



# Future Challenges Facing SEE Pulsed Laser Technique

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QSS Group Inc/NASA GSFC  
**Dale McMorrow,**  
Naval Research Laboratory

To be presented by Stephen Buchner at the 2006 Single Event Effects Symposium (SEESYM), April 10, 2006 to April 12, 2006 in Long Beach, CA.

1



# What is the Basis of the Pulsed Laser Technique?

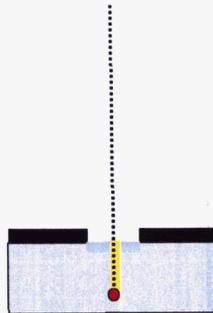
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2

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## Charge Generation by Ion Beam

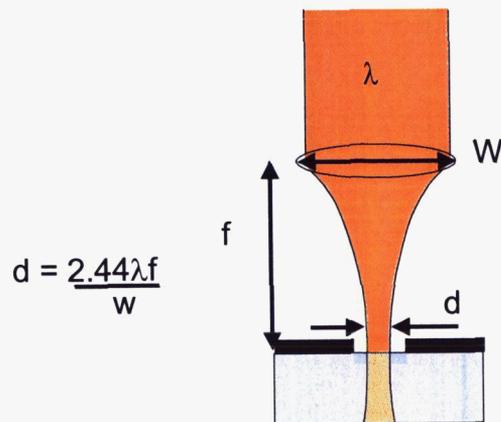


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3



## Charge Generation by Pulsed Focused Laser Beam



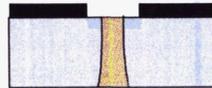
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4

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# Charge Generation by Pulsed Focused Laser Beam



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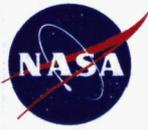


# What are the Challenges?

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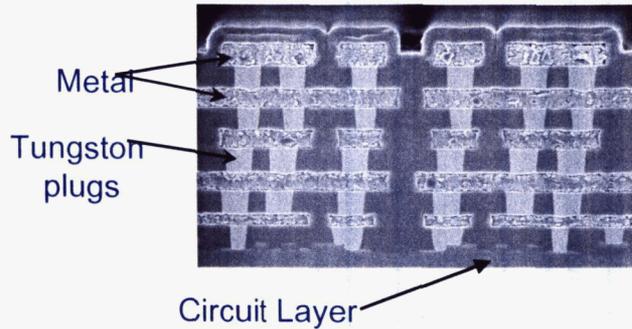
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## Future Challenges

- **Metallization**



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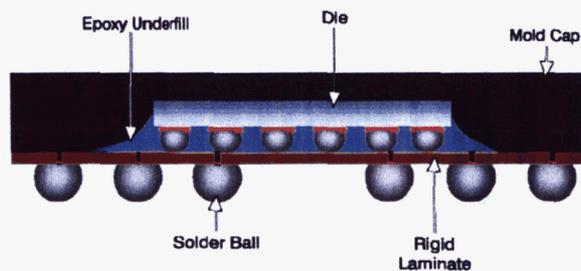
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## Future Challenges

- Metallization

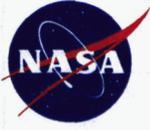
- **Packaging**



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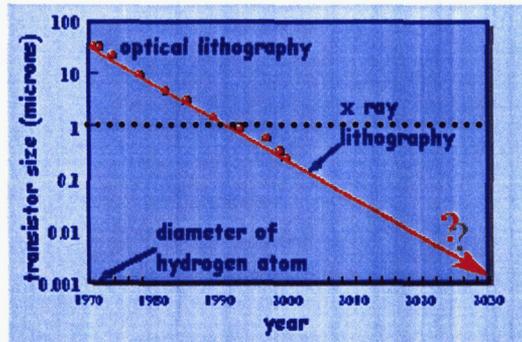
8

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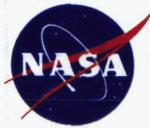
# Future Challenges

- Metallization
- Packaging
- **Scaling**



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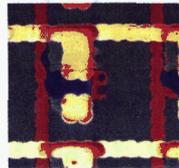
9



# Future Challenges

- Metallization
- Packaging
- Scaling
- **Exotic Materials**

*Plastic Transistor*



*Carbon Nanotubes*

*Magnetic Memory*

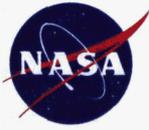


*Single Molecule Transistor*

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10

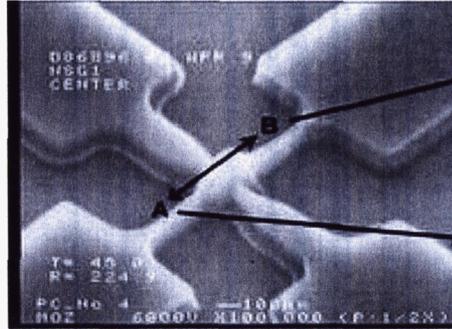
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# Future Challenges



- Metallic Structures
- Packaging
- Sensors
- Exotic Materials
- **Novel Structures**



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11



# Future Challenges



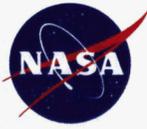
- Metallic Structures
- Packaging
- Sensors
- Exotic Materials
- **Equipment**

**\$\$\$\$\$\$ and cumbersome**

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12

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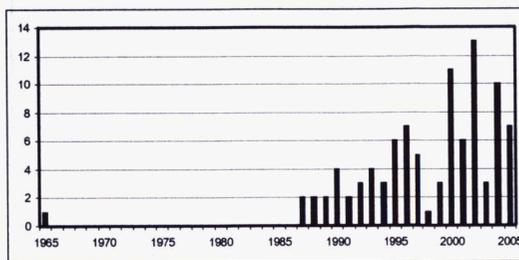
# Current State of Technique

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13



## ~100 Papers



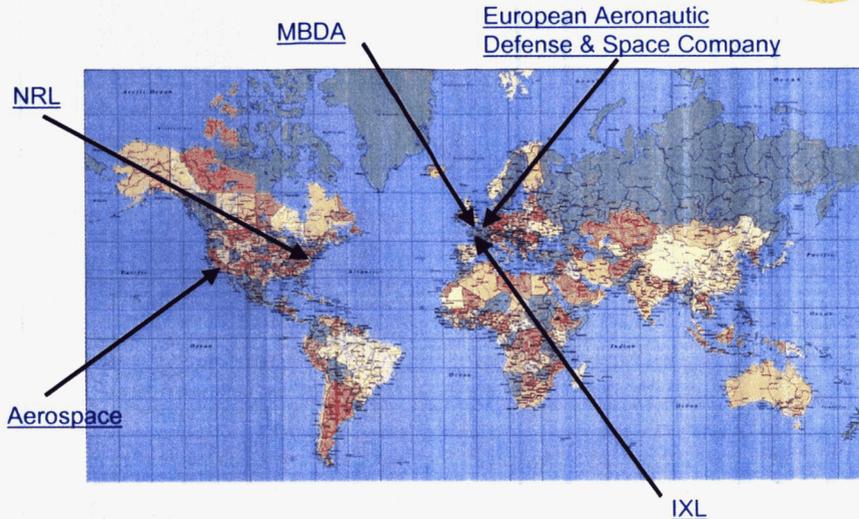
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14

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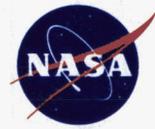


## 5 Facilities



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15



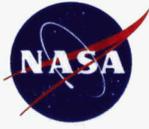
## Pulsed Laser Can Produce ...

- **Single Event Transient (SET)**
- **Single Event Upset (SEU)**
- **Single Event Latchup (SEL)**
- **Single Event Snapback (SES)**

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16

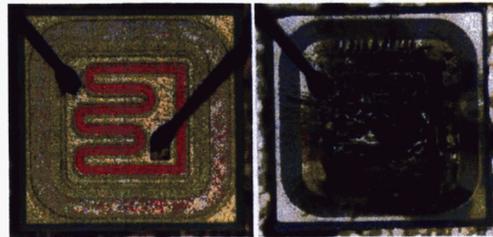
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## Pulsed Laser Cannot Produce....



- **Single Event Gate Rupture**
- **Single Event Burnout due to metal**

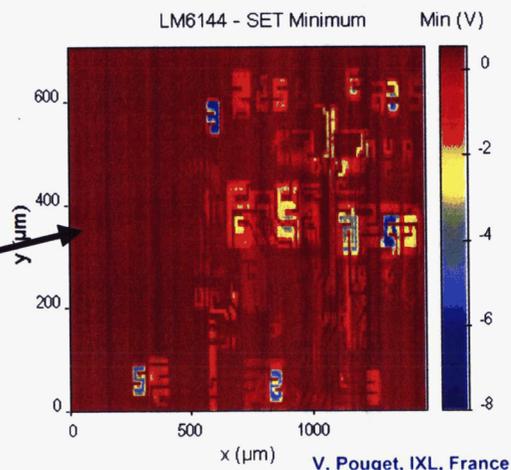
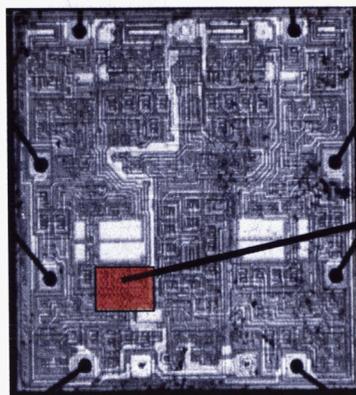


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17



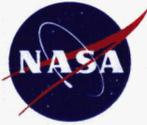
## Spatial Information



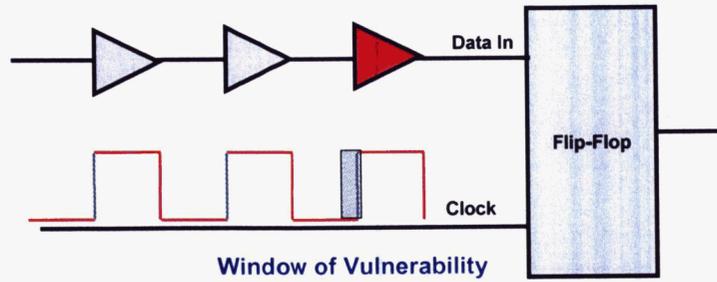
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18

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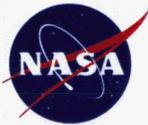


# Temporal Information



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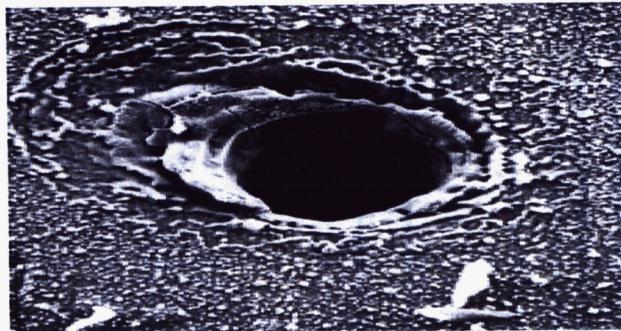
19



# Very High LET



LET  $\gg$  100 MeV.cm<sup>2</sup>/mg  
Limited by material damage



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# Caveats

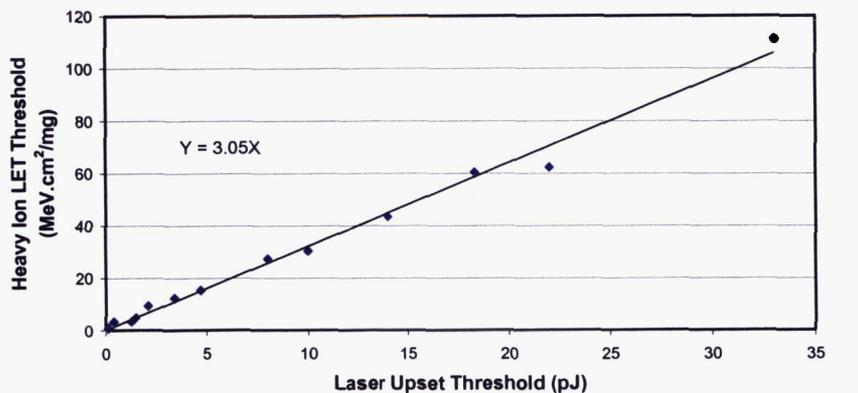


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21



# Ion LET Threshold from Laser Energy Threshold



McMorrow IEEE TNS 2000

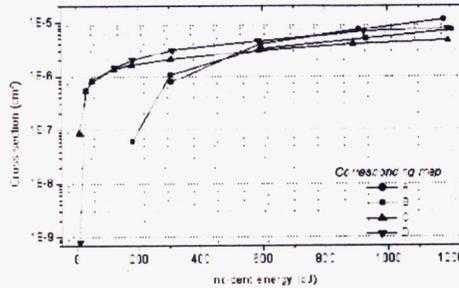
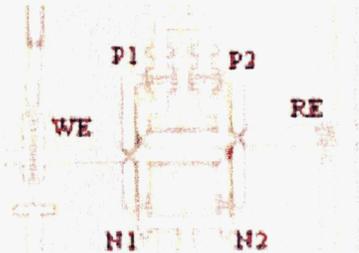
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# Cross-Section



- No metal.
- Large structures.

V. Pouget, IXL, France

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23



# Cross-Section

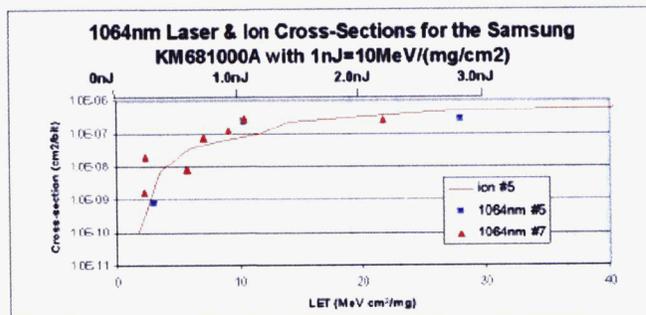


Figure 2.15. Calibration of the infrared results against the ion cross section for the Samsung KM681000A

Chugg et al. ESCIES Report

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24

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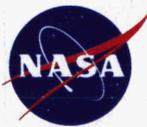


## The Future...



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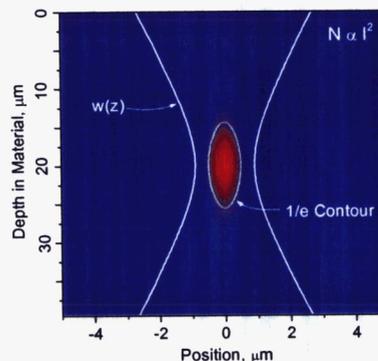
25



## Two Photon Absorption (TPA)



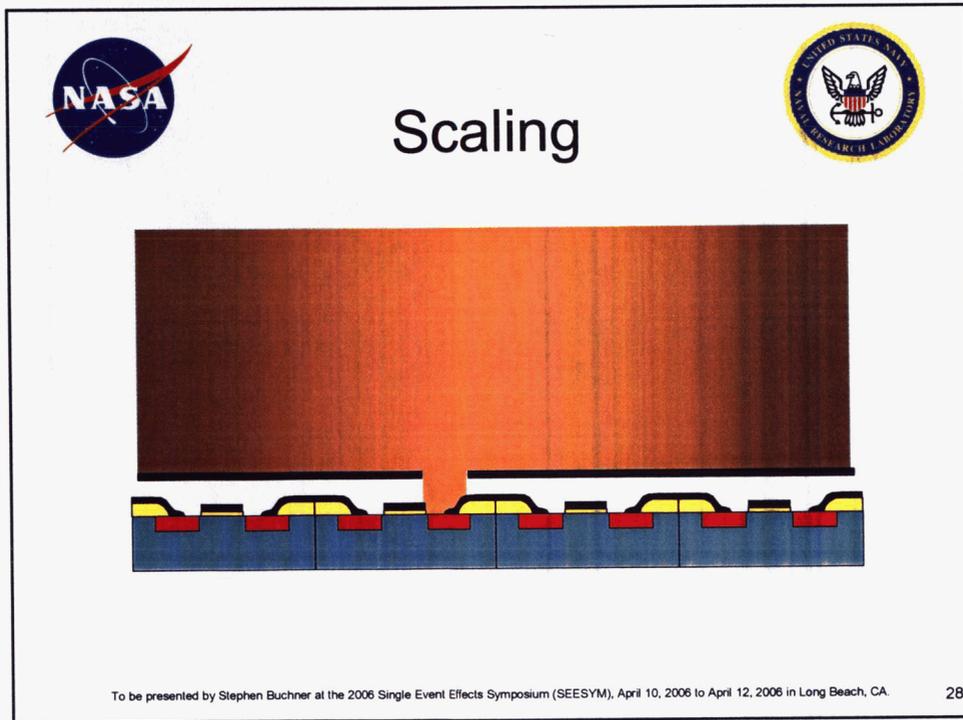
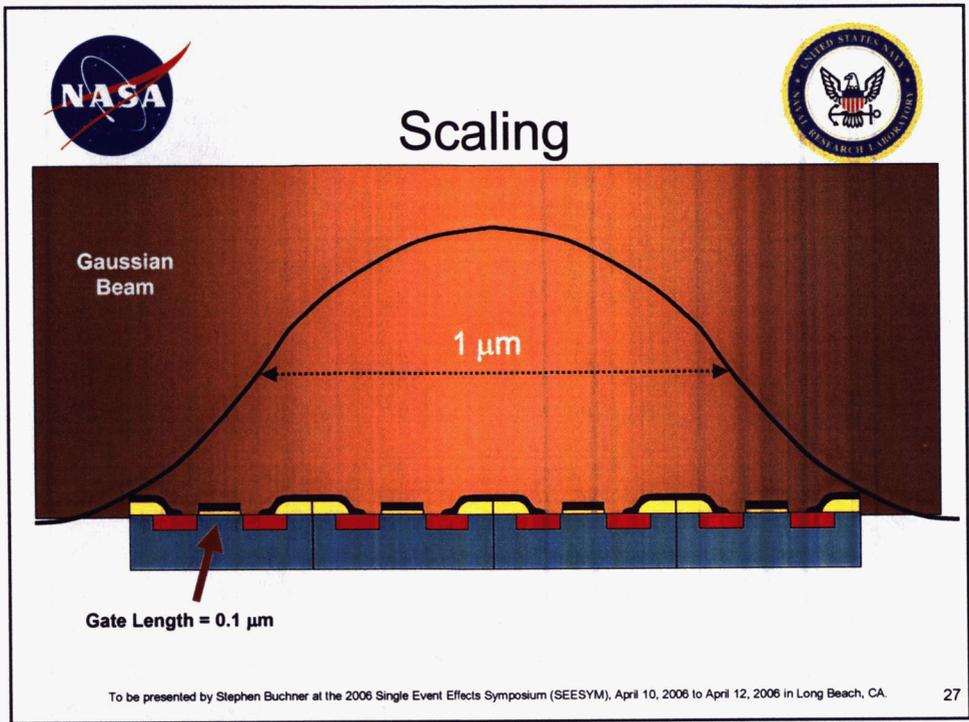
TPA avoids the problems associated with metal on the top surface and with flip-chip packaging by having the light incident from the backside.



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26

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## New Materials

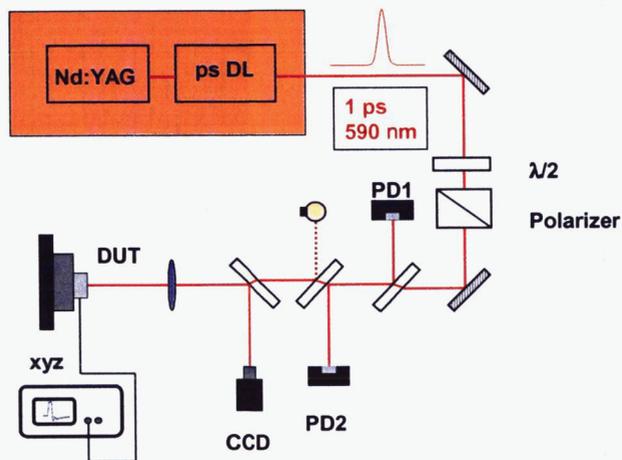
- Adjust the wavelength to ensure absorption

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29



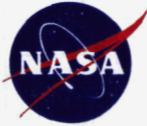
## Equipment



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30

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## New Laser Source

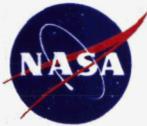


- < 100 ps pulse width
- Single shot to 100 MHz
- Pulse Energy = 8 pJ
- Multiple wavelengths



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31



## Summary



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32

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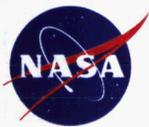
Try it, you'll like it!



Life Cereal Ad 1972 - 1987

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33



## Summary



- **Challenges for the pulsed laser:**
  - Metal
  - Package
  - Scaling
  - Exotic materials
  - Novel devices
  - Equipment
- **One has to be innovative to handle the challenges**

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