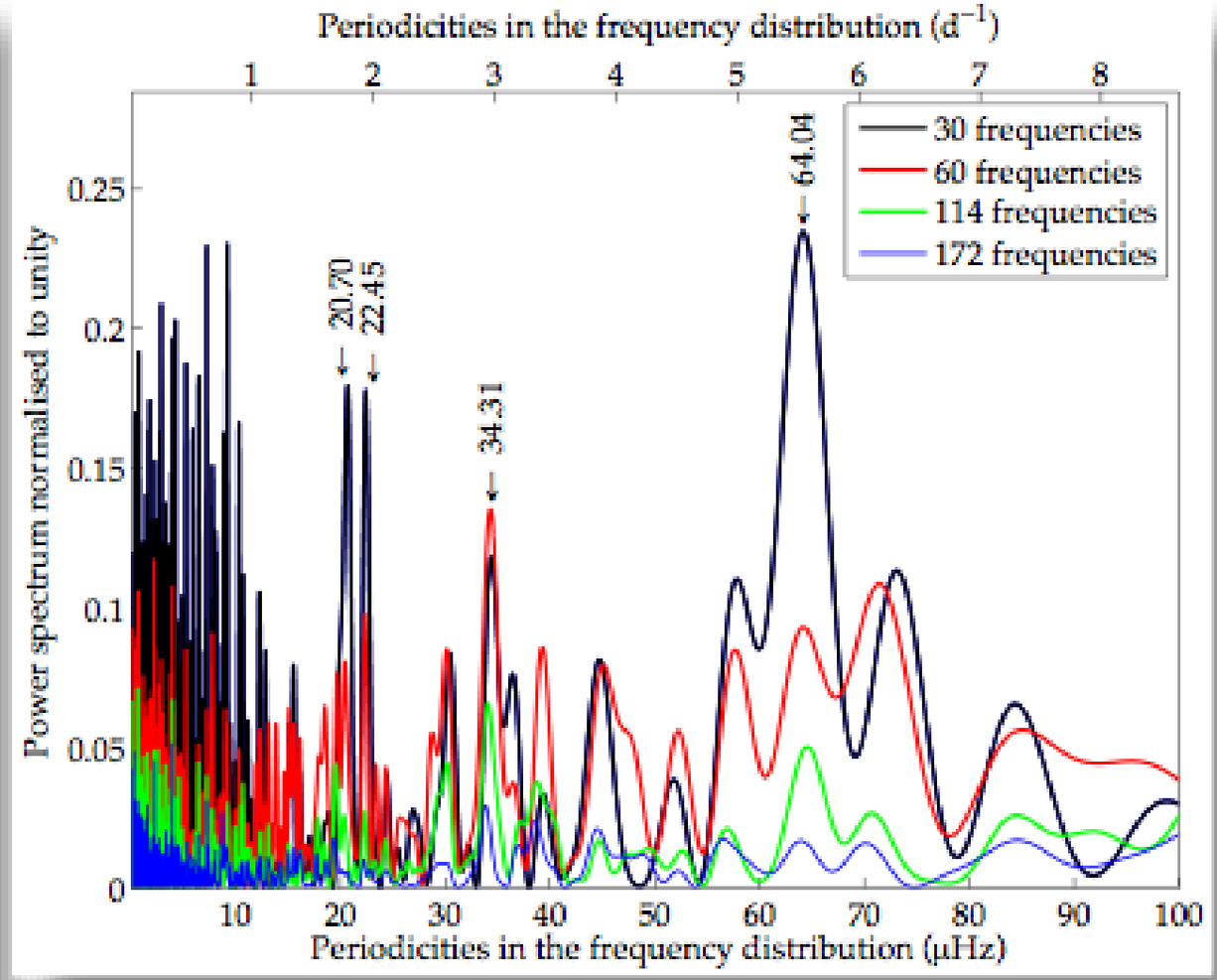
VIRGO@SOHO

Patterns at a glance



FREQUENCY PATTERNS IN A-F STARS



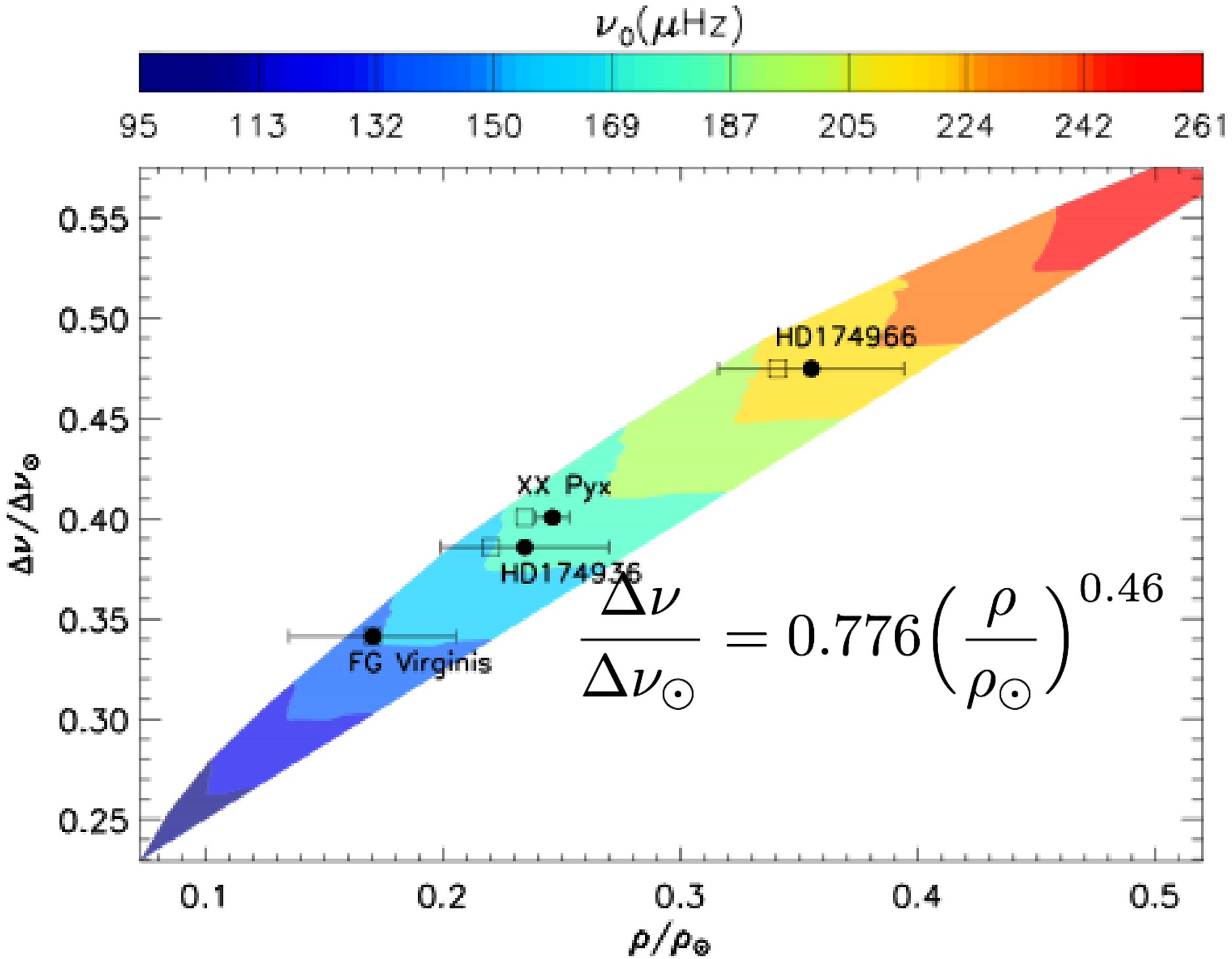


García Hernández et al. (A&A 506, 79 ,2009)

$\Delta\nu$

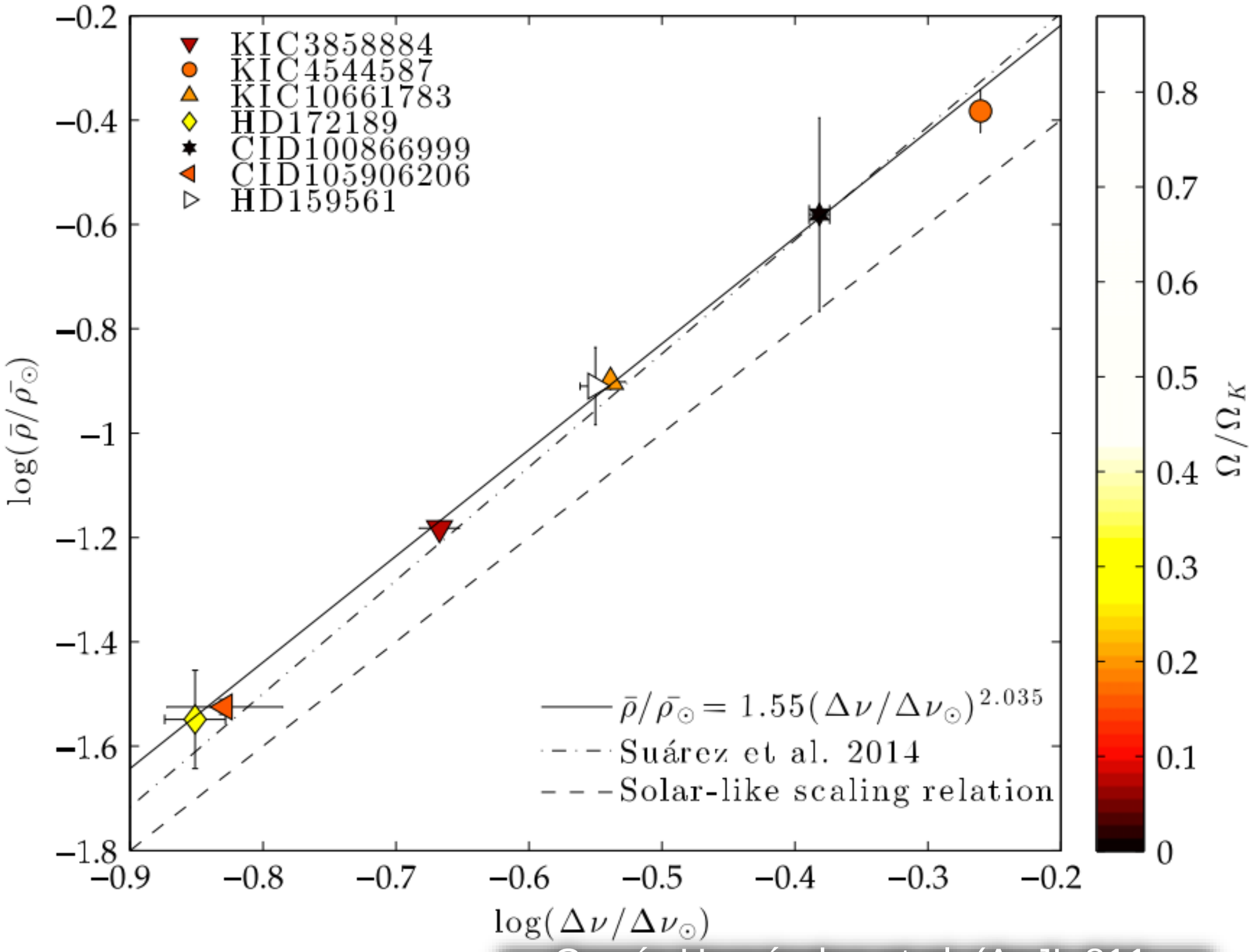
Quasi-Periodic spacing

Δν-ρ relation similar to solar-like



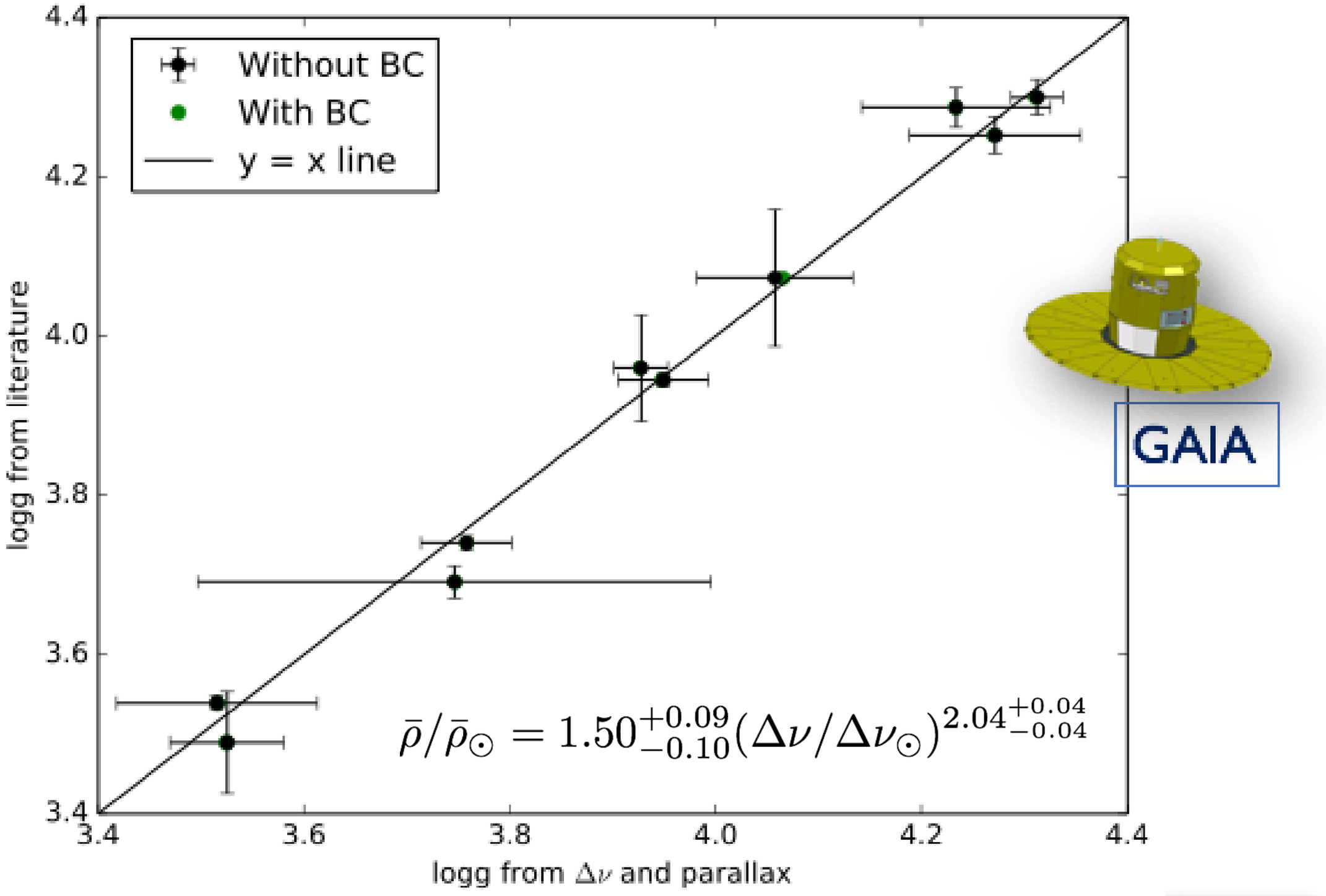
Suárez et al. (A&A 563, A7, 2014)

Confirmed empirically with eclipsing binaries



García Hernández et al. (ApJL 811, L29,2015)

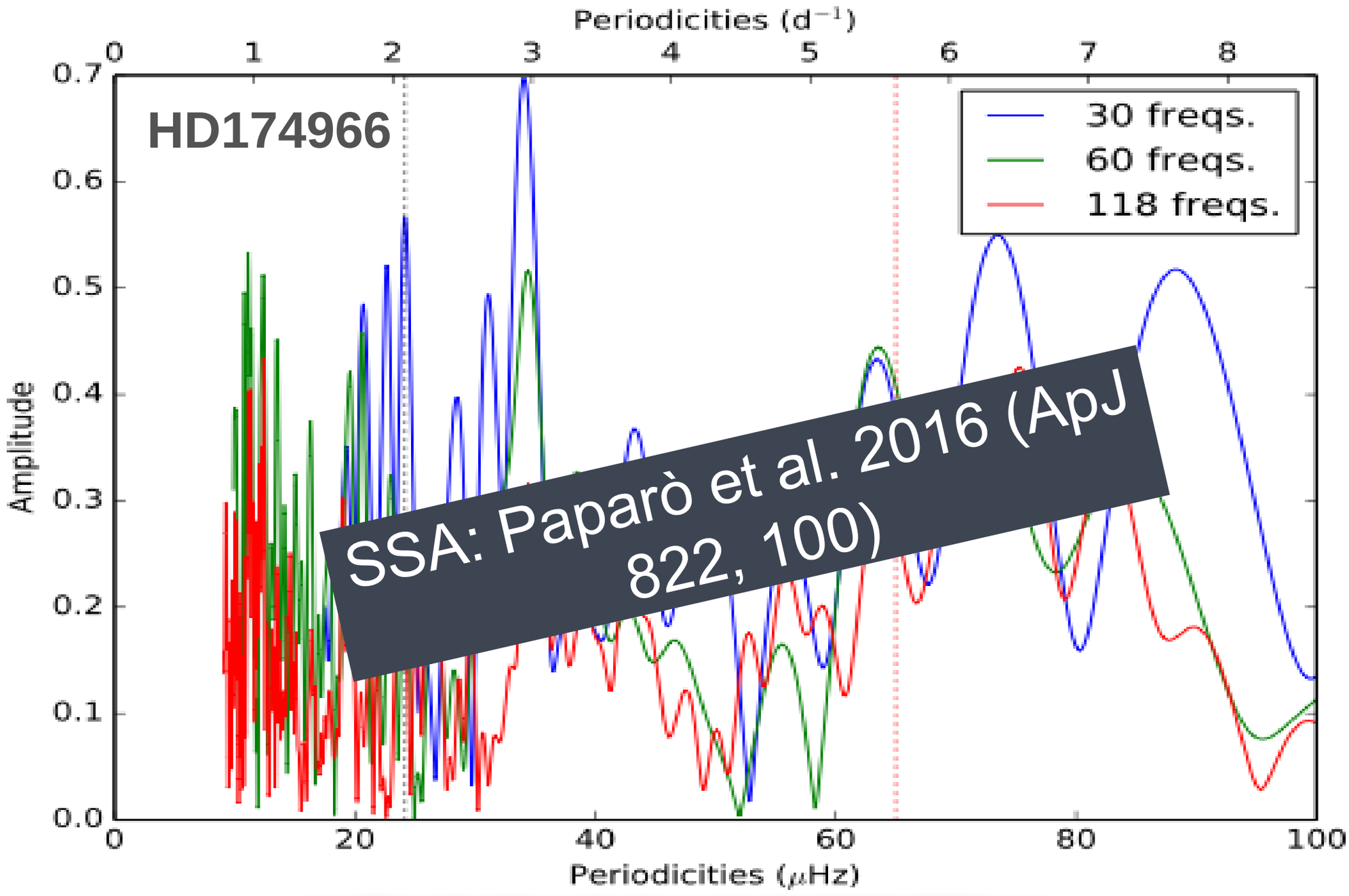
We can derive more precise g !



García Hernández et al. (ApJL 2017, in press, arXiv:1707.06835)

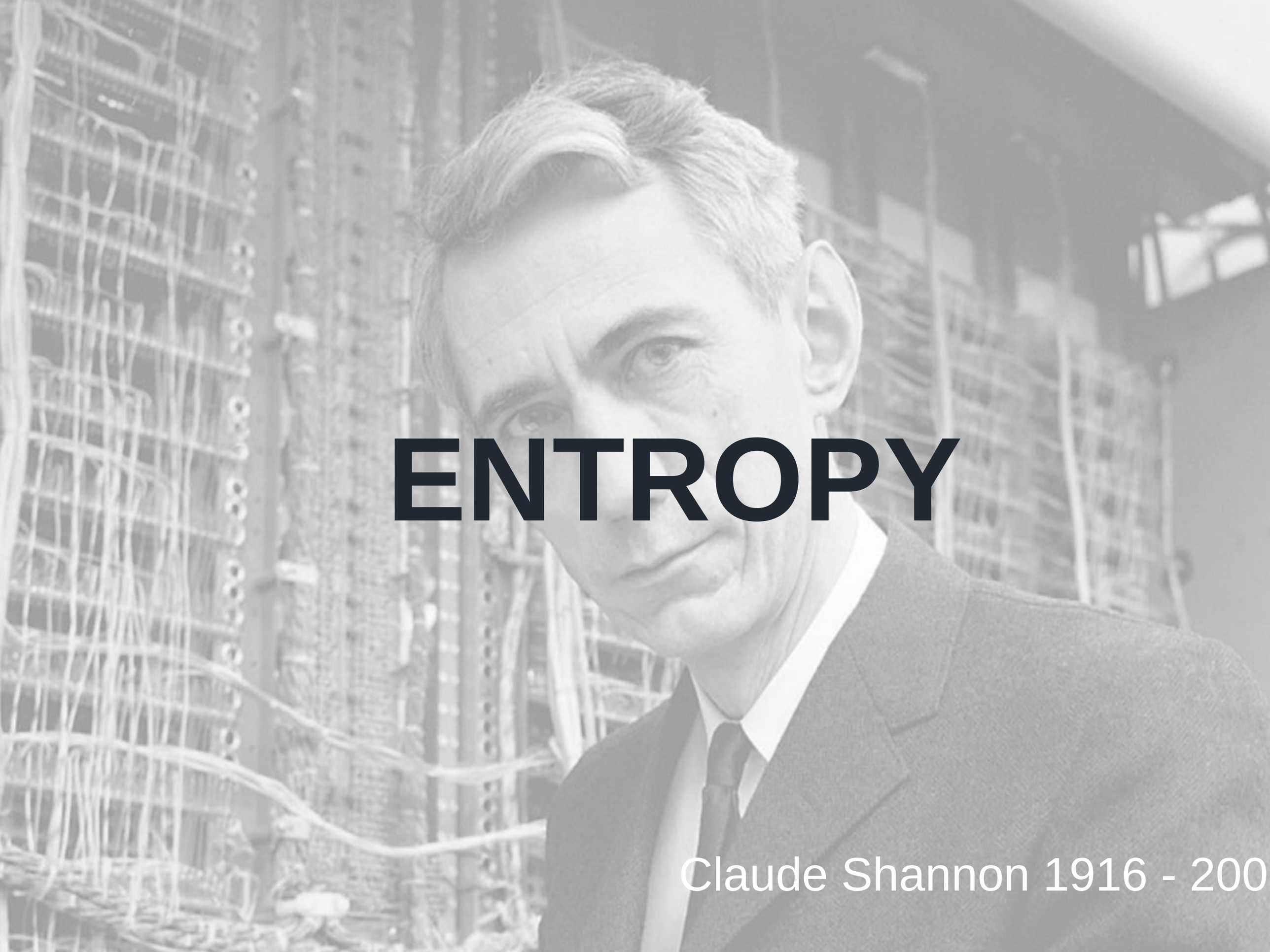
A-F STARS

Processing, eye-trained,…sometimes (faith…)



García Hernández et al. (A&A 559, A63,2013)

Claude Shannon 1916 - 200



ENTROPY

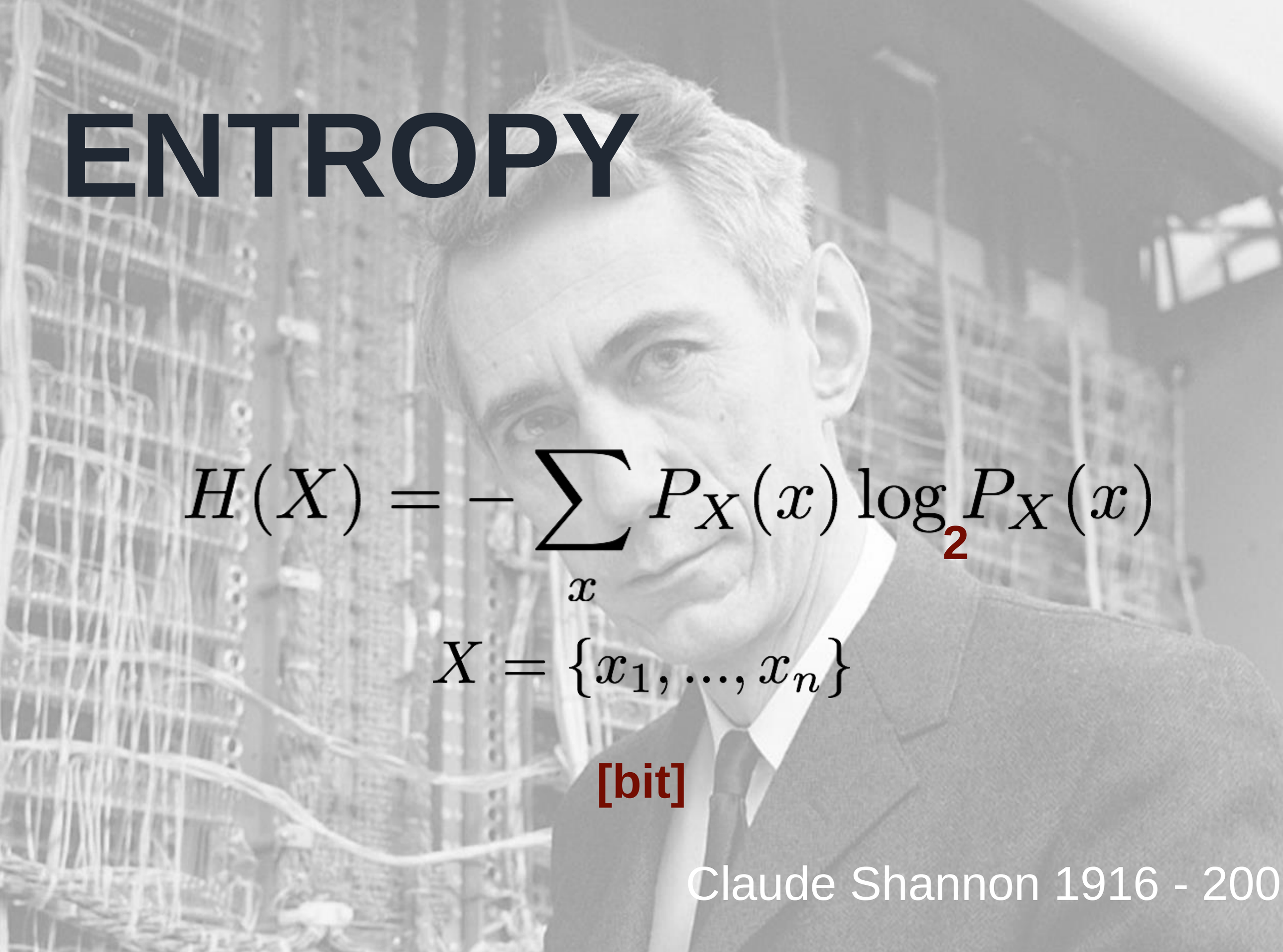
Claude Shannon 1916 - 200

ENTROPY

$$H(X) = -\sum_{x} P_X(x) \log_2 P_X(x)$$

$$X = \{x_1, \ldots, x_n\}$$

[bit]



Claude Shannon 1916 - 200

ENTROPY

$$H(X) = H_{\max}$$

All x_i equally probable

information is harder to find

more uncertainty

$$H(X) = H_{\min}$$

Some x_i more probable

information is easier to find

less uncertainty

[A measure of the cost (in bits) of encoding a given informatio

Claude Shannon 1916 - 200

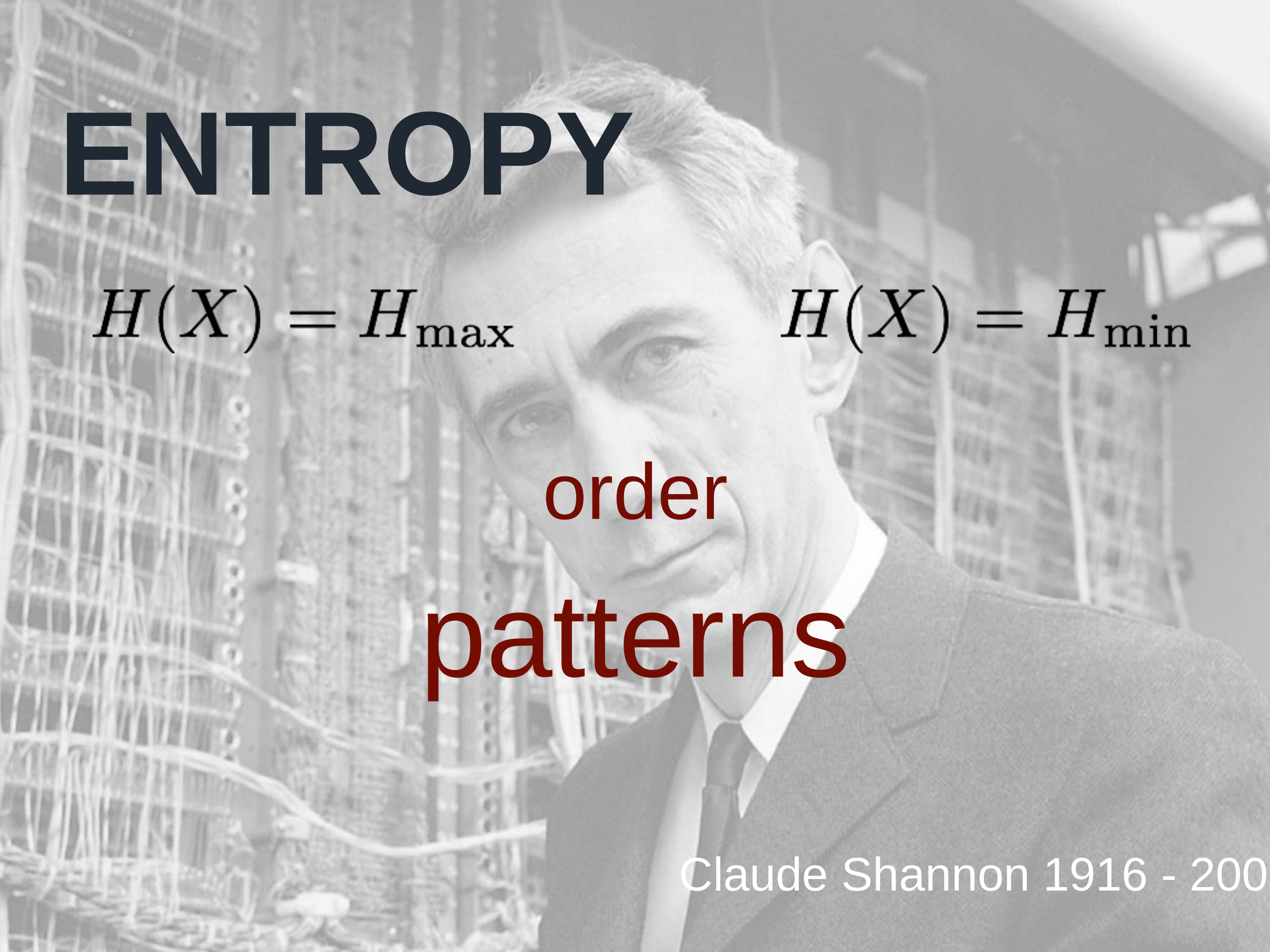
ENTROPY

$$H(X) = H_{\max}$$

$$H(X) = H_{\min}$$

order

patterns



Claude Shannon 1916 - 200

ENTROPY

$$H(X|Y) = \sum_y P_Y(y) \left[-\sum_x P_{x|y}(x|y) \log P_{x|y}(x|y) \right]$$

$$P_{x|y}(x|y) = \frac{P_{XY}(x,y)}{P_Y(y)}$$

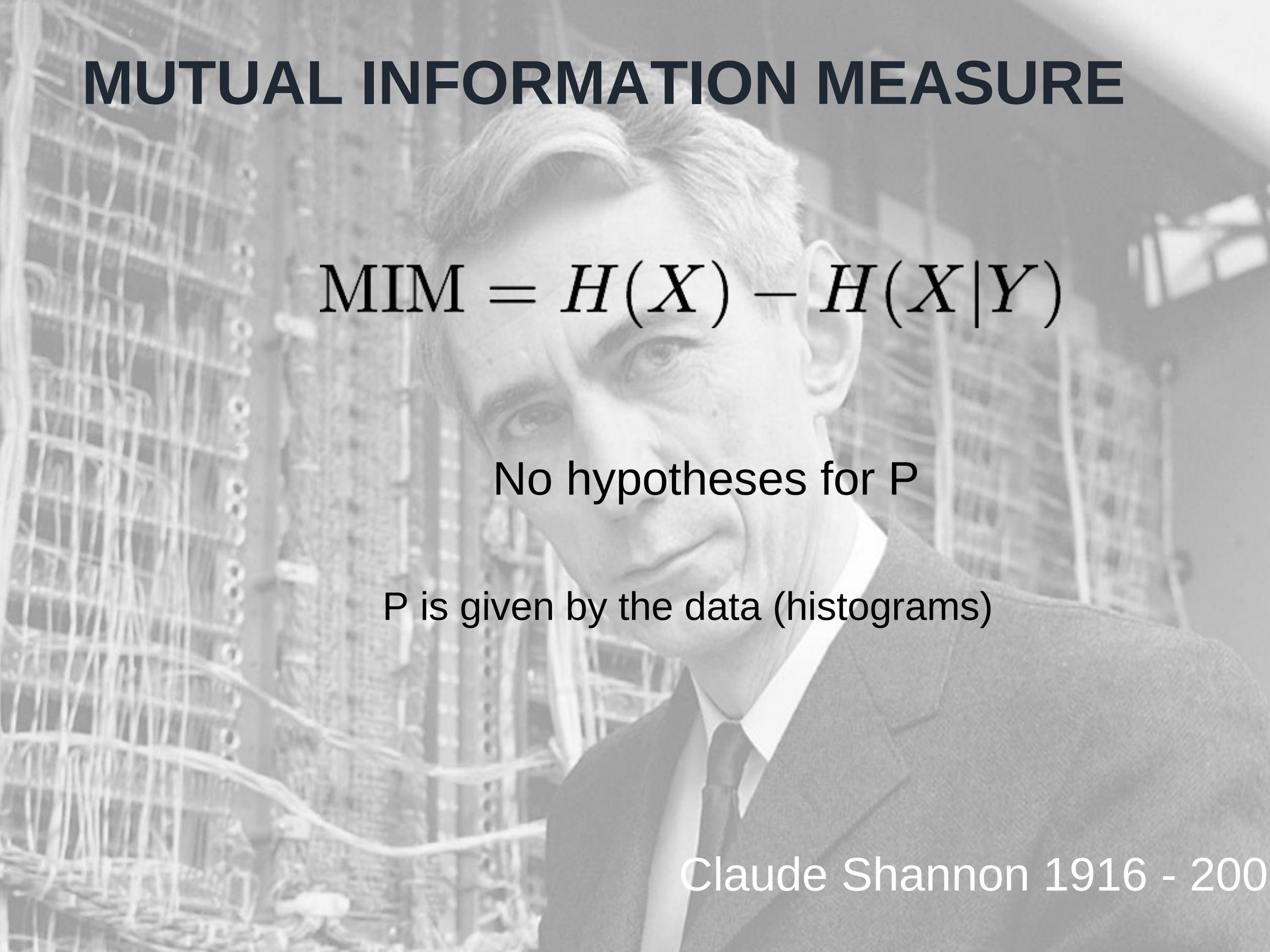
Claude Shannon 1916 - 200

MUTUAL INFORMATION MEASURE

$$\mathrm{MIM} = H(X) - H(X|Y)$$

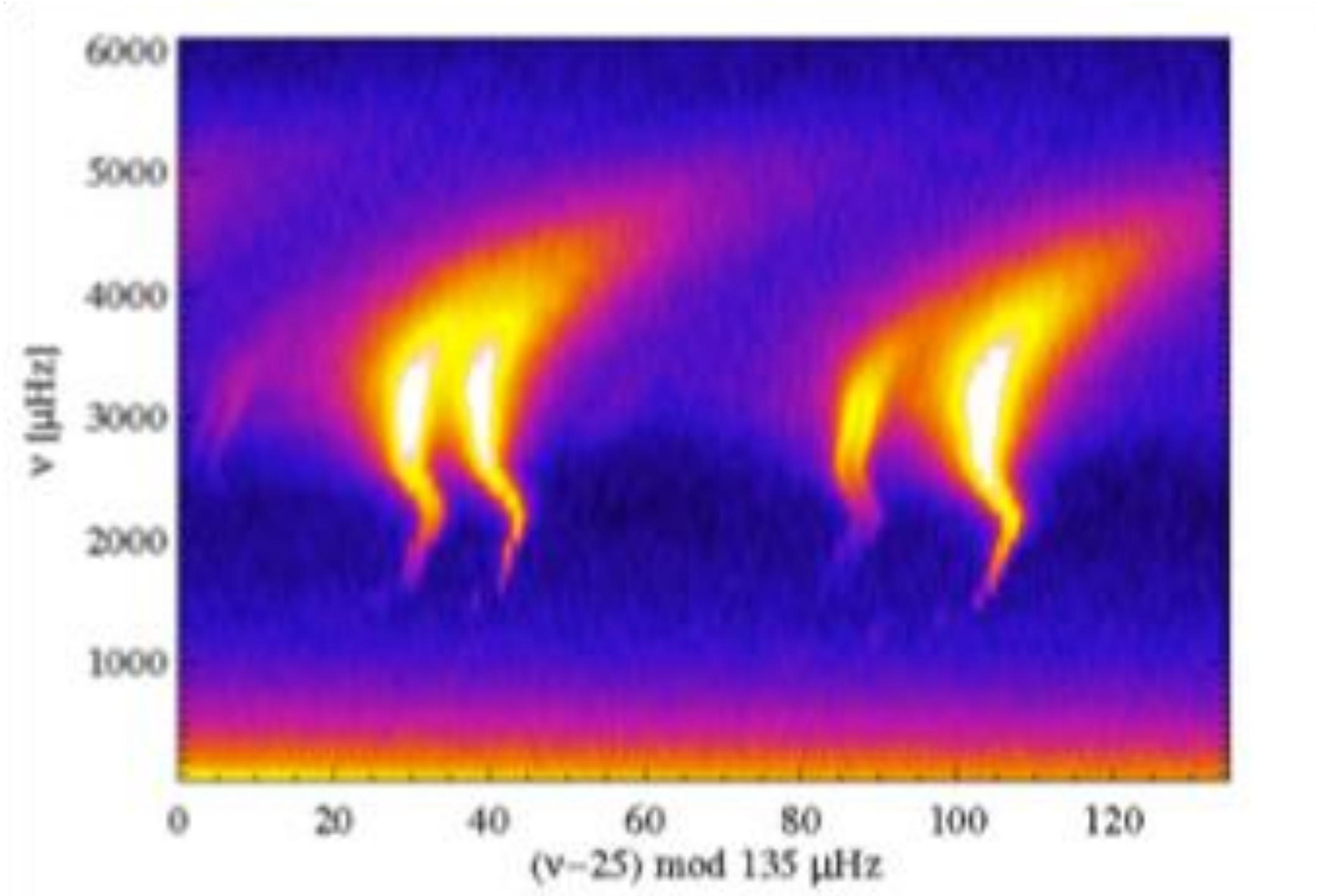
No hypotheses for P

P is given by the data (histograms)



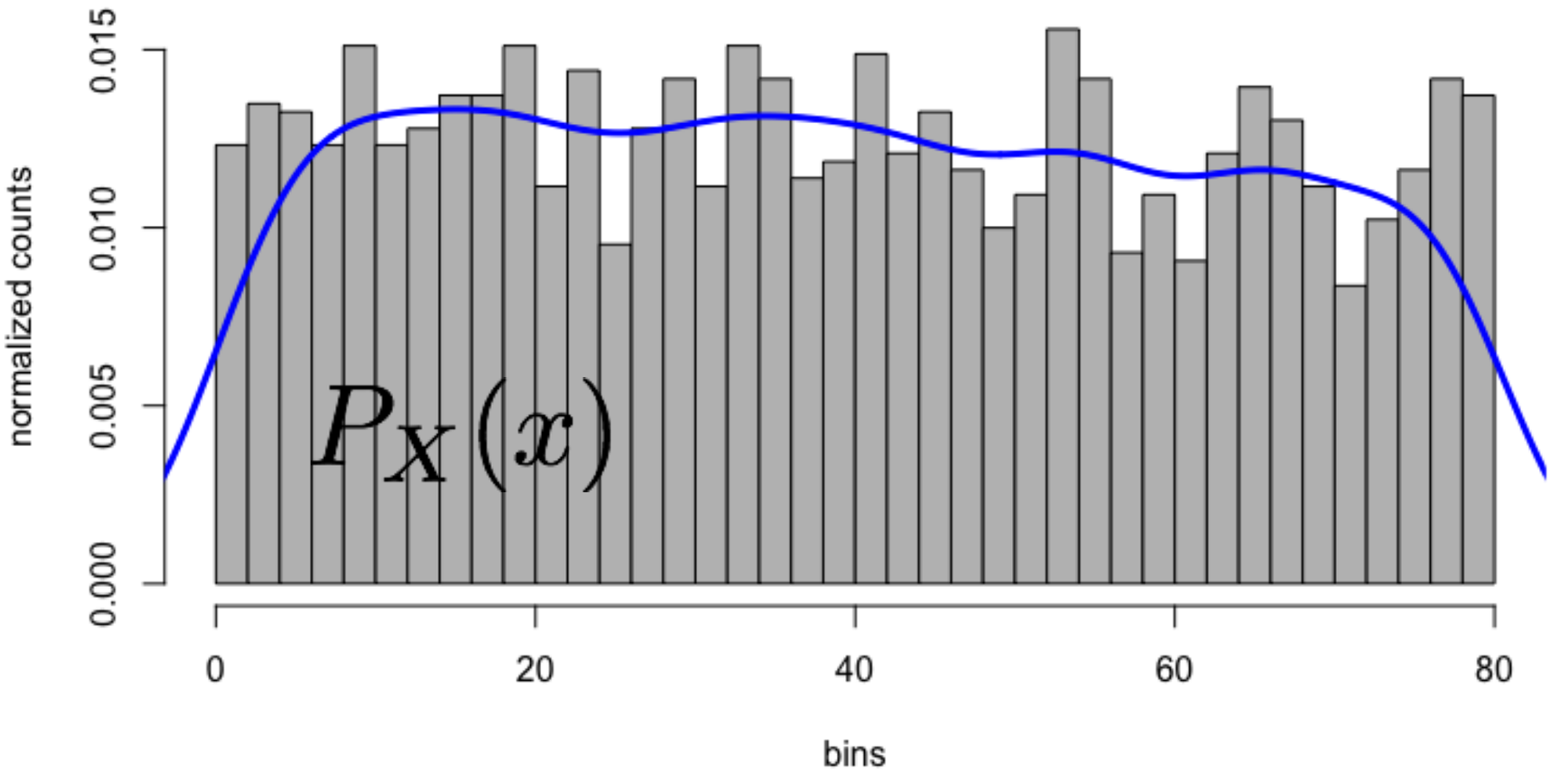
Claude Shannon 1916 - 200

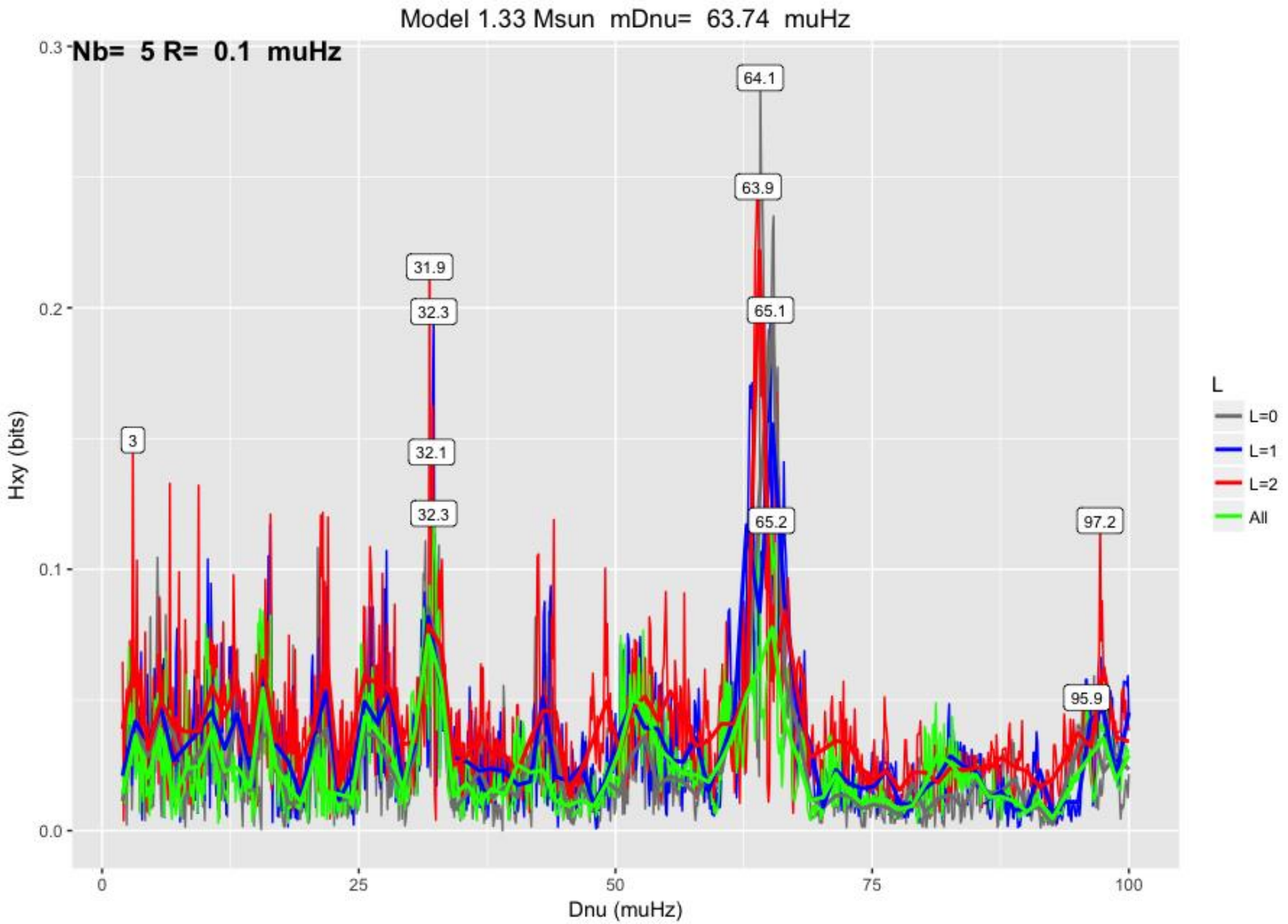
$y \longrightarrow H(Y)$



$x \longrightarrow H(X)$

$$x \longrightarrow H(X)$$





Suárez et al. (2017, in prep.)

FREE PARAMETERS

B

Bin size

R

Resolution

F

Freq. Domain

FREE PARAMETERS

B

R

F

Bin size / No of bins

$$N_{\mathrm{b}} = 1 + log_2 N_f$$

FREE PARAMETERS

B

R

F

Resolution

$$R \equiv |\Delta\nu_j - \Delta\nu_{j-1}|$$

$$x \longrightarrow H(X)$$

FREE PARAMETERS

B

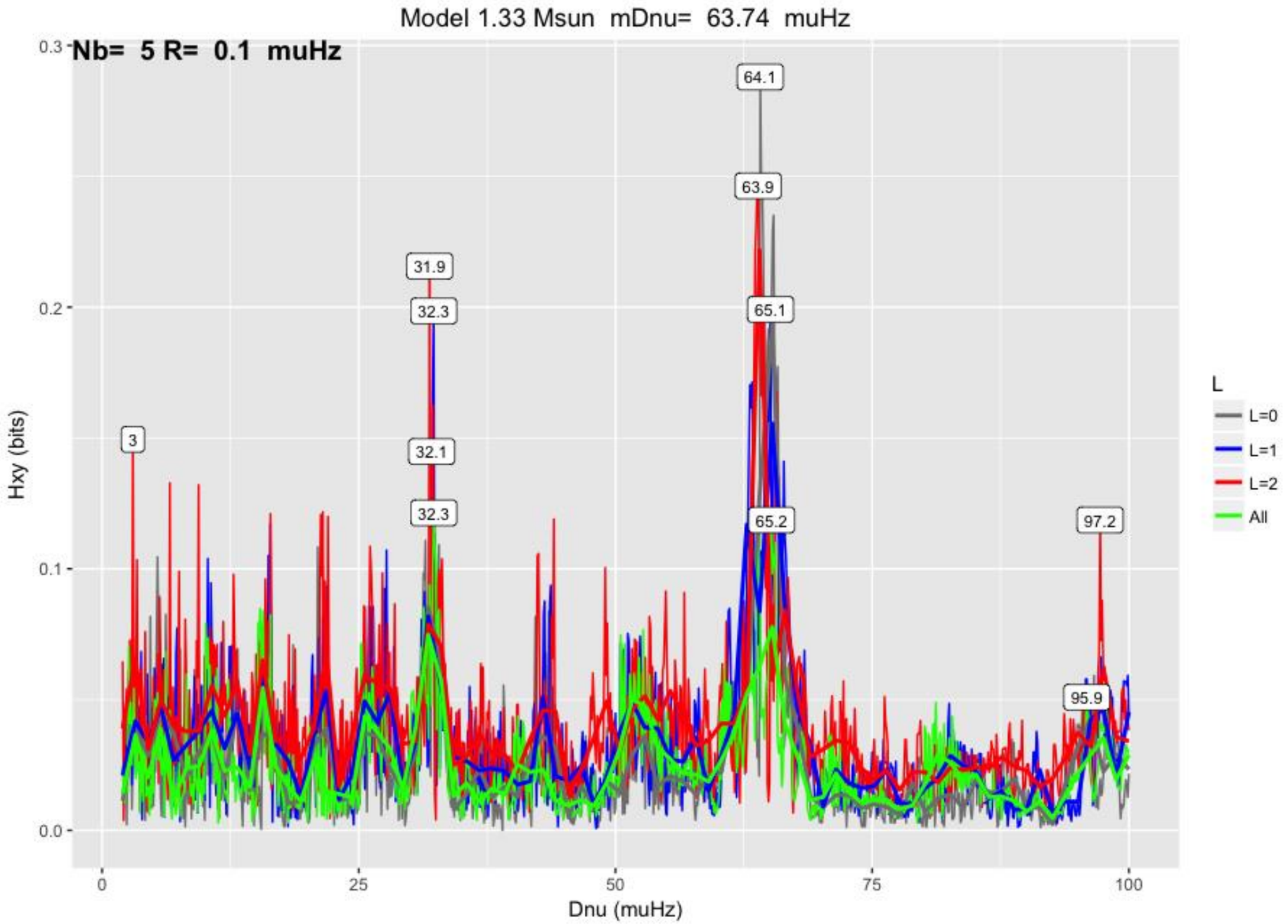
R

F

Frequency Domain

$$D \equiv [f_{\min}, f_{\max}]$$

A SOLAR-LIKE MODEL



Suárez et al. (2017, in prep.)

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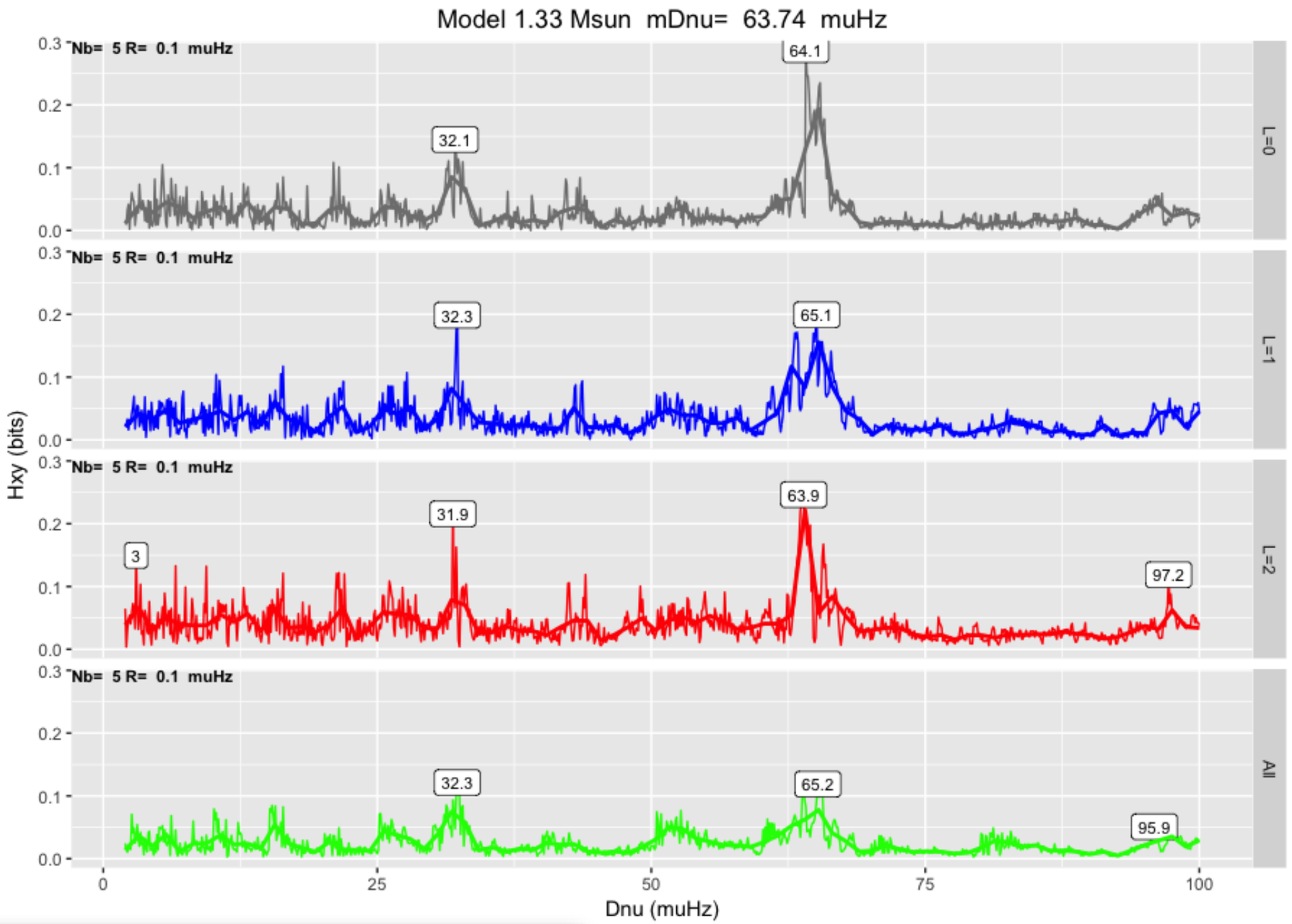
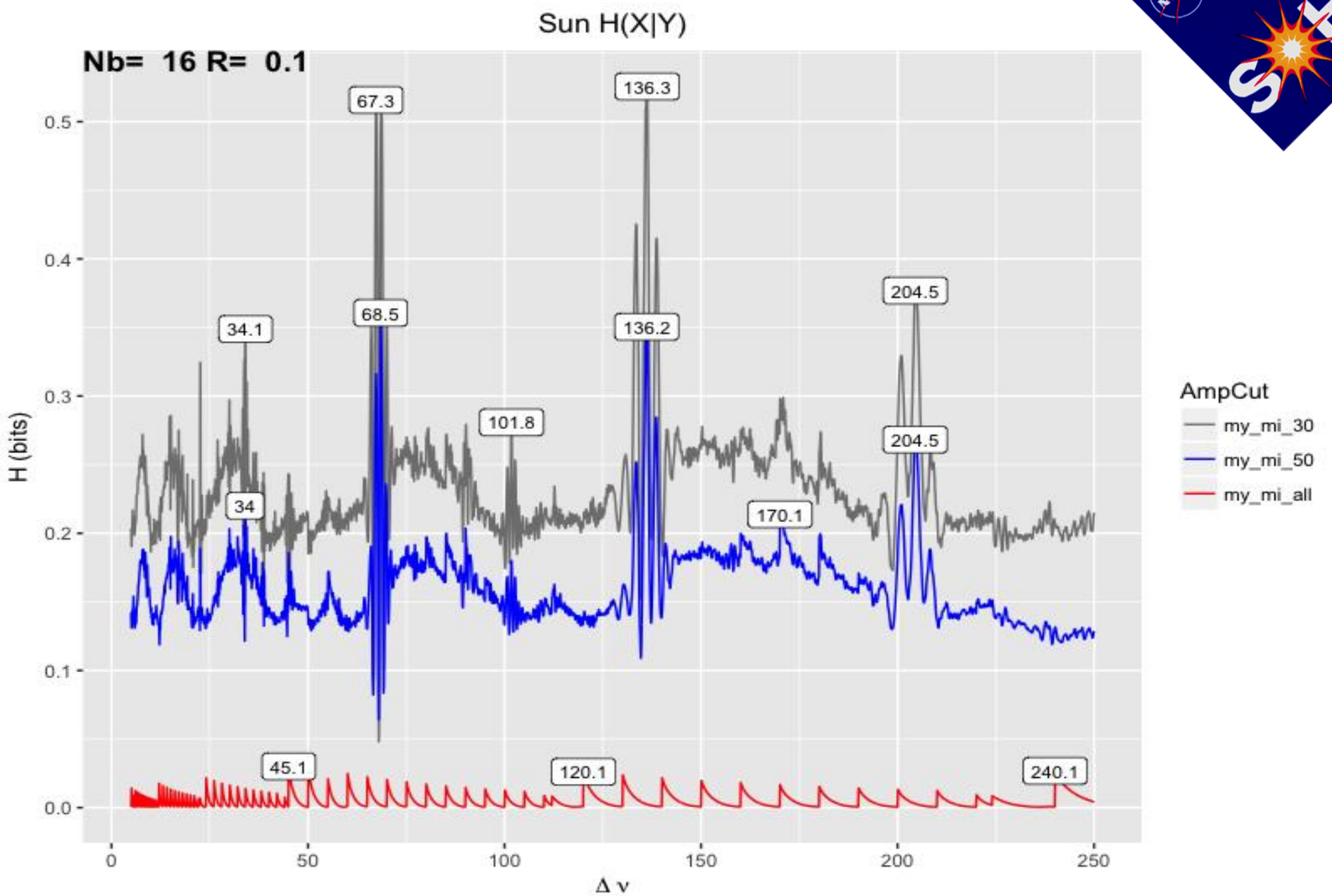


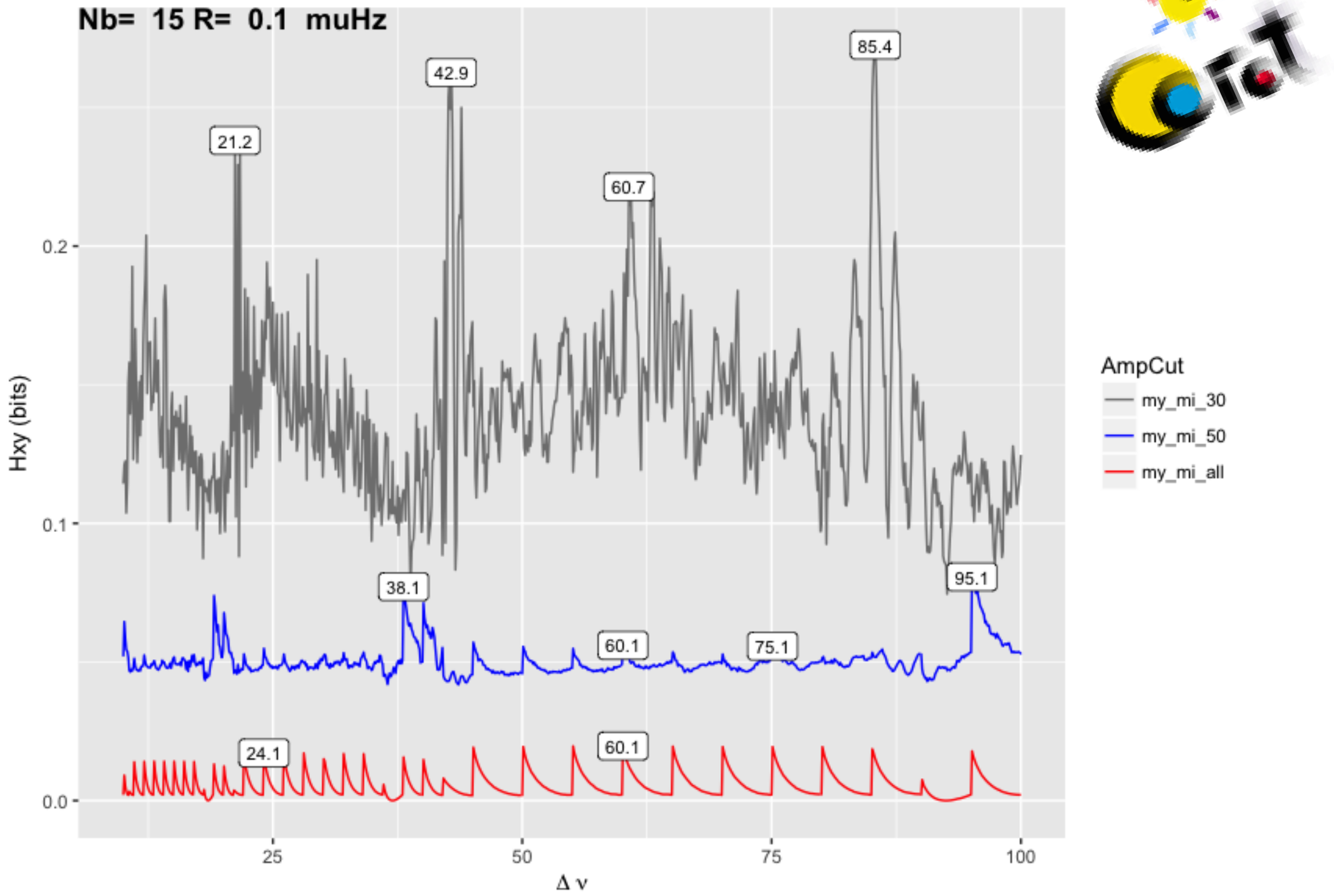
Suárez et al. (2017, in prep.)

THE SUN



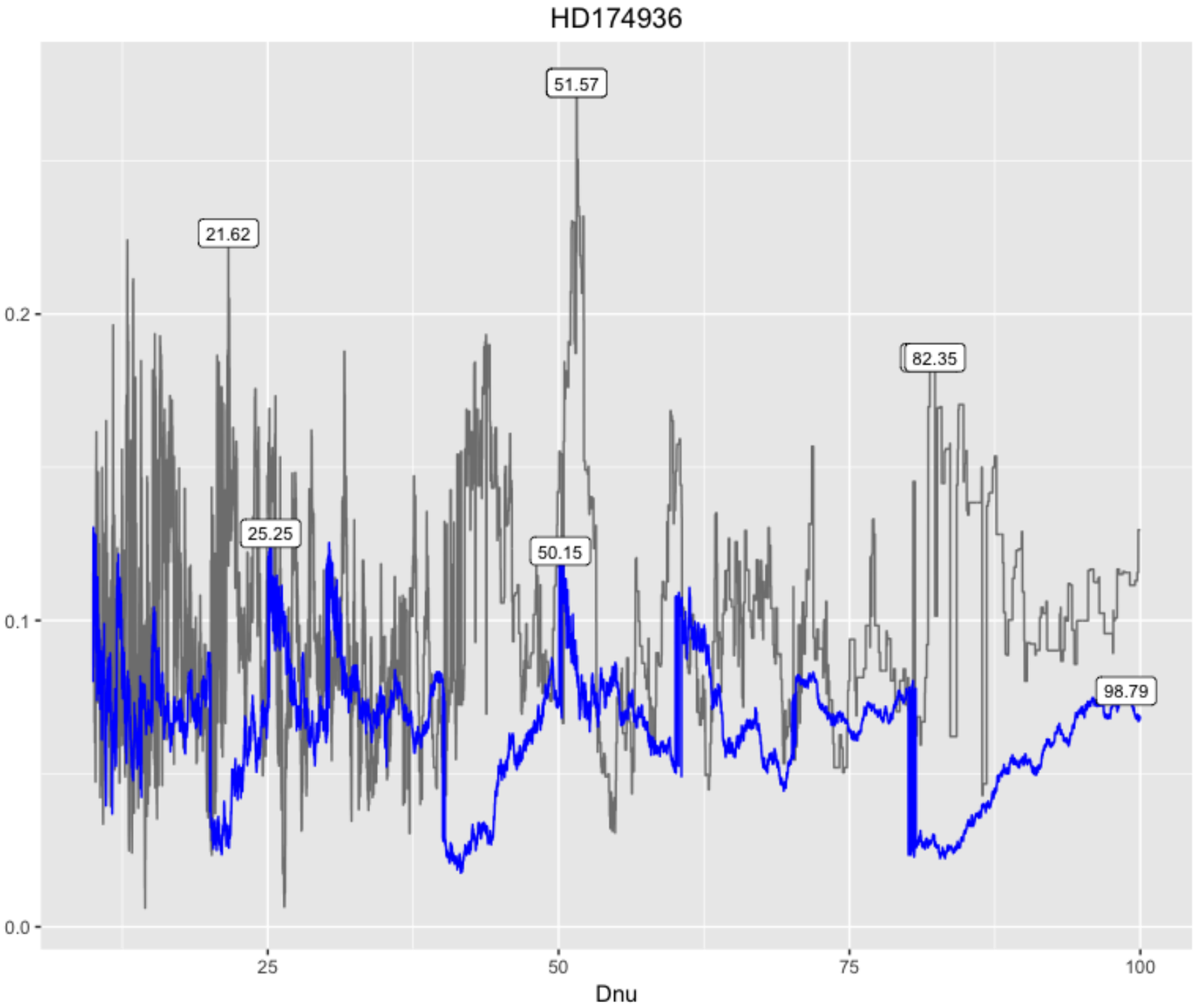
Suárez et al. (2017, in prep.)

HD49933



Suárez et al. (2017, in prep.)

HD174936

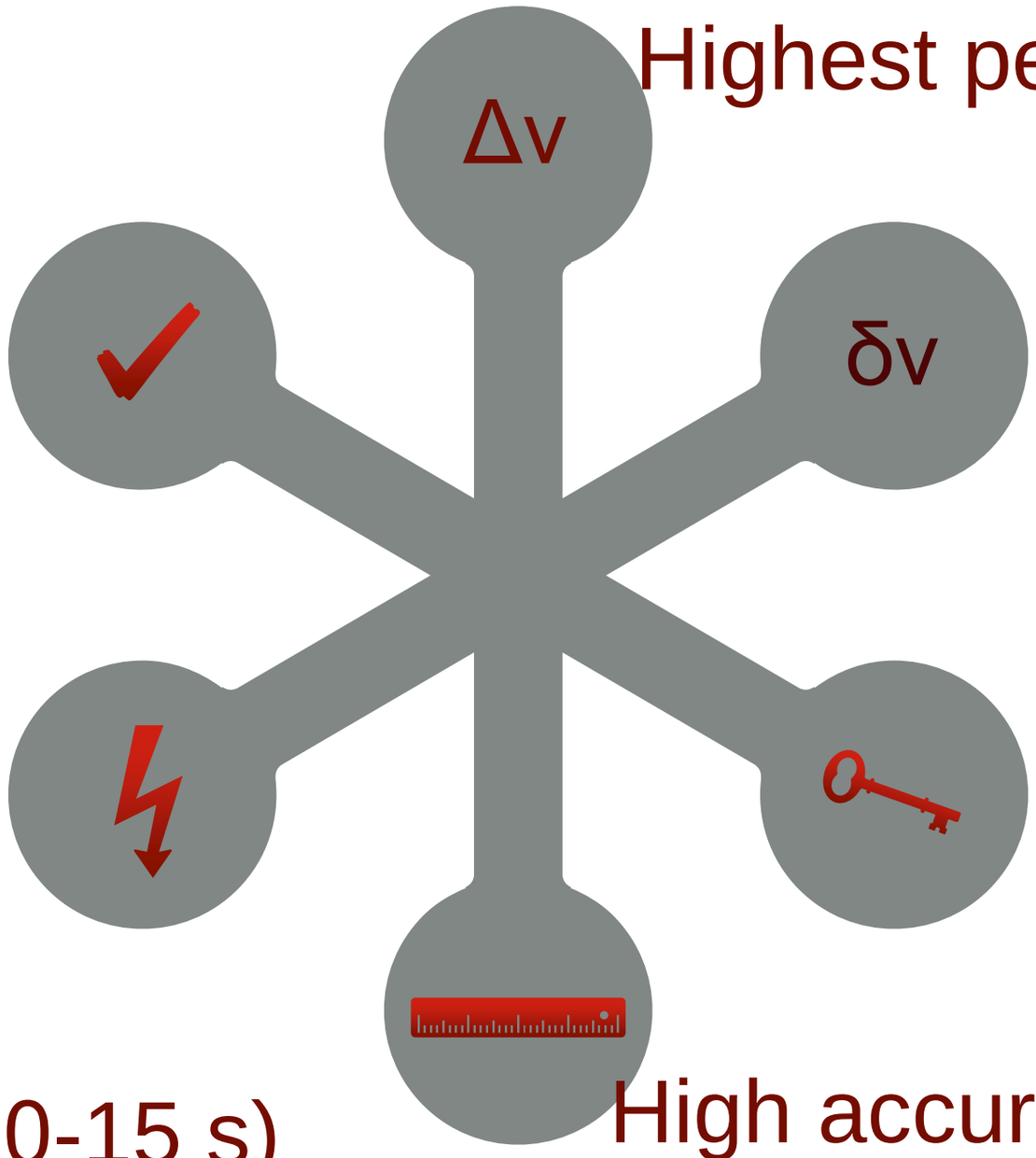


Suárez et al. (2017, in prep.)

	Δν (μHz) from DFT	Δν (μHz) from MIM
HD174936	52 ± 5	51.7 ± 0.01
HD174966	65 ± 1	67.4 ± 0.01
HD50870	86.8 ± 5	89.7 ± 0.1

Suárez et al. (2017, in prep.)

PRELIMINARY CONCLUSIONS



Robust

Highest peak

Other periodicities

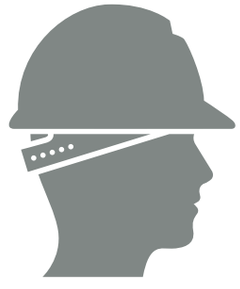
Number of bins

Fast

R= 0.01 μHz (10-15 s)

High accuracy

FUTURE WORK



Search for other patterns

Large/Small separations

Activity

Rotation

g modes

FUTURE WORK

Full automatisation

Apply to all CoRoT/Kepler legacy data

Comparison with other methods

Precise gravities

scaling relations

Get ready for pipeline integration (PLATO!)