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Plasmon Based Split-Grating Gate Terahertz Detector

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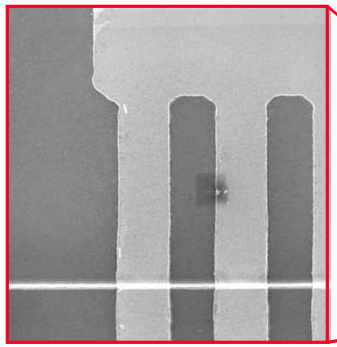
Outline

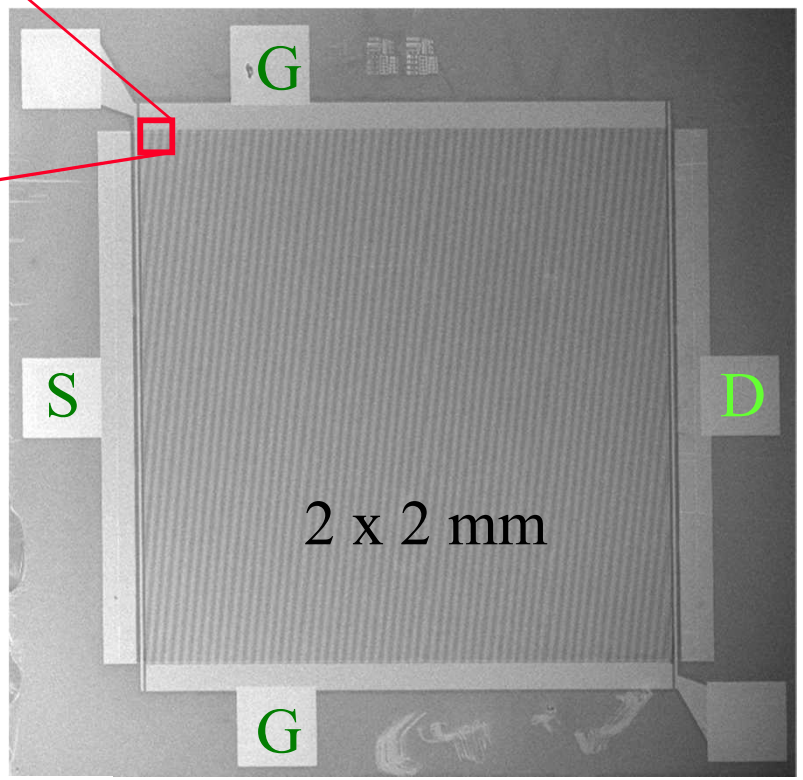
- Background
- Split-Gate Detectors
- Measurements and comparison
- Conclusion

THz Detector Design

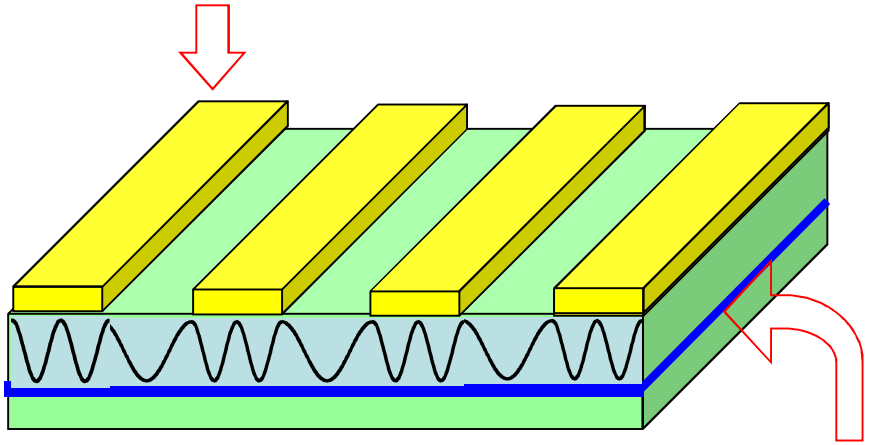
Plasmon:
Collective oscillation



Top View



Periodic Grating
Ti/Au Gate



GaAs/AlGaAs
Single or double quantum wells

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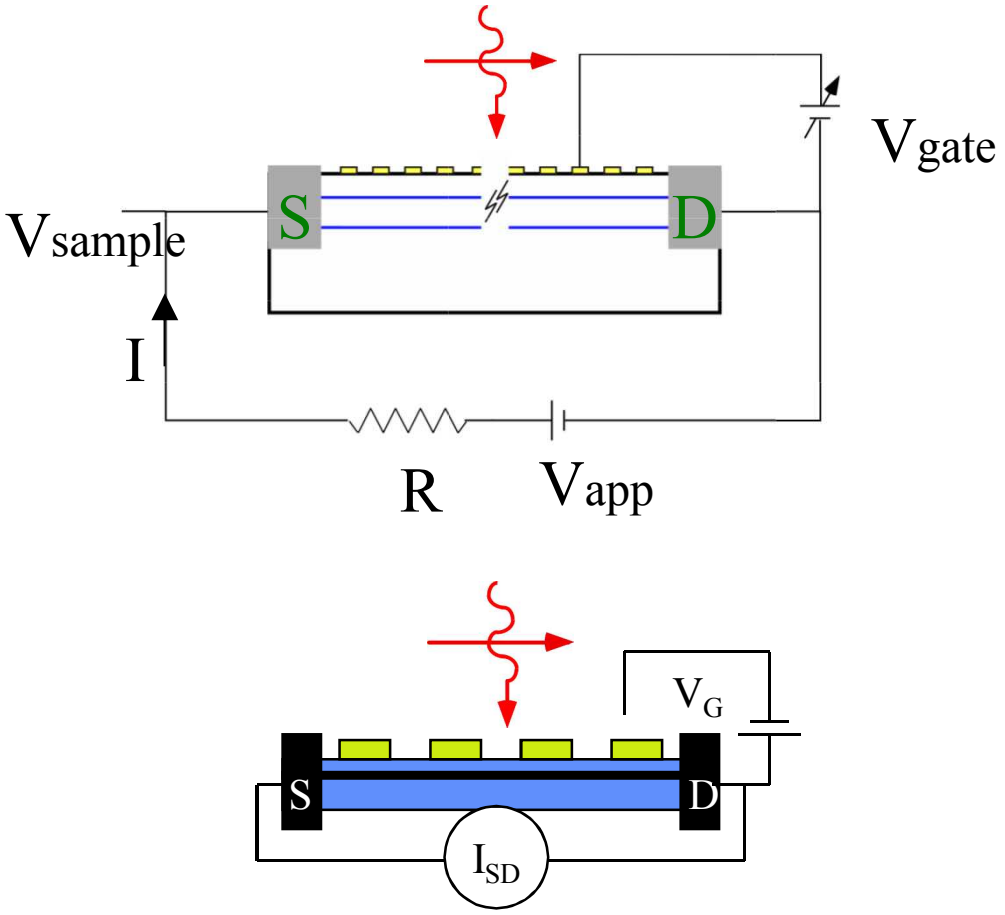
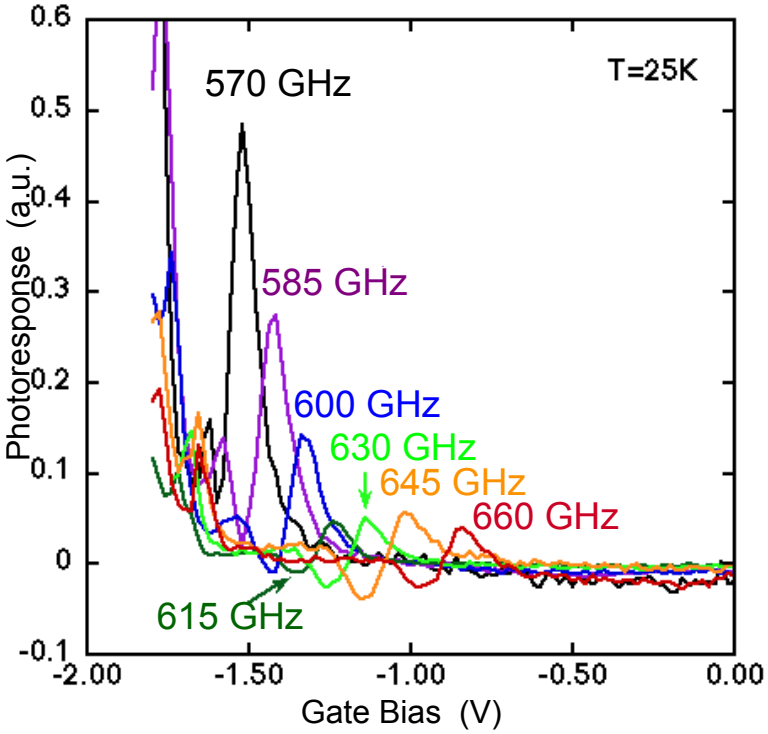
Standard Measurement Geometry



Double Well Detector



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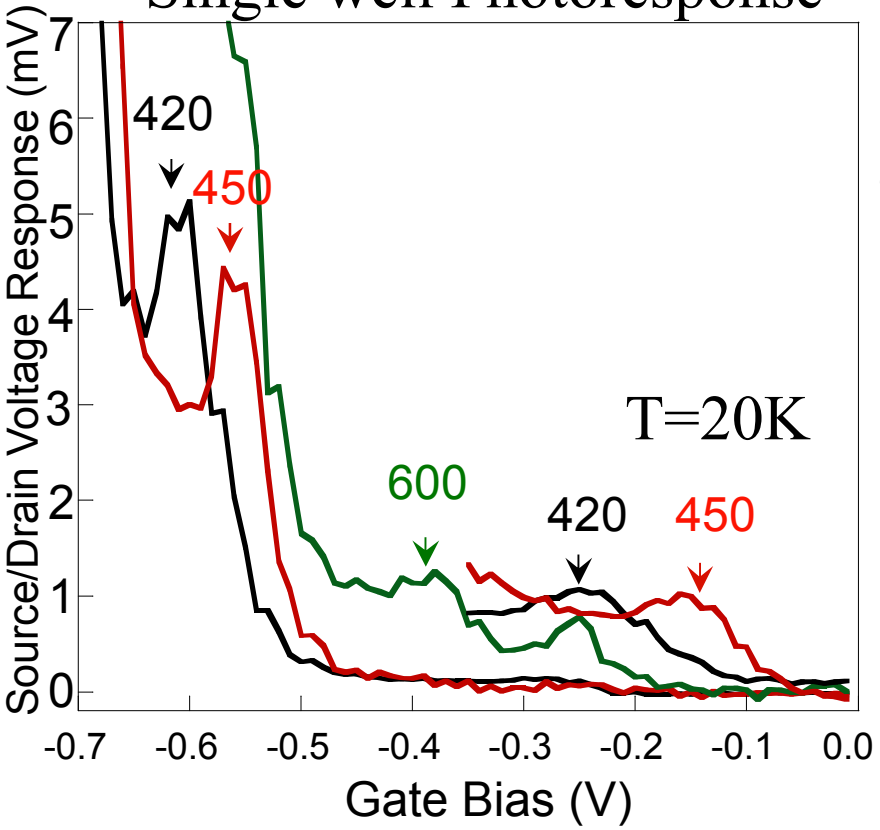
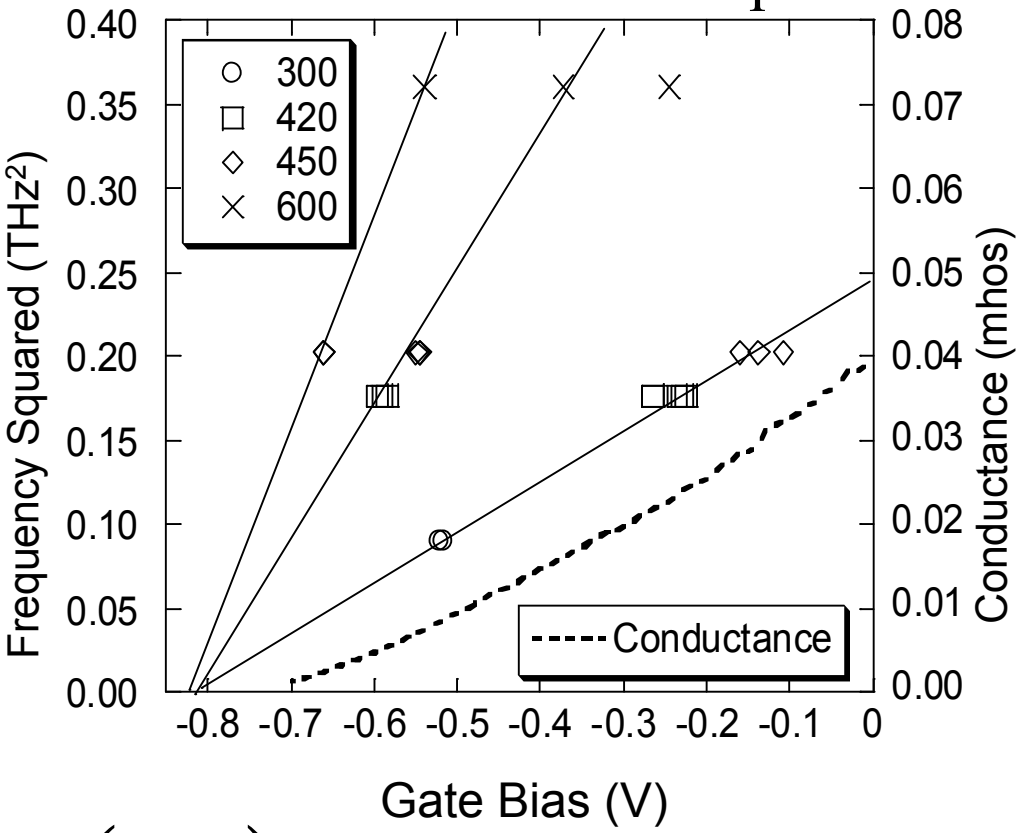
Tunable Photoconductive Detector

Single well Photoresponse



Plasmon Mode-Map



$$f_p^2 \propto n(V_G)k_j$$

APL **87**, 193507 (2005)

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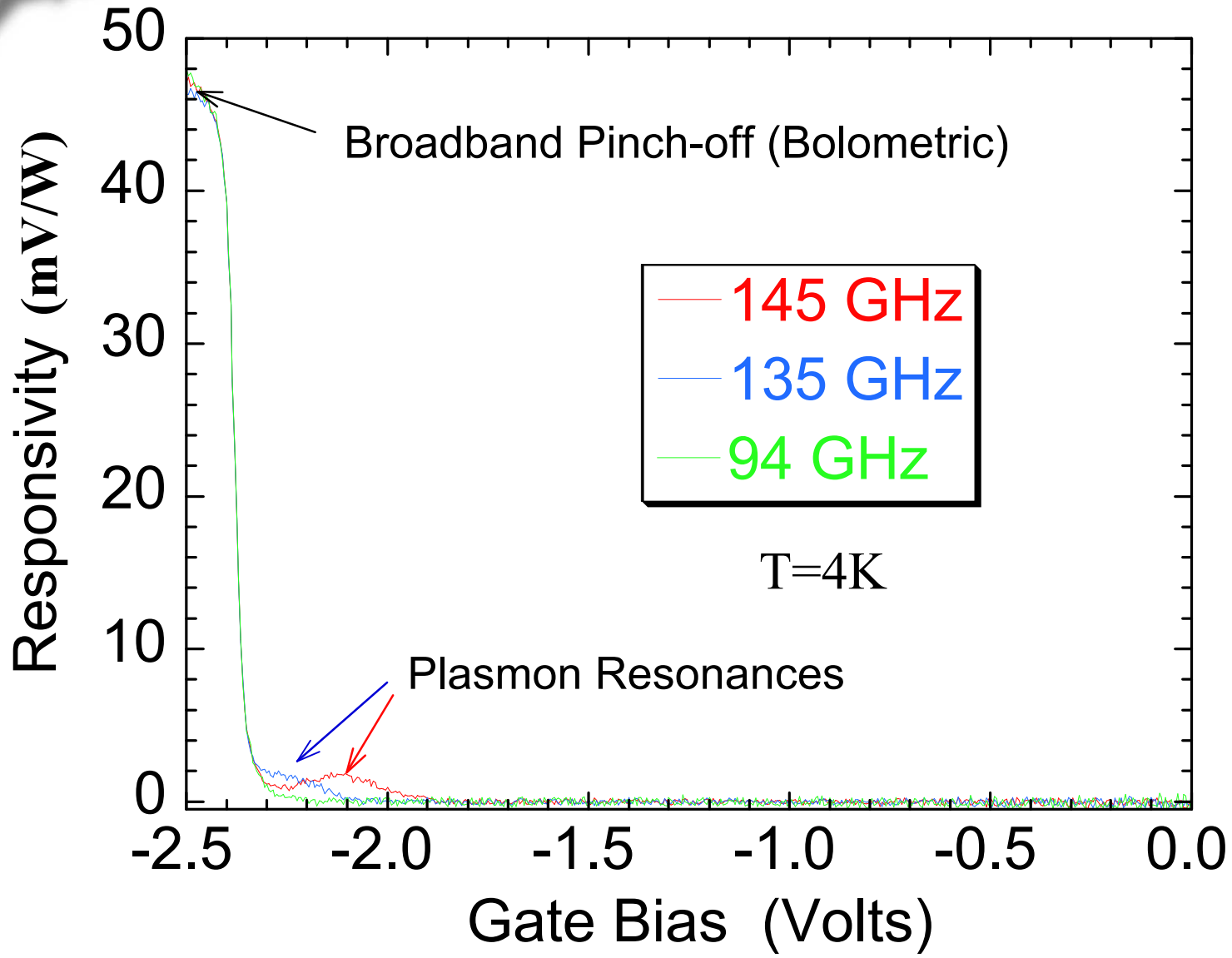
Split Gate Detector - Motivation



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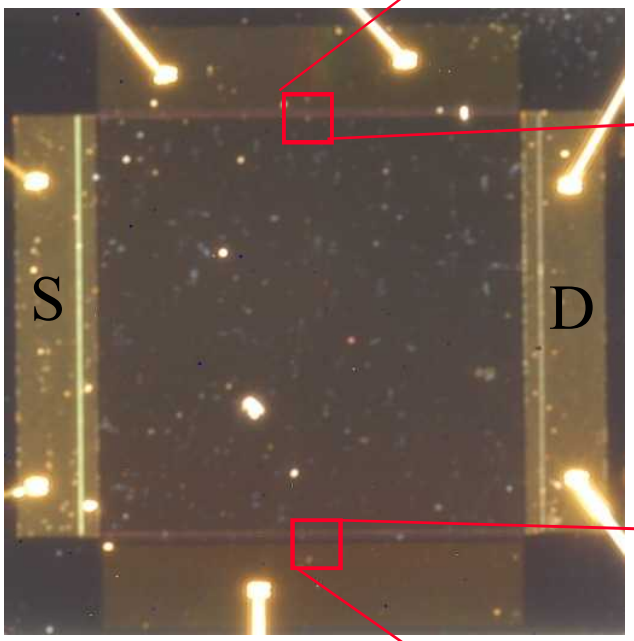
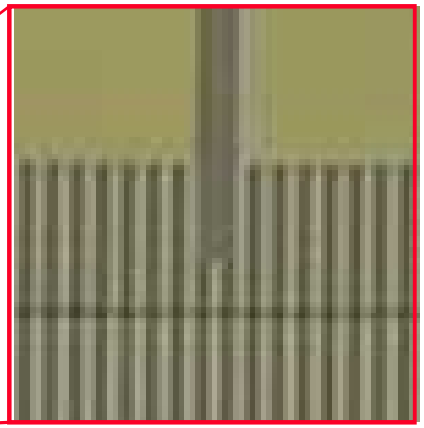
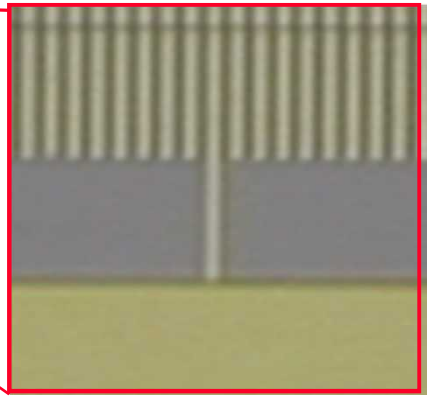
Split Gate Detectors







GOAL:
Combine tunability
&
High Responsivity

Majority of gate biased at plasma frequency (defines absorption frequency)

Single gate line biased to depletion (defines responsivity)

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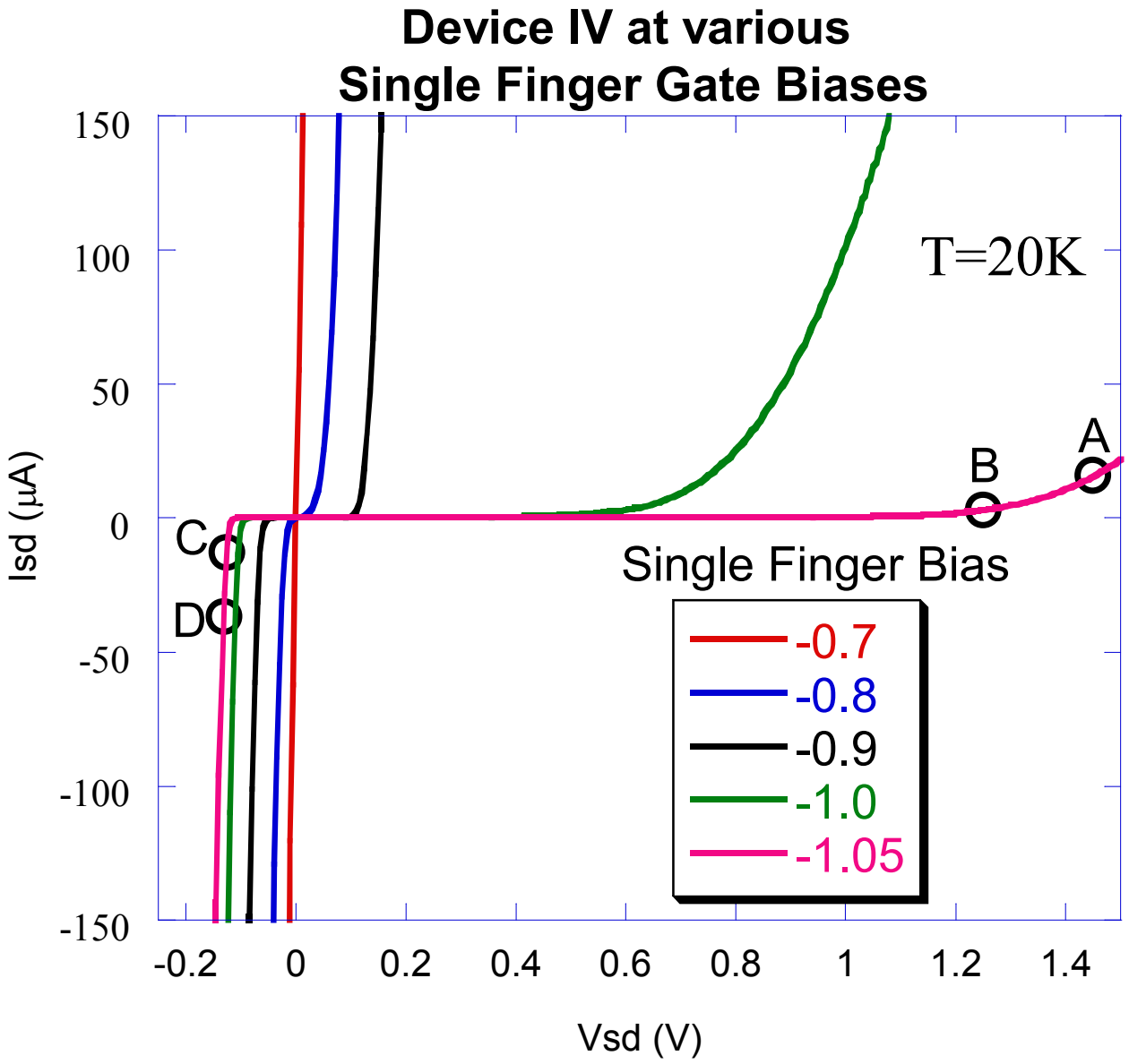
Split Gate Detectors IV Characteristics



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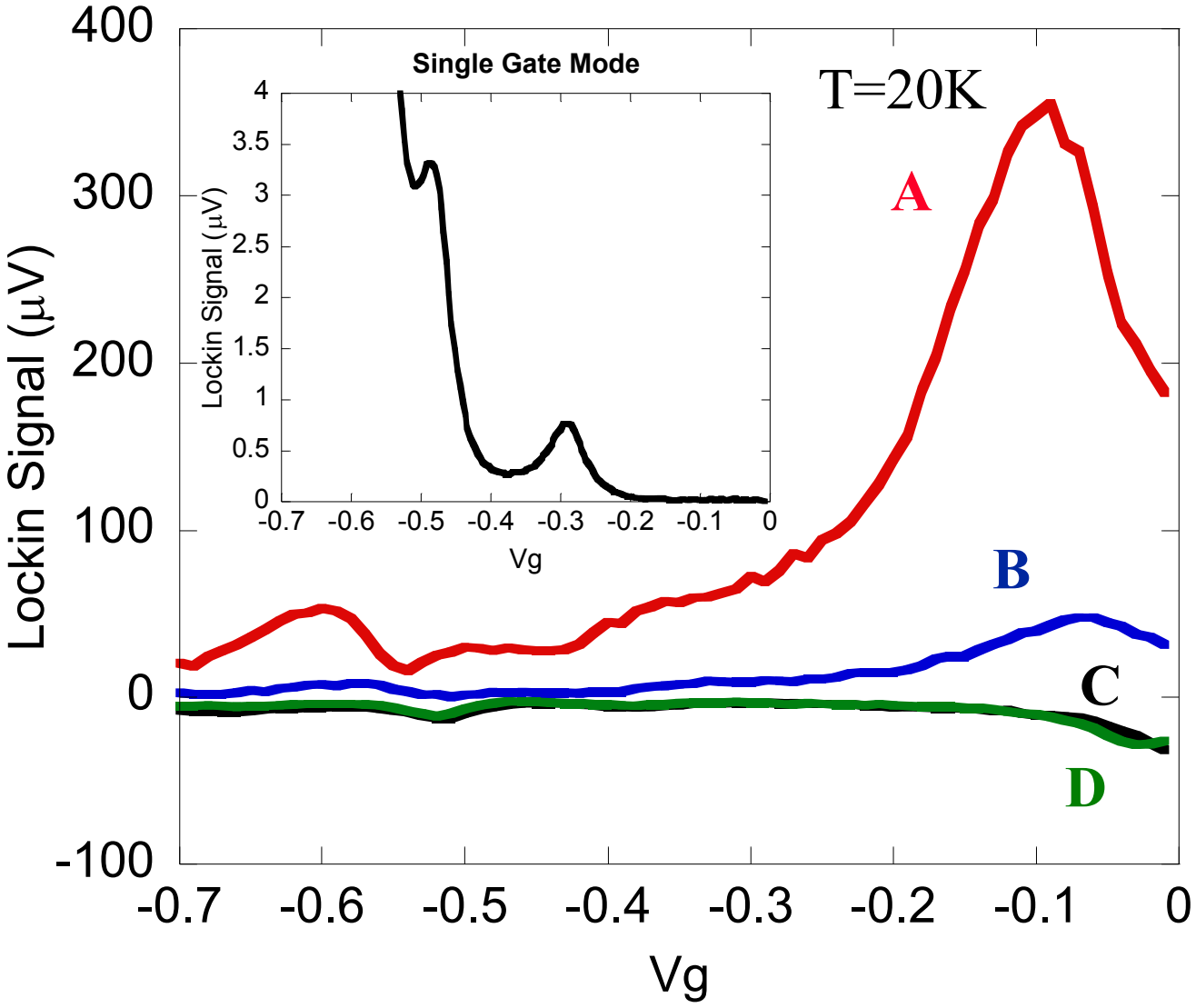
Split Gate Detectors

393 micron excitation Split Gate Mode
Various Operating Points



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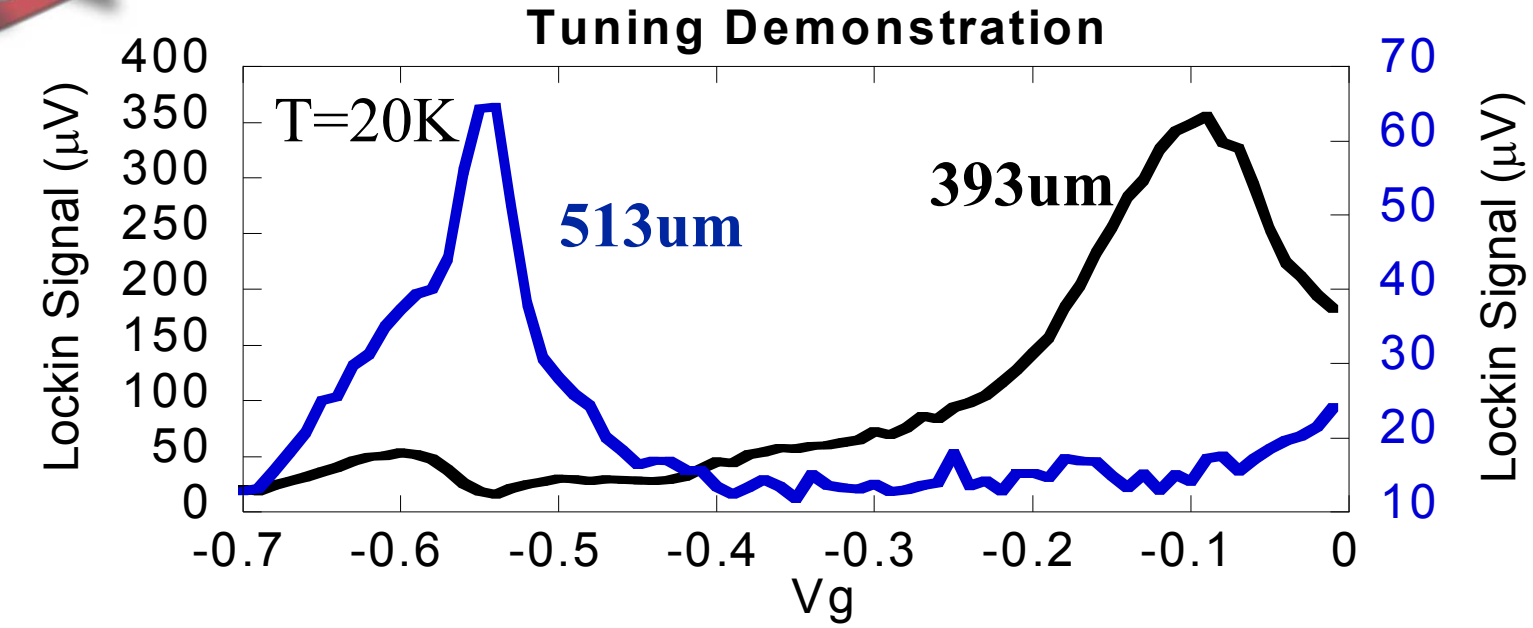
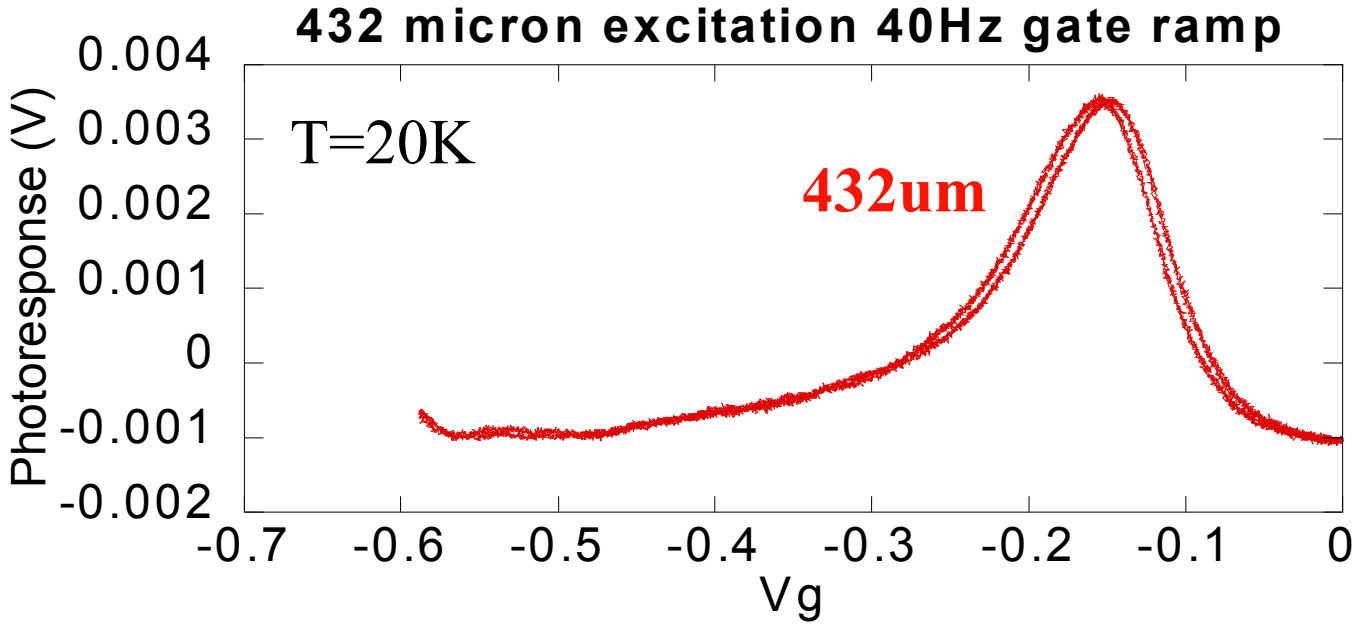
Split Gate Detectors





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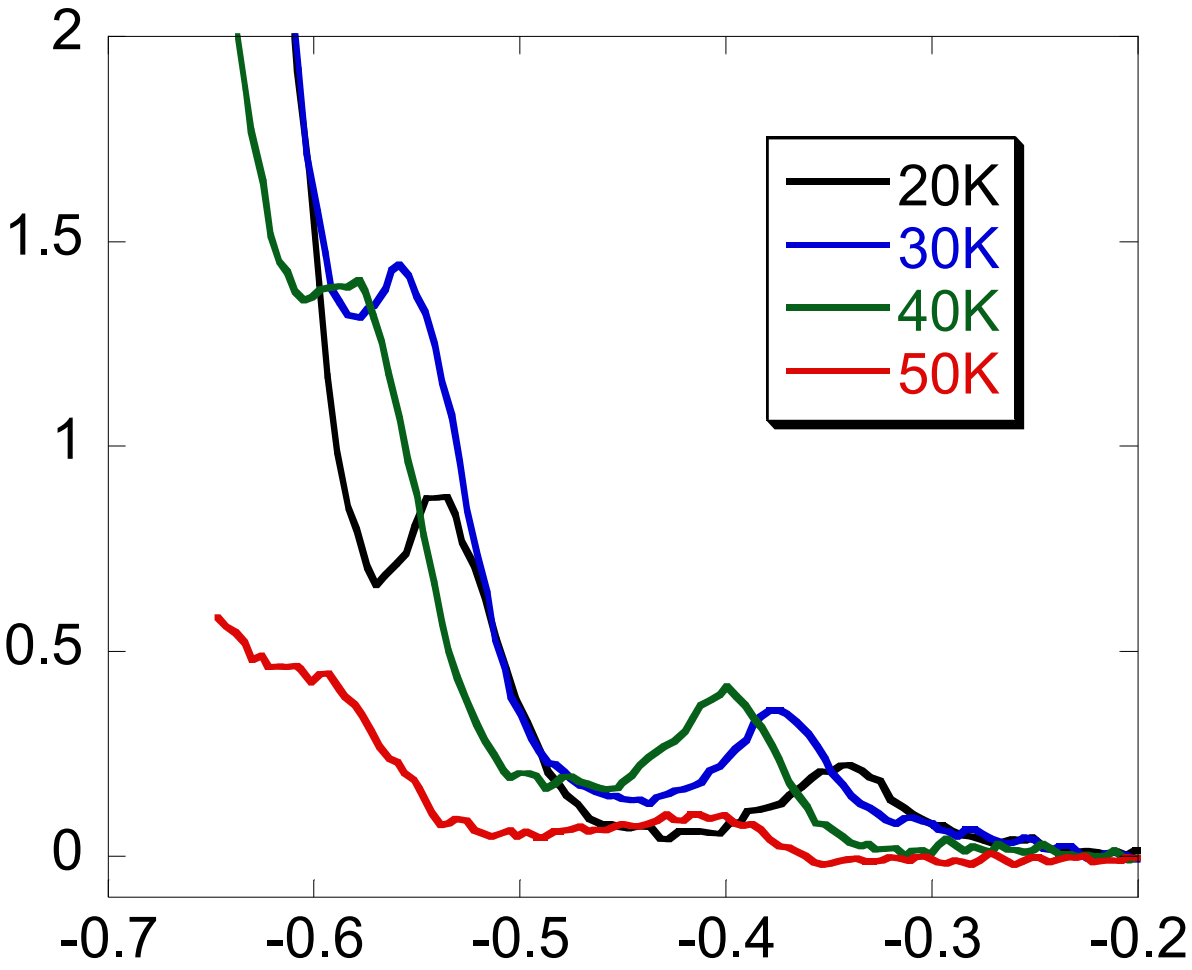
Conclusions

- Split grating-gate detectors offer several orders of magnitude increased responsivity over single gate counterparts
- Split gate detectors retain tunability similar to original design
- Need to better understand fundamental operating principles to further enhance photoresponse

Temperature Dependence
Single Gate Mode



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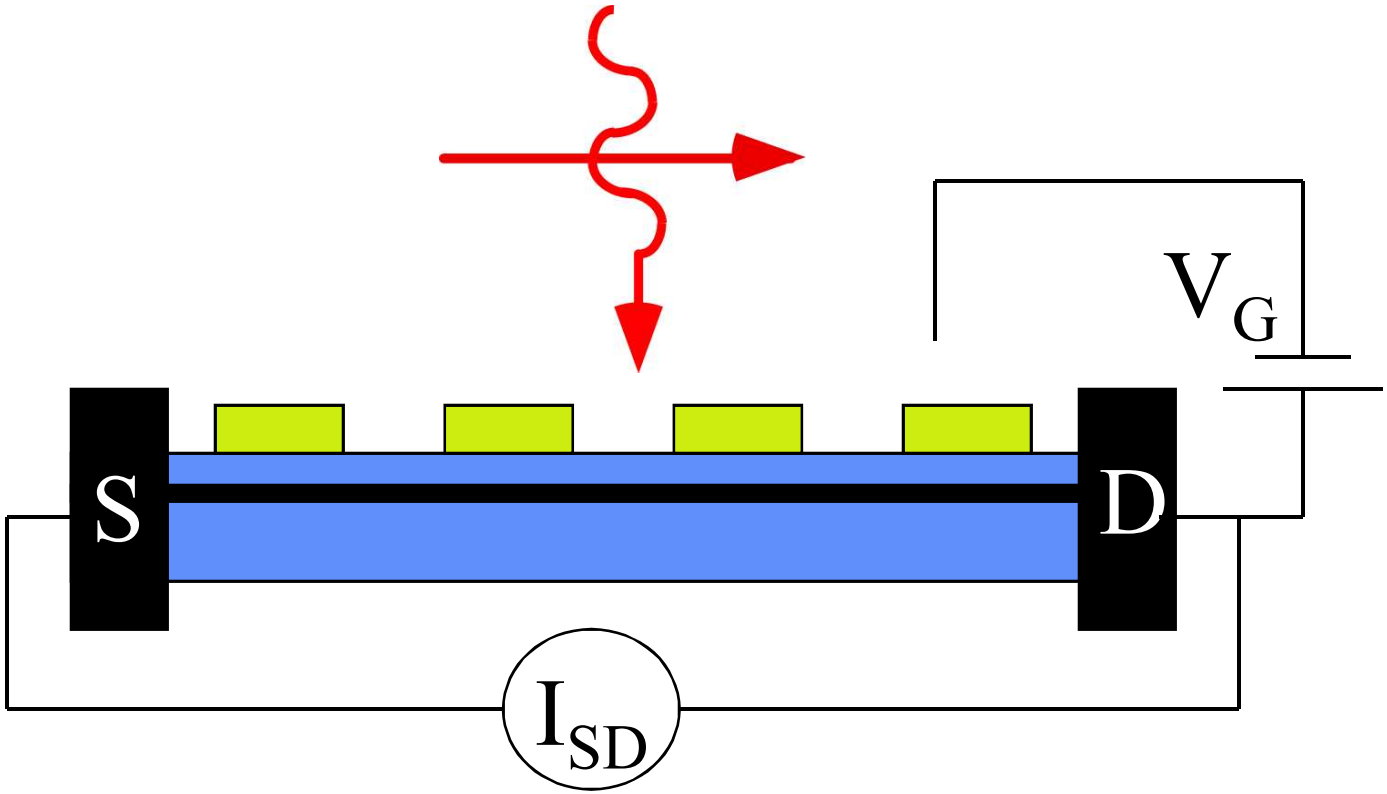

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