Lecture 13
ual Environment for dynamic AFM (VE
verview of capabilities; F-Z curve to

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Please go to www.nanohub.org and regist
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Overview

hat is VEDA?

Open-source simulator for AFM

hy do simulations?

xperiments

may involve unanticipated elements

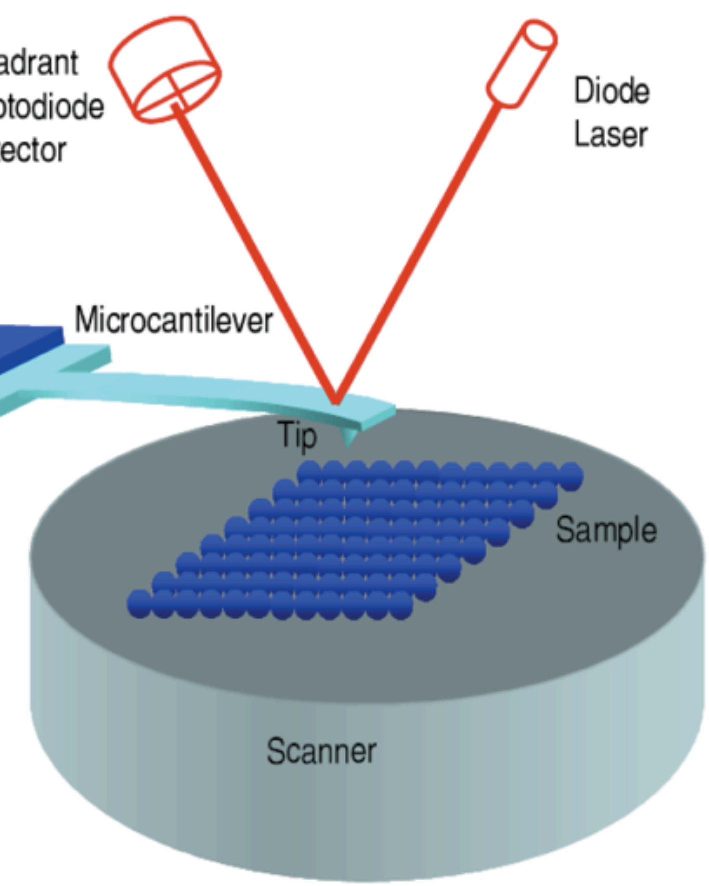
expensive/time consuming

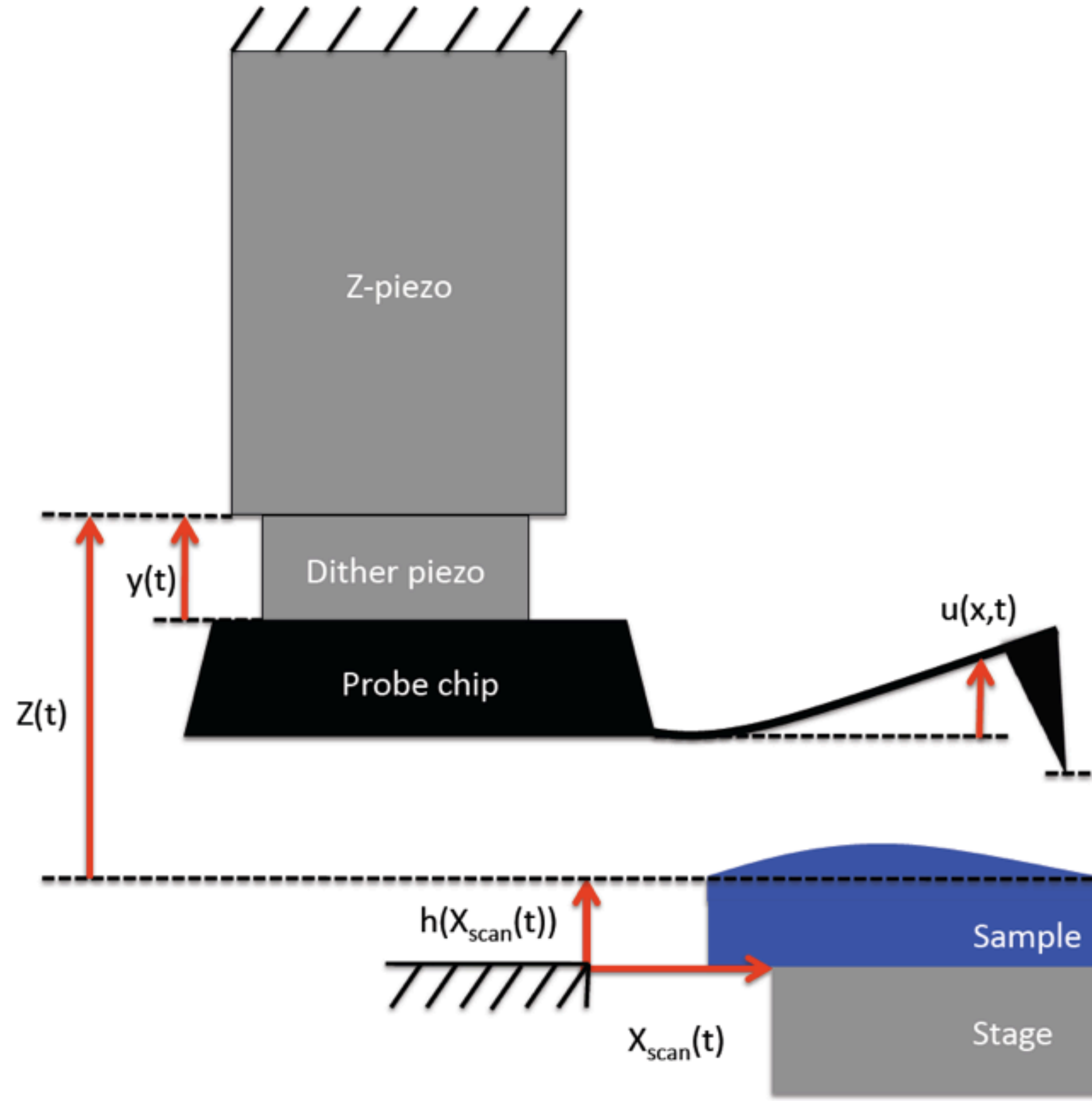
limited observables

imulations are useful because

the environment is controlled

Some preliminaries...





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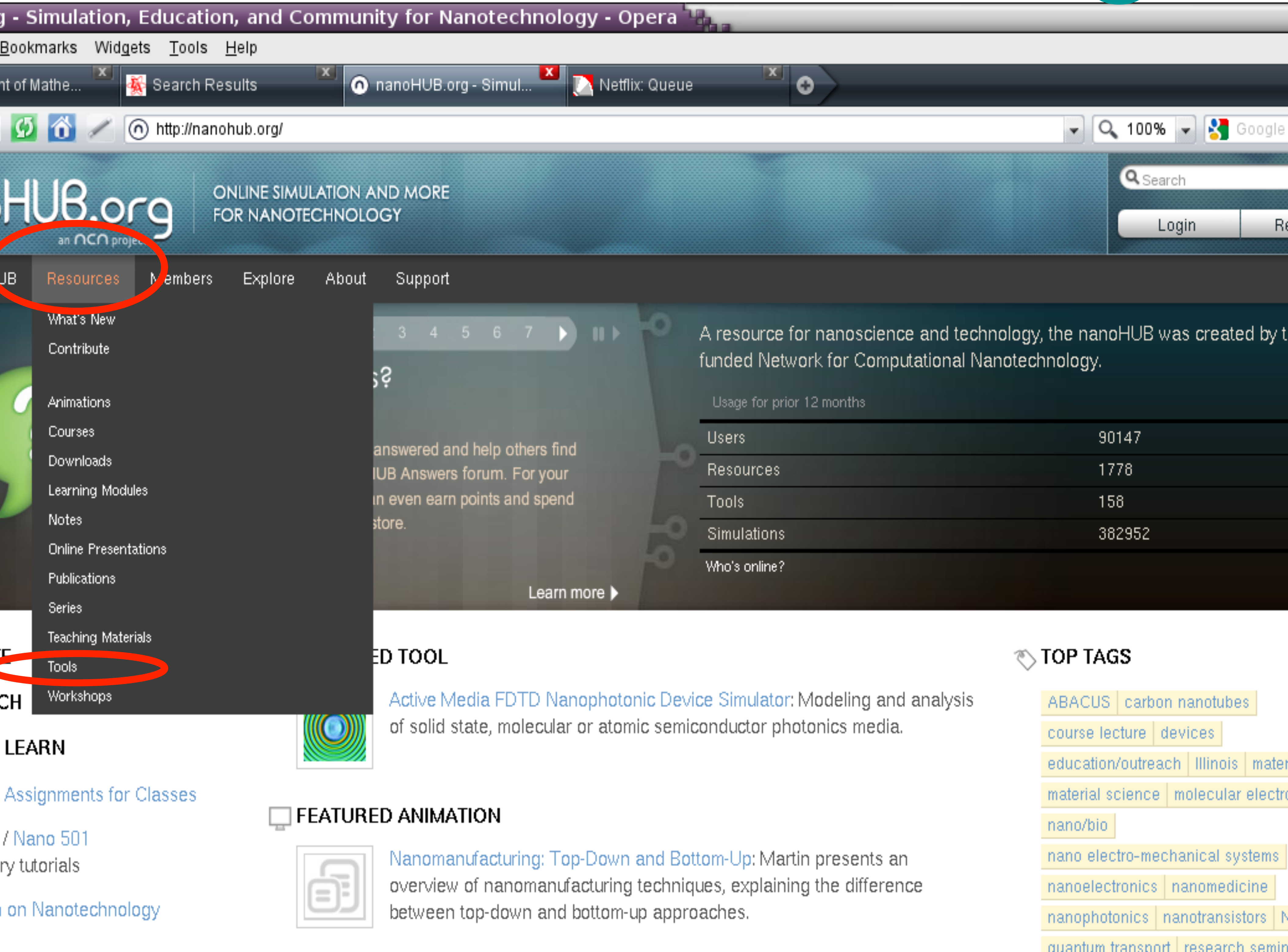

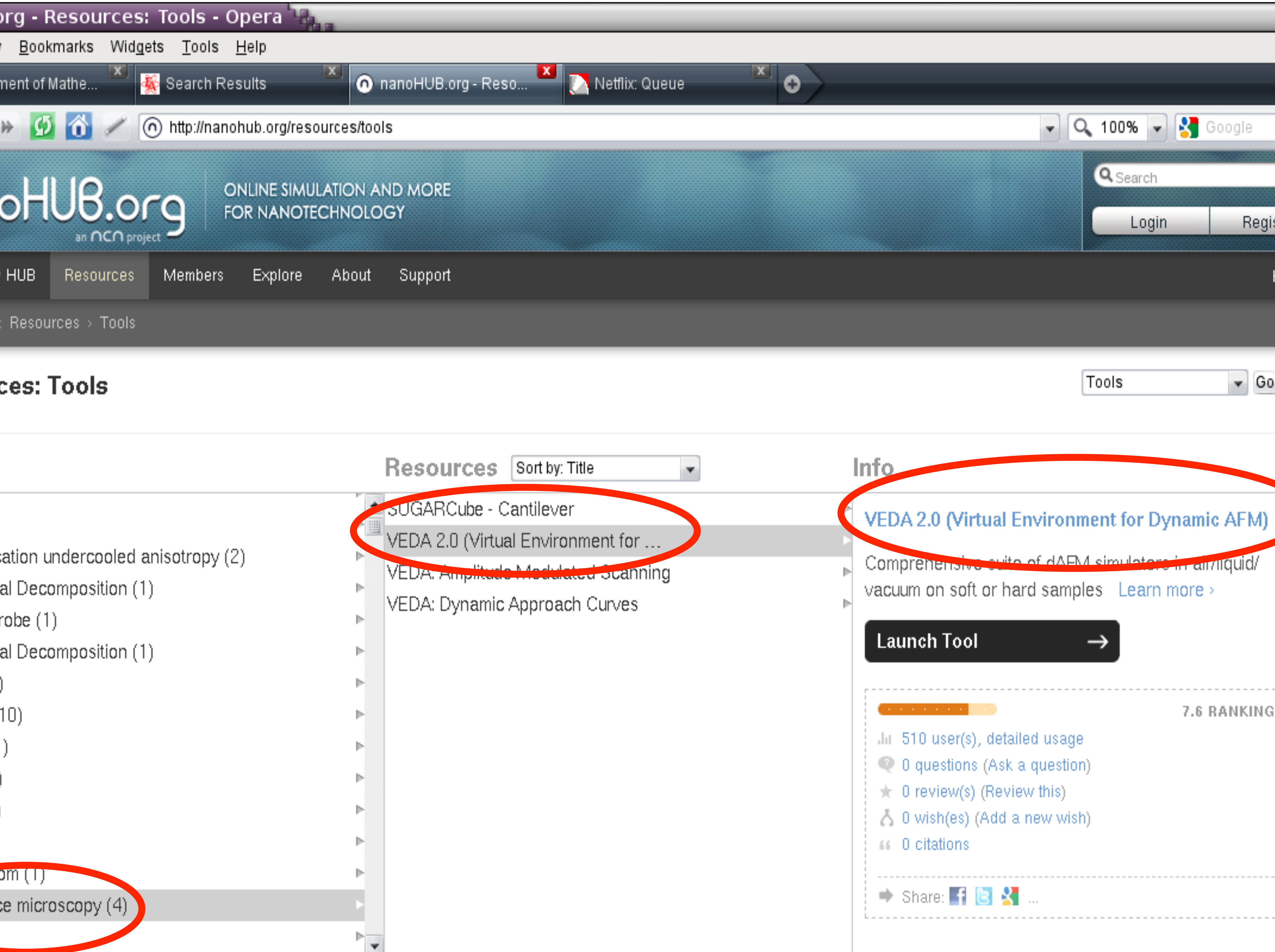
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VEDA 2.0 (Virtual Environment for ...
VEDA: Amplitude Modulated Scanning
VEDA: Dynamic Approach Curves
ation undercooled anisotropy (2)
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VEDA 2.0 (Virtual Environment for Dynamic AFM)
Comprehensive suite of dAFM simulators in air/liquid/
vacuum on soft or hard samples
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VEDA 2.0 (Virtual Environment for Dynamic AFM) › About

Virtual Environment for Dynamic AFM)

John Melcher, Daniel Kiracofe, Laurene Tetard

AFM simulators for air/liquid/vacuum on soft or hard samples

Launch Tool

Version 2.0.12 - published on 10 Aug 2010

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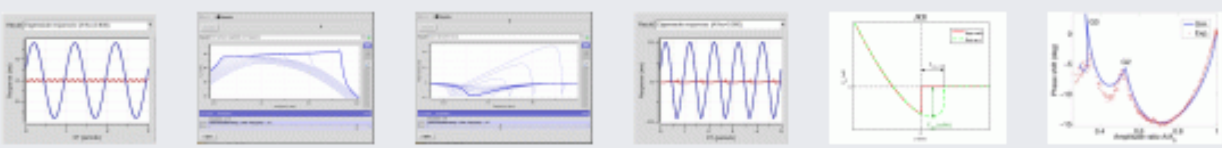


VEDA is a suite of tools for simulating many different aspects of dynamic AFM under a range of operating modes and environments. VEDA consists of four tools:

Dynamic Approach Curves tool: accurately simulates an AFM cantilever excited at resonance and brought towards a sample surface. Two version are available: basic and advanced. The basic tool simulates oscillations of a single eigenmode of the cantilever, while the advanced tool simulates multiple eigenmodes and multiple excitation frequencies.

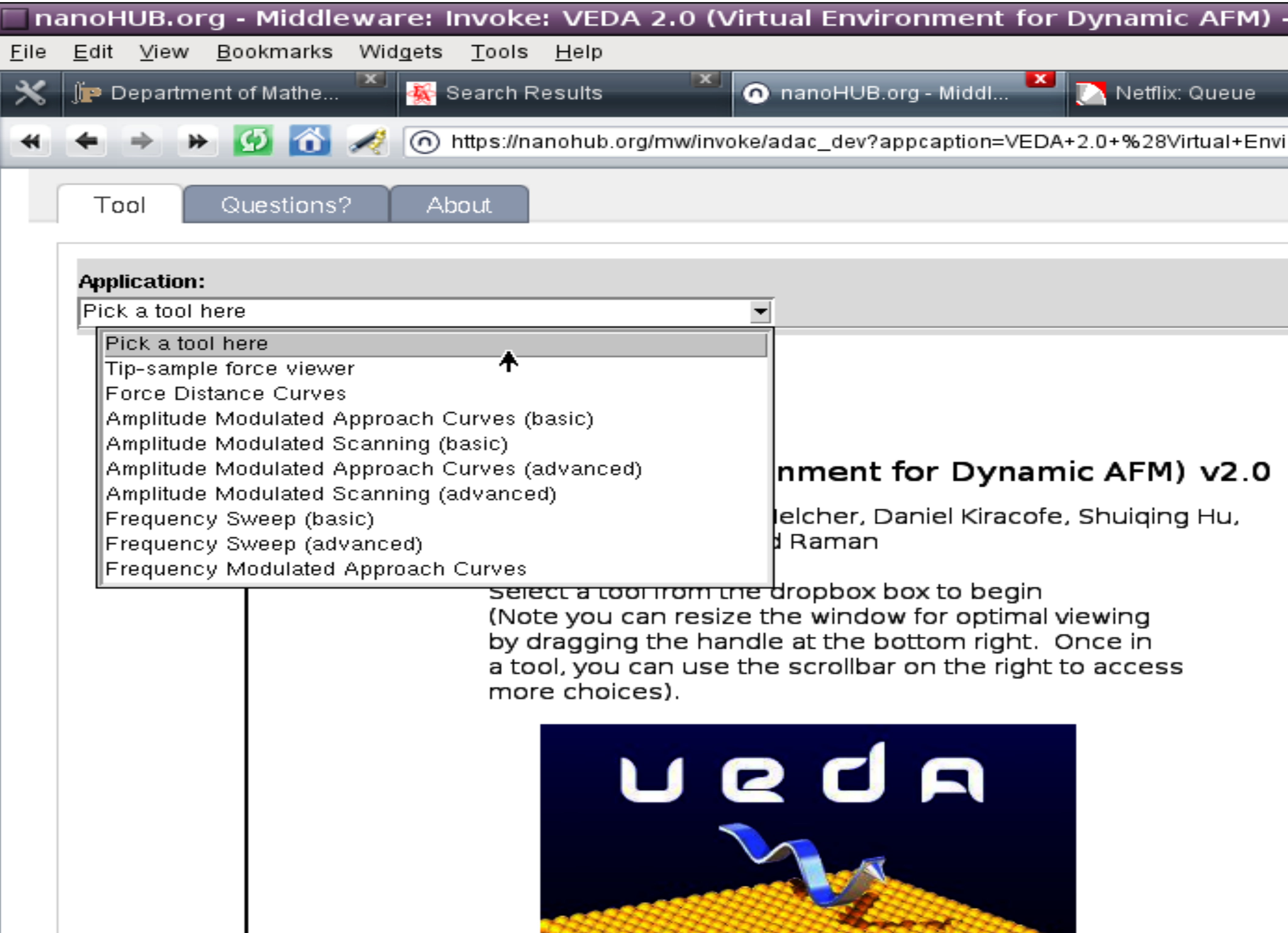
SEE ALSO

Part of: NCN Simulation To

Part of: NCN Simulation To

RECOMMENDATION

- Introduction t Environment f
- VEDA: Amplit Scanning
- VEDA: Dynam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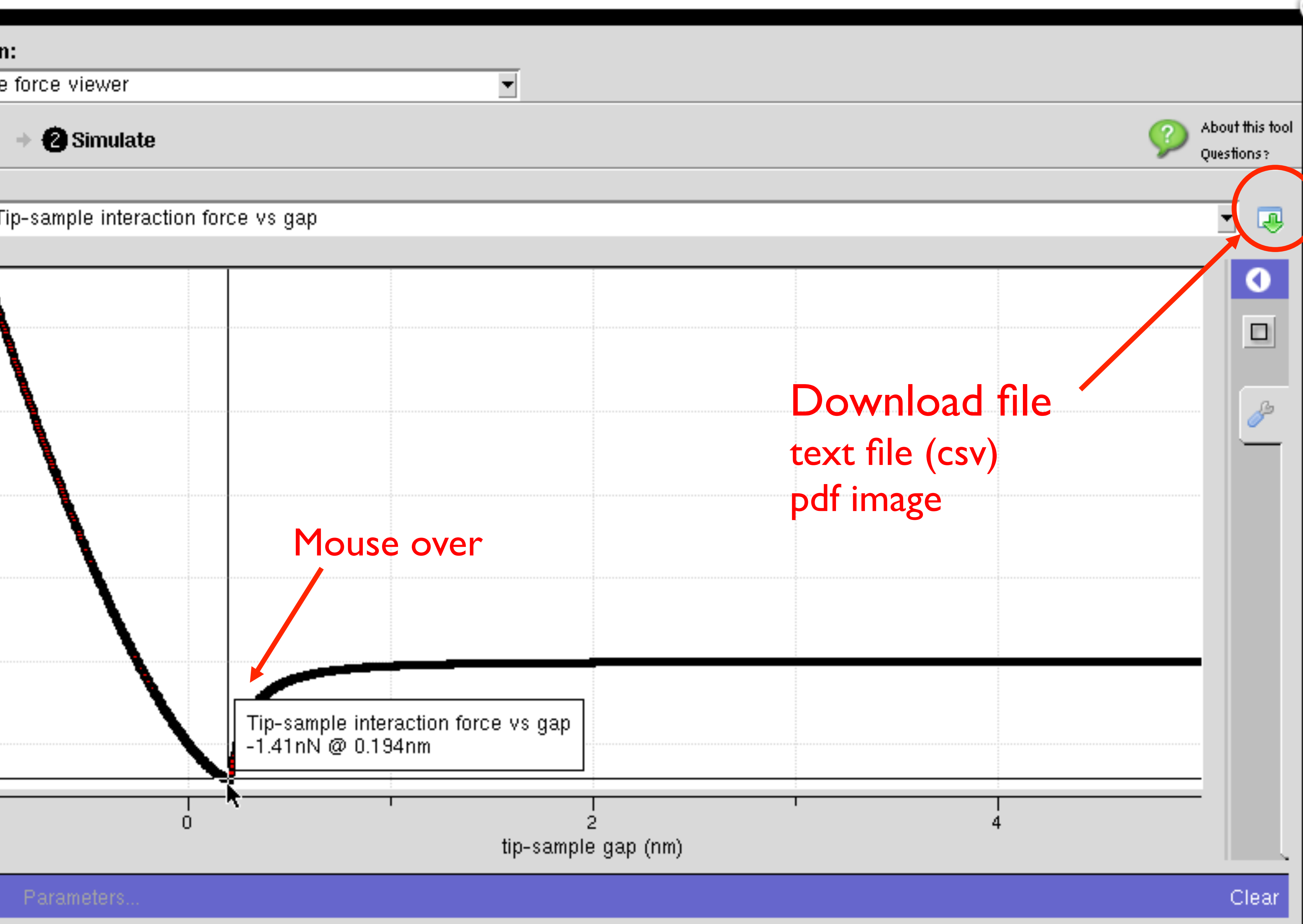
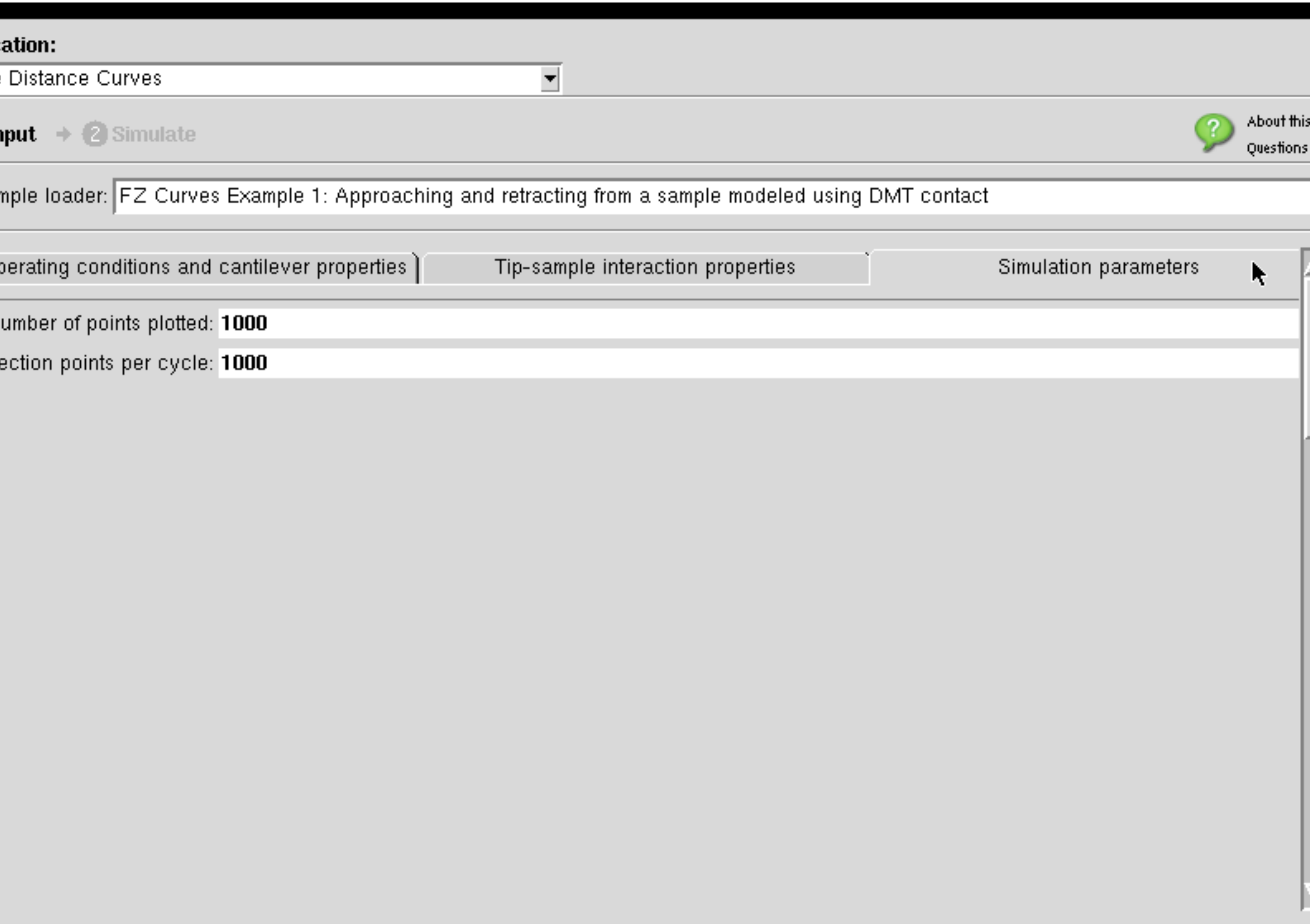
Frequency Sweep (basic)
Frequency Sweep (advanced)
Frequency Modulated Approach Curves
nment for Dynamic AFM) v2.0
elcher, Daniel Kiracofe, Shuiqing Hu,
Raman
(Note you can resize the window for optimal viewing
by dragging the handle at the bottom right. Once in
a tool, you can use the scrollbar on the right to access
more choices).
veda

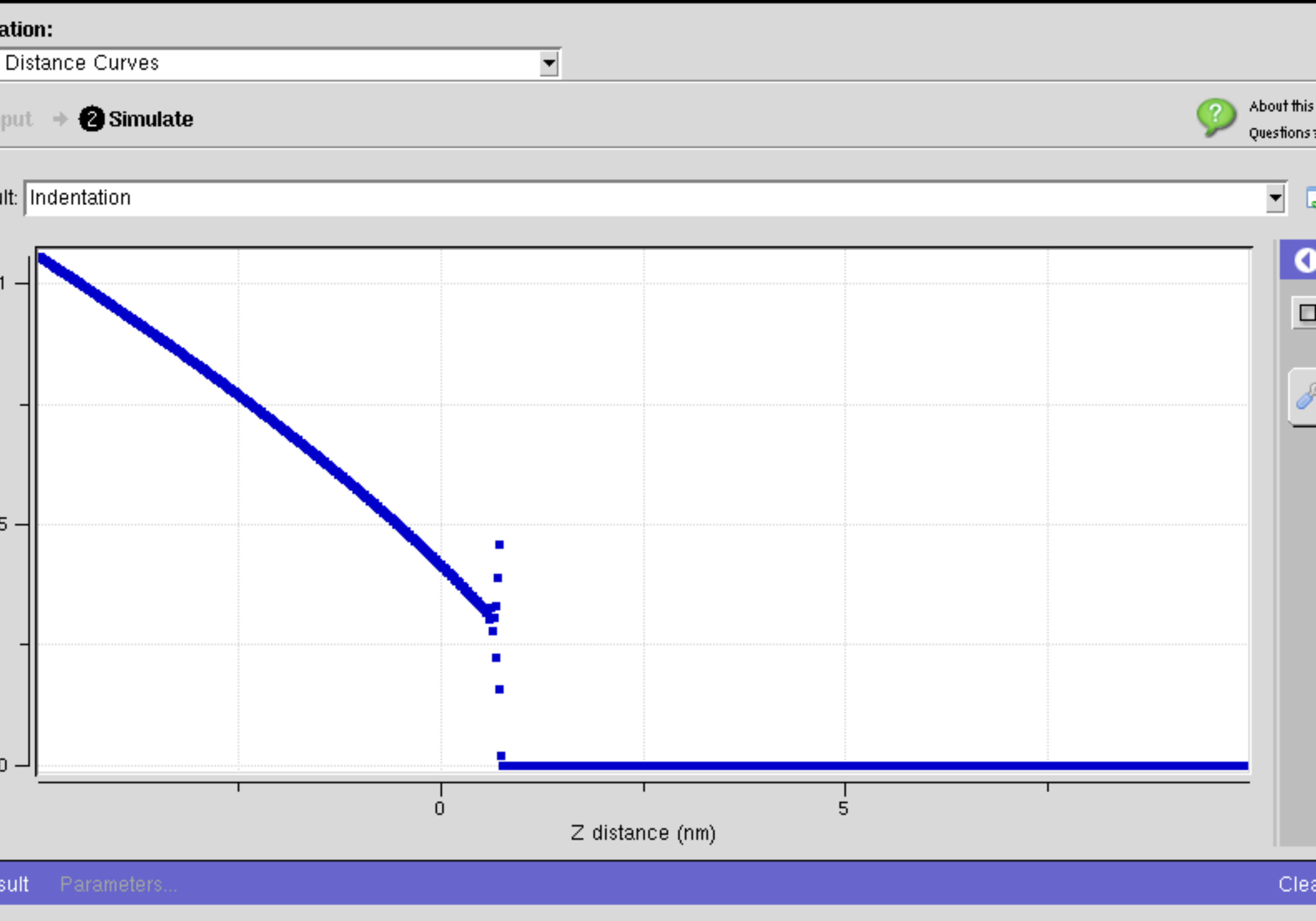
Tip-sample force viewer tool



Force Distance Curves



Inputs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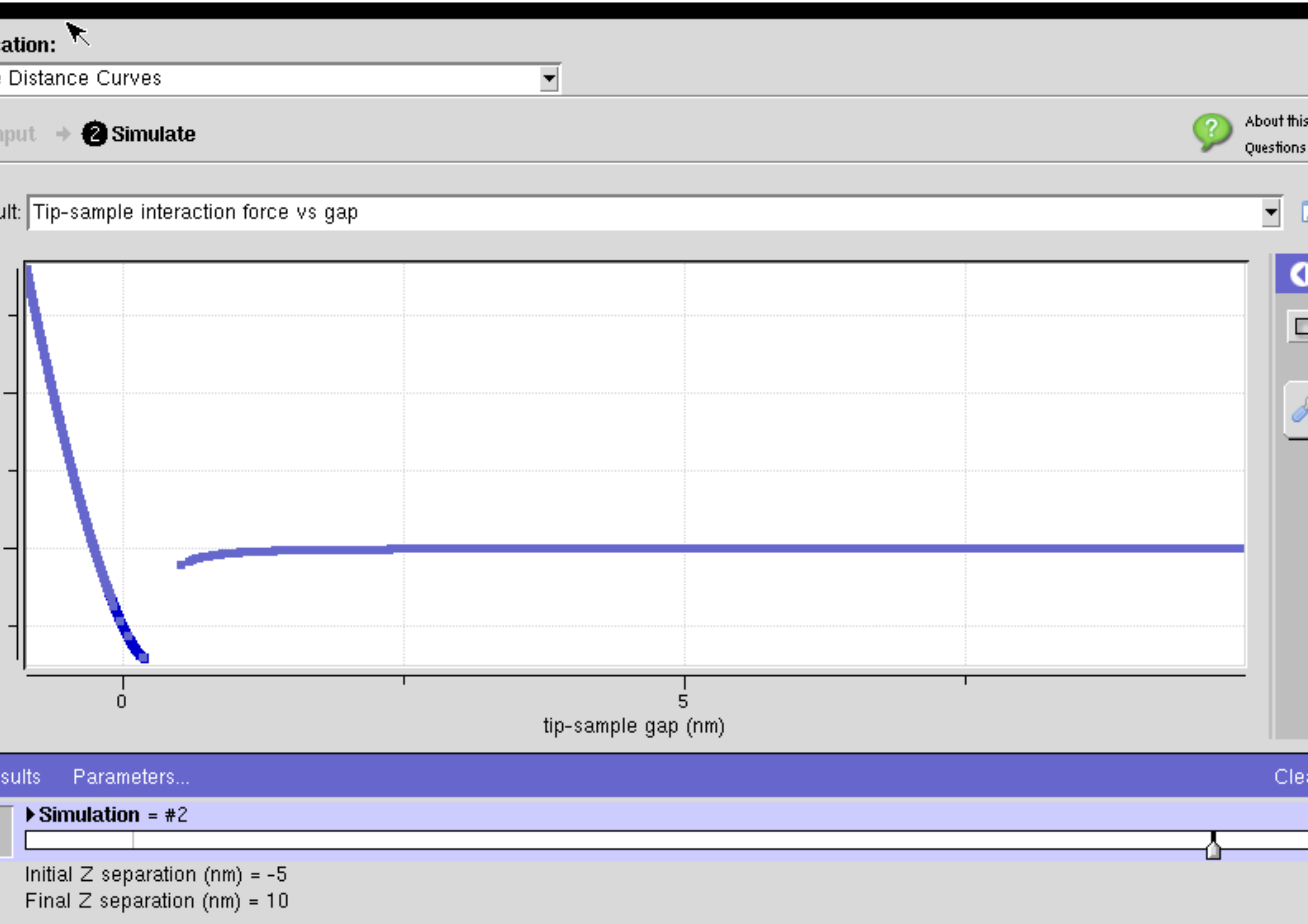
Inputs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Distance Curves
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Questions
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5
tip-sample gap (nm)
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Parameters...
Clea
Simulation = #2
Initial Z separation (nm) = -5
Final Z separation (nm) = 10

Problem 1

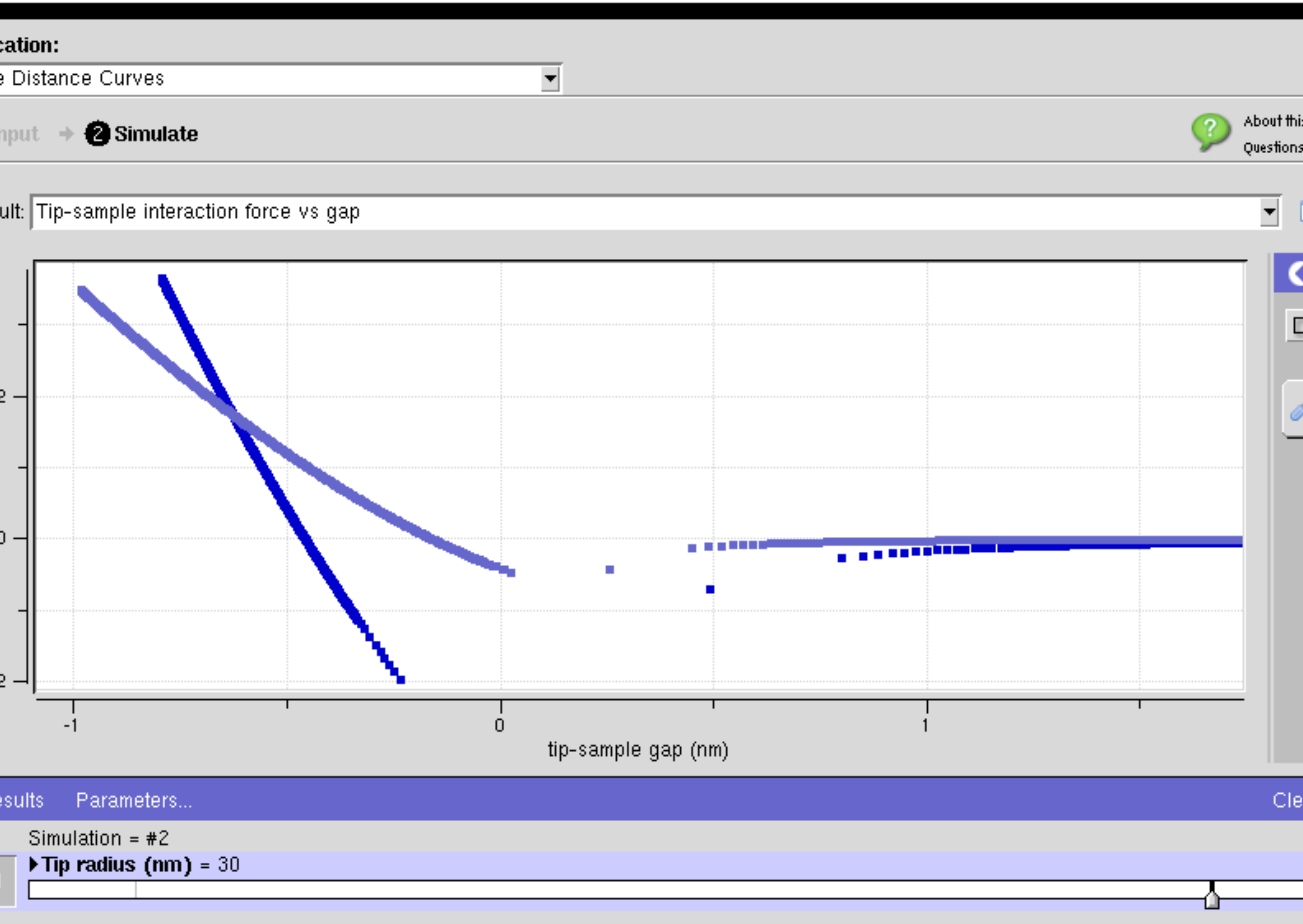
u are trying to determine the modulus of elasticity of a
mple. You will be fitting an experimental "Tip-sa
eraction force vs gap" (aka F-d curve) to a DMT m
u believe that your tip radius is 10 nm, but in actualit
is damaged and it is really 30 nm.

hat will happen your estimation of the elasticity?

e all parameters from Example 1 except tip radius.

ke ~5 minutes to work through this and then we'll go
e answer

Problem 1: Solution



roblem 2 - cantilever selection

u are trying to determine the stiffness of a soft biolo nple. If you apply more than 200 pN force, you troy the sample. Your cantilever choices are 0.1 N/ n and 10 N/m. Which cantilever stiffness will be best ?

Use linear contact tip-sample model, k = 0.5 N/m

Hint 1: first determine the maximum Z you can apply ach stiffness.

Hint 2: think about possible experimental errors

N/m
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best.

largest
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same force
more robust
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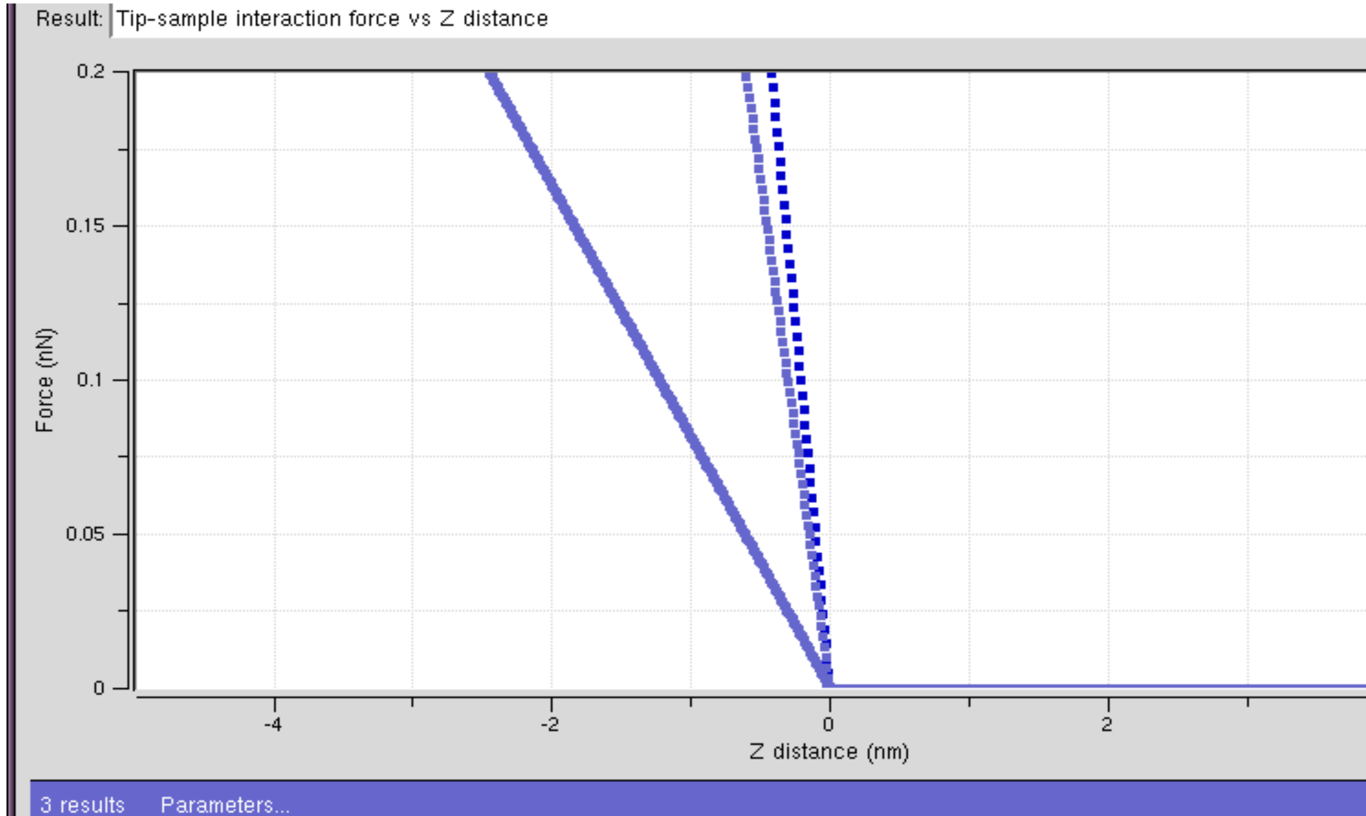


are trying to determine the Young's modulus (i.e. stiffness) of a hard
The extension of the Z-peizo is limited to 10 nm beyond the point of
ct between the tip and sample. Your cantilever choices are 0.1 N/m, 1
10 N/m. Which cantilever is best and why?

e Hertz, E= 60 GPa.

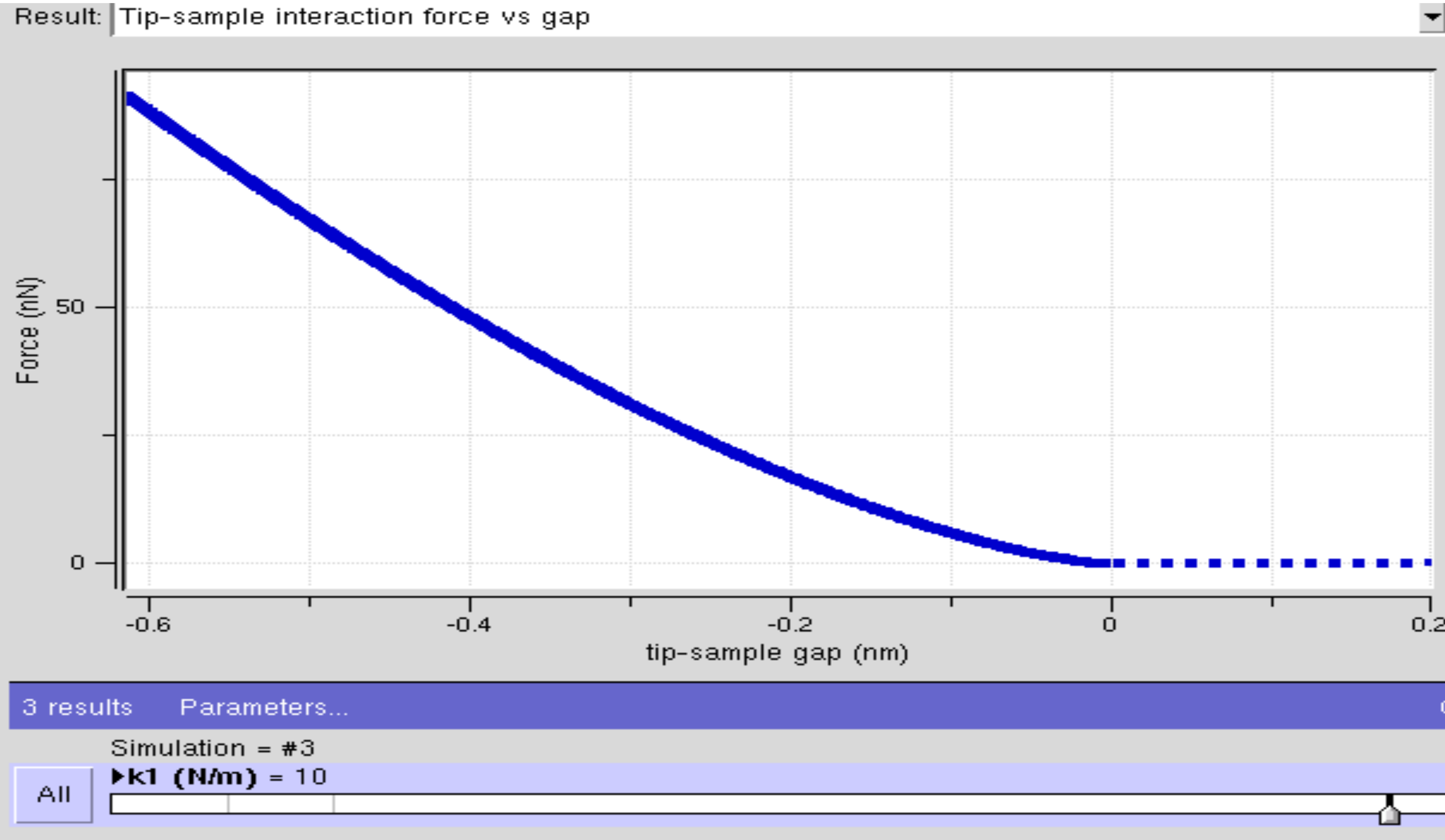
nt: use Zf = -10 nm

gain, think about experimental errors

get done early, try downloading your problem 2 and 3 simulation
s into Excel and applying experimental errors to the data.

random noise to observed deflection and Z motion, and then conver
rce-gap (remember gap = Z + deflection, Force = deflection * stiffness

Problem 3 solution



N/m cantilever will be best. Applies more force – mor