



New Mexico Highlands University
Morehouse College
Georgia Institute of Technology



Light Matter Interactions: Theory and Applications (LMITA)

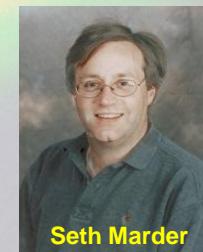
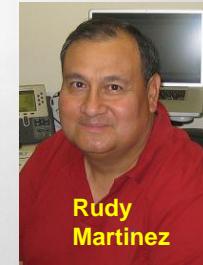
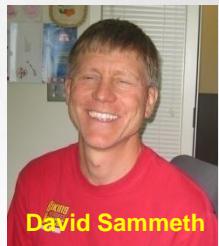


Greetings from
NMHU President
Dr James Fries





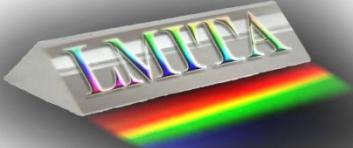
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Transformative research – from idea to application

- Biophotonic materials
- Crystalline NLO/EO materials
- Photovoltaic organic materials





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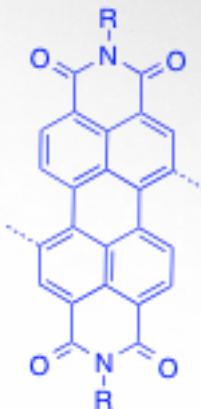


Marder Group - Georgia Tech Center for Organic Photonics and Electronic (COPE) & School of Chemistry and Biochemistry

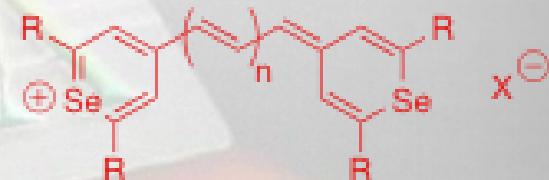
Design and synthesis of organic materials and surface-modifiers for electronic and photonic applications including:

- light-emitting diodes, photovoltaics, field-effect transistors, capacitors
- all-optical switching, optical power limiting

Extensive collaboration on characterization and device work within COPE, CMDITR, and beyond; crystallography collaborations with NMHU

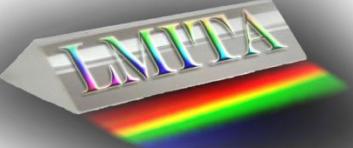


perylene diimides – crystalline, liquid-crystal, and polymeric derivatives can show high electron mobilities useful in field-effect transistors



selenopyrylium-terminated polymethine dye with promising linear and nonlinear properties for all-optical switching





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The Marder Group

• **Organic Electronics:** novel compounds as charge transporting materials for

- Light Emitting Diodes (LED)
- Photovoltaics (OPV)
- Field-Effect Transistors (FET)

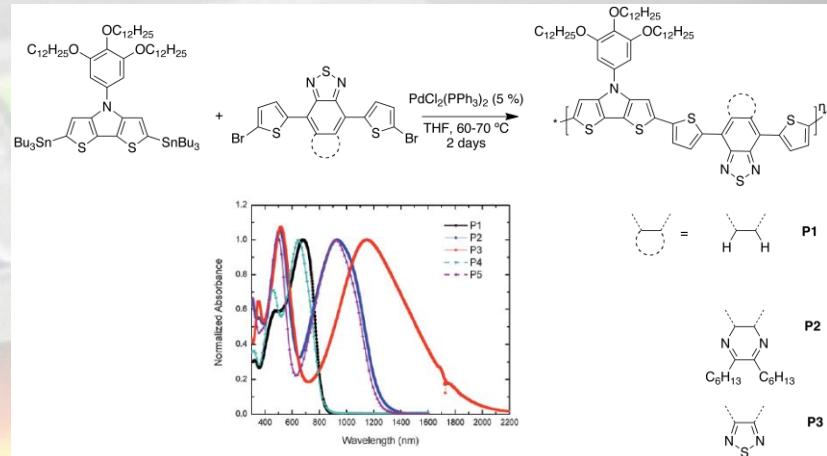
• **Nonlinear Optics:** synthesis of dyes with large two-photon absorption cross sections for applications in:

- Optical Limiting
- All-Organic Switching

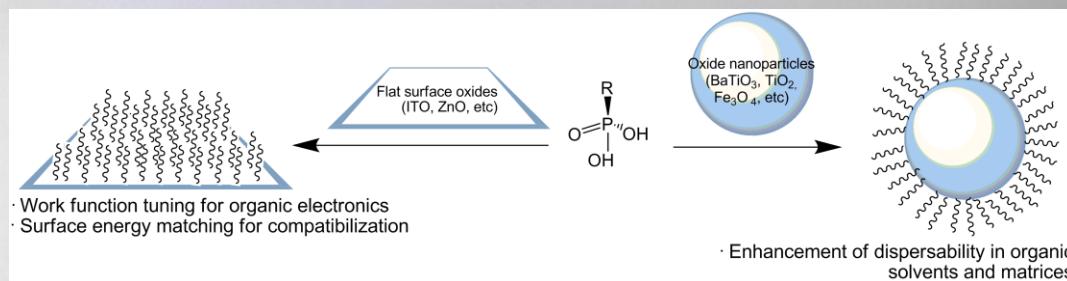
• **Surface Modification by**

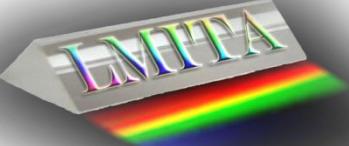
- Phosphonic Acids (PA's)
- Dendritic Growth of Amino Groups for application in electronics, biosensors and thermochemical nanolithography

Example of the synthesis of the low band gap conjugated polymers as semiconductors in OPV



Modification of oxide nanoparticles and flat surfaces with PA's



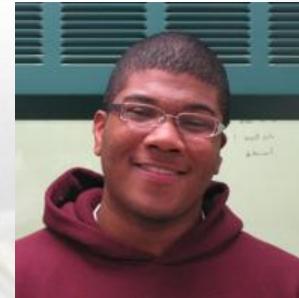


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Starting with the team of undergraduate researchers pictured, we have begun the exploration of new methods for the synthesis of conjugated π polymers as electron acceptor materials using the building blocks shown. Our reaction development focuses on:

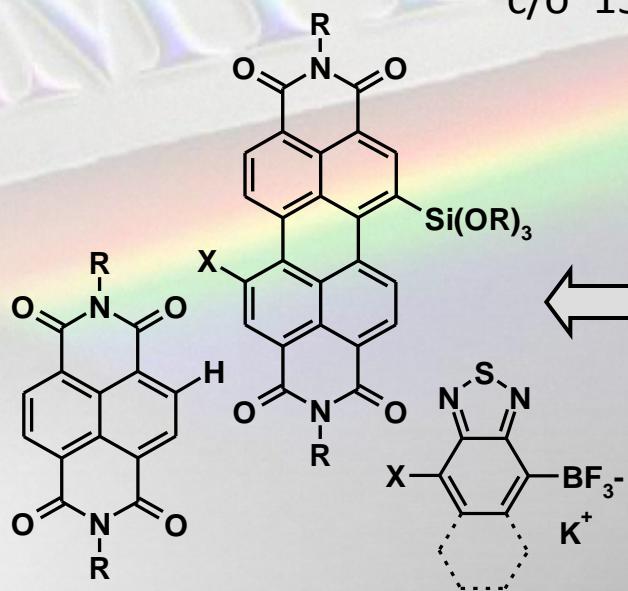
- Introduction of new organometals as coupling reagents to simplify purifications (i.e. organosilanes or perfluoroborate)
- Affecting the direct C-H arylation of coupling partners to electronically-activated and/or deactivated chromophores



Wallace Derricotte
c/o '13



Akil Foluke
c/o '10



New Functional
Materials for Organic
Photovoltaic Devices



Yulia Getmanenko, GATech

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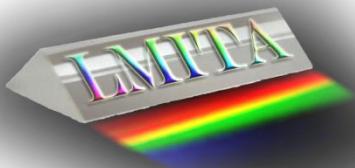
The main goal of this project is to develop solution processable electron-transporting oligomers for efficient air stable organic field-effect transistors (OFET). A convenient synthetic method for the preparation of key intermediates , dihalides 3a-d suitable for cyclization, was developed and mono- and dicarbonyl-fused tricycles 4 with different R¹ groups are under investigation as electron-transporting materials.



Paul Tongwa, NMHU

Organic Letters – Published on Line, April 2010

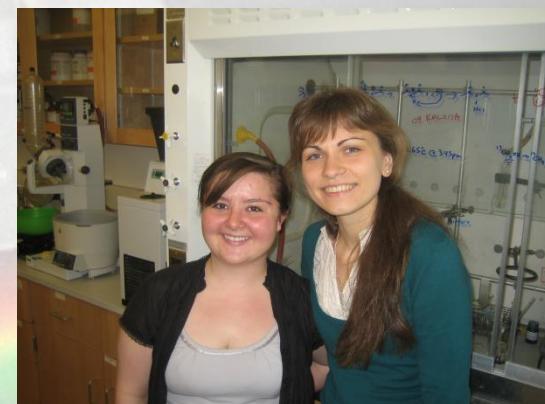
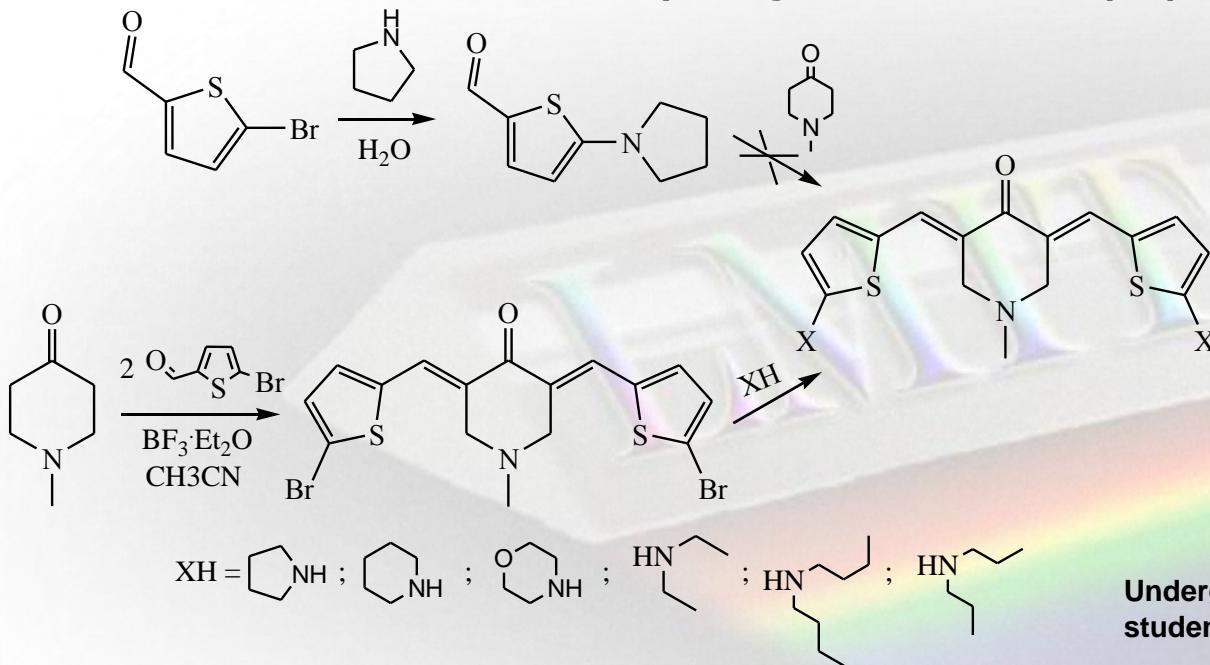
"Base-Catalyzed Halogen Dance Reaction and Oxidative Coupling Sequence as a Convenient Method for the Preparation of Dihalo-Bis-Heteroarenes" Getmanenko, Yulia; Tongwa, Paul; Timofeeva, Tatiana; Marder, Seth



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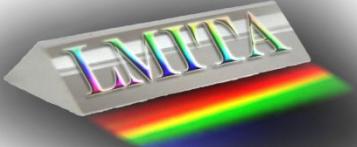


The synthesis of the **3,5-bis[(hetero)arylidene]-4-piperidones** presents interest due to high antiviral and antitumor activity along with fluorescent properties.

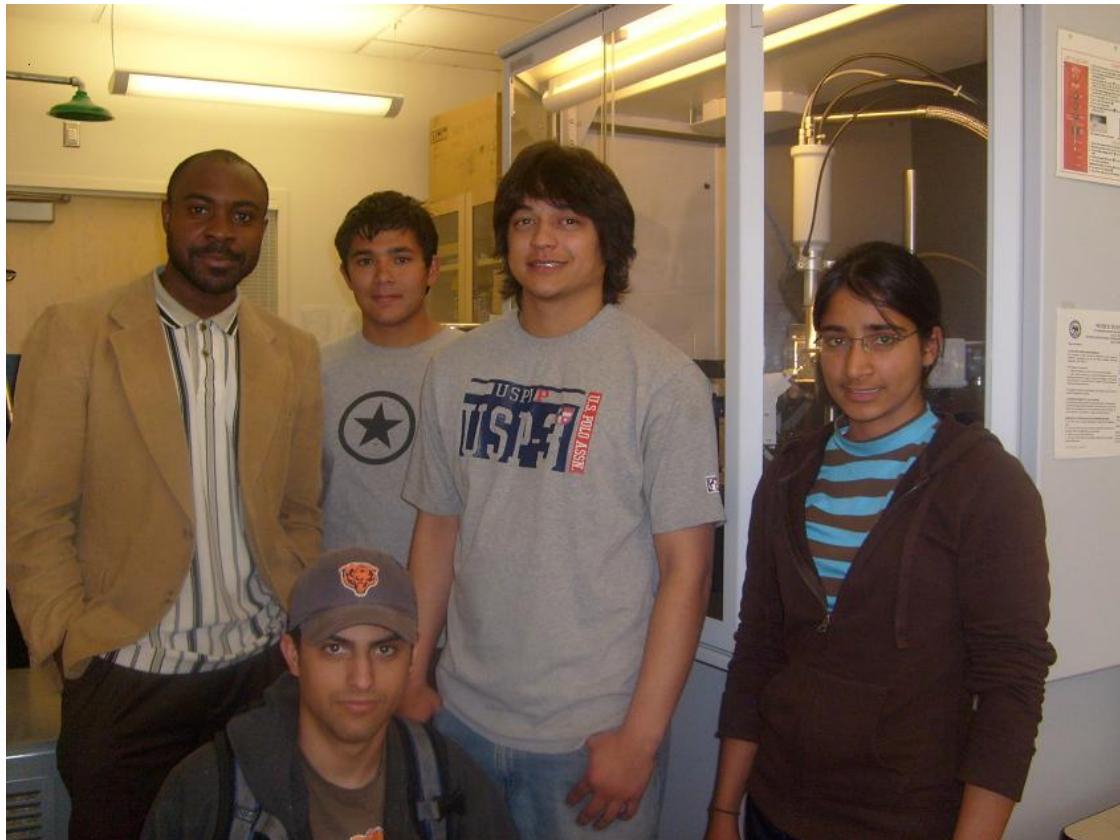


Undergraduate student Rachel Lucero and graduate student Evgenia Leonova working on the project

The general aim is to find mild and effective synthetic route for the synthesis of the E,E-3,5-bis(thienylidene)piperid-4-ones bearing amino-substituents, that will be tested as materials for photodynamic therapy.

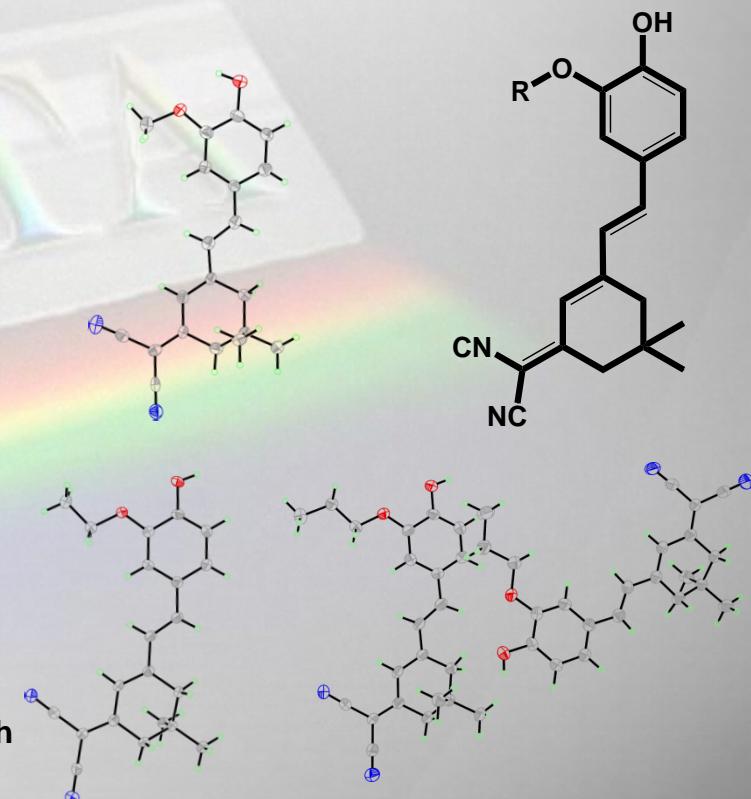


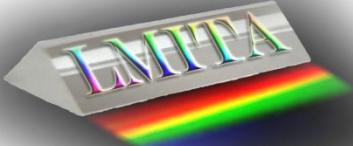
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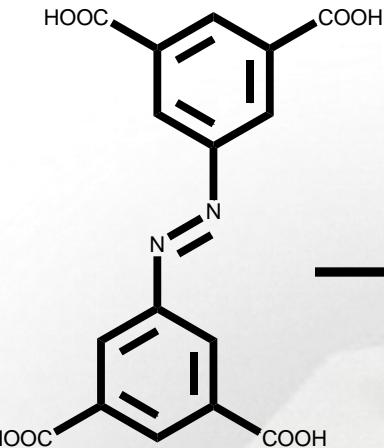
Researcher Paul Tongwa with group of undergraduate students: Joseph Torres, Joel Zazueta, Bhupinder Sandhu and Isaiah Otero

Structural characterization of non-liner optical molecules synthesized at Prof. Dalton group at University of Washington.



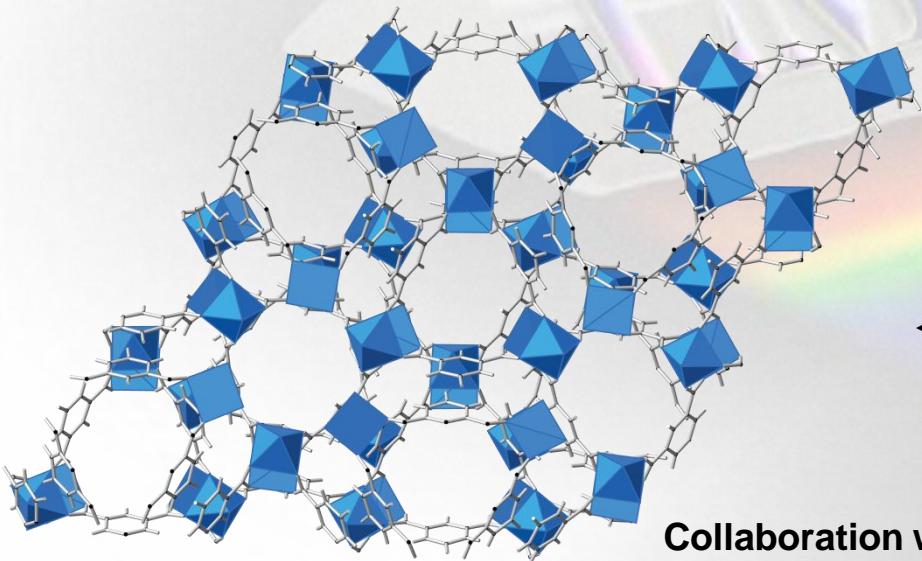
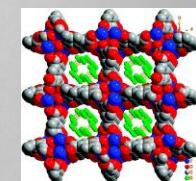
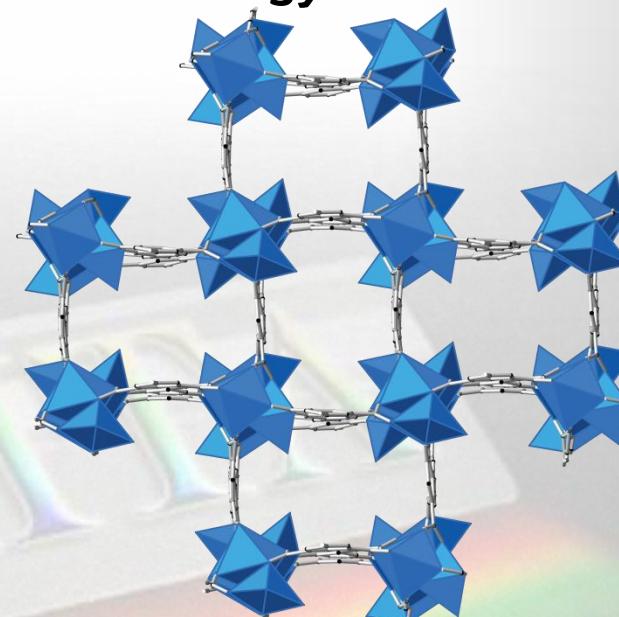


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$\text{Cd}(\text{NO}_3)_2$

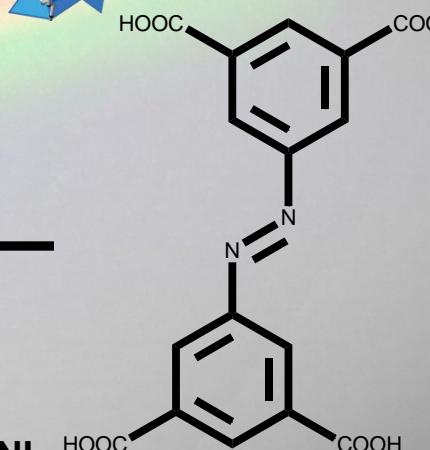
DMF

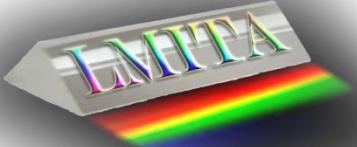


$\text{Zn}(\text{NO}_3)_2$

DMF

Collaboration with Dr. Junhua Luo, LANL

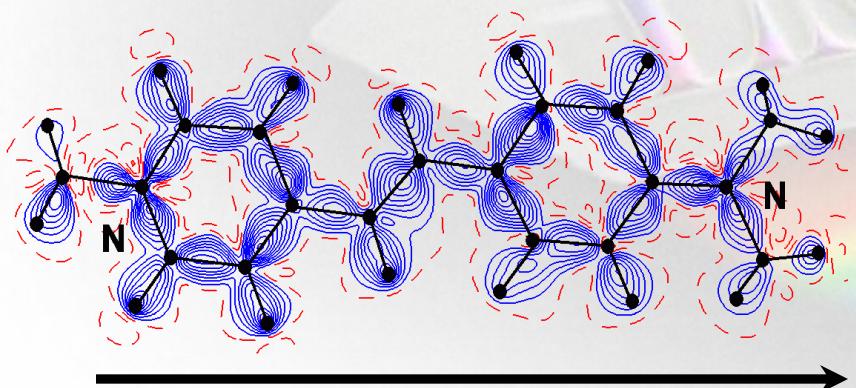
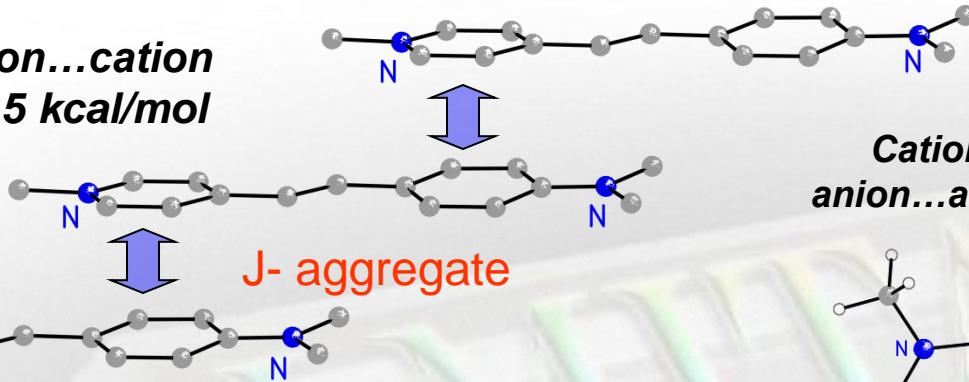




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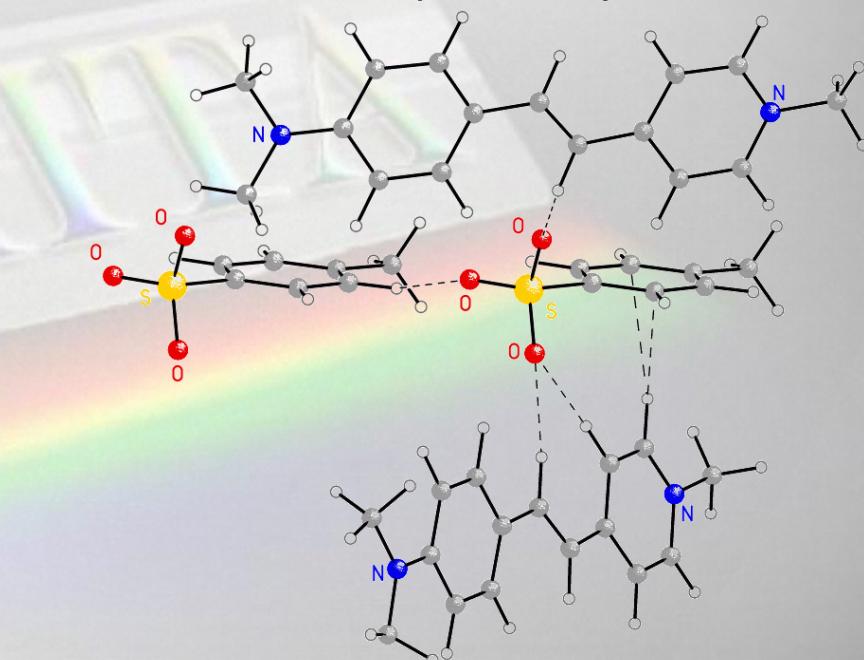
Energy of cation...cation interactions 7.5 kcal/mol



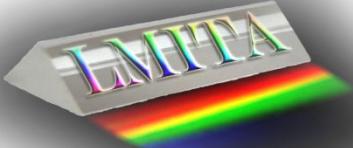
7.9 D in the crystal (X-ray data)

8.2 D in the isolated cation (CAM-B3LYP)

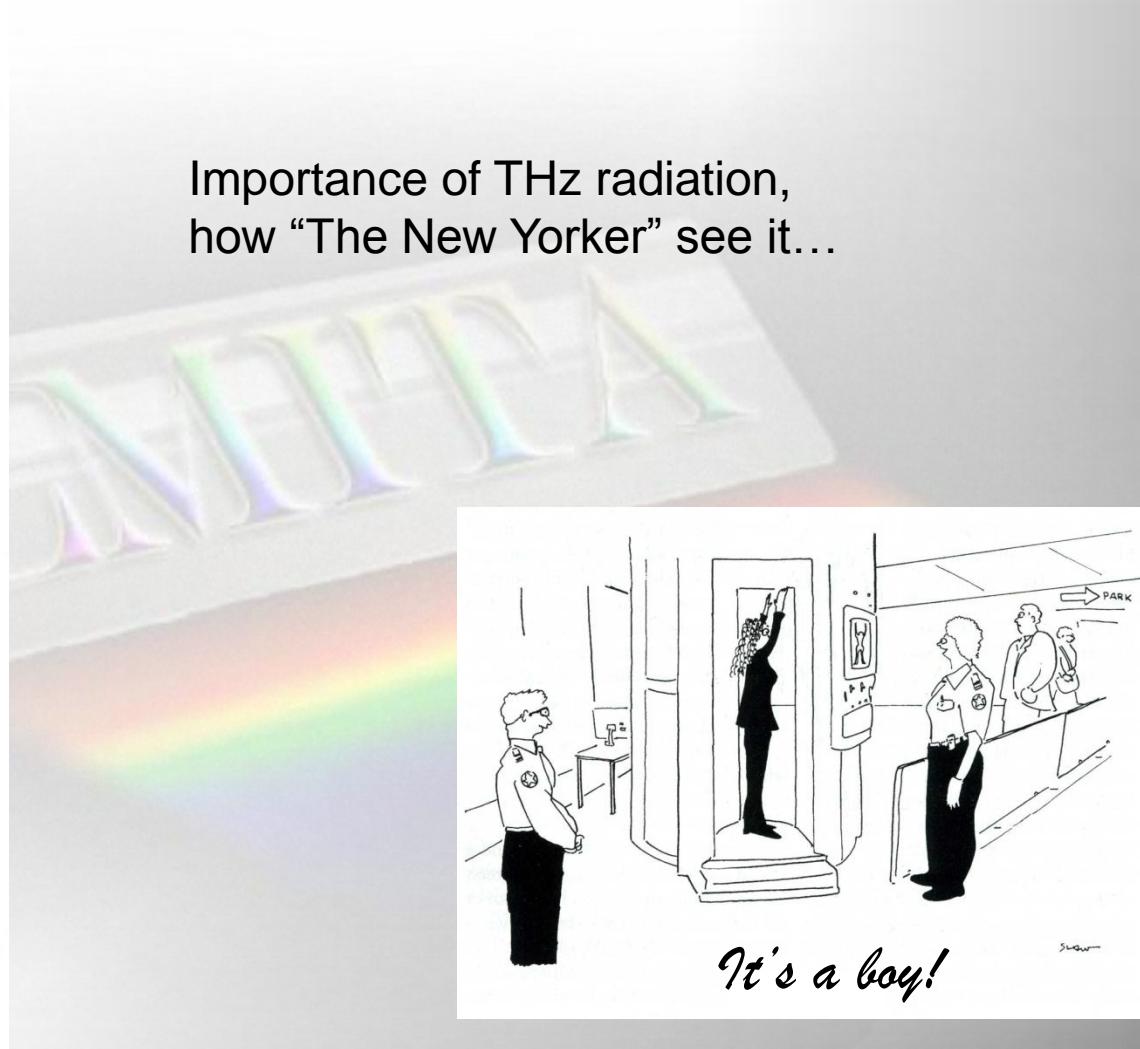
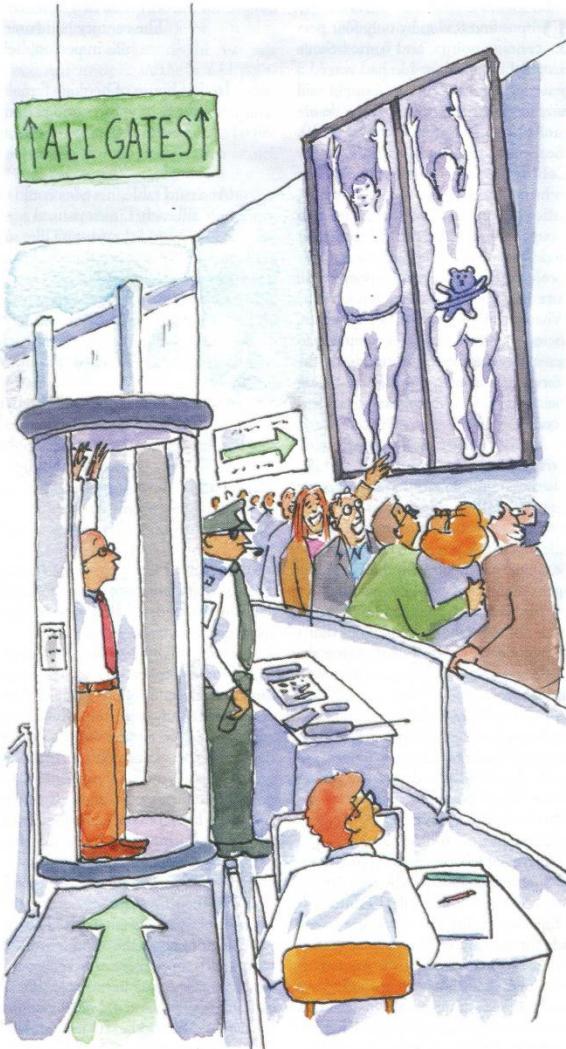
Cation...anion (17 kcal/mol) and anion...anion (2 kcal/mol) interactions

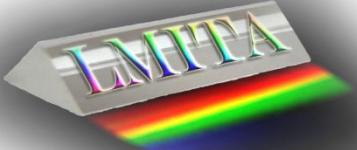


The charges of cation and anion in the crystal of DAST are 0.87(2) and -0.87(2)e

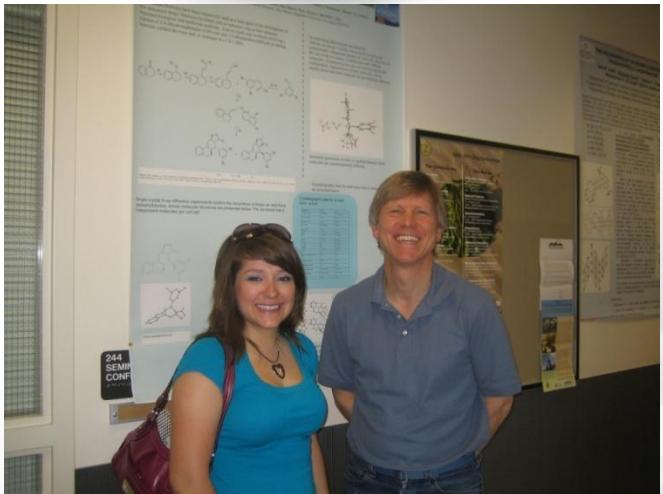


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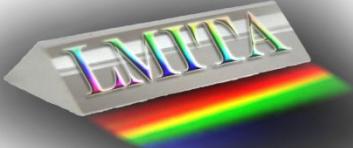


Undergraduate student Sarah Espinoza and Prof. David Sammeth discuss plans for summer.

Plans for summer:

Train students on the spectroscopic characterization of prospective compounds for photodynamic therapy. This will include: lifetime, quantum yield, UV- Vis absorption and two-photon cross-section measurements

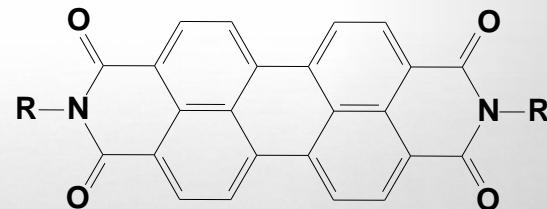
Summarize and publish work on current TPA compounds that have been synthesized, characterized both structurally and spectroscopically.



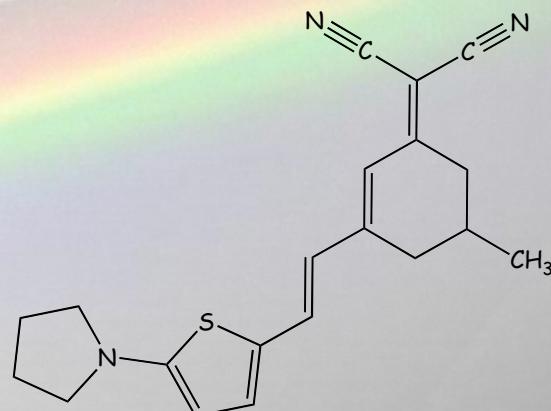
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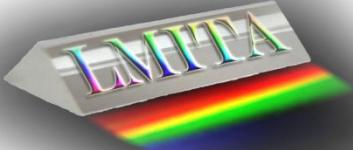


Dr. Rodolfo Martinez's group will be using stable-isotope labeling in order to optimize synthetic sequences of electron-acceptor materials for photovoltaic organic materials.



Graduate students Crystal Rae Ulibarri and Carlos Herrera involved in synthesis of NLO materials at Martinez group.

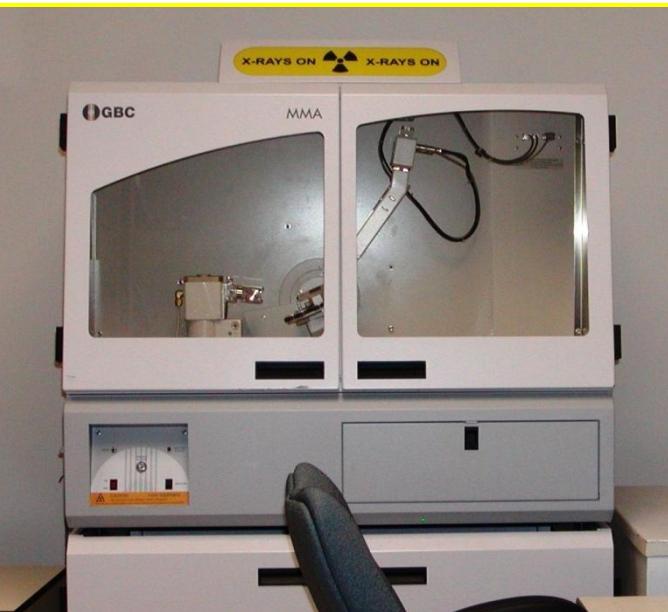




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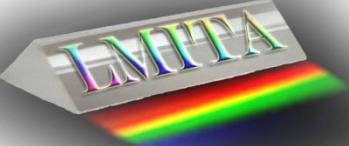
Powder X-Ray Diffractometry



- *Evaluating the stability of lanthanide compounds in acid media*
- *Evaluating the intermolecular interactions in crystals*
- *Characterizing crystalline materials for nonlinear optical and electro-optical applications*



Prof. Jennifer Lindline and graduate student Scott Valdez discussing thesis defense plans.

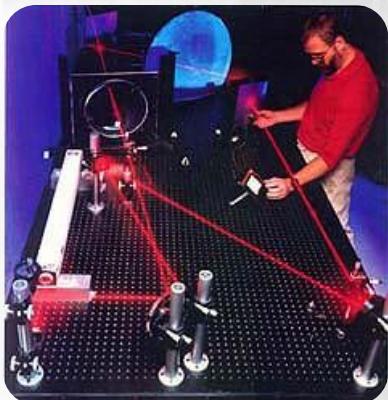


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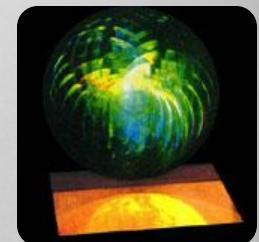
PREM website building

Computer science group who worked on PREM website (from left to right):
Dr. Gil Gallegos, Lina Skinner, Kamal Davis



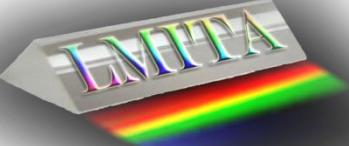
Fred Unterseher and Rebecca Deem's Holography Class

The course addresses topics in analog/digital holography. Topics to be discussed include transmissive, reflective and digital holographic techniques. Additionally, students will learn about the nature of light (wavefront reconstruction) and optical bench tools/techniques. Students will develop several analog holograms and be introduced to digital holographic principles using Matlab.

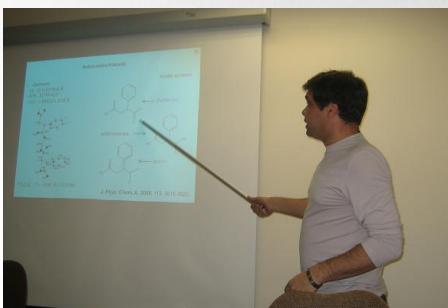


Department of Energy Faculty Student Teams Summer Research at Sandia National Laboratories

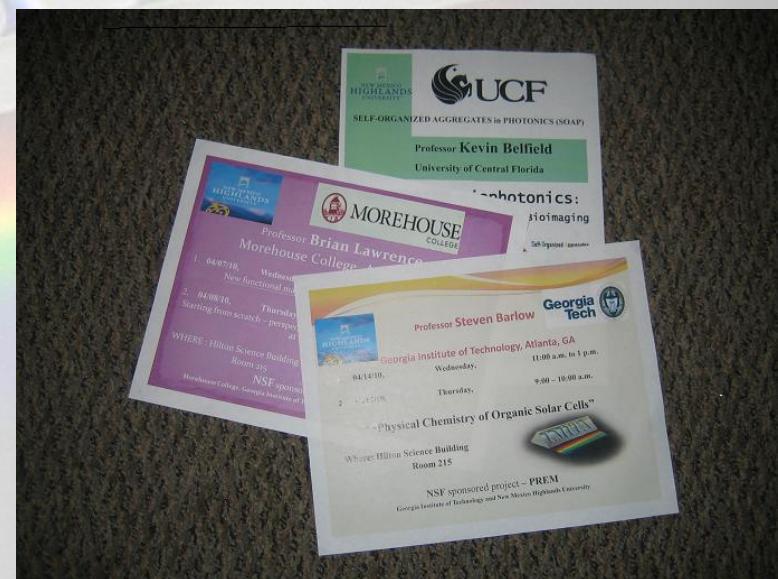
NMHU CS students, Michael Salazar and Jeffrey Thornton, will be mentored by SNL staff scientist Wendy Amai and NMHU CS faculty member, Gil Gallegos, in the areas of embedded systems design/implementation, robotic system design/control and sensor/actuator identification/testing. These students will be learning to design and deploy robotic systems used for national security.

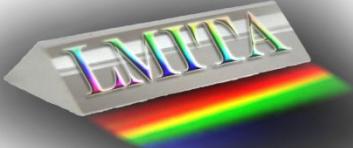


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Invited lecturers:
Prof. Kevin Belfield (UCF)
Prof. Brian Lawrence (MC)
Prof. Konstantin Lyssenko (RAN)
Prof. Stephen Barlow (GATech)
Prof Artem Masunov (UCF)





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Some data

Publications:

4 publications in peer-reviewed journals, 1 accepted paper

Presentations:

ACS regional meeting at El Paso, October 2009 – 5

MDITR retreat, Seattle, February 2010 – 2

NMHU Research Day, April 2010 – 3

Summer internship:

University of Washington – 2

University of Central Florida – 2

Georgia Institute of Technology – 1

Sandia NL – 2

Demographics:

Hispanic – 8, African American – 2, Asian – 4, White – 3;

Undergrad – 10; Graduate – 7; M – 7; F – 10



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FUTURE PLANS

Fall Lectures series

GA Tech Partners

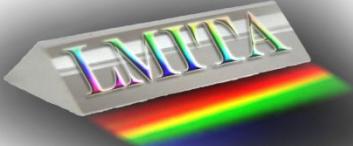
Seth Marder
Jan-Luc Breda
Joe Perry
Keith Oden

UTEP

Keith Pannell
Carl Dirk

Ambitious goal ---

To teach students to present their results in form of publication in peer reviewed journals.

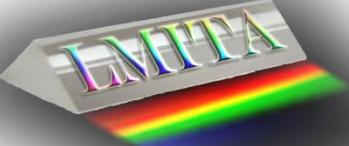


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Thank you very much for your attention

Many thanks to NSF people for organization of this meeting



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Success Story

Tiffany Kinnibrugh

Sophomore Math NMHU 2003
BS Math/Chem NMHU 2004
MS Chem NMHU 2007
PhD Candidate TAMU 2010

2 Summers at UW
2 Summers at Sandia NL
1 summer at Russian Ac. Sc.

5 Papers in ACS journals
NMHU/GATech

1 Paper with Sandia NL

2 Papers with UW



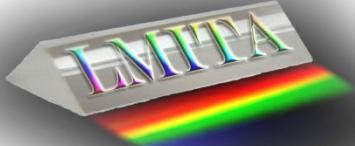
MDITR Retreat, University of Arizona, Tucson, February 2006

Jose Gallegos

Sophomore Envir. NMHU 2003
BS Envir/Chem NMHU 2008
MS Envir. program at NMTech

Summer at UW

Paper in ACS journal
NMHU



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Integration of research and education

In Chemistry, Physics, Biology, and many other disciplines

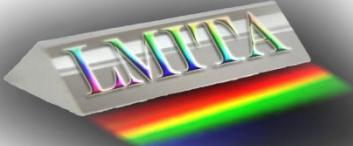
RESEARCH=EDUCATION=RESEARCH

Research gives knowledge which are not in the textbooks

Presentations

Publications

**Way to self-esteem -
Not always to high salary
And quality time**



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Everybody's impacts are very welcomed !

- [**Base-Catalyzed Halogen Dance Reaction and Oxidative Coupling Sequence as a Convenient Method for the Preparation of Dihalo-bisheteroarenes**](#)
 - Yulia A. Getmanenko, Paul Tongwa, Tatiana V. Timofeeva and Seth R. Marder
 - *Org. Lett.*, Articles ASAP (As Soon As Publishable)
- [**Electronic Properties of the 2,6-Diododithieno\[3,2-*b*:2',3'-*d*\]thiophene Molecule and Crystal: A Joint Experimental and Theoretical Study**](#)
 - Roel S. Snchez-Carrera, Susan A. Odom, Tiffany L. Kinnibrugh, Tissa Sajoto, Eung-Gun Kim, Tatiana V. Timofeeva, Stephen Barlow, Veaceslav Coropceanu, Seth R. Marder and Jean-Luc Brdas
 - *J. Phys. Chem. B*, **2010**, 114 (2), pp 749–755
- [**Porous Metal–Organic Frameworks Containing Alkali-Bridged Two-Fold Interpenetration: Synthesis, Gas Adsorption, and Fluorescence Properties**](#)
 - Ruqiang Zou, Amr I. Abdel-Fattah, Hongwu Xu, Anthony K. Burrell, Toti E. Larson, Thomas M. McCleskey, Qiang Wei, Michael T. Janicke, Donald D. Hickmott, Tatiana V. Timofeeva and Yusheng Zhao
 - *Crystal Growth & Design*, **2010**, 10 (3), pp 1301–1306
- [**Alkynylated Aceno\[2,1,3\]thiadiazoles**](#)
 - Anthony Lucas Appleton, Shaobin Miao, Scott M. Brombosz, Nancy J. Berger, Stephen Barlow, Seth R. Marder, Brian M. Lawrence, Kenneth I. Hardcastle and Uwe H. F. Bunz
 - *Org. Lett.*, **2009**, 11 (22), pp 5222–5225