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| *Title:* | Transparent Substrate Chip Slappers for uDetonics |
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| *Intended for:* | JMP TCG-X Spring Meeting<br>Los Alamos, NM<br>March 29-31, 2011 |

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Form 836 (7/06)

# Transparent Substrate Chip Slappers for uDetonics

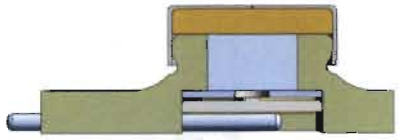
**Steven Clarke**
**Los Alamos National Lab**
**TCG-X Spring 2011**
**March 30, 2011**
**Los Alamos, NM**

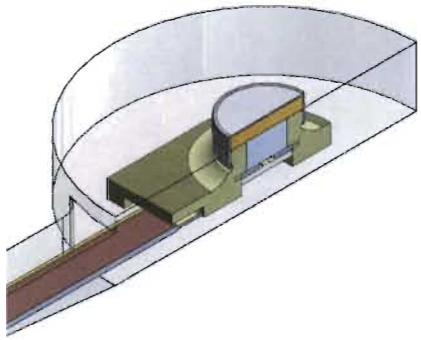
# Outline

- New Chip Slapper based Detonator design from non-JMP funds
- New diagnostic configurations possible with design
- Proposed Schedule
- Conclusions

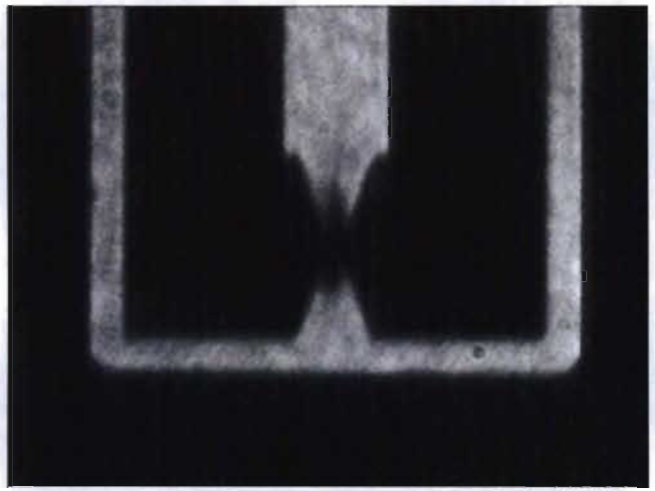
# New Generation of Chip Slapper Based Detonator

- W-6 (non JMP funded effort) is developing a new family of chip slapper based detonators.
- Design allows for access to the rear face of the chip.
- Proposed new task in JMP TCG-X is to use that access for diagnostics.
- KCP will build a series of chips "exactly like" the production chips on clear substrates.
- We will use some of the chips as unloaded chips, and some will be built into detonators with clear potting material.



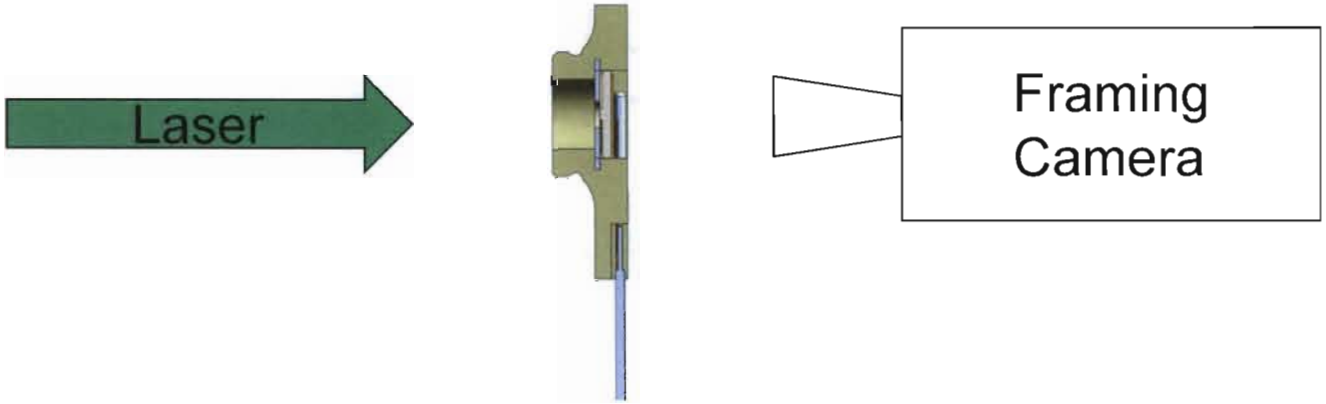


# Shadowgraphy of IH MEMS device Function



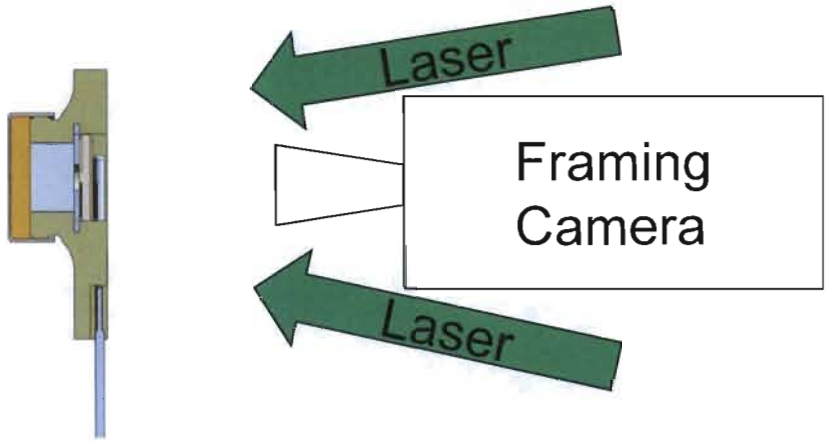
- **Ultra High Magnification**
- **White is air, black is metal**
- **5 ns Exposure, 10 ns interframe times**
  - Note jump after frame 8, because of dual image chip min framing time.
- **We have better optics now, specifically for this kind of experiment.**

# Shadowgraphy of Chip Function



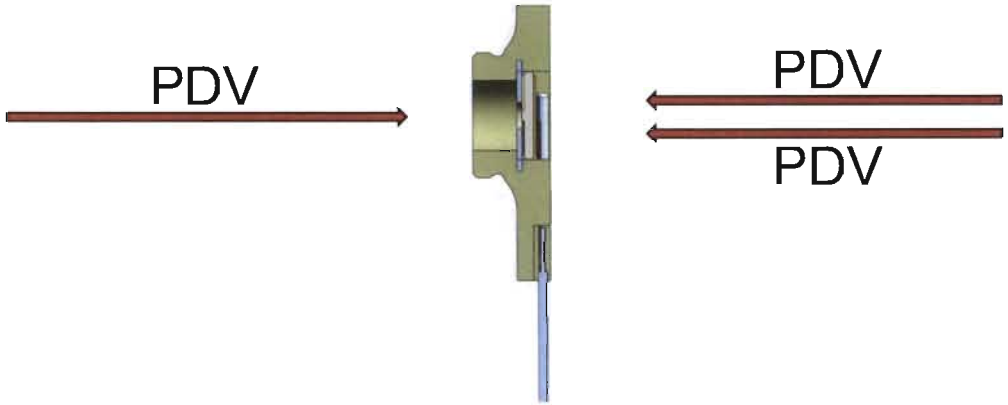

- **Unloaded Chips on Clear Substrate**
- **Observe time resolved images of Chip Function**
- **Imaging of:**
  - Bridge vaporization
  - Flyer formation? (tearing patterns? Early vs. Late time patterns)
  - Lands Burnback (early time or late time?)

# Framing Camera Imaging of Chip Function



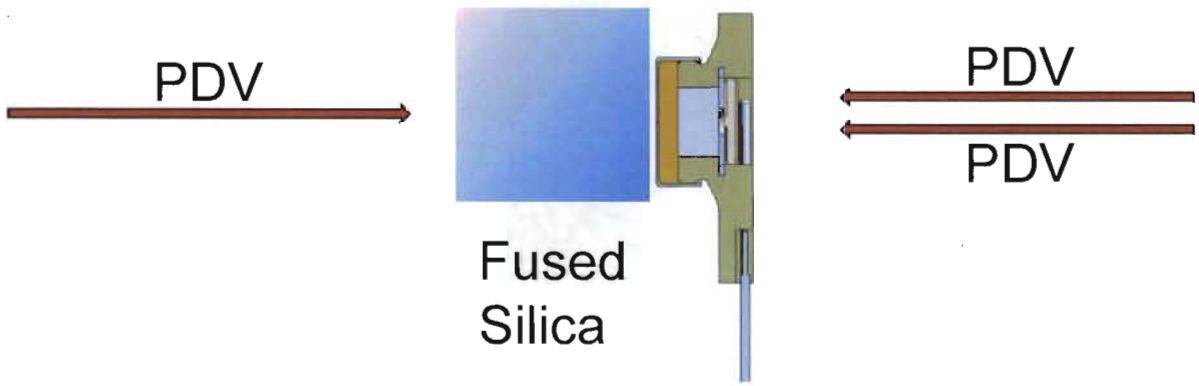

- **Loaded Chips on Transparent Substrate**
- **Observe Time Resolved images of Chip Function**
- **Images of:**
  - Flyer shape and condition at time of pellet impact
  - Flyer tearing timing vs. pellet impact
  - Any change in Bridge vaporization images with pellet in place?

# PDV of Chip Function



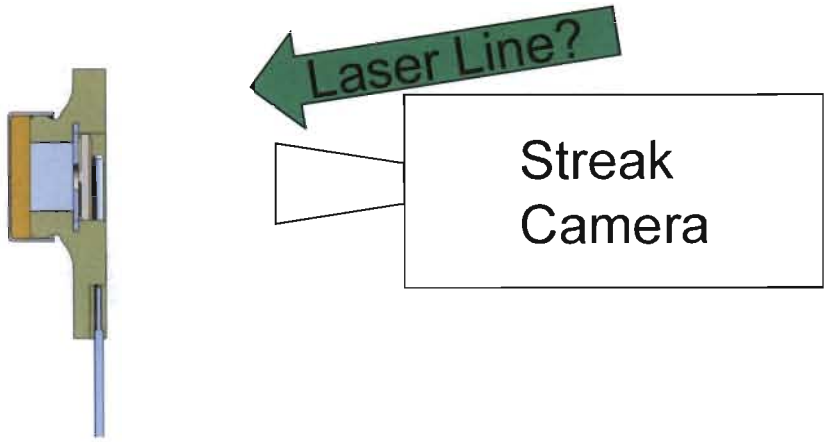

- **Unloaded Chips on Clear Substrate**
- **PDV from the "front" to observe flyer velocity**
- **PDV from the "back" to measure flyer velocity as well?**
  - Look "around" the bridge to see flyer motion away from probe?
  - Look "at" the bridge to see the bridge motion independent of the flyer motion?

# PDV of Detonator Function



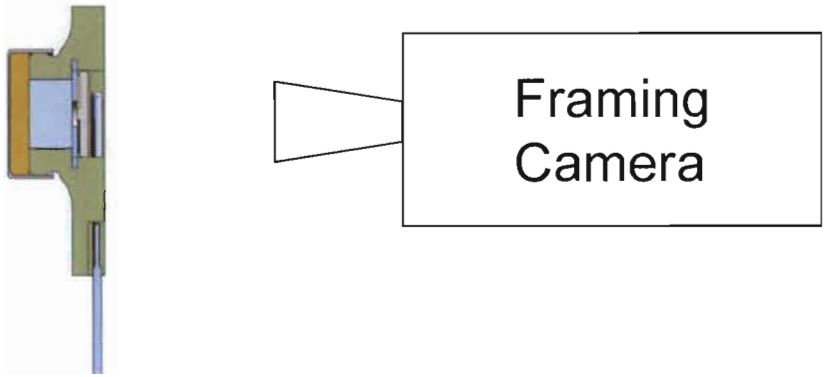

- **Loaded Detonators on Clear Substrate**
- **PDV from the "front" to observe pressure output**
- **PDV from the "back" to measure flyer velocity as well?**
  - Look "around" the bridge to see flyer at time of pellet impact?
  - Look "at" the bridge at time of pellet impact? Does Bridge impact as well?

# Streak Camera Imaging of Detonator Function




- **Loaded Detonators on Transparent Substrate**
- **Observe Streak images of Detonator Function**
- **Images of:**
  - Flyer shape and condition at time of pellet impact?
  - Detonation Spreading on initiation face of pellet?

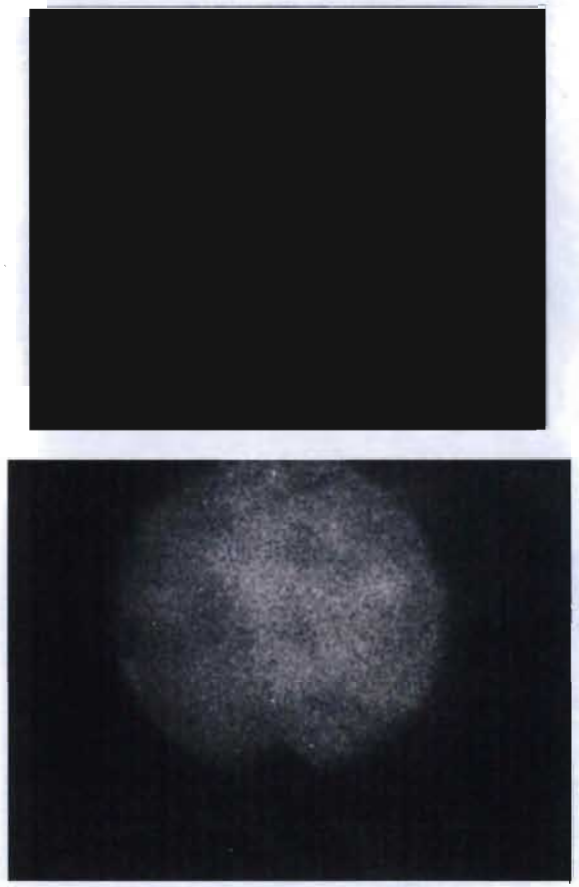
# Framing Camera Imaging of Detonator Function




- **Loaded Detonators on Transparent Substrate**
- **Observe Time Resolved images of Detonator Pellet Function**
- **Images of:**
  - Detonation Spreading on impact fact of pellet

# Framing Camera Images of Detonator Break Out

- Early images from several years ago
- Framing Camera images of breakout on face of detonator
- In this subtask, similar images would be obtained from the initiation face of the pellet.



# Timeline

- **Late FY11**
  - Discussion with KCP on chip fabrication issues
  - KCP to begin clear substrate fabrication(?)
- **Early FY12**
  - First try for many of the diagnostic configurations, especially the chip only configurations
  - Fabrication of clear substrate detonators (HE loading, clear potting, etc.)
- **Decision Gate (Spring FY12 TCG Meeting)**
  - Promising diagnostic configurations will be continued
  - DOD equivalent that could be produced on a clear substrate
- **Late FY12 and FY13**
  - Systematic test matrix of most valuable diagnostic configurations

# Conclusions

- **Clear Substrates offer a new viewing angle for observing chip and detonator function.**
- **Duplicate design with regular substrate will be extensively tested with Neyer, schlieren, PDV, DODO, etc.**
- **Not all the diagnostic options describe will work, but we believe enough will work to add unique insight of chip and detonator function.**
- **We have some DOD chip slappers on glass from SDI from an earlier JMP project, which we will try to work up into some similar tests.**
  - Those DOD chips had issues with delaminating when soldiering leads.
  - We can discuss with KCP making any DOD chips on clear substrates as well.
  - Might the chip in the SPIDER be manufactured on clear substrates as well?
- **Suggestions, Comments, Past history doing similar work?**
- **Need DOD POC and Advocate**