

Title: Physics in Nature Presentation: Expanding - Growing Railroads and Cracking Roads

Date: Aug 19, 2011 09:30 AM

URL: <http://pirsa.org/11080097>

Abstract:

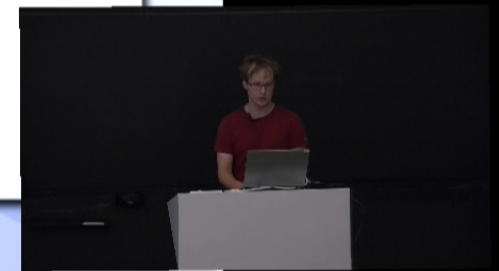
Thermal Expansion

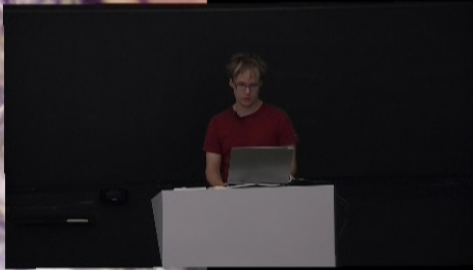
- Kinetic energy increases with T , increasing average separation of constituents
- Exceptions: water at 4°C , silicon in low T
- -- or high if you like superconductors
- Exceptions usually due to phase changes or lattice vibrations



Expansion Coefficients

- Linear: $\alpha = \frac{1}{L} \left(\frac{\partial L}{\partial T} \right)_p$
- Similarly for volume and area
- Usually determined experimentally, but good theoretical models also exist
- For an ideal gas, volumetric expansion coefficient is $\frac{1}{T}$





Effects & Applications

- Sun kinks (railroads, bridges)



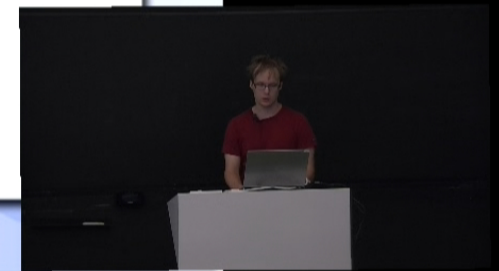
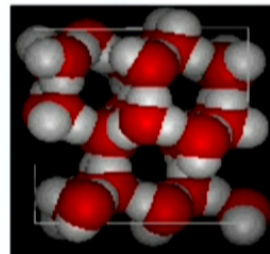
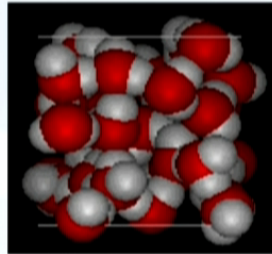
Effects & Applications

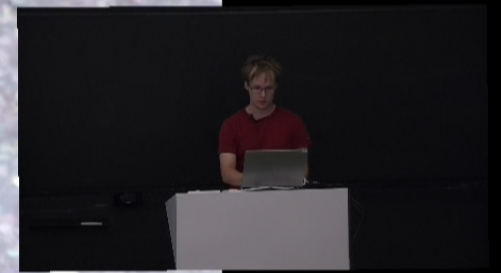
- Sun kinks (railroads, bridges)
- Droopy power lines
- Thermometers
- Hot air balloons
- Fitting things together (Induction shrink fitting)



Freezing Water

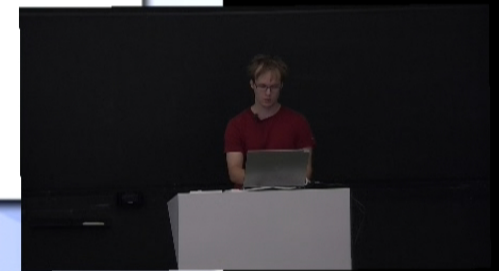
- Water expands when cooled from 4C
- Hydrogen bonds become more stable
- Water becomes less densely packed





Effects

- Cracked roads, boulders, pipes, damaged foundations of buildings
- Ice crystals damage cells: problem for crops, animals, and cryonics
- Many plants cope by “hardening”
- Some organisms use antifreezing agents



Summary

- Increasing temperature often leads to expansion...
- ...but not always
- Come up with better road coverings
- Don't put full bottles in the freezer



Thank you!

