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A National Science Foundation Science & Technology Center

NAPAC2019
NORTH AMERICAN PARTICLE ACCELERATOR CONFERENCE

Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)

Ultrafast Nonlinear Photoemission From Alkali Antimonide Photocathodes

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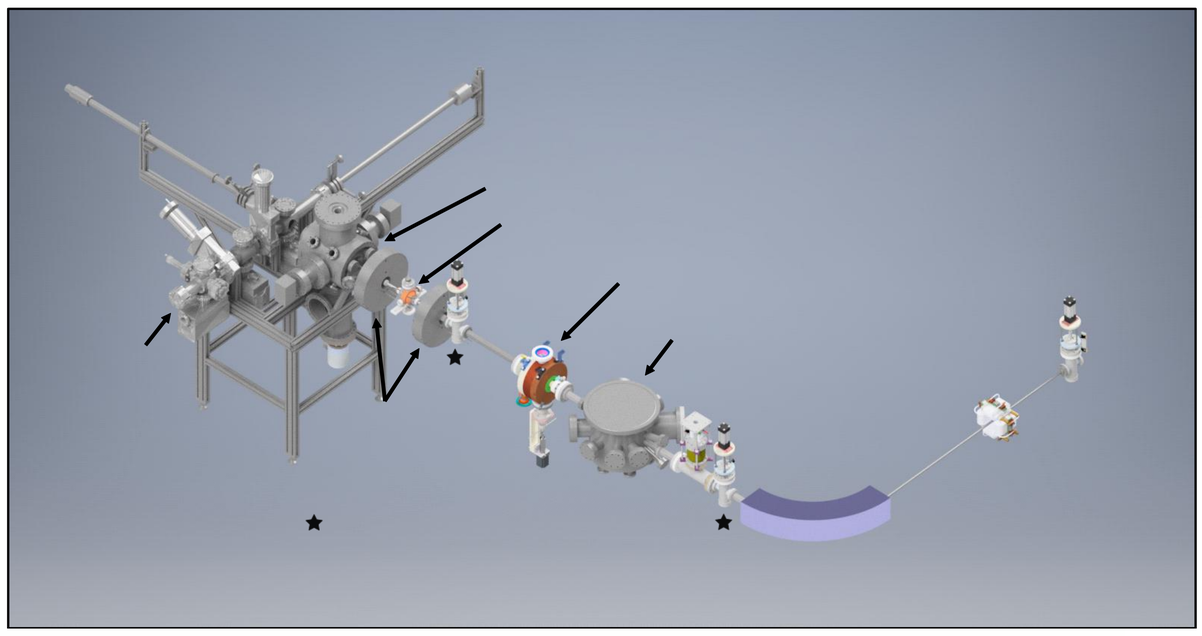
Introduction

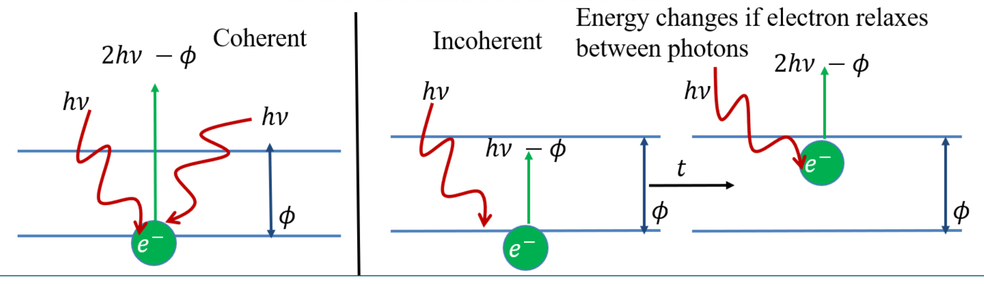
Alkali antimonides are an extremely interesting photocathode for use in next-generation accelerators due to their combination of high QE and low MTE at threshold. With the increasing need for femtosecond scale electron beams, understanding nonlinear photoemission properties of these cathodes become critical for achieving maximum brightness.

Photocathode diagnostic beamline.

Equipped to do solenoid scans and direct emittance measurements.

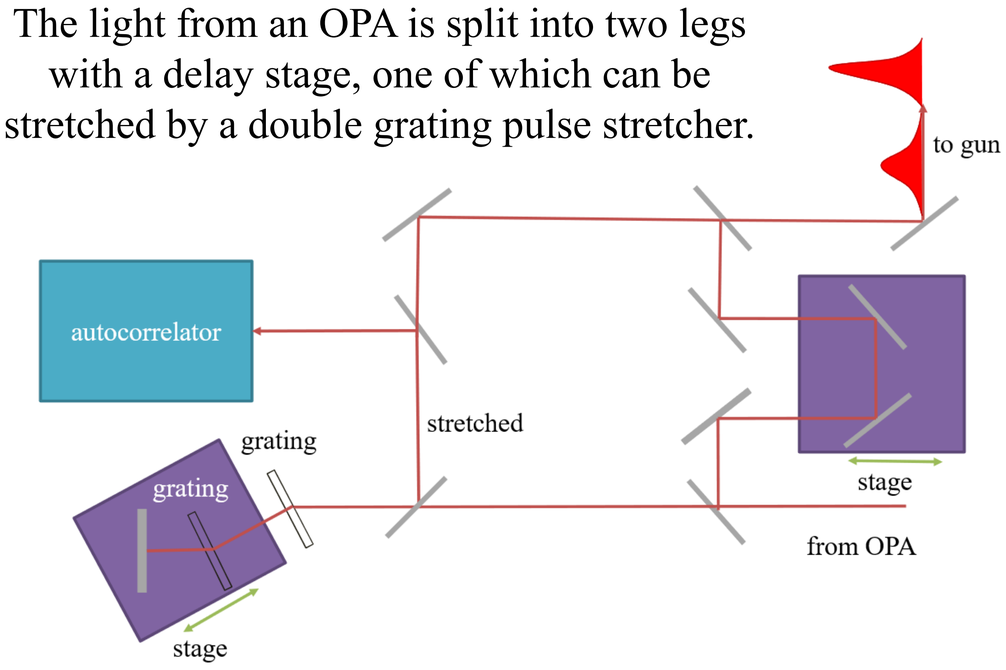


Photoemission model.

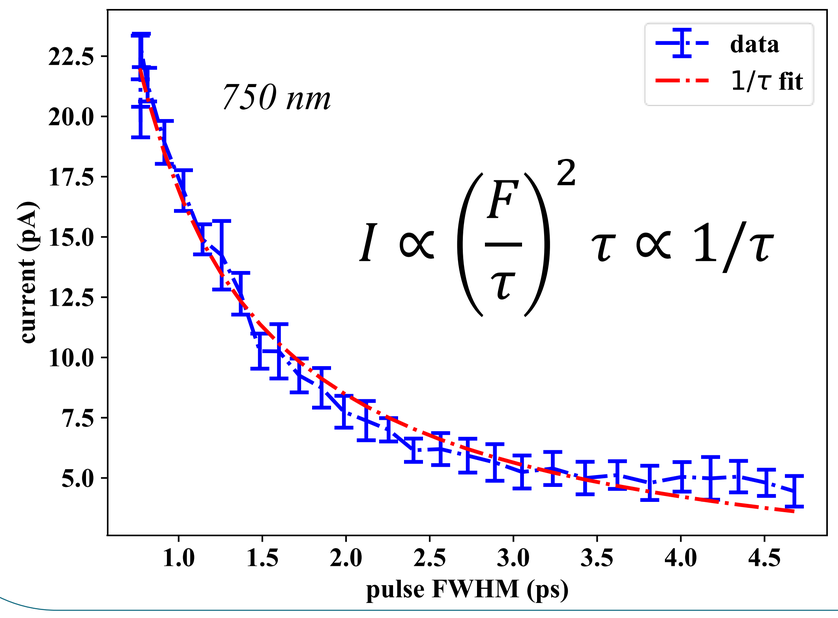


Optics setup.

The light from an OPA is split into two legs with a delay stage, one of which can be stretched by a double grating pulse stretcher.

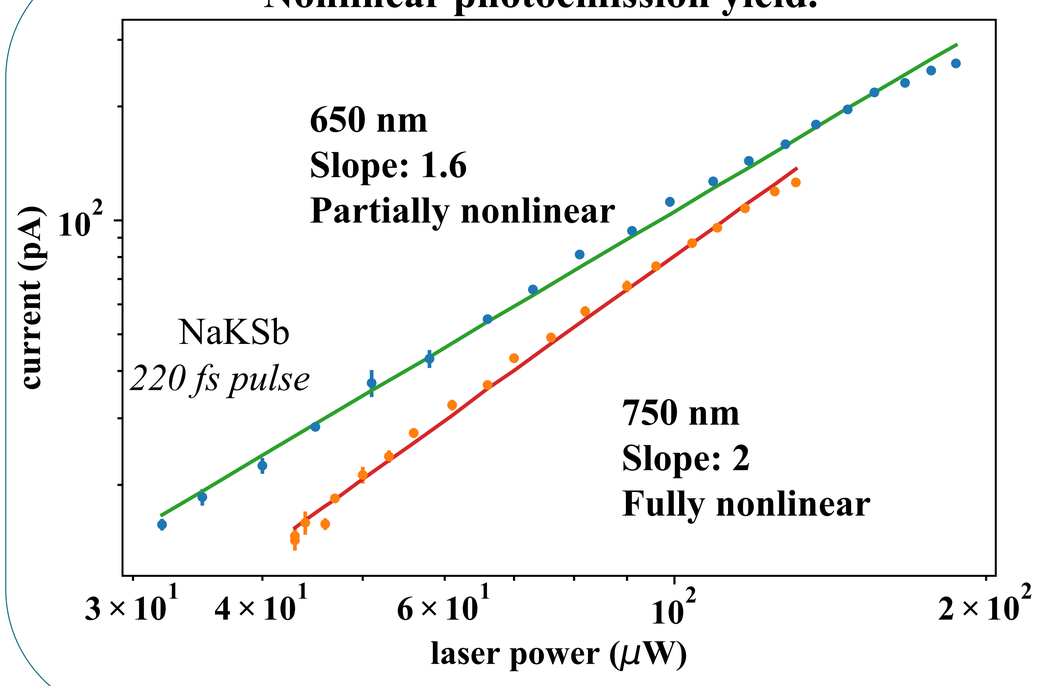


Yield dependence on pulse length. The yield goes as $1/\tau$, indicating the same two-photon process that the power scan showed.

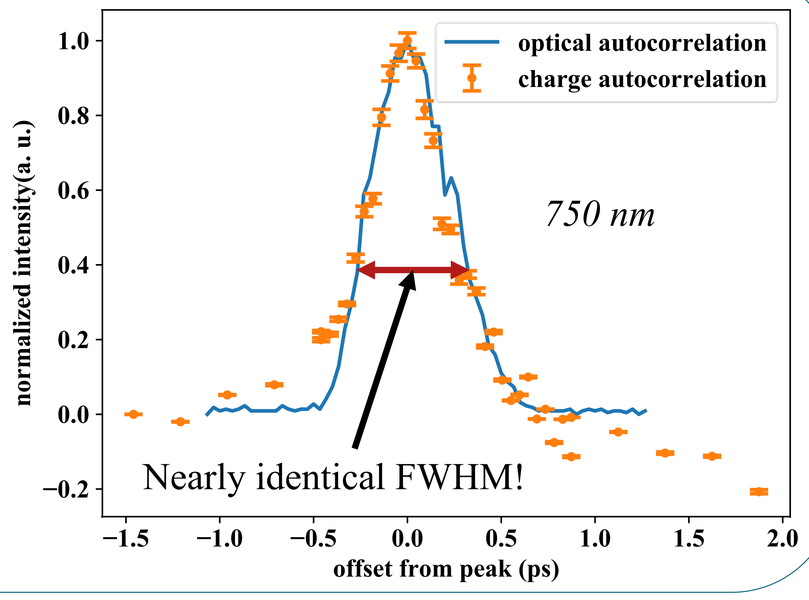


I = photocurrent
F = laser fluence
τ = pulse length

Nonlinear photoemission yield.



Charge autocorrelation.
The trace from an optical autocorrelator roughly matches the charge autocorrelation, indicating no long-lived incoherent processes



Conclusion

We have measured the onset of nonlinear photoemission with femtosecond laser pulses for that first time on alkali antimonides. Future plans will involve a variety of methods to characterize the effect this has on MTE, and eventually the full 6D phase space.

Supported by National Science Foundation award No. PHY-1549132.