



ALL YOU NEED TO KNOW ABOUT THIS COURSE

# STATISTICAL ANALYSIS IN EXPERIMENTAL PARTICLE PHYSICS

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Kai-Feng Chen

National Taiwan University

# WHAT YOU NEED TO KNOW AT THE FIRST PLACE

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- We are going to discuss **STATISTICAL ANALYSIS**, in particular, statistical analysis for experimental particle physics.
- This means that we will cover the following topics in a **practical manner**:
  - Probability (Frequentist versus Bayesian)
  - Random numbers
  - Parameter estimation (data modelling and fitting)
  - Hypothesis tests and limit calculation
  - ... and particle physics examples!
- Nothing related to your statistical mechanics here!



# HOW WILL WE RUN THIS COURSE

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- We have 2 hours every week, but I do not want to fill the lecture time with just “lectures”, which is definitely not the best way to run this course for sure!
- For each topic, we will have an introductory lecture first.
- After the lecture, we will have some **(long) exercises** which you have to go through them (*which requires some coding and tests!*).
- At the subsequent lecture hours, we will discuss what you find, including your results and troubles/problems you meet. **Please present your work with a short set of slides, as your homework assignment.**
- Will run the whole course in this manner: **lecture** – **exercise** – **presentations** – **lecture** – **exercise** – **presentations**... until all the topics are covered.



Yes, practice is very important, as I always say so!



# COURSE ARRANGEMENT...

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- Basically we are going to have 5 main lectures to be discussed in this semester. I may try to come up 6<sup>th</sup> lecture to cover some uncovered topics, but it may not be realized in the end...
- There are also several optional topics included as “inter-lectures”, we can go through them if needed (*depending on your needs*).

Lecture 1: Introduction to Probability  
Lecture 2: Probability Distributions

*Easy(?) stuff;  
Just for you to warm up!*

Lecture 3: Parameter Estimation  
Lecture 4: Interval Estimation  
Lecture 5: Hypothesis Test

*Real topics to be discussed!*

Inter-Lecture: Introduction to ROOT  
Inter-Lecture: Briefing on Random Numbers  
Inter-Lecture: Fitting with Minuit & RooFit

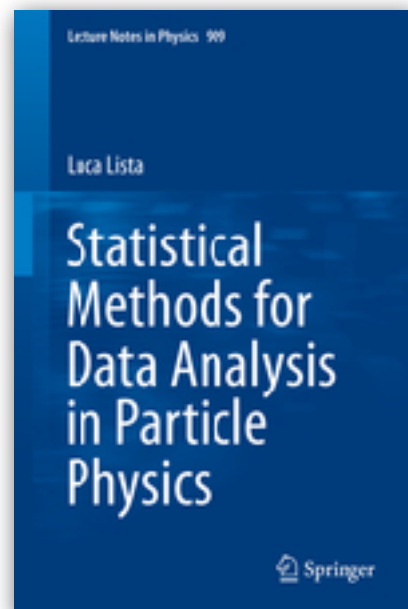
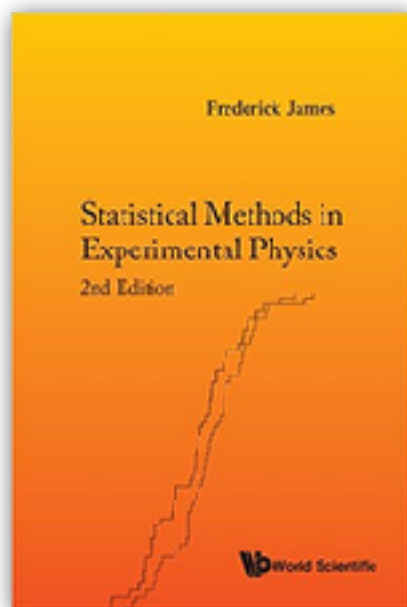
*To patch the missing  
technical aspects!*



# TEXTBOOK / REFERENCES

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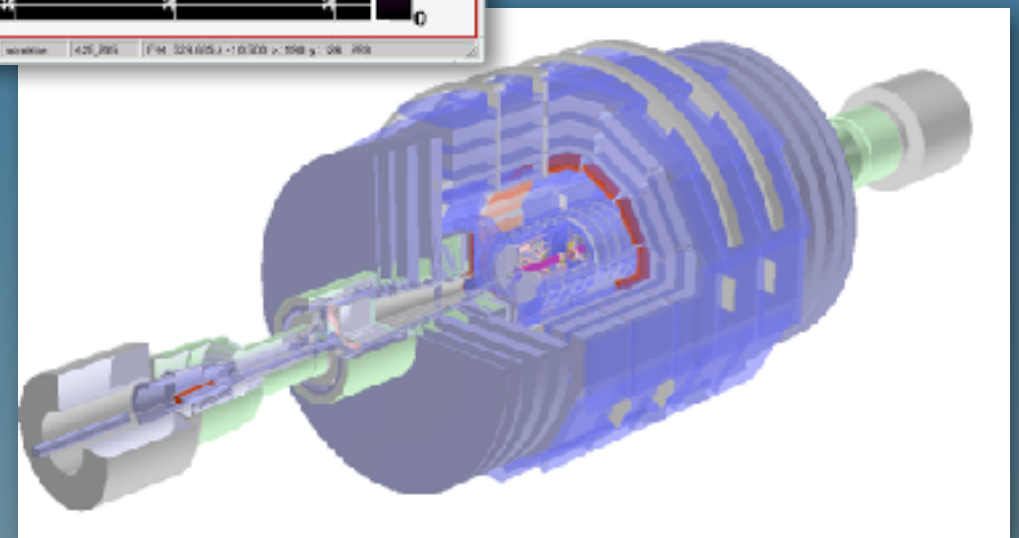
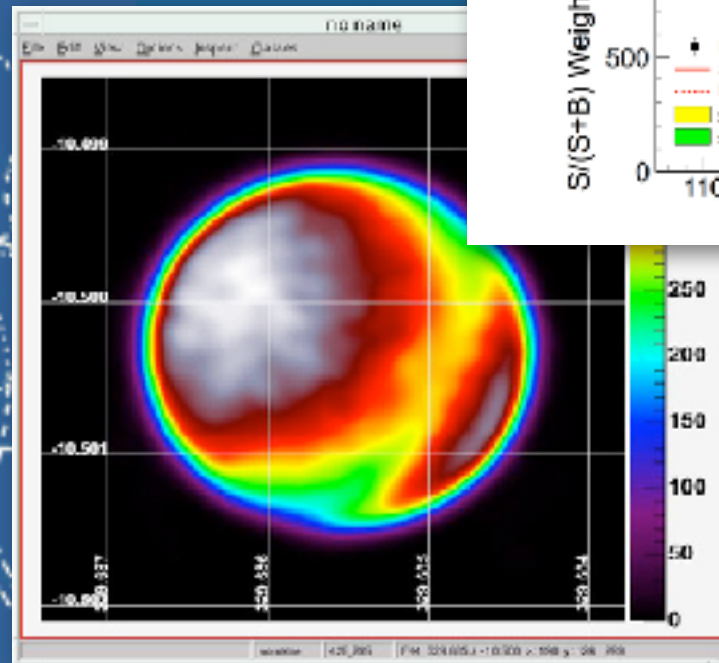
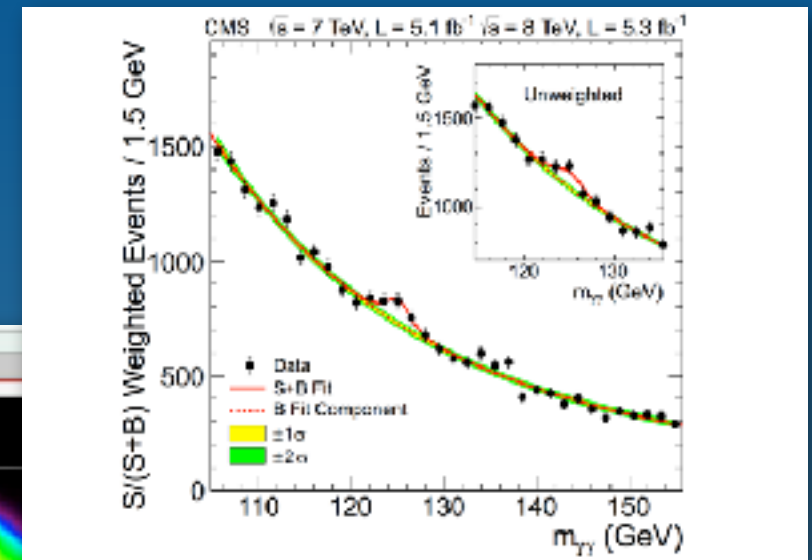
- The materials (slides, examples) will be added to the following web:  
<http://hep1.phys.ntu.edu.tw/~kfjack/lecture/hepstat/>
- Most of the stuff used in this course is coming from “*Statistical Methods in Experimental Physics*” by Frederick James.
- Some of the materials is based on the book by Luca Lista “*Statistical Methods for Data Analysis in Particle Physics*”.
- You are not required to buy the books, but if you want, you can get one of them and go through them; alternatively you will have to do googling as your ultimate reference.



# MINIMUM SKILLS REQUIRED

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- In order to follow the exercises in this lecture, you need to know how to use **ROOT**, and for sure, some **C/C++**, which is the core language of ROOT. Some of my script might be written in python, but I assume you can digest it without a problem.
- If you never touched C++ before, you are strongly recommended to start immediately with some standard C++ textbook and go through it as soon as you can.
- If you have never tried ROOT before, you'd better to get the software installed, try several tutorials now. For ROOT reference, you can get it from another course given by me last-last-last year:  
<http://hep1.phys.ntu.edu.tw/~kfjack/lecture/hepcomp/>
- In fact, this course can be treated as a follow up course of the previous one.



# ROOT

Data Analysis Framework

<https://root.cern.ch>



# GRADING

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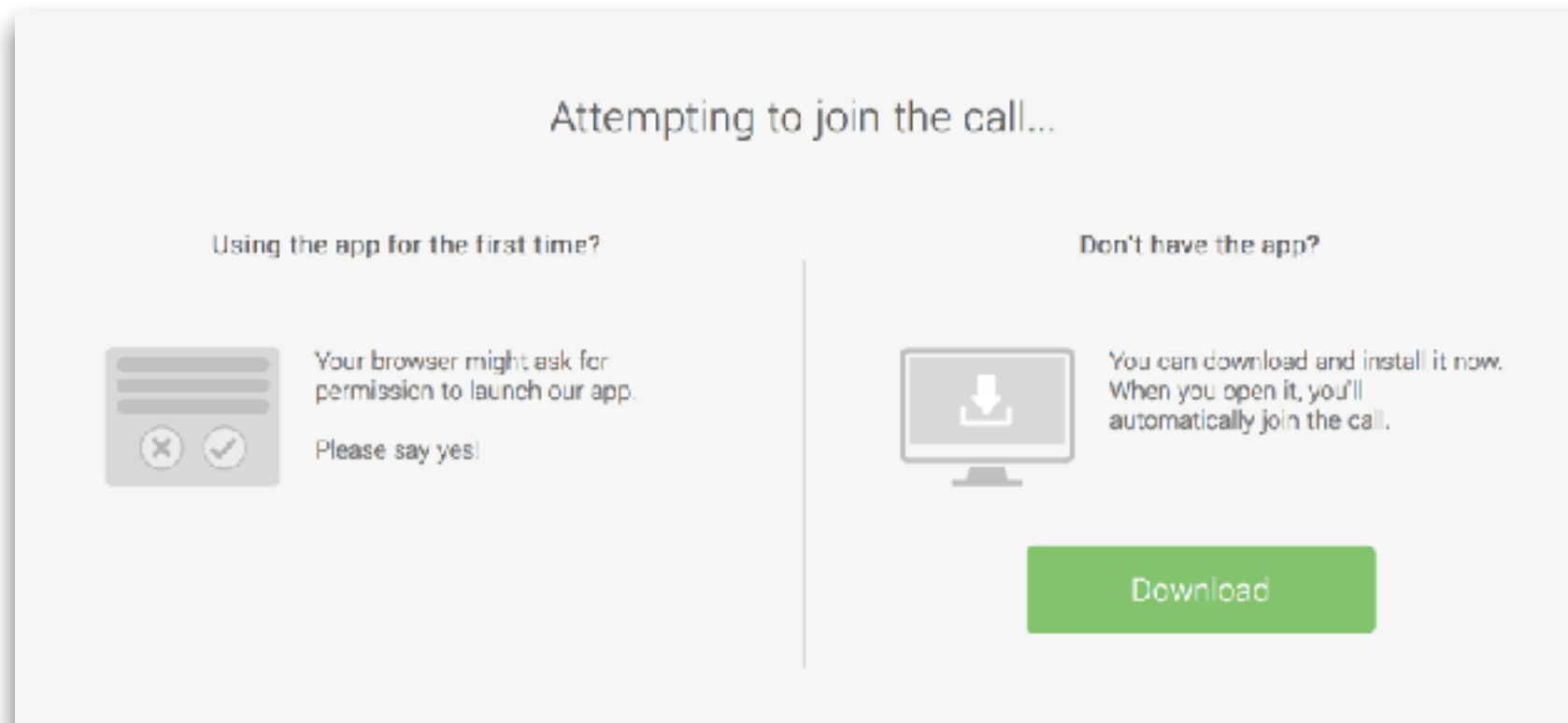
- Yes, still need to talk about grading, unfortunately.
- We will **NOT** have examines, the grading will be based on your exercises during the whole semester.
- Expected to have **4 exercises + 1 optional oral report** (*on one of the assigned exercises*).
- For every exercise, you will have to prepare a set of slides with your results and upload it to NTU CEIBA web.
- For every exercise we will ask for volunteer(s) to present your work in oral.



# WHENEVER I'M AWAY...

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- If I'm away from Taiwan, we will rely on the vidyo service provided by CERN.
- Please try to join this course with the following link (*will be used throughout the whole semester*):  
<http://vidyoportal.cern.ch/flex.html?roomdirect.html&key=cbKbegqMZ7Mt>
- You can try it now, and you shall see this:

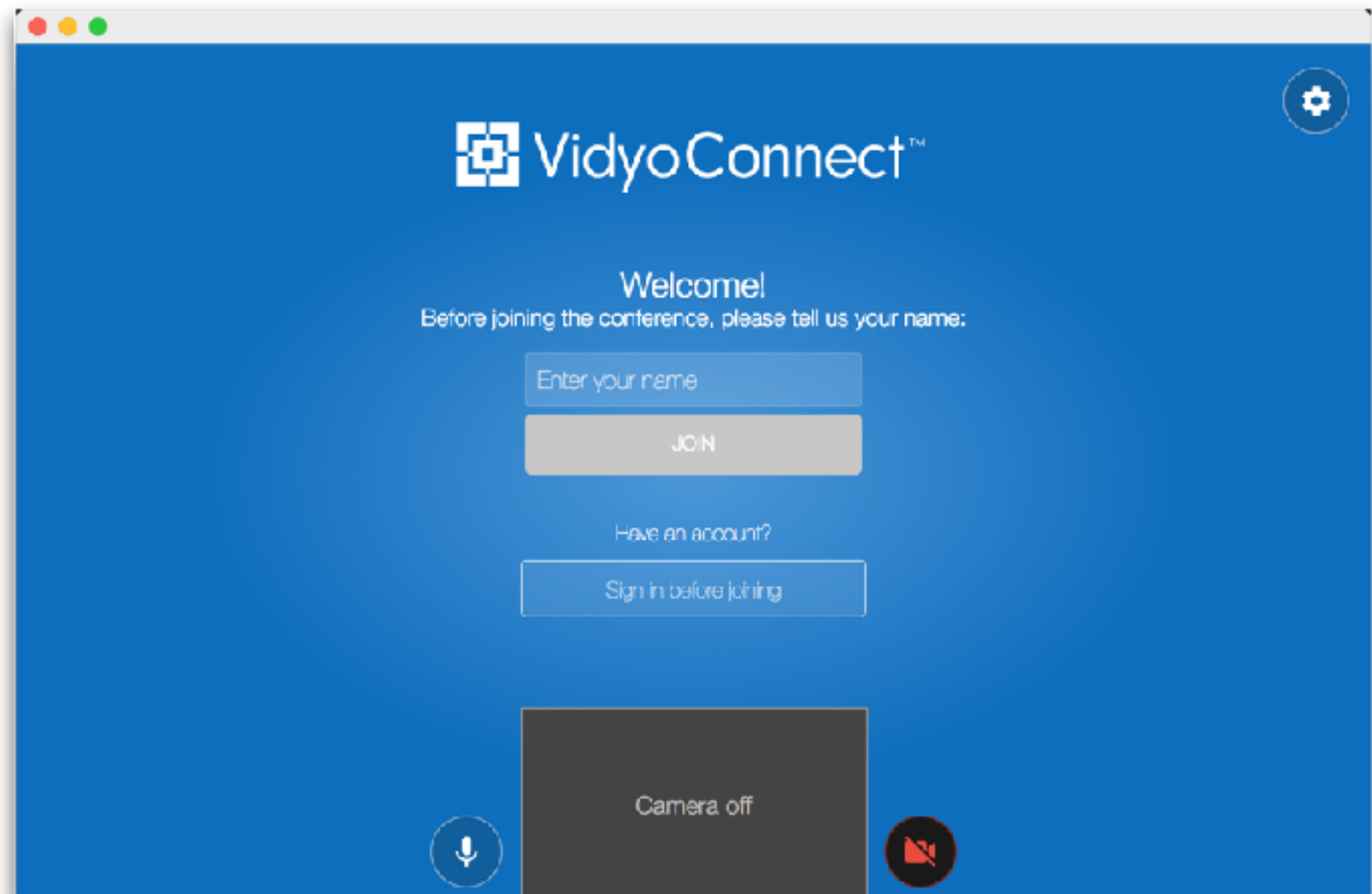


*You will have to install the application first.*

# JUST TYPE IN YOUR NAME!

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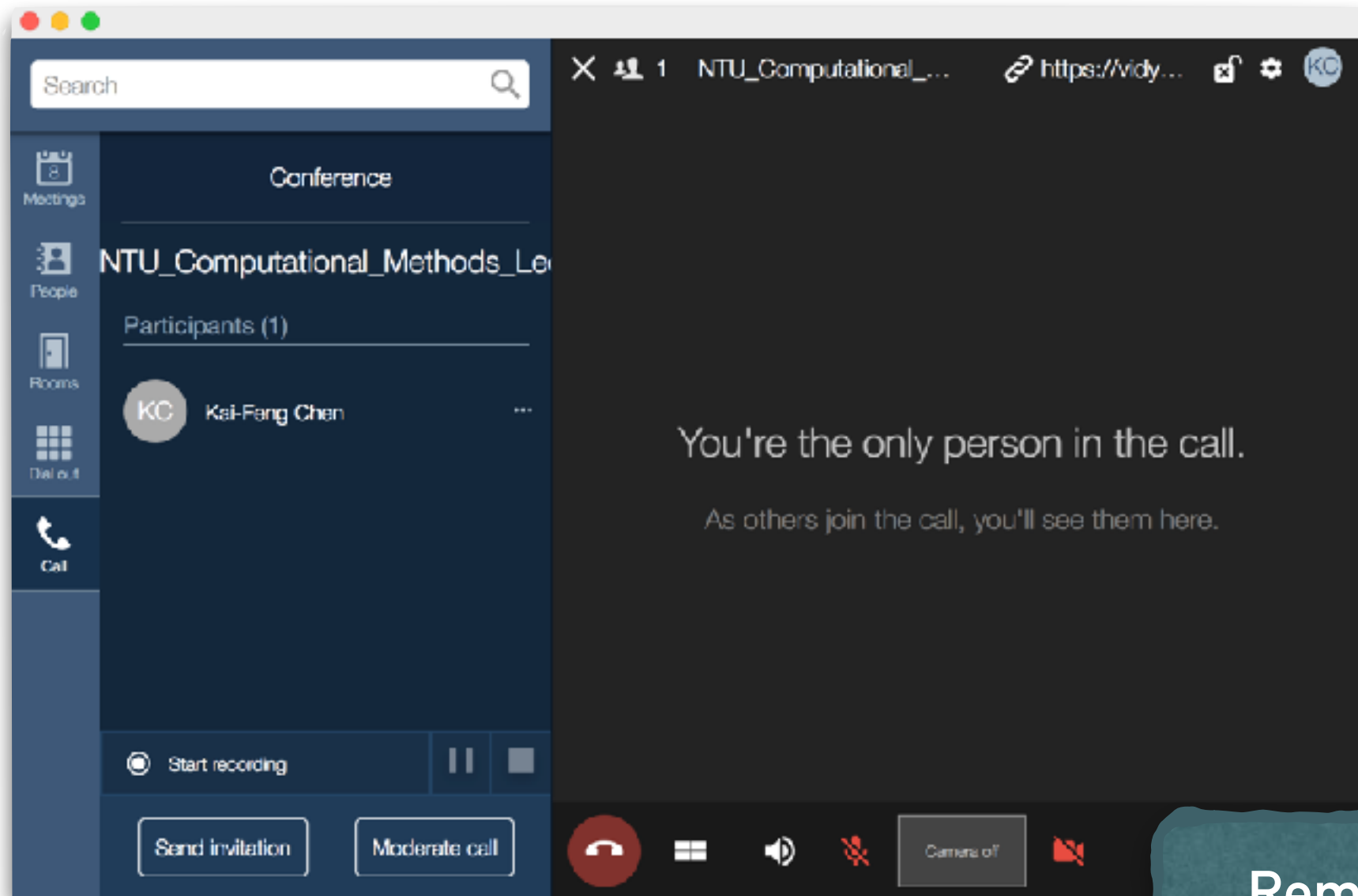
- Please remember to enter your **full name** here, otherwise I do not know who is who... (*Chinese is also fine! Please do not type-in your nickname!*)





# IF EVERYTHING GOES WELL...

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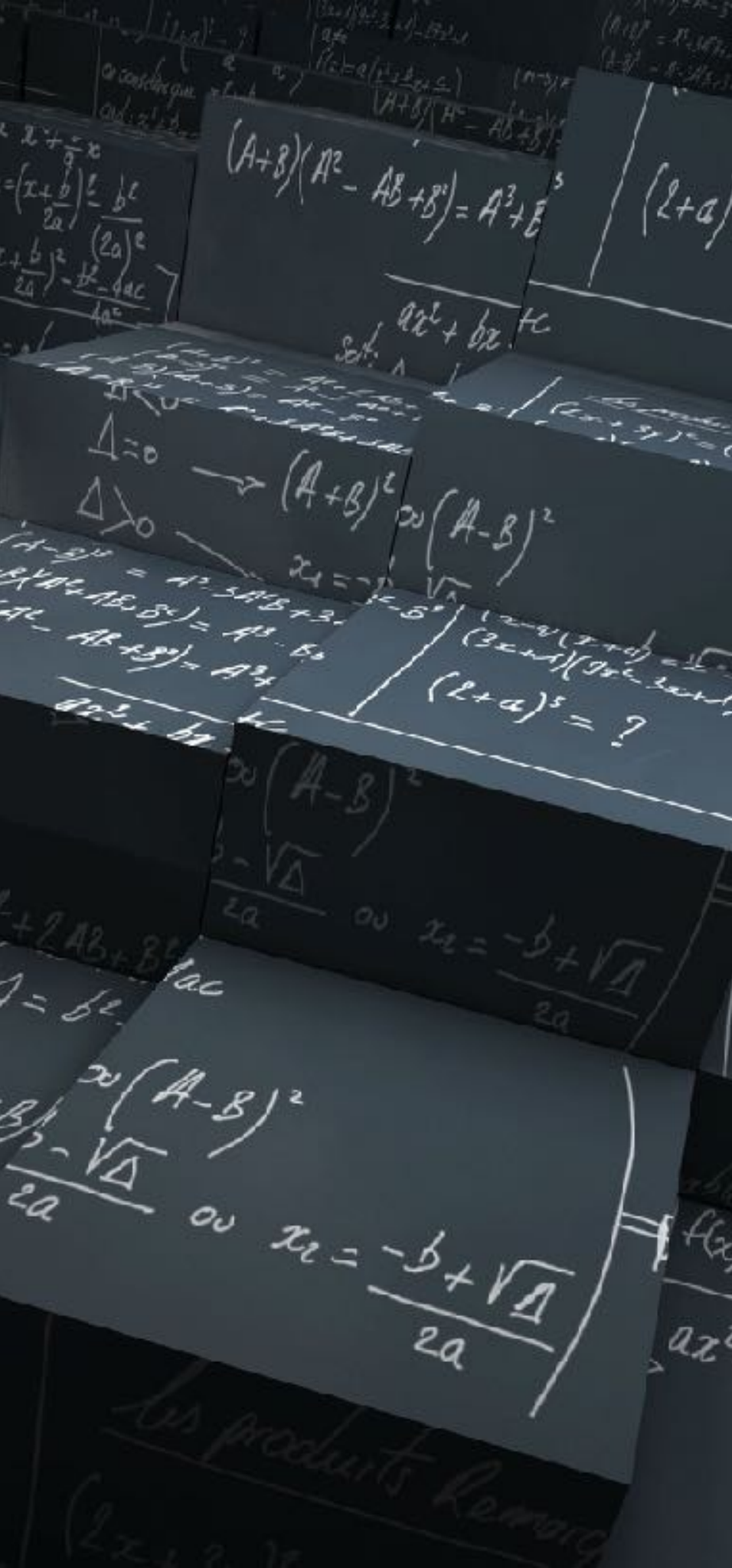


*If everything goes well, this is what you shall see.  
If not, try to use a different network or system.*

*I strongly recommended all of us please try it now!*

*In any case, if you cannot connect, please send a message to me right away!*

**Remark: NTU wifi might have some firewall problem. You can either use VPN, or use a different network source.**



## BEFORE MOVING AHEAD...

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- Let's solve all of the issues now! (e.g. course sign-up, just realized you are in a wrong classroom, etc.)
- If you never tried vidyo connection before, I strongly suggest you can try it right away.
- You are strongly recommended to bring your laptop here. From time-to-time I may "throw-out" some testing code for you to try.