

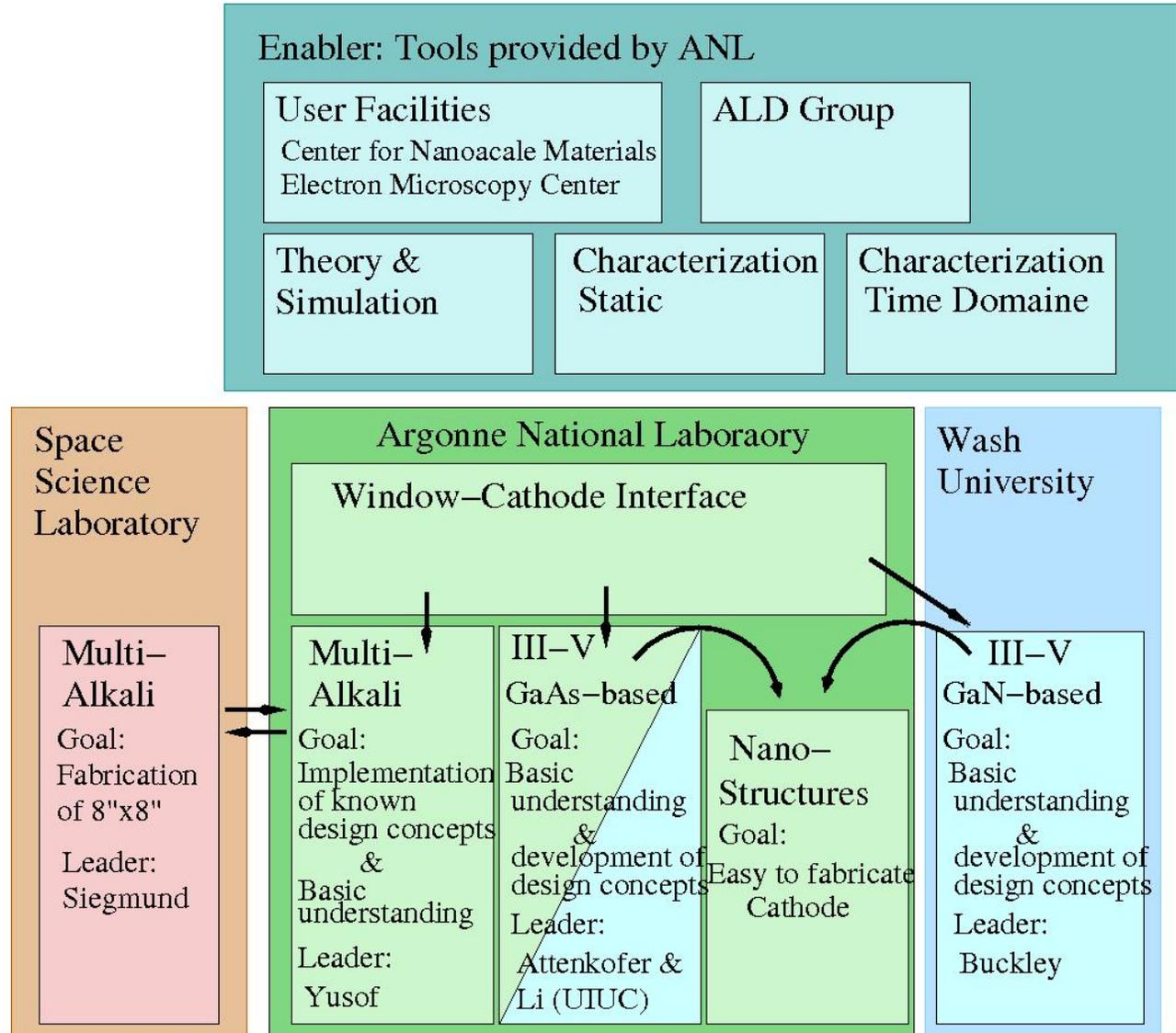
Organizational overview: Group, Collaborators, Existing and Required Resources

Klaus Attenkofer

Bernhard Adams, **Kathleen Broughton***, Matthieu Chollet, **Ryan Dowdy***, Ernesto Indacochea, **Zeke Insepov***, **Slade Jokela***, Xiuling Li, **Anil Mane***, Qing Peng, Thomas Prolier, **Matthew Wetstein***, Igor Veryovkin, Zikri Yusof, Alexander Zinovov

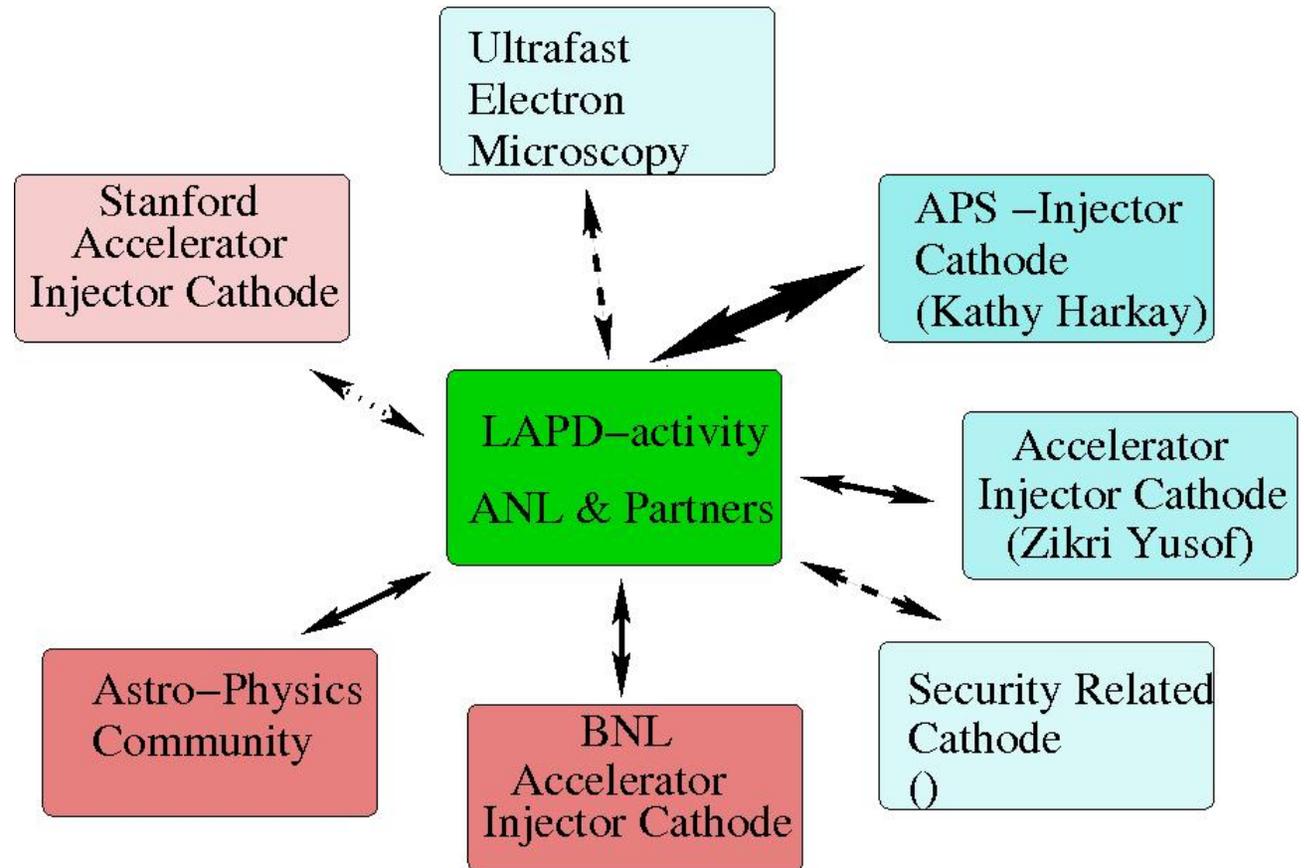
The Structure: Who is Doing What?

- Integration of 4 partners
- Collaboration partners bring:
 - Growth expertise (III-V and multi-alkali)
 - World class growth facilities
 - Standard and unique characterization tools
 - Connection to industry
 - Connection to science community (future funding)
- Unique effort for cathodes
 - Size
 - Completeness (growth, macroscopic and microscopic characterization, theory/simulation)



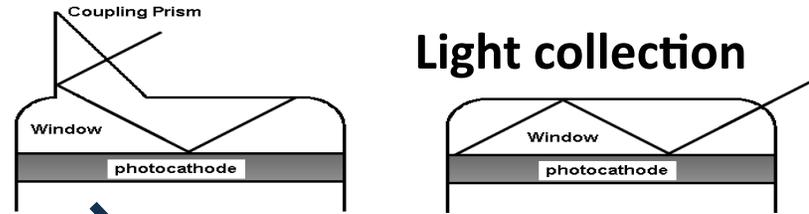
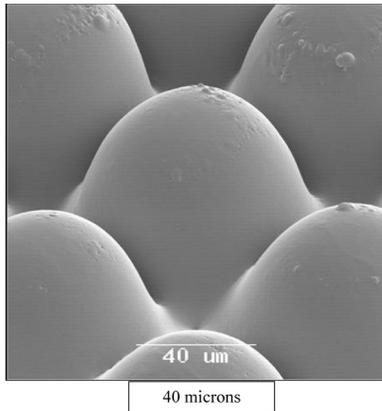
Collaboration Partners & Outreach

- Unique situation: Large need for new cathodes:
 - Accelerators
 - Ultrafast Electron Microscopy
 - Ultrafast detectors
- Collaboration partners have contact to 5 communities
 - Accelerators
 - Electro Microscopy
 - Astro-Physics
 - Homeland Security
 - Synchrotron Sciences
- Good connection to “outside world”



The Goals: What has to be done

Reduction of reflections



Light collection

Anti-reflection coating (air-window)

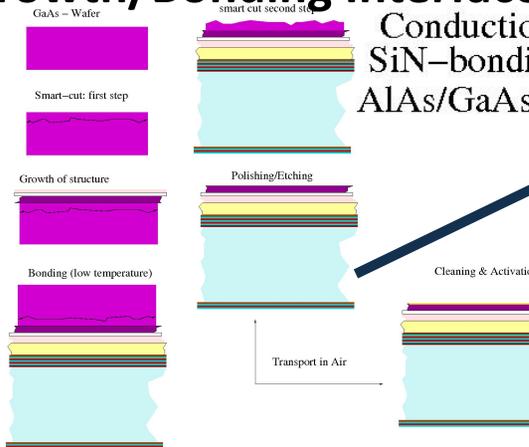
Glass Window

Anti-reflection coating (window-cathode)

Bonding Line

SiO₂-protection layer

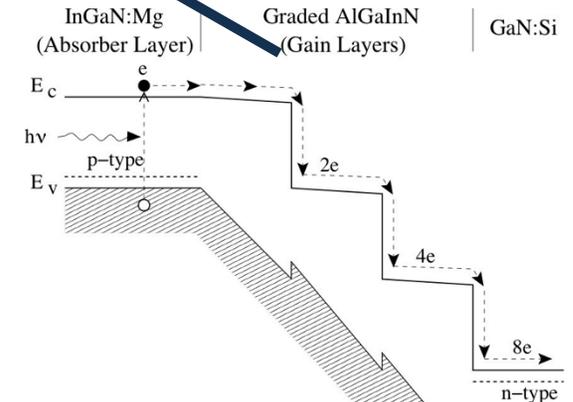
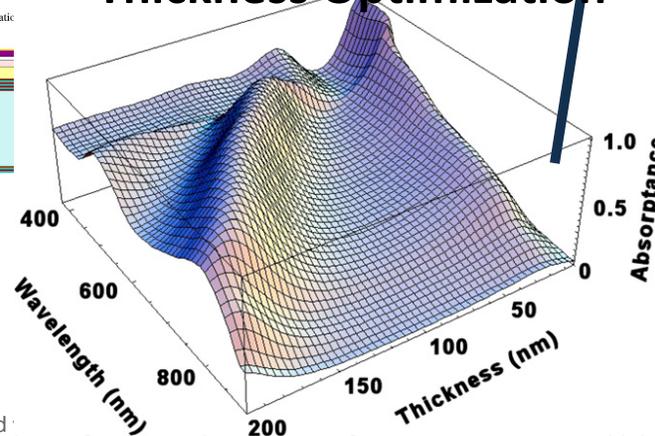
Growth/Bonding Interface



Conduction Layer
SiN-bonding Layer
AlAs/GaAs-Cathode

NEA-layer

Thickness Optimization



Bandstructure Engineering & NEA

Process compatibility (transfer Process)

Go to "Insert (View) | Header and Footer" to add



A Novel Approach in Cathode Development: Fabrication, Characterization, Simulation

Concept
(for example electric field enhancement)

Iteration Process:

Microscopic Theory

Macroscopic modeling of doping concentrations & carrier behavior

Growth of film system

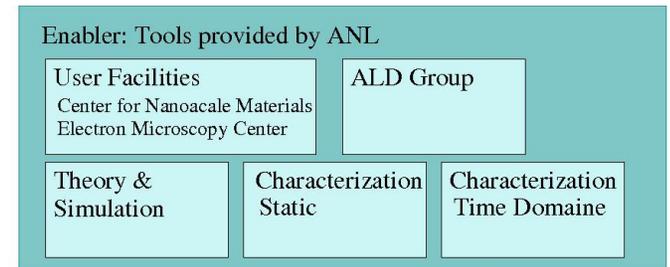
Macroscopic and microscopic

Proof of Concept
(positive or negative and reason why)

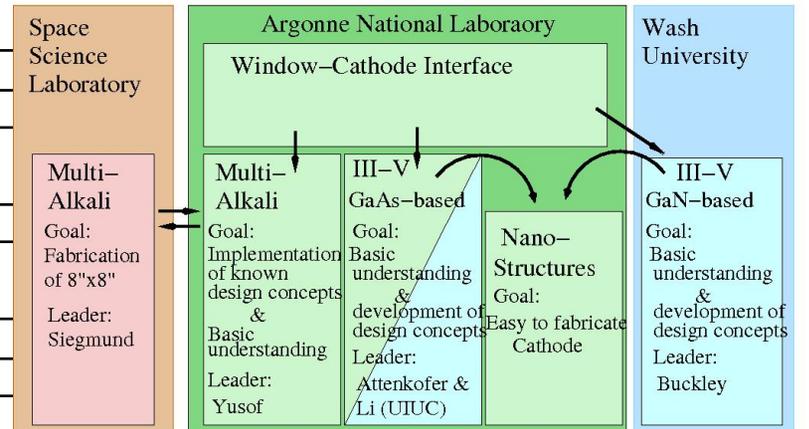


The Existing Group And Funding

Task	Lead Scientist	Student/Postdoc
Characterization/static	Igor Veryovkin	Slade Jokela
Characterization/timing	Bernhard Adams	Matthew Wetstein
ALD coating	Jeff Elam	Anil Mane
Simulation Theory	Zeke Insepov	TBD (not funded)
User facilities	Lead scientist of scientific task	Correlated support person



Task	Lead Scientist	Student/Postdoc
ANL/cathode total	Klaus Attenkofer	30% Alexander Paramonov
ANL/Window-Cathode interface	TBD	Kathleen Broughton
ANL/Multi-Alkali	Zikri Yusof	TBD
ANL/GaAs	Klaus Attenkofer/ Xiuling Li*	Ryan Dowdy (UIUC): growth** Kathleen Broughton: activation
ANL/nano	TBD	TBD
Wash/GaN	James Buckley*	Daniel Leopold (scientific staff)*



M&S: so far about \$25K (Travel & instrumentation)

The required infrastructure

The Minimum Requirement

- Use of existing Growth facilities
- Missing link is Growth/Activation Chamber
- ANL strength is characterization & Theory/Simulation
- III-V samples can be transported on air (not activated)
- Multi-Alkali have to be prepared on site (under instruction from SSL?)



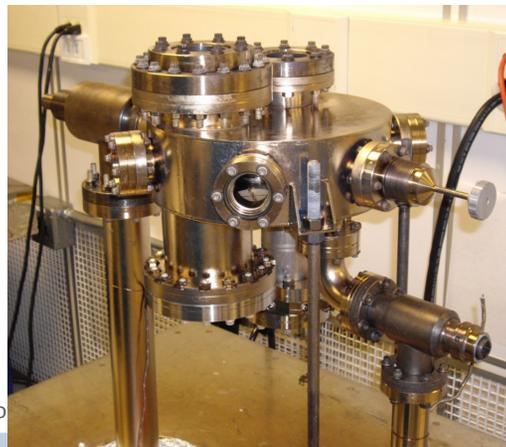
UIUC ↔

GaAs-based



Wash ↔

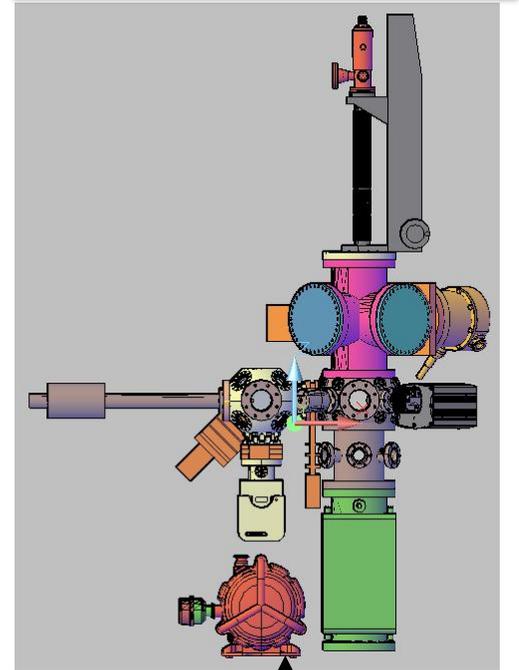
GaN-based



SSL ↔

Multi-Alkali

ANL: Growth/Activation Chamber



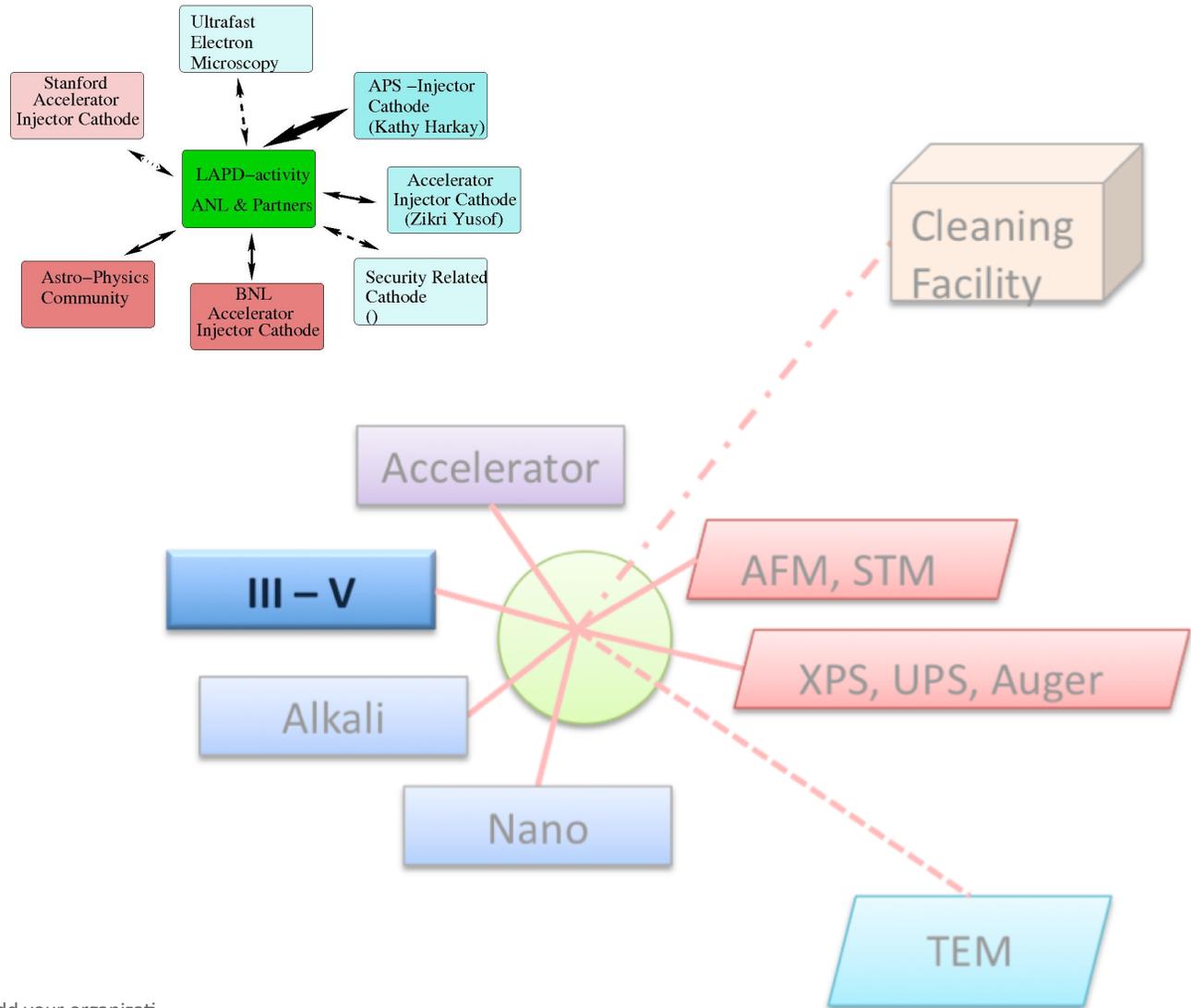
ANL-Characterization & Theory/Simulation



The Required Infrastructure

The Optimum Characterization System

- Cathode village
 - Cluster tool
 - Interface to user facilities
 - Theory/simulation block
 - Link to major growth facilities
- Investments
 - ~\$250K per building block
 - ~0.5-1 Scientist
 - 0.5 technician
 - 0.1 computing
- Benefit
 - Unique facility
 - Serving important community to DOE



Summary

- **Goal:** Novel approach to cathode development (rational design).
- **Structure:** Collaboration with leaders in the field are established.
- **Impact:** Connections to other communities are made.
- **Infrastructure:** Use of existing capabilities possible.
(about \$250K-\$300K necessary investment)

- Creation of a cathode center will
 - Interconnect experts in growth, characterization, and theory/simulation.
 - Cathode program will be comparable to the “large players”.
 - Requires significant investments and integration in lab-structure: M2D2?
 - A national laboratory is the right place.

You have the possibility to form a center, is it necessary?

