



Nonlinear, non-oriented receptive fields in early visual cortex: Possible precursors to second-order processing

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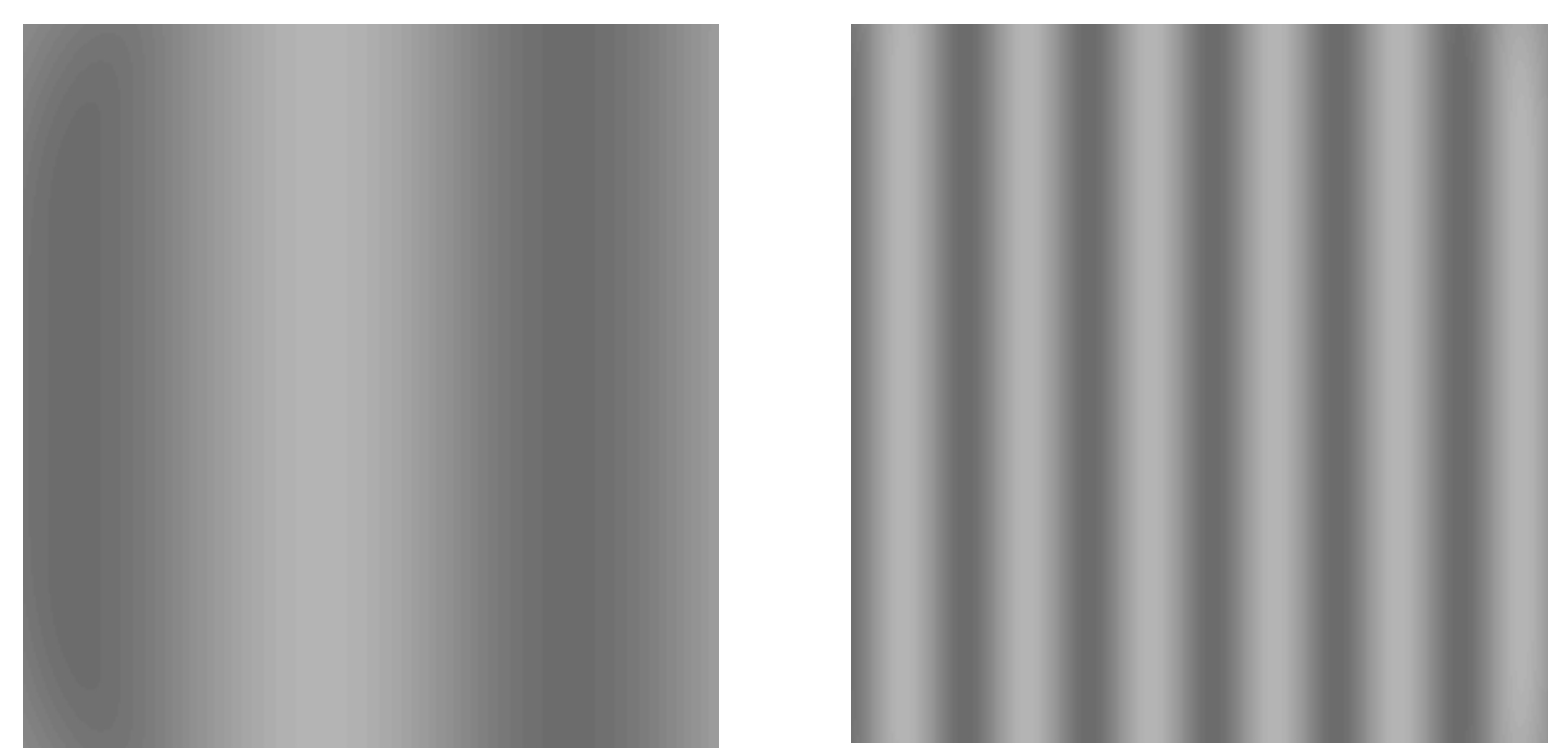
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Introduction

- Neurons selective for the orientation of both luminance (1st order) and contrast (2nd order) boundaries form a considerable proportion in early visual cortex (cat Area 18, macaque V2).
- Neural mechanism underlying receptive fields of these neurons is unknown.
- Recent evidence suggests that inputs from LGN Y cells could be pooled together in cortex to build these receptive fields (Rosenberg et al., 2010; Demb et al., 2001).
- But nonlinear RFs of Y cells can only signal increase in contrast but not decrease.
- Given this, we hypothesize that there is an intermediate processing stage at the cortical level which provides inhibition to 2nd order responsive neurons.

Stimuli and Methods



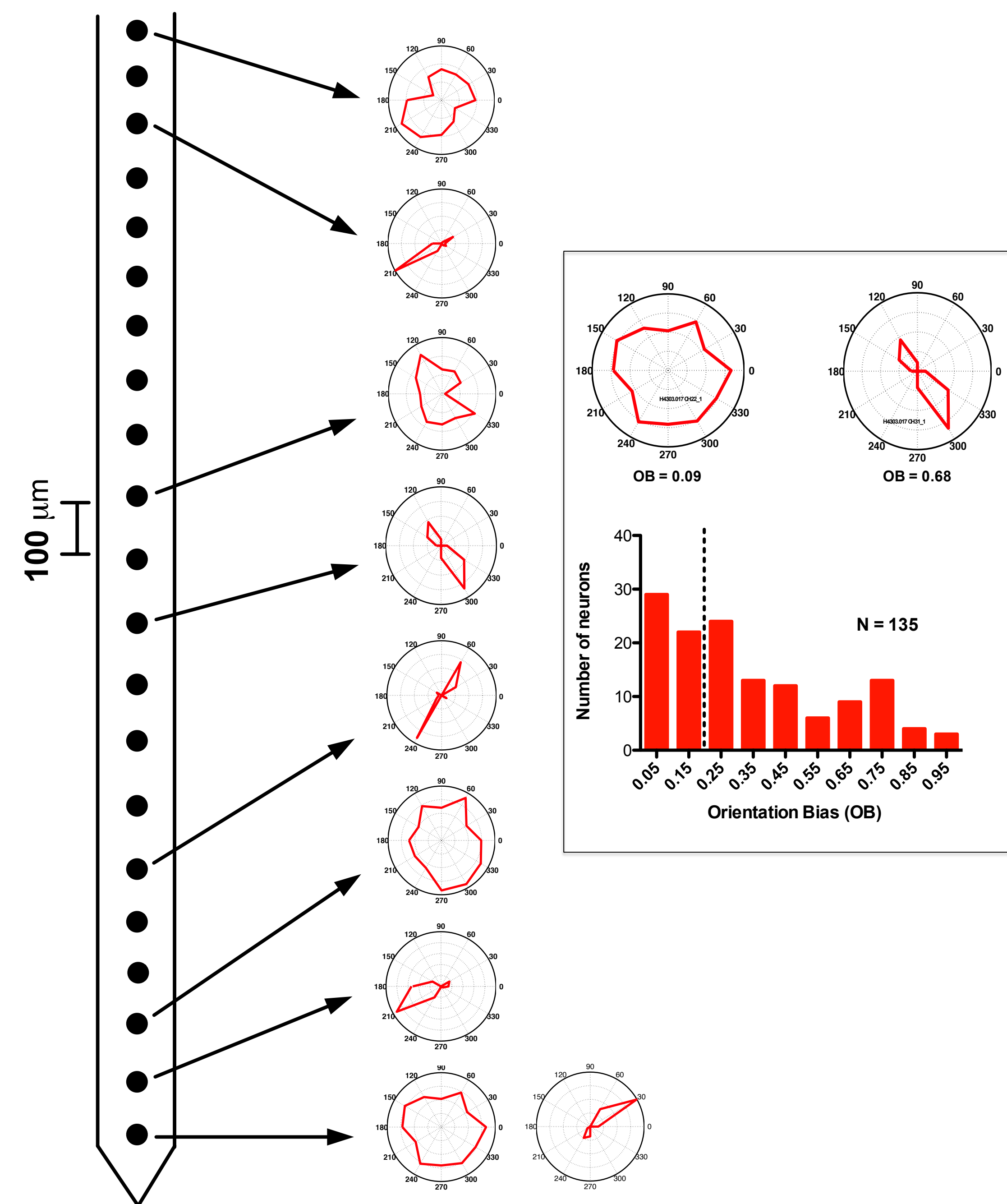
Stimulus

- Sinusoidal grating.
- Temporal Modulation: Drifting or Contrast reversing.

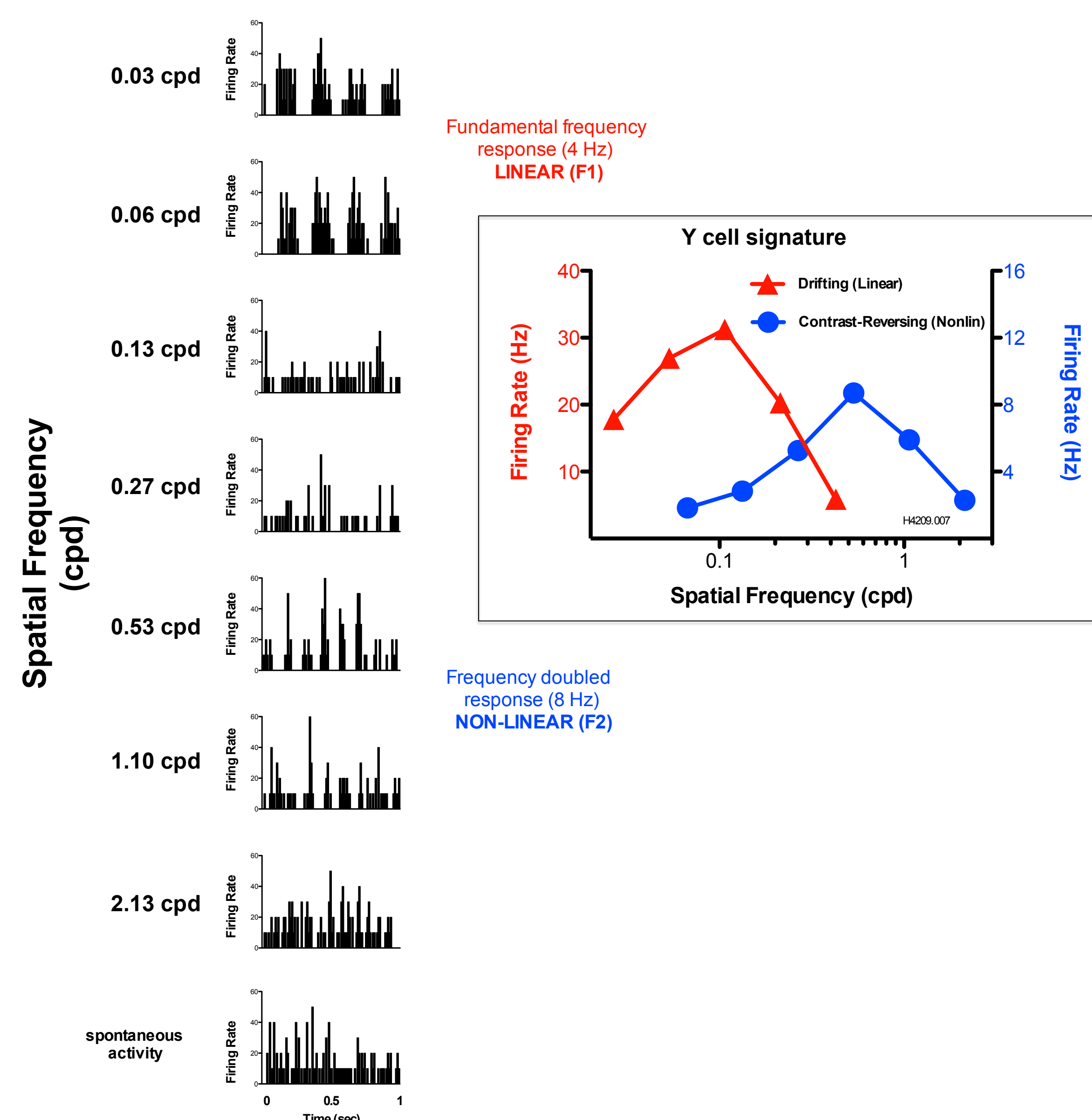
Methods

- Anesthetized, paralyzed cats.
- Extracellular, single-unit recording in Area 18 using 32 channel linear arrays.
- Response measured as average firing frequency for complex cells and 1st & 2nd harmonic modulations for simple cells.
- Manual spike sorting using Plexon Offline Sorter.

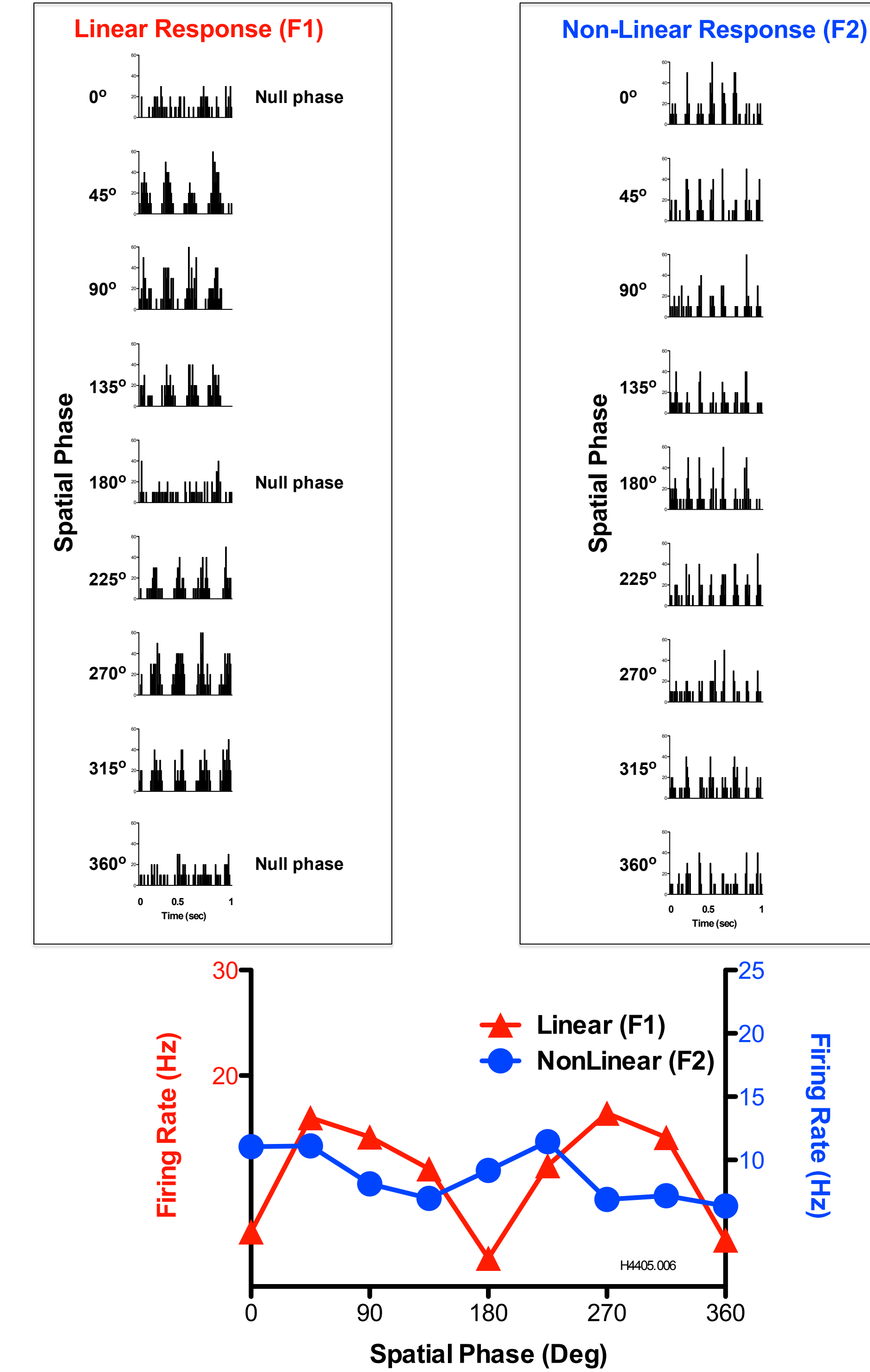
Ori tuning to drifting grating



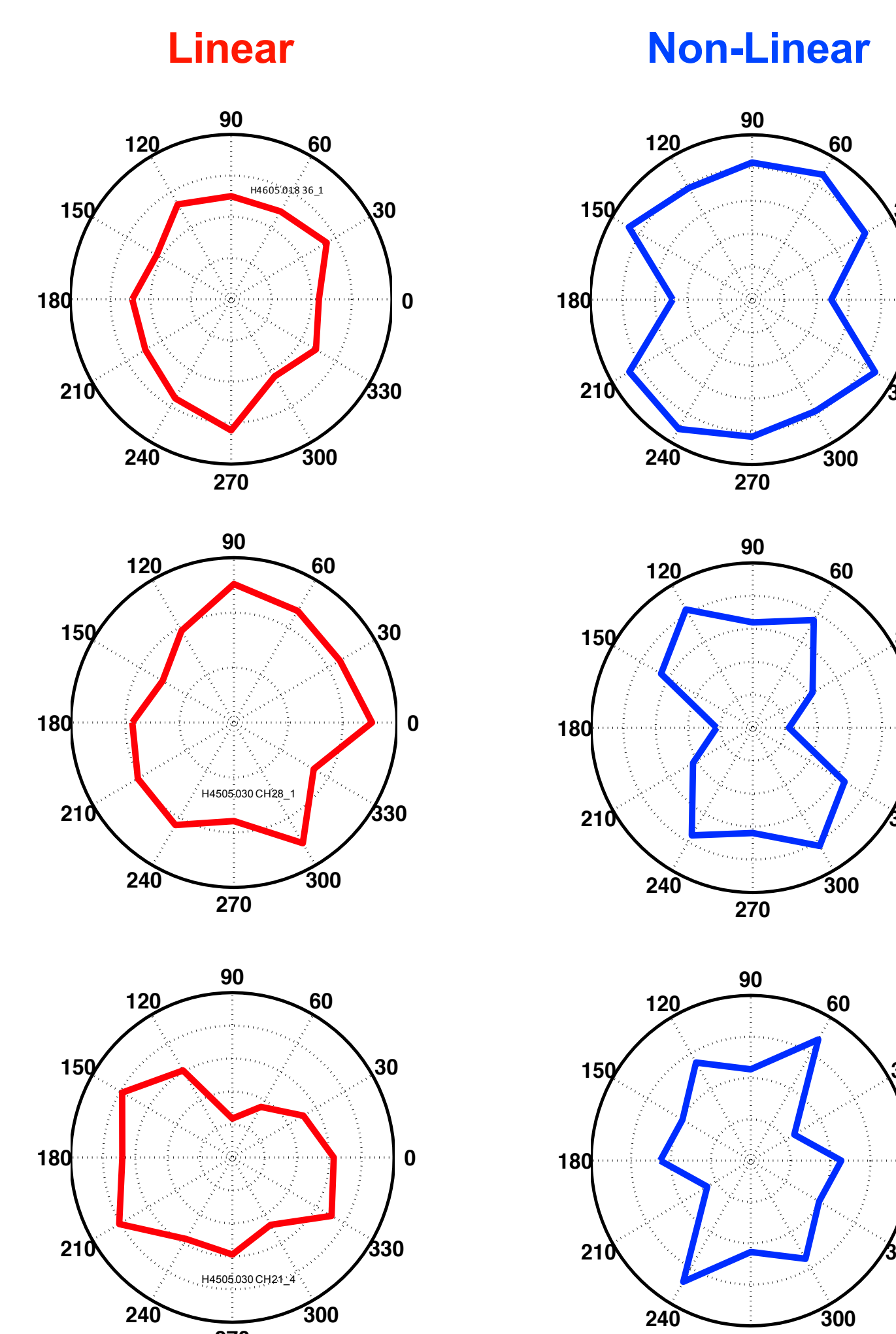
Spatial Frequency tuning



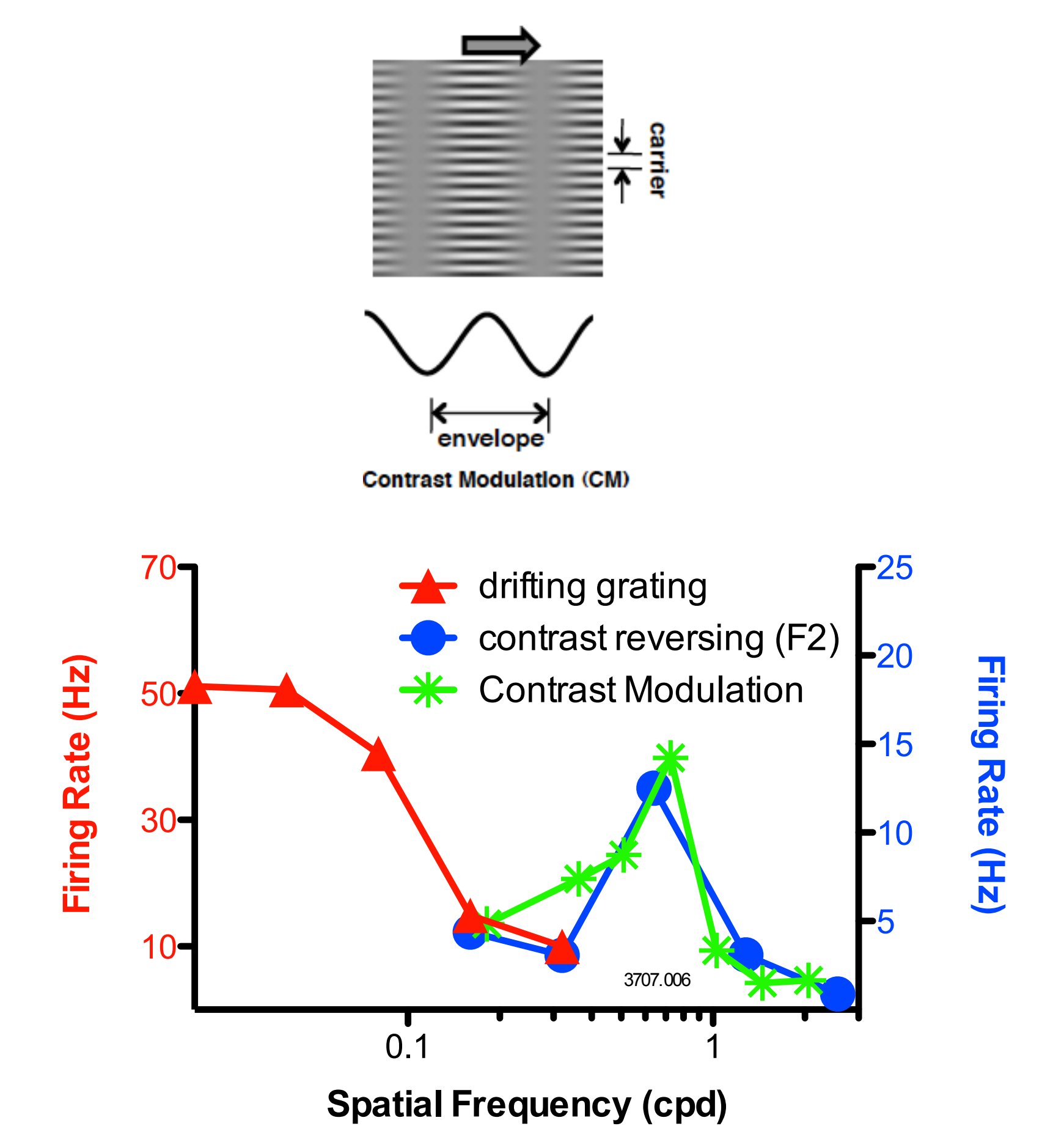
Spatial phase dependence



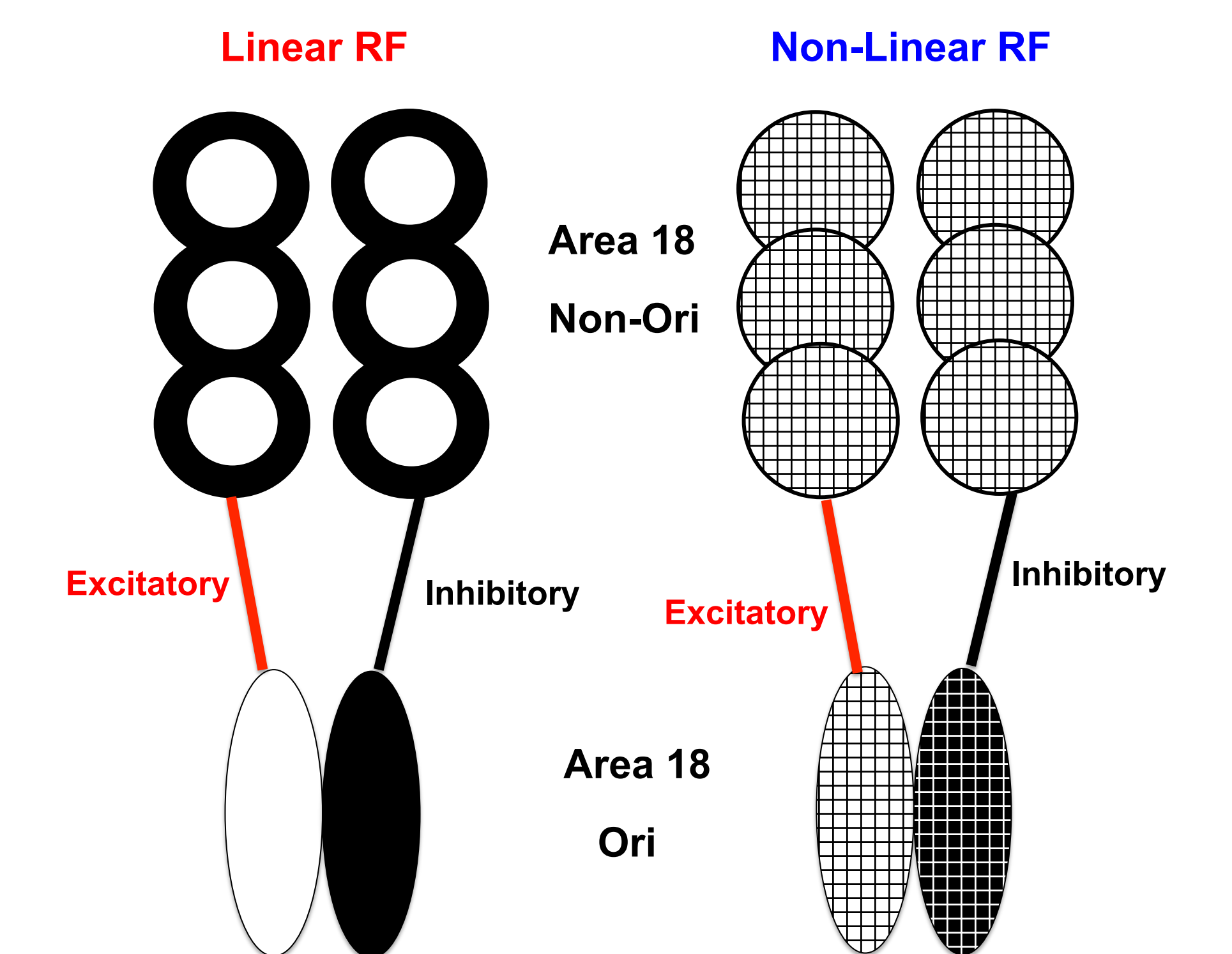
Ori tuning



Contrast Modulation



Receptive Field Model



Conclusion

- Y like receptive fields of these cortical neurons suggests that they receive input from LGN Y cells.
- These neurons could provide an important intermediate stage in building cortical orientation selective second-order neurons

References & Acknowledgements

1. Rosenberg et al 2010
2. Demb et al 2001
3. Crook et al 2008

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