



**ARO**

# ARO/ARL Workshop on Ultraviolet Devices & Communications Systems

**Brian Sadler**  
**Army Research Laboratory**

**Robert Ulman**  
**Army Research Office**

**Zhengyuan (Daniel) Xu**  
**University of California, Riverside**

23 April 2008

UV Workshop





# Acks & Logistics

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Prof Chris Davis (UMd) , Terrence Moore (ARL), Mike Wraback (ARL)

Plenary Speakers (bio's on web site), panel members

You, for attending (~ 10 academia, 10 industry, 15 govt)

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Receipts will be emailed

Coffee shop closes 2pm (?)

[www.ee.ucr.edu/~dxu/CFP-UVworkshop08.html](http://www.ee.ucr.edu/~dxu/CFP-UVworkshop08.html)



# Motivation

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- Ultraviolet (UV) based technology has great promise for indoor and outdoor military and commercial applications, especially communications. This is based on the significant recent progress in deep UV solid state devices (LEDs and APDs), the unique atmospheric channel characteristics (non-line of sight scattering, solar blind operation), and successful experimental UV test-beds.



# Workshop Goals

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- Focus on solar blind, primarily communications
- Review device state-of-the-art
  - LEDs
  - APDs
- Look at unique aspects of propagation indoors/outdoors
- Consider testbeds and systems issues
- Discuss the near and longer term future
  - Issues, investments, applications



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Time	Title	Presenter
07:30-08:00	Registration	
08:00-08:30	Welcome and Opening Remarks; UV History & Potential Applications	Brian M. Sadler, Army Research Laboratory, USA; Robert Ulman, Army Research Office, USA
08:30-09:15	Deep Ultraviolet LEDs and Lasers using AlGaN	Asif Khan, University of South Carolina, USA
09:15-10:00	Ultraviolet Avalanche Photodiodes Based Upon AlGaN Grown on Free-Standing AlN and GaN Substrates	Russell Dean Dupuis, Georgia Institute of Technology, USA
10:00-10:30	Coffee break	
10:30-11:15	SiC Avalanche Photodiodes	Joe C. Campbell, University of Virginia, USA
11:15-12:00	Atmospheric Propagation Effects Relevant to UV Communication	Arun K. Majumdar, Naval Air Warfare Center, CA, USA
12:00-13:00	Lunch on-site	
13:00-13:45	The Indoor Optical Wireless Channel: Characteristics and Challenges	Dominic O'Brien, Oxford University, UK
13:45-14:30	Solar Blind Ultraviolet Communication Test-bed and Performance Study	Zhengyuan Xu, University of California, Riverside, USA
14:30-15:00	Coffee break	
15:00-16:00	Panel discussion session	Christopher C. Davis, University of Maryland, USA; Mohsen Kavehrad, Pennsylvania State University, USA; Brian M. Sadler, Army Research Laboratory, USA (moderator) ; Isaac Shpantzer, CeLight Inc., USA; Robert Ulman, Army Research Office, USA (moderator); Michael Wraback, Army Research Laboratory, USA; Jian H. Zhao, Rutgers University, USA
16:00-16:10	Concluding Remarks	Brian M. Sadler, Army Research Laboratory, USA; Robert Ulman, Army Research Office, USA

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# A Little History

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- G. L. Harvey, NRL TR, 1964
  - “A survey of ultraviolet communication systems”
- J. A. Sanderson, Applied Optics, 1967
  - “Optics at the Naval Research Laboratory”
- S. E. Sunstein, MIT thesis, 1968
  - Scattering based UV link at 26 km (xenon flashtube, PMT)
  - “A scatter communications link at ultraviolet frequencies”
- D. M. Reilly, MIT thesis, 1976
  - “Atmospheric optical communications in the middle ultraviolet”
- E. S. Fishburne, TR, Aeronautical Res. Assoc., TR, 1976
- J. J. Puschell, Proc. Tactical Comm. Conf., 1990
  - 400 kHz LAN, 265 nm, mercury-xenon lamp
- Z. Xu, B. Sadler, “Ultraviolet Communications: potential and state-of-the-art” (IEEE Comm Magazine, May 2008)

Many decades of R&D – are we there yet?



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