Final Talk

8-11am Tuesday , May 8, 2012

Your name:

Speaker's name:

What is a one (or two) sentence summary of the main point of the talk.

Was the talk well organized? Quality of slides?

Write down one question for the presenter; one thing you didn't understand.

Was the student able to answer questions?

Overall grade (10 is best, 1 is the worst):

Presentation Rubric (Developed by Information Technology Evaluation Services, NC Department of Public Instruction).

	Evaluating Student Presentations				
	1	**2**	**3**	**4**	**Total**
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow.	Student presents information in logical, interesting sequence which audience can follow.	
Subject Knowledge	Student does not have grasp of information; student cannot answer questions about subject.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student is at ease with expected answers to all questions, but fails to elaborate.	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration.	
Graphics	Student uses superfluous graphics or no graphics	Student occasionally uses graphics that rarely support text and presentation.	Student's graphics relate to text and presentation.	Student's graphics explain and reinforce screen text and presentation.	
Eye Contact	Student reads all of report with no eye contact.	Student occasionally uses eye contact, but still reads most of report.	Student maintains eye contact most of the time but frequently returns to notes.	Student maintains eye contact with audience, seldom returning to notes.	
Elocution	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	
				Total Points:	

One sentence summary:

US universities create bridges between physics and biology

[WASHINGTON] A number of leading US research universities are planning new institutes to bring physical and biomedical scientists together. This reflects a growing feeling that these fields should be linked more closely in both research and teaching.

One of the largest initiatives comes from Stanford University, where the Nobel-prizewinning physicist Steven Chu and biochemist James Spudich are spearheading a proposal for a research centre housing 50 faculty members, spanning disciplines from applied physics to clinical medicine.

Multidisciplinary research centres are also planned at the University of Chicago, which is setting up an 'interdivisional institute' straddling the biological and physical sciences, and the University of California at Berkeley, which is planning a building for its bioengineering department and some faculty members from molecular biology and several physical science departments.

In addition, Princeton University is due to announce plans this week for an interdisciplinary genomics institute in a new $40 million building connected to its molecular biology department.

before the centre can receive formal approval from Stanford's board of trustees, its supporters expect the plan to go ahead, and hope to have the new building by 2002.

The project is currently called 'Bio-X', reflecting the desire to mix biologists with researchers from other disciplines, but without an explicit agenda of techniques to be used or problems to be solved.

"We just want to mix smart people applied physics and biology departments, starting in September.

Bio-X is motivated partly by the growing perception that a deeper understanding of complex biological systems will need a more quantitative type of biology that is closely integrated with the physical sciences.

Much of molecular biology already relies on experimental techniques invented by physicists, such as NMR and X-ray diffraction. But as biology becomes more data-rich, it increasingly requires the analytical and computational methods characteristic of the physical sciences.

At the same time, physicists are finding new problems in biology. For example, Chu, who won the Nobel prize for work on laser cooling of trapped atoms, now also works on the behaviour of single protein molecules.

The desire to bring together scientists from different disciplines stems from an awareness that traditional departments can be physical barriers to cross-fertilization. This is part of the thinking behind Princeton's new institute, planned to be built within two years, with about 12 faculty drawn from physics, chemistry, mathematics and

Order of speakers:

Andrew

Sam

Abdel

Danylo

Conrad

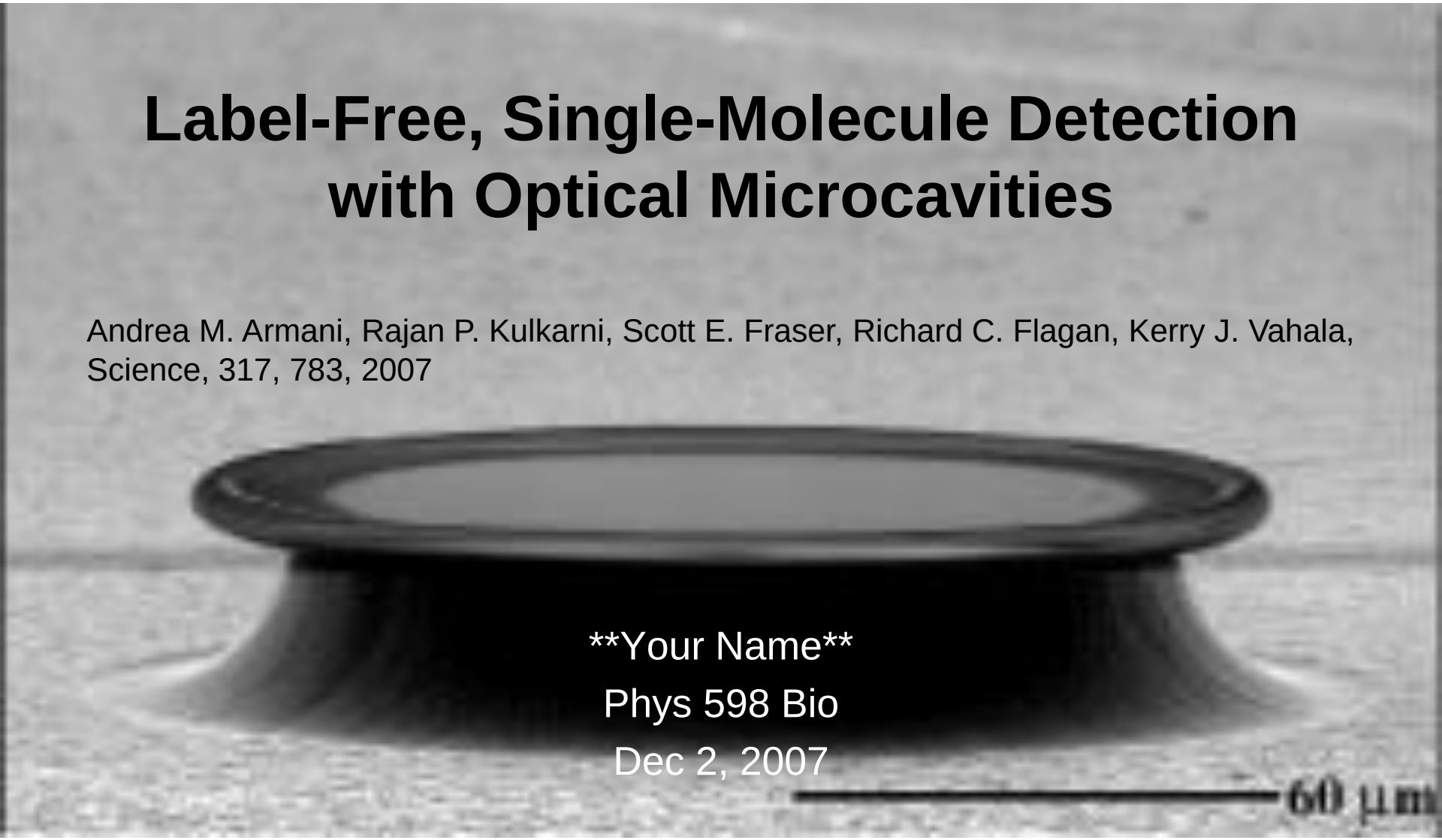
Guannan

Article: Fraser, Science mag. article—microcavity, label-free. 10/10. Way cool! Very clear presentation! It was a pleasure having you in class.

Clear, simple motivation. Why it's important.
Lots of pictures.
Have an introductory phrase and a concluding phrase for each slide.
Clear, short Conclusion
Have 10 slides
- have about 1 slide/minute—fast
- 1.5 min/slide-reasonable
- 2 min/slide—reasonable but slow.

Label-Free, Single-Molecule Detection with Optical Microcavities

Andrea M. Armani, Rajan P. Kulkarni, Scott E. Fraser, Richard C. Flagan, Kerry J. Vahala,
Science, 317, 783, 2007



Your Name

Phys 598 Bio

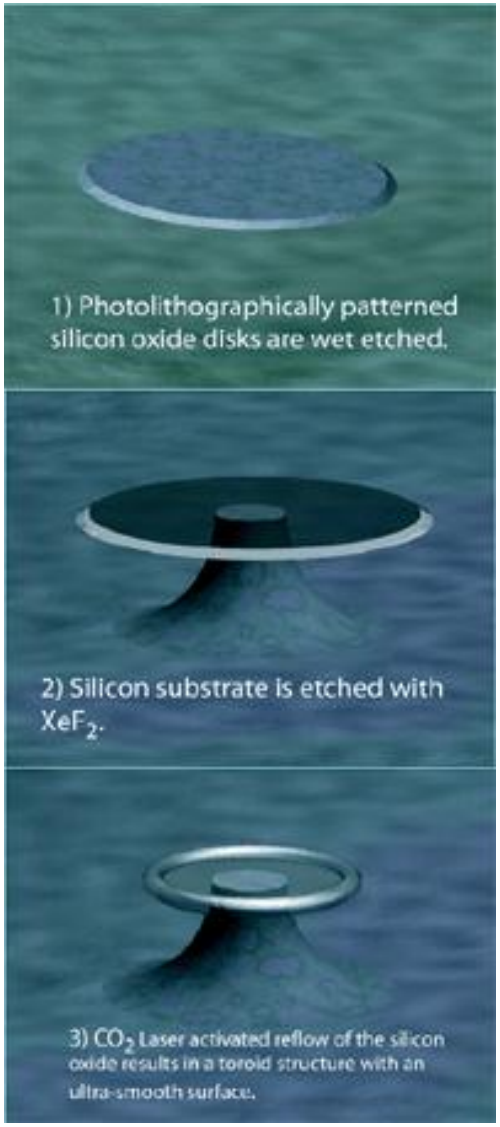
Dec 2, 2007

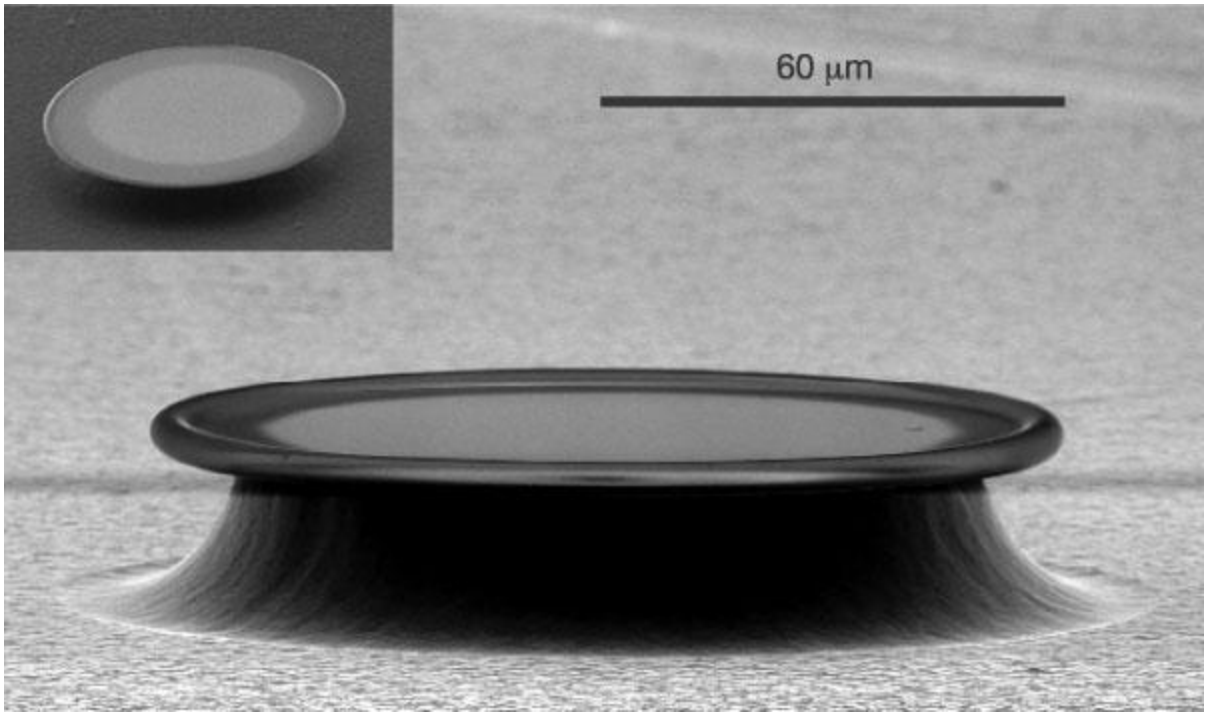
Motivation

- Current single molecule detection techniques require **labeling** the target molecule

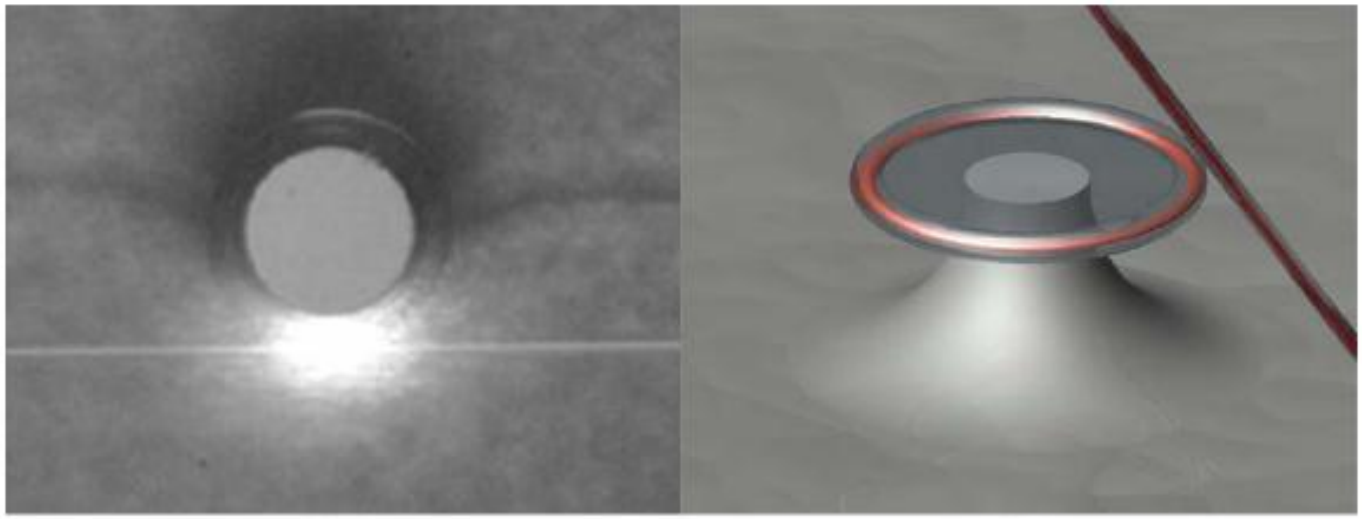
- In my chosen paper the authors report a highly specific and sensitive **optical sensor** that allow for **label-free detection of single molecules**

Preparation of the toroid optical microcavity





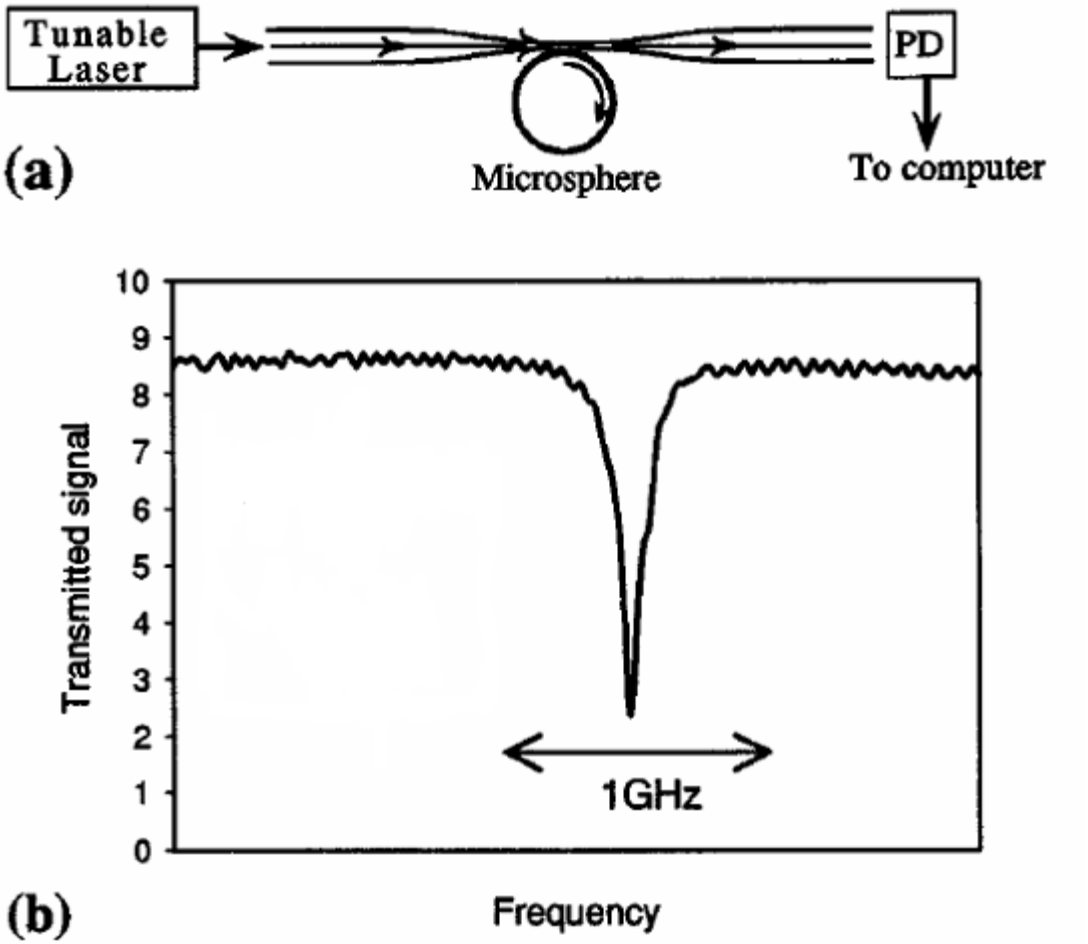
Scanning electron micrograph of a toroid before (inset) and after CO_2 laser reflow.



Optical Micrograph Rendering

Light is efficiently (>99%) coupled from the tapered optical fiber to the “whispering gallery” mode of the toroid. These toroids have typical Quality factors (Q) of 10^9.

Experimental setup

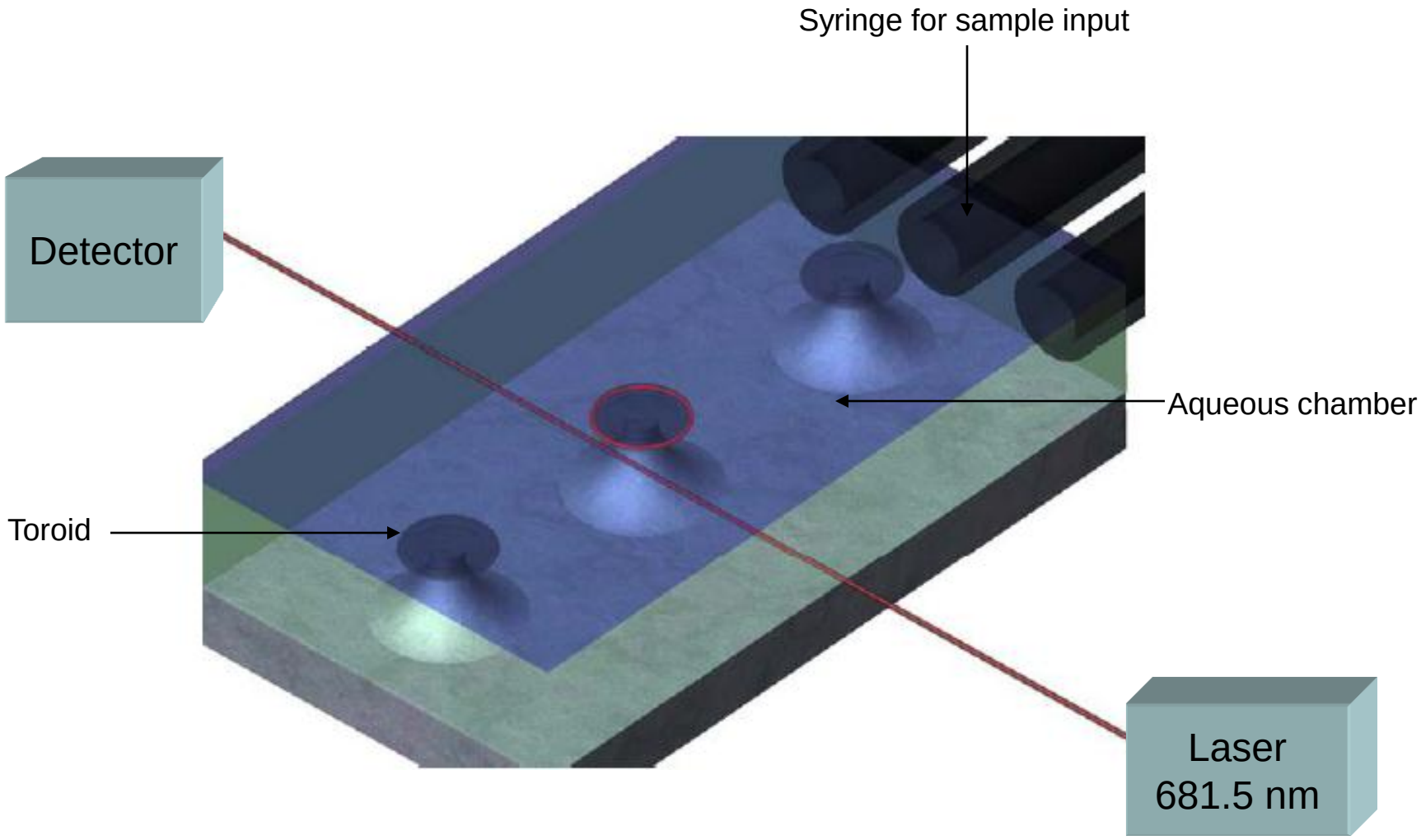


- The optical fiber couples light into the microcavity at a specific frequency.

- For a ultra high Q micro-cavity like the toroid, the **binding of a single molecule** leads to a **change in the resonant wavelength** (pm). The high Q-value allows for the sensitive detection of these pm shifts.

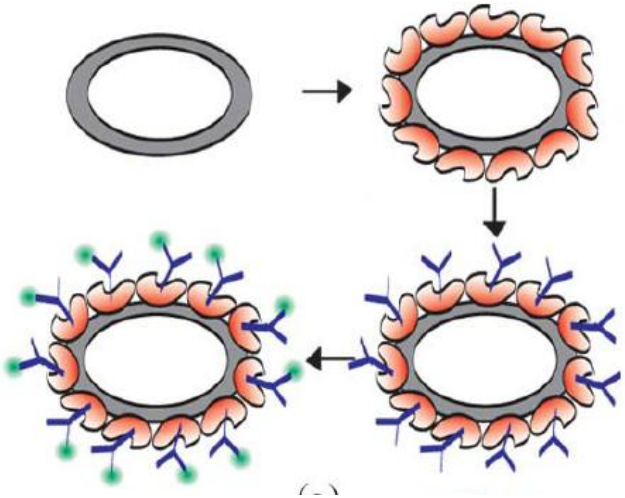
Knight et. al., 22, 15, 1129, Optics Letters, 1997

Single molecule detection

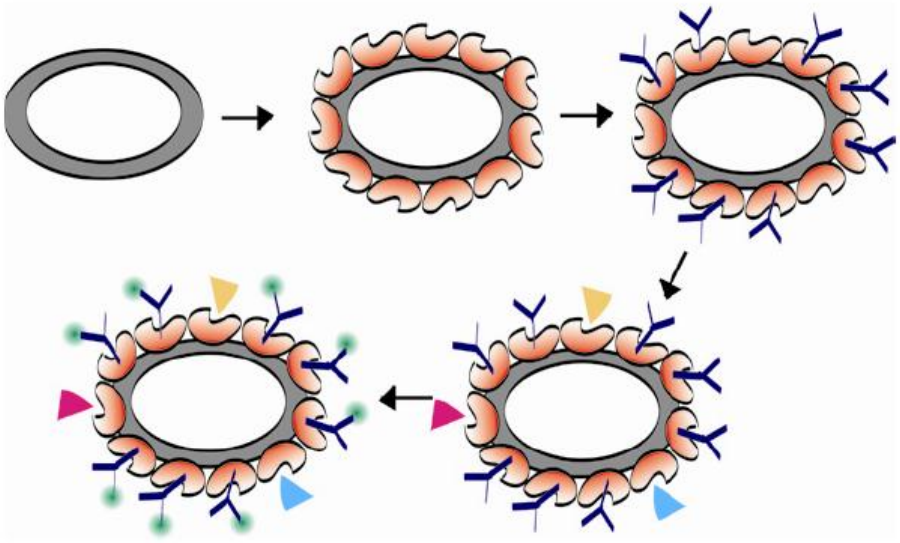


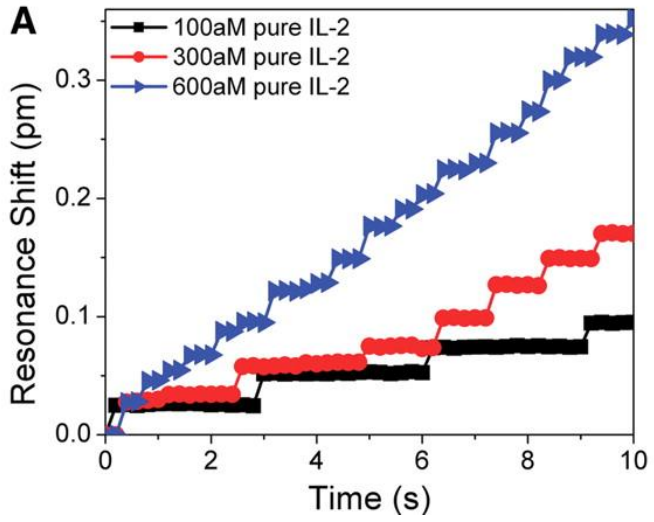
IL-2 detection

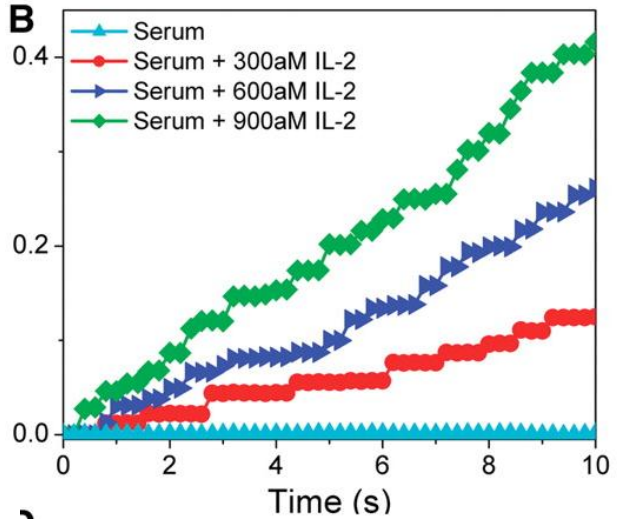
Pure IL-2



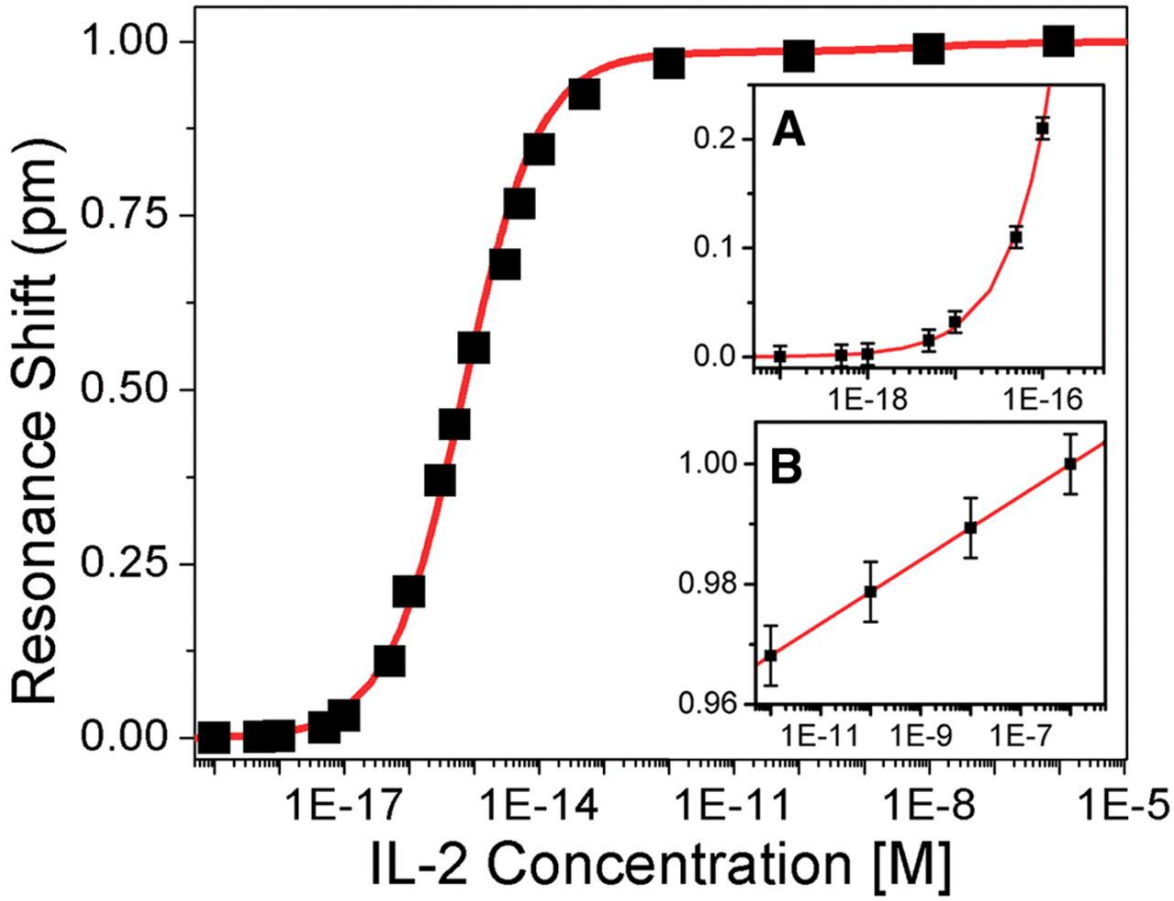
IL-2 in serum







Dose Response Curve



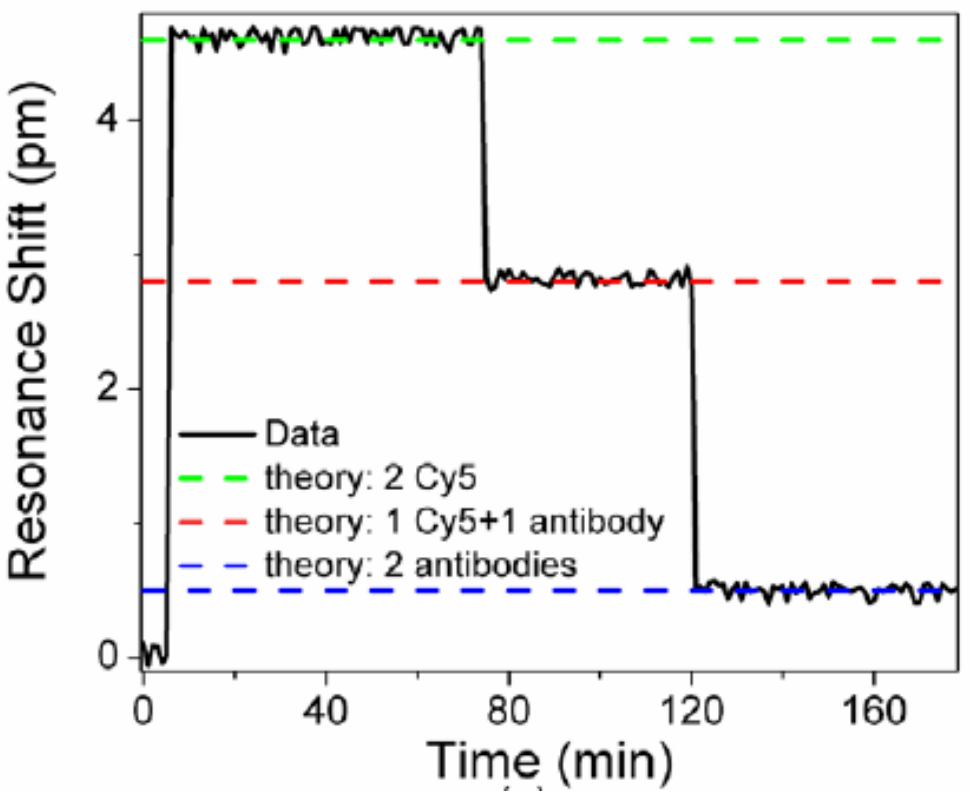
Shows that the microtoroid is capable of detecting concentration from aM to μM.

Summary

The authors have developed a method that allows for reliable detection of single molecules without the use of specific labels and furthermore the detection system allows for detecting concentration from the atto to micromolar range.

Thank You !

Quantal photobleaching



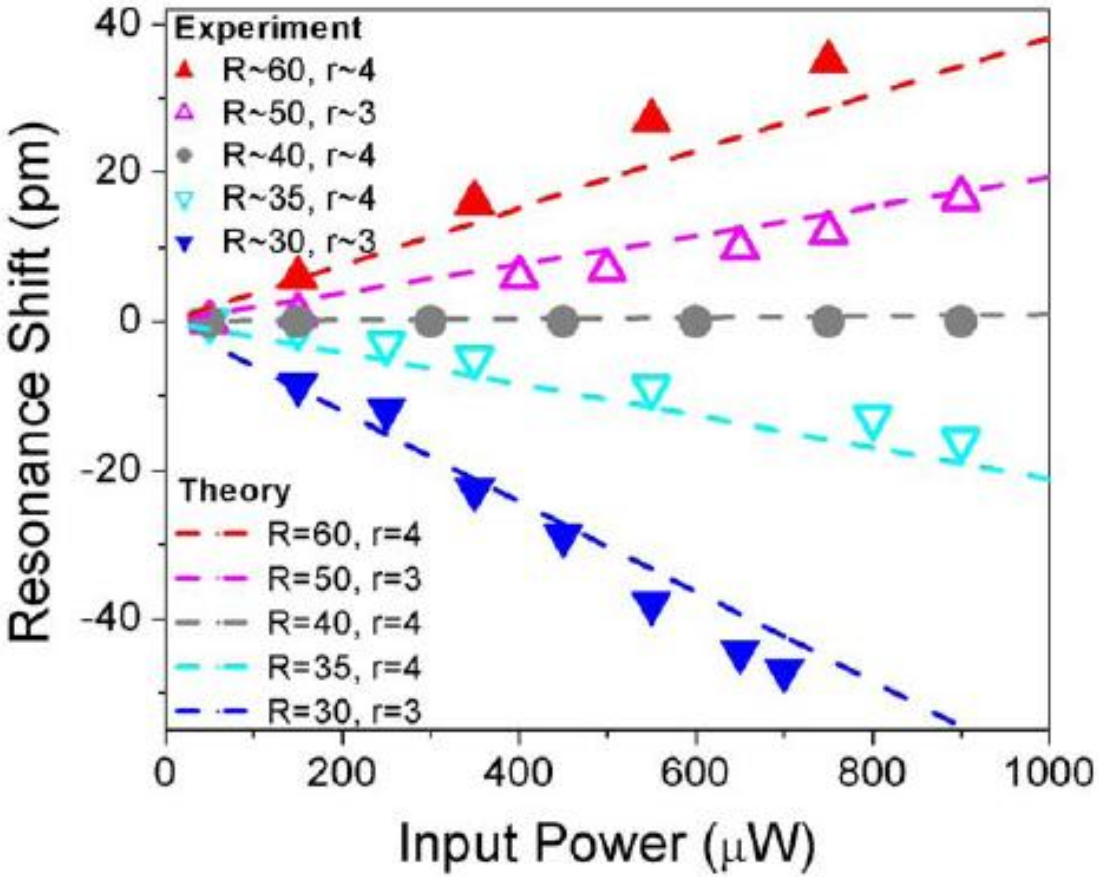
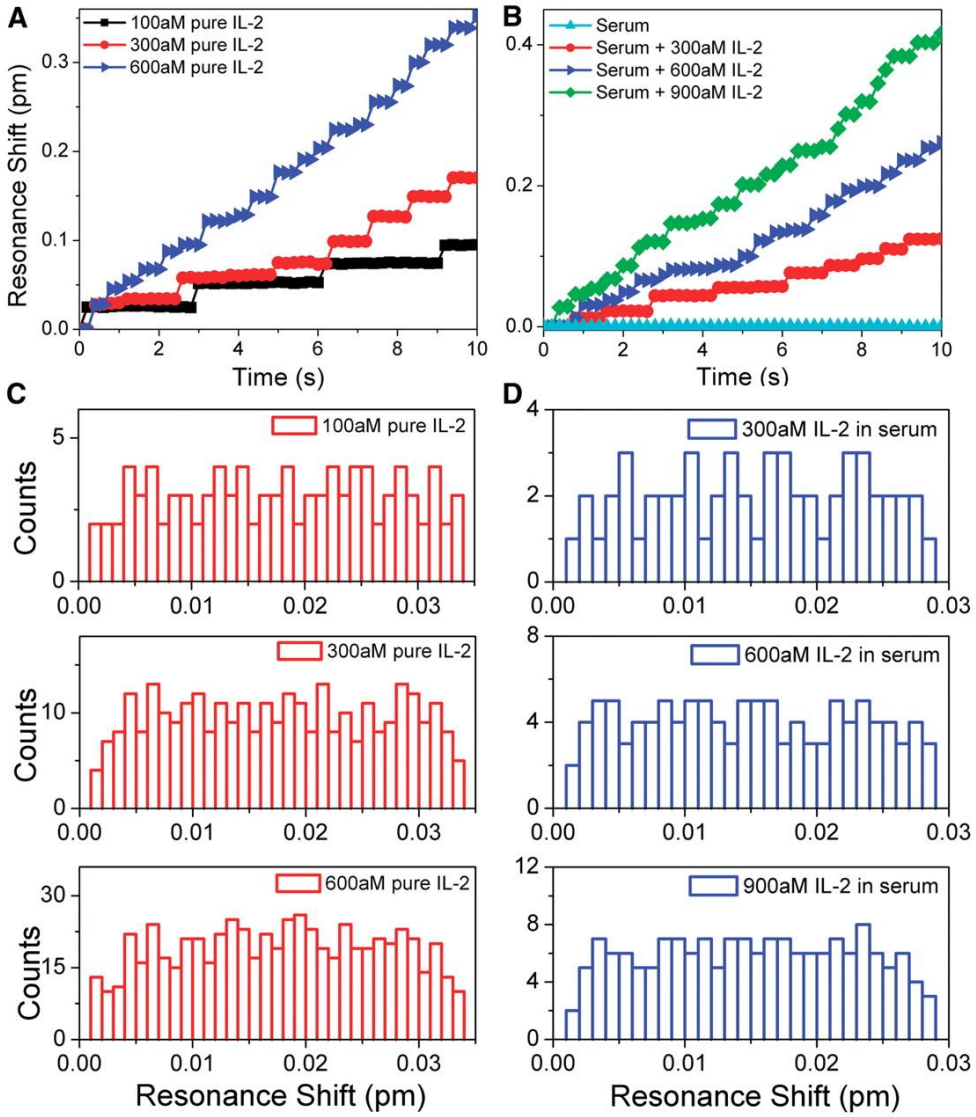
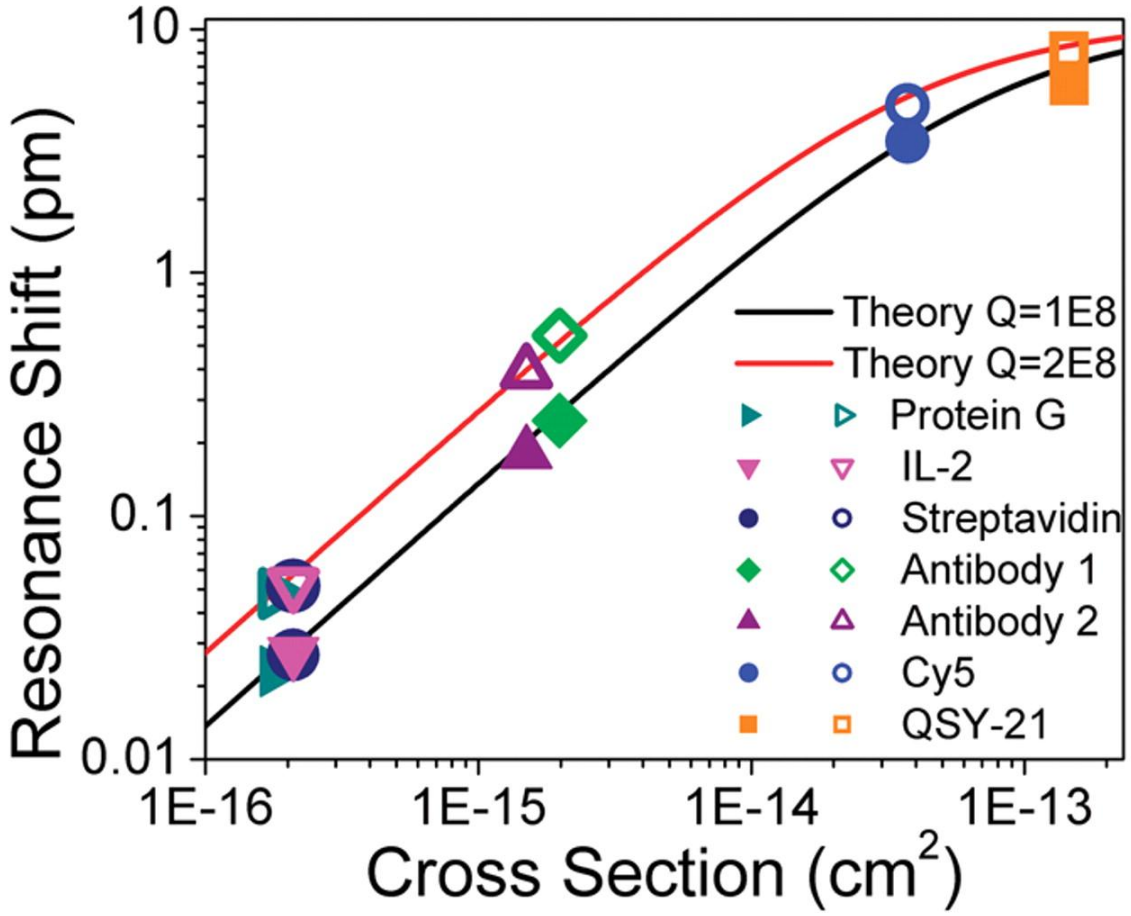


Figure S7: Measured tuning of the whispering gallery mode versus coupled optical power. Each data set corresponds to the major and minor radii indicated (in microns). Larger radii experience a red shift while smaller radii experience a blue shift with increasing coupled power. At a diameter of about 80 microns, the neutrality condition is observed. The dashed lines are the predictions based on the model.


A
100aM pure IL-2
300aM pure IL-2
600aM pure IL-2
Resonance Shift (pm)
Time (s)
B
Serum
Serum + 300aM IL-2
Serum + 600aM IL-2
Serum + 900aM IL-2
Time (s)
C
100aM pure IL-2
300aM pure IL-2
600aM pure IL-2
Counts
Resonance Shift (pm)
D
300aM IL-2 in serum
600aM IL-2 in serum
900aM IL-2 in serum
Resonance Shift (pm)


10
1
0.1
0.01
Resonance Shift (pm)
1E-16
1E-15
1E-14
1E-13
Cross Section (cm^2)
Theory Q=1E8
Theory Q=2E8
Protein G
IL-2
Streptavidin
Antibody 1
Antibody 2
Cy5
QSY-21

My comments: ATPase rotation, Kinosita, Nature. A brilliant piece of work. Good choice. Good that you covered how they used gold particle. Excellent conclusion. Very clear about 90 degree rotation. Unclear about 30 degree rotation—they have two possibilities, and how to distinguish between them. 9.5/10.

Resolution of Distinct Rotational Substeps by Submillisecond Kinetic Analysis of F_1-ATPase

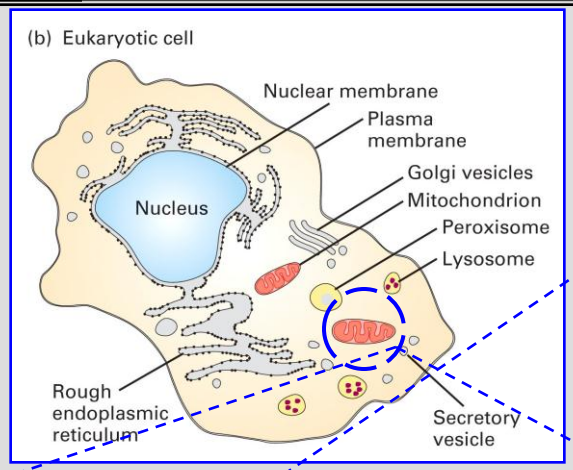
Nature 410(2001)

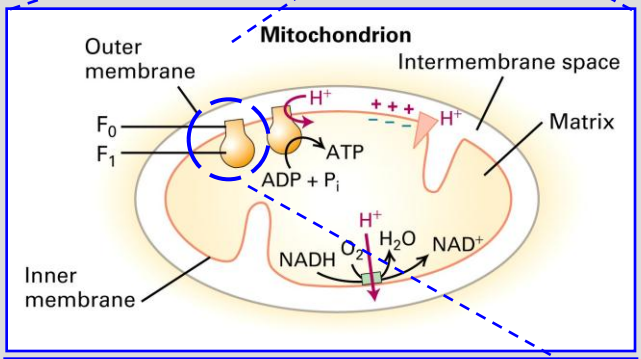
Single Molecule Biophysics

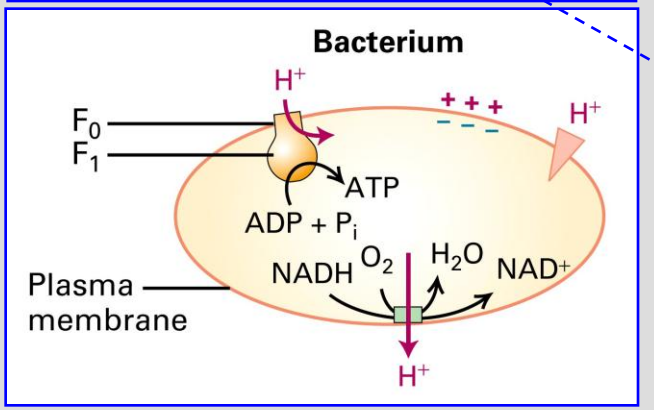
Your Name

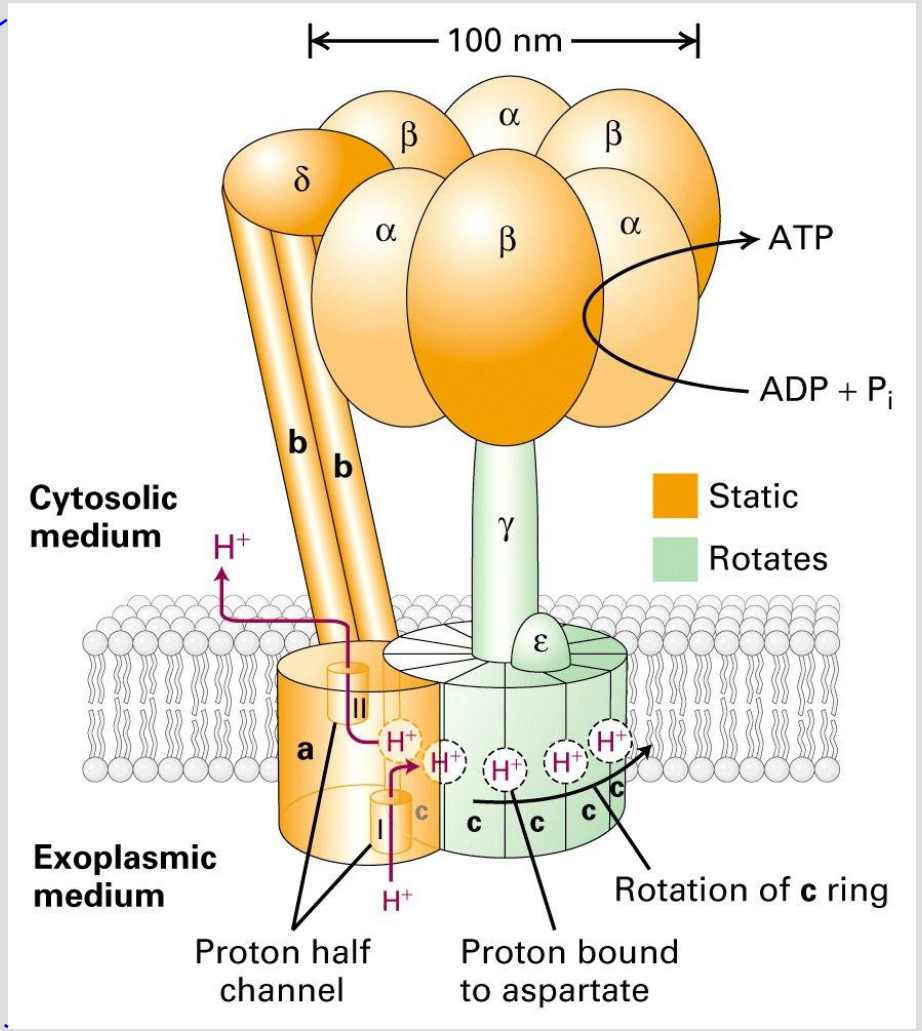
One (or two) sentence summary

F_0F_1:Rotary Motor for ATP Production





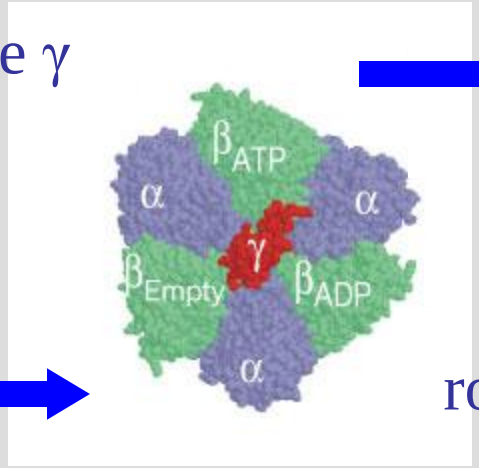




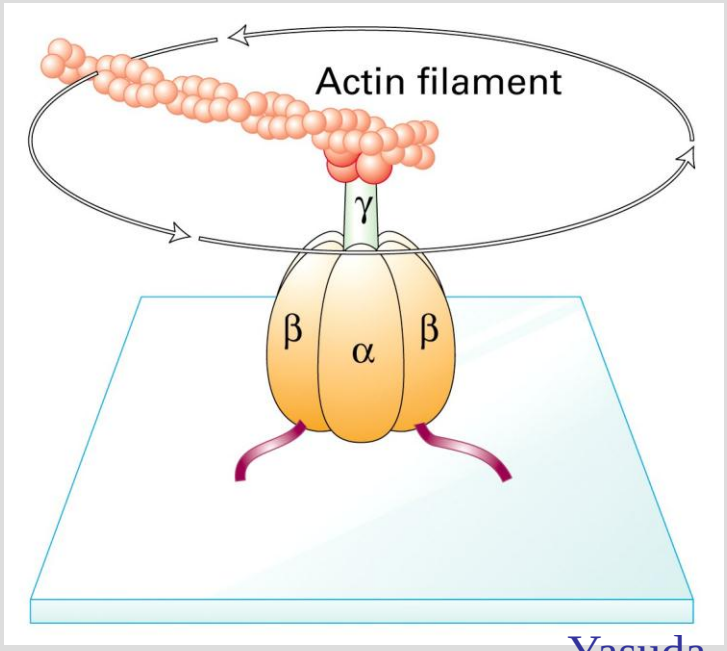
γ-subunit of F_0F_1 rotary motor rotates in steps of $120^\circ = 90^\circ + 30^\circ$

Previous Study

rotate the γ subunit → ATP

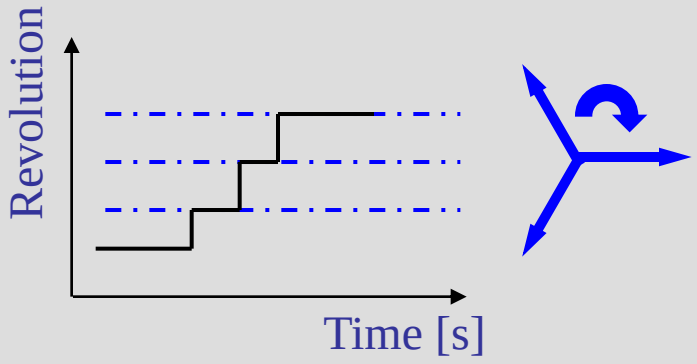


ATP → rotation

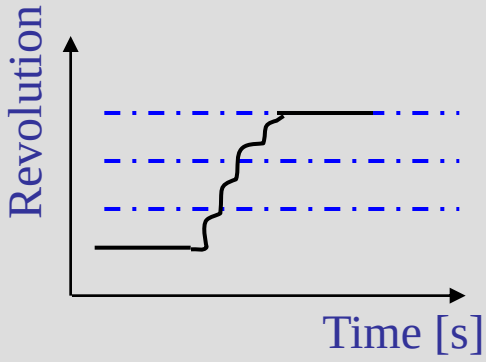


Yasuda, Cell 93, 1998

Low ATP concentration: Stepwise



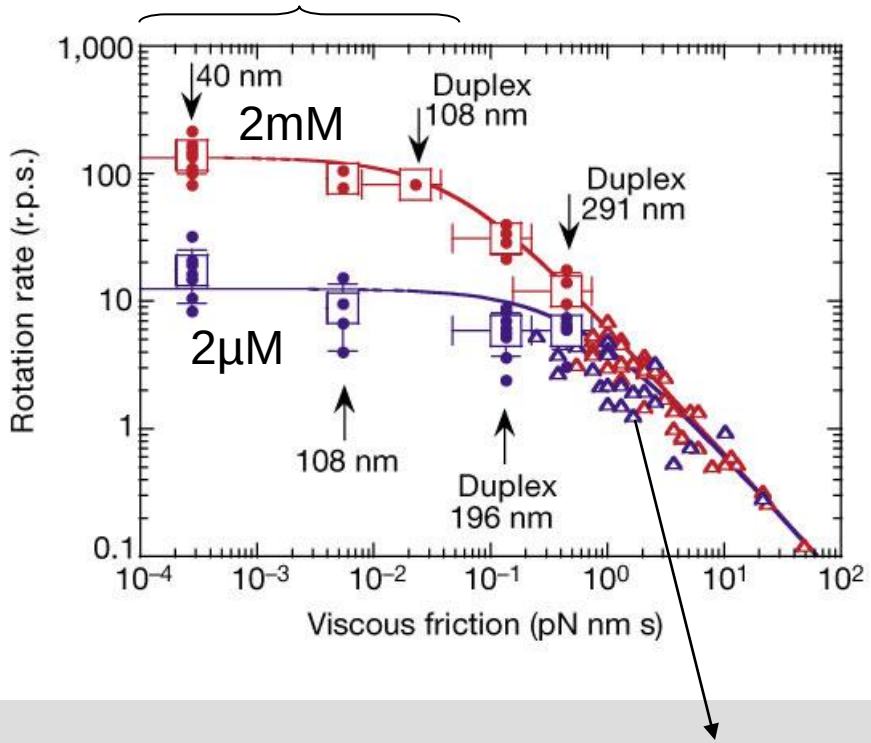
high ATP concentration: Smooth



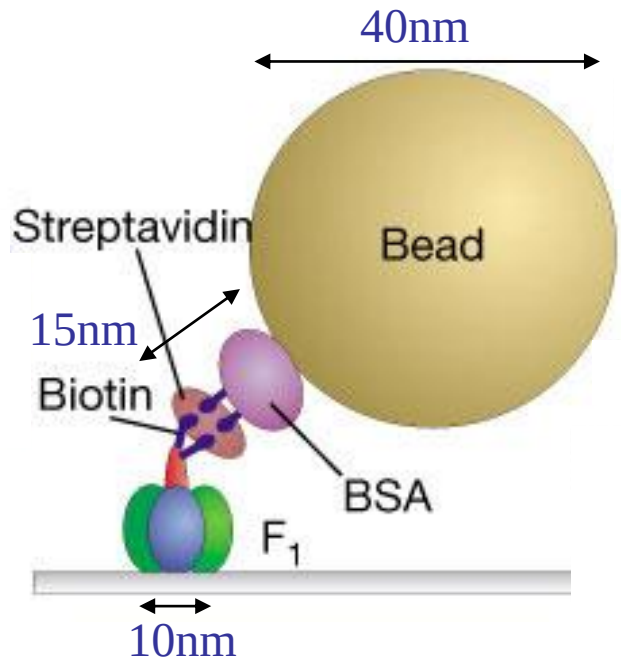
Due to viscous friction on the Actin filament

Improvement: Decrease the Particle Size

stepwise rotation

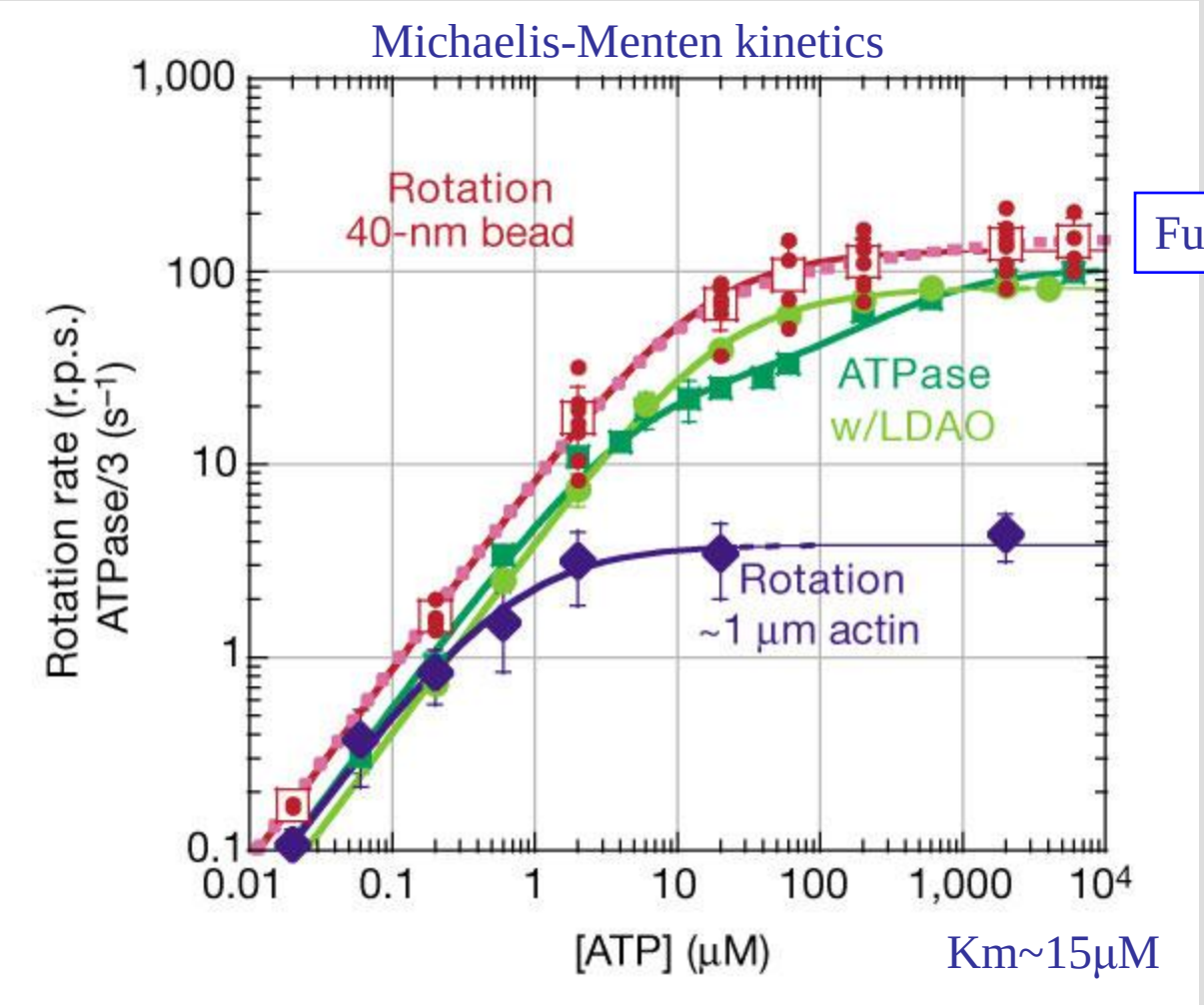


load-dependent portion: (actin filaments)



10^{-3} to 10^{-4} times smaller friction

3 ATPs per Revolution

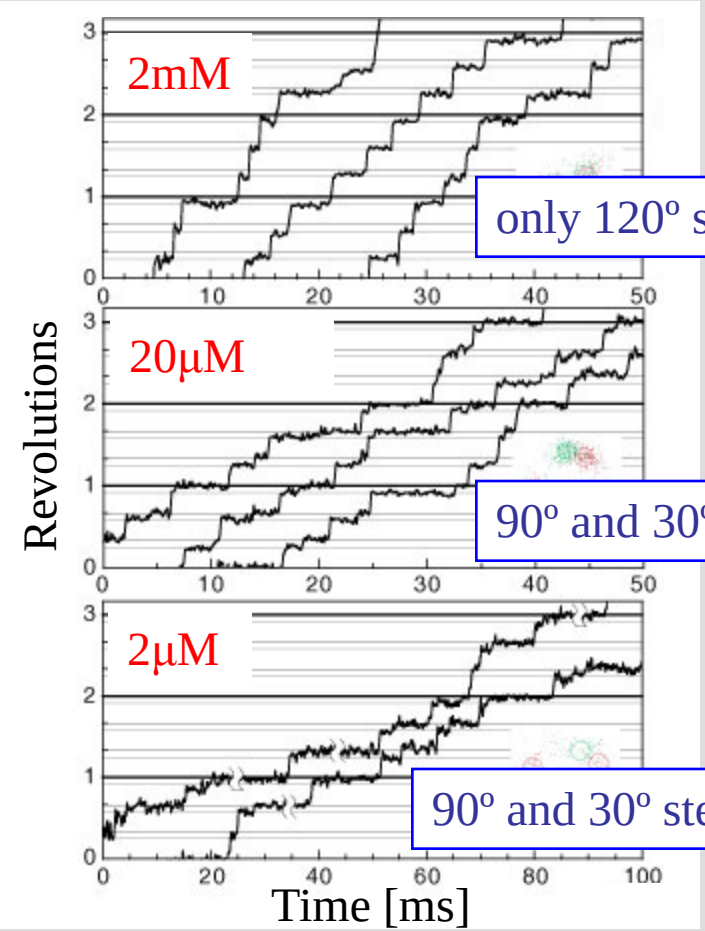


Full speed ~134 r.p.s.

Observation #1

R.P.S.~1/3 ATP hydrolysis rate → 3 ATPs per revolution

The 120 step consists of 90 and 30 substeps



only 120º steps

very fast, not captured in this setup

90º and 30º steps

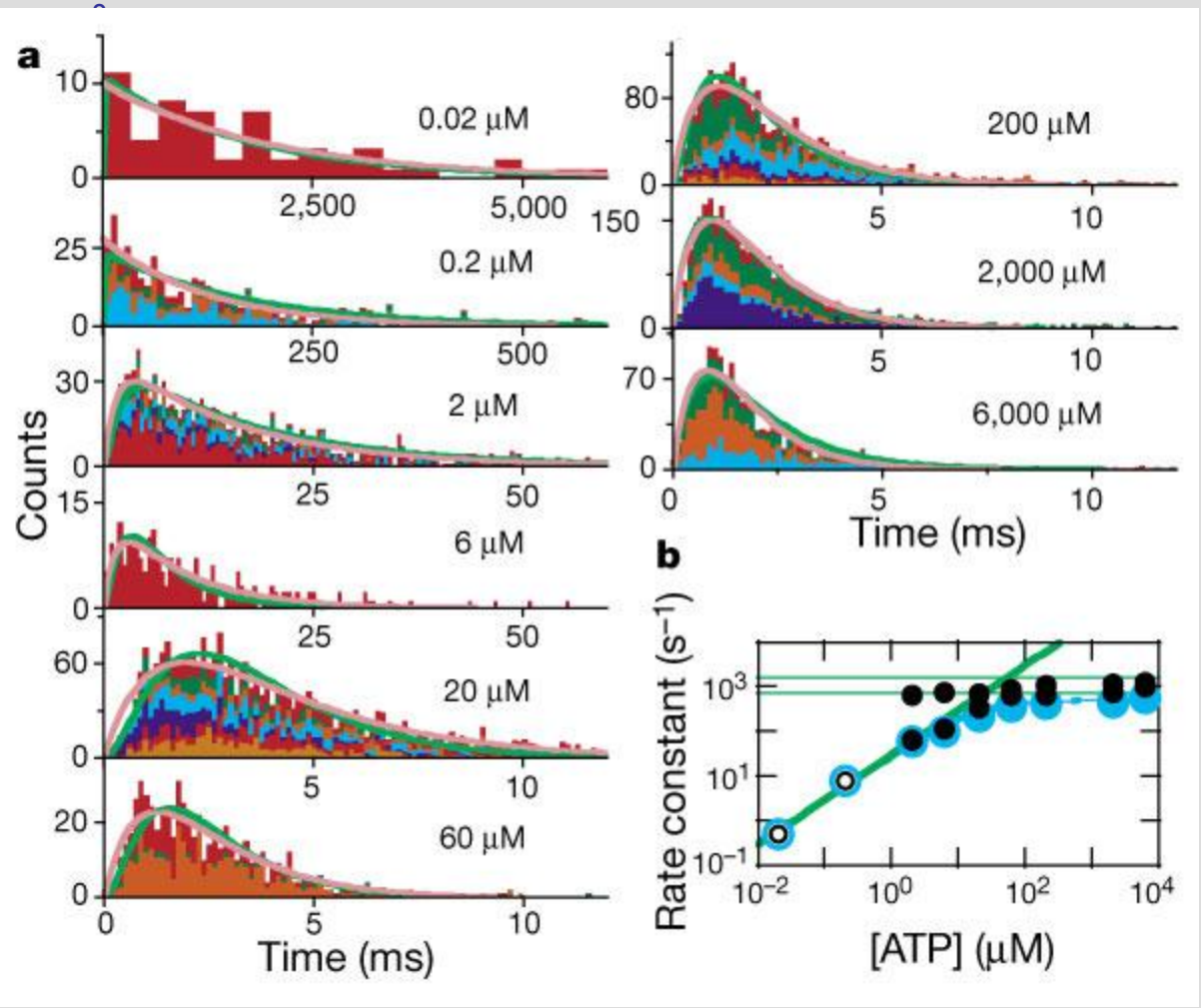
90º and 30º steps

Observation #2

120º=90º+30º

Two ~1ms Reactions Before a Next Step

Histogram of times between two main steps (90° or



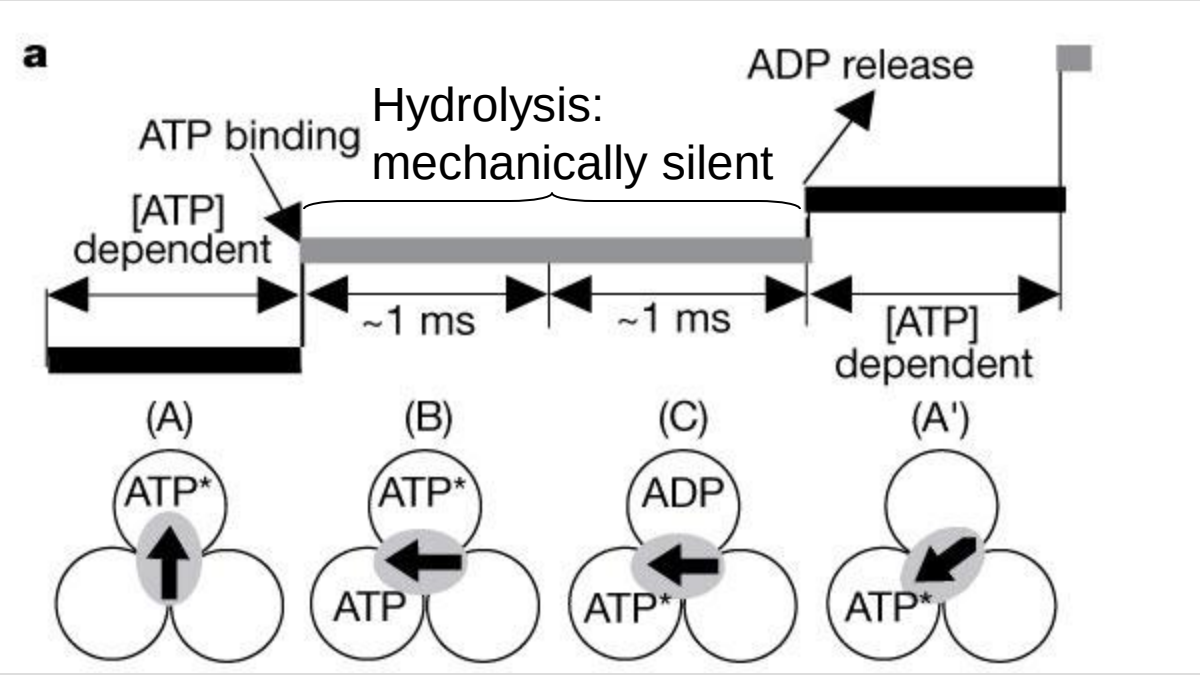
Low ATP: $\exp(- k t)$

High ATP: $[\exp(- k_a t) - \exp(-k_b t)]$

Observation #3

3 times constants: one for ATP binding and two~1ms for reaction

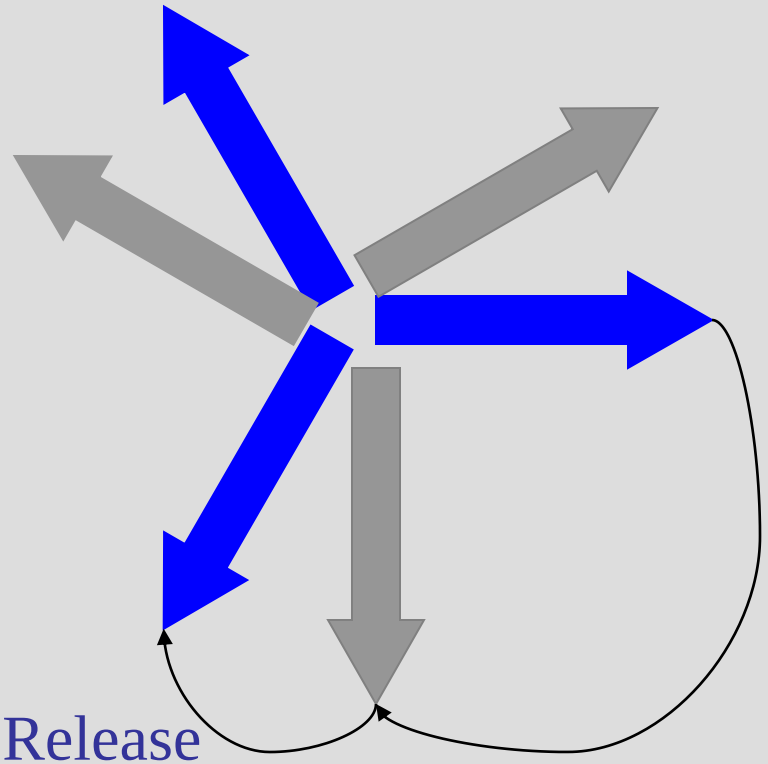
Proposed Mechanism



Substeps of 90˚ by ATP binding and 30˚ by product release

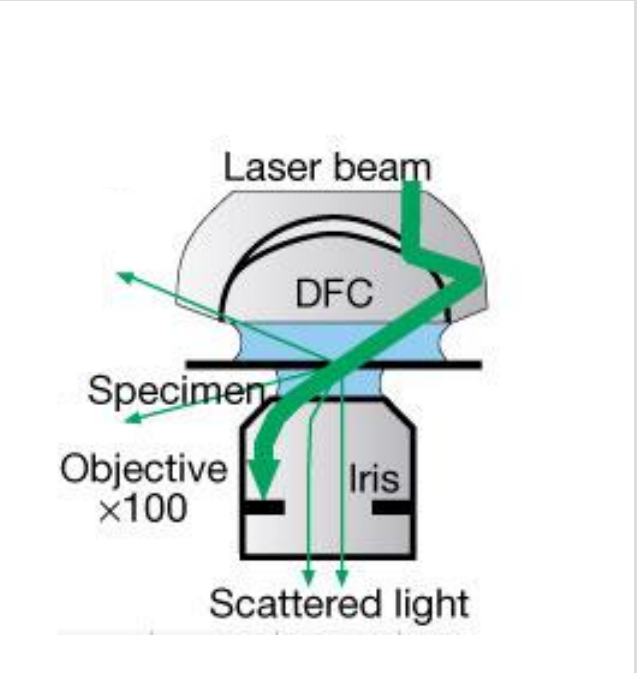
Conclusion

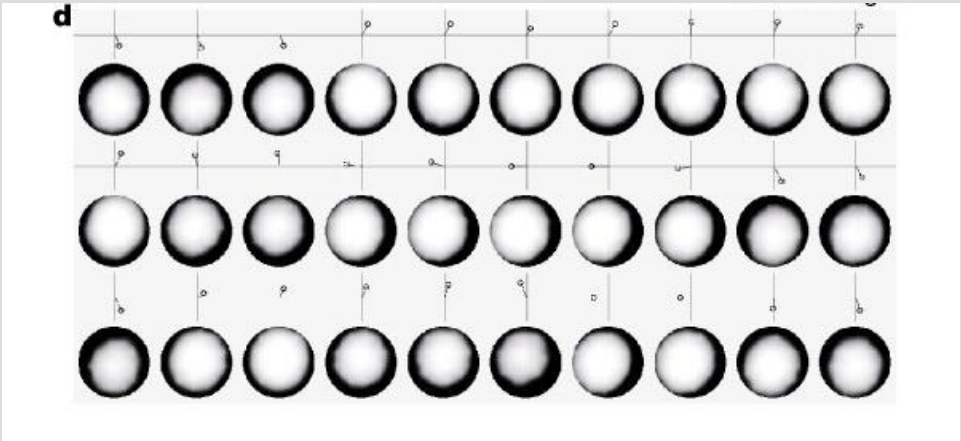
γ-subunit of F_0F_1 rotary motor rotates in steps of
120° =90° +30°



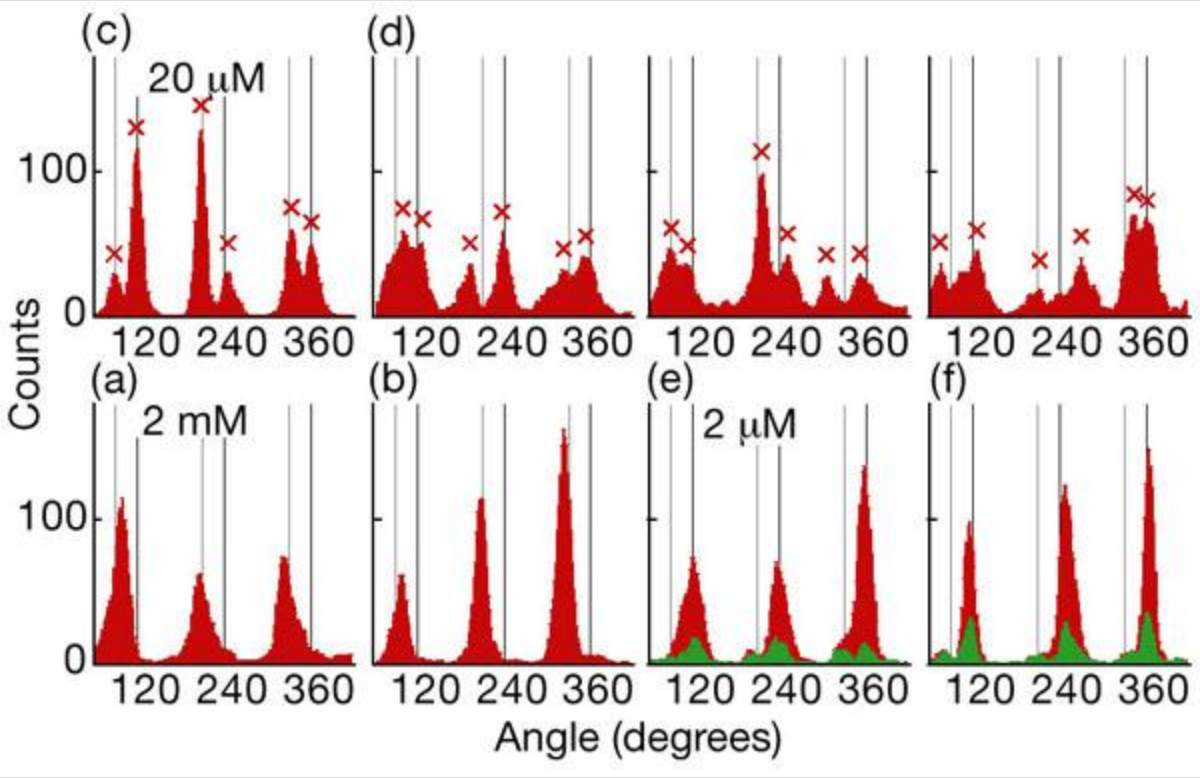
Microscopy

- Laser dark field microscopy
- Light scattered by beads was collected
- The intensity distribution had a single large peak and a second small peak at four times the intensity of the first peak. Because an object smaller than the wavelength scatters light in proportion to the square of its volume, the peaks should correspond to single and duplex beads.
- From the collected image the beam centroid was obtained.
- For a bead of radius a, frictional drag is $\xi = 8\pi\eta a^3$





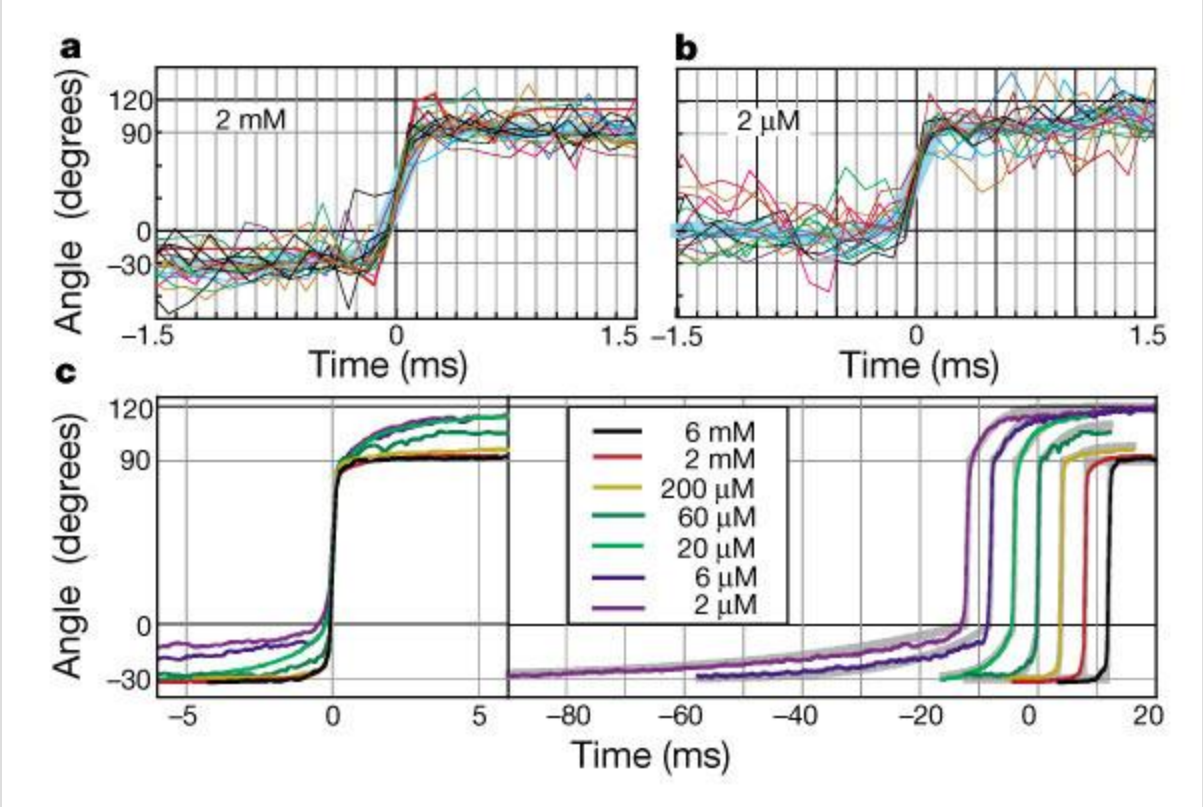
- At 2mM ATP, 0˚ dwell time is ~0.02 ms which is out of resolution of current experiment. Therefore the dwell times are 90˚.



green: 2-ms intervals before and after the main steps

Steps Are Fast

- The whole step completes within ~0.25 ms. The instantaneous stepping is well above 1000 r.p.s.
- Presence of distinct and fast ~90˚ substeps is clear at all [ATP]<60μM.
- Physiological [ATP]~ mM



Gray line is c is the theoretical curve

- Two ~1m rate constants can be explained by each being release of one of the hydrolysis product (phosphate or ADP). Or one being splitting of ATP to ADP and phosphate and the other being release of the two.