



Fiber Aging

WBS 2.2, 2.3

5 June 2007: CD-2/3a Review

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Summary

- Wanted to determine how the reaction between pseudocumene and fiber cores depends on concentration
- Result: There's a high power law dependence on concentration
 - High concentrations react on the scale of minutes
 - Low concentrations react on the scale of years or longer
 - NO_vA uses an extremely low concentration



Preparation

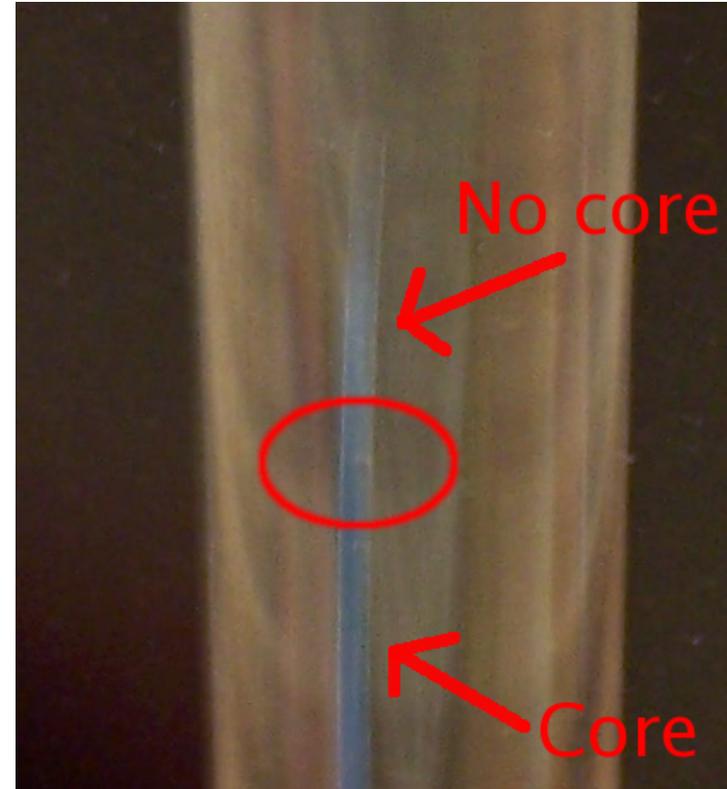
- Immersed 1.0mm fibers in concentrations of pseudocumene between 5% and 100%
- Set up for long term test
 - tubes are well sealed to prevent evaporation
 - stored on a shelf at room temperature
 - clearly labeled for future grad students/archaeologists





Measurement

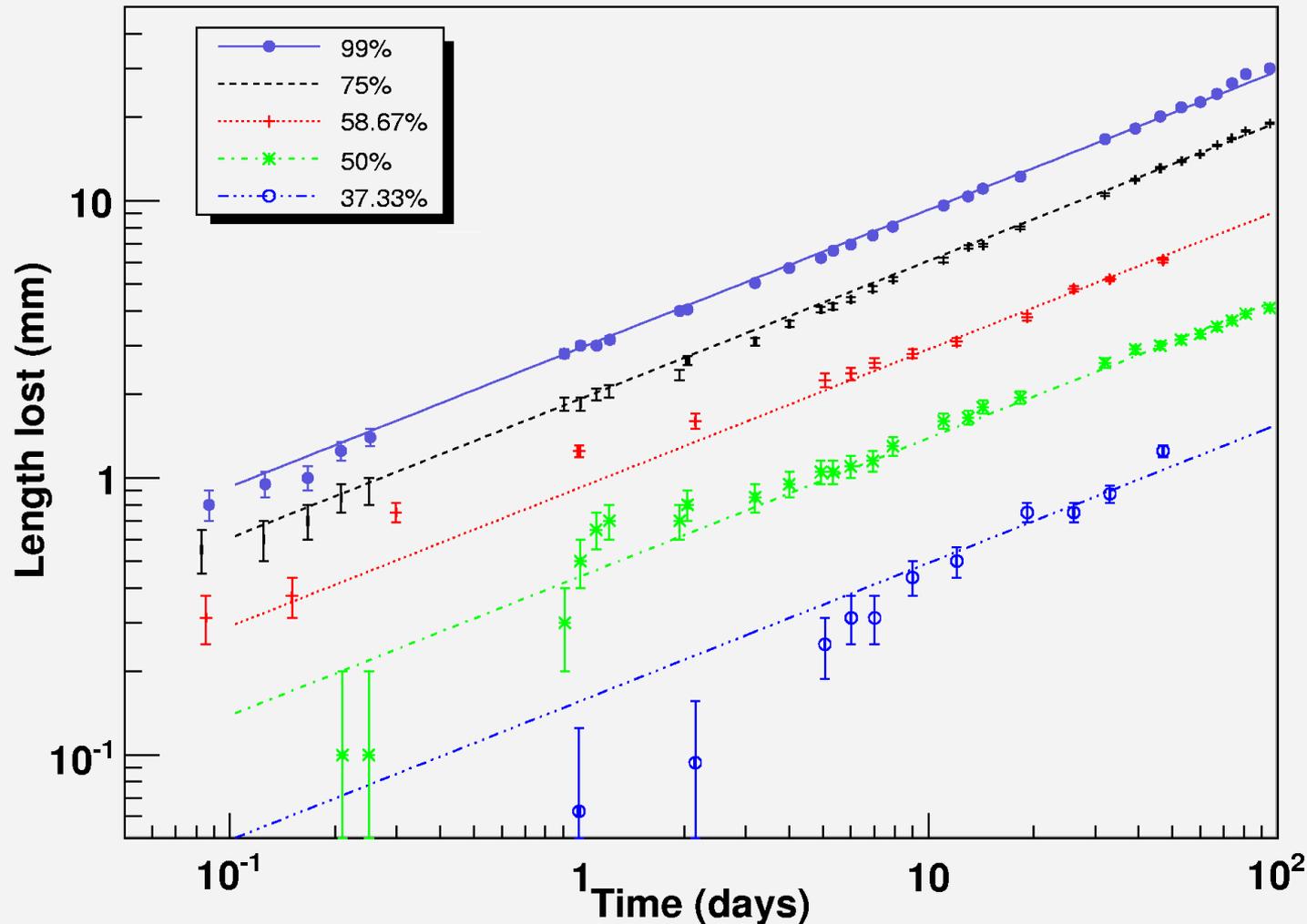
- Visually inspected over time for amount of core loss
 - Hard to photograph, easy to see
- Lengths down to 1/16 mm are measurable
 - coarse diffraction grating + magnifying glass
 - Maybe can improve future measurement of short lengths with an optical comparator (a.k.a. fancy overhead projector)





Core loss \propto square root of time

Length of core lost vs. Time





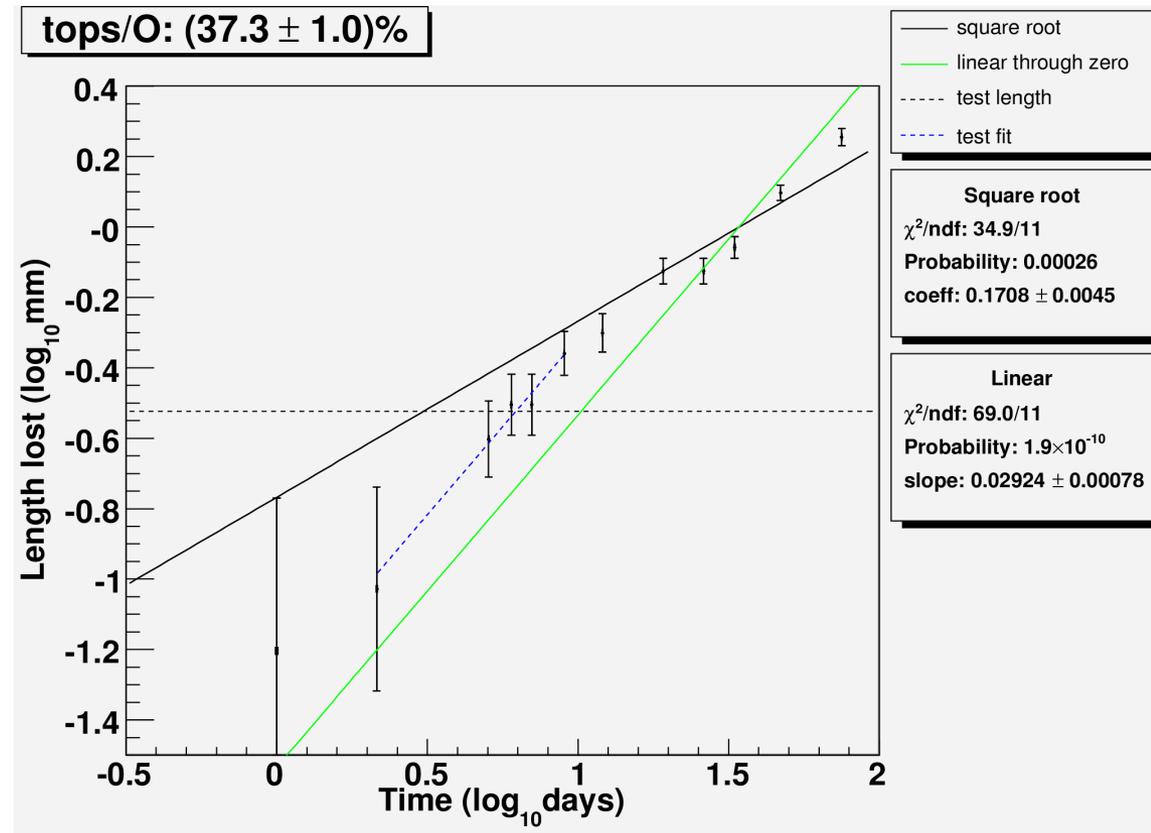
Rate Details

- Square root relationship holds at least down to ~40%
 - Best explanation is that reaction proceeds faster than diffusion through product substance
- Below 40%, rate starts to look more linear
 - makes sense if diffusion rate $>$ reaction rate
 - not enough data yet to say for sure
- Below 25%, no loss observed over 120 days
 - as of 14 May 2007
 - study ongoing



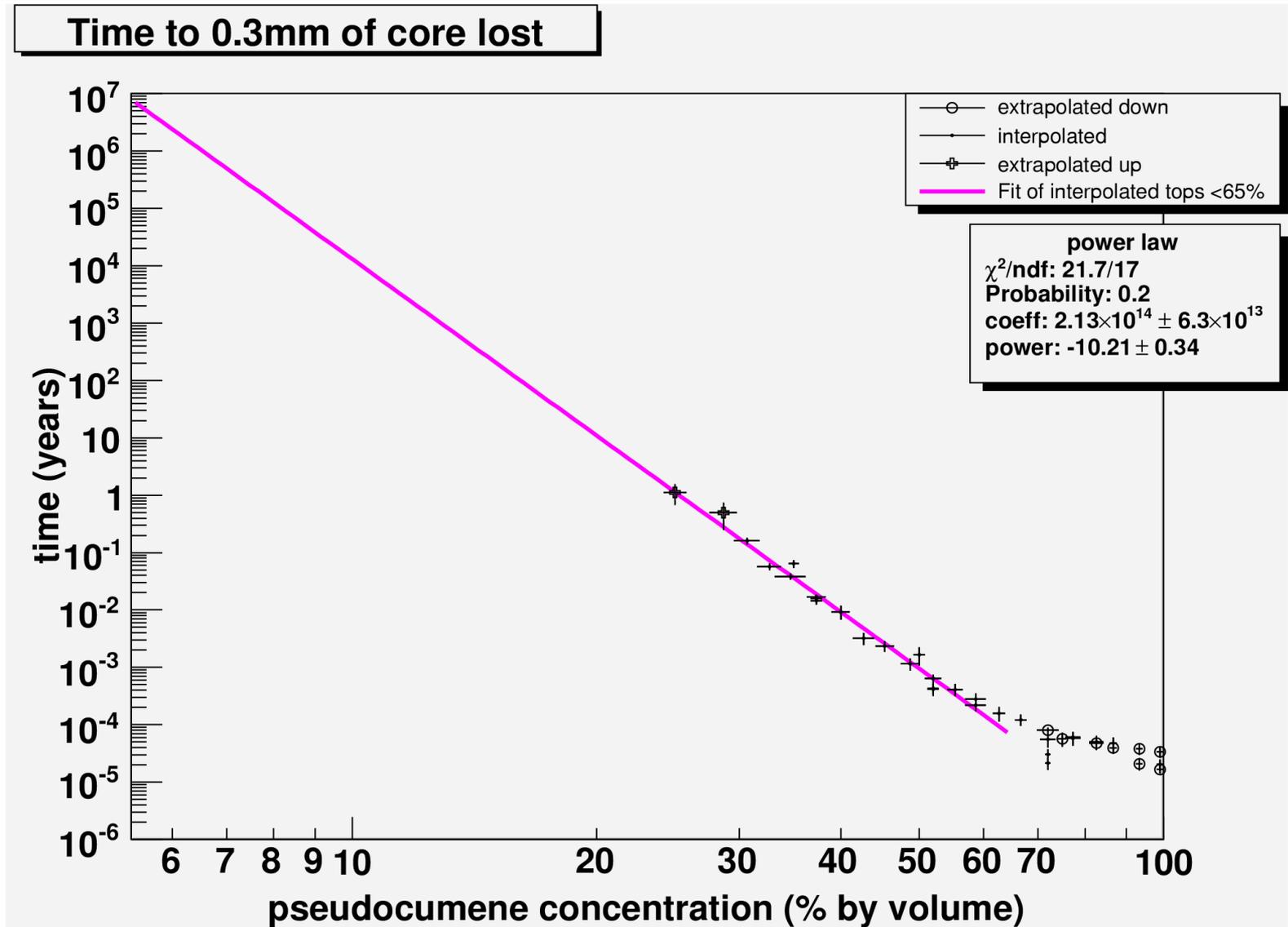
Analysis

- Metric: Time until 0.3mm of core lost
 - easy to measure well
 - shorter would be better, but harder to measure
 - $\sim 1/2$ of NO ν A fiber core diameter
 - this method reduces need to understand rate





Results





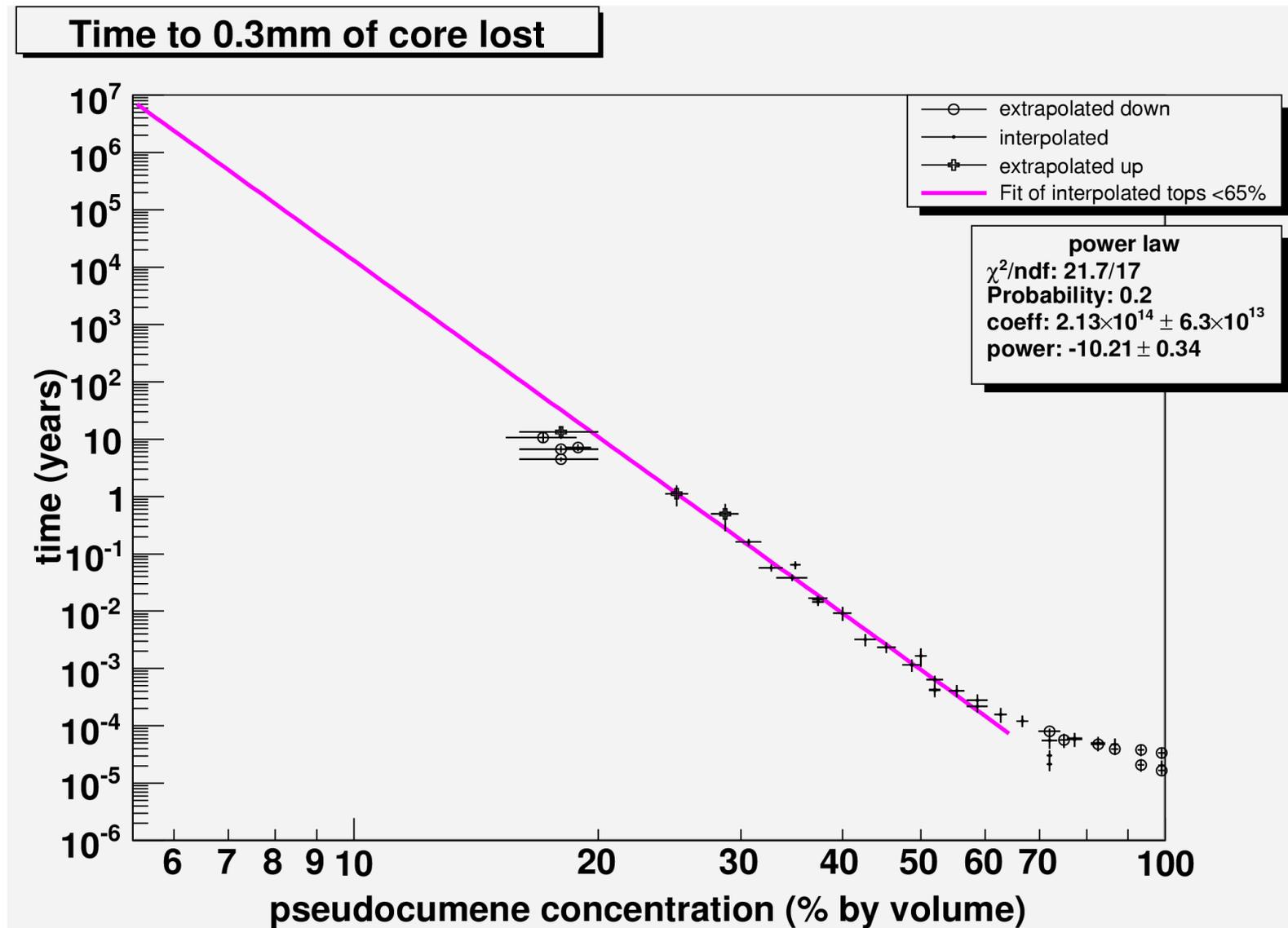
Unexpected Data

- On a high dusty shelf found fibers in scintillator dated Jan 1997
- Average core loss at ends $\sim 0.5\text{mm}$
- Analysis at Indiana found $\sim 16\%$ pseudocumene
 - Probably Eljin 517H equivalent with some evaporative loss
 - Parafilm added April 2007 to slow pseudocumene loss





Results with 11 year data





Conclusion

- Extrapolation to 5.3% (NO ν A) says that loss of any exposed core is:
 - estimated at 0.3mm in 7,000,000 years
 - <0.3mm in 700,000 years at 99.7% confidence
- Estimated loss of exposed core in 20 years:
 - 1nm assuming constant rate of loss, <10nm at 99.7%
 - <1.6 μ m at 99.7% if loss $\propto \sqrt{t}$ even at low concentration
 - seems very unlikely on physical grounds
- Even with ultrapessimistic extrapolation, no conceivable chance of losing 0.25mm ($\frac{1}{2}$ NO ν A core diameter) in 20 years



Quick Mention: Calorimeter

- 12 year old WLS fiber/liquid scintillator calorimeter
 - 10% pseudocumene
- Compared 122 days of new cosmic ray data to old data
- No change: New width is 1.027 ± 0.033 of old width

