Curriculum Vitae

Czank Thomas Rafael

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Personal Info

Birth Date: 1989/12/29
Place of Birth: São Paulo-SP, Brazil
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Education

2008/03–2012/12 Bachelor degree in Physics - University of São Paulo

2013/04–2015/08 Master's degree in Physics - Tohoku University
(Tip enhanced Raman spectroscopy of carbon nanotubes)

2015/09–2018/11 PhD degree in Physics - Tohoku University
(The search for a dark sector muonic gauge boson $Z^{'}$ at the Belle experiment)

Languages

- English - Fluent
- Spanish - Fluent
- Japanese(N2) - Advanced
- Portuguese - Native Speaker

Professional Experience

2021/12– **Occupation:** Postdoctoral Researcher
Institution: Tokyo Metropolitan University

Supervisor: Kakuno Hidekazu

Activities: Statistical analysis for dark matter candidate detection using the data taken by the Belle Experiment during its 10 years of operation. The Belle Analysis Framework `basf` is based in `C/C++` it is used to select the particles and its variables relevant for the analysis. These variables relationship is studied to design an optimal set of selection criteria that will maximize the signal (dark matter candidate) and minimize the background (everything else). With the selection criteria defined we move on to scan the data in searching for a signal that matches our *pdf* obtained from a Monte Carlo simulation based on the theoretical model for the dark matter candidate. If we can get a fit of the *pdf* over data that is statistically significant and good (low enough chi square) we can claim to have found a new particle.

This position is due to my work during PhD that searched for a dark matter, Z' candidate that couples to muons (a heavier electron). At TMU we are searching for a dark matter candidate that couples to taus (a heavier muon) or to neutrinos (no charge and no mass, invisible) an analysis that requires a much finer tuning to the selection criteria.

`CERN ROOT` A `C/C++` framework for statistical analysis of high energy physics (HEP) data developed at CERN. I used the **standard fitter** which is based on **chi-square minimizer** (Minuit). Also a **Bayesian calculator** to estimate the confidence level of the coupling strength between Z' and the other particles.

2018/12–2021/11   **Occupation:** Postdoctoral Researcher
Institution: Institute for Physics and Mathematics of the Universe (Kavli IPMU)
Supervisor: Higuchi Takeo
Activities: Statistical analysis and development of tools for the Time Dependent Charge Parity Violation (TDCPV) study group inside the Belle II experiment. TDCPV can be defined as one of the ways to measure the lack of anti-matter in the universe. The Belle II experiment, an upgraded version of the Belle experiment which was designed to measure the Charge Parity Violation in the B meson system, and it was responsible for the 2008 physics nobel prize, has a better instrumentation than Belle and it will also collect 40 times more data due to the upgraded collider Super KEKB. Initially I got acquainted with the Belle II analysis framework, `basf2`, similar to `basf` it is based in `C/C++` but it has an interface based on `python`. I reconstructed the $B^0 \to \psi(2S)K_S^0$ decay mode and evaluated how many valid events could be found in the short time Belle II operated. Later I worked on the reconstruction of the $B^0 \to D^* \ell \nu_\ell$ a decay mode that is unrelated to TDCPV but since it is one of the greatest portions of the neutral B meson decay it is used as a control

sample for the TDCPV analysis. The control sample study required a classification of the different background sources.

This analysis was done using `ROOT python` bindings due to the use of the `basf2 python` interface. Lists of variables could be imported from `basf2` into `ROOT` macros. Besides this, **pandas dataframes** were used to apply selection criteria upon the data as well as checking correlations and reducing size of original data samples. And finally `rootpandas` were used for file conversion from `.root` into `.ascii` since some of the original Belle tools for TDCPV analysis were still dependent on this format.

Most of the Belle II experiment data taken and simulations are stored in a grid of computers around the institutions that participated in the Belle II collaboration so I also experienced some grid computing.

2012/04–2013/04   **Occupation:** Data analyst
Institution: HSBC Asset Management Brazil
Supervisor: Fontenele André N.
Activities: Development of a MySQL Database to manage fixed income investment funds.

Skills

- **Programming Languages**: Python, C++, FORTRAN, LaTeX
  and *Mathematica*.

- **Statistics**: Parameter estimation, statistical tests, chi-square tests, fitting

- **Linux related**: `bash`, `zsh` shells, user management, network management
  and `docker`.

- **Machine Learning**: `CERN ROOT TMVA` package, multivariate analysis. Experience with Boosted Decision Trees developing non linear selection criteria with a set of discriminant variables to minimize background.

Sagamihara, 2022/09/28