B3 RESEARCHER (MAXIMUM 7 PAGES WHICH INCLUDES A CV AND A LIST OF MAIN ACHIEVEMENTS)

- **Research experience**

Education and Professional Appointments/Employment:

2011 - now Assistant Professor
Waseda University, Faculty of Science and Engineering
ATLAS experiment: FTK development, measurement of top cross section

2009 – 2011 Junior Researcher
Waseda University, Research Institute for Science and Engineering
ATLAS experiment: FTK development, measurement of top cross section, SCT operation

March 2009 Ph.D in Physics. Title "Study of the Top Quark Production Mechanism in 1.96-TeV Proton –Antiproton Collisions", Supervisor: Prof Fumihiko Ukegawa –University of Tsukuba, Ibaraki Japan

2006 – 2009 Student in Doctor's Programs
University of Tsukuba, Graduate School of Pure and Applied Sciences
CDF experiment, Study of top quark production mechanism,
CDF run operation, Plug Pre-shower Detector Calibration

2004 – 2006 Student in Master's Programs
University of Tsukuba, Graduate School of Pure and Applied Sciences
PMT study for the CDF detector,
Physics study by Monte Carlo simulation

Operative Systems, Programming languages and Scientific Software:

- ✓ Good Knowledge of Windows systems from version 9x to the latest version.
- ✓ Very good knowledge of GNU/Linux system, derived by Debian, Fedora, Ubuntu distribution.
  Good ability as user and as administrator, with knowledge of the common tools used for below tasks: Shell scripts in BASH and TCSH, Lisp, AWK and other tools.
- ✓ Very good knowledge of the C/C++ language and other common languages: Java, Python, Perl and FORTRAN, used usually in conjunction with the most common scientific libraries.
- ✓ Knowledge of advanced programming schemes like multi-threading programming.
- ✓ Knowledge of debugging and code testing by GDB.
- ✓ Very good knowledge of languages used to create documents and to present results: Latex, HTML, XML and PHP.
- ✓ Very good knowledge of Monte Carlo generators for the particle collider physics: Pythia, Herwig, AlpGen and MC@NLO.
- ✓ Very good knowledge of ROOT framework
- ✓ Good knowledge of the common software bundles for personal productivity: Windows Office and Open Office.

My research work has focussed on the breakthrough of rules governing the fundamental particles and their interactions, working at the most high energy hadron colliders available in the last 30 years, the Tevatron near Chicago (USA) and the LHC at CERN (Switzerland). Since the beginning of my research I worked on competitive top quark physics at the CDF experiment first, and at the ATLAS experiment after. These researches were measurements made to study deeply the Standard Model, with the main goal of understanding which physics is hidden beyond it. Additionally I worked on the trigger system development to increase the capabilities of my

experiments to collect more efficiently large samples for future interesting physics analysis results. The subject of my master's degree, Ph.D and post-doctoral research is described below:

- ✓ **Performance study of Photo Multiplier Tube (PMT) for the CDF detector**

I worked on the PMT performance study during my master's degree. I did base calibration and performance check of all produced Multi-anode PMT for the Central Pre-Shower detector (CPR2) upgrade project for the 2004. CPR2 detector is the combination of the scintillator tiles, the Wave Length Shifter fibbers and PMTs. CPR2 is able to reject the fake electron produced by a pi0 photon. Checked performance (variability of output charge from 16 channels and cross talks) satisfied the requirements and so PMT's were installed in CDF. Then I studied the long time stability reproducing high luminosity environment conditions for some type of PMTs, using a simple test setup. I found unstable behaviour for the fine mesh PMT using the Time Of Flight (TOF) detector that used the same PMTs. The TOF is made of one scintillator bar and PMTs located around the beam pipe at 1.6 m. Main task of TOF detector is separation for low P_T π_and K meson using difference of flight time. Its PMTs are exposed at 1.4 T magnetic fields, so fine mesh PMT that have resistance properties for the magnetism was chosen. The gain of the PMTs dropped about 40 % for high frequency inputs used to reproduce the high luminosity environment. I found that the reason of the gain drop was basically the charge up of the PMT's base due to the dynode damage. Finally the gain drop was resolved by increasing the applied voltage for the PMTs.

Study for the top pair production system at CDF experiment

The top quark was discovered at CDF and D0 experiment at Tevatron in 1995. The Tevatron was the only collider that could study the top quark at that time. My Ph.D thesis reported measurements of the production cross section of the top quark pair and identification of the initial state of the sub-process, whether it was a gluon-gluon pair or a quark anti-quark pair. The measurement of the production cross section is the most important for all analysis using this process, and also serves as a good test of the Standard Model. A measurement of the gluon fusion gives a knowledge of the gluon content of the proton at large values of x, as well as providing a test of the perturbative QCD calculations. In addition a large difference from expectations would indicate new physics behind the SM. The gluon fusion and quark annihilation have different top quark spin correlations. The two processes can be differentiated if we can access the top pair spin information. Because the top quark decays immediately, before hadronization, due to the short lifetime, the top quark spin information is preserved and transferred to its decay products. I used the angular correlations among decay products to infer the initial state of the sub-process. In the standard model, the top quark decays into a W boson and a b-quark almost 100% of the time. The W boson subsequently decays into either a pair of quarks or a lepton-neutrino pair. I used di-lepton channel final state where both Ws decay leptonically. Finally gluon fusion fraction was measured by fits of these leptons flight direction angle that indicate initial spin state. This was the first measurement of the gluon fusion fraction using the top quark pair spin correlation. Both measured values were consistent with the Standard Model expectations.

- ✓ **Study for the silicon detector at ATLAS**

My first research work as post-doct was a study for the semiconductor system (SCT) at ATLAS. SCT is the silicon strip tracker with 6 M strip channels, and it is also one of the inputs of the FTK processor. I measured the noise occupancy using the number of the hits that could not be associated to a real track. The residual hits were counted after the space point hits subtraction. The measured noise occupancy was consistent with the expected value calculated with full equivalent noise charge. My method can be used for the online noise occupancy measurement during the ATLAS operation.

- ✓ **Top quark pair production cross section measurement at ATLAS**

In the first phase of the ATLAS data taking, the study of the top quark was one of the highest priorities of the ATLAS physics program. In particular, the measurement of the top quark pair production cross-section is important because top pair events constitute a major background to

several new physics scenarios. I measured the production cross-section in the full hadronic final state where both W bosons decay into jets, characterized by a nominal six-jet topology. Tow jets are required to be identified as originating from a b-quark using a secondary vertex b-tagging algorithm that identify the long lifetime of the b-quark. This channel has the advantage of a large branching ratio (46%) although it suffers from a huge QCD multi-jet background. The analysis was started by the very beginning of data taking at LHC, with low luminosity. Subsequently the trigger data collection became more difficult due to the luminosity increase. My work on FTK (see below) will have a large impact on this analysis and many others taking into account heavy flavours. My measured cross section was consistent with the Standard Model and it was combined to other decay channels for publication.

- ✓ **FTK study at ATLAS**

Currently I'm working on the FTK project at the Waseda University. I provided many contributions in different areas:

(1) I developed a standalone program that could simulate the FTK processing time measured on Monte Carlo generated events. FTK needs to provide the track information before the start of the L2 event analysis, so latency estimation is one of the important information to validate the FTK project. My work started from the reconstruction of the SVT latency in the CDF experiment where both data and simulation were available. After good consistency checks of SVT timing on data and simulation, I estimated the FTK latency including all the timing details of each board in the system. This process allowed me to gain a deep understanding of the whole FTK system. FTK was demonstrated to be enough fast for L2 trigger and my work was an important part of the FTK TDR.

(2) I participated to the design and test of the first prototype of the FTK input mezzanine, FTK_IM, the first FTK device found by the data coming from the detector. The small mezzanine has powerful FPGAs to perform 2D clustering of pixels and 1D clustering of strips and to find the best estimate of the position of the particle interaction in the silicon. This project is collaboration between Waseda and INFN Frascati, and is the reason of my travels to Frascati in the past.

(3) I participated to the vertical slice activities during 2012 developing the FTK_IM firmware and working on the setup of the AMBoard with which we could take the first FTK data. We checked the first real data inputs from the ATLAS detector selecting small regions (few silicon modules) that where connected by fibers to the FTK input mezzanines. We could show the capability of the group to insert hardware on the experiment without causing troubles to the data taking.

(4) Finally I worked for the production of Associative Memory banks. I optimized the method for bank production to make it faster and suitable for study of real, not just simulated data. I also participated to test AMboards that have been used in the vertical slice. I could acquire experience on the AMsystem in that occasion.

- **<u>Research results including patents, publications, teaching, etc</u>**

Invited Talks

Title "**Top quark production at ATLAS**",
Naoki Kimura On behalf of the ATLAS collaboration
16 th International Conference in Quantum Chromo Dynamics.
Montpellier, France. July 2012

Title "**A Fast Hardware Tracker for the ATLAS Trigger System**",
Naoki Kimura On behalf of the ATLAS TDAQ Group
6th International Workshop on Semiconductor Pixel Detectors for Particles and Imaging.
Inawashiro, Japan. September 2012

Title "**Top quark physics and Higgs search results at CDF experiment**"

Naoki Kimura for the CDF Collaboration
The physical Society of Japan 2010 Fall meeting
Fukuoka, Japan. September 2010

Title "**Measurement of the relative fraction of the gluon-gluon fusion in top-antitop production process at 1.96 TeV proton-antiproton collisions using CDF**"
Rencontres de Moriond EW
La Tuile, Italy. March 2009

Publication

I am on the author-list of CDF (2007-) and ATLAS (2009-) collaboration. I have more than 200 publications. Here are those where my contribution is important. At hadron colliders publications with data are signed by the whole collaboration and there is no definition of the main author. The author list is published in alphabetical order. CDF and ATLAS collaborations have respectively about 600, and 3000 physicists.

1. Serch for the Standard Model Higgs boson in the H to tau+ tau- decay mode in sqrt(s) = 7 TeV pp collision with ATLAS
[ATLAS Collaboration] JHEP 1209 (2012) 070

2. Search for resonances decaying into top-quark pairs using fully hadronic decays in pp collisions with ATLAS at sqrt(s) = 7 TeV
[ATLAS Collaboration] JHEP 1301 (2013) 116

3. The Fast Tracker real time processor and its impact on muon isolation, tau and b-Jet online selection at ATLAS.
A. Andreani, N.Kimura (25th on 56).IEE Trans.Nucl.Sci.59(2012)348-357.

4. Measurement of the top quark pair cross section with ATLAS in pp collisions at sqrt(s) = 7 TeV using final states with an electron or a muon and a hadronically decaying tau lepton.
[Atlas Collaboration], Phys.Lett.B717(2012)89-108.

5. Evidence for a Mass Dependent Forward-Backward Asymmetry in top Quark Pair Production.
[CDF Collaboration], Phys.Rev.D83:112003,2011.

6. Measurement of the Top Pair Production Cross Section in the Dilepton Decay Channel in ppbar Collisions at sqrt s = 1.96 TeV
[CDF Collaboration] Phy.Rev.D82:052002,2010.

7. Enhancement of the ATLAS trigger system with a hardware tracker finder FTK.
A. Andreani, N.Kimura (23th on 51). JINST 5:C12037, 2010

8. A Measurement of the t anti-t Cross Section in p anti-p Collisions at s^(1/2) = 1.96-TeV using Dilepton Events with a Lepton plus Track Selection.
[CDF Collaboration] Phys.Rev.D79:112007, 2009.

9. Cross Section Measurements of High-p(T) Dilepton Fianl-State Processes Using a Global Fitting Method.
[CDF Collaboration] Phys.Rev.D78:012003, 208.

10. Search for Standard Model Higgs Boson Production in Association with a W Boson at CDF

[CDF Collaboration], Phys.Rev.D78:032008, 2008.

11. Precise measurement of the top quark mass in the lepton+jets topology at CDF II
[CDF Collaboration], Phys.Rev.Lett.99:182002, 2007

Teaching experience

Lectures of the Mechanics

2011- now, 22 hours/year, Waseda University, Faculty of Science and Engineering

I'm lecturing the classical dynamics using differential equation for the First-year student.

Seminar and exercise class for the physical mathematics

2011- now, 60 hours/year, Waseda University, Faculty of Science and Engineering

I managed this class that made up of exercise of the physical mathematics and student presentation by seminar for the first-year students.

Teacher: lab course. "optical circuit element"

2011- now, 90 hours/year, Waseda University, Faculty of Science and Engineering

I teach the basic elements and texture for the optical circuit element for third-year students.

Teaching Assistant: lab course "measurement of the muon lifetime"

2004-2006, 40 hours/year, Tsukuba University, Graduate School of Pure and Applied Sciences

I teach the measurement of the muon lifetime using simple detector of scintillators and PMTs for the third-year students.

- **Leadership qualities**

I could get very good leadership experience during my Ph.D. study at the CDF experiment during my analysis in the top quark sector. I studied the top quark production mechanism using the top spin correlations and I participated to the measurement of the top pair production cross-section including the best estimation of background. It was a very competitive research field, discussed in a large and aggressive group of physicists, however I could demonstrate the validity of my ideas and methods, despite my young age. We measured the cross section in several data sets with different luminosities and finally I was chosen to be one of the two leaders in the group. Using a lot of statistics I demonstrated that the old method to estimate the background reached critical limits for precision measurements. So I proposed a new method to keep high the quality of the analysis. The proposal was not accepted at the beginning, because all other analysis (mass measurement, resonance search, property measurements etc) using the same decay channel would have been strongly affected by this decision. I suggested a correction to the new background estimation method that positively combined data and Monte Carlo expectations. At the beginning also the new proposal was criticized. But I could demonstrate its robustness and the many improvements provided by it so that, finally, it was adopted. Our group could estimate the top pair production cross section and the results were published. My proposal has become a standard and was used by many other analyses based on this top channel decay. This was a research field where leadership capabilities were very important and I could exercise them.

Moving at Waseda, I was one of the few physicists in charge of the activation of an experimental particle physics laboratory at the Waseda University. A small group made by one associate professor and 2 post-doctoral researchers was in charge of activating by scratch this activity. I'm part of this group and I am leader of the ATLAS group. A total of 13 students joined the ATLAS group in the 5 years of laboratory activity, under my responsibility. Presently 2 PHD students are working on Higgs search using Higgs decaying to τ-leptons, 1 PHD student and 2 master's students are working on hardware development. First I educated the students by demonstration of my work in front. I assign tasks to the students, giving them strong motivation to