SMARTHEP Yearly Meeting 2023 at Lund University

**ATLAS EXPERIMENT**

Lara Calic
27th of November, 2023

Run: 359010
Event: 1742126393
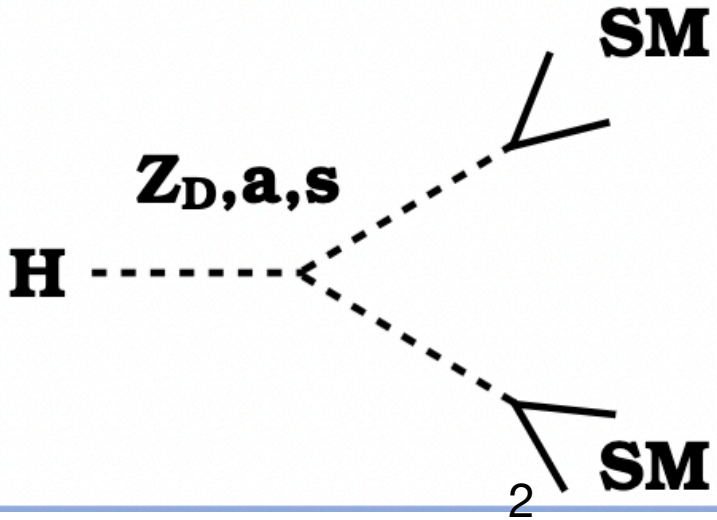2018-08-24 00:23:29 CEST

dielectron-muon candidate event

Project 1: Double Charged Higgs boson decays into final states with leptons

Exotic group: collaboration among Italy (Bologna, INF University), Slovenia (Ljubljana, IJS), and Sweden (Lund University)
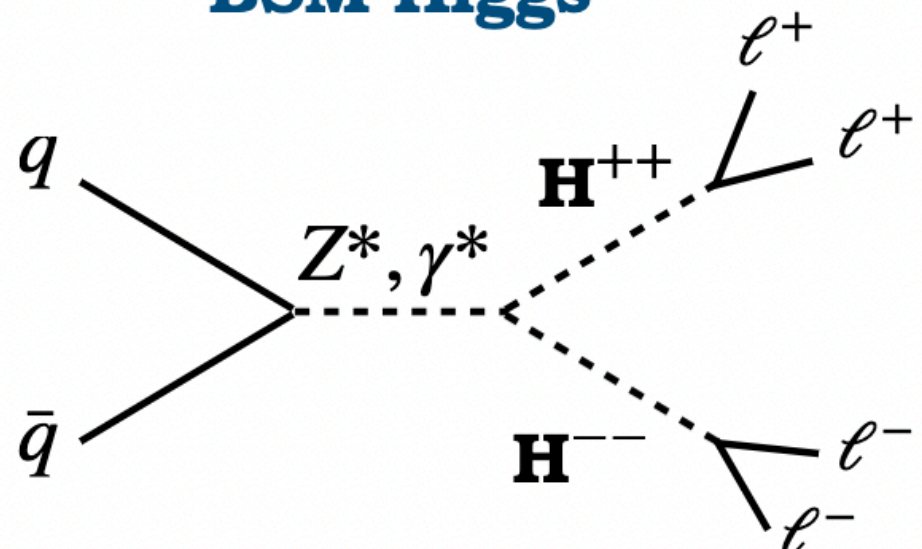
Not all of us!
Jan Gavranovič
Jernej Debevc
Miha Muškinja
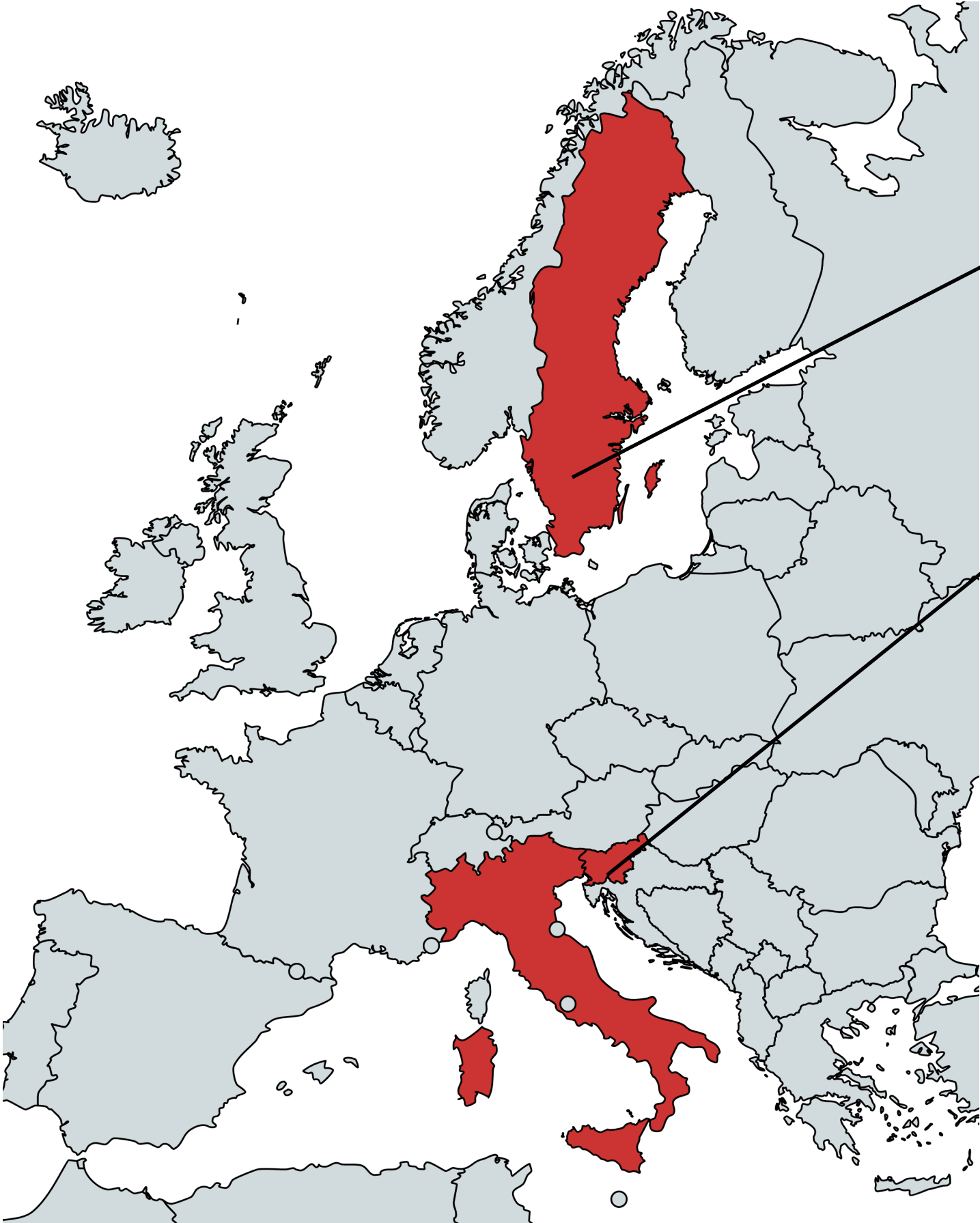
Different ways to access to BSM physics

Exotic Higgs decays

H ---- Z_D, a, s ----< SM

----< 2 SM

BSM Higgs

q, $\bar{q}$ → Z^*, γ^* → H^{++} ----< ℓ^+, ℓ^+

H^{--} ----< ℓ^-, ℓ^-

How do we search for BSM Higgs bosons at the LHC?

- variety of ways:

  - **Direct search for new neutral and charged Higgs bosons**

  - **Indirect search by measuring the mass, coupling, and production mechanism of the SM Higgs boson**

  - **Searches for neutral Higgs (mostly including bb and gluon fusion) and charged Higgs (often including production in top decays and searches for single taus)**
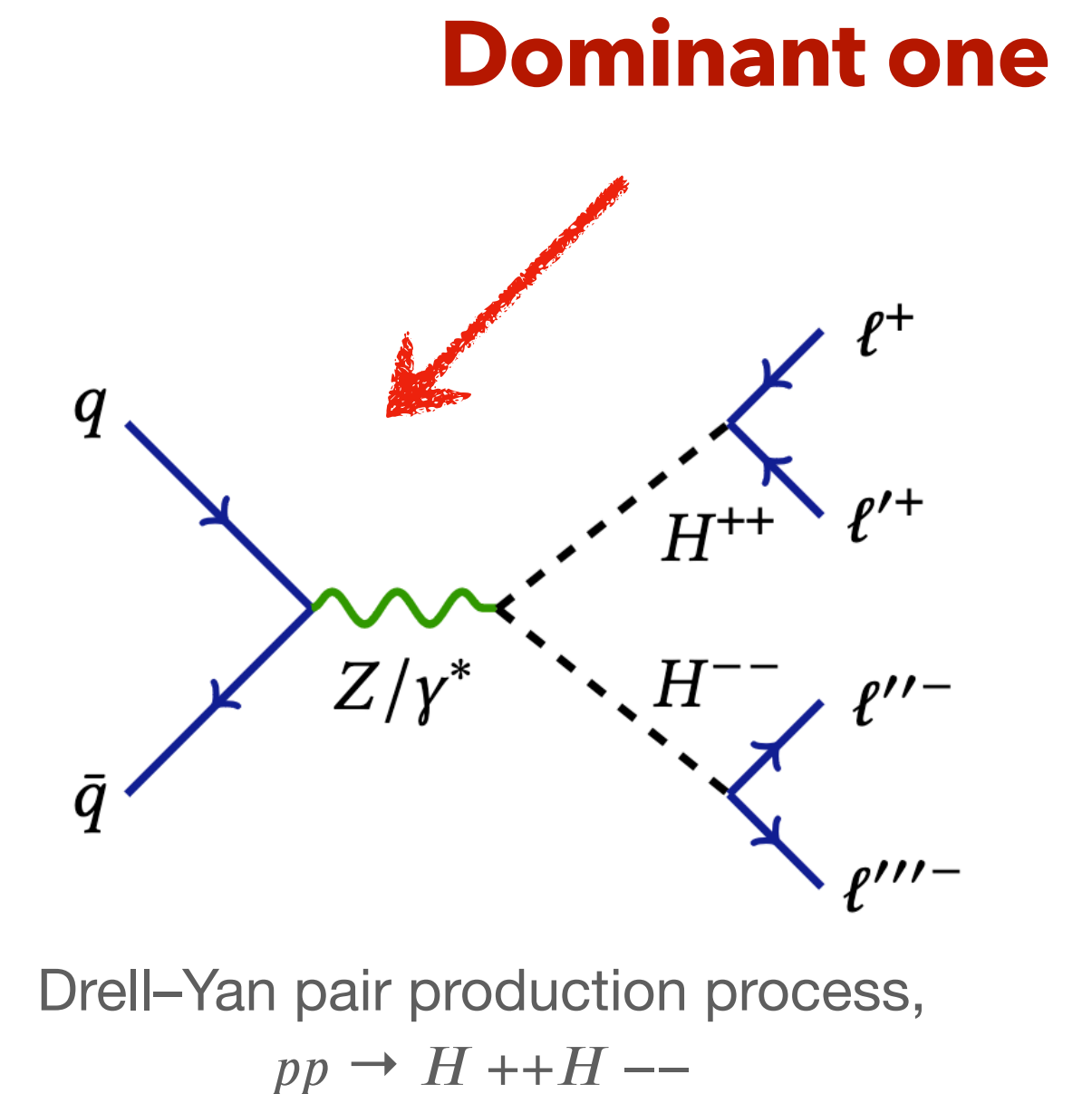
  - **2HDM models (Type I,II, III)**

Main Backgrounds

Dominant one

- Drell-Yan,
- Diboson,
- Fake non-prompt leptons

Signal Selections

High values of and pT m($\ell\pm\ell\pm$) lead and used as fit variable m($\ell\pm\ell\pm$)lead

Our focus of interest:
$H\pm\pm \rightarrow \ell\pm\ell\pm$

Drell–Yan pair production process,
$pp \rightarrow H{++}H{--}$

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H±± → ℓ±ℓ±

Model

- Benchmark from Left-Right Symmetric Model (LRSM)
- Diboson, FNP, others
- final states featuring two, three or four light leptons

- Display of observed and expected 95% Confidence
- inclusion of +/- 1 and +/- 2 SD uncertainty bands around the expected limit (frequentist approach)

Plot

- Observed (black solid curve) and expected (black dashed curve) 95% CL ULs on the double charged Higgs bosons pair production
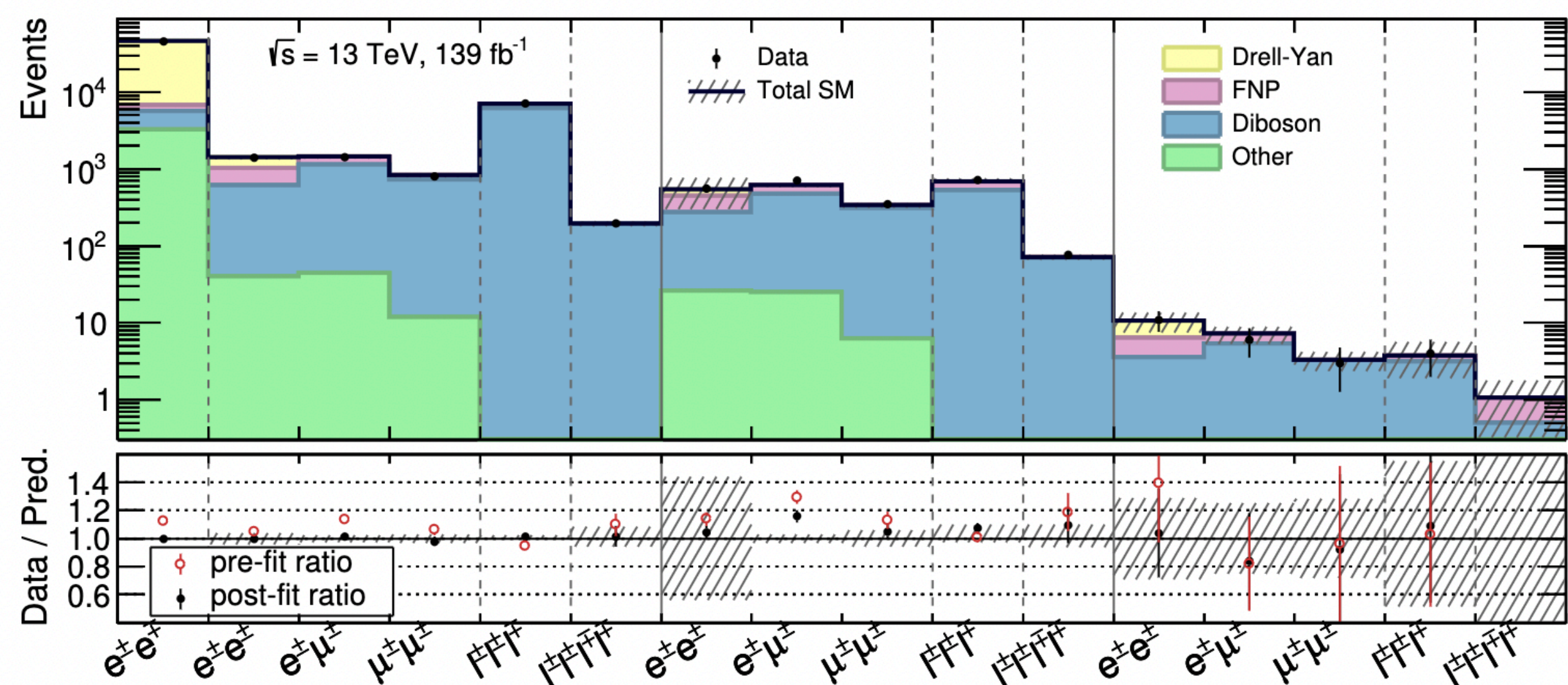
The numbers of observed and expected events in the control, validation, and signal region for all channels in the cut-based analysis, split by lepton flavour and electric charge combination

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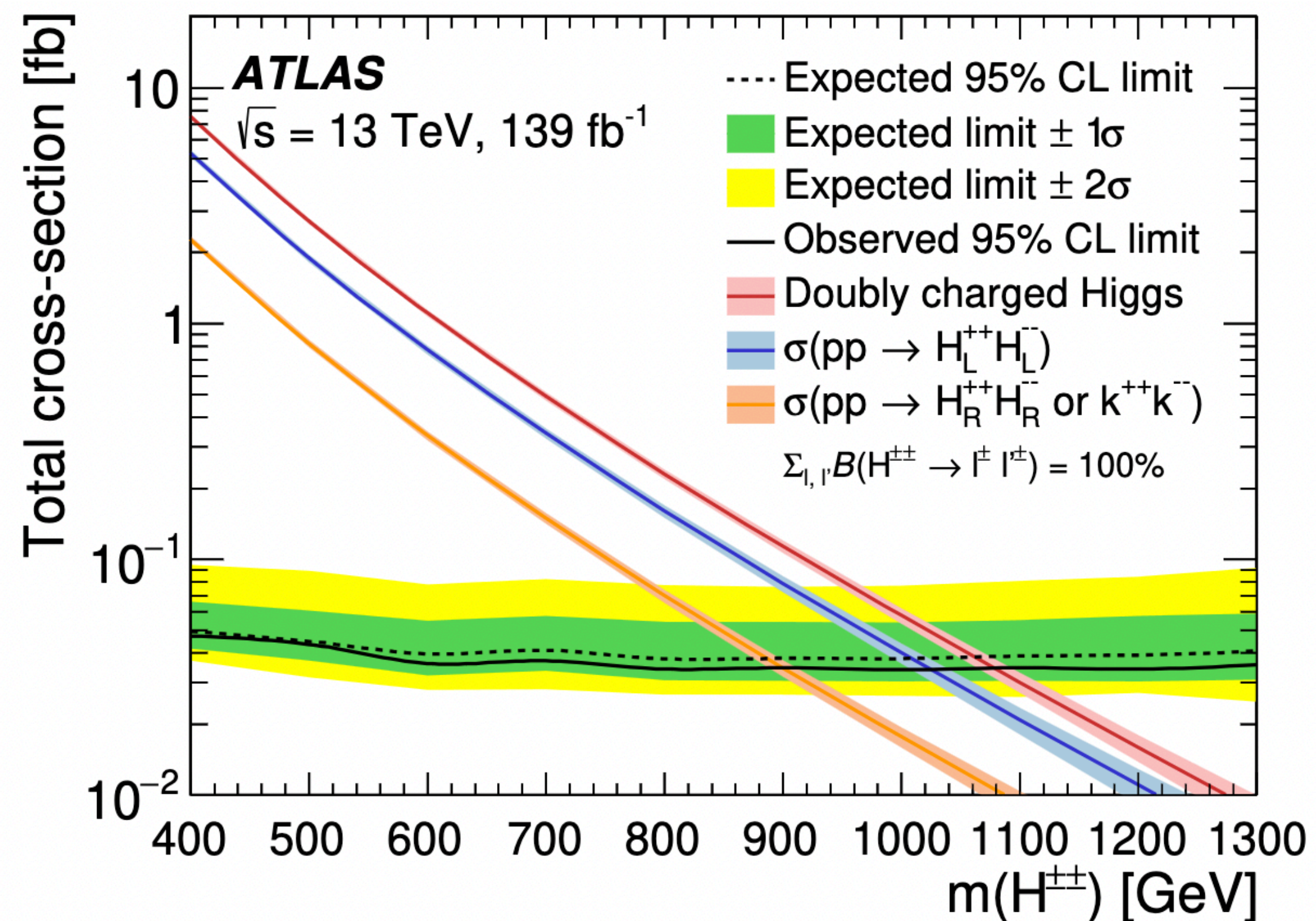
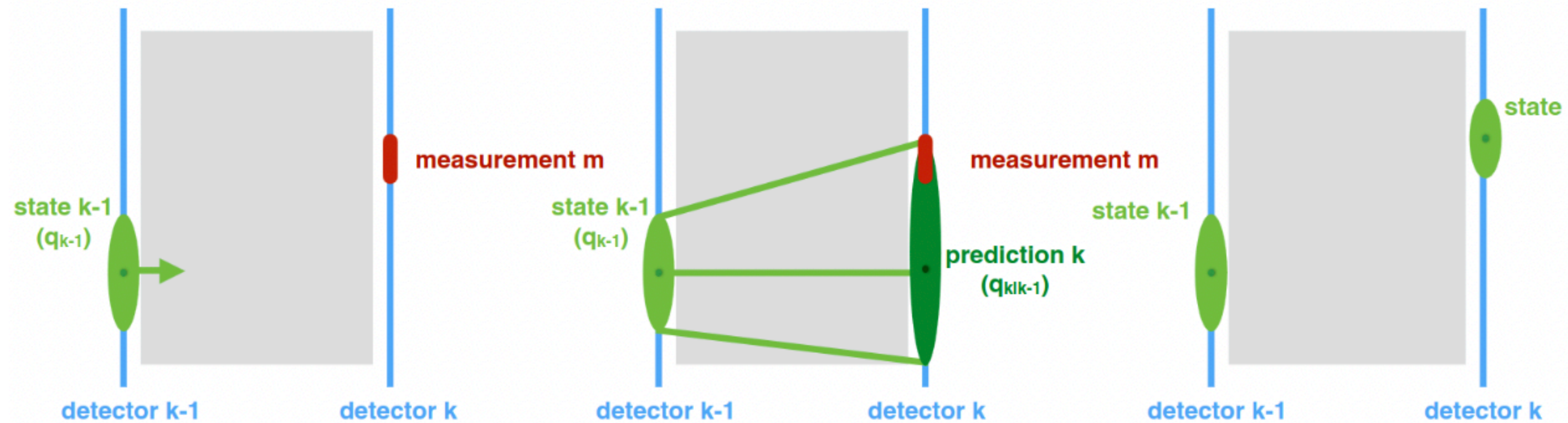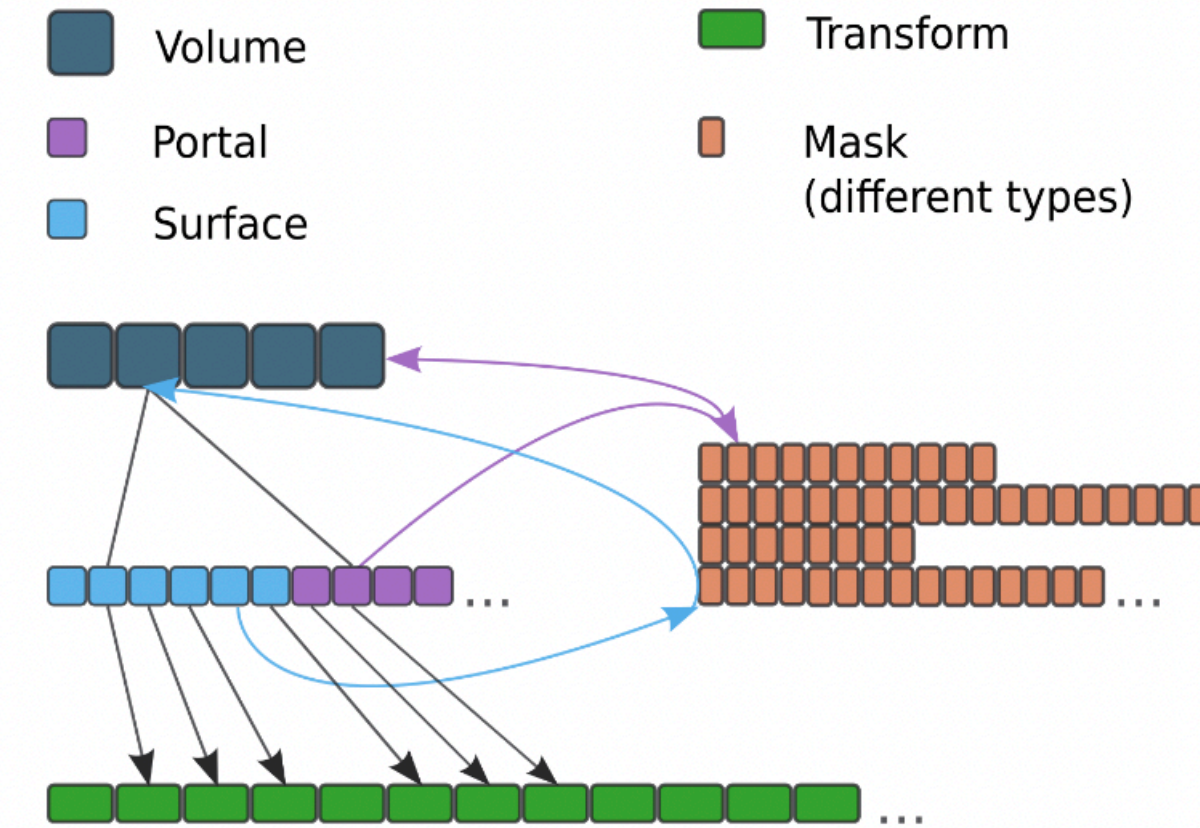# Project 2: ITk alignment with the ACTS KF

My contribution

Geometry container

- **Track state incorporates measurements via Kalman Filter formalism**

- **Start from track seed parameters**
- **Predict parameters at next surface**

- **Search for matching measurements**
- **Kalman update stage: Update track state measurement**

PR: Implementation of the misalignment of individual sensors in correlated way
PR: grouping mechanism
PR: Alignment of superstructures
PR: Selective misalignment
PR: Studying the implemented mechanism

Volume
Portal
Surface
Transform
Mask (different types)

measurement m

state k-1
(q_{k-1})

measurement m

state k-1
(q_{k-1})

prediction k
$(q_{k|k-1})$

state

state k-1

detector k-1   detector k

detector k-1   detector k

detector k-1   detector k

Thank you!