KLA-Tencor

Accelerating Yield

Progress towards Actinic Patterned Mask Inspection

Dan Wack

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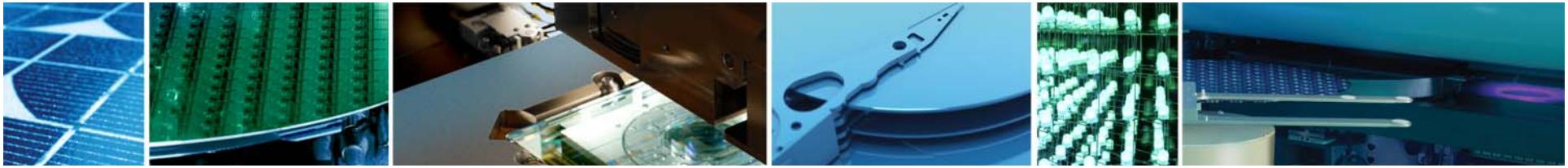
International Symposium on EUVL



Acknowledgments

- RAPID Div Engineering team
- Partners and Suppliers
- Customers

Latest Reticle Inspection Solution

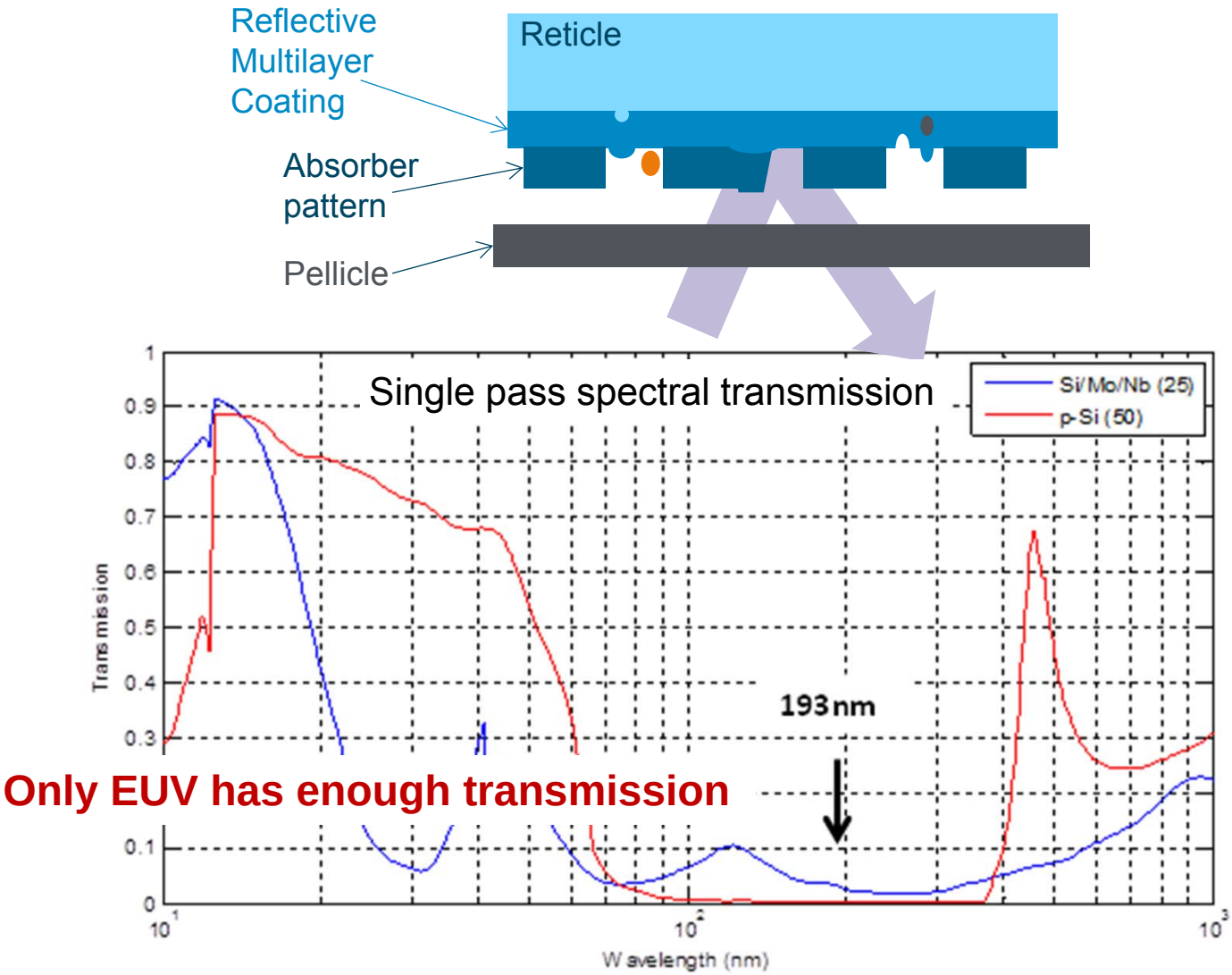
- EUV patterned masks and blanks
- Optical; Complex OPC, Quartz etch reticles
- For ≥ 10nm Generation
- *Practical sensitivity limited by edge roughness*

Teron 630

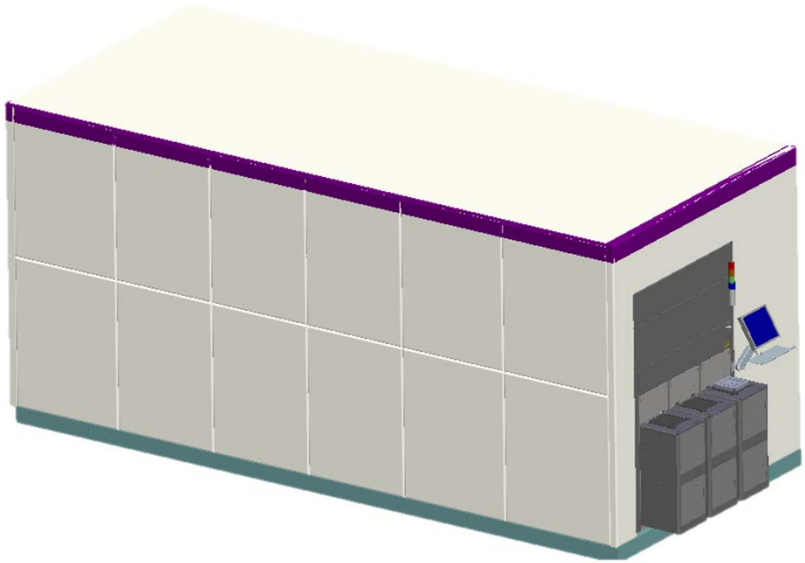
Industry proven sensitivity for advanced optical and EUV Mask applications

EUV Reticle Defect and Inspection Challenges

Pellicle transmission effects will narrow the wavelength choices



EUV Actinic Patterned Mask Inspection Tool

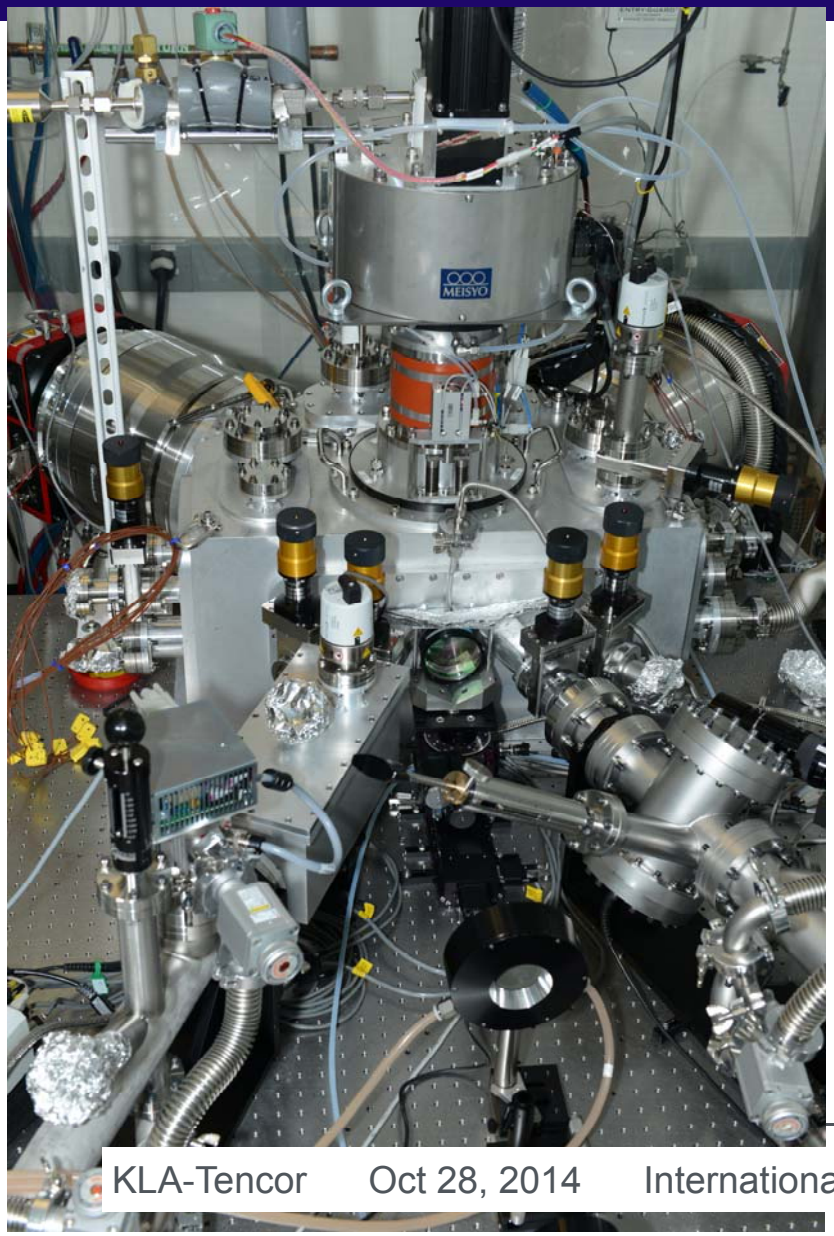


- EUV actinic inspection is a must for EUVL High Volume Manufacturing due to:
  - Phase defects
  - ML Blank defects
  - Contamination defect risks
  - Throughput
  - Through-pellicle inspection

710 Program

The world's only EUV Actinic Patterned Mask Inspection (APMI) System

Multiple Source testbeds based on Xe LPP



Source Prototype has:

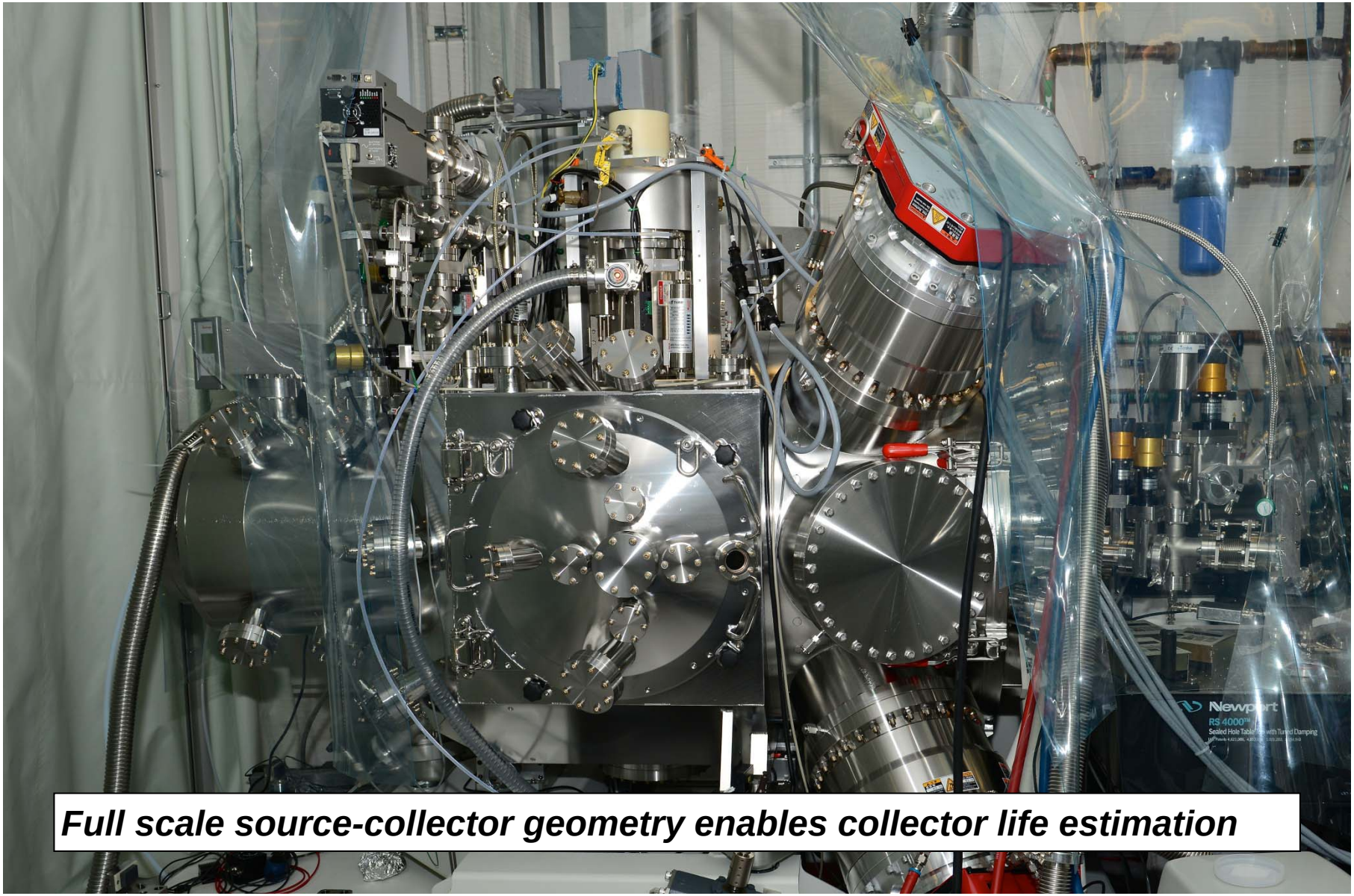
800 W pulsed YAG laser (commercial)
Xe ice thickness ~ 0.8 mm
Stable operation over 10s of hours

Source test results show:

Brightness, stability meet prod'n reqmts
Conversion efficiency ~ 0.5%
Ice crater depth ~ 0.2 mm

Xenon recycling feasibility proven

Collector lifetime characterization test stand



Full scale source-collector geometry enables collector life estimation

Optics Lifetime & Contamination Control Strategy

Leverage 193nm experience

EUV contam growth rate models

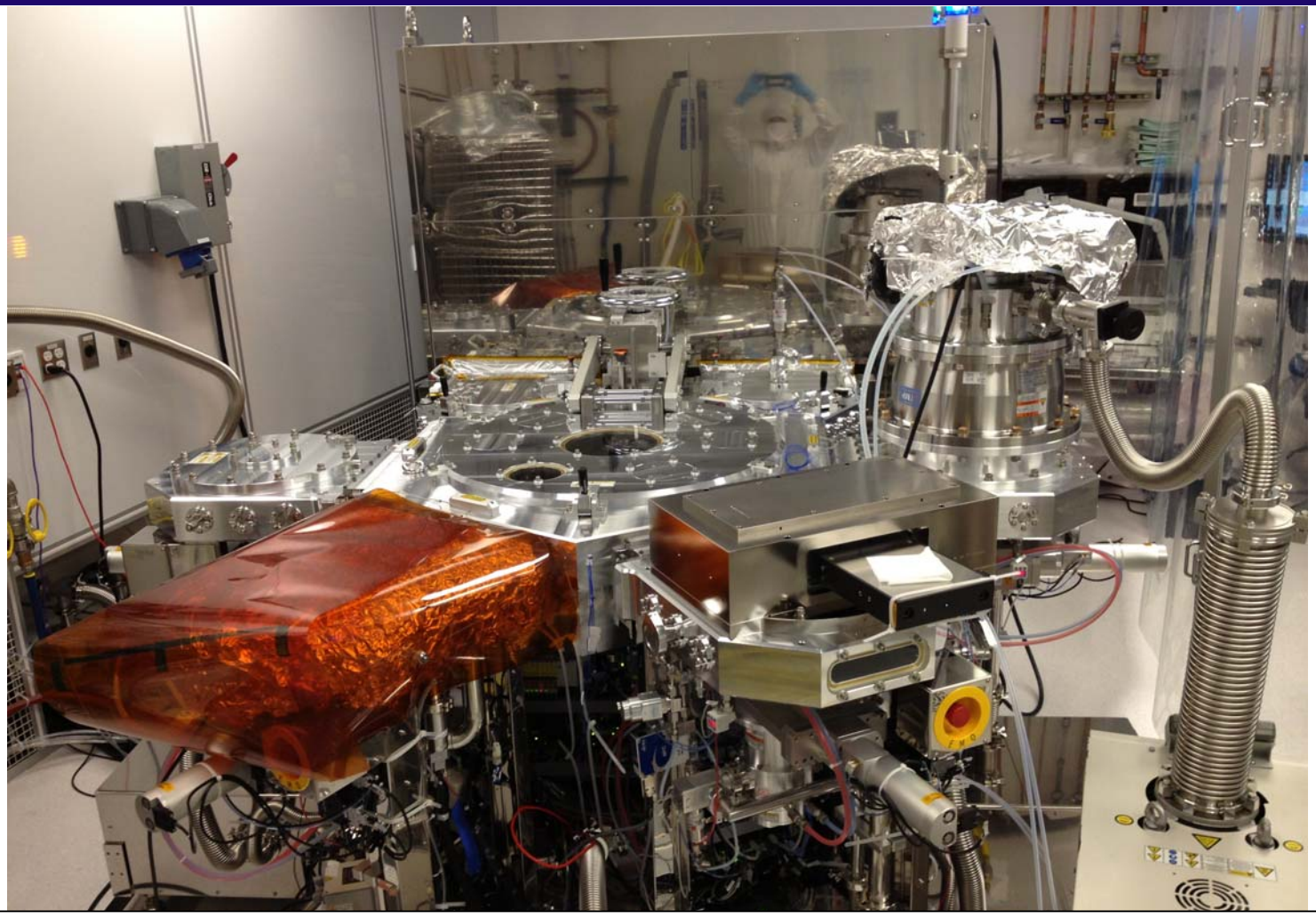
Iterative vacuum system design

EUV optical component tests

Vacuum component particle tests *at 28 nm sensitivity*

Vacuum Particle Test Stand

Vacuum System and component particle testing



Vacuum wafer handler enables component test at Surfscan sensitivity

Outgassing, Metrology, and Analytical tools

Capability established for atmospheric high-power 193 has been extended to ultra-clean vacuum regime

Assessment of EUV pellicle interaction with APMI

Characteristic	Assessment	Risk
Optical	Negligible effect on inspection performance	
Pellicle exclusion vol	No interference at 2.5 mm standoff	
Reticle Handling	No impact expected (to be checked)	
Thermal effects	Current estimate of peak temps: ~60% of HVM scanner	

710 Program Summary

- System Architecture defined
- EUV-specific large format image sensor designed and tested
- Optics concepts provide large field and high transmission
- Xe LPP source prototype shows required brightness
- Ultra-clean vacuum prototypes tested
- Pilot prod'n facility ready for build-out
- Ongoing new component/subsystem test

Program ready for full-scale development

Thank You