

# 2008 Solar Annual Review Meeting

**Session: PDIL/CIGS platform**  
**Company or Organization: NREL**  
**Funding Opportunity: EE&RE**

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## Design Team

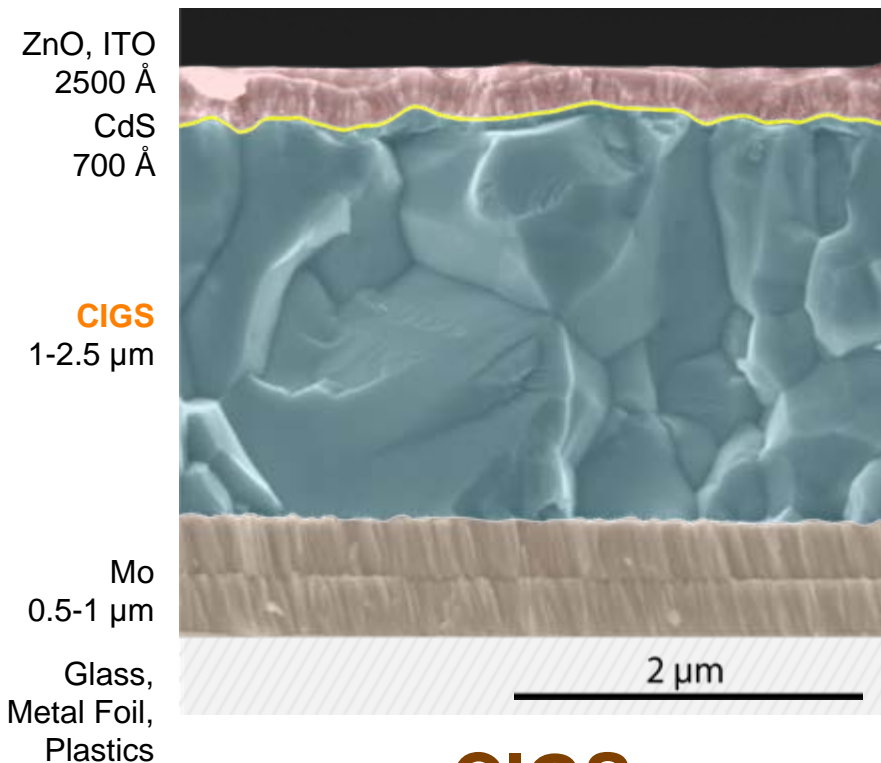
Miguel Contreras (leader), Rommel Noufi,  
Brent Nelson, Steve Robbins  
Glenn Teeter, Tim Gessert

## Input/support from:

Dean Levi, Brian Keyes, Sally Asher, Craig Perkins,  
Aaron Ptak,

Kannan Ramanathan, David Young, Fallah Hasoon,  
Jehad Abushama, Ingrid Repins

# The CIGS cell and its processing



**CIGS**

- layer 1: DC sputtering for back contacts
- layer 2: UHV CIGS evaporation
- layer 3: RF sputtering for “window” layers (CdS, ZnS, others)
- layer 4 : RF sputtering for TCO’s
- metallization or top contacts + AR coatings

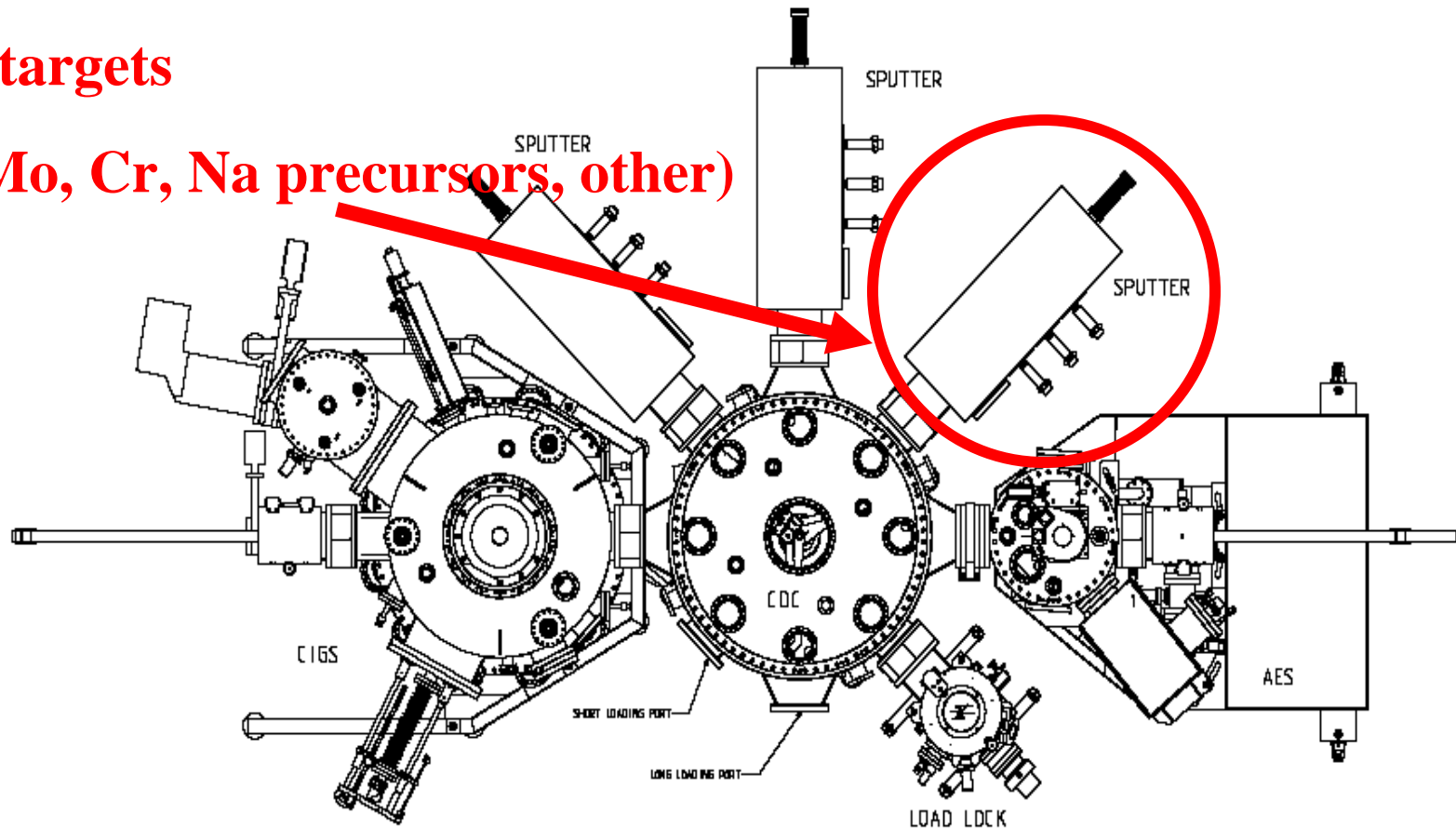
# The CIGS Cluster Tool 1



**Back Contacts by DC sputtering**

**3 targets**

**(Mo, Cr, Na precursors, other)**

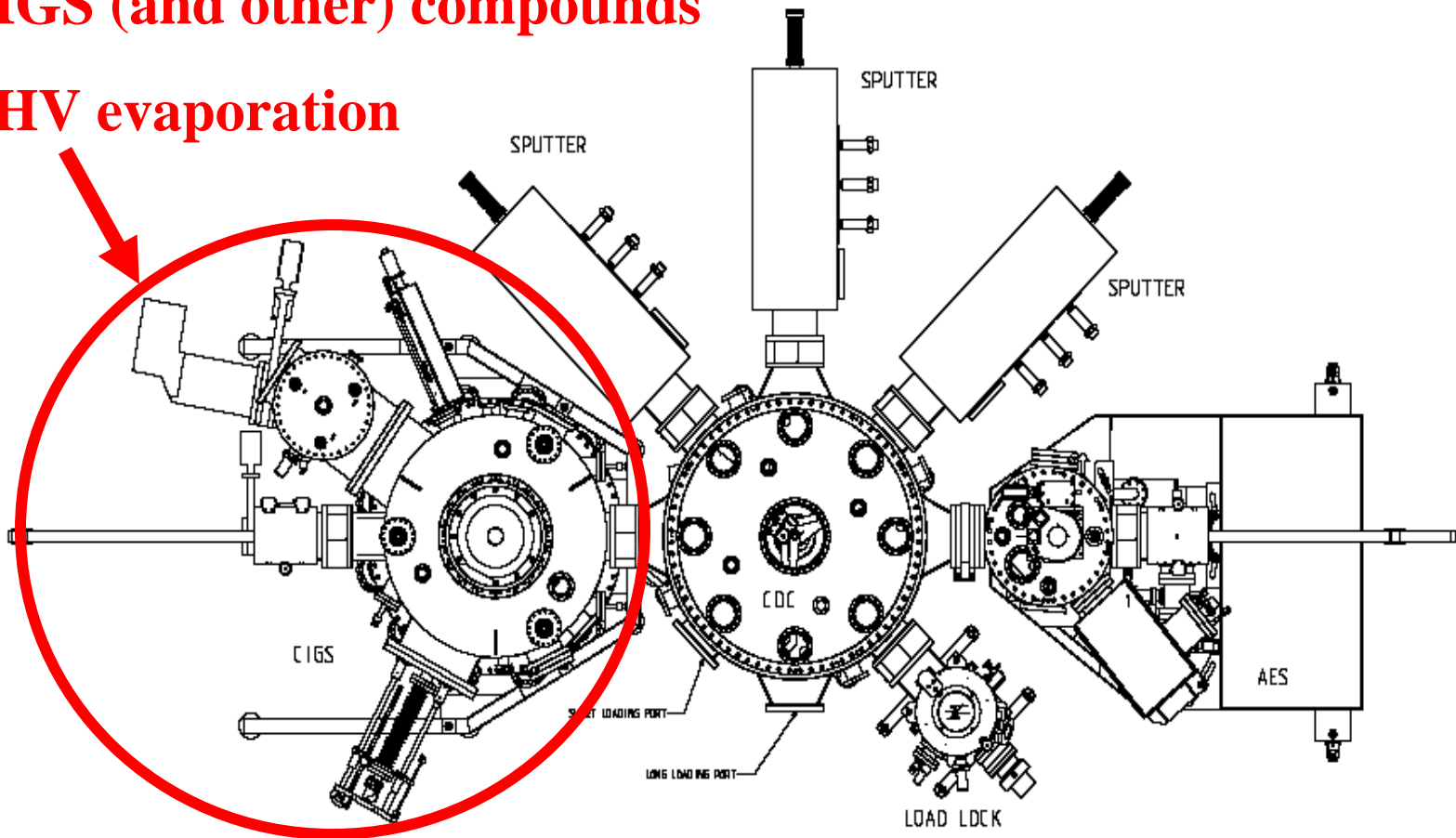


# The CIGS Cluster Tool 2



**CIGS (and other) compounds**

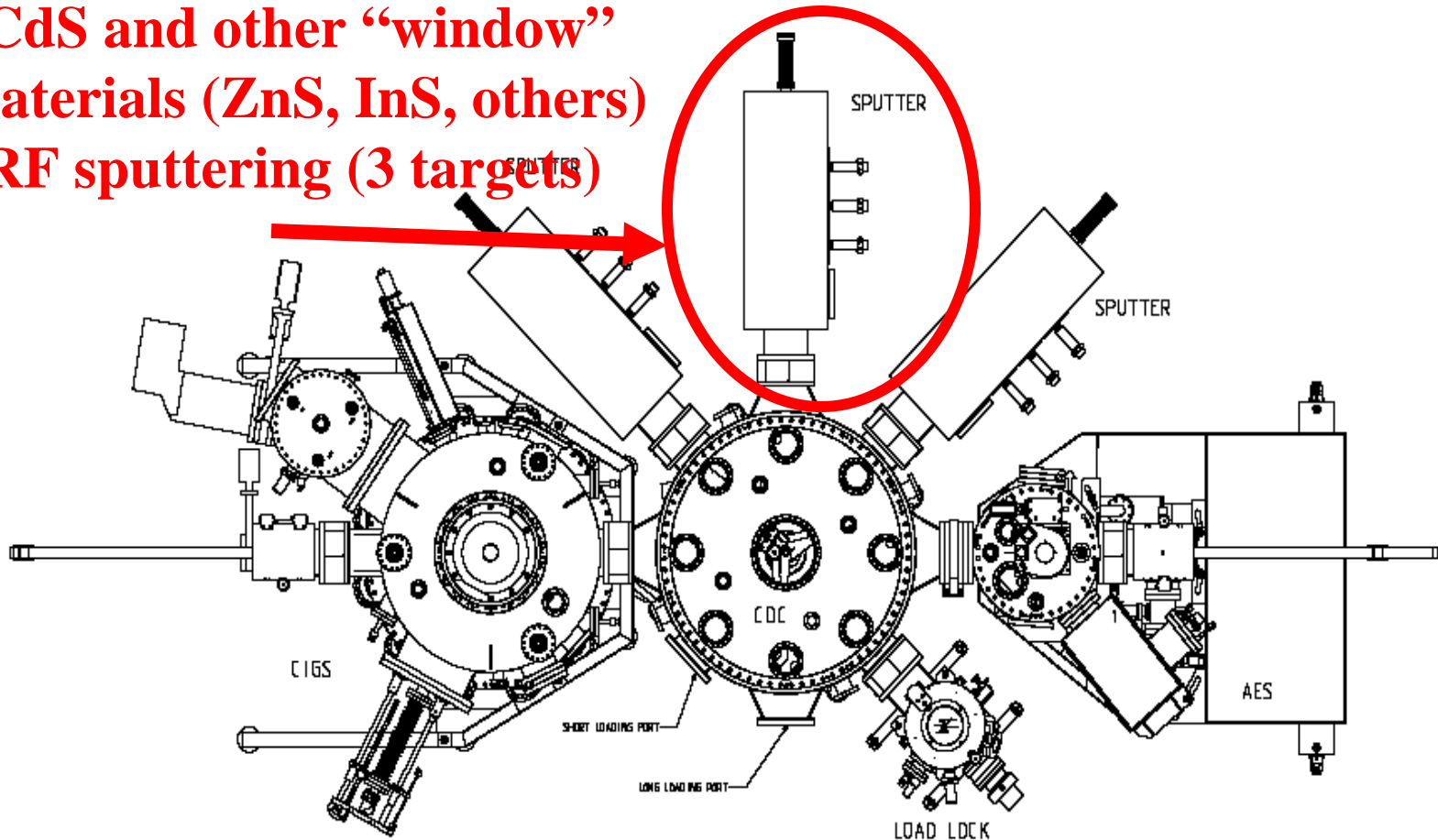
**UHV evaporation**



# The CIGS Cluster Tool 3



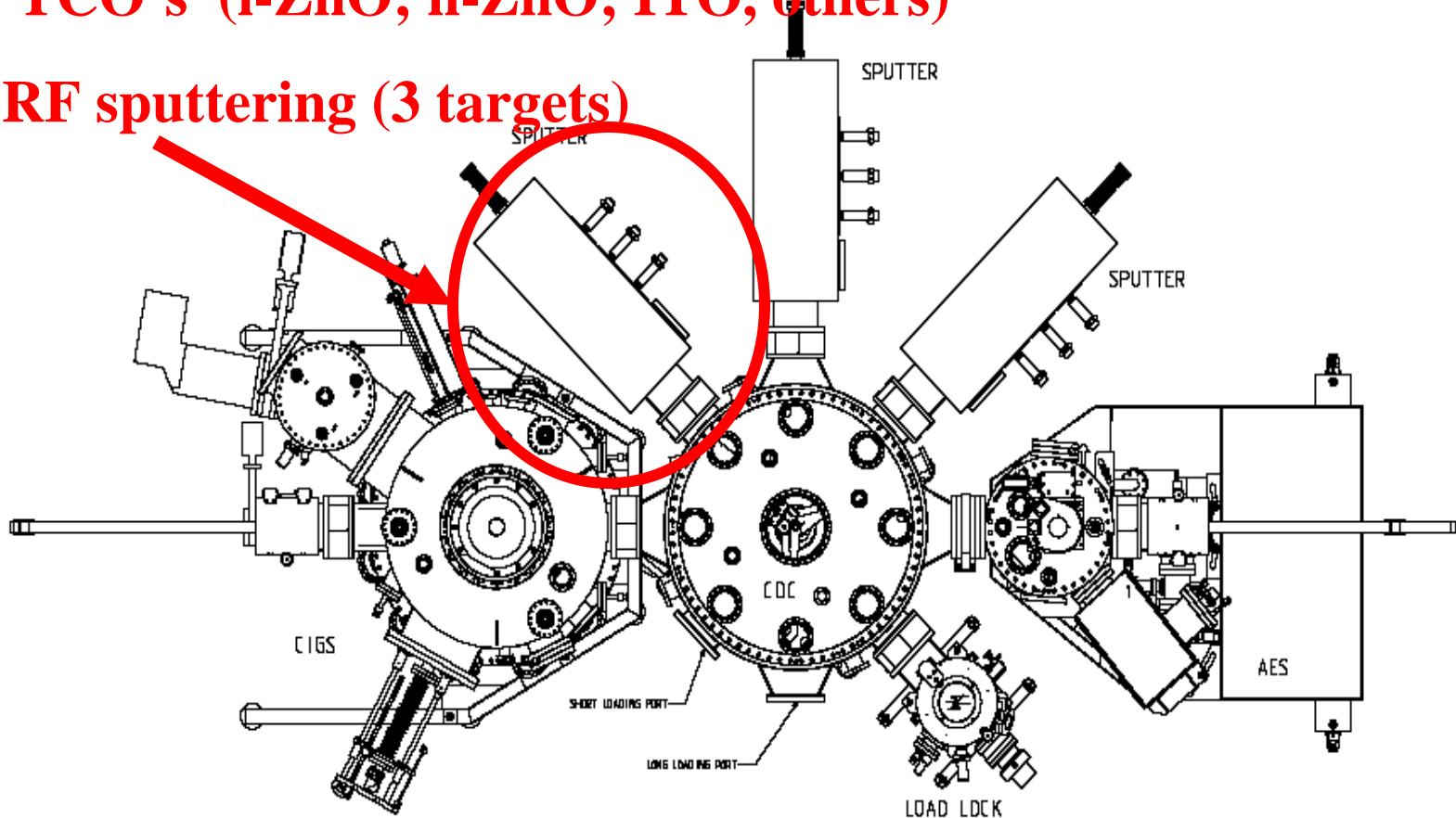
- \*CdS and other “window” materials (ZnS, InS, others)
- \*RF sputtering (3 targets)



# The CIGS Cluster Tool 4



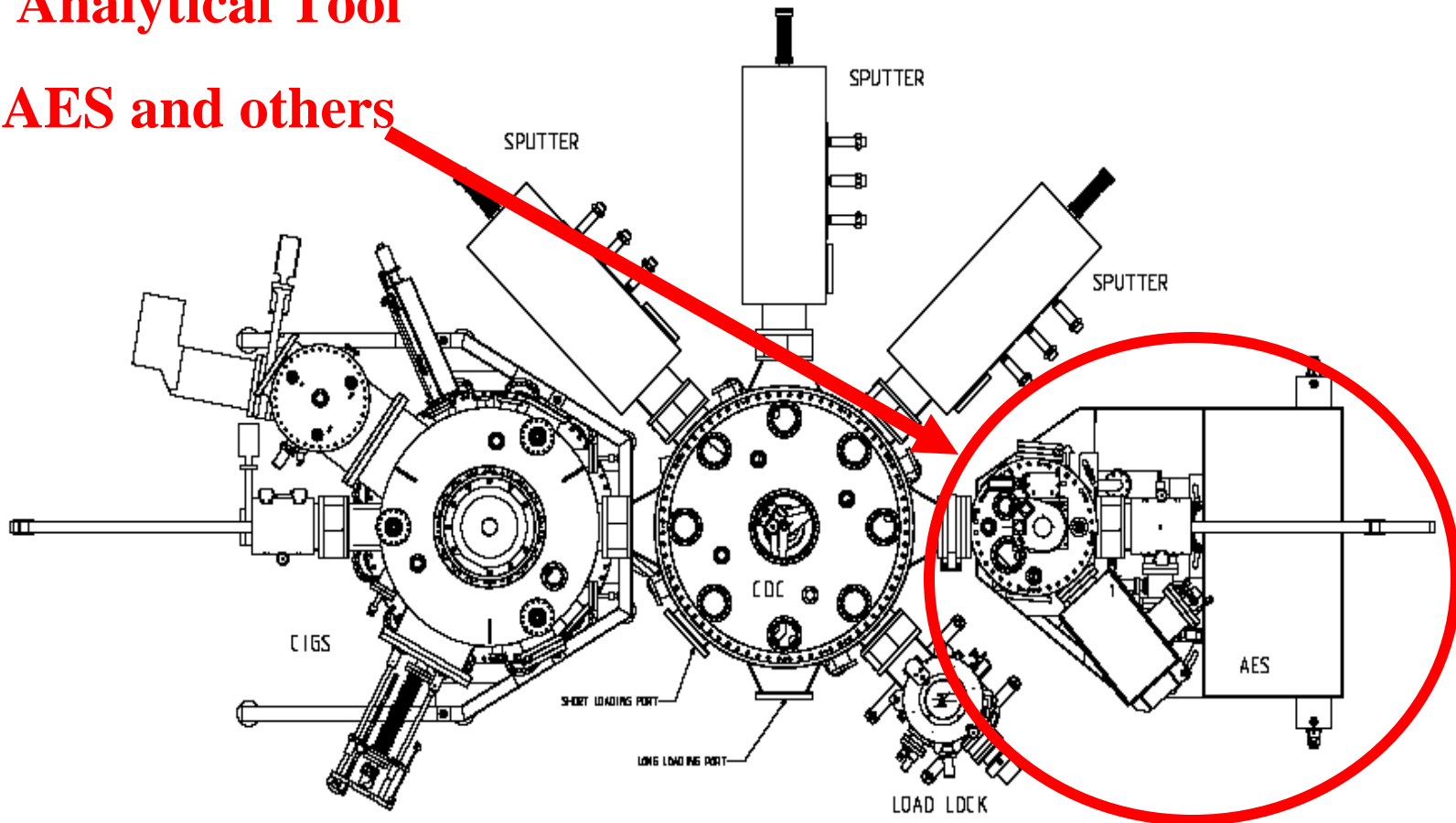
- TCO's (i-ZnO; n-ZnO; ITO, others)
- RF sputtering (3 targets)



# The CIGS Cluster Tool 5



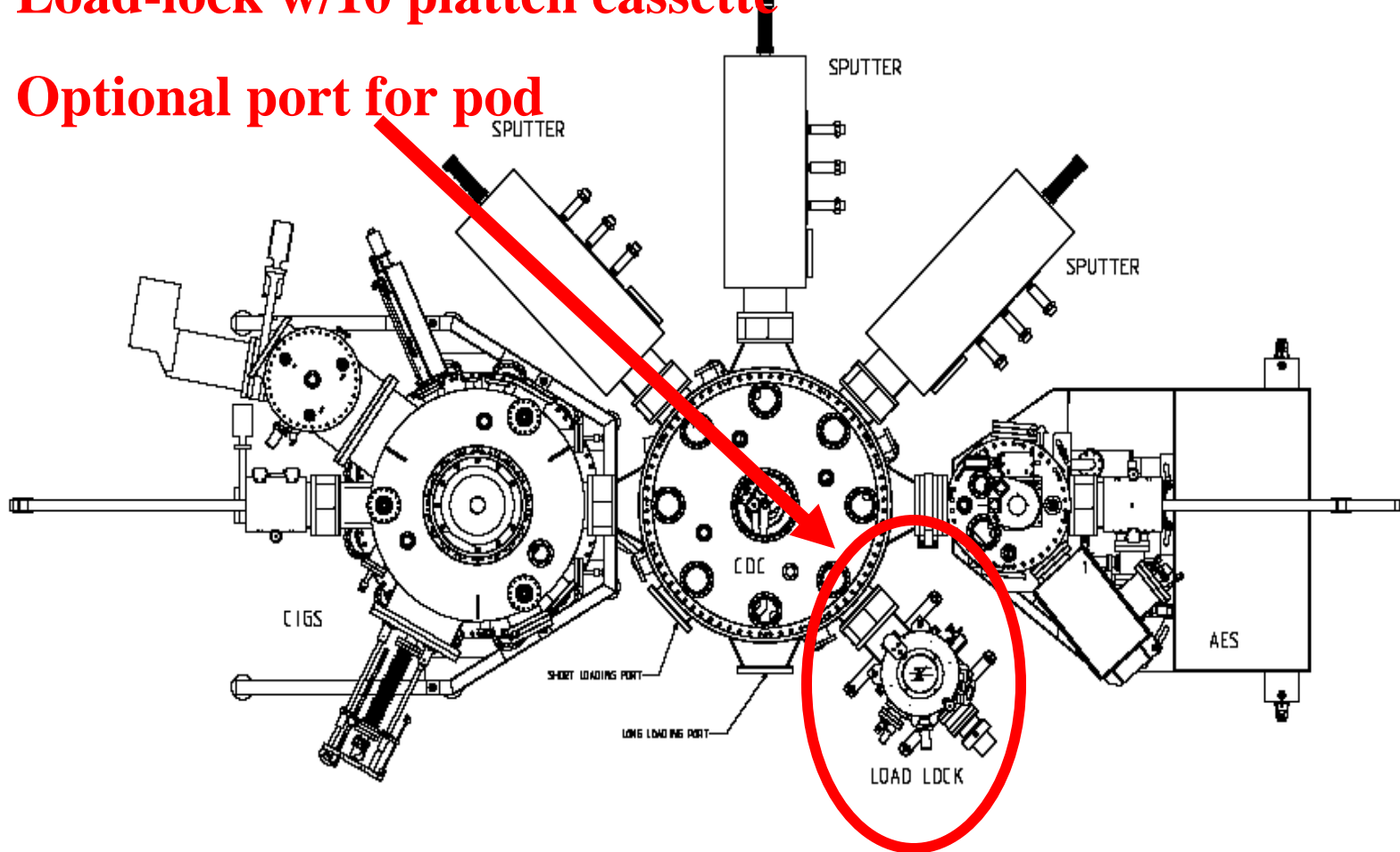
- Analytical Tool
- AES and others



# The CIGS Cluster Tool 6



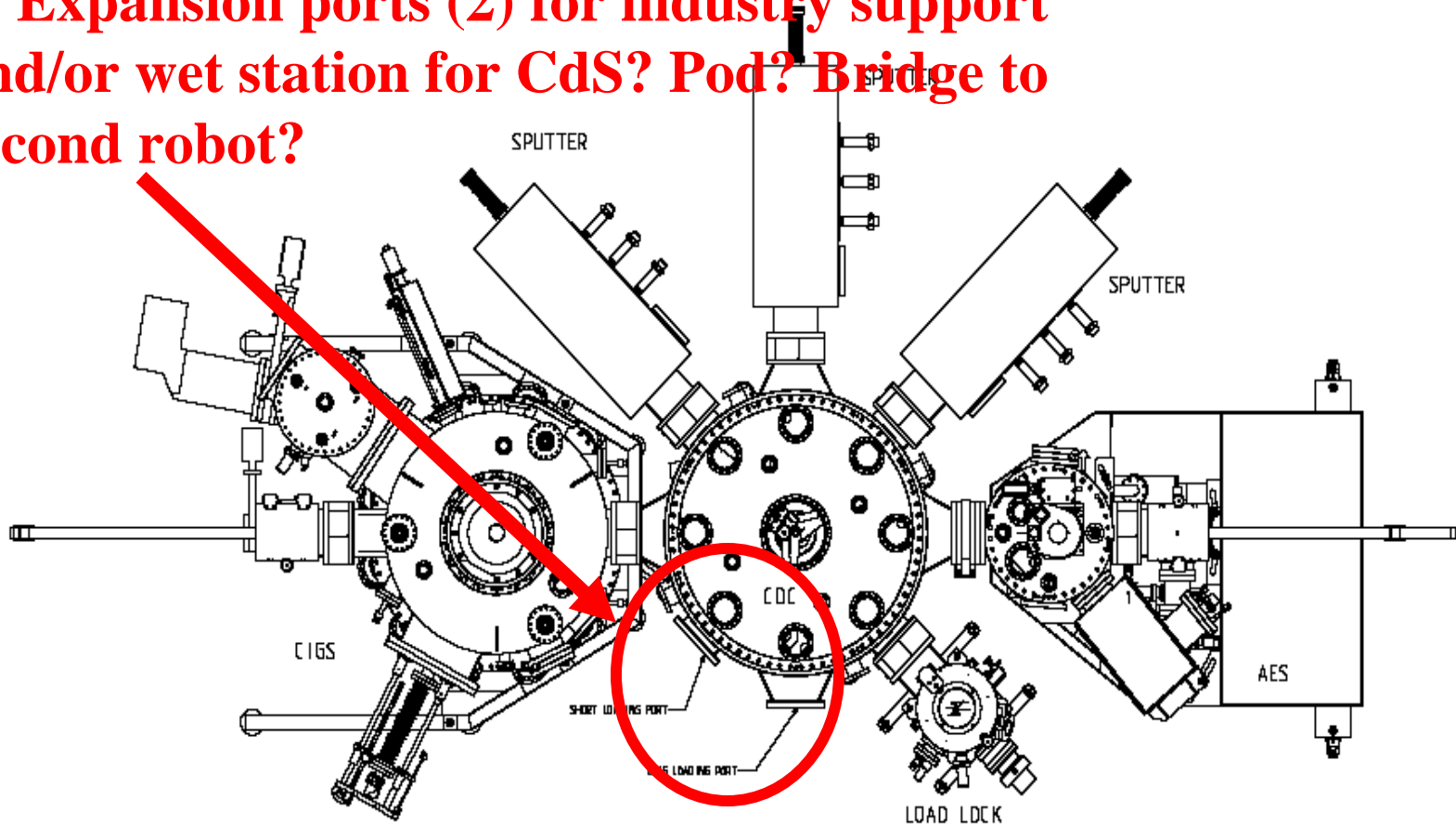
- Load-lock w/10 platten cassette
- Optional port for pod



# The CIGS Cluster Tool 7



- Expansion ports (2) for industry support and/or wet station for CdS? Pod? Bridge to second robot? second robot?



# Design Concepts



**#1** Allows for state-of-the-art CIGS solar cell fabrication in an integrated fashion and enables new fundamental studies

**#2** Allows all process steps to manufacture a CIGS coupon of 6" x 6" (PDIL std) adding new capabilities aimed at addressing relevant issues to industrial processes. Tool must also interface with other tools

**#3** Supports commercialization efforts by US industry working in CIGS PV technology by addressing highly specific industrial issues

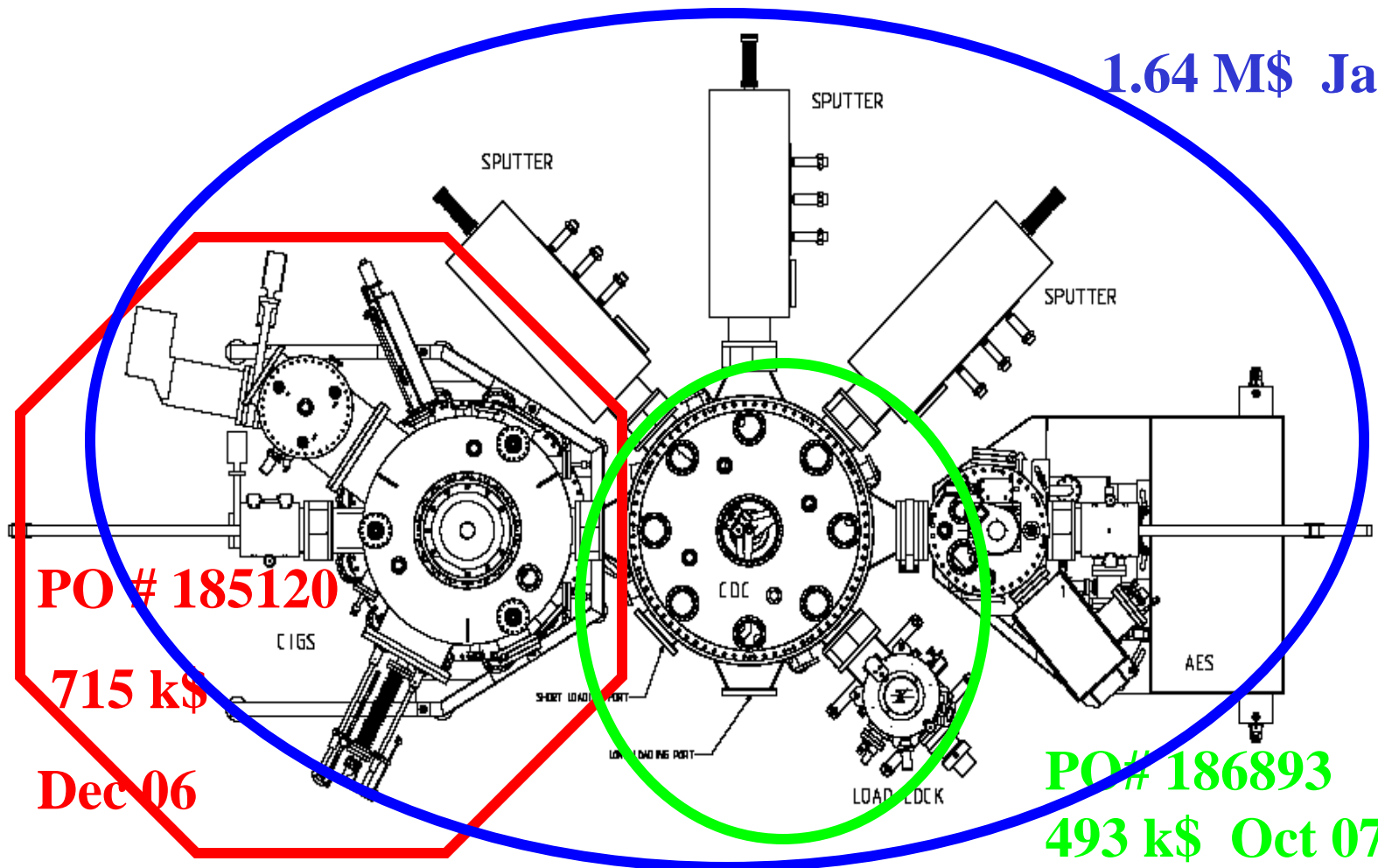
**#4** Allows for future expansion (new processes, new compound semiconductor materials, etc.)

# Cluster Tool costs/ordering



PO # 187426

1.64 M\$ Jan 08



PO # 185120

715 k\$

Dec 06

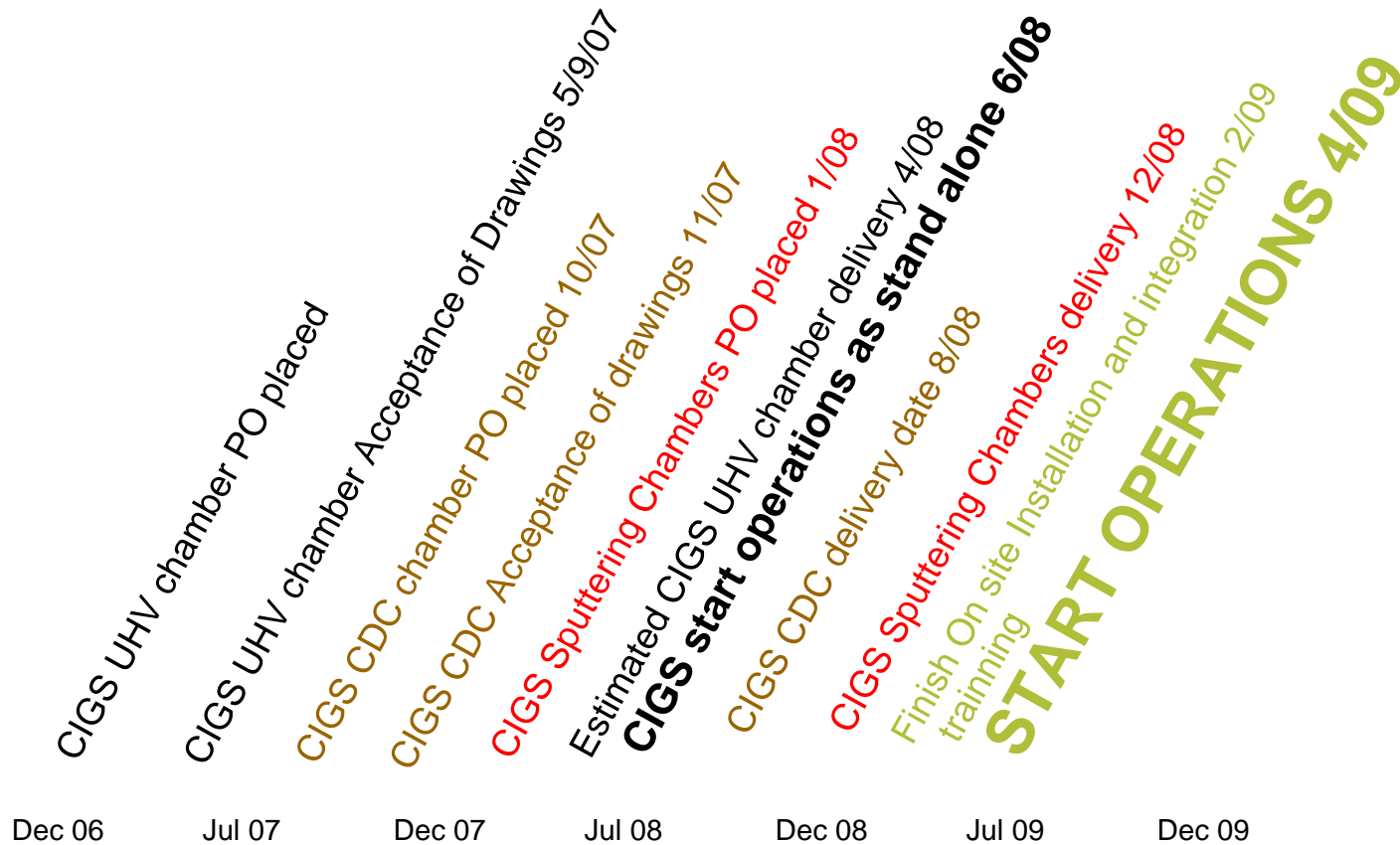
PO# 186893

493 k\$ Oct 07

# The CIGS chamber



# The CIGS Cluster Tool Timetable





- **Barriers encountered or anticipated that may inhibit success of programs**
  - The standard size of substrates (6"x6") will require the use of larger amounts of materials than we currently use: increase of operational costs to run the tool (true for all conversion technologies tools) => need for increased funding/support
  - The demand for steel (including that used in the fabrication of vacuum chambers) continues to increase to record levels worldwide. There is a possibility the construction of the sputtering modules (last items purchased to build the CIGS tool) may be delayed due to this current market situation in the steel industry.



# CdTe Platform

Tim Gessert

		PV Technology Road Maps						
		Wafer Si	Film Si	CPV	CdTe	CIGS	OPV	DSPV
Platform								
Thin Si								
Wafer Rep.								
CIGS								
CdTe								
Atm. Proc.								
M&C Ind.								
M&C Cluster								