National Research Tomsk State University

Лаборатория анализа данных физики высоких энергий Томского государственного университета

Measurement of differential cross-sections of a single top quark produced in association with a W boson with ATLAS at $\sqrt{s} = 13$ TeV

Research and Development Plans 2026

Neda Firoz

Goal: separate **tW (top+anti-top)** from **$t\bar{t}$** in the **1j1b dilepton** region

• Identify the best-performing classifier for signal vs background in HEP datasets with bigger statistics using a fair, reproducible benchmark.

•**Platforms:** Python, TMVA (ROOT) and R

•RScope: Test a broad set of ML classifiers under high-statistics conditions (large MC + control samples).

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Algorithms (minimum set)

- **Baselines:** Logistic Regression, Naive Bayes.
- **Trees/Boosting:** Random Forest, Gradient Boosting / XGBoost (Python/R), TMVA BDT variants.
- **Margins / NNs:** SVM (feasible subsets), MLP (Python/R/TMVA).
- Deep Learning experiments planned ahead after implementing Machine learning on HEP data.

USE HEP metrics (measurable)

ROC AUC, PR AUC, F1, Background rejection @ fixed signal efficiency (e.g., at 70%, 80%, 90%).

Significance metrics

AMS or $S/\sqrt{S+B}$ (at analysis working points)SIC / ROC curves, confusion matrix at chosen thresholds.

Robustness checks

k-fold CV (5 or 10), stability across systematic variations (where available).

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Optimization plan (all platforms)

- Hyperparameter tuning budget: ≥ 50 trials/model (grid/random/Bayesian where available)Overtraining control: train/test AUC gap ≤ 0.03 (or documented + mitigated)
- Target: ≥ +2% AUC (or improved significance/working point) vs untuned baseline

Deliverables

- Best model(s) identification per analysis scenario with AUC + significance evidence
- Reproducible code delivery for Python, TMVA, R, ready for analysis integration with higher statistics data.
- Publication of results in the suggested journals by mentors.

Personal development Plan

- Two VAK journal articles have been accepted for publication and one VAK article plus one IEEE conference proceeding article has been published in December 2025. This was communicated to Natalie.
- Finalized and submitted two more articles to satisfy VAK review requirements for Ph.D. thesis defense in January 2026. It will be communicated soon when the acceptance notification arrives, adding the details of the grant in acknowledgement section.

•Awaiting review, most probably they will be accepted in 3 or 4 weeks for publication in March and June issues of 2026.

•Aiming for submission of PhD thesis with required criteria fulfilled in March 2026. The new supervisor was allotted officially and I have received the official orders of papers of her consent.

•Final Defense of the Candidate of Science degree.

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Thank you for your attention!!!