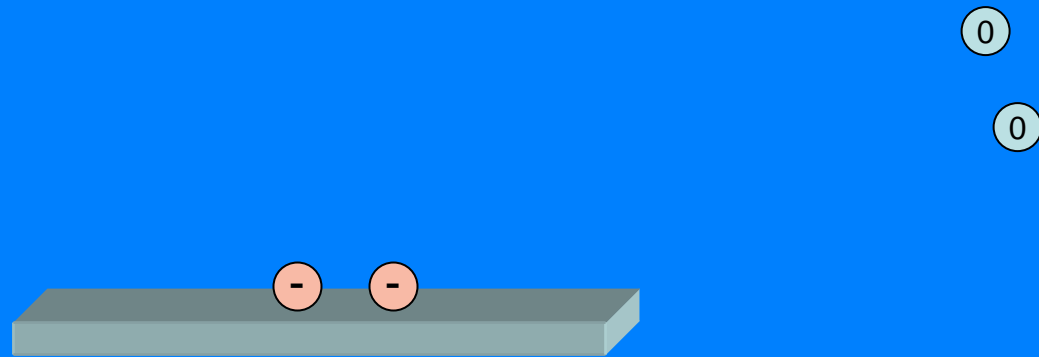


Efficient Detection of Low Energy Neutral Atoms in Space



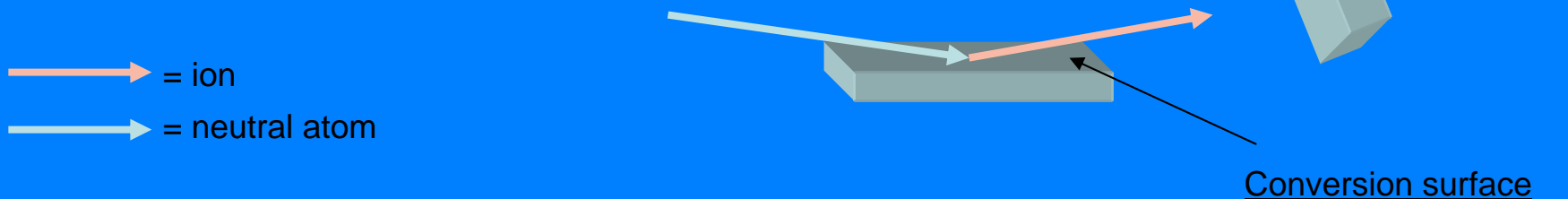
William Zinicola, UNC-W
NASA-GSFC/UMD
Dr. Fred Herrero, GSFC
Dr. Michael Coplan, UMD

Why do We Want to Detect Neutral Atoms

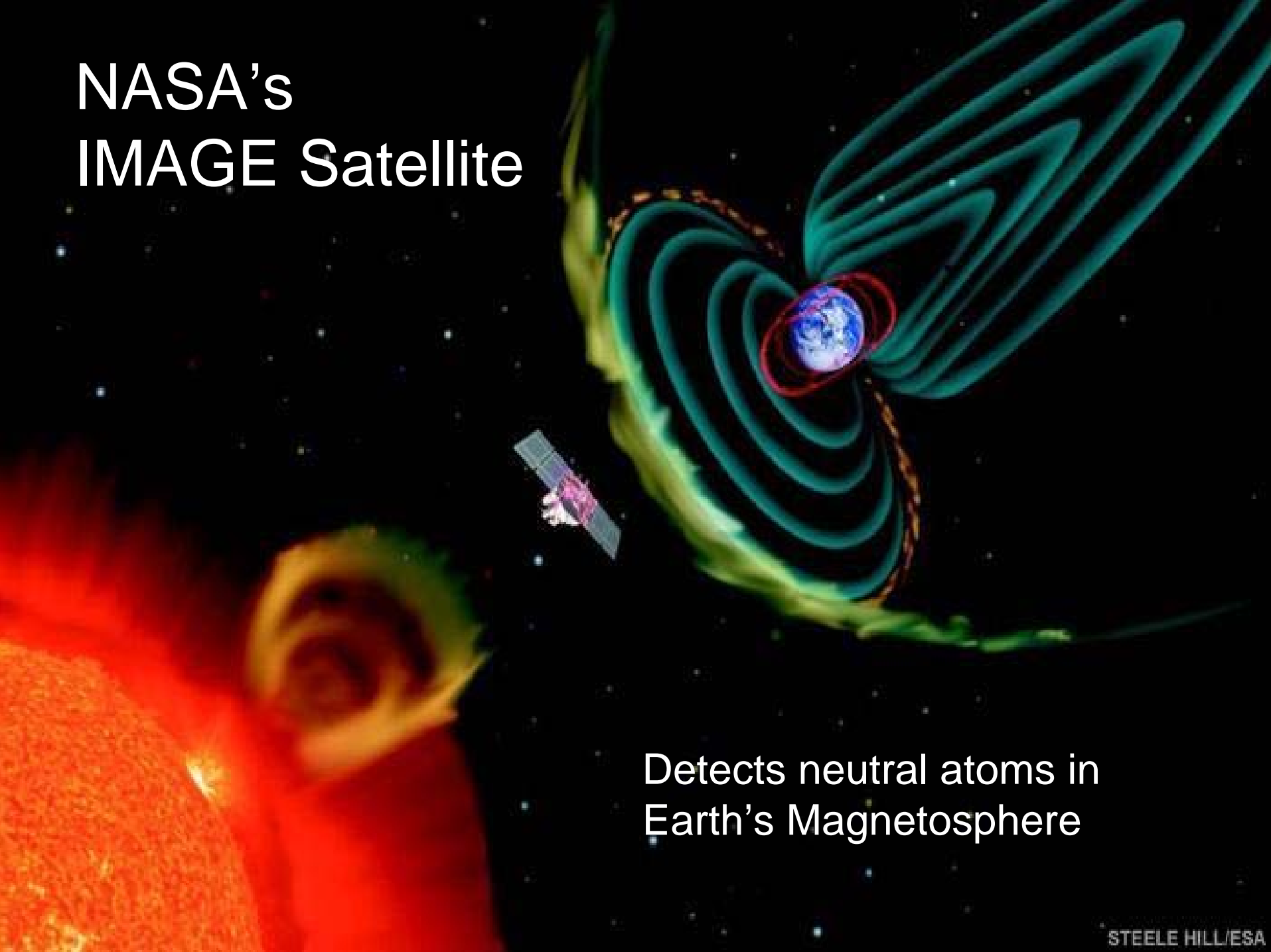
- Neutrals are born from positive ions in a plasma
- Invisible to E&M fields:
 1. remote detection
 2. Global view of system
- Preserve the parent ion's characteristics:
 1. energy
 2. direction
 3. mass

How do We Plan on Detecting Them

- Converting neutrals to negative ions



NASA's IMAGE Satellite



Detects neutral atoms in
Earth's Magnetosphere

Why do We Want to Detect Neutral Atoms

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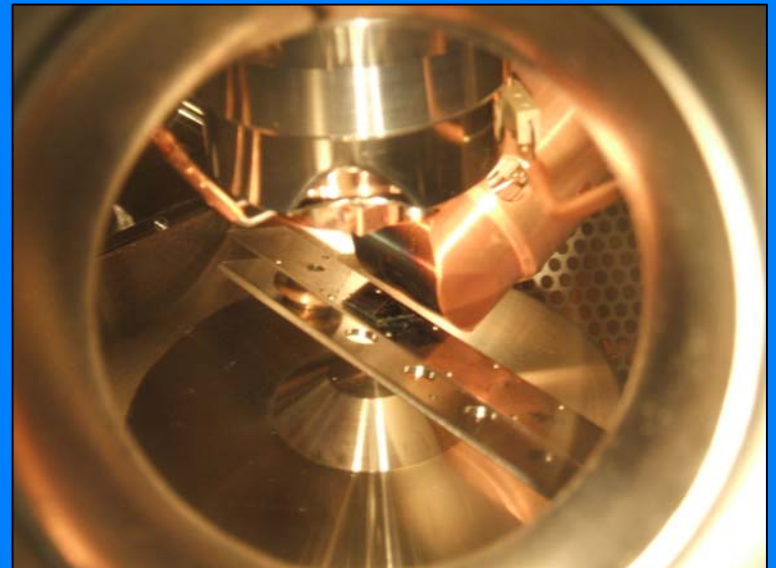
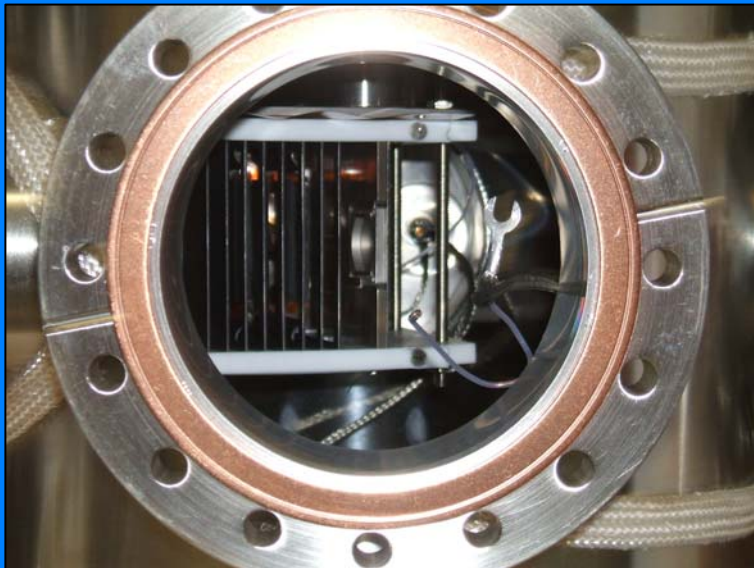
How do We Plan on Detecting Them

- Converting neutrals to negative ions



My Job

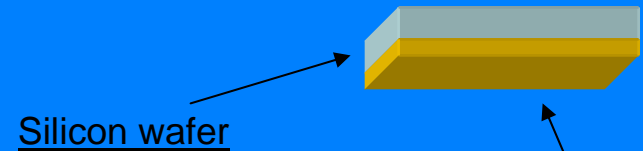
- Fabricate conversion surfaces
- Analyze surface for contaminants using X-ray Photoelectron Spectroscopy
- Find efficient means of removing surface contaminants
- Calculate work function of the surface material using XPS
- Analyze these simple surfaces for a relationship between work function and conversion efficiency



Conversion Surface Selection & Fabrication

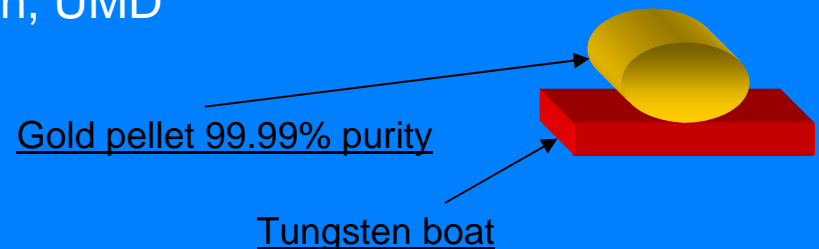
Selection

- We believe ideal conversion surface must have a low work function Gold surface
- Ag, Au, and Pt



Fabrication

- Deposition surface: 1cm x 1cm P-type silicon wafer with 110 orientation
- Deposition source: Ag & Au → Thermal evaporation
Pt → E-beam deposition
- Deposition facility: Nano-Science Department, Kim Engineering Building
Dr. Tom Loughran, UMD



Analysis of XPS Data

Silver Surface

	<u>Ag</u>	<u>C</u>	<u>O</u>
Orig. Comp	88.45%	9.30%	2.25%
Heating	5 MIN	@	110 C
Comp-Heating	100.00%	0.00%	0.00%
Etching	NONE	NONE	NONE

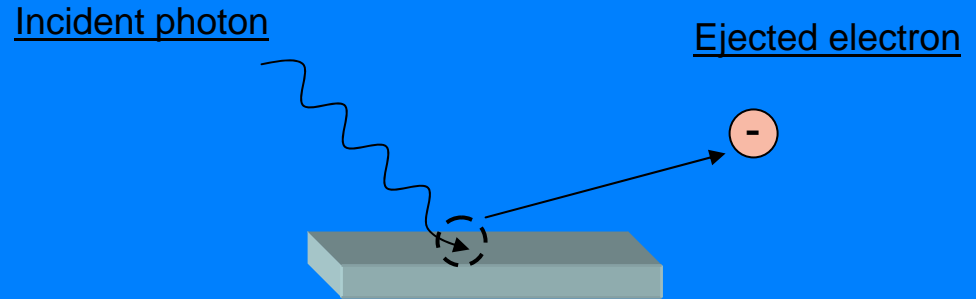
Gold Surface

	<u>Au</u>	<u>C</u>	<u>O</u>
Orig. Comp	78.70%	16.20%	5.10%
Heating	5 MIN	@	130 C
Comp-Heating	100.00%	0.00%	0.00%
Etching	NONE	NONE	NONE

- Heating between 110-130 degrees Celsius for about 5 minutes removes 100% contaminants

Importance of Work Function

$$hf_{\text{photon}} = \Phi + \frac{1}{2}m_e v_e^2$$

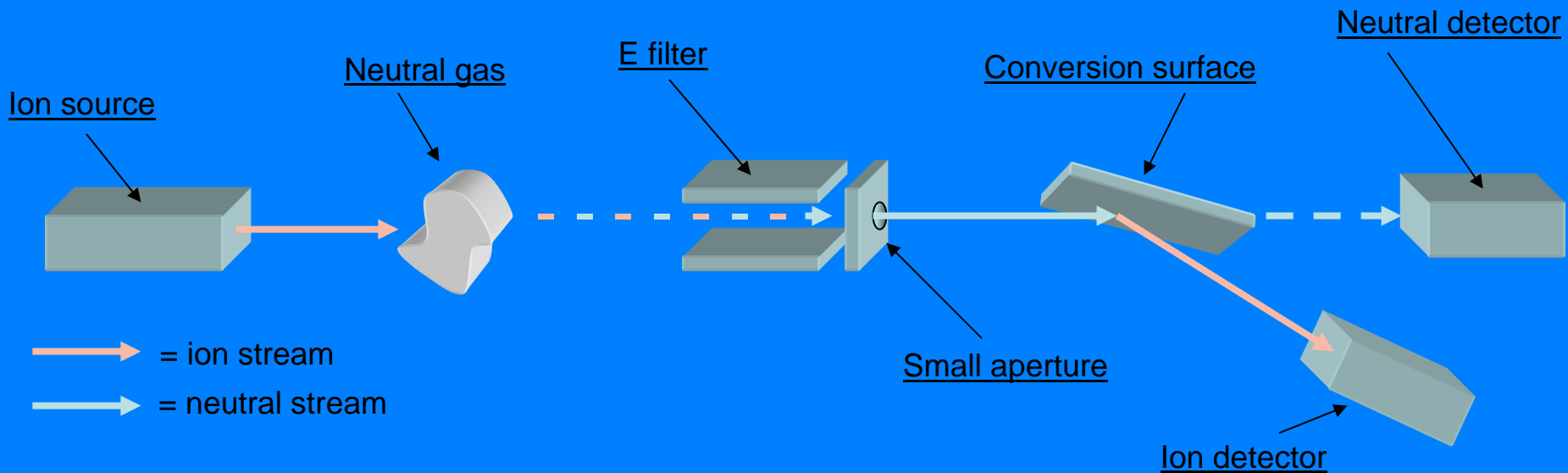


- Work function is a basic physical property of the surface
- Work function \longrightarrow Conversion efficiency

$$\downarrow WF \Rightarrow CE \uparrow$$

Neutral Atom Detection

- Present efficiency is about 0.1%
- Goal is to achieve conversion of LENA's to negative ions that can be analyzed and detected using conventional methods.

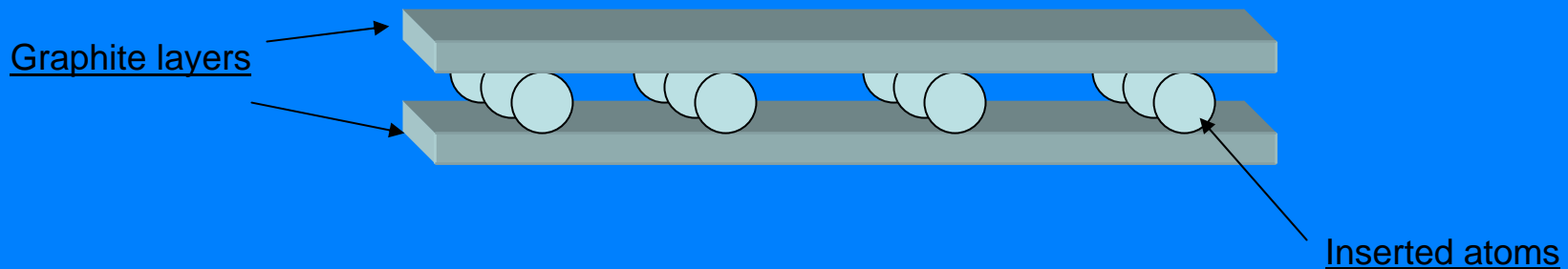


Where Do We Go From Here

- Simple surfaces → Composite surfaces



Intercalated graphite
Dr. Jack Fischer, Univ. of Pa.



A Special Thanks To

- Dr. Michael Coplan, UMD-IPST
- Dr. Fred Herrero, NASA-GSFC
- Dr. Mark Shappairio
- Dr. Bindhu Varughese, UMD-XPS
- Dr. Tom Loughran, UMD-Nano-Science
- Dr. Jack Fischer, U-Penn-Intercalated Graphite
- Patrick Hughes, UMD-Grad. Student
- Ed Cole, UMD-Student Shop
- Liz Dart Caron, AIP
- Dr. Gary White, AIP

