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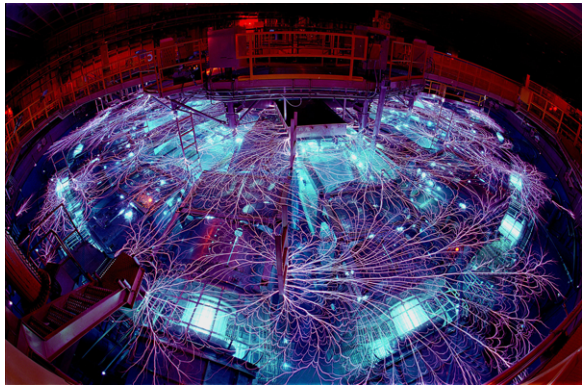
Lincoln 6 Post-Shot Update

D.B. Sinars, C.A. Jennings, R.D. McBride *et al.*

MagLIF Working Group Meeting

6/7/2012



U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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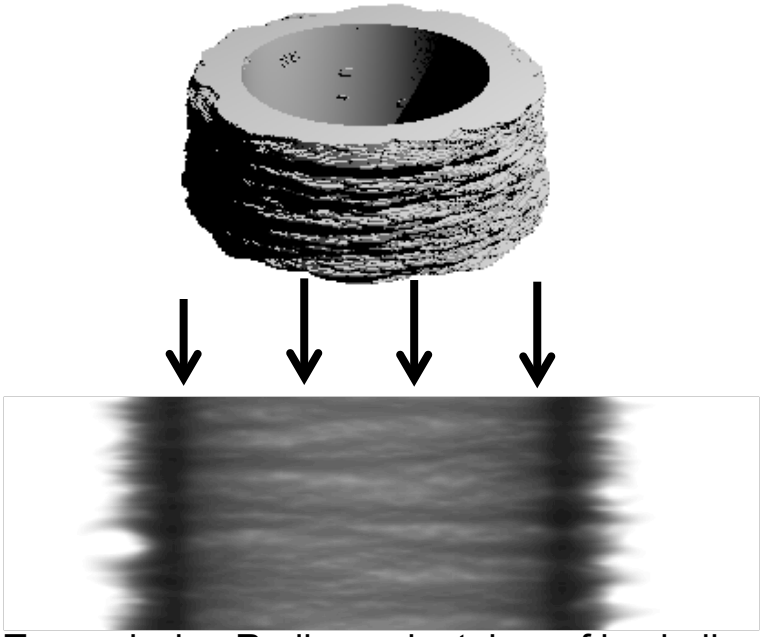
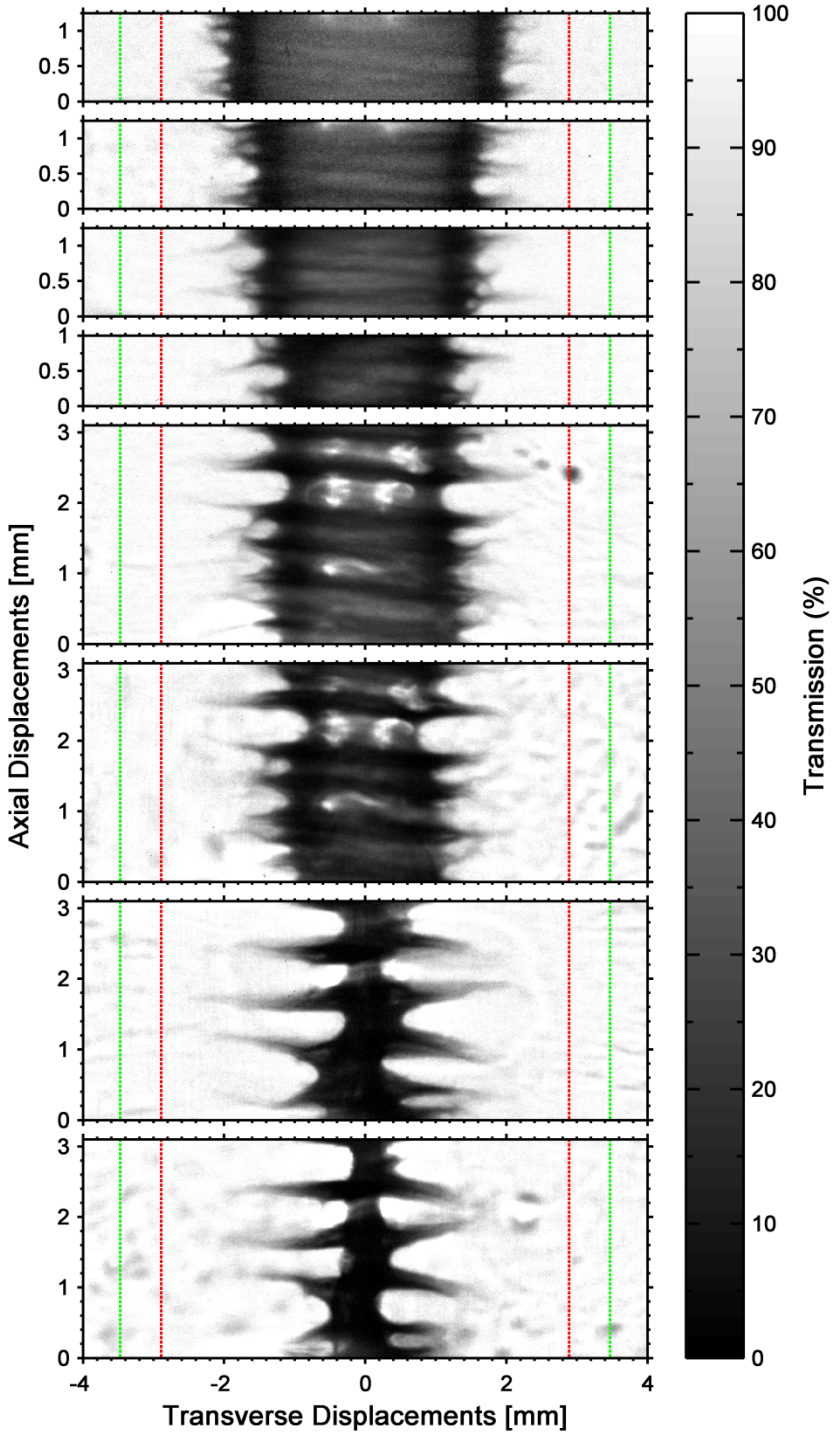
This Lincoln series builds on modeling done for previous Be Lincoln experiments

Ryan's McBride's previous Lincoln experiments studied AR=6 Be liner implosions

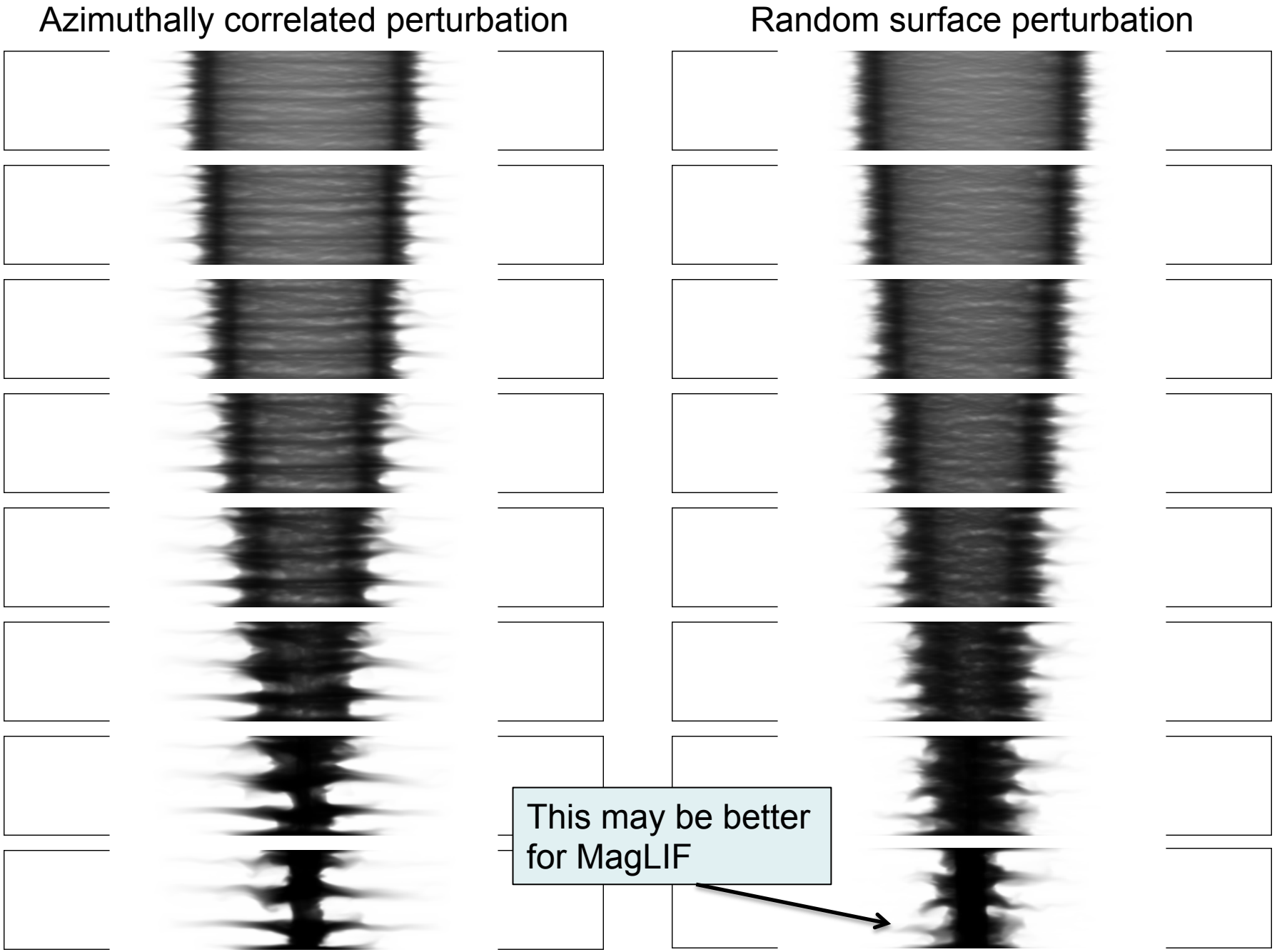
Modeling by Chris Jennings using Gorgon suggests that even a small amount of azimuthal correlation can be damaging



6 keV Transmission Radiographs taken of imploding liners



The effect of correlation is most evident late in time



Our liner targets are typically diamond-turned on a lathe to get good surface finish, but this results in azimuthal machining marks that may be seeding MRT growth

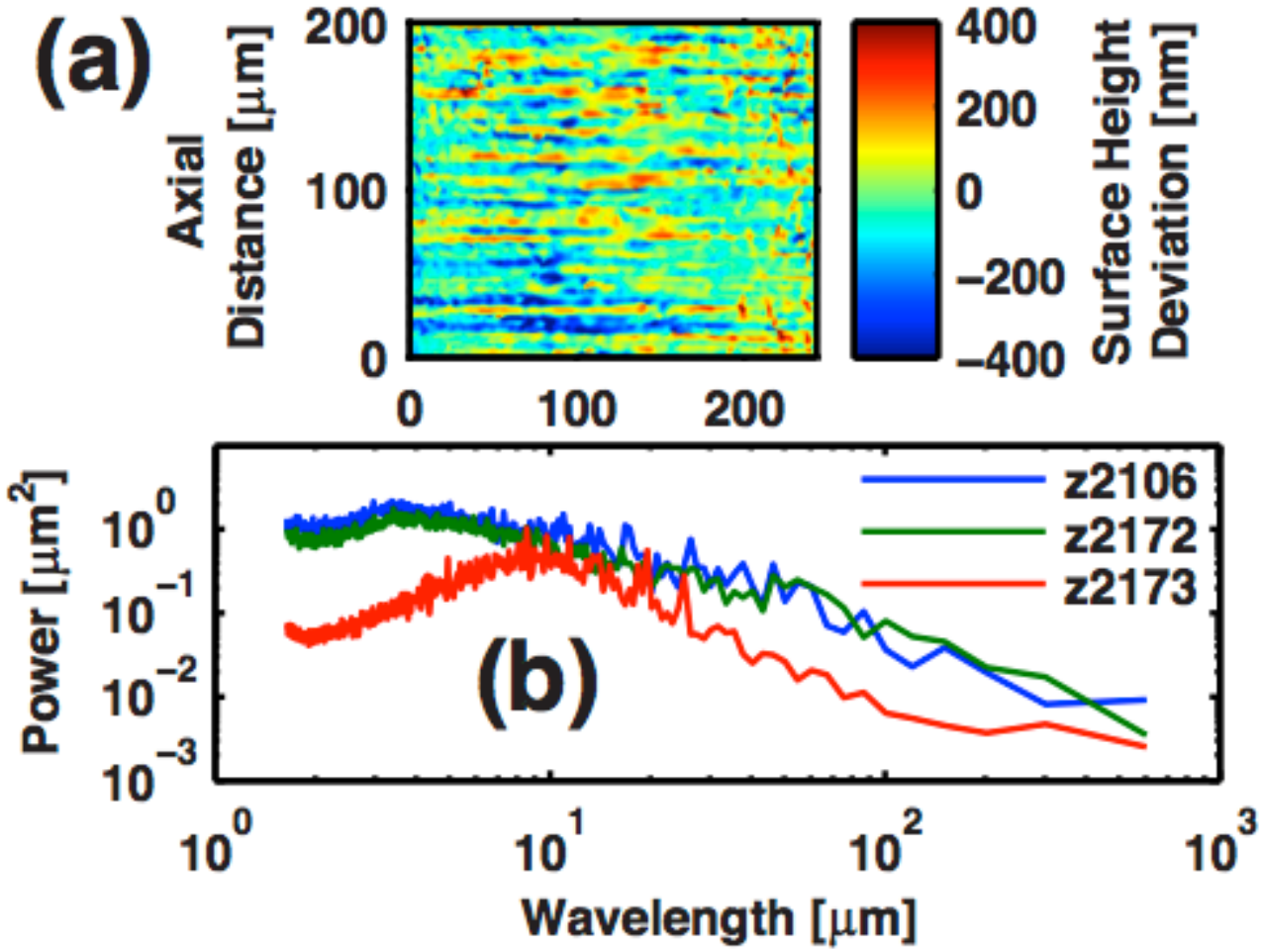


Figure from R.D. McBride et al., submitted to Phys. Rev. Lett. (2012).

Lincoln 6 is testing the hypothesis that the late-time structure of a liner implosion will be more random if we eliminate azimuthally-correlated structures

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- This is related to the question—is there a surface roughness specification for MagLIF targets to work? If so, what is it?
- One possible reason the surface structure may not matter is if electro-thermal instabilities* in the bulk material can play a dominant role in seeding the magneto-Rayleigh-Taylor instability

* K.J. Peterson, D.B. Sinars et al., manuscript in preparation

For Lincoln 6, we worked with General Atomics to develop a post-machining, axial polishing technique

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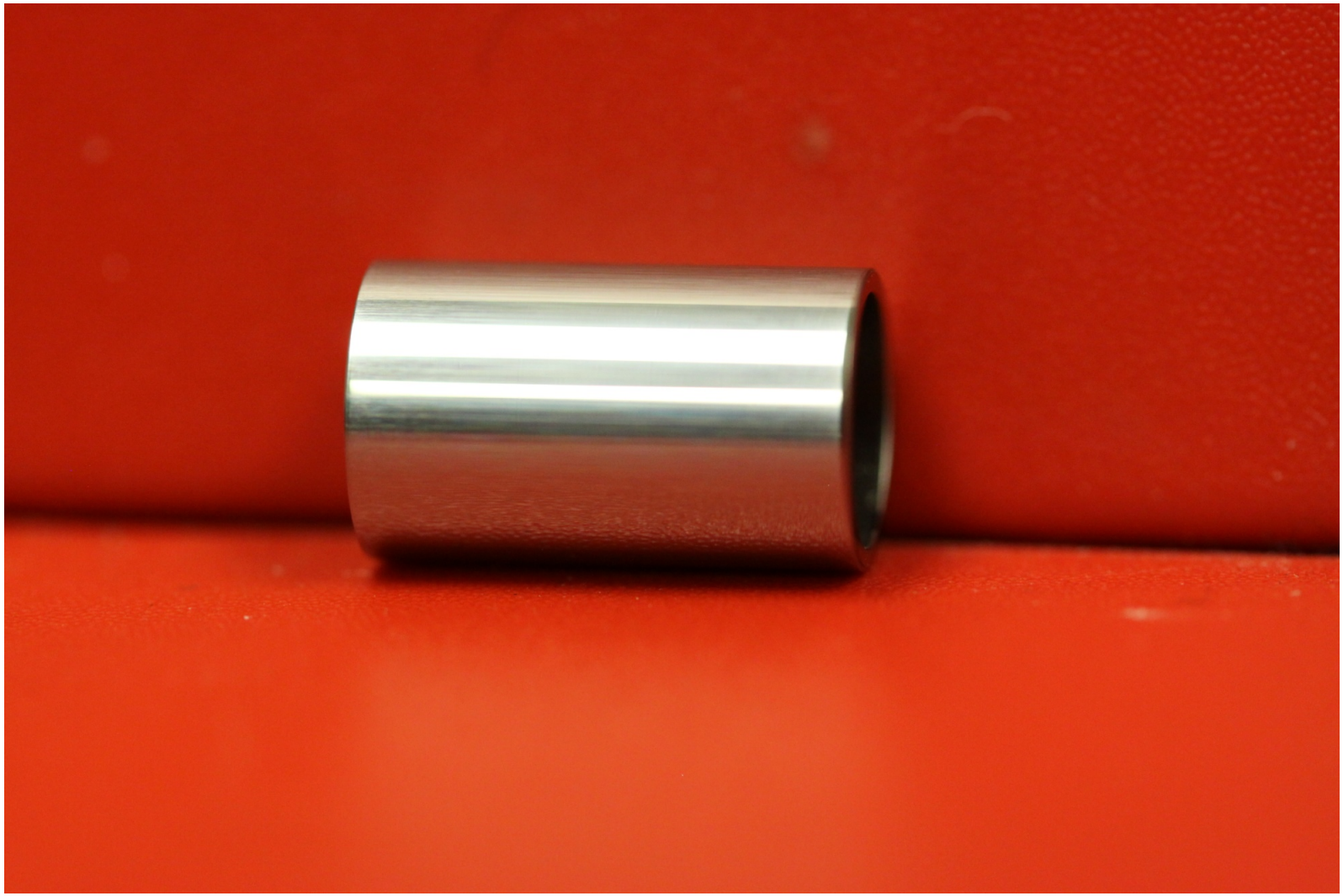
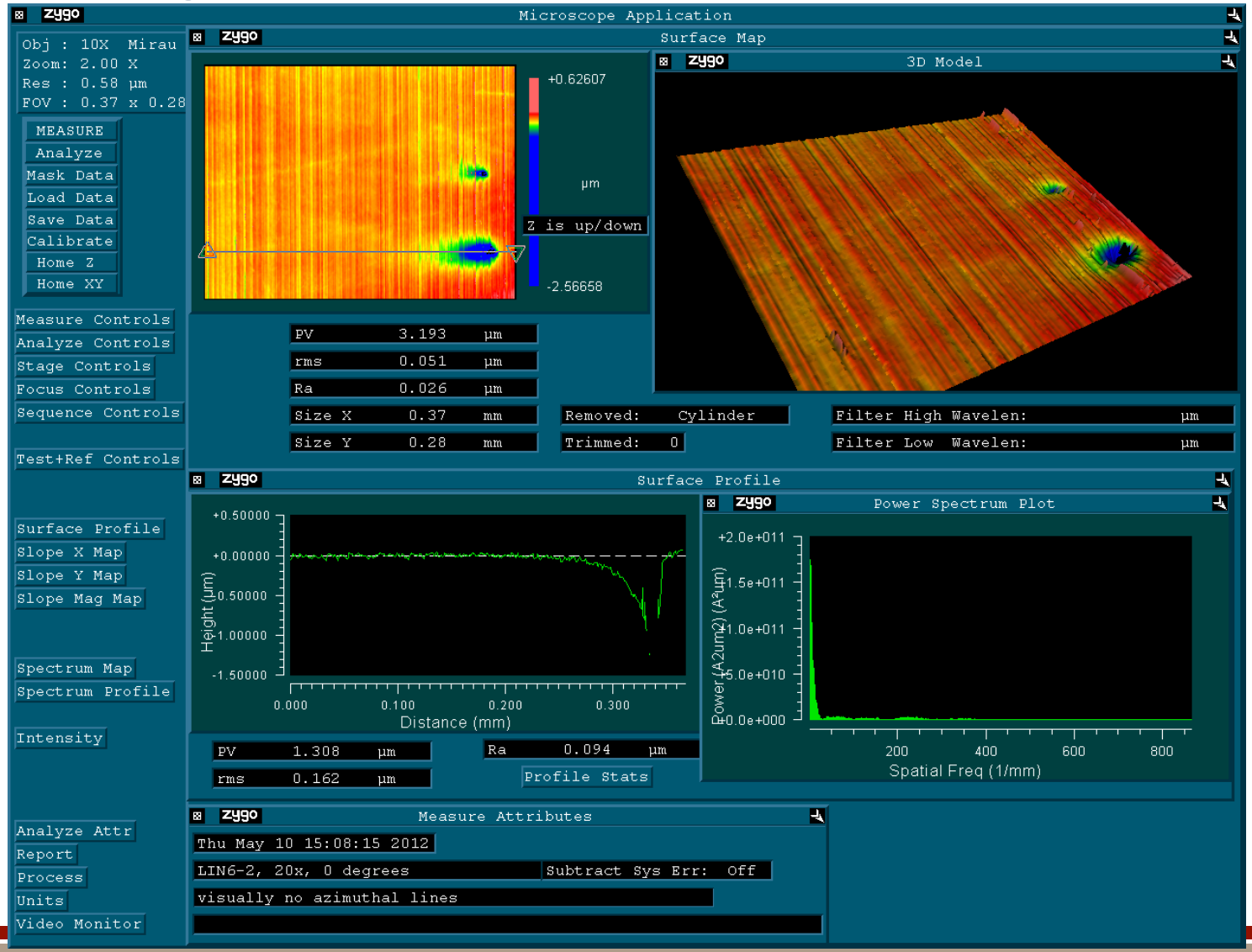


No Azimuthal Lines Are Obvious To The Naked Eye

Example surface characterization data from Lincoln 6 target shows that axial polishing results in only z-oriented grooves and overall better surface finish



LIN6-2, 20x, 0 Degrees

We fielded 3 out of our existing 4 Lincoln 6 hardware sets in May

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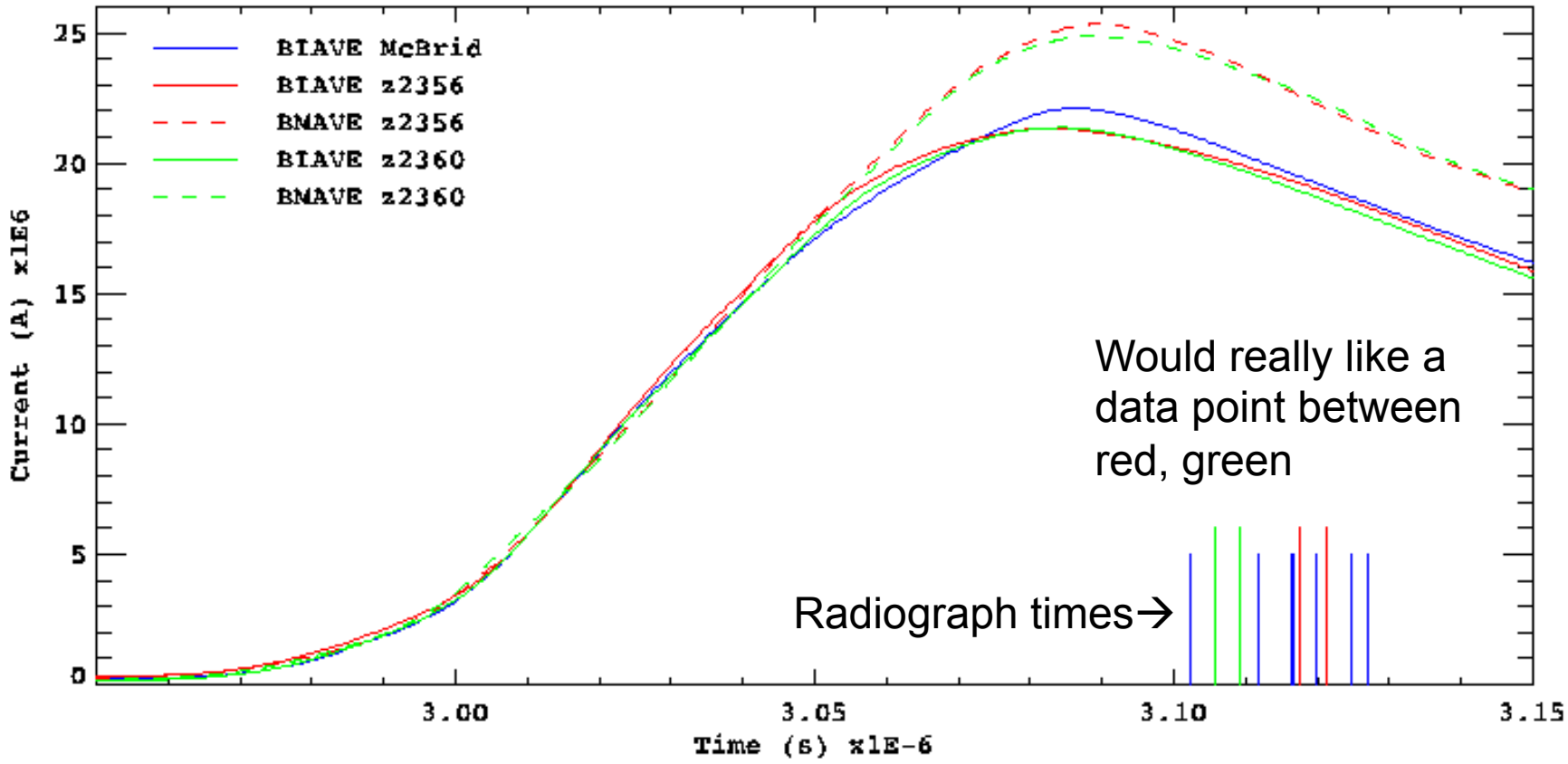
- Problems with the Pu experiment caused the shot series to spill over into May 21-22, causing us to lose two of the nine shot days available for Catron + Lincoln
- We successfully interleaved the Catron and Lincoln shots, giving the Catron team time to refurbish their diagnostics in between experiments (e.g., GRAPHIC)
- Lincoln 6 shots:
  - Thursday, May 24: z2356
  - Tuesday, May 29: z2358 --No radiography data due to an error with the T1 triggering system that fires ZBL on Z shots
  - Thursday, May 31: z2360

We obtained similar BIAVE currents to Ryan's original series, as well as radiography data at times close to several of his radiographs



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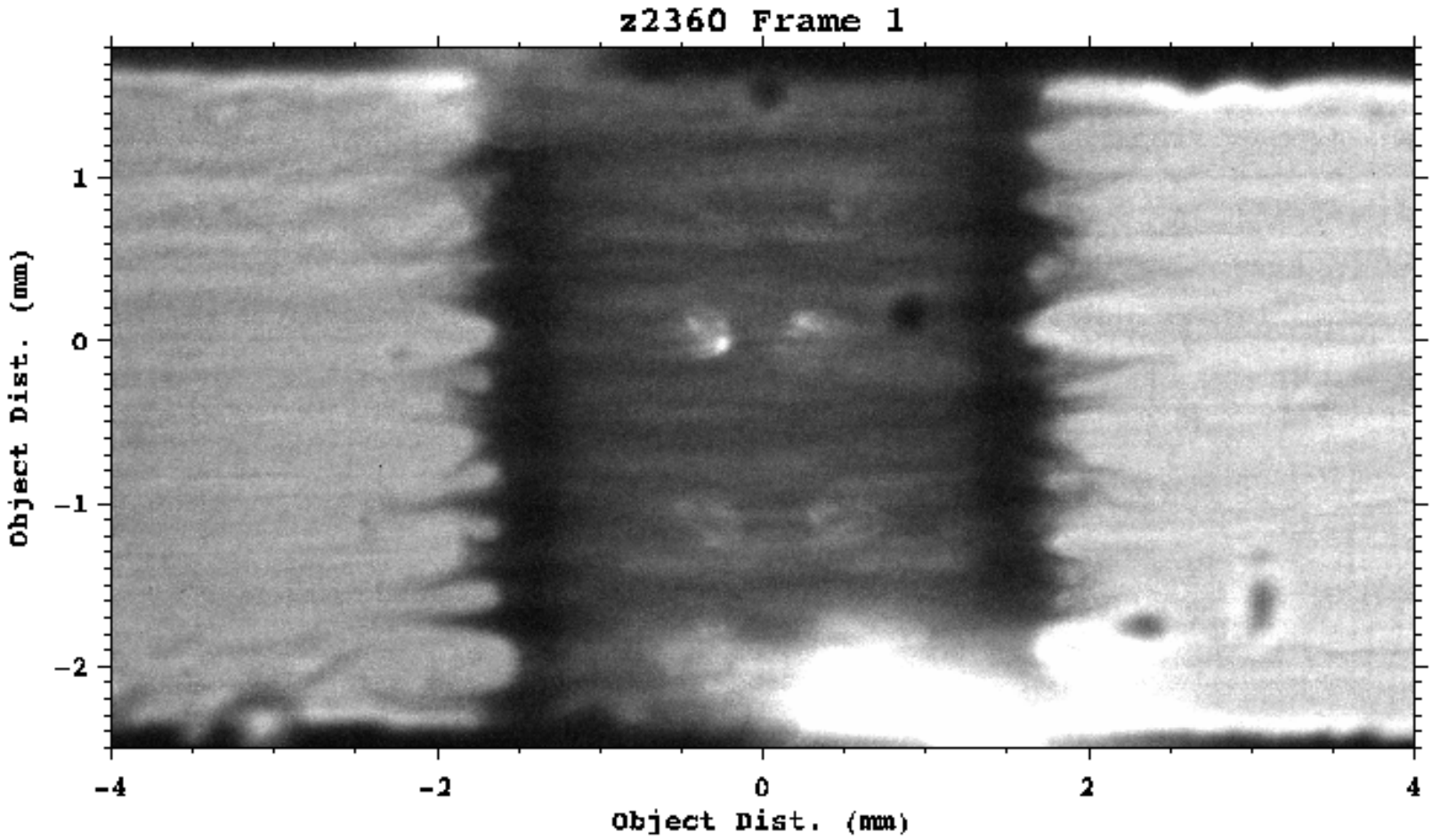
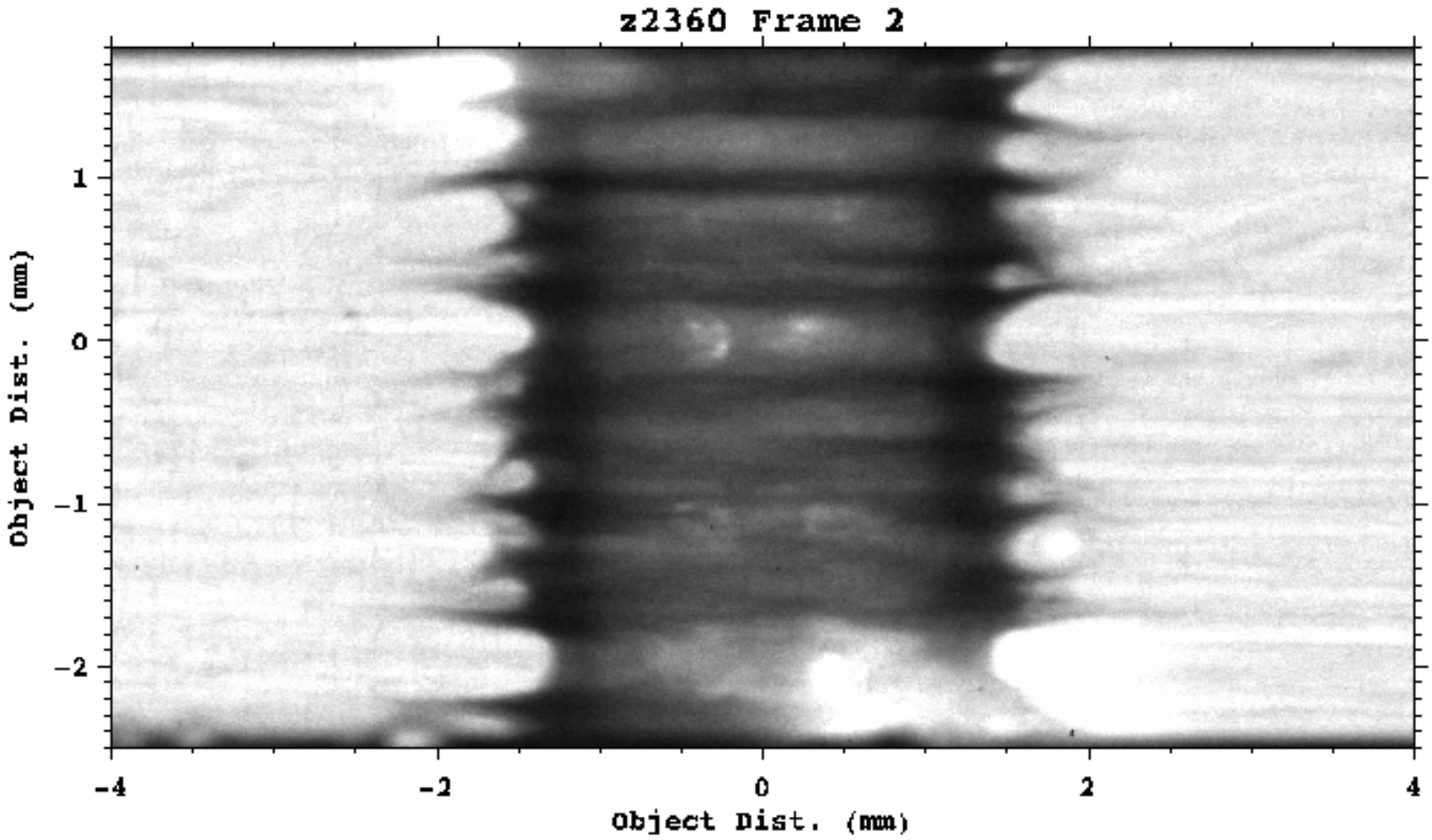
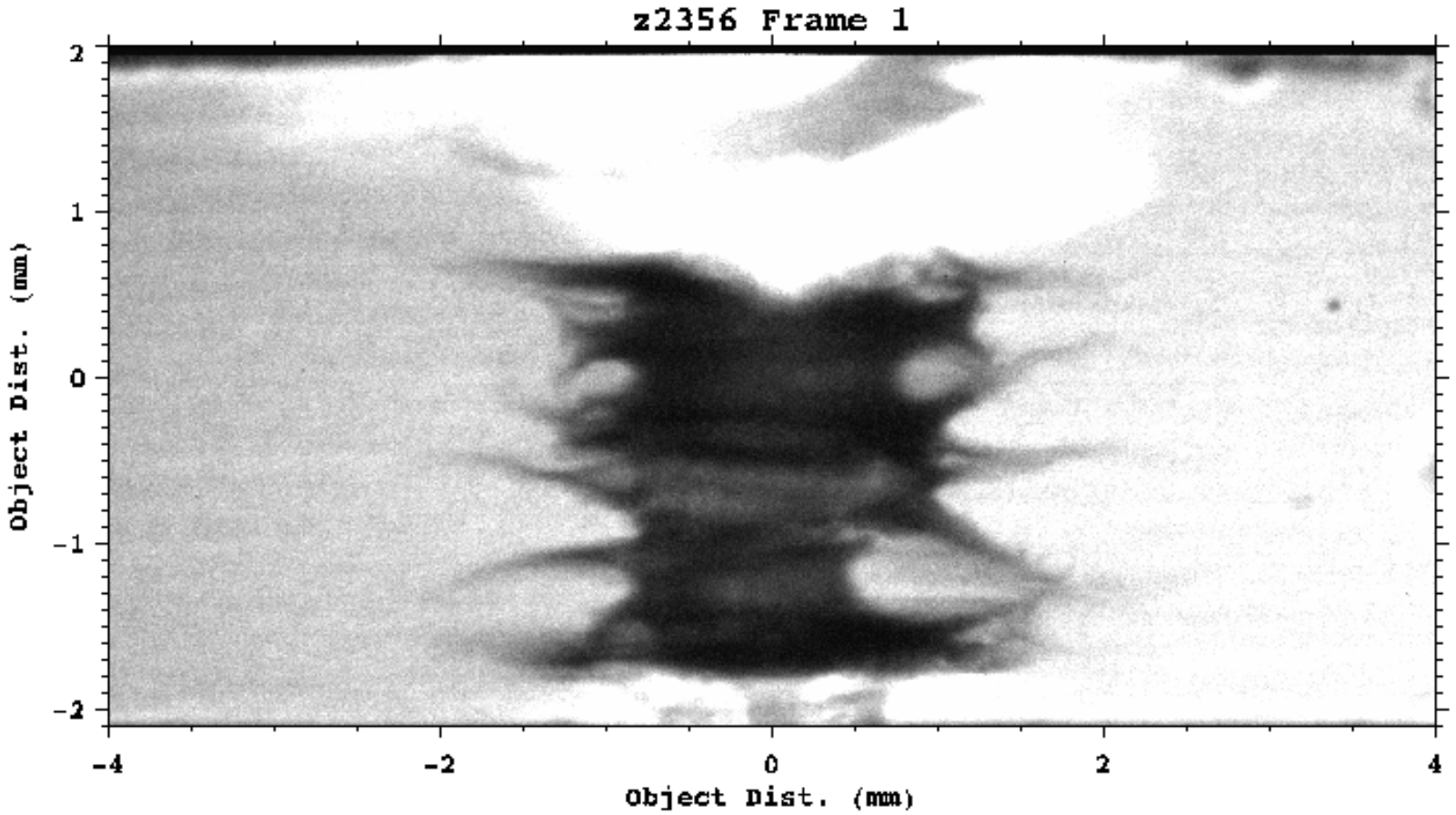
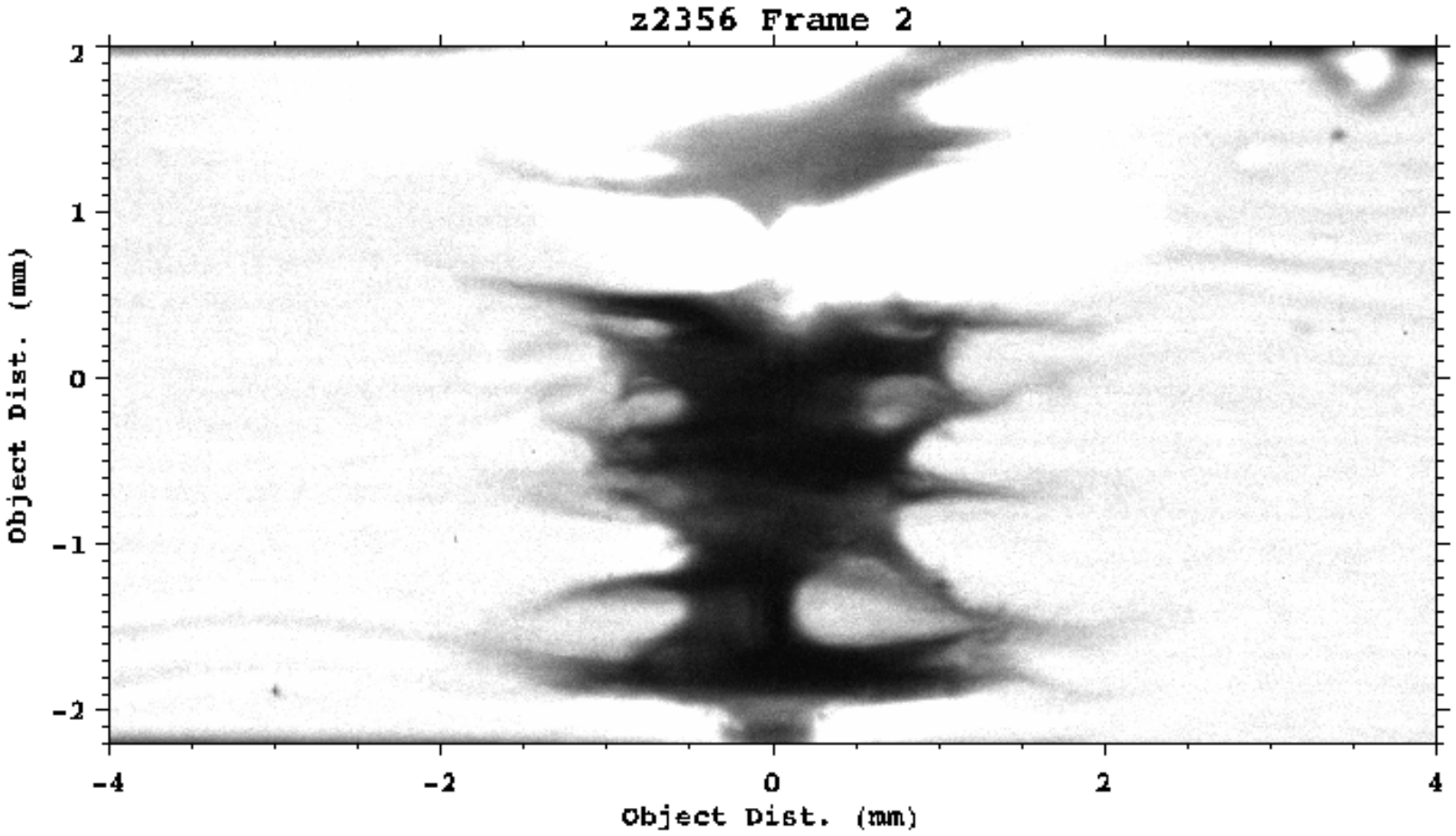



z2360 Frame 2
Object Dist. (mm)
1
0
−1
−2
−4
−2
0
2
4
Object Dist. (mm)


z2356 Frame 1
Object Dist. (mm)
2
1
0
-1
-2
-4
-2
0
2
4
Object Dist. (mm)


z2356 Frame 2
Object Dist. (mm)
2
1
0
-1
-2
-4
-2
0
2
4
Object Dist. (mm)

There is a few ns variation in timing

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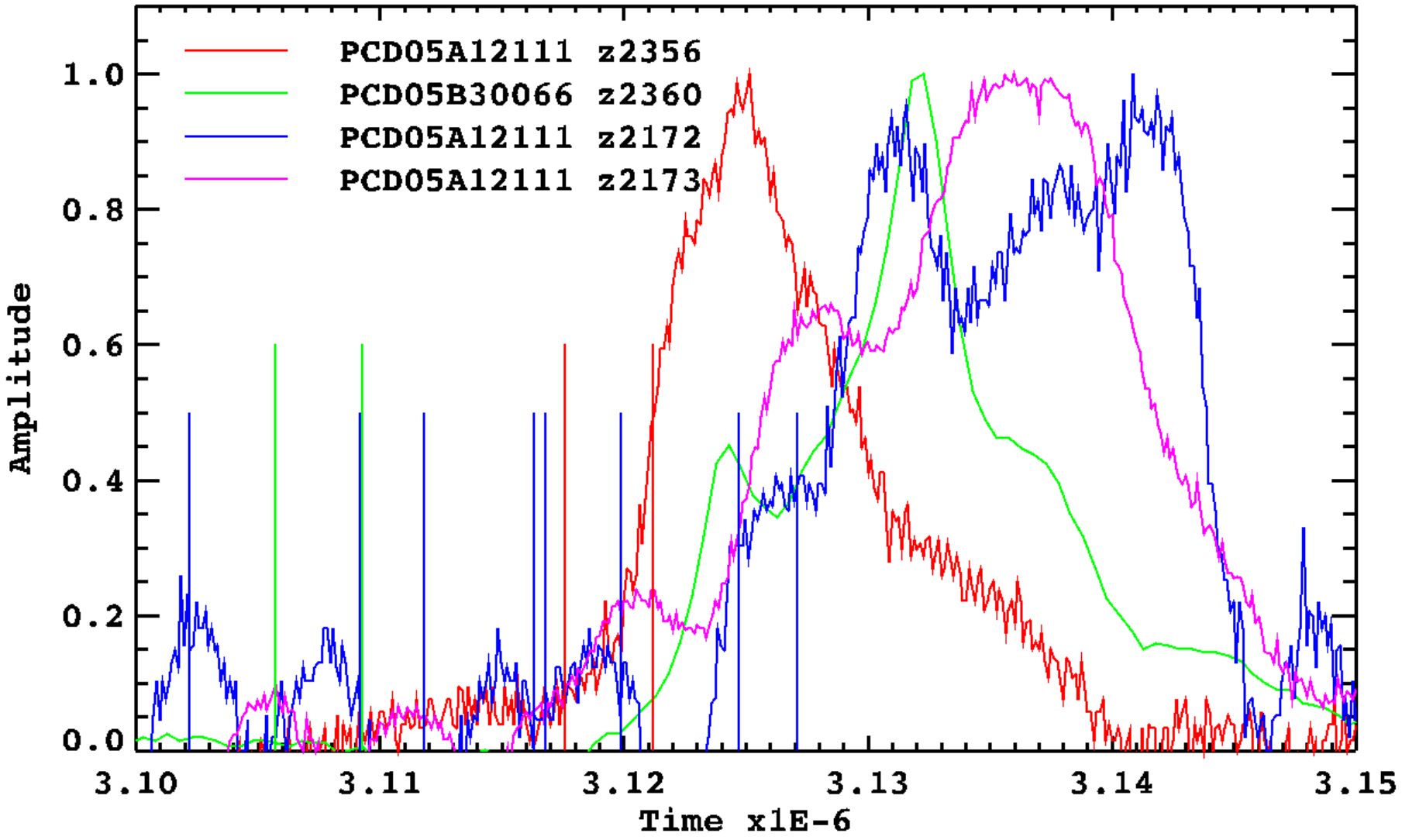

Comparison to previous data appears to show very similar structure at early time

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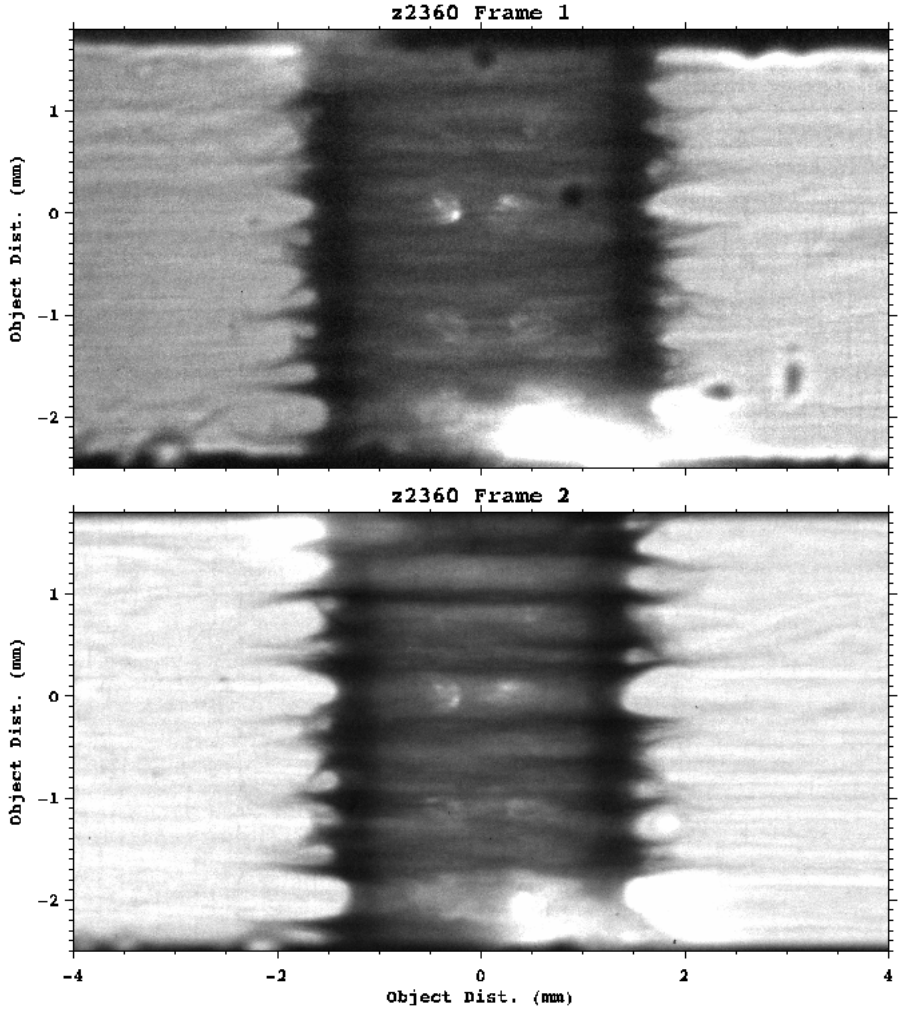
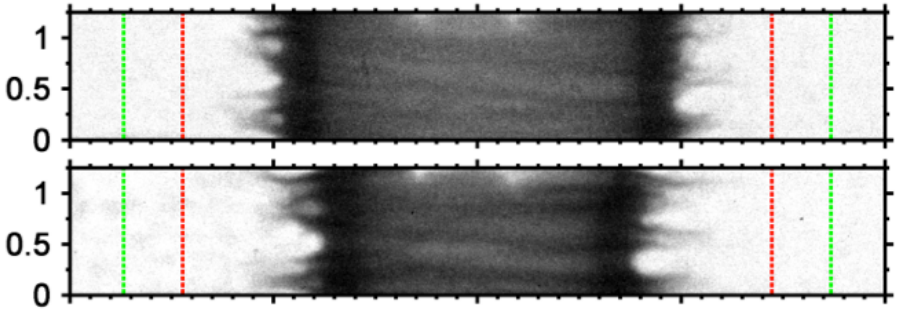
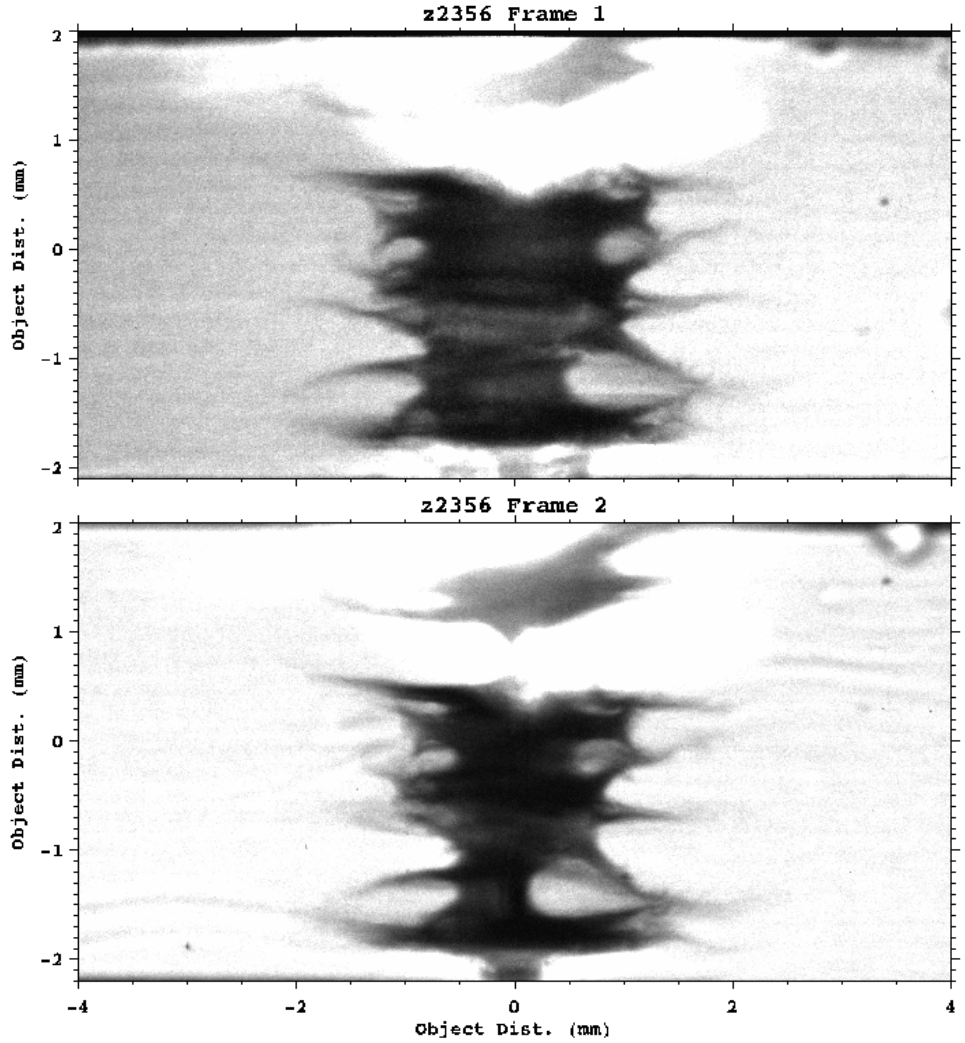
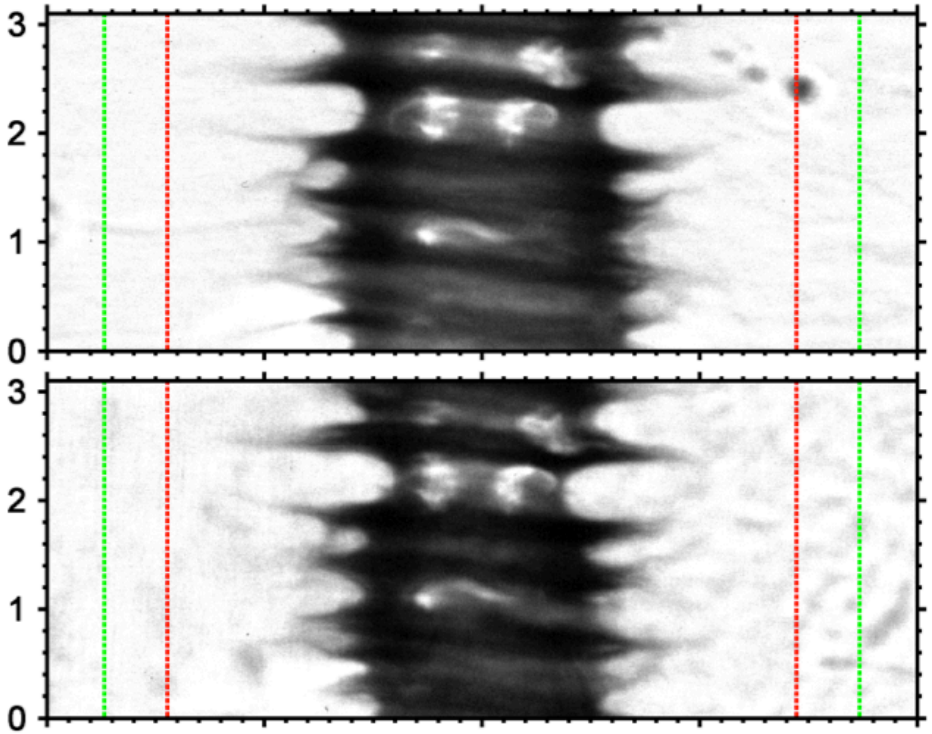




Z2360 Frame 2 at equivalent time to z2105 Frame 2

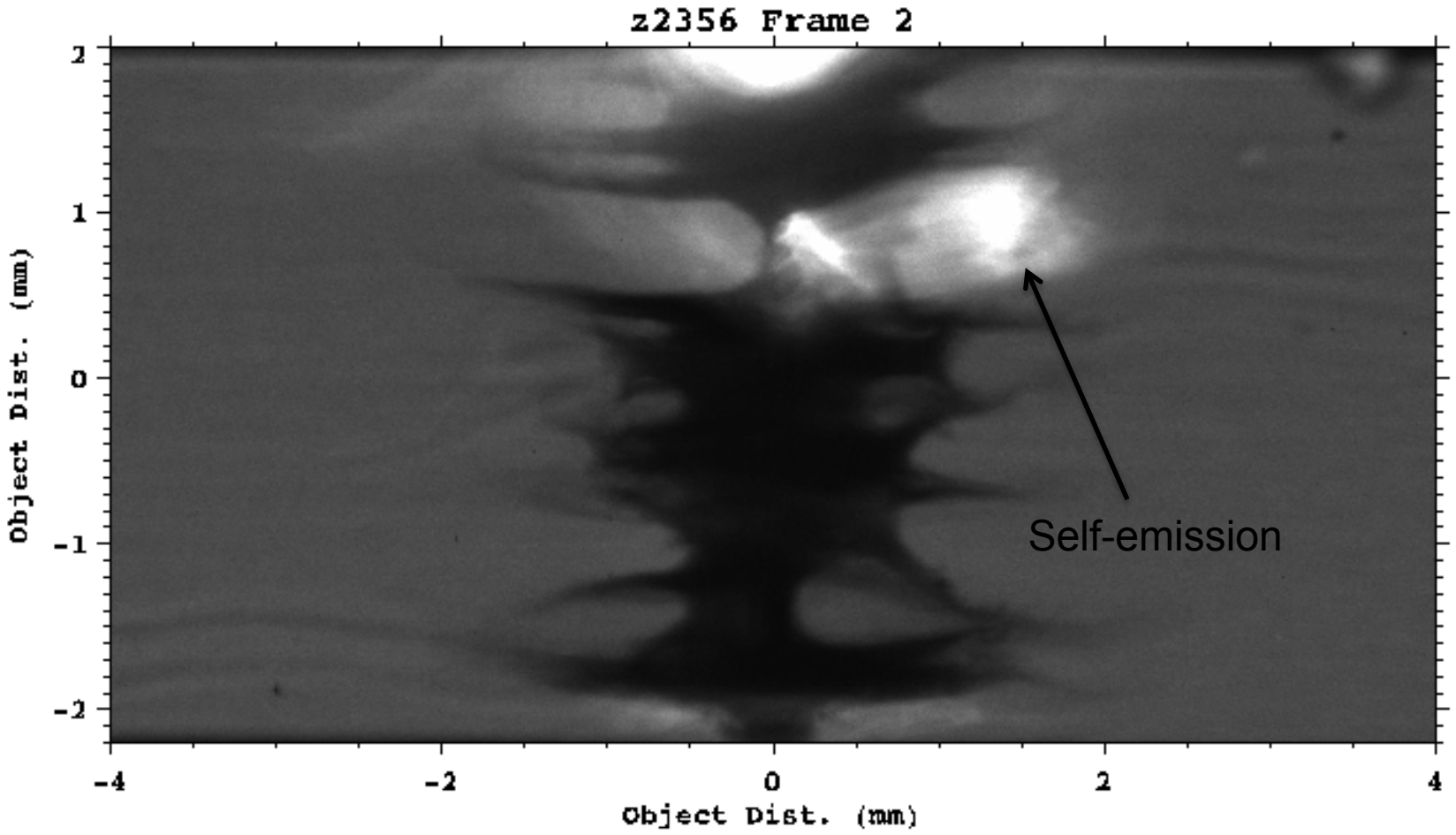
Comparison to previous data appears to show differences at late times





Z2356 frame timings nominally within 1 ns of z2172 timing…
…but there may be several ns implosion timing difference?

A re-scaled image that shows the self-emission structure better



We fielded 4 PCDs + 2 SiDs, and obtained very nice SiD data

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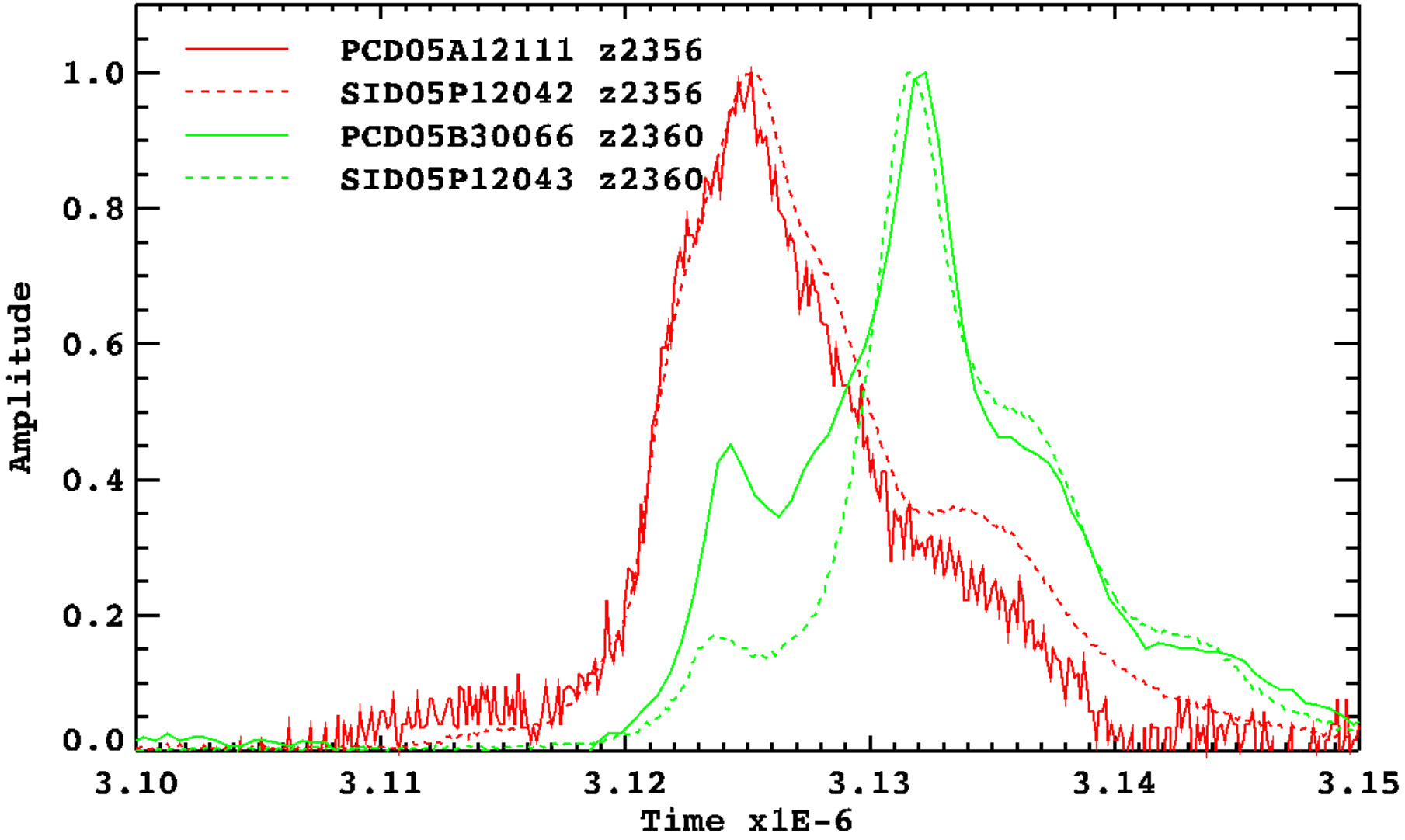

Where do we go from here?

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- Have one more target + hardware set remaining. Tentative goal would be to obtain a timing intermediate to the two sets of data obtained so far this series
- It is not obvious yet whether this is "better" for MagLIF or not —the z2356 structure didn't look particularly nice in that some axial segments appeared to be imploding well before others?