

# **Toshiko Yuasa Prize 2020: “Search for new particles at large particle accelerators”**

---

**Yu Nakahama**

(Nagoya University, Kobayashi-Maskawa Institute)



2021 Joint workshop of TYL/FJPPL and FKPPL,  
online, on 10-12 May

# Introduction

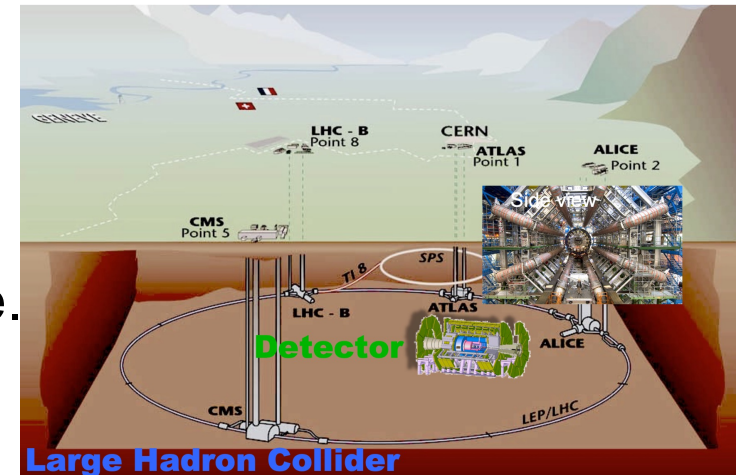
---

- It's my greatest honor to join the TYL/FJPPL-FKPPL workshop as a winner of the Toshiko Yuasa Prize.
- It's my fourth time to join this workshop series.
  - In 2009 May, in Tsukuba.
    - I happened to join “the Toshiko Yuasa lab. inauguration ceremony”.
  - In 2010 June, in Annecy.
  - In 2018 May, in Nara.
  - In 2021 May, online.
- Today's talk: a few selections of my research achievements, concerning this prize.

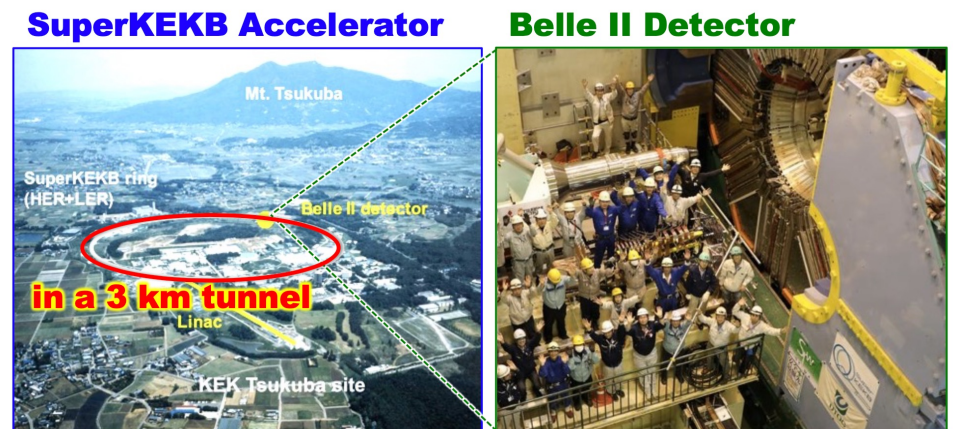
# Searches for New Physics

- There are two major ways in searching for New Physics beyond the Standard Model of Particle Physics.

- 1: **Direct search for new particles.**
  - At energy-frontier experiments  
e.g. LHC-ATLAS at CERN in Swiss/France.
- 2: **Indirect search for deviations** in measurements from the Standard-Model expectations.
  - At luminosity-frontier experiments  
e.g. Belle (II) at KEK in Japan.

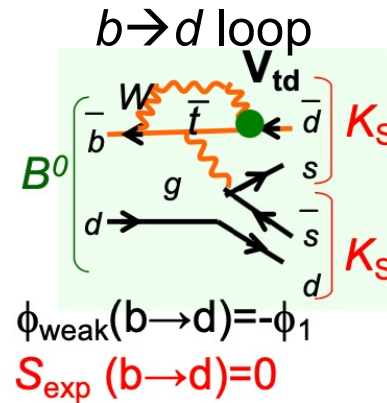


- I committed to both studies.

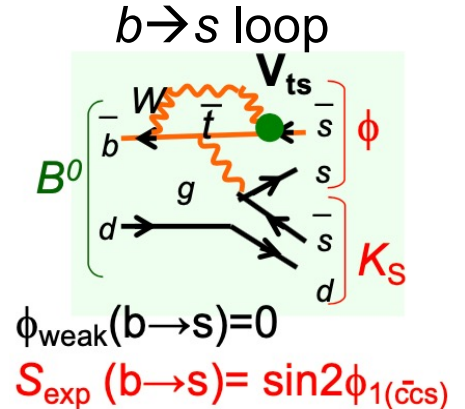


# Turning point in my research life; Japan → France

- I received my PhD in 2009 spring.
  - I measured *CP*-asymmetries in Flavor-Changing Neutral-Current decays of  $B_d$  mesons at Belle.



“PRL 100, 121601 (2008),  
 Y. Nakahama et. al.”



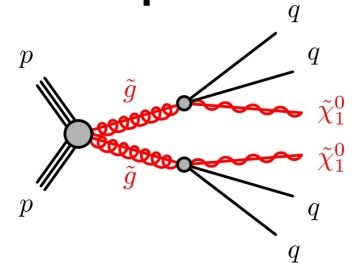
“PRD 82, 073011 (2010),  
 Y. Nakahama et. al.”

- My PhD supervisor told me that the LAL-Orsay group was looking for a Post-Doc for ATLAS.
- Soon after, I had a chance to talk with the ATLAS group leader, Prof. Daniel Fournier, who came to Tsukuba for the TIPP conference 2009. I got my first PD position in Orsay.
- I could integrate myself in ATLAS efficiency.
- After all, I continue to live in France for more than 10 years; first in Paris and then around CERN.

# Direct New-Physics searches in ATLAS

(2011-)

- A number of super-symmetric-particle searches since LHC's start, with focus on inclusive searches for gluinos and squarks (in all-hadronic final states as analysis coordinator).

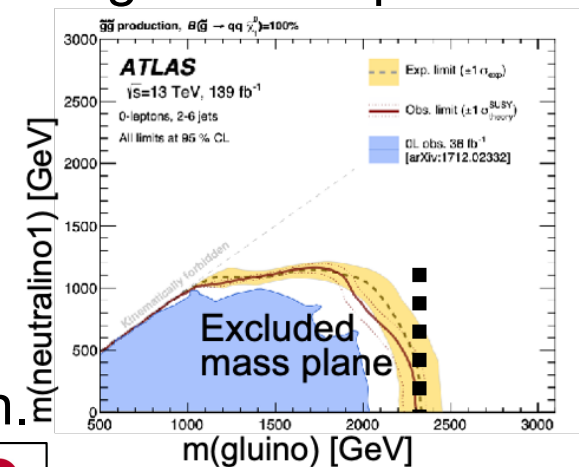


- The latest result with the full Run 2 dataset  $139 \text{ fb}^{-1}$ 
  - Developed a complete analysis with Machine-Learning and complex fit.
  - Tightest constraint on  $m(\text{gluino}) < 2.3 \text{ TeV}/c^2$ .

“JHEP 02 (2021) 143, G. Aad et. al.”

- Collaboration in TYL/FJPPL project (2018, HEP\_08) led the analysis success.

- Two PhDs were received from France and Japan.



- Prospect (in my studies): Search for Long-Lived-Particles, which is less explored so far.

# Triggering in ATLAS

(2011-)

- Triggering collision events is crucial for hadron colliders.
- No trigger, no physics.
- **Committed to trigger developments, commissioning and operation.**
- Trigger menu coordinator in Run 2.
  - **Exploited the full discovery potential and achieved a huge range of the energy-frontier ATLAS physics program with priorities,**
  - by realizing the complex data taking of ATLAS at higher luminosities.
- Still actively engaged in the trigger community e.g.
  - Development of multi-threaded triggers, as muon trigger coordinator.
  - Discussion on the strategies for Run 3 (2022-), as a panel chair of the Trigger Workshop 2020.

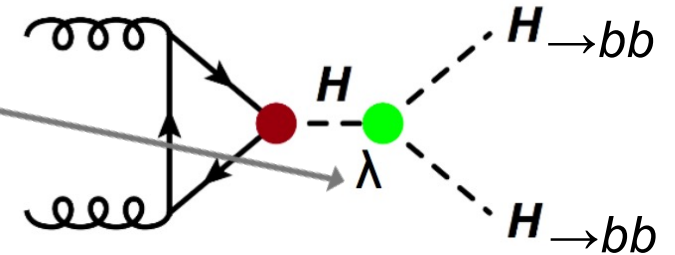


# Search for Higgs-pair productions in ATLAS

(2017-)

- An emerging & promising area of Higgs physics towards High-Lumi LHC, for full understanding of the Higgs mechanism.

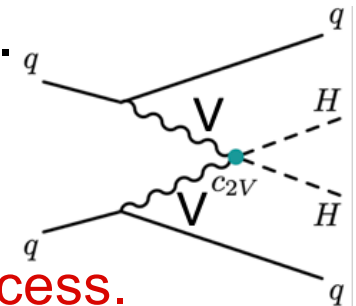
- Can measure the Higgs self-coupling  $\lambda$ .
- Sensitive to New Physics even in current stat.



- Focusing on 4  $b$ -jet final state with the highest stat. (analysis coordinator in 2018-2020).

- Understanding production processes is important.

→ **World's first hh-prod. search in Vector-Boson Fusion process.**



- Constraint on Higgs coupling  $VVHH$ ,  $C_{2V}$ .

“JHEP 07 (2020) 108, G. Aad et. al.”

- Prospects: Non-resonant analysis for the  $\lambda$  measurement on going. Trigger strategy for Run 3 analyses under development.

# Thank you all for supports & collaborations

---

- Prof. Iijima Toru for recommending me for this prize.
- My team members in the Nagoya KMI & HEP group.
- My host researchers in Tokyo, LAL-Orsay, CERN, and Nagoya, for kindly providing me with excellent & independent research environments, and supports.
- My collaborators in ATLAS and Belle.
- And, my family.

THANK  
YOU

The text 'THANK YOU' is written in a large, orange, hand-drawn font. The letters are slightly irregular and have a soft, glowing effect. The words are arranged in two lines: 'THANK' on top and 'YOU' below it. Several small, yellow, five-pointed stars are scattered around the text, some above and some below, adding a celebratory feel.





# Thank you for listening!