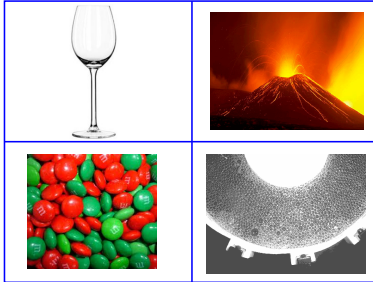


# Physics Research and Physics in Daily Life

**Katharina Vollmayr-Lee**



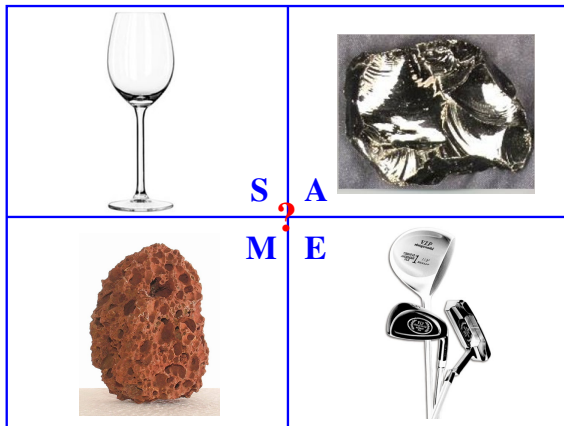
Bucknell, Residential College, February 27, 2014

Physics is fun  
Physics is pretty  
Physics is everywhere

## Outline:

- ▶ my research: computer simulation of glasses
- ▶ physics in daily life:
  - ▶ icecream, snowflake
  - ▶ oil, vinegar, dish soap
  - ▶ M & Ms
  - ▶ balloons, toothbrush

# My Research: Computer Simulation of Glasses



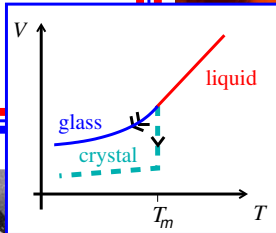
## Acknowledgments:

A. Zippelius, H. Castillo

former undergraduates:

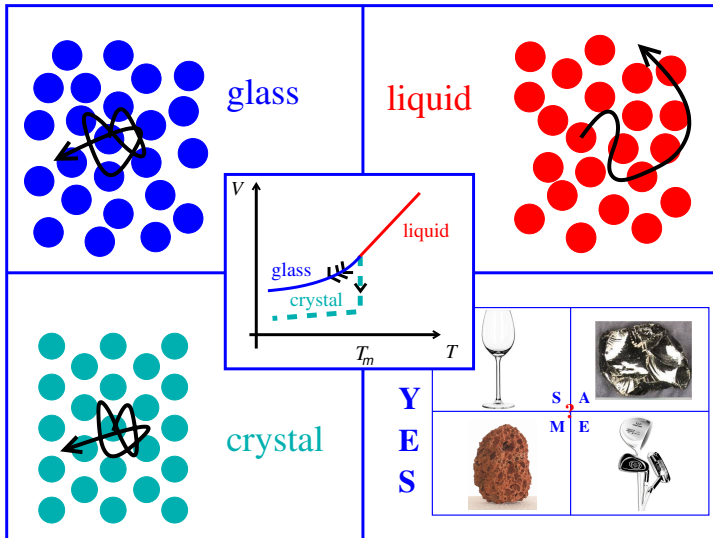
R. Bjorkquist, L. M. Chambers, Ch. H. Gorman

# What is a Glass?

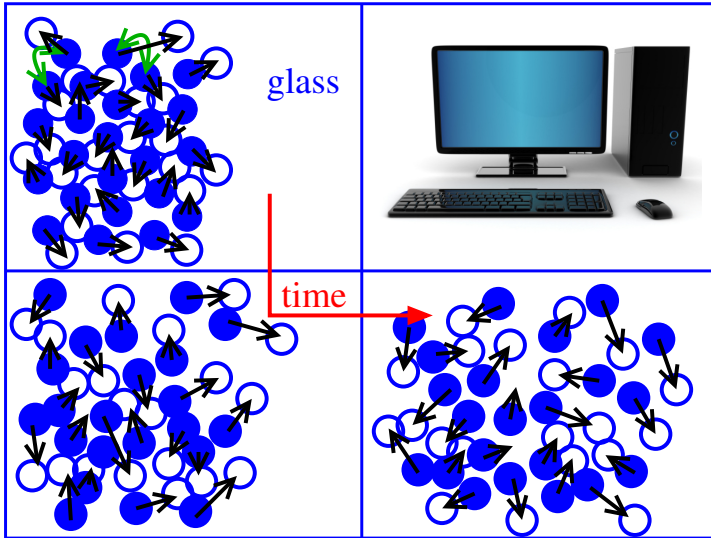




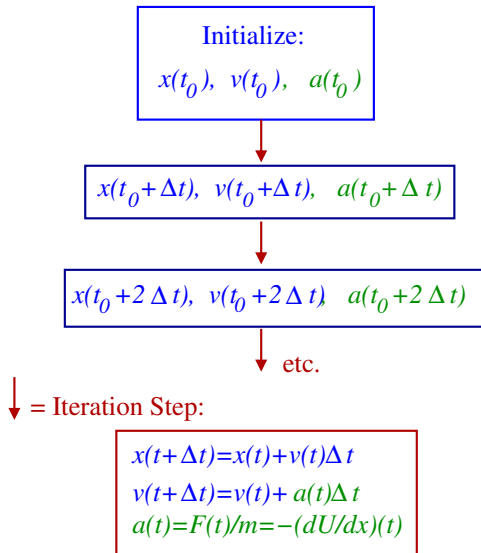
# What is a Glass?



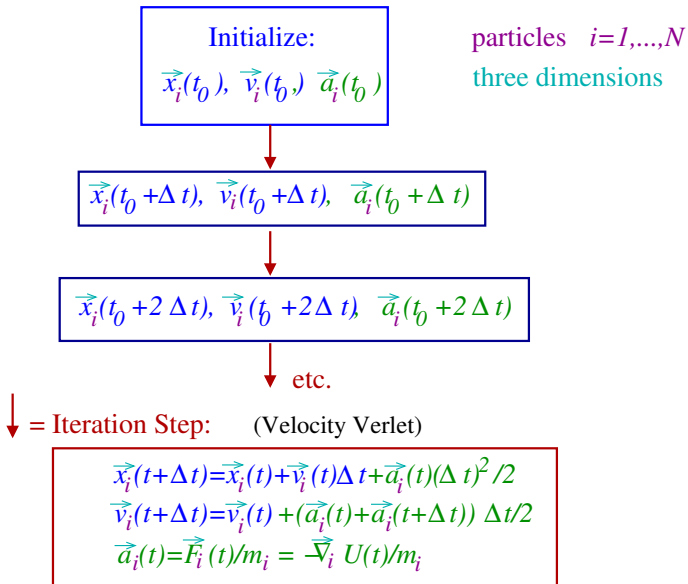
# Computer Simulation



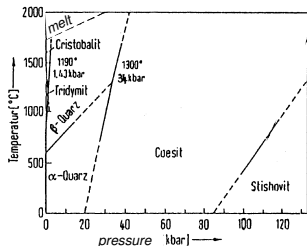
## Numerical Solution: Euler Step



# Molecular Dynamics Simulation



# System: SiO<sub>2</sub>



[S. Stoeffler and J. Arndt, *Naturwissenschaften* 56, 100 (1969)]

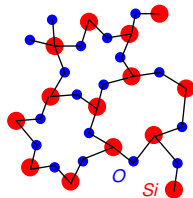
- ▶ rich phase diagram
- ▶ similar to water (H<sub>2</sub>O)

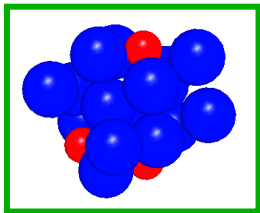
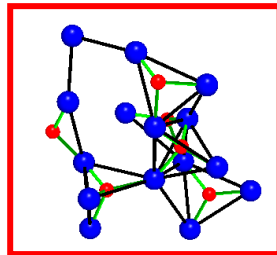
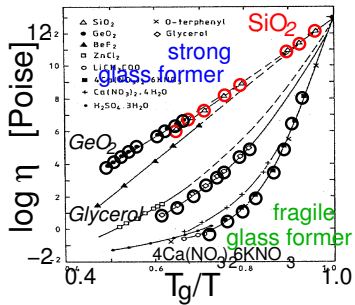
## Model: BKS Potential

[B.W.H. van Beest *et al.*, PRL 64, 1955 (1990)]

$$\phi(r_{ij}) = \frac{q_i q_j e^2}{r_{ij}} + A_{ij} e^{-B_{ij} r_{ij}} - \frac{C_{ij}}{r_{ij}^6}$$

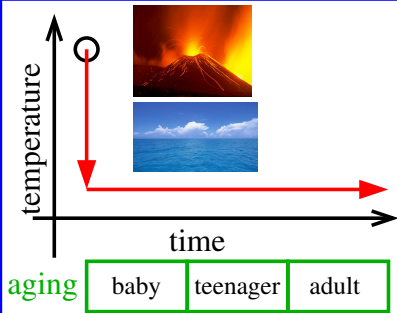
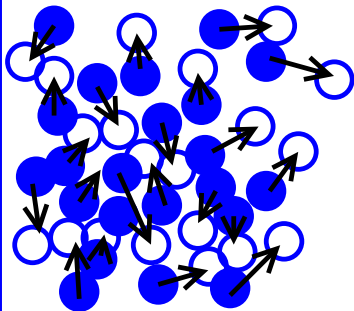
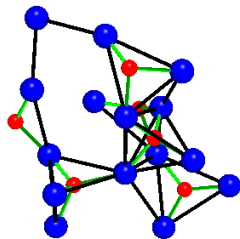
112 Si & 224 O       $\rho = 2.32 \text{ g/cm}^3$   
 $T_c = 3330 \text{ K}$

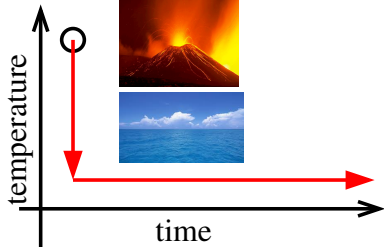




N  
O

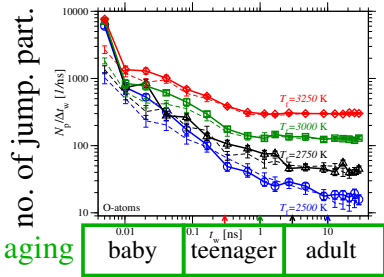
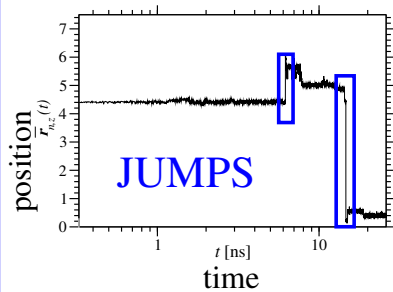






aging

|      |          |       |
|------|----------|-------|
| baby | teenager | adult |
|------|----------|-------|



aging

|      |          |       |
|------|----------|-------|
| baby | teenager | adult |
|------|----------|-------|

[PRL 2013]

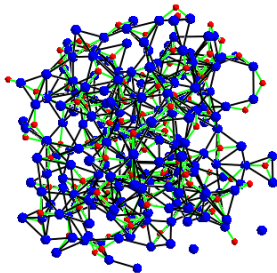
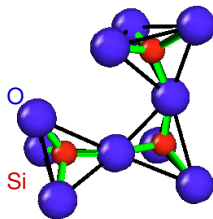
YES

S A  
M E



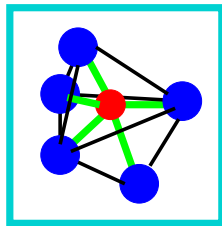
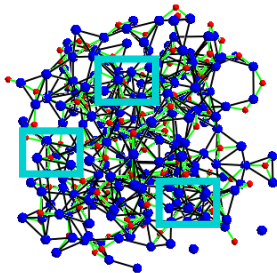
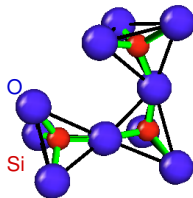


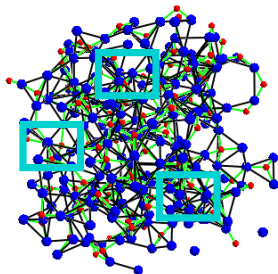
Structure



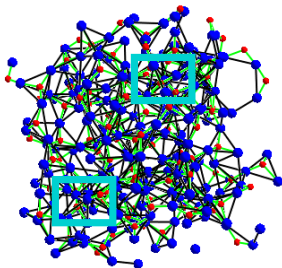
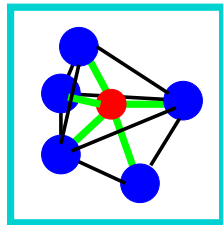
Highly Ordered

# Defects

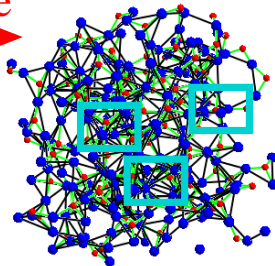


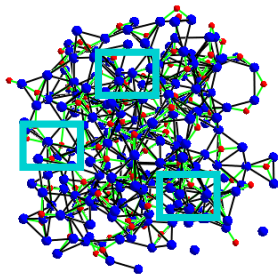


Defects

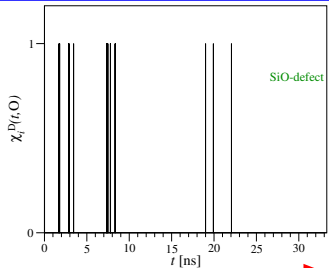
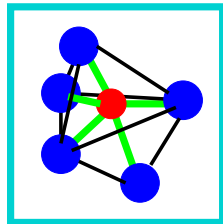


time



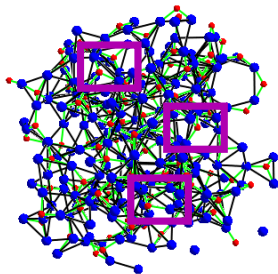


Defects

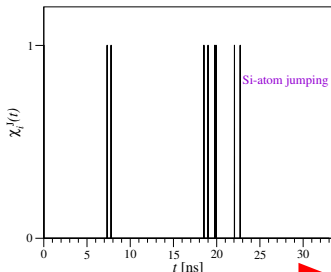
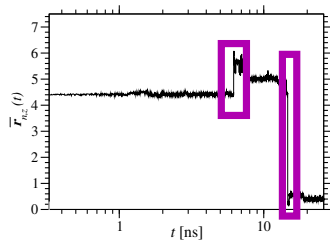


time

SUDDEN

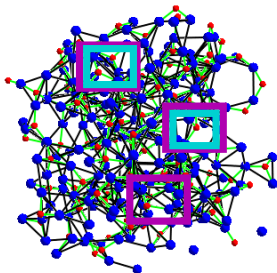


Jumps



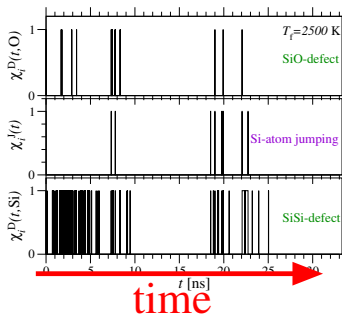
time

SUDDEN



Jumps

Defects



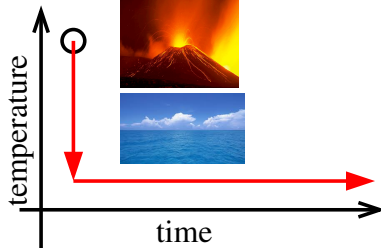
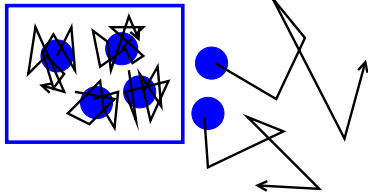
HIGHLY  
CORRELATED



S A  
M E



## dynamic susceptibility



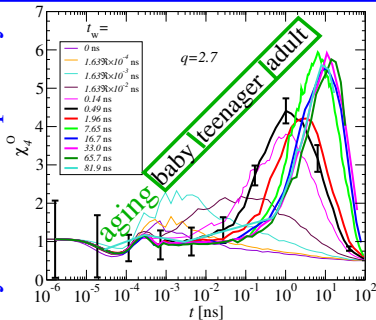
aging

baby

teenager

adult

## dynamic susceptibility

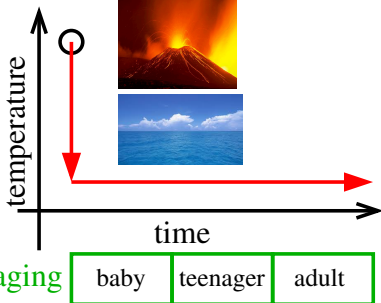
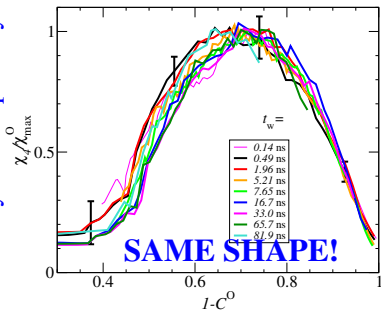


S A  
M E

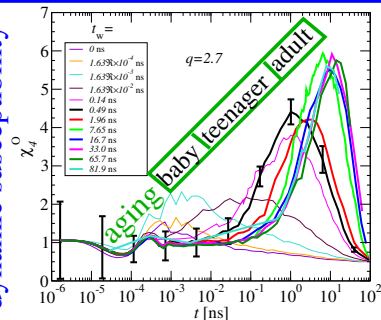




norm. dyn. susceptibility



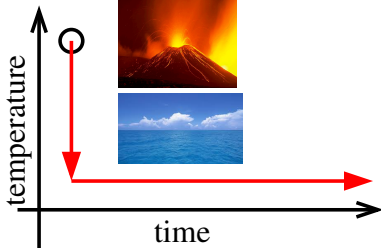
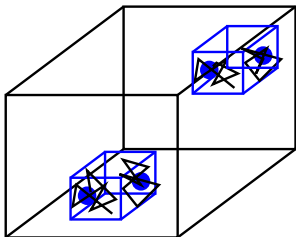
dynamic susceptibility



YES



distribution



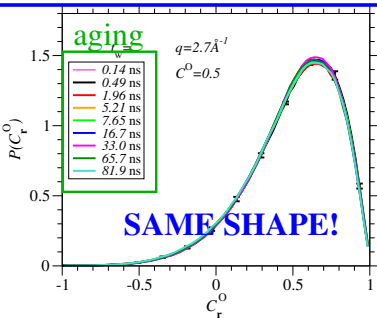
aging

baby

teenager

adult

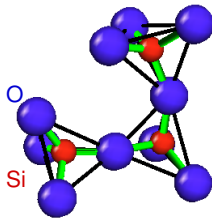
distribution



YES

S A  
M E

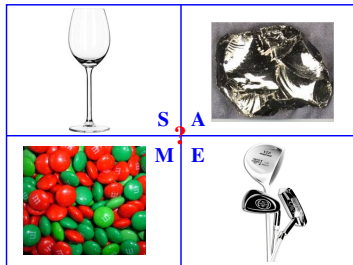




## Research Summary:

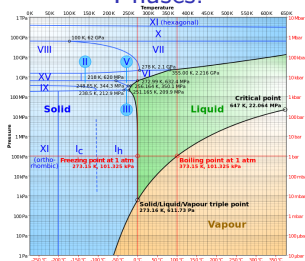
Physics is Fun  
Physics is Pretty

Y  
E  
S

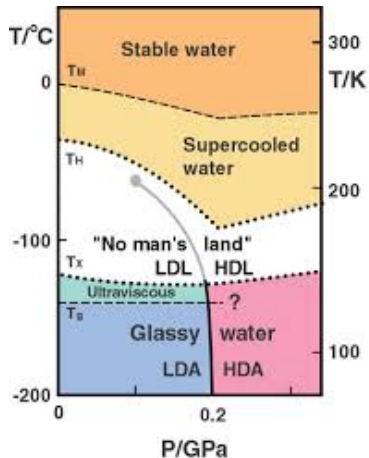


# Physics in Daily Life: H<sub>2</sub>O

## Phases:



## Snowflakes:



# Physics in Daily Life: Granular Matter

Grains:



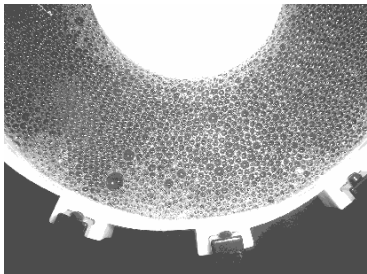
M & Ms:



[Donev et al., Science 303, 5660 (2004)]

# Physics in Daily Life: Soap Bubbles

Sheared Soap Bubbles:



M. Dennin, UC Irvine

Thin Film:



# Summary

Physics is fun  
Physics is pretty  
Physics is everywhere