
06-11-08 JX

½ of these samples failed:

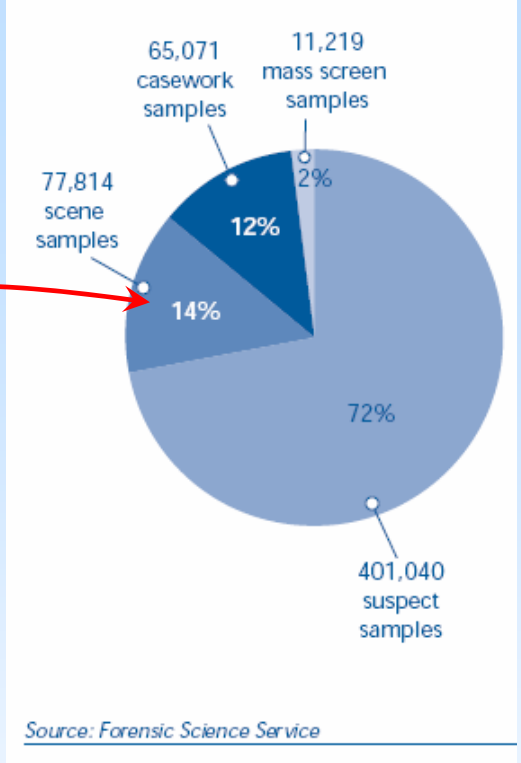
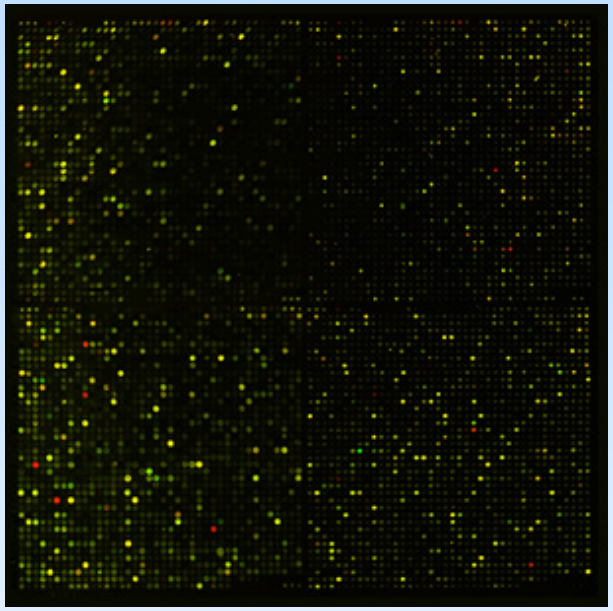
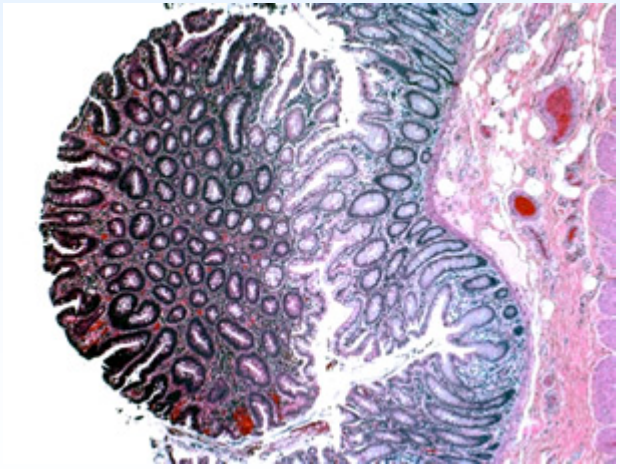


Table 2. Phase I short tandem repeat (STR) results on skeletal remains from the victims of terrorist attacks on the World Trade Center on September 11, 2001

STR profiles	No. (%) of skeletal remains
Full (13 loci)	3,500 (27.2)
High partial (7-12 loci)	2,233 (17.4)
Low partial (1-6 loci)	2,712 (21.1)
No results (0 loci)	4,404 (34.3)
Total	12,849 (100.0)

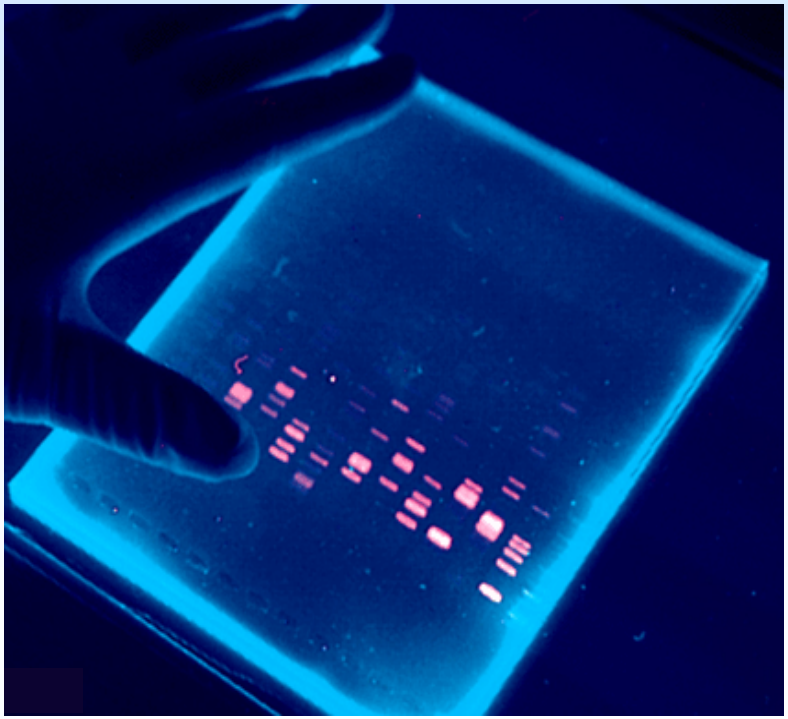


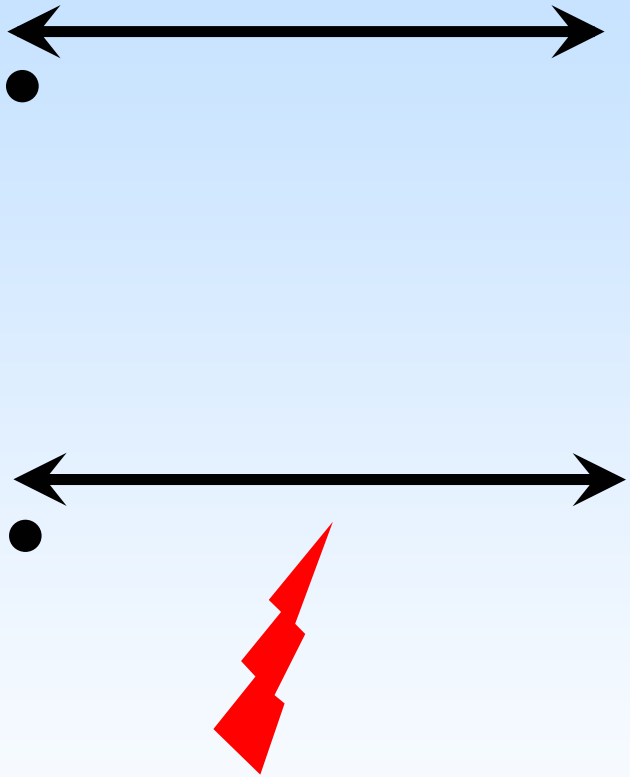


Beyond CSI

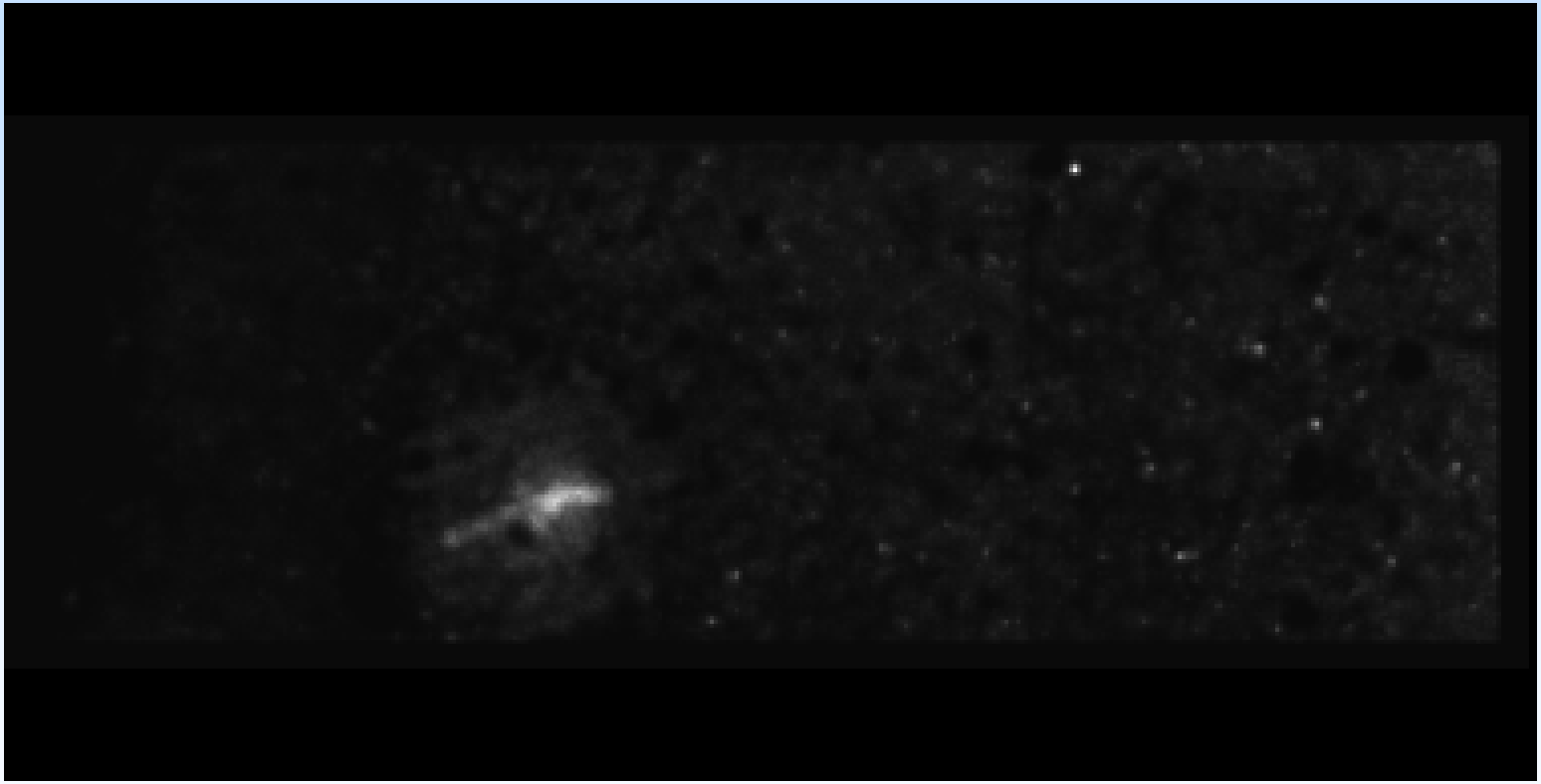
Ultra-sensitive DNA analysis for forensics and clinical diagnostics

Andre Marziali
Applied Biophysics Laboratory
Engineering Physics
Department of Physics and Astronomy
University of British Columbia

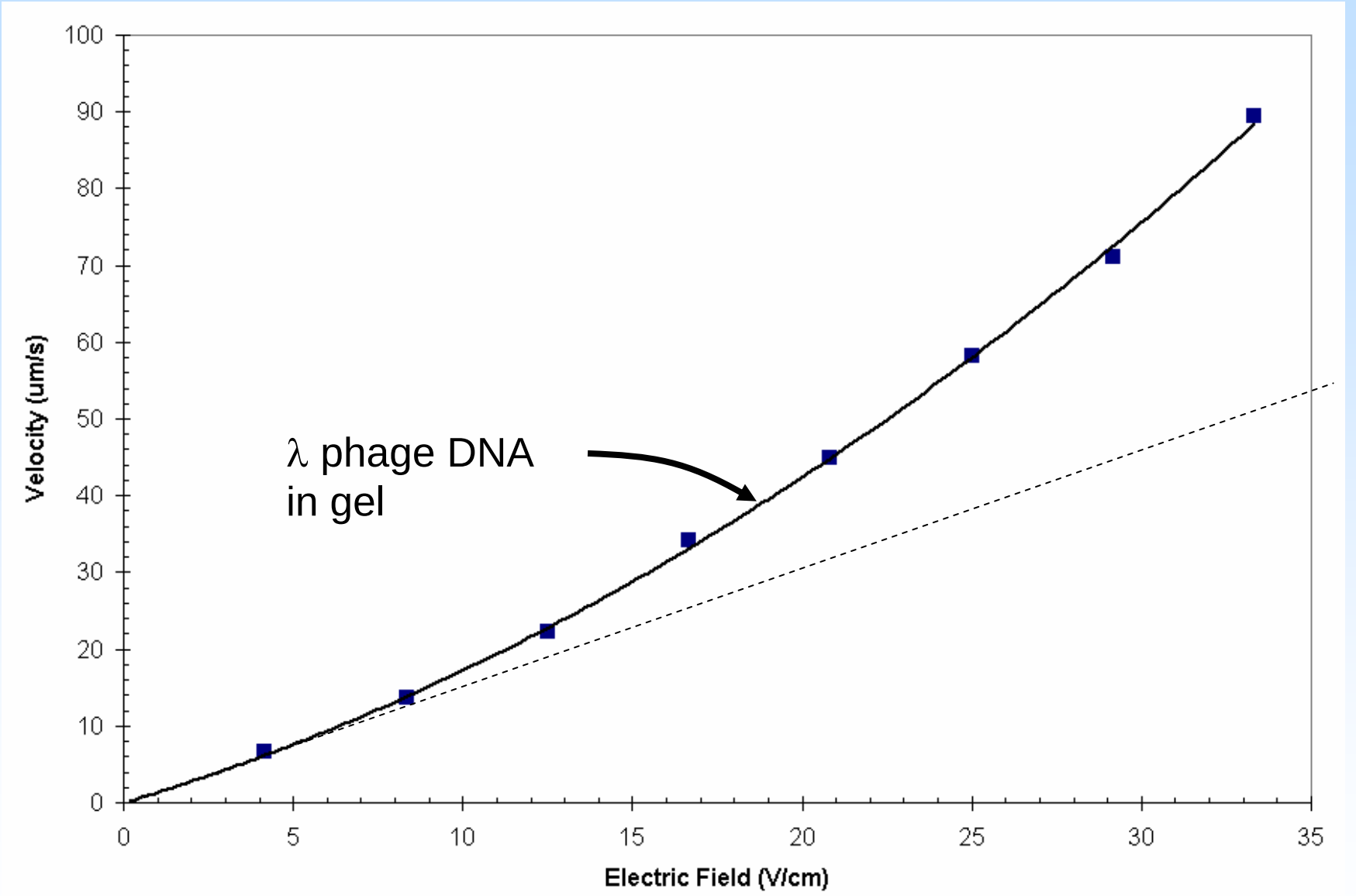




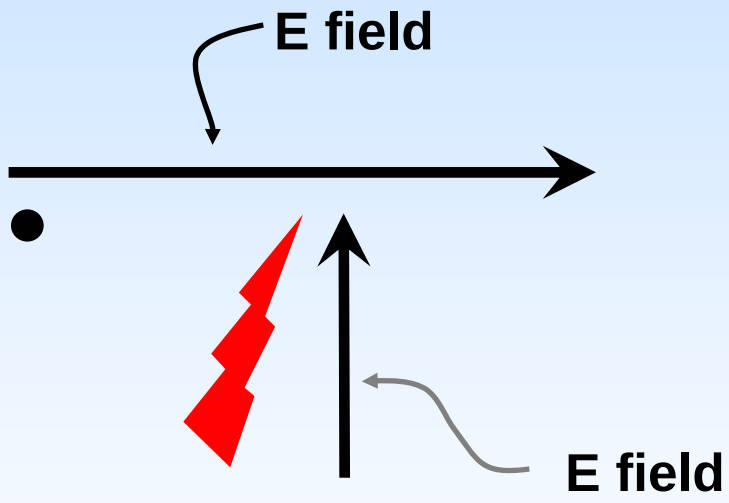
Synchronous Coefficient of Drag Alteration: SCODA



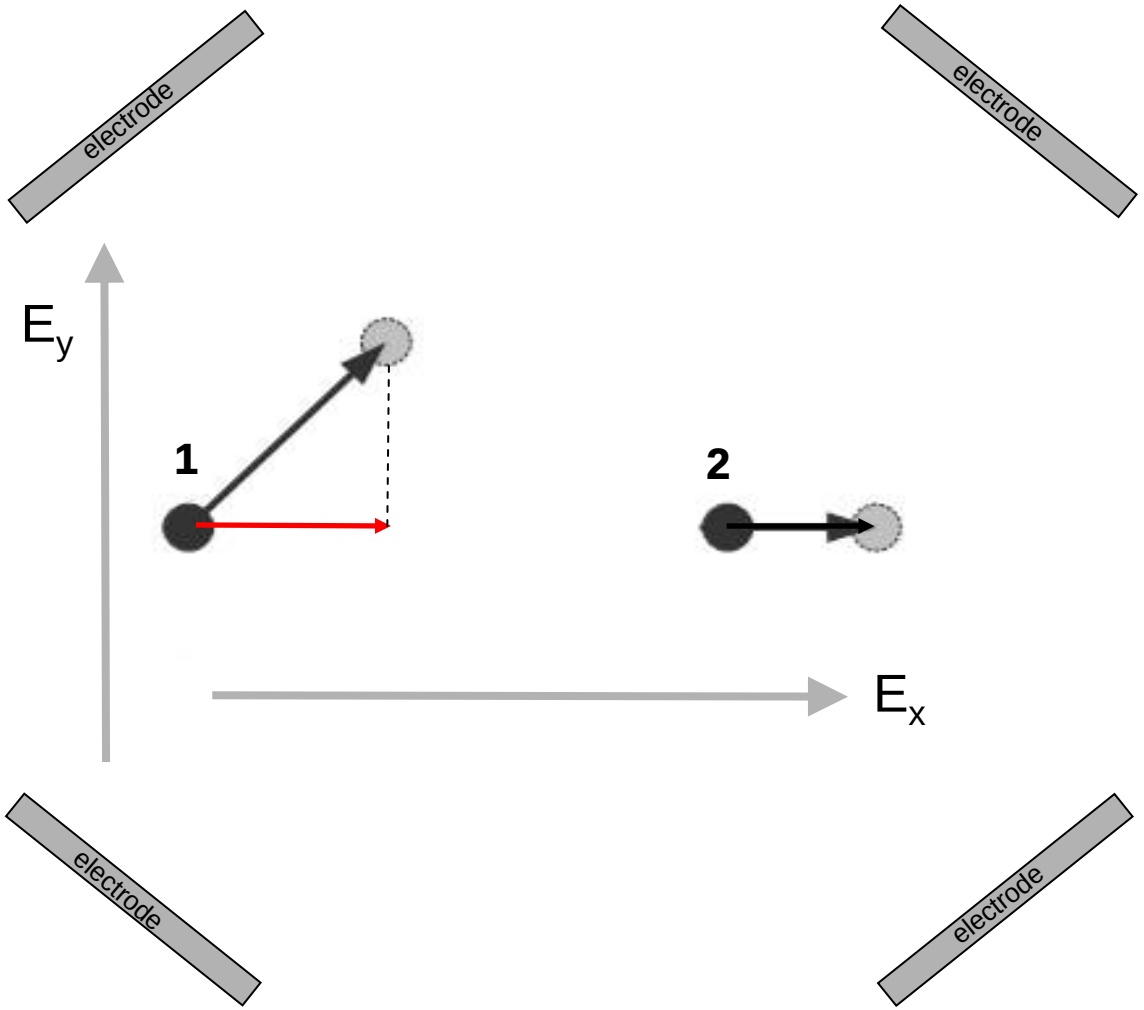
http://www.umich.edu/~morgroup/hsvm.html

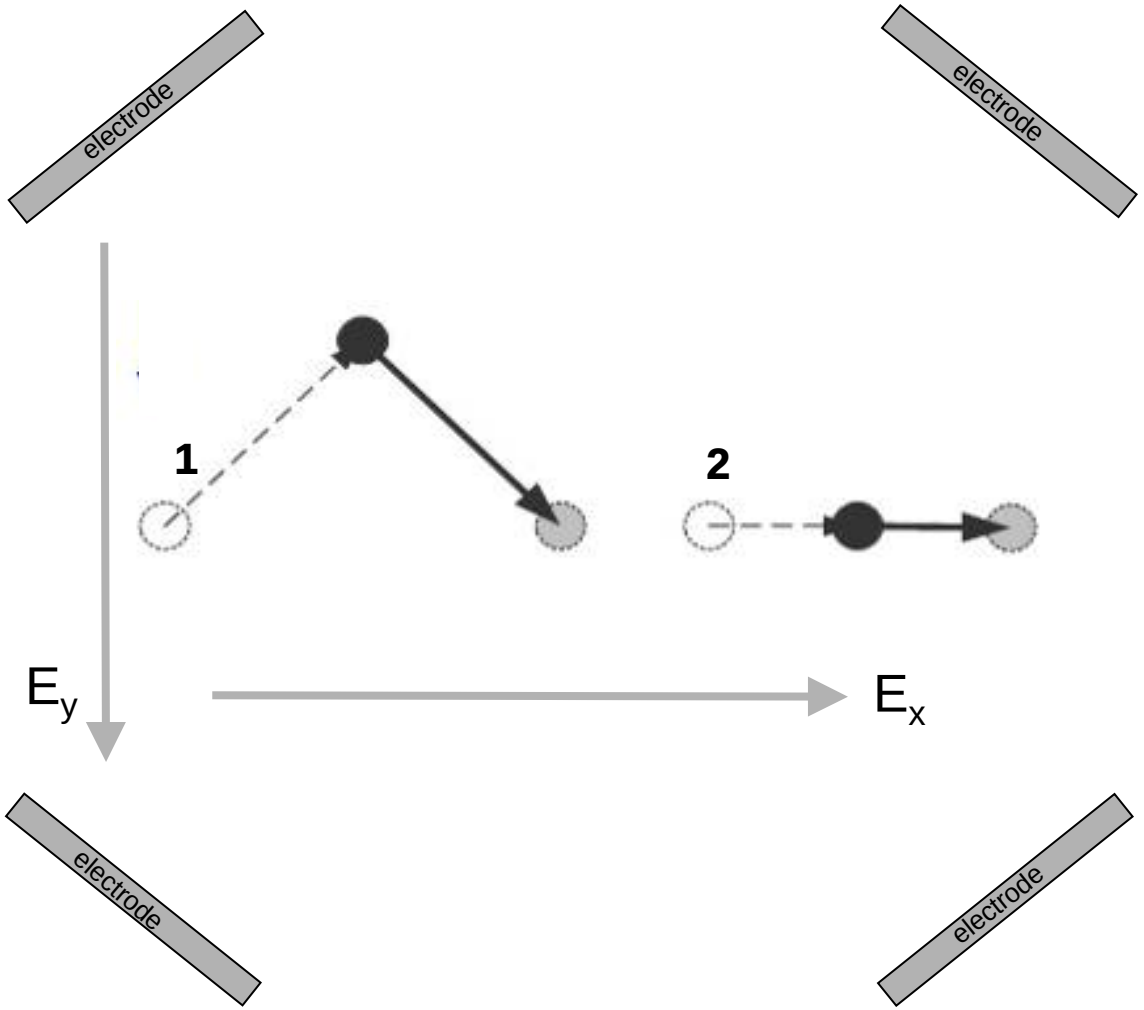

100
90
80
70
60
50
40
30
20
10
0
Velocity (um/s)
λ phage DNA
in gel
0
5
10
15
20
25
30
35
Electric Field (V/cm)

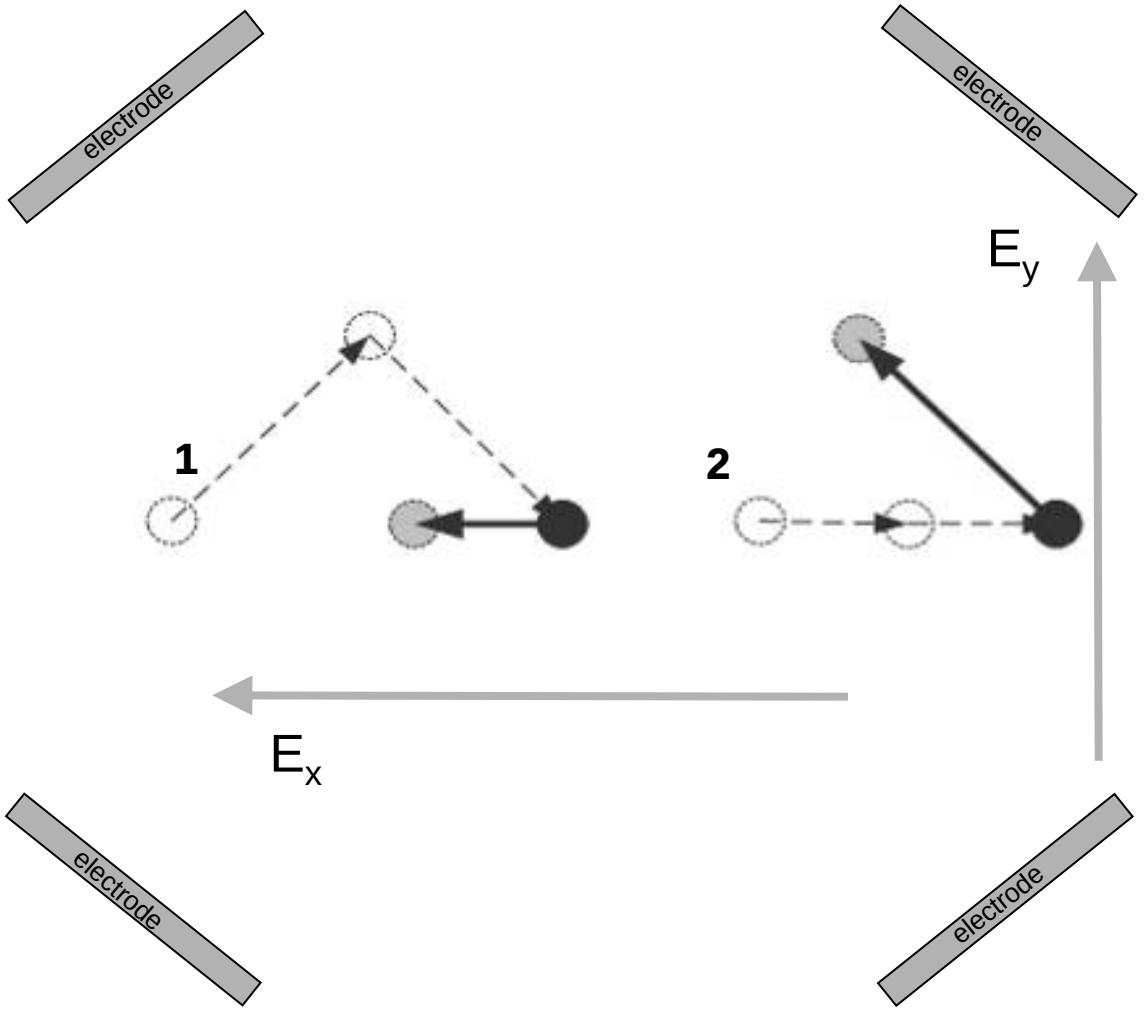
$$\vec{v} = \mu \vec{E}$$

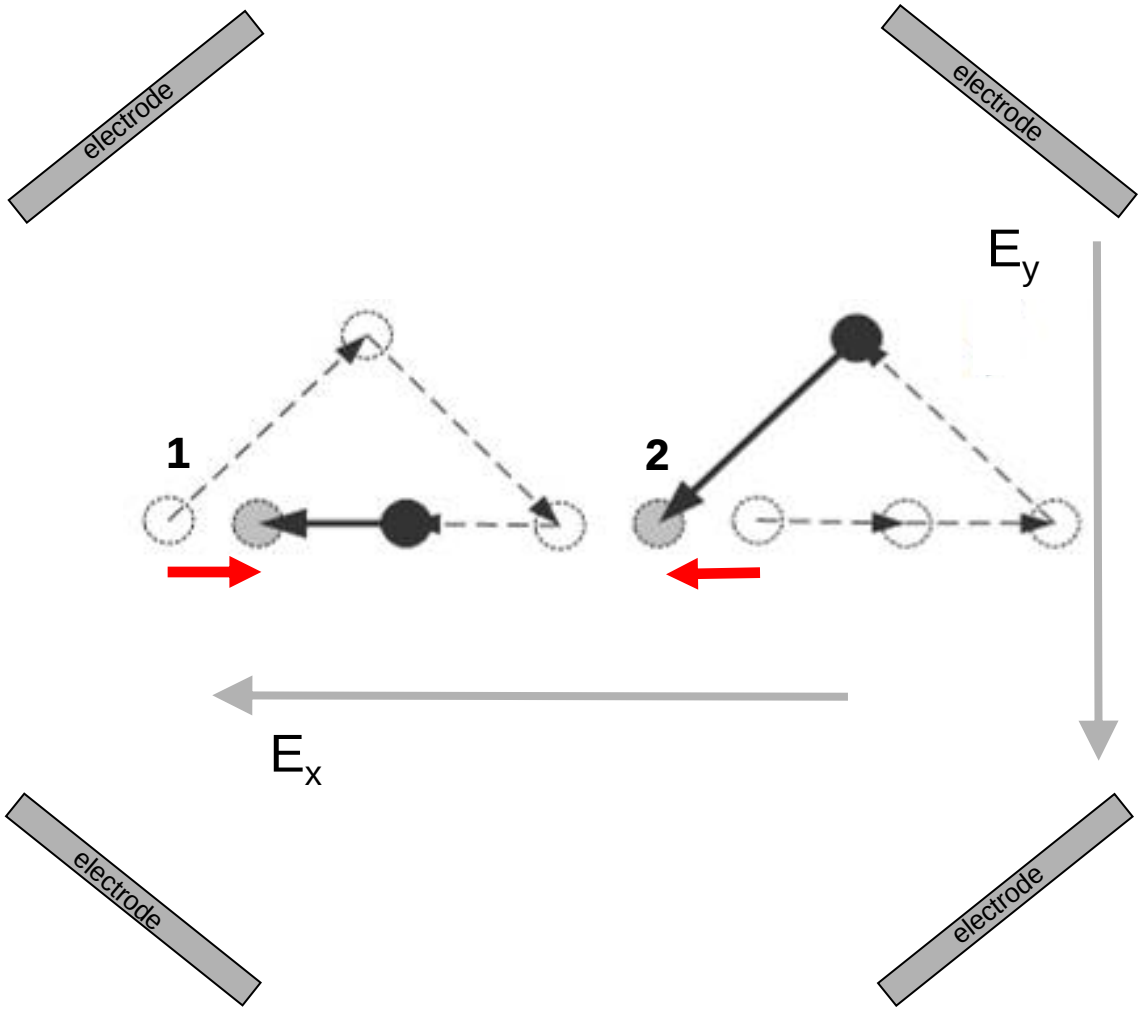


$$\mu(E) = \mu_0 + kE$$


electrode
electrode
E_y
1
2
E_x
electrode
electrode


electrode
electrode
1
2
E_y
E_x
electrode
electrode


electrode
electrode
E_y
1
2
E_x
electrode
electrode


electrode
electrode
E_y
1
2
E_x
electrode
electrode

Assume a quadratic velocity term $\vec{v} = k\hat{\mathbf{E}}(E)^2$

… and a rotating driving field: $E_x = E\cos(\omega t)$ $E_y = E\sin(\omega t)$

The quadratic term in the velocity generates a 2nd harmonic of ω:

$$\mathrm{d}v_x = k\left[\left(E + \frac{E_x^{\,2}}{E}\right)\mathrm{d}E_x + \left(\frac{E_x E_y}{E}\right)\mathrm{d}E_y\right]$$

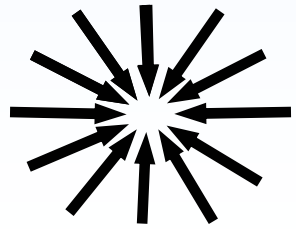
$$\cos^2(\omega) = \frac{1}{2} + \frac{1}{2}\cos(2\omega) \qquad \mathrm{d}v_{x_{\cos 2\omega}} = \frac{kE}{2}\left[\cos(2\omega t)\right]\mathrm{d}E_x$$

So we beat this 2nd harmonic with a perturbing field at frequency 2ω:

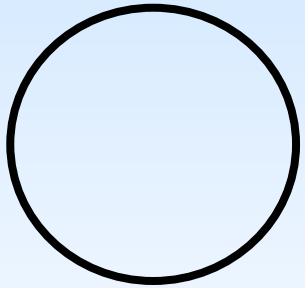
$$\mathrm{d}E_x = -\mathrm{d}E_q\, x\cos(2\omega t) \qquad \mathrm{d}E_y = \mathrm{d}E_q\, y\cos(2\omega t)$$

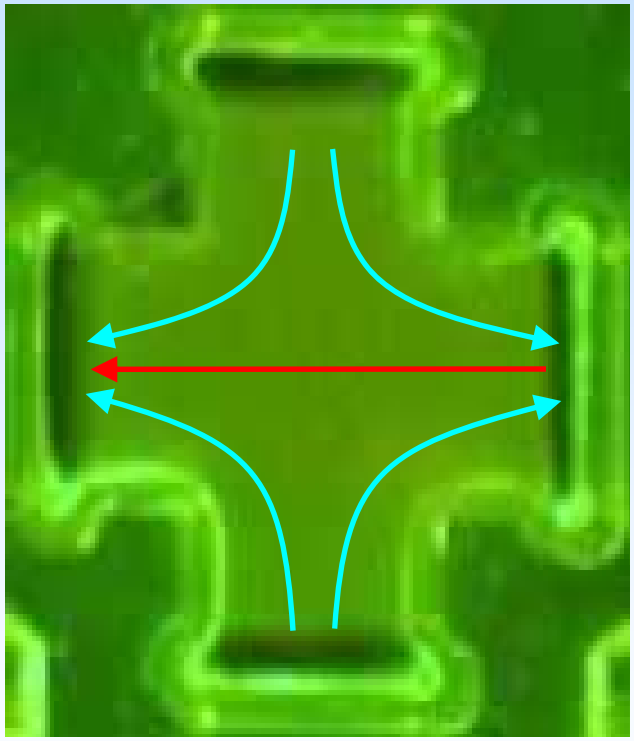
$2\cos^2(x) = 1 + \cos(2x)$

$$\overline{\mathrm{d}\vec{\mathbf{v}}} = -\frac{kE\mathrm{d}E_q}{4}\vec{\mathbf{r}}$$

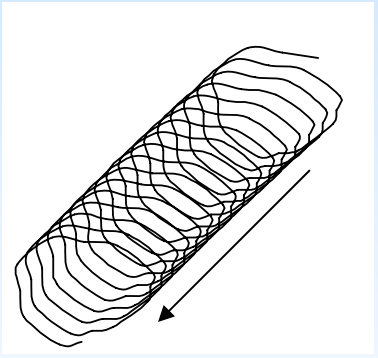


Most molecules:

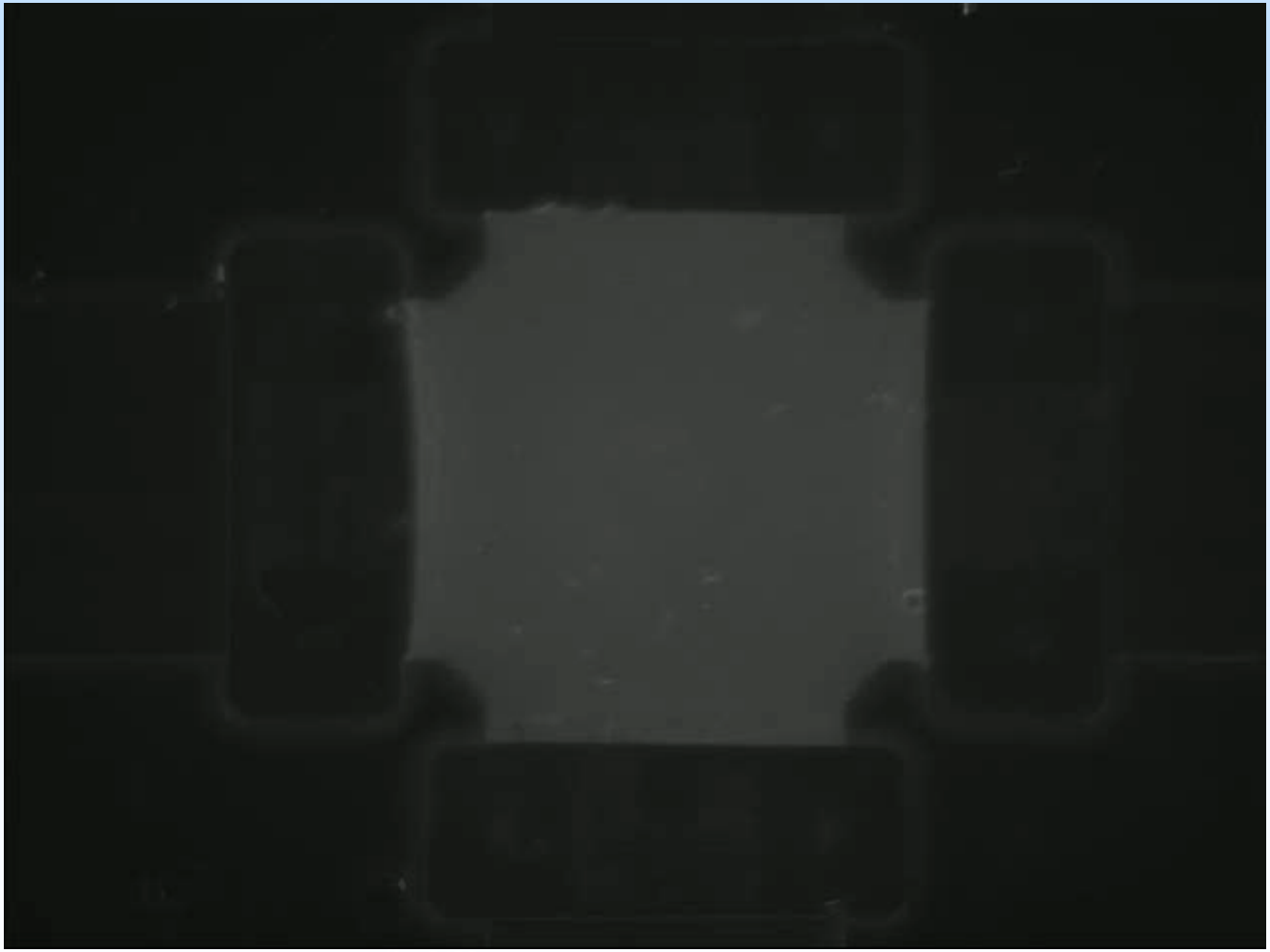




DNA and RNA:

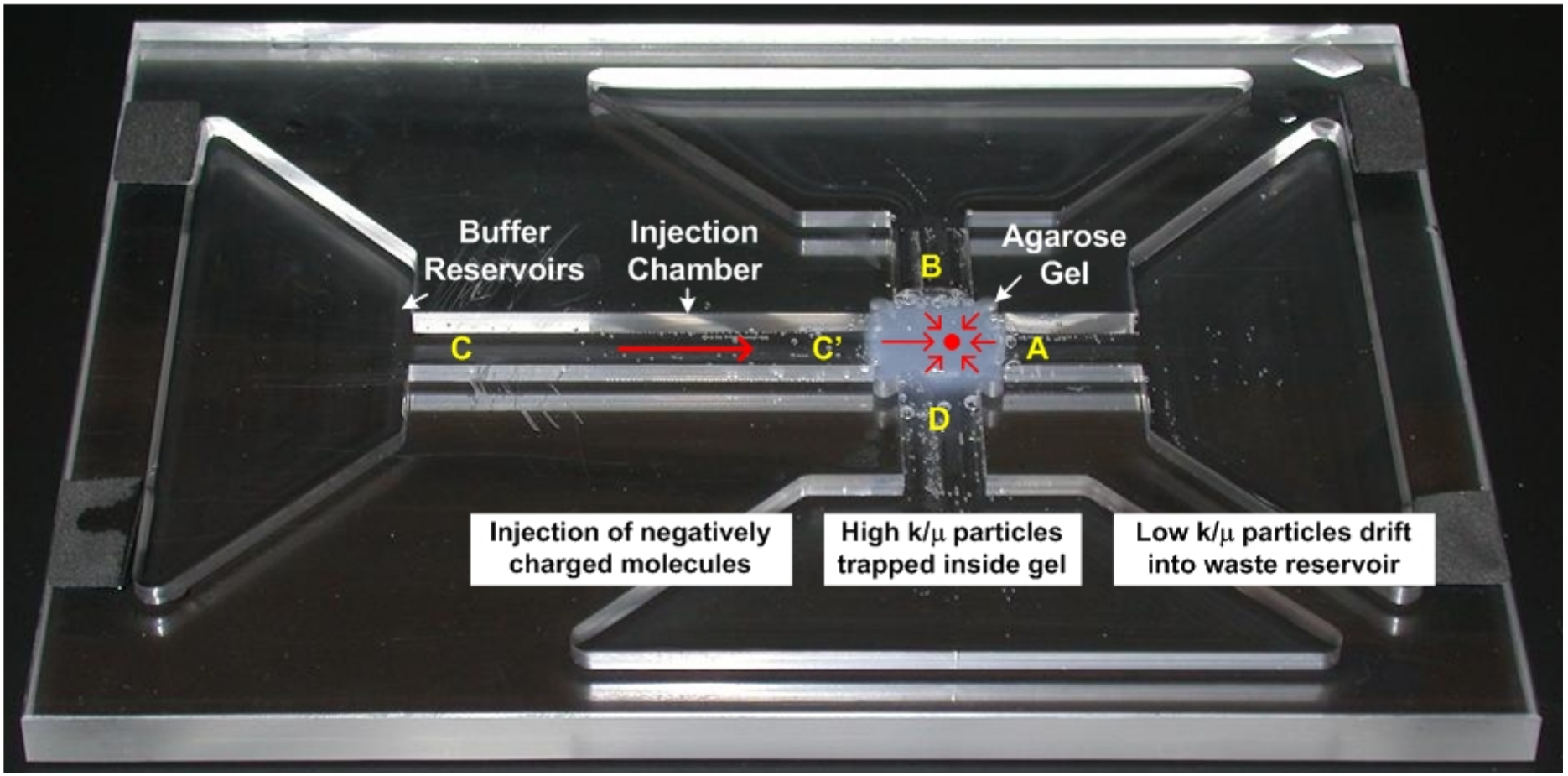


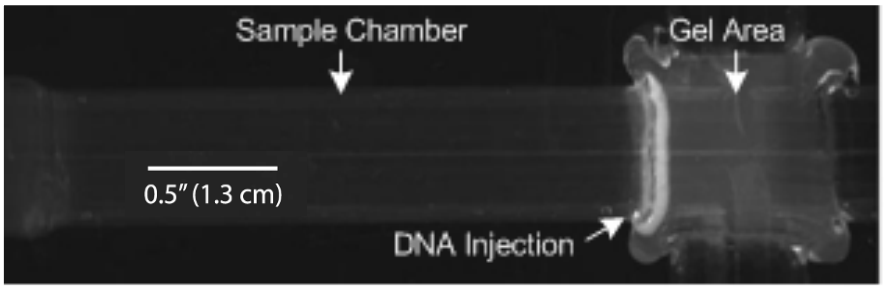
DNA Concentration

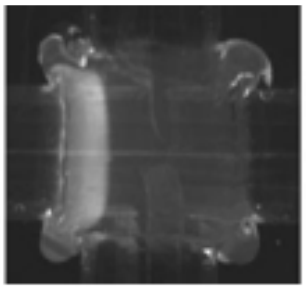


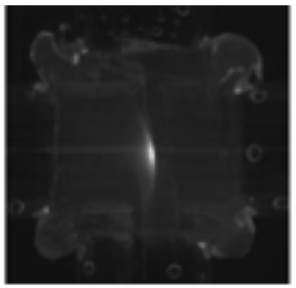
A. Marziali, J. Pel, D. Bizzotto, L. Whitehead, *Electrophoresis* 2005, *26,* 82–90

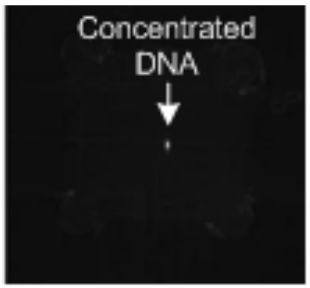
Boreal Genomics

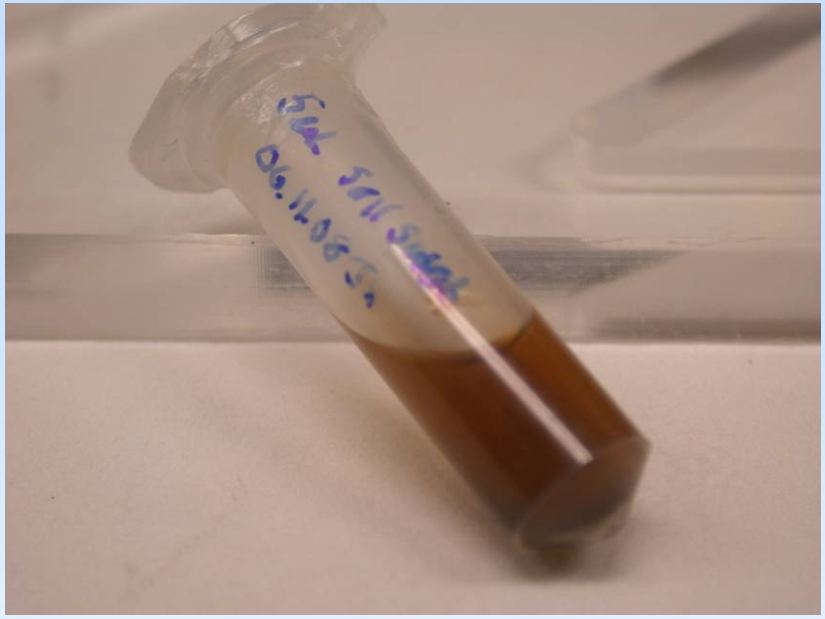

Buffer Reservoirs
Injection Chamber
Agarose Gel
B
C
C'
A
D
Injection of negatively charged molecules
High k/μ particles trapped inside gel
Low k/μ particles drift into waste reservoir

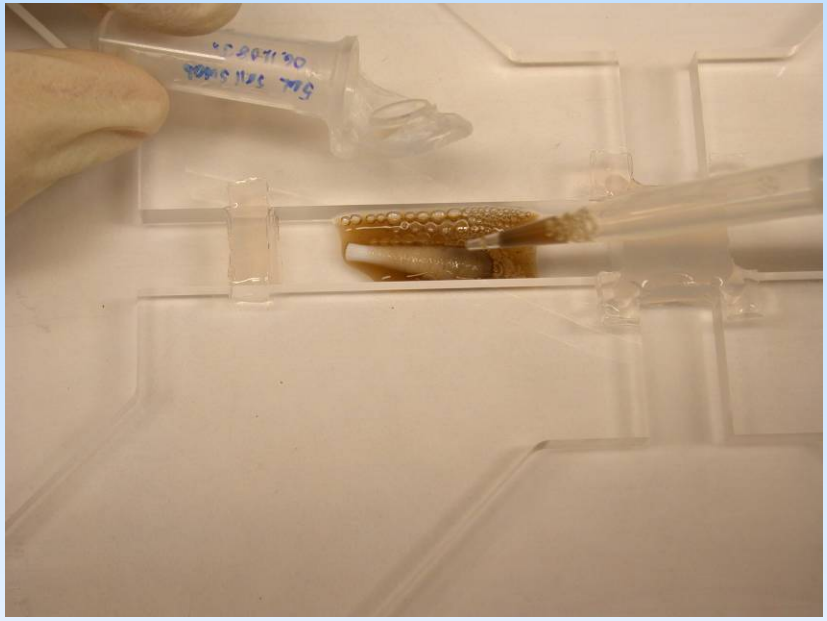

Sample Chamber
Gel Area
0.5″ (1.3 cm)
DNA Injection

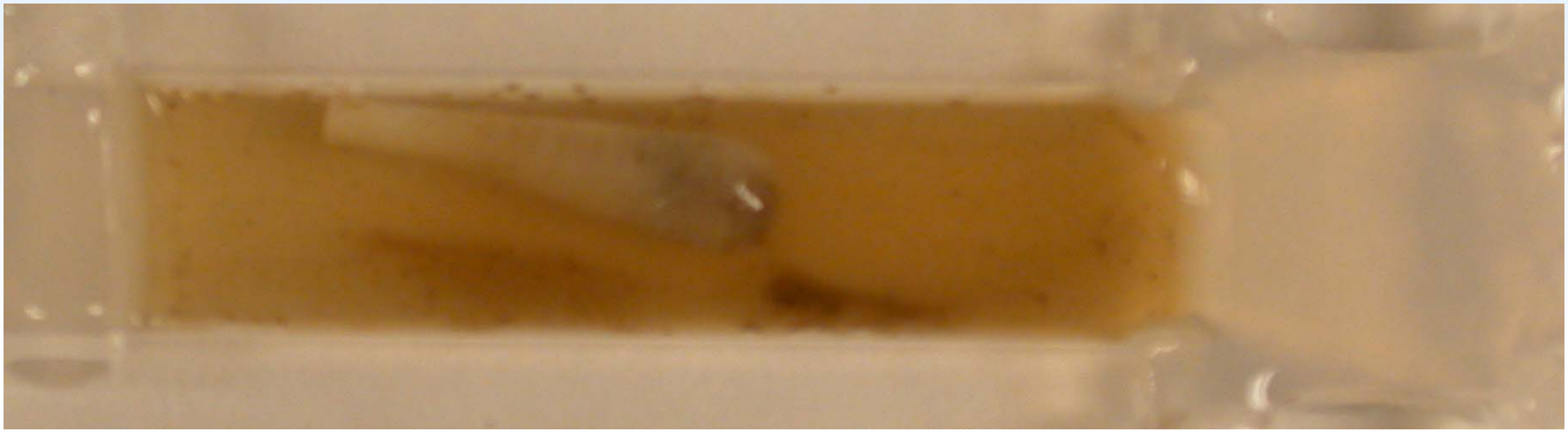


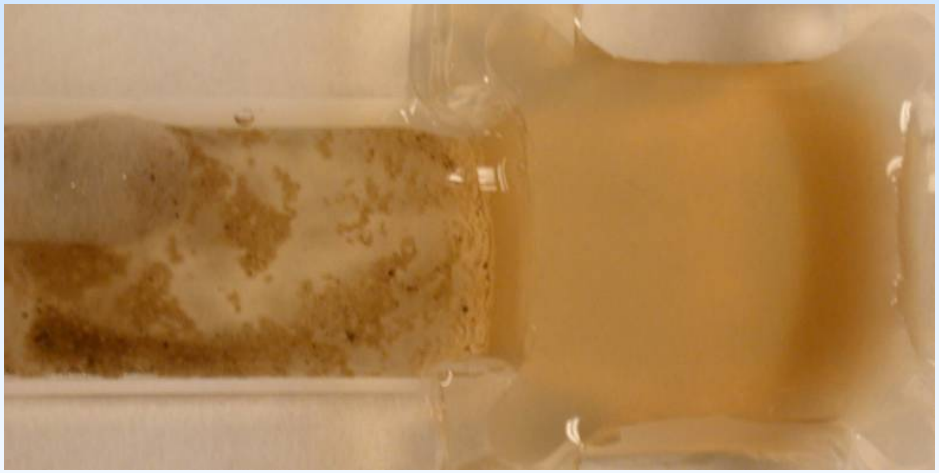


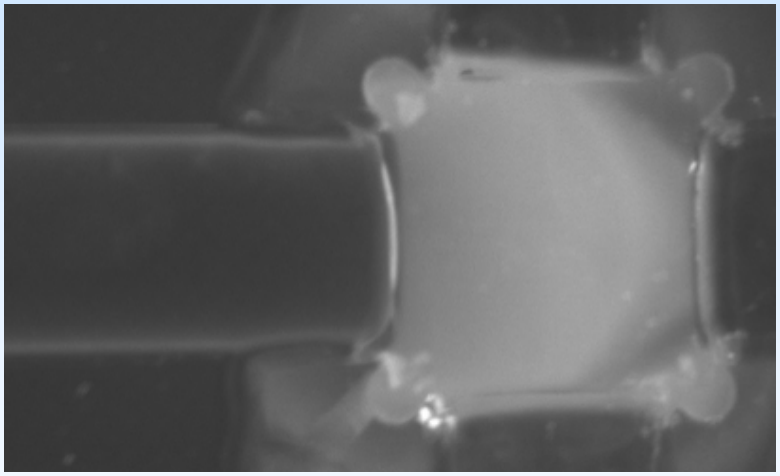

Concentrated DNA

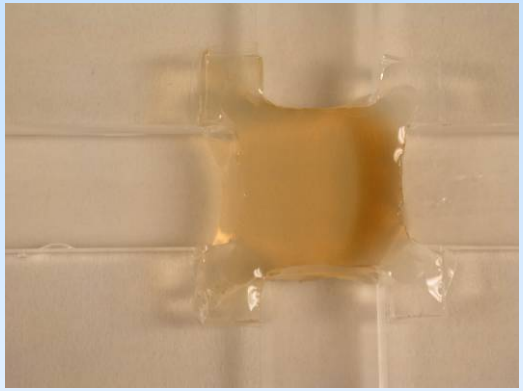
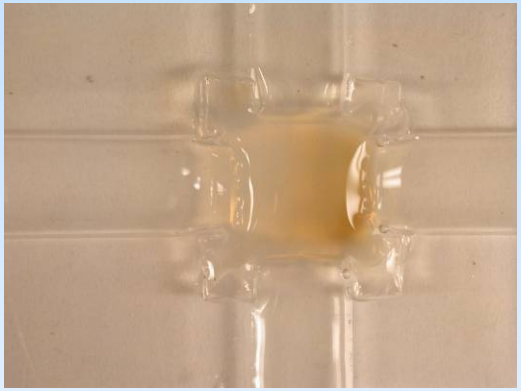
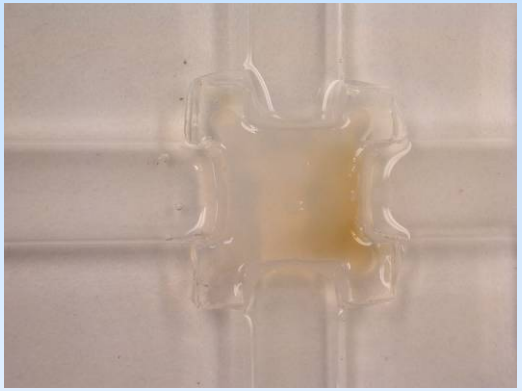
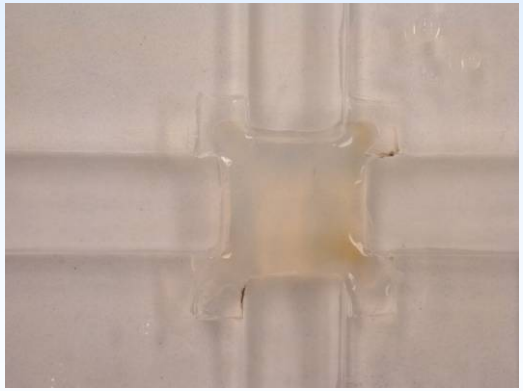
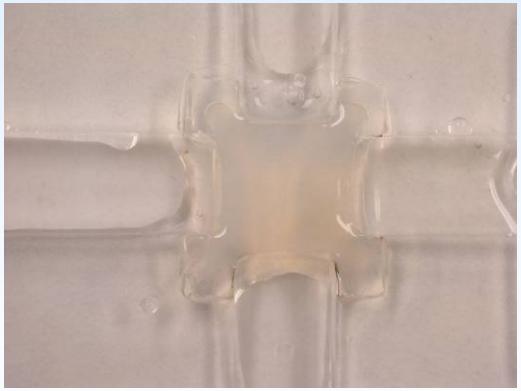
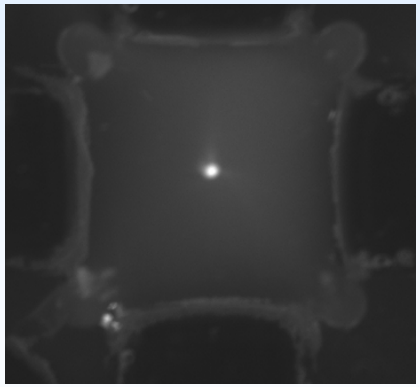


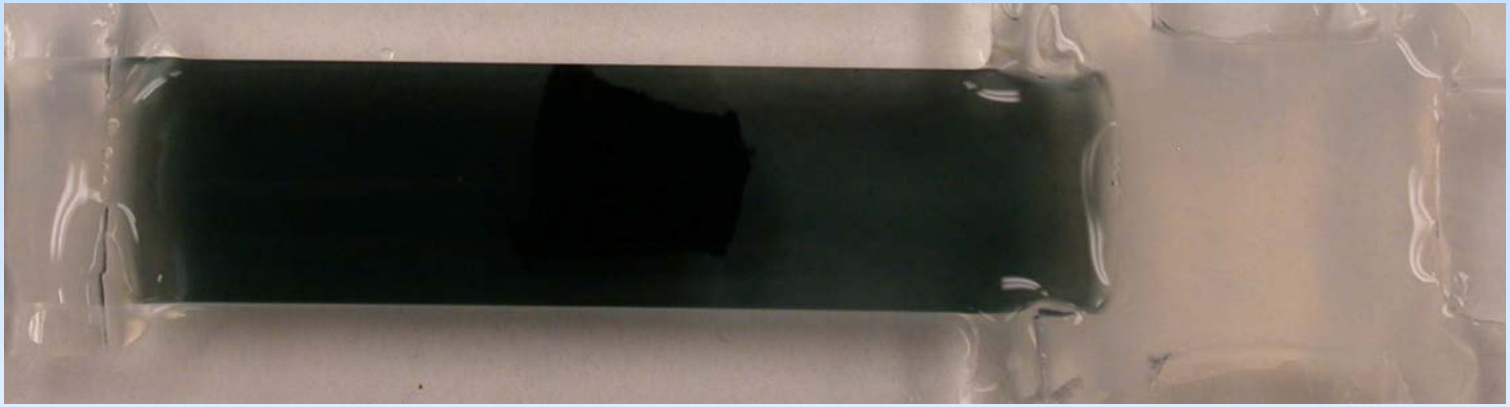


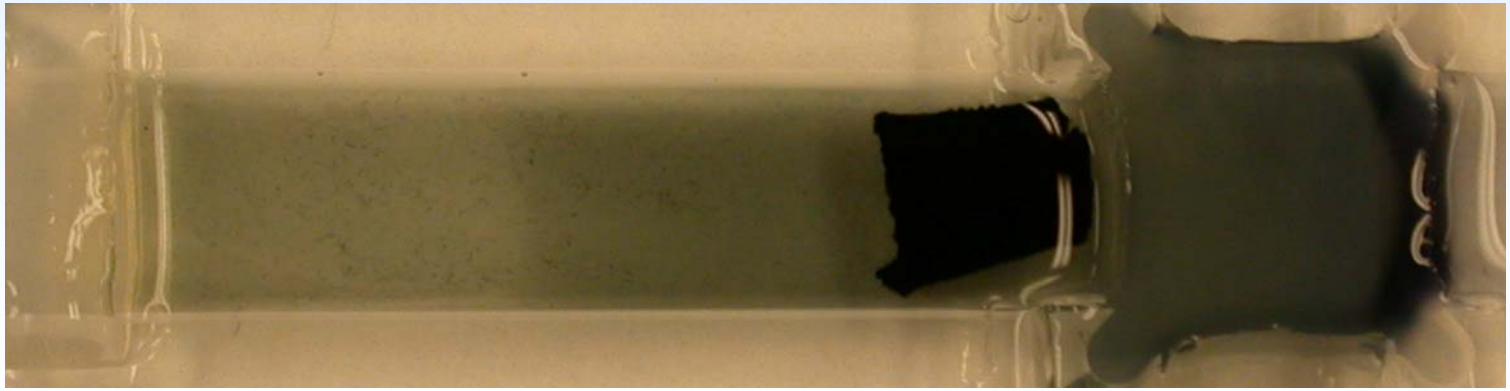


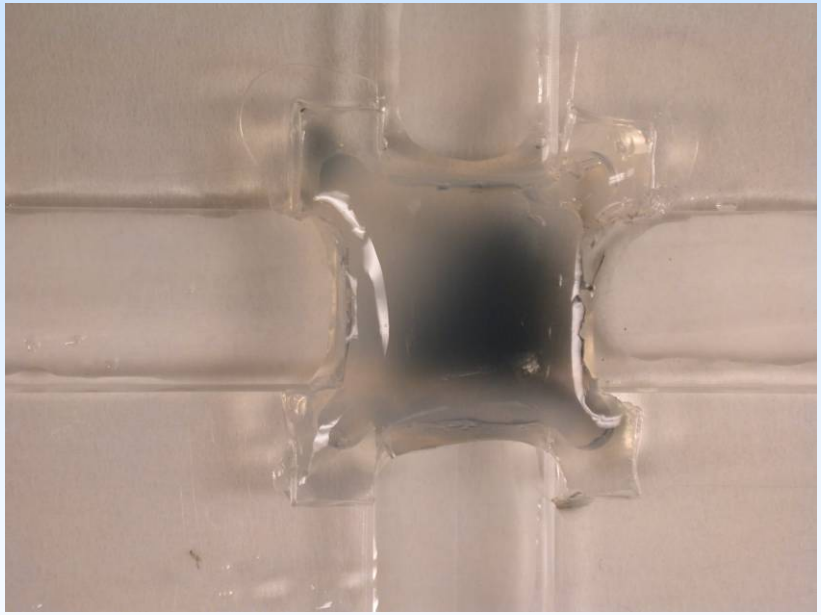


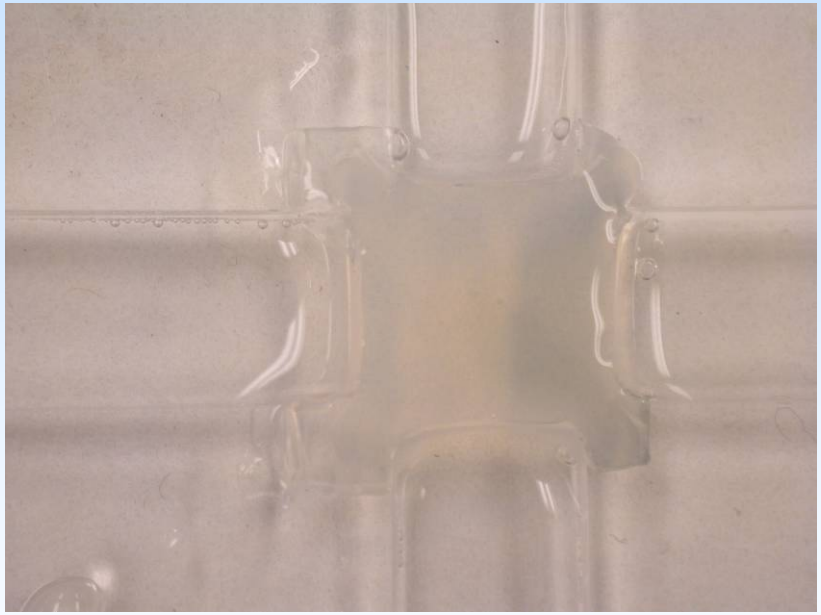


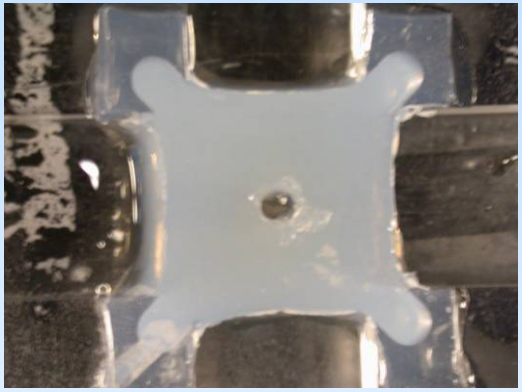













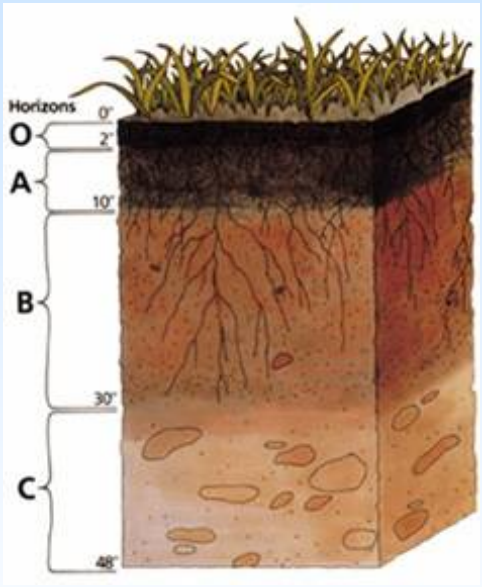


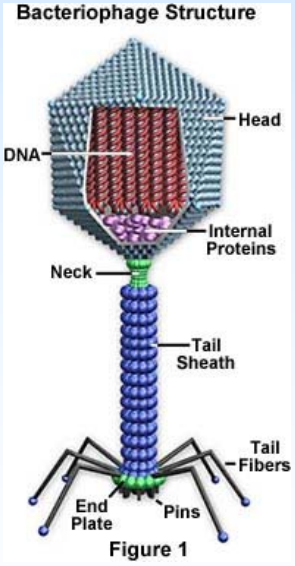


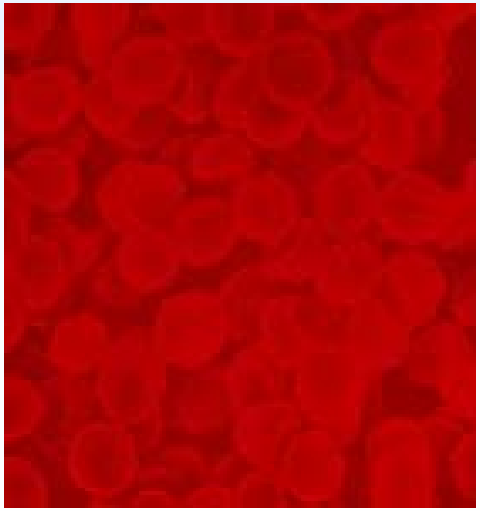
RCMP code	Description	~ Vol (uL)	AVG- [ ] (ng/uL)	TOTAL DNA (ng)
1	0.5ul on soil	100	0.13	**12.80**
2	0.5ul on soil			
3	1ul in soil	60	0.26	**15.54**
4	1ul in soil			
5	5ul on soil	60	1.43	**85.50**
6	5ul on soil	60	0.26	**15.84**
7	0.5ul + water on filter paper	200	0.04	**8.60**
8	0.5ul + water on filter paper			
9	1ul + water on filter paper	120	0.06	**6.85**
10	1ul + water on filter paper			
11	5ul + water on filter paper	120	0.45	**54.00**
12	5ul + water on filter paper			
13	1ul on FTA			
14	1ul on FTA	60	0.05	**3.23**
15	2.5ul on FTA			
16	2.5ul on FTA	60	0.13	**7.74**
17	1ul on denim			
18	1ul on denim	100	0.31	**31.10**
19	2.5ul on denim			
20	2.5ul on denim	60	0.22	**13.35**
6	Hemastix samples	120	0.38	**46.08**
7	Hemastix samples	200	0.08	**16.80**
8	Hemastix samples	120	0.07	**8.40**
10	Hemastix samples	100	0.04	**3.80**


JLICE


© Tony Rath Photography

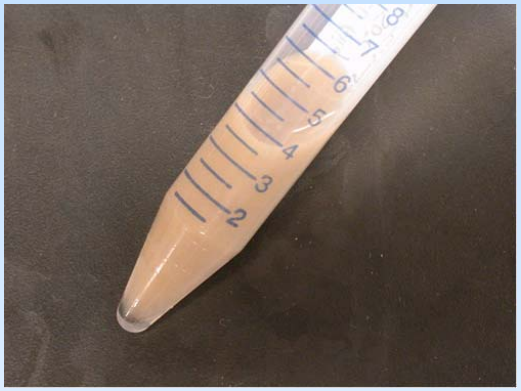

Horizons
O
A
B
C
0"
2"
10"
30"
48"


Bacteriophage Structure
Head
DNA
Internal Proteins
Neck
Tail Sheath
Tail Fibers
End Plate
Pins
Figure 1

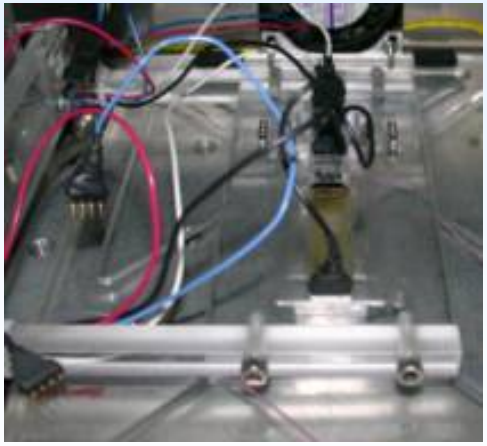


Courtesy of Rob Holt, GSC

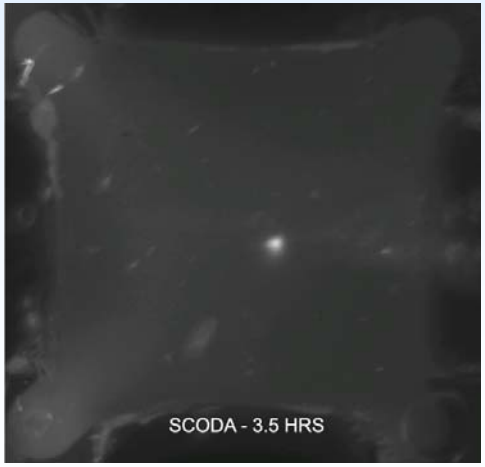
1. Lysis



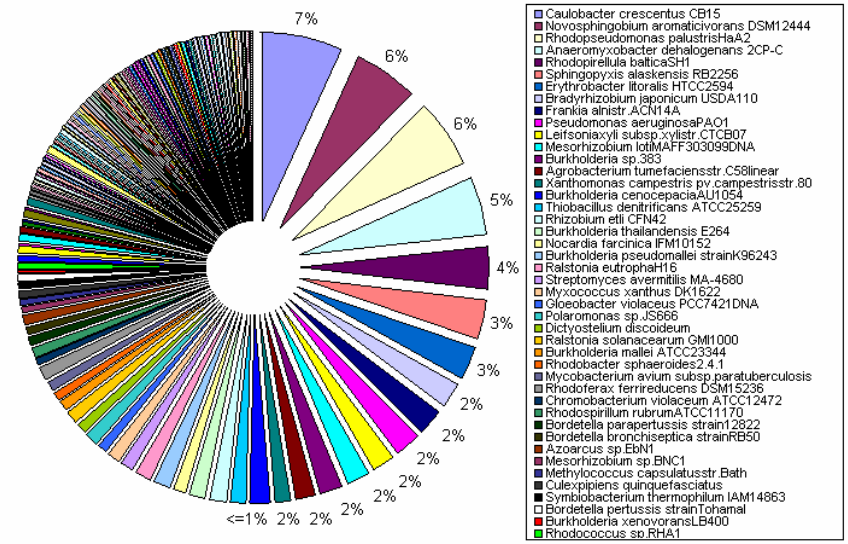
2. Loading



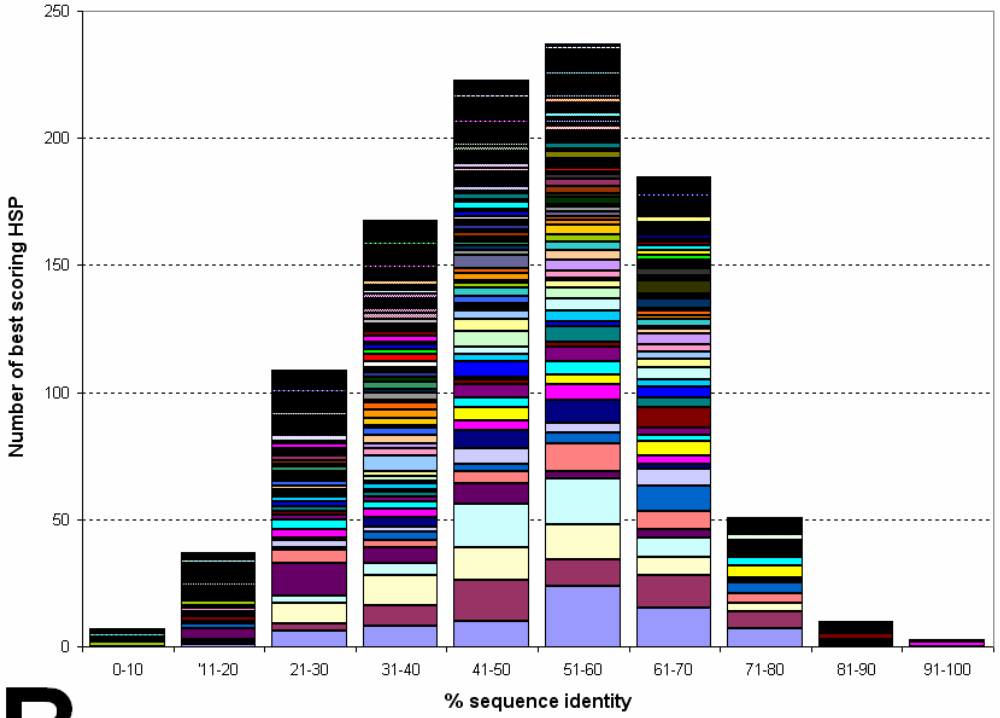
3. Electrophoresis



4. Concentrated DNA



A



B

Courtesy of Rob Holt, GSC

P.S. I didn't do much of the actual work....

But I did hire some excellent people that did:

Vincent Tabard-Cossa
Matthew Wiggin
Carolina Tropini
Dhruti Trivedi
Nahid Jetha
George Sterling
Chris Feehan

David Broemeling
Joel Pel
Giorgia Tropini
Laura Mai
Ivan Chan
Gareth Mercer

Dylan Gunn
Peter Eugster
Jason Thompson
... and many others

genome.gov
National Human Genome Research Institute
National Institutes of Health

GenomeBritishColumbia

CIHR IRSC

UBC

NSERC CRSNG

ENPH

Collaborators:
Lorne Whitehead
Julian Davies
Rob Holt (BCCA–GSC)
Vivian Miao
Karen Lu
Hiron Poon (RCMP)

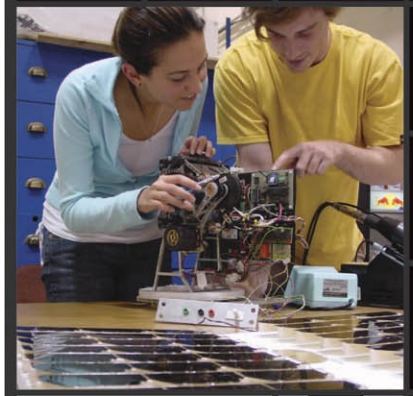
Boreal Genomics

http://www.physics.ubc.ca/~andre/

ENGINEERING PHYSICS PROGRAM

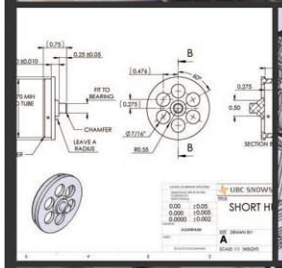
DEPARTMENT OF PHYSICS & ASTRONOMY

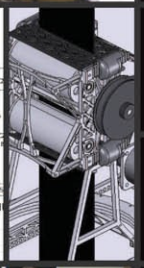
TURN IDEAS INTO REALITY



Invent. Create. Discover.

Learn from Science and Technology leaders while developing hands-on skills in one of the best undergraduate applied physics programs in North America.





ENPH

FOR MORE INFORMATION:

WWW.ENGPHYS.UBC.CA

UBC ENGINEERING PHYSICS

Andre Marziali, Ph.D., P.Eng.
Director

andre@physics.ubc.ca