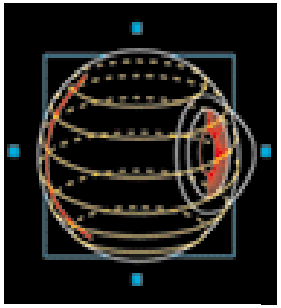

THE SCHEPENS EYE RESEARCH INSTITUTE

"DUPLEX", NOT SIMPLE, CELLS ARE THE MAJOR CELL TYPE IN STRIATE CORTEX OF ALERT MONKEYS.

M. Gur[1,2*], I. Kagan[1] and D.M. Snodderly[2]

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[2]Schepens Eye Research Institute, Boston, USA

Methods

- A simple fixation task
- Exclusion of segments affected by rapid shifts in eye position
- Compensation (“stabilization”) for eye drifts

In the anesthetized monkey:

Complex cells = not Simple cells;

Relative modulation (RM, AC1/DC)<1

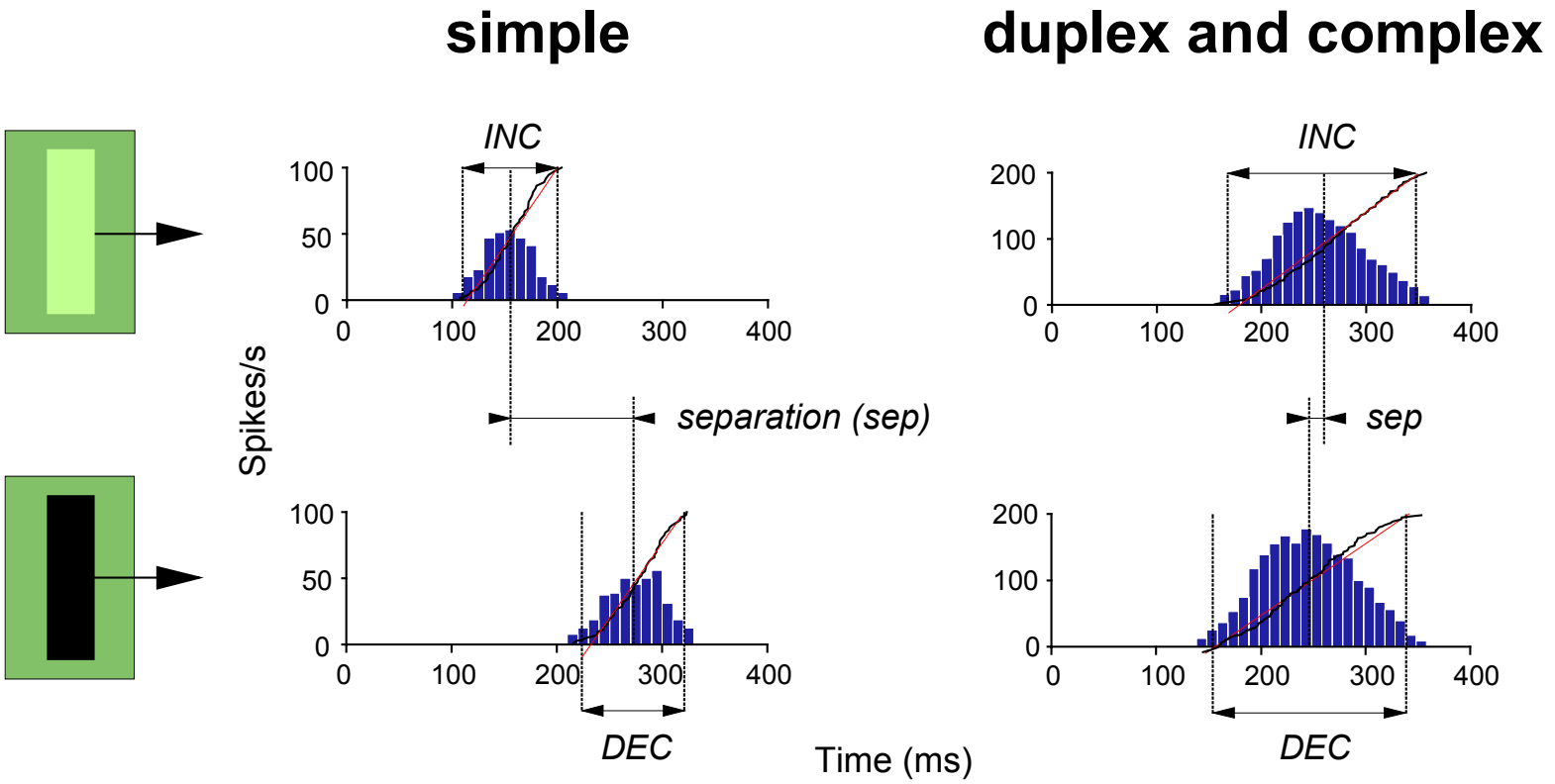
(Scottun et al., 1991).

In the alert monkey:

Can two populations be distinguished by the spatial arrangement of their increment and decrement zones?

Does this spatial organization correspond to relative modulation?

Estimation of Overlap Index (OI)



OI = -0.02 **OI = 0.89**

$$OI = \frac{0.5 \cdot (INC + DEC) - sep}{0.5 \cdot (INC + DEC) + sep}, \quad sep = \left| INCcenter - DECcenter \right|$$

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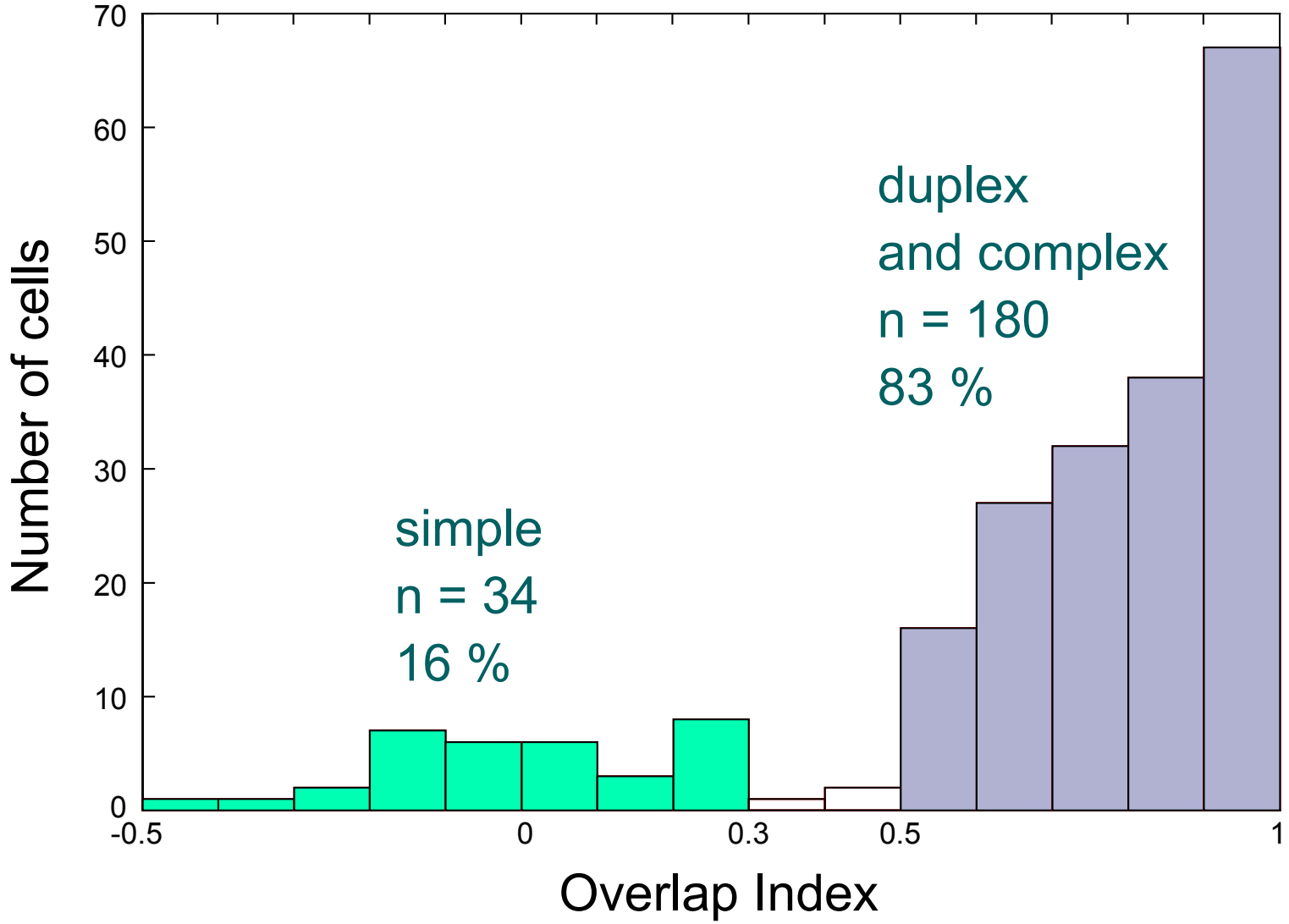
Distribution of Overlap Index (OI), n=217



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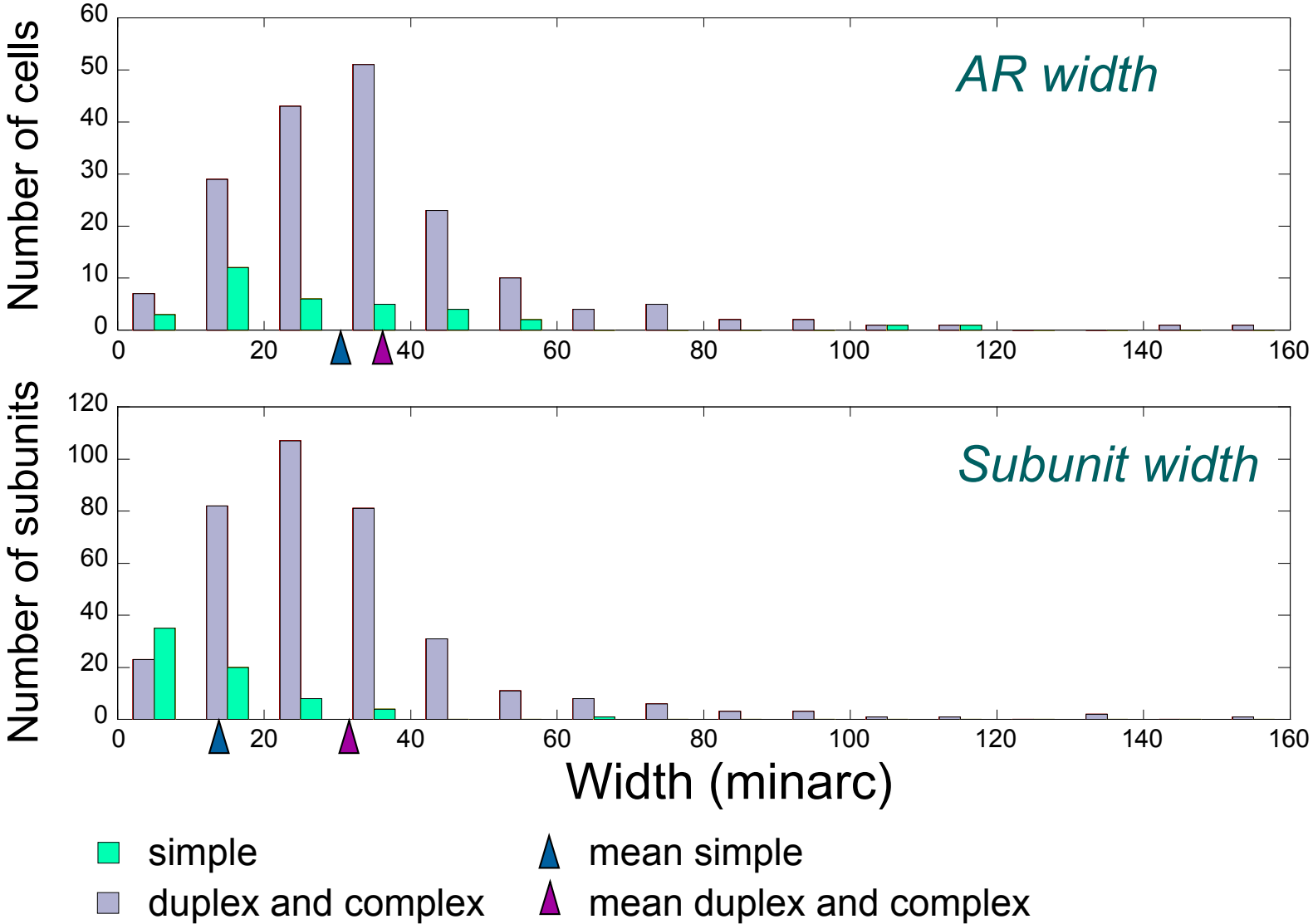
Activating Region (AR) width and subunit width



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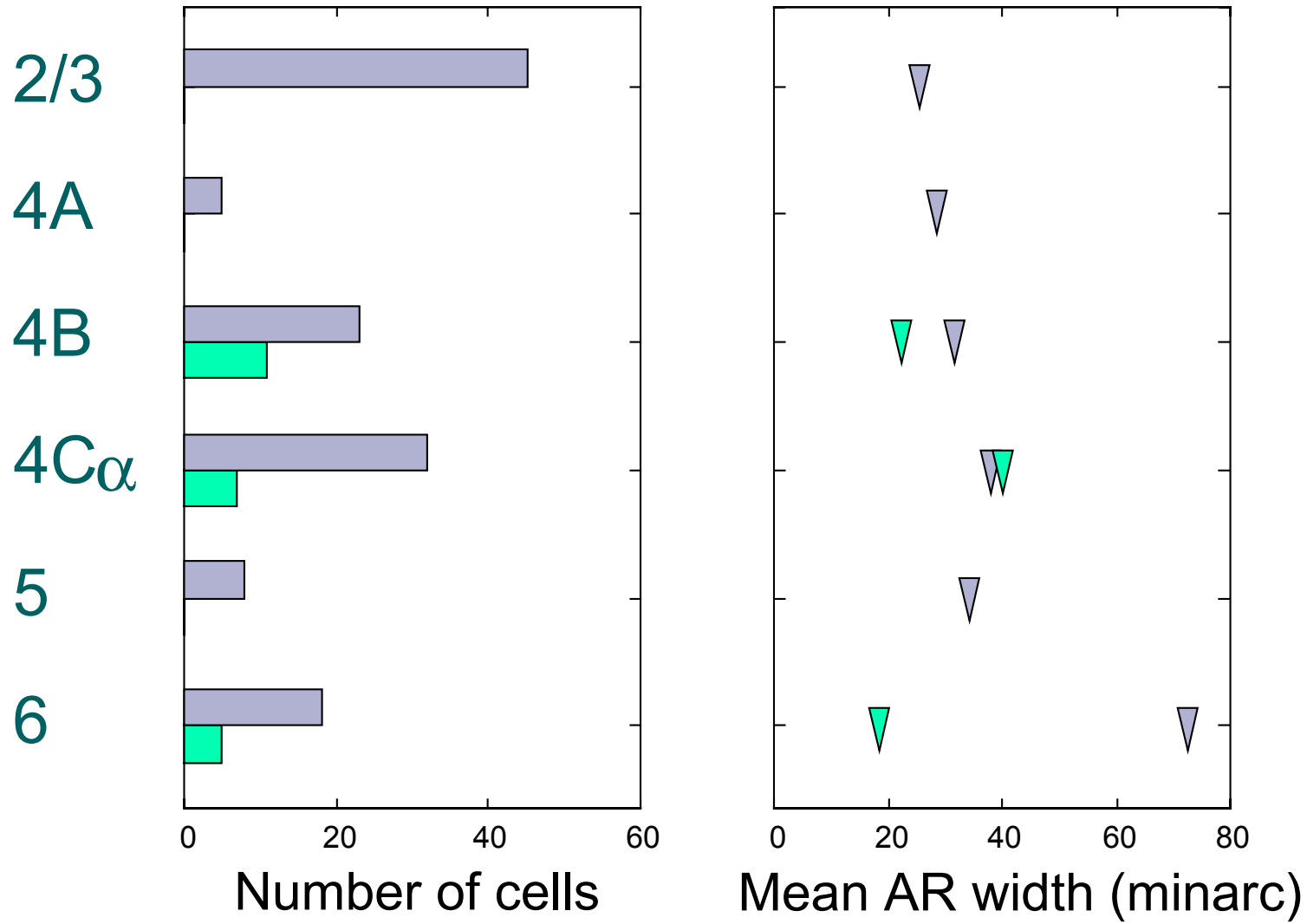
Layers Assignment, n=153



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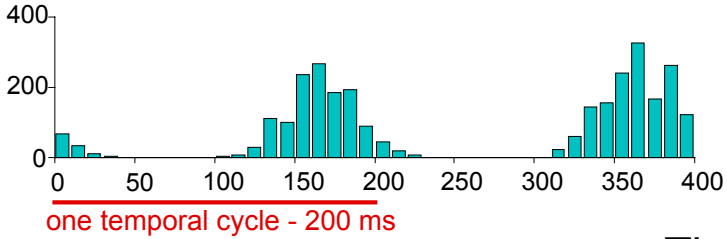
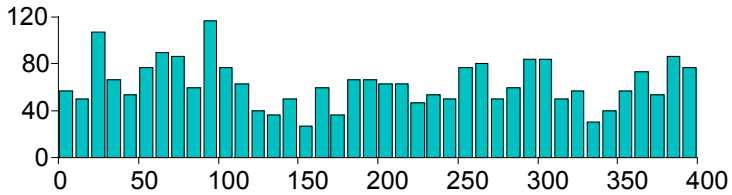
Example: Simple and Complex Cell

Simple cell (10982)
On response to flashes.
OI = -0.17, AR = 17', BD 0 spk/s.

Complex cell (24884)
On-Off response to flashes.
OI = 0.9, AR = 37', BD 0 spk/s.

Drifting grating TF 5 Hz

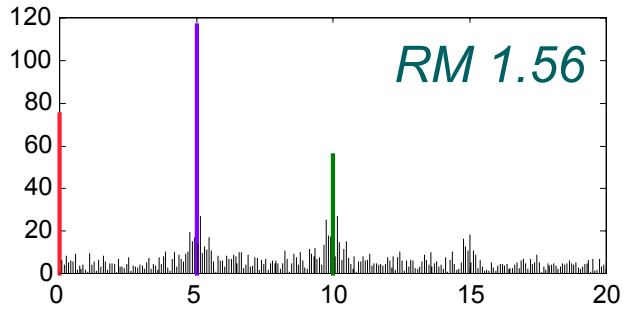


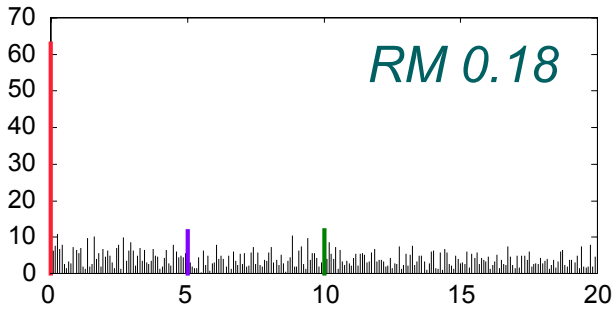


Time (ms)

Harmonic analysis

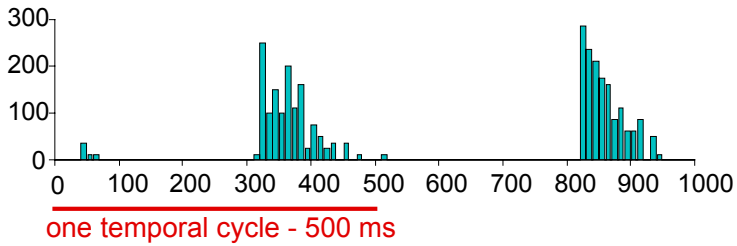
Spikes/s

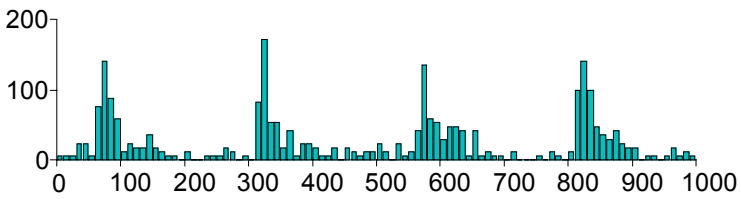




Hz

Counter-phase grating TF 2 Hz





Time (ms)

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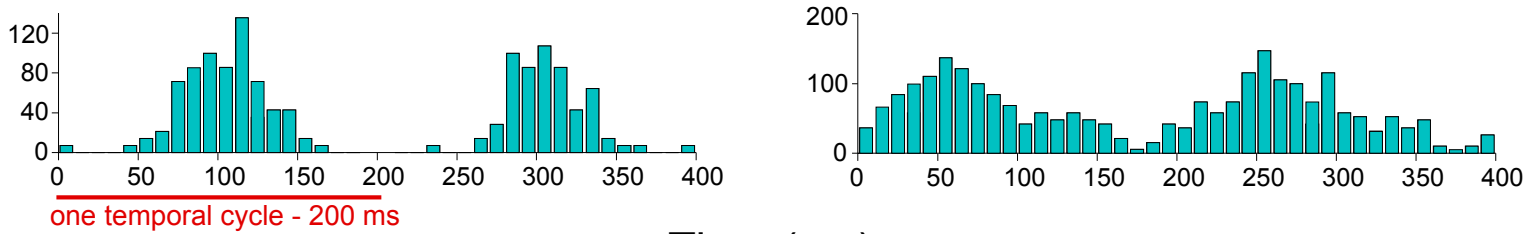
Example: Duplex Cells

Duplex cell (06681)
On-Off response to flashes.
OI = 0.94, AR = 20', BD 0.5 spk/s.

Duplex cell (06984)
On-Off response to flashes.
OI = 0.9, AR = 31', BD 1 spk/s.

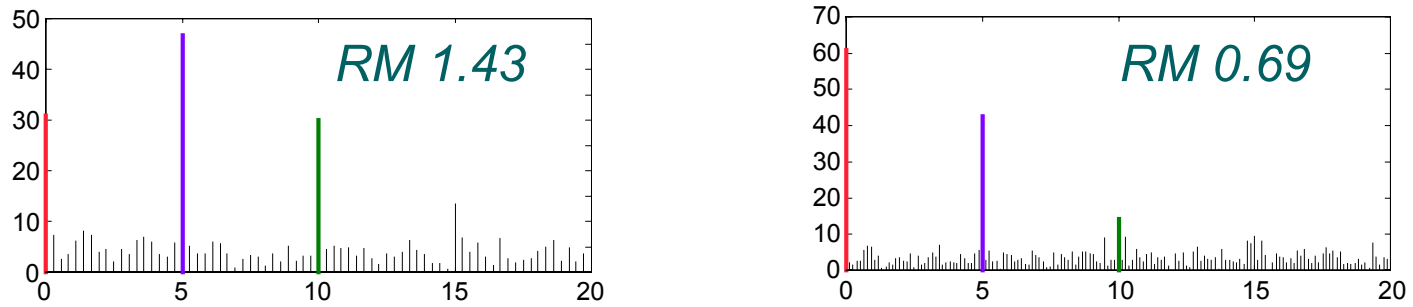
Drifting grating TF 5 Hz



Time (ms)

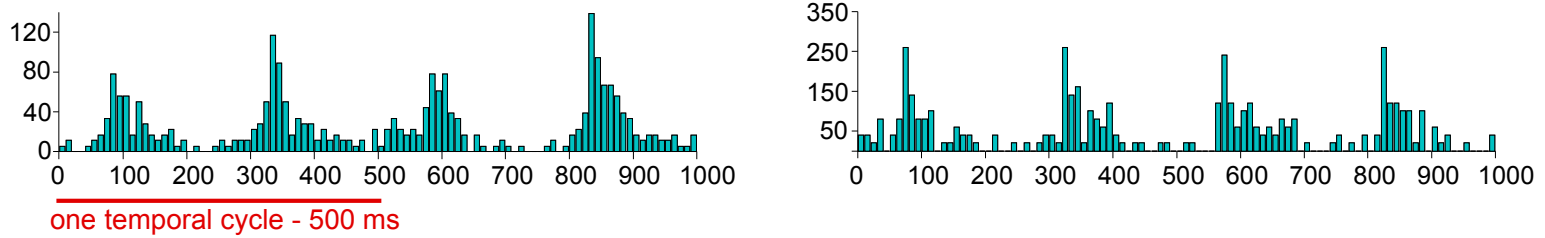
Harmonic analysis

Spikes/s



Hz

Counter-phase grating TF 2 Hz



Time (ms)

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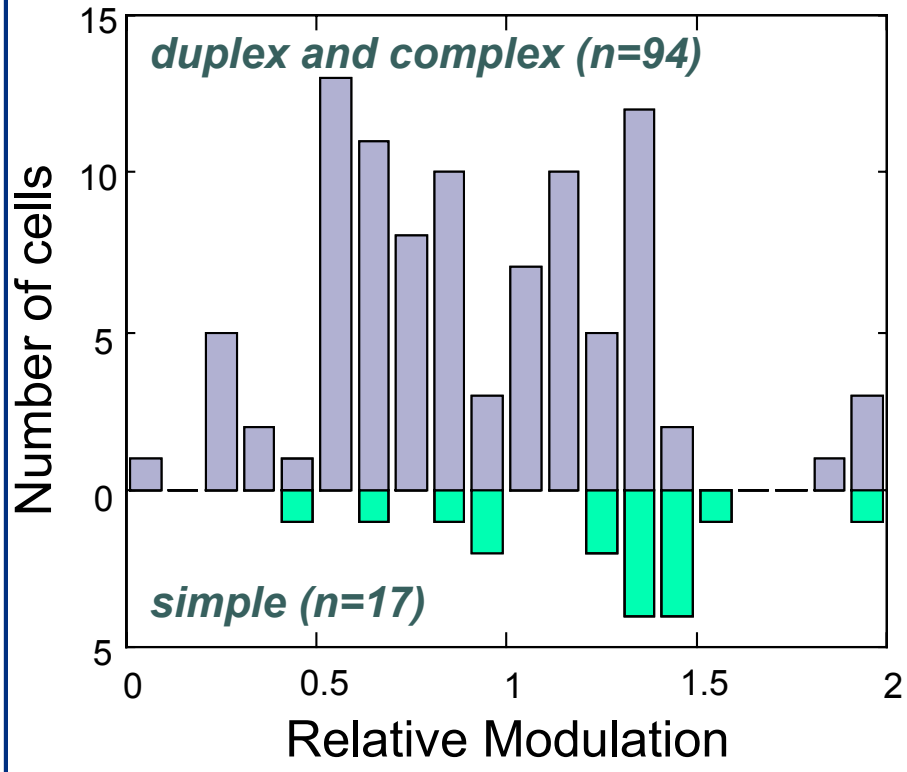
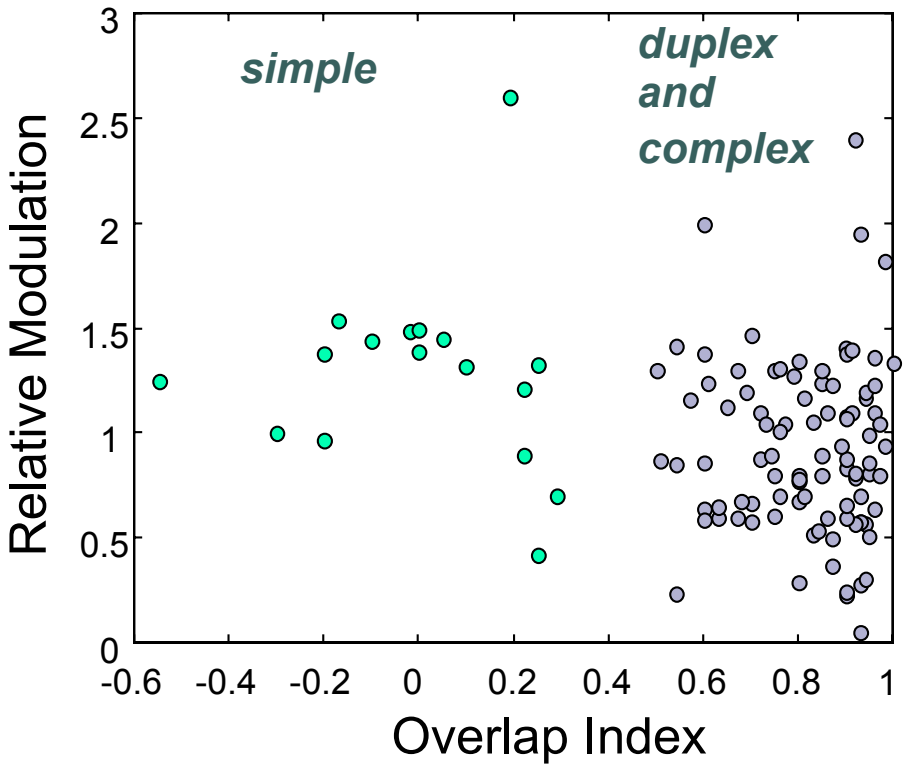
Relative Modulation (RM) Distribution (n=111)





$$RM = \frac{AC_1}{DC - DC_{spont.}}$$

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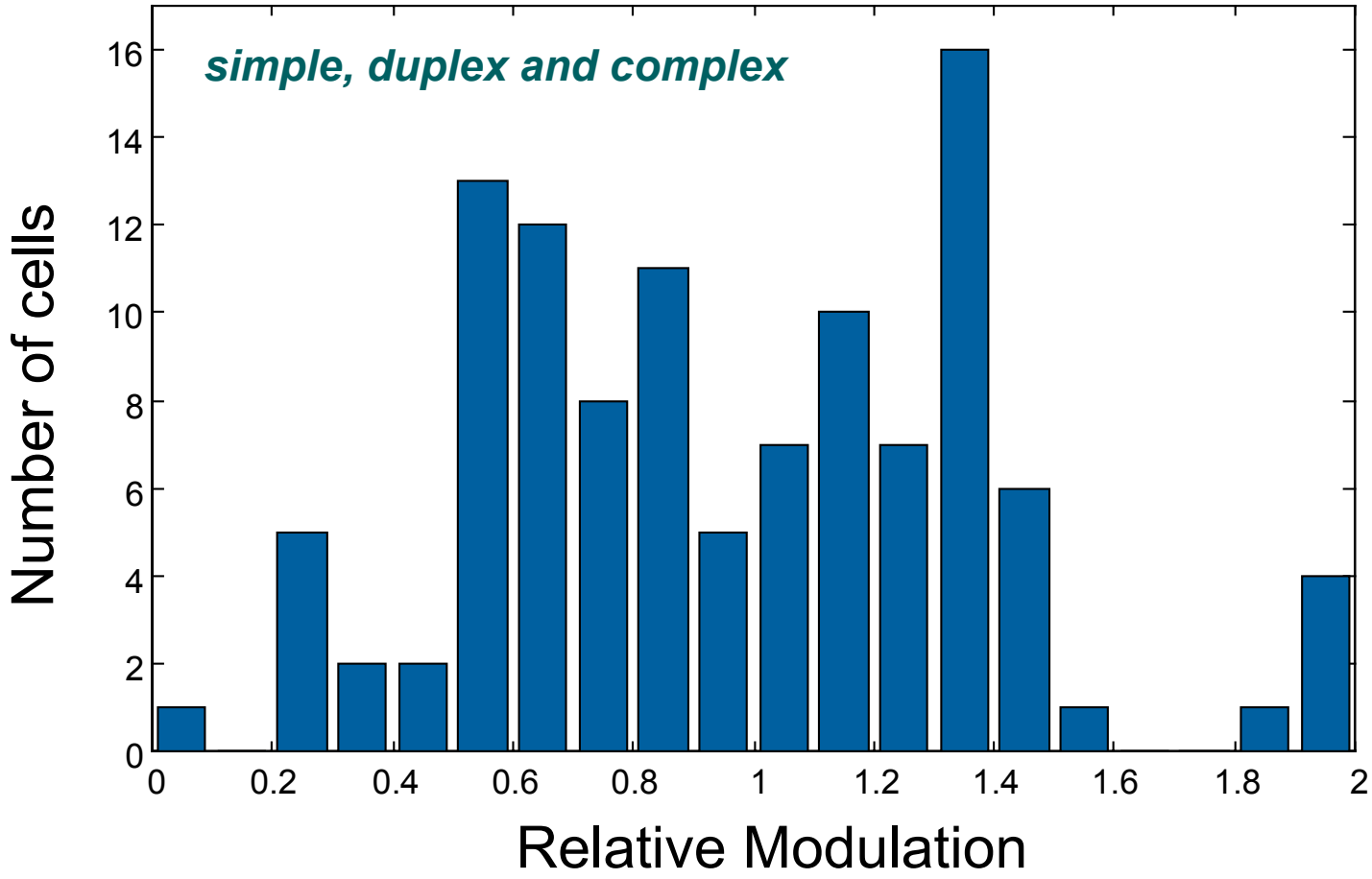
Relative Modulation (RM) Distribution (n=111)



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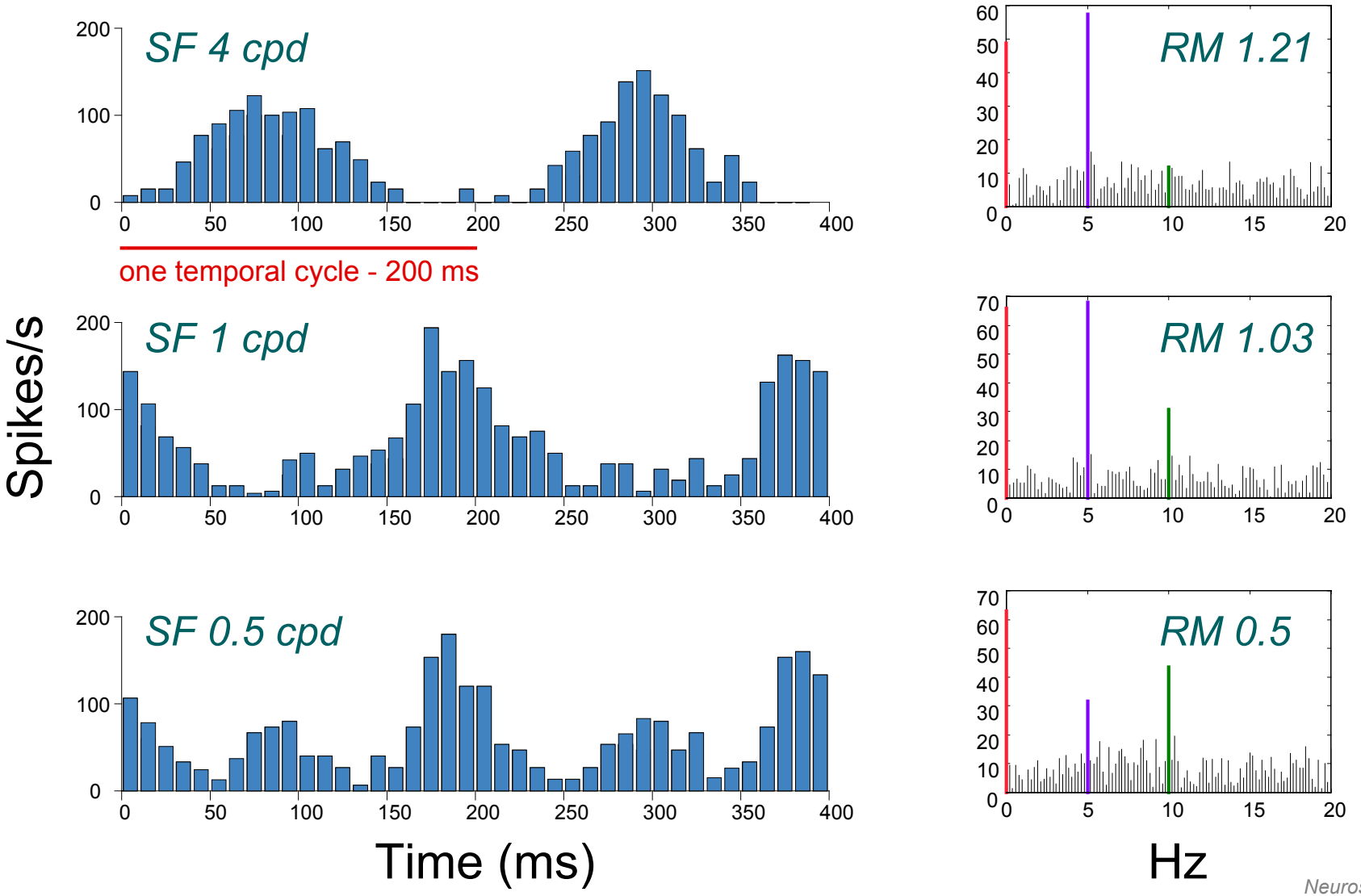
Linear Modulation *vs.* Frequency Doubling

Duplex cell 28682. OI 0.94, AR 19', BD 2 spk/s. Responses to drifting grating TF 5 Hz.



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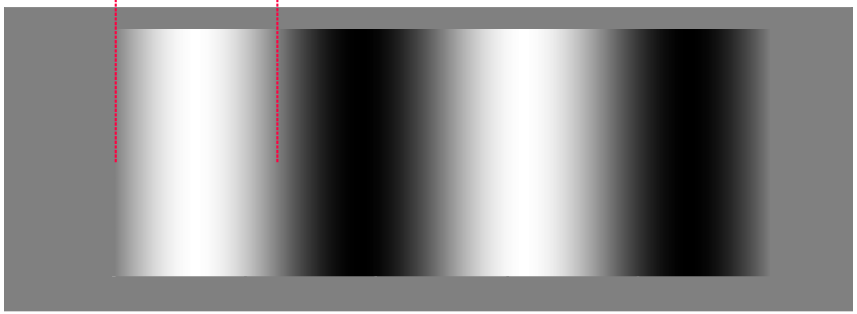
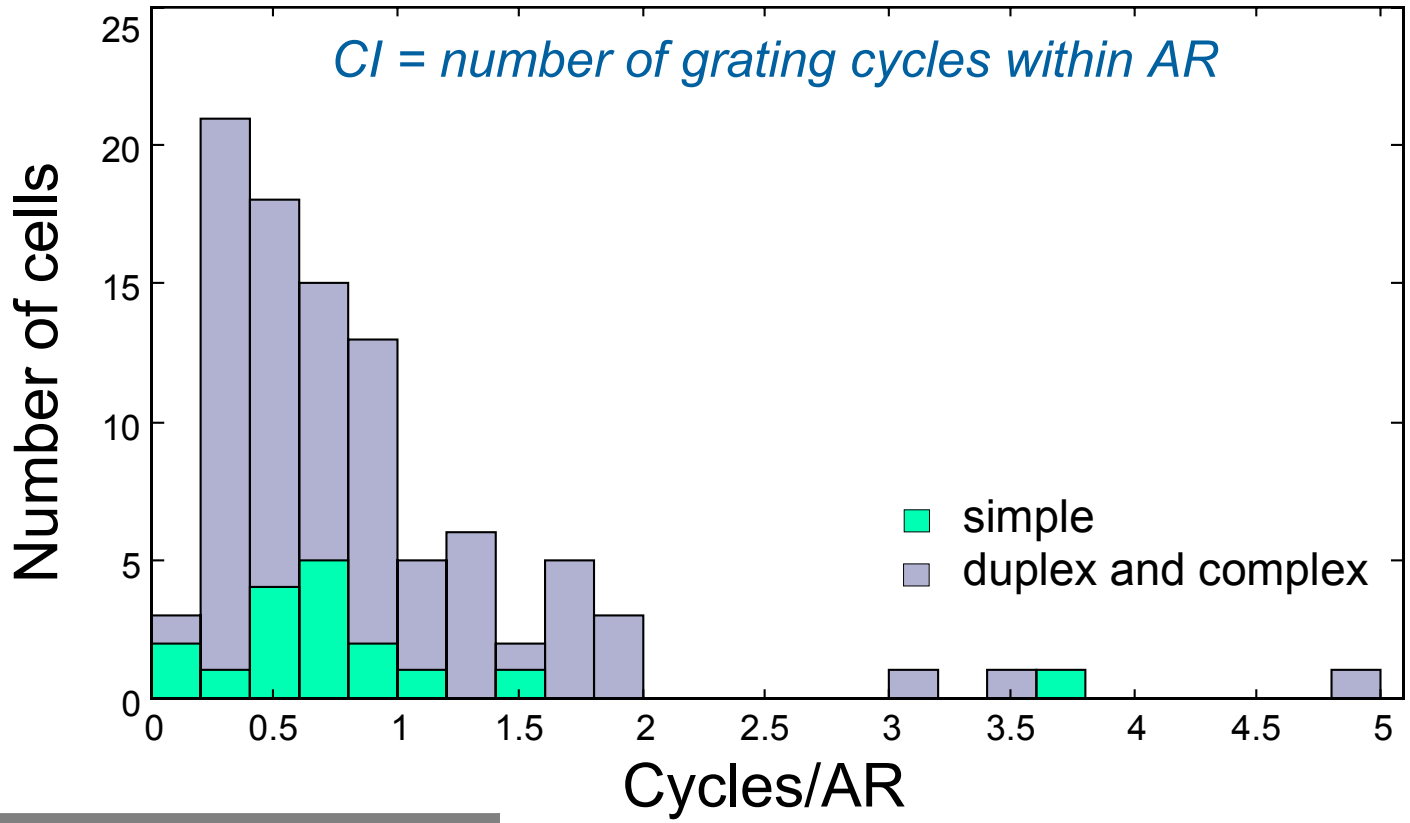
"Complexity Index" (CI) Distribution



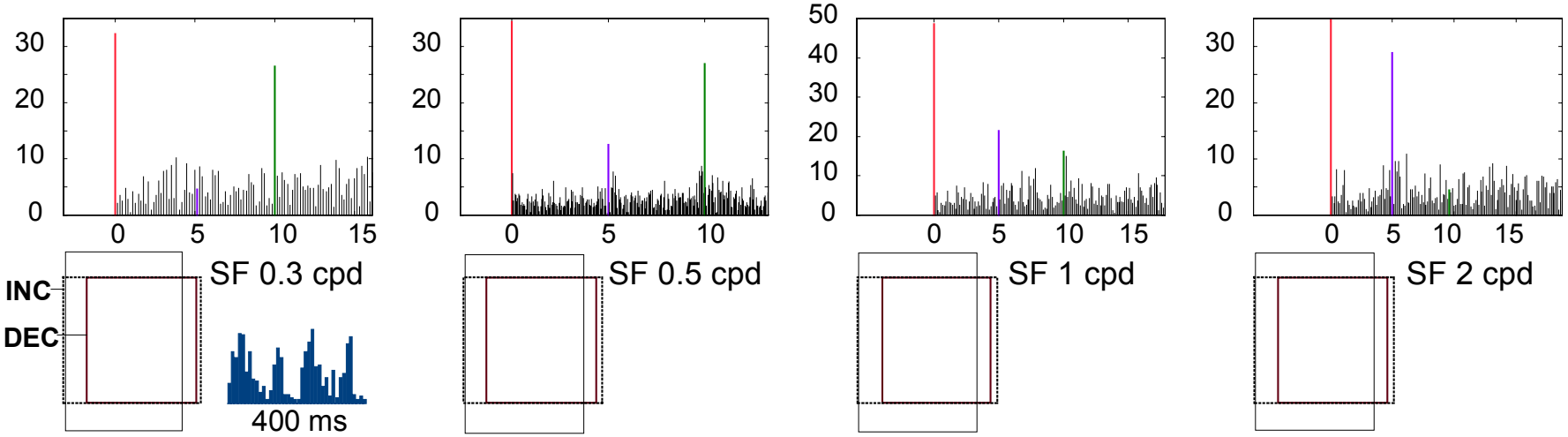


CI = 0.5

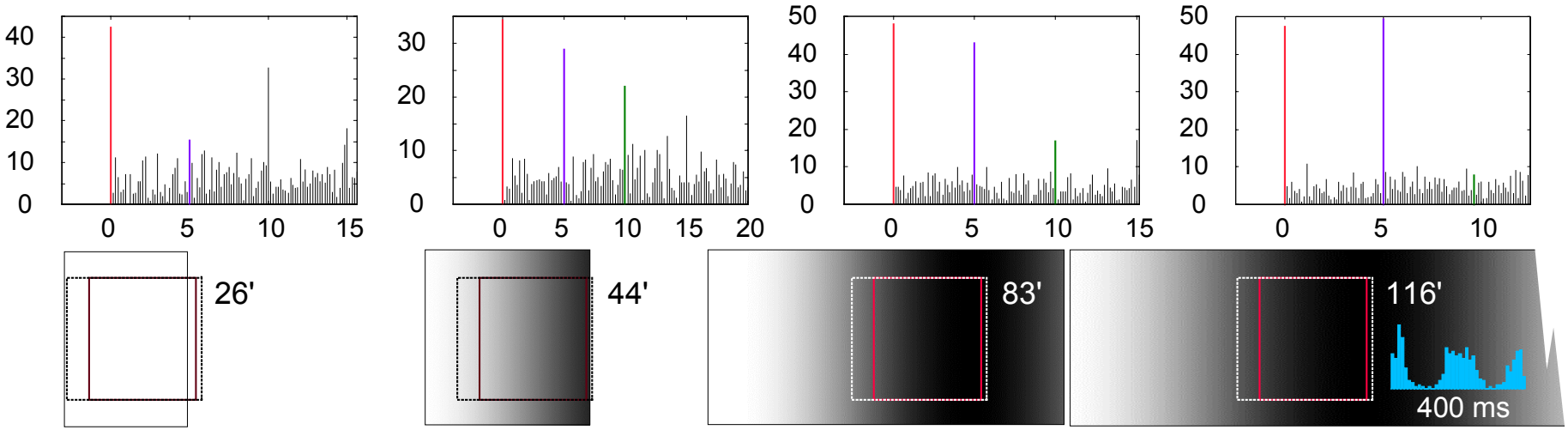
Spatial Frequency and Size Effects

Duplex cell (15884). OI = 0.97, AR = 34', BD 0 spk/s

Drifting Sine, Window 23', TF 5 Hz, various SF - spectra of responses



Drifting Sine, SF 0.5 cpd, TF 5 Hz, various Window sizes



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Summary

- Spatial organization of increment and decrement zones distinguishes two populations:
- Simple cells (16%), non over-lapping zones, are found only in layers 4Cα, 4B, and 6 (Magno stream?).
- Most (83%) cells in the alert monkey striate cortex have overlapping increment and decrement zones. Of these, most (Duplex cells) show considerable modulation at the driving frequency. Optimal spatial modulation frequency is usually predicted by RF width.
- We assume that the behavior of Duplex cells results from dynamic interactions of excitatory and inhibitory mechanisms.