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Welcome to Minnesota physics graduate program presentation and Interviews

- Interviews are 15 minutes – I need 5 minutes to make a note about each interviewee.
- It's very important for you to know, and can convince me so, why it makes sense to go to a graduate school for your career development instead of going to business and make a lot more money.
  - Which experience tells you this is so?
  - "Many of your classmates are doing," is not good enough.
  - You have a good GPA, GRE, etc. is not good enough.
  - Think about what graduate school education will give you, and think about why it is good for your career even though
    - Your pay while you are student is only $16k/9 months ($21k/12 months).
    - You will be working more than 60 hours/week to be successful.
    - You won't have long vacations in the summer, winter, … - actually, coming home may be difficult because of the US immigration rules.

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Minnesota physics graduate program overview

Yuichi Kubota (窪田有一)
Director of Graduate Studies

Outline

- Who should come to Minnesota (U.S.) for physics graduate studies?
- Brief history of Chinese students in MN
- Our program
  - What are graduate studies for? For whom?
  - Research Areas in Minnesota
  - What should you expect in Minnesota
  - Highlight of researches
- Life in Minnesota

Grad School is different from undergrad

- If you have not done independent research, yet, you should think hard before you decide to go on to graduate school.
  - You may not like what you have to do in graduate school.
  - About 50% of graduate students drop out before they earn PhD.
- Having done well in classrooms in university by itself is not a good reason to go on to graduate school.
  - Even in theory, you need to be curious what kind of problem is interesting to solve, not just solving problems provided by a professor.

Completion rate for Chinese students

Since 1990

PhD	23	40%
MS	16	29%
Other PhD/MS (MN or else)	11	20%
Left program	6	11%
Still active in PhD	19	-
Total	56 + 19	100%

Who should come to Minnesota (US) for physics graduate studies?

- We want students who will be successful in doing research and move on to research career. This means that you
  - are interested in doing research
    - not about taking more difficult classes, though for some theory-oriented students, this may be relevant
  - are interested in the kind of physics our faculty members are interested in.
  - have reasonable English, particularly spoken English, and also are interested in improving it.
  - Are outgoing, and interested in learning about America, American culture, American people, improving English, etc.

What does "Research" means

- You like to fool around with things to figure out how they work.
  - You used to fix your car, but now you want to work with something more fundamental (esoteric)
- You like to work on one-of-a-kind unique challenges, not the same thing over and over.
- You don't mind spending endless hours to figure out things.
  - you don't mind if you don't get quick answers.

Some differences with MIT, etc.

- They have more famous professors than we do.
- They support more first-year students to do research early (having more money)
  - Now, our department can also support several students to do research early independent of professors' money. – big change from the previous years.
  - This money can be used to support foreign students as well as U.S. students.
- For some of you, starting research later may be a better fit.
  - Typical MN students start research in their 2nd- to 3rd-year.
  - This gives them more time to decide which physics sub-field to pursue your PhD.
  - You can take classes for 1-2 years to solidify your physics knowledge at a slower pace.

Are you ready to start research quickly?

- If so, please check with me when you get an acceptance from us.
  - We are always interested in attracting these good students with a competitive offers.
  - If you get a better financial offer, let us know so that we can re-consider our package.
- Who should ask?
  - Either you are advanced (you learned Analytical Mechanics, Electrodynamics, Quantum Mechanics and Statistical Mechanics-Thermodynamics well), and you can skip most or all of the “first-year” classes, and jump into higher-level classes
  - Or if you already have a solid research experience so that you can handle courses and research at the same time.

Statistics of admission

- There are ~180 applicants from China this year - typical
- We will most likely make offers to about 30 Chinese students, of which 10-15 will decide to accept our offers.
- If you believe you belong to this group of 30 students according to our criteria, please be forceful in presenting yourself to us.

What will you do in Graduate school?

- Take more classes (1-2 years)
- Teaching undergraduate students (0-2 years)
- Doing independent research (3-4 years)
  - What else?
    - Broaden one's view
      - Colloquium and seminars
      - Get to know other professors and students, and what they do.
    - Have some life so that you are healthy both physically and mentally.

Do the following "homework" now so that you will be a HAPPY grad student

- Know the sub-field(s) you are interested in going.
  - Though you don't finalize it for a year or two after the start of Graduate school
- Know which professors are in that sub-field
- Learn about them (their research, style of advising, …) as much as possible
- Choose schools where there are professors you want to work with.
  - Many of them have web pages (though they may not be up-to-date, myself included☹)
  - Google is another source of info
  - Many of you have friends in UMN who can tell you about our faculty, etc.
  - You can always Email us and ask questions.
    - If direct Email does not produce answer, send me the Email, and I will forward it to the professor. This often results in a reply.

Status of our admission decision

- We are working on American students' admission decision right now.
- Hope to make most of admission decision on Chinese students in early March.
  - Some of the borderline cases may take until April

No Fee until you decide to come to MN

- At Minnesota
  - You apply to the department for financial support
  - You apply to the Graduate School for admission (real admission decision is made by the department)
  - We don't collect application fees for financial support to encourage any qualified students to apply.
    - No need to apply to the Graduate School unless we make you an offer of financial aid, and you decide to take it.
    - Once you decide to come to Minn and apply to the Graduate School, you will have to pay a fee.

When you need to make your decision?

- You should take your time, and don't tell anyone about your decision until 4/15/10 or you are really sure about your decision.
- You are under NO OBLIGATION to tell any US graduate programs if you are taking anyone's offer until 4/15/10.
  - Even if you tell a graduate program that you intend to go (take their financial support) there, you can change your mind until 4/15.
    - However, if you think you may change your mind, it's better not to tell anyone your premature decision.
  - If a graduate school tells you that you must tell (threaten) them about your decision before 4/15 and otherwise, they would withdraw your financial support, you should tell them that it's illegal.

What will you and we do today in interview?

- We will tell you want kind of researches we do. You tell us what makes you believe that
  - You know what doing research means.
  - You like doing research, and
  - you will be a great researcher

  while demonstrating that
  - you know enough physics and
  - your English communication ability is adequate.

History of Chinese students in Minnesota

- First students in 1914.
- 8000 students have come since then.
- Currently about 1200 students study on Minnesota campus.
- Hoff Lu (Lu Hefu卢鹤绂) graduated in 1941 from physics
  - Many in agricultural departments
- China center has organized courses for Chinese businessmen and political figures.
  - Minnesota MBA program offered at Zhongshan University in Guangzhou.
  - Minnesota Law school at the China University of Political Science and Law in Beijing

What research areas are covered in Minnesota

- Condensed matter (exp and theory)
- Particle physics
  - Quarks, neutrinos, Higgs boson, dark matter, extra dimension, supersymmetry
- Nuclear physics
- Cosmology
- Space physics
  - Electric and magnetic field in space
- Biophysics
- Physics education – college physics teaching

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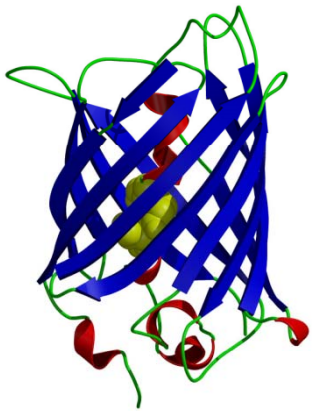
Biophysics

From a Single Molecule to Brains: Biological Physics at Minnesota

Single molecule → Assembly → Single Cell → Organ

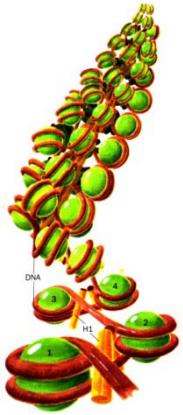


Green Fluorescent Protein

How does it fold?

How does this machine work?

Prof. Shklovski



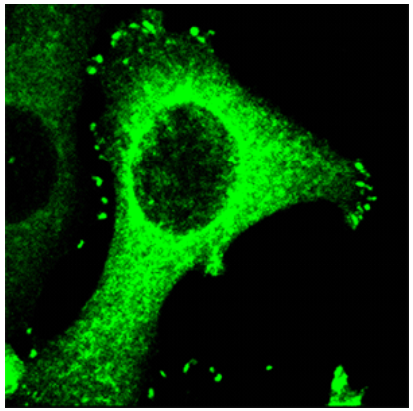
Chromatin Fiber

How do proteins assemble?

Prof. Mueller

What are the roles of charges in organizing DNA?

Prof. Shklovskii



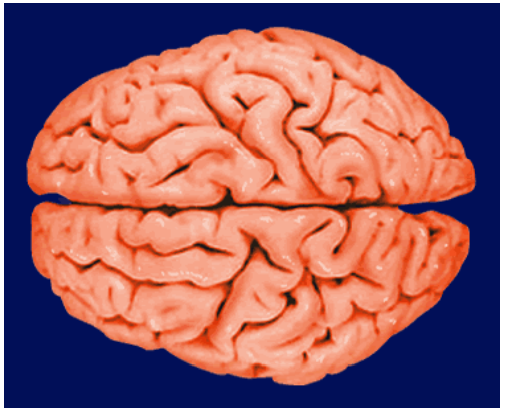
Fluorescent Cancer Cell

How does the cellular machinery work?

Prof. Mueller

How do muscles contract?

Prof. Broadhurst



Human Brain

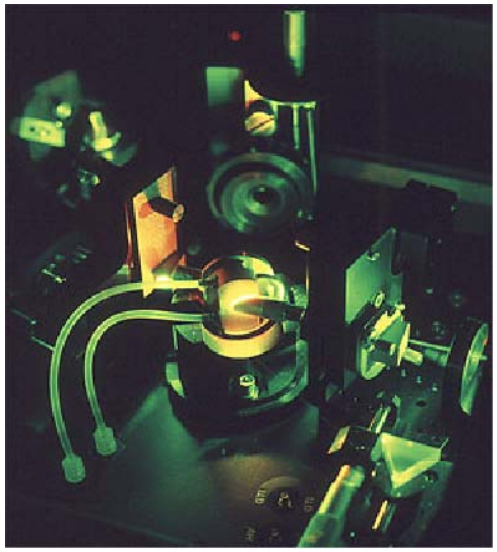
How do we think?

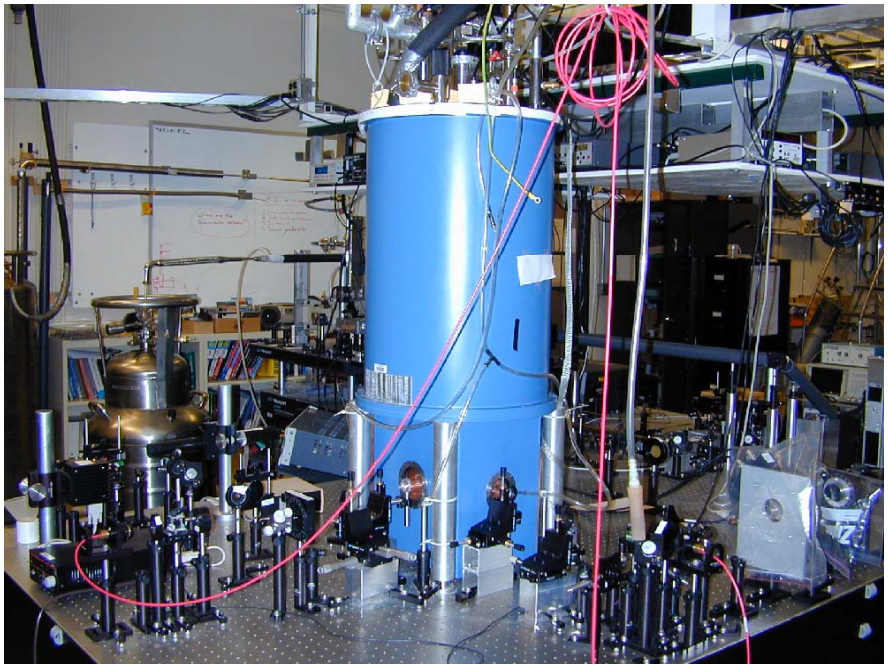
Prof. Broadhurst

Condensed matter

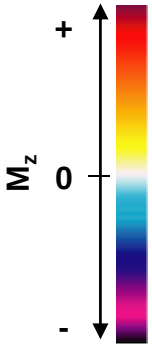
- Studying and utilizing electron spins in semiconductor
- Molecular machines, nanofabrication
- Magnetic force microscopy on super conducting film
- Superconductor
- Amorphous semiconductors
- Sand piles
- Liquid crystals

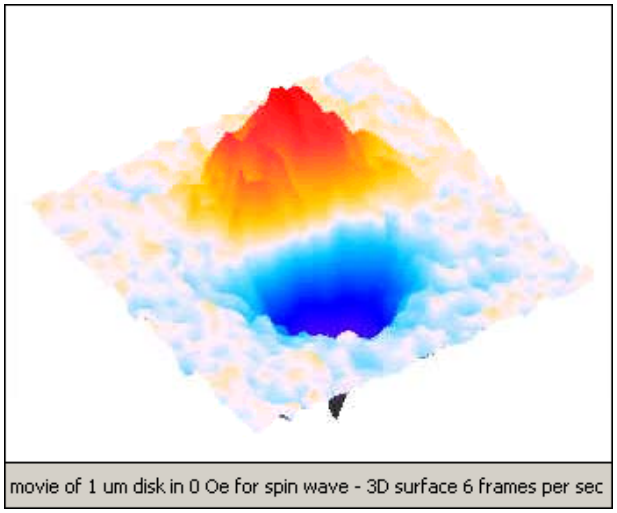
Crowell Group – Spin Dynamics and Spin Transport





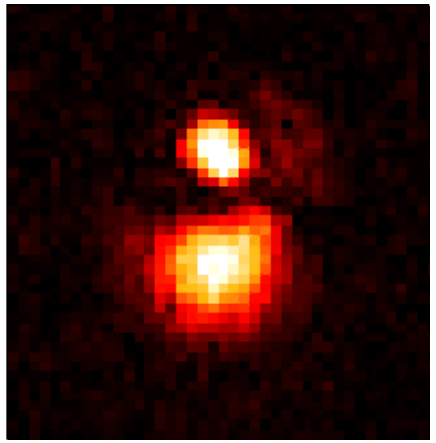
- Picosecond Movies:





1 frame= 40 ps

FFT

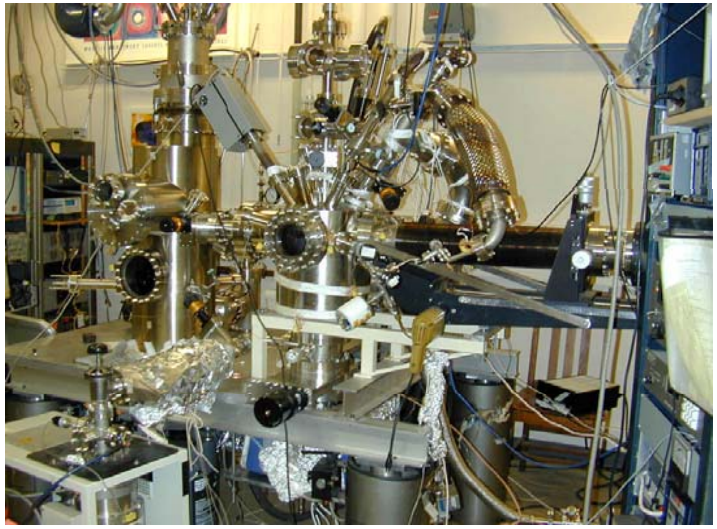


1 frame= 0.2 GHz

Freq (GHz) 0 8

FFT power integrated over space

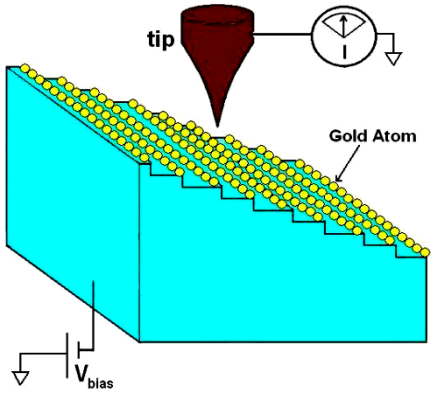
Tunneling and Transport in Nanowires



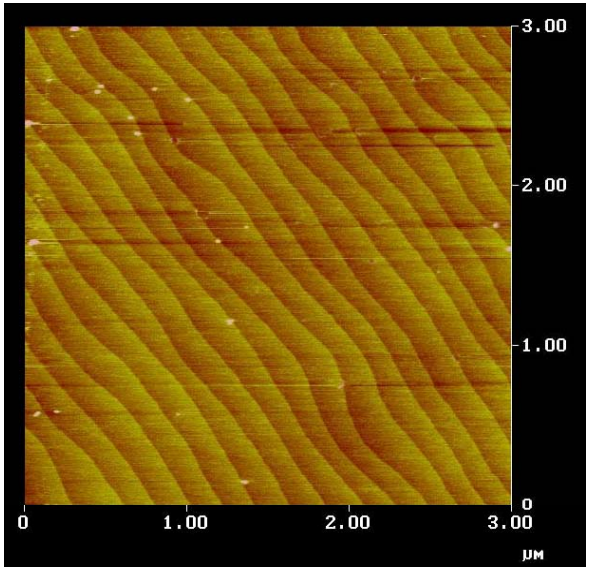
The STM is the in the left hand chamber and the sample preparation system is the right hand one.

- Fabricate one-dimensional metallic wires by growth at step edges. With sufficiently small cross-sections the motion perpendicular to the channel axis will be effectively frozen out.
- The study of electrical transport properties of such systems can lead to an understanding of Luttinger Liquid behavior
- In one dimension Landau's Fermi Liquid Theory fails even for very weak interactions.
- Image shows a substrate with well-define step edges onto which metal will be deposited. Schematic shows the experimental setup.
- Tunneling spectra if they indicate a power law density of states can be used to demonstrate the existence of a Luttinger liquid and to quantify its properties.

Schematic of experiment Showing the STM tip and The gold chains collected At the step edges.



Atomic force microscope scan showing steps on the surface of a strontium titanate supstrate. The metal wires will form at the step edges which are one unit cell high. There are some small dust particles on the surface.



Space

- Chemical evolution of the solar system using meteorites
- Particle acceleration and energy conversion, that occur in plasmas in solar system.
- Nonlinear plasma waves and the physics of auroral particle acceleration
- theory and numerical modeling of auroral processes, magneto-hydrodynamic (MHD) waves

Cosmology

- Seek to understand the early universe by looking for the remnants of the Big Bang.
- Hanany:
  - cosmic microwave background (CMB) radiation using Liquid He temperature (low noise) detector on balloons
- Olive
  - Theory of nuclear synthesis in early universe (Big Bang)
- Qian
  - Neutron stars/Blackholes – origin of elements
- Liliya Williams (astronomy)
  - Micro lensing

Nuclear Physics (theory)

- Reproduction of Big Bang conditions by collision of nuclei to understand BB
- QCD in these conditions and quark-gluon plasma

High-Energy Physics

- MINOS experiment – neutrino oscillation
  - NOVA experiment?
- LHC-CMS experiment – Extra Dimensions, Higgs, Supersymmetry, New Physics
- Cold Dark Matter Search experiment in Minnesota mine
  - Deep underground Lab in Canada, too.

Typical timeline

- First ~ 2 years:
  - Take classes
  - Prepare for and take “qualifying” exam to prove that you know much of undergrad and some grad physics you learned
  - Start talking to professors
  - Summer is a great time to work with a professor on research – “test drive” for both.

Timeline II

- 3-5 years
  - Research
  - Research
  - Research
  - Seminars and colloquia to broaden your view
  - Stay fit (mentally and physically) despite a life in the basement

Life in on campus

- Sports and culture
  - Play team sports such as soccer and broomball in the “intramural leagues.”
    - Organize teams in physics
  - Play individual sport (badminton, tennis) in the Rec Center.

Life in Minnesota

- Culture
  - Play music – have great music department
  - Go to concerts
    - Minnesota orchestra, music students orchestra.
    - Chinese pipa (琵琶) player, Gao Hong, Chinese music composer, Zhang Ying
  - Many art museums, even one on campus

sports

- Vikings (NFL)
- Twins (MLB), Saints
- Timberwolves (NBA), Lynx (WNBA)
- Wilds (NHL)
- Thunders (soccer)

Great support for Chinese students

- Friendship Association of Chinese Students and Scholars
  - www.tc.umn.edu/~facss
- However, there are problems with such a great Chinese support community.

Issue with the great support

- Isolation of Chinese students from the rest of the department
  - We certainly have more than a critical mass of Chinese students so that they can be “self sufficient.”
  - You could be reasonably healthy mentally without talking to non-Chinese students.
- But is this healthy? Is this what you come to the US for? Would this be good for your future career?
  - Why do they do this? (excuses)
    - It’s easies to talk to Chinese students because we understand each other.
    - I can be a funny guy when speaking in Chinese but it’s hard to be funny in English.
    - I can cook smelly Chinese food around Chinese students.
    - I never thought I would be spending so much time with other Chinese students before I came here, but it’s so much easier. .

Practical problems

- One senior Chinese TA was found to be sitting in the corner of his discussion class, not teaching.
  - It appears that his English actually deteriorated and he did not feel comfortable talking with his students in English.
  - He also failed his qualifying exam, partially due to the fact that he did not understand what was required to pass his test despite communications from the faculty.
- One former USTC student told me that it is a shame that he is learning English by watching "Friends" on his computer rather than live American and other physics students.

Solutions

- Greater commitment from new students to be integrated into the larger department culture
- Departmental promotion of meaningful cross-cultural activities
  - Not a large party where people stand around talking with people they normally talk anyways, and eat mediocre food.
  - Study groups crossing national lines.
  - Sports, movie viewing and other cultural activities crossing national lines.
    - Teach non-Chinese how to play Badminton, Ping Pong, learn to play broom ball, play basket ball with Americans (and others)
  - Parties which invite a small number of people from different cultures
- If the problem persists, we may be forced to reduce admissions of Chinese students in the future.

If you keep your promise to be involved in larger communities

- Your life will be so much richer, at least in a few years when you overcome obstacles,
- The department will gain by having more academic and cultural vitality,
- American students will gain from your background, which often involves more vigorous formal training,
- You will gain from American, Russian, Turkish ways of thinking if you keep your mind open.
- …

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So who should apply to Minn

- Less than 20% of applicants are accepted.
- If you feel you are in the top 30%, apply.
  - not in terms of GPA, GRE or TOEFL but
  - in terms of research potential:
    - Interest in physics, enthusiasm, motivation
    - Creativity, originality,
    - Independence, organization
    - Relevant physics/math knowledge,
    - Knowing know-how of research
    - Will to be part of American research community
- How many of these qualities have you demonstrated to yourself, your adviser, and to us?
- Is it reflected in your Statement of purpose and your letters of recommendation?
- If not, send in supplemental info in your on-line application page so that your application is more complete.
- If you don't feel you are in the top 30%, work on the above qualities in the next few years and apply later.

Are graduate studies for you?

Does Minnesota look good to you?

Are there professors in MN you want to work with?

Now what? (Next two days)

- Interviews are in room 2222.
- We have to stick with 15 minutes/person.
  - Think about how to use them to your best advantage, considering that I will ask you questions so that you cannot use all 15 minutes for you to talk.

The END

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Support for students

www.tc.umn.edu/~facss : Friendship Association of Chinese Students and Scholars