2010 Annual Conference and Business Meeting
May 9-11, 2010
Las Vegas, NV

Development of an Automated Measurement System for LED Lifetime Test

Yuqin Zong[1], Cameron Miller[1], Yoshi Ohno[1]
Jeff Hulett[2], and Greg McKee[3]

[1] National Institute of Standards and Technology, Gaithersburg, Maryland
[2] Vektrex, San Diego, California
[3] Labsphere, North Sutton, New Hampshire

Motivation

Lifetime of an LED (L_{70})

- required spec for Energy Star qualification
- believed to be long (eg. 50 K hours = 5.5 years!)
- time-consuming and costly testing

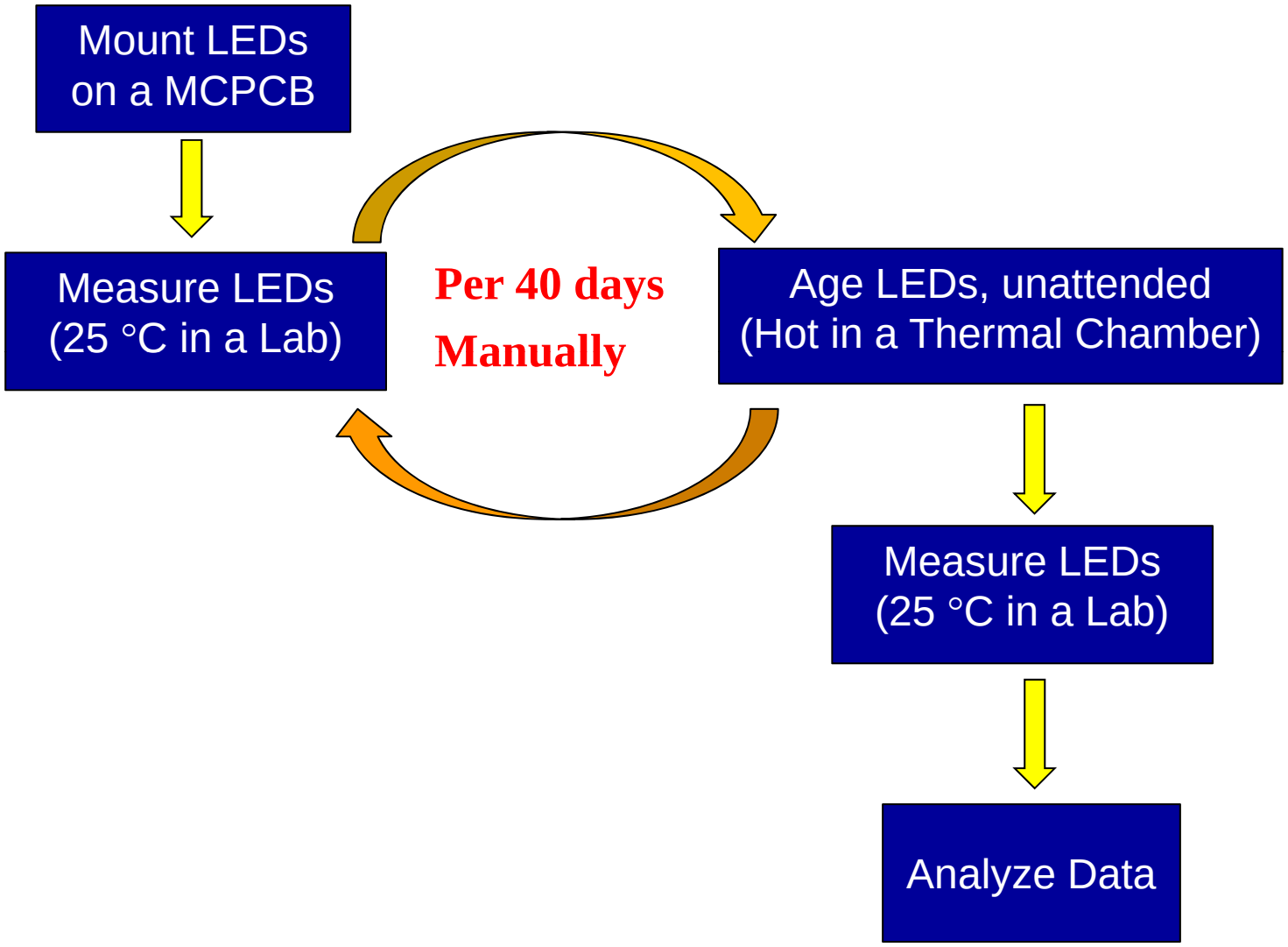
Possible solutions:

- Perform accelerated test, but no acceptable approach yet.
- Perform a "short" period of time test (eg. 6000 hours (250 days) in the IESNA LM-80-08), and extrapolate data to predict lifetime – requires a method/model (IES TM-21).

NIST Plan

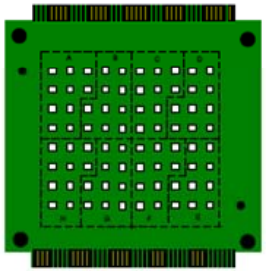
- Develop a fully automated measurement system by following LM-80 guidance.
- Select LEDs from the market.
- Perform lifetime test for 3-5 years.
- Add new unit(s) in the future if necessary.
- Generate a database automatically with a large amount of data with assigned measurement uncertainties.

A typical workflow for a LED lifetime test

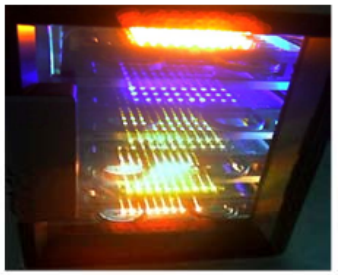


Typically instruments/equipment

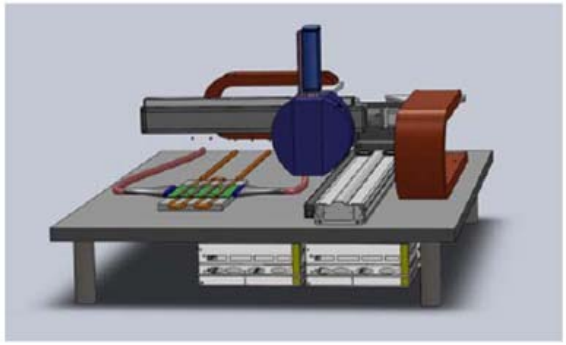
Power Supply, Switching Unit



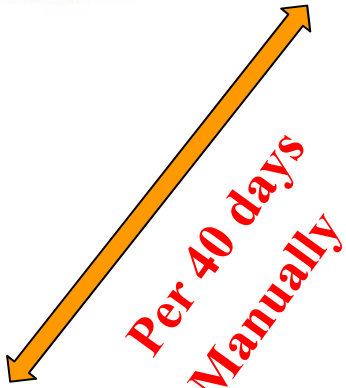
LED MCPCB



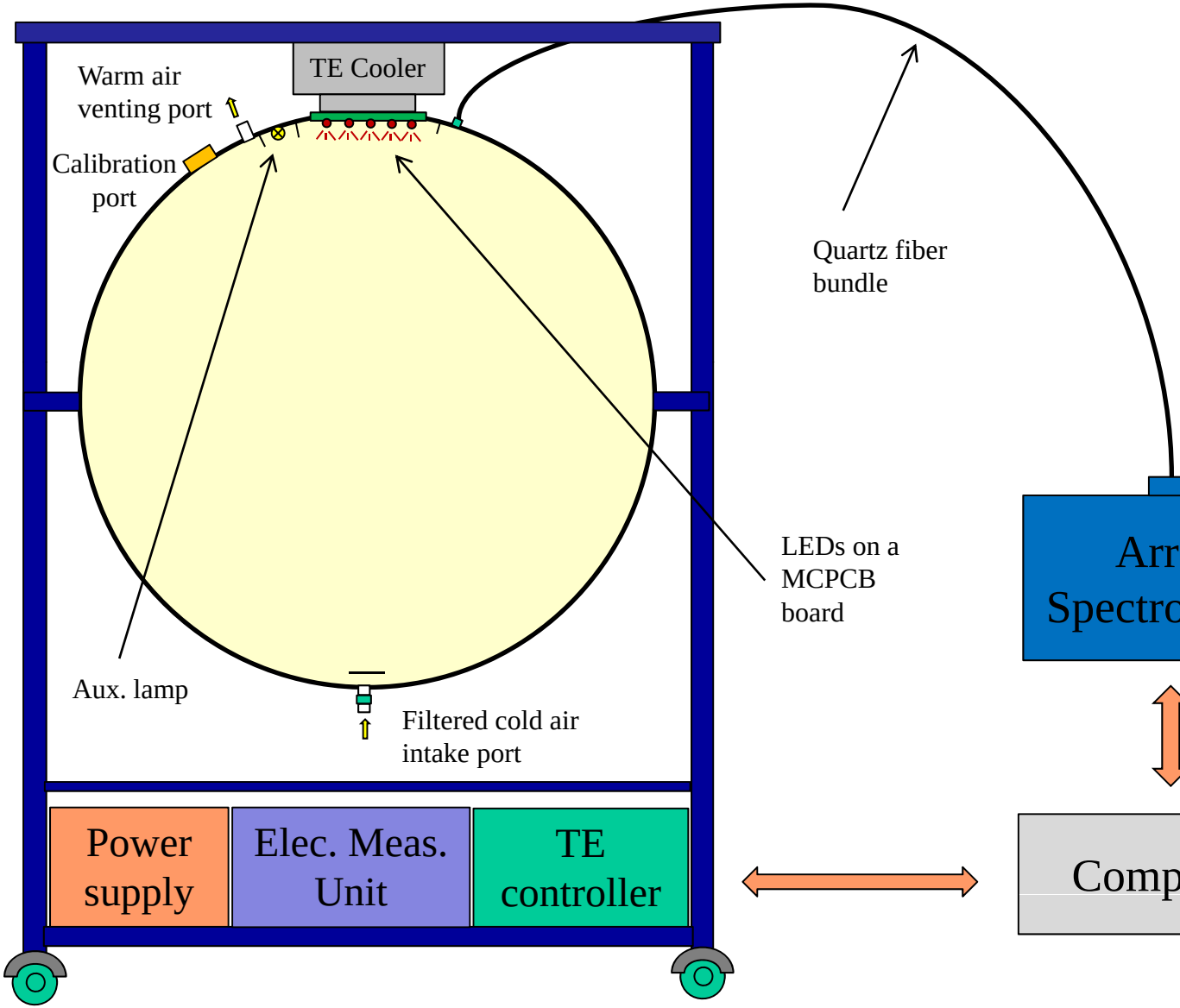
Thermal Chamber



X-Y Scanning LED Measurement System

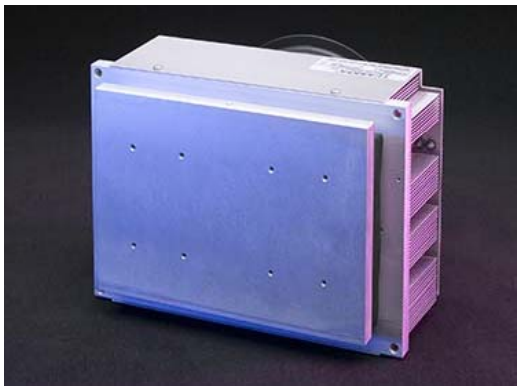


A new, fully automated system being developed at NIST



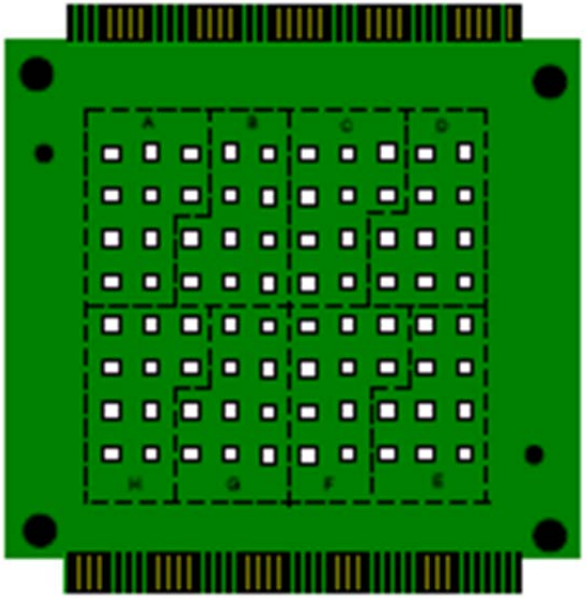
Automatic measurement under in-situ condition and at 25 °C room temp. **Can be very frequent!**

Key Component - Large temp-controlled heat sink



- 6” x 8.5” cold plate.
- 400 W input power.
- 280 W cooling power at 25 °C ambient temp.
- Very affordable.

Key Component - Large 6” x 6” MCPCB board

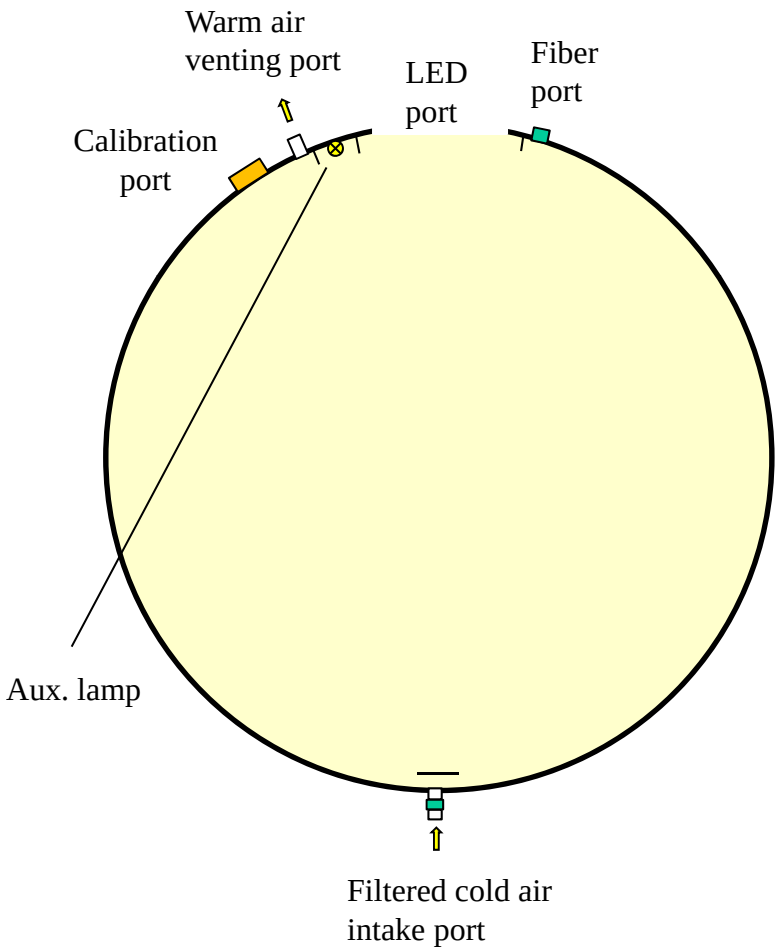


- Eight 10 LED arrays.
- Total 80 LEDs.

Key Component - Power supply and switch unit

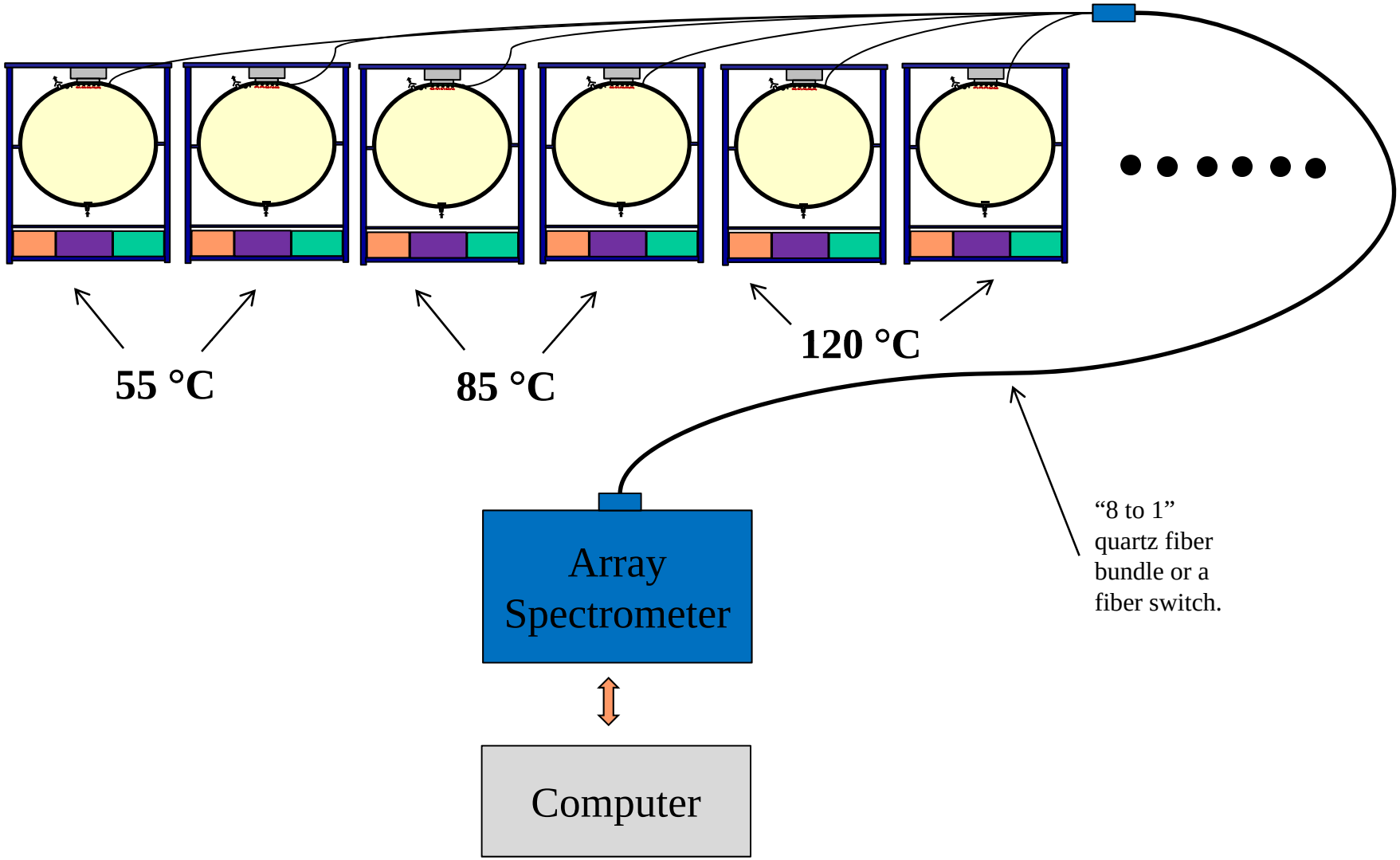
- 0-5A, 0-200 V
- DC and pulsed operation
- <10 μs pulsing for junction temperature measurement.
- 8 channels to power up the eight LED arrays.
- Ability to turn on/off one LED at a time for optical measurement.
- Built-in multi-layer LED protections.

Key Component - Integrating sphere



- 80 cm diameter.
- $BaSO_4$ coating with 90 % reflectance.
- Intake and venting ports to avoid contamination.
- source-detector adjacent geometry (by P. Hanselaer) to reduce the error due to change of spatial nonuniformity.
- Detachable LED & TE-cooler assembly for measurement verification.

Multiple units, expandable



LED samples

- One model per manufacturer,
- Three operating currents per model,
- Three case temperatures per model,
- 10 LEDs per test condition.

Total 90 LEDs per model to be tested

Timeline (preliminary)

2010 June - overall design completed

2010 September – purchasing contract awarded

2010 November - system delivered

2011 January - system integration at NIST completed

2011 March - testing starts

Acknowledgements

Melissa Ford, Vektrex
Dan Scharpf and Joe Jablonski, Labsphere

US Department of Energy

THANK YOU