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Title:	Onion Skins, Snowballs, and Half Peaches, Oh my ...
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Form 836 (7/06)

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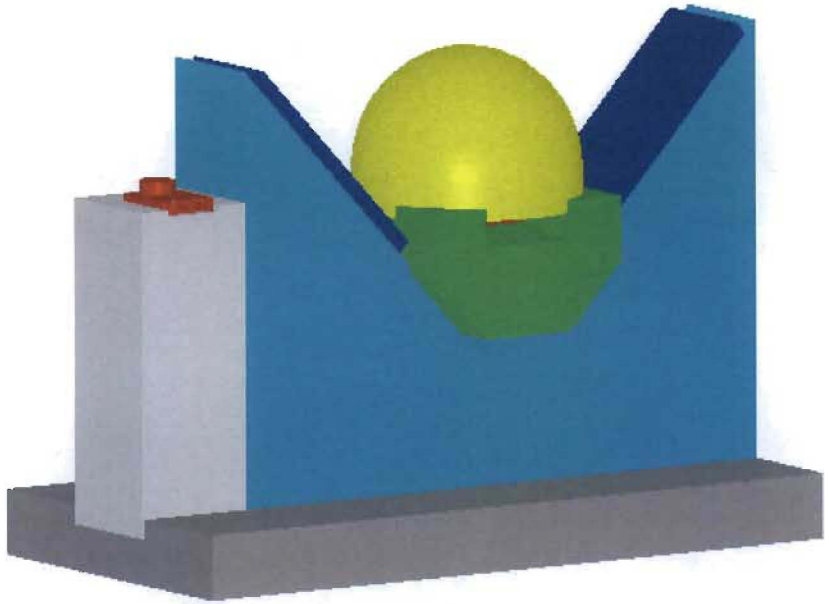
What is an Onion Skin Test

- **Explosive train test**
- **Powder lot acceptance**
  - Measured amount of corner turning
- **Experimental explosives**
  - Compared changes in explosive sequence
- **Complete explosive train test**
  - Captures propagation from initiator to main charge
  - Includes glue joints, gaps, and assembly tolerances
- **Evaluates:**
  - Det to Booster transfer
  - Booster to Main charge
  - Corner turning

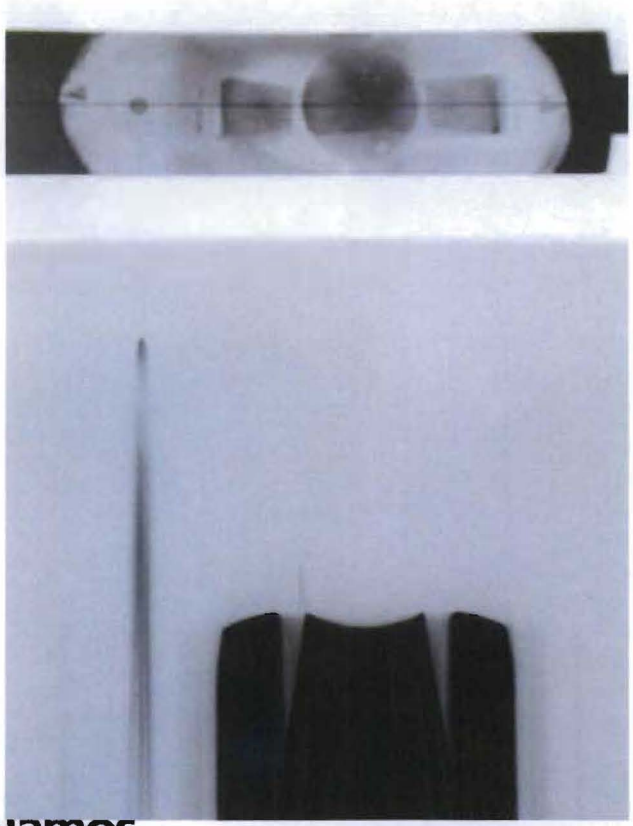


Analysis Options: Point Timing

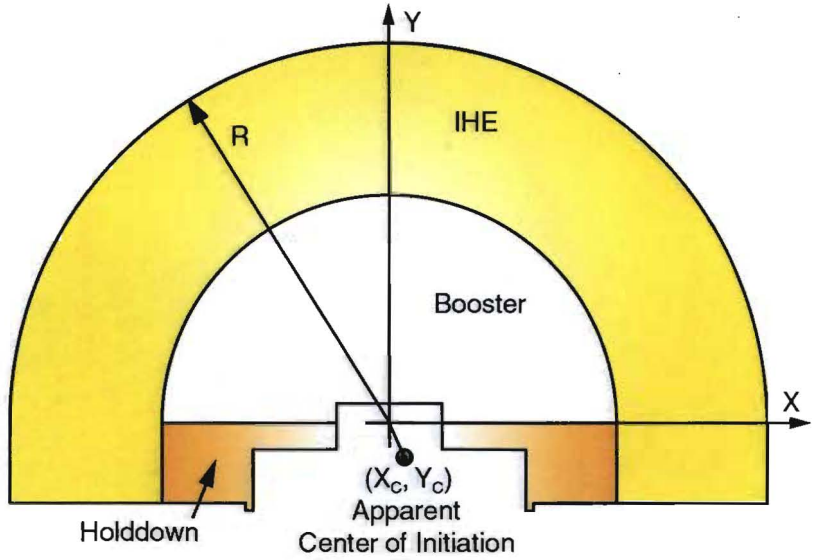
- 4 timing points (AWE)
- 4 TOA pins, at 4 angles from 0 (pole) to 50 degrees (or more or less)
- Break out time on all pins has to be with a certain time window

Onionskin Experiment

Film Record

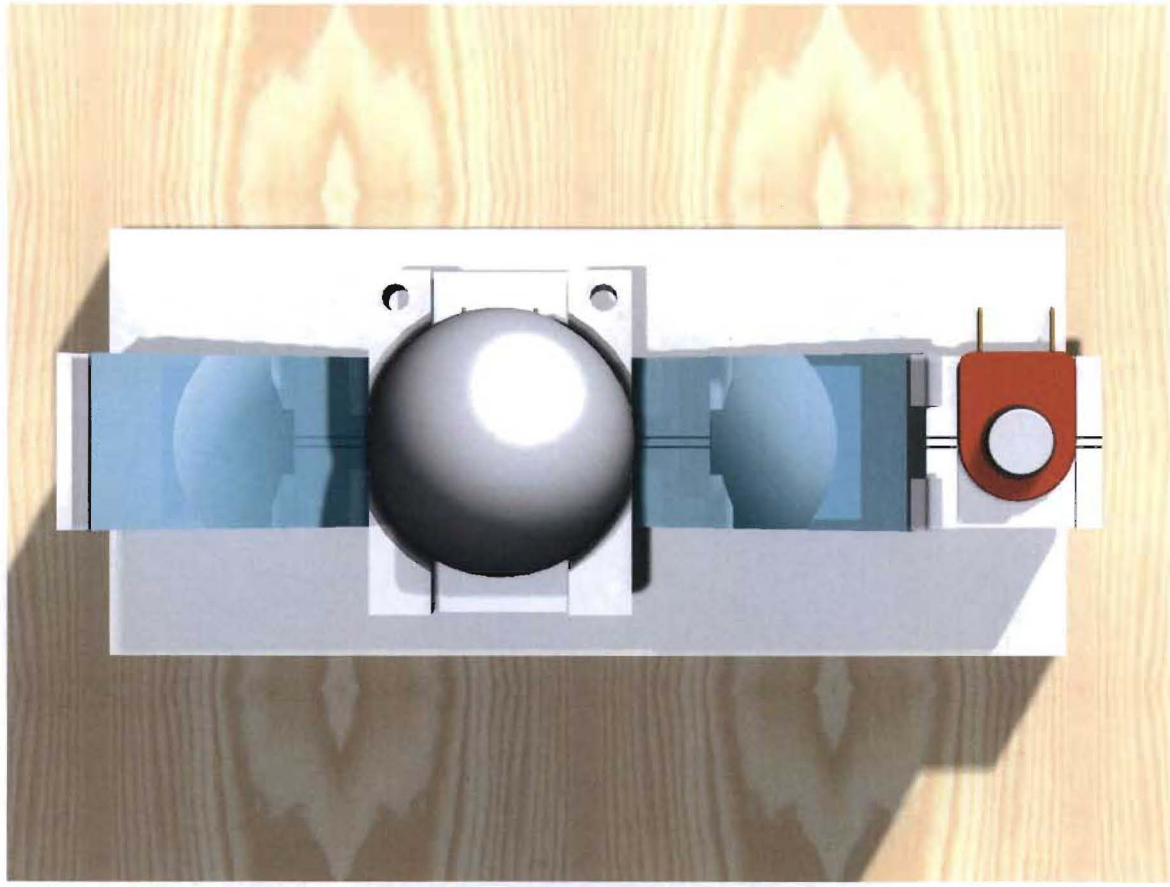


Onionskin Section



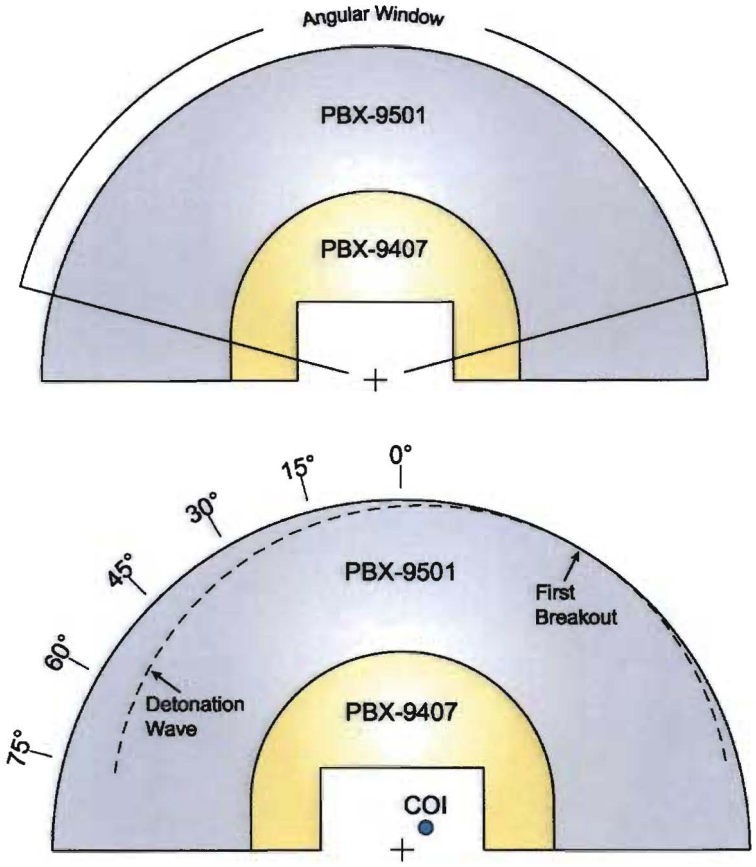
Onionskins have traditionally been done only for IHE systems, including PBX 9502

Streak Camera View of Assembly



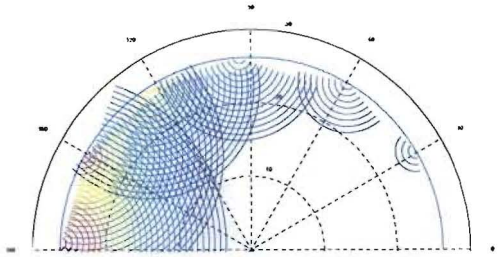
Streak Camera Based Analysis: Included Angle

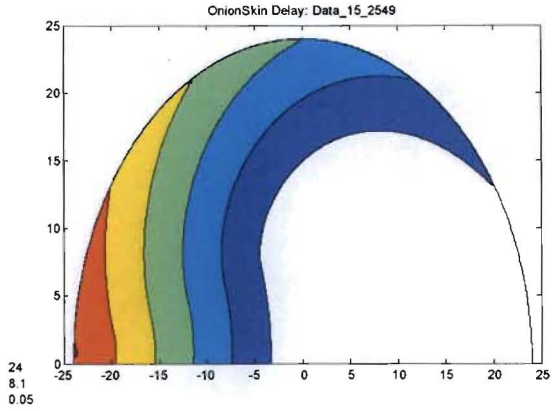
- **Included Angle between two points**
  - First light breakout
  - Within certain timing window
- **Sometimes expressed as percentage (of 90 or 180 degrees)**
- **A "pass/fail" kind of test for booster and/or main charge material acceptance tests**



Streak Camera Based Analysis: Detonation Wave Reconstruction – Dick Yactor

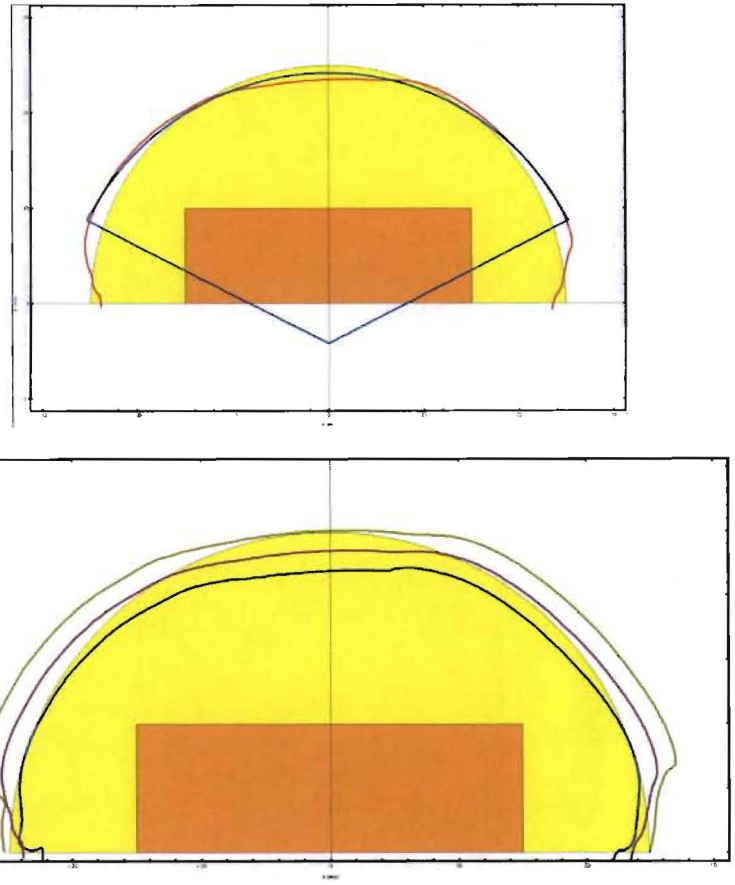
- Assume "perfect" spherical det wave would have entire surface break out at the time time.
- Use timing delays to estimate how far behind spherical the det wave is at each angle position.
- Draw rings for each locus of points that could be det wave location for each angle
- Use eye to "integrate" overall det wave shape at any given time delay
- Assumes that det wave is moving at constant velocity.





Streak Camera Based Analysis: Detonation Wave Reconstruction – Chuck Forest

- Assume perfect spherical det wave would break out at the same time.
- Timing delays can be thought of as a "phase delay" of sweeping wave.
- Phase delay can be converted to phase angle of breakout relative to surface normal.
- Phase angle and timing give parametric equation of det wave location.
- Can fit parametric data to get COI or plot parametric data to get wave shape



Pulsed Imaging camera based analysis:

- Aquarium Shots, where water is a quench medium and controls det products.
- Pulsed Camera takes multiple images and overlays them.
- Perfect spherical wave would show fully filled circle.
- Break out delays as a function of angle show up as rings.
- Corner turning delays, on center initiation, etc. show up as distortions of the rings

What are other analysis techniques (historic or current)

- **DOD?**
  - Do you have something similar?
  - What kind of analysis do you do?
  - Who can I talk to?
- **DOE?**
  - Sandia version of this test?
  - Pantex / NTS version different from LLNL/LANL version?
  - Who can I talk to?

Future of Onion Skins: What more do we need from test?

- **Pressure – at distinct points**
  - PDV probes to replace 4 points of AWE system
  - PDV probes on non-streaked areas of hemi – LLNL / LANL / Pantex
  - 32 / 64 or more PDV (porcupine / hedgehog) on hemi
- **2D Surface**
  - Cross streaks?
  - Framing Camera?
    - Similar to the aquarium shots?
- **Pressure – continuous**
  - Line ORVIS (like VISAR)
  - Schlieren
    - Extend SIAS approach to curved surfaces
- **Embedded probes**
  - Embedded PDV
  - Embedded FBG – LLNL
  - Embedded pressure probes?

Future Analysis of Onion Skins
What other analysis do we need?

- **Full scale modeling? (LLNL?)**
- **Corner turning metric?**
  - Is breakout angle the best metric?
  - Tunneling vs. decaying vs. growing?
- **Center of Initiation metric?**
  - Assumption of constant velocity – any way to remove that assumption?
  - "Refraction" at interfaces inside the explosive – many variable problem?
- **Margin calculations?**
  - Acceptable margin at each angle? Continuous function?
  - Normalized? Against what? (pole? first breakout? average breakout?)