Observation of the associated production of a top quark and a Z boson in pp collisions with the ATLAS detector

Motivation

- Rare process predicted by the SM
- Important background of tHq
- Helps to probe tZ and WWZ couplings
- tllq cross section at NLO is about 102 fb

Event selection

- 3 well isolated leptons (muons or electrons), $p_T > 28/20/20$ GeV
- 1 Opposite-sign same-flavour lepton pair to reconstruct Z boson mass, $m_{ll} > m_Z - 10$ GeV
- 2 or 3 jets including the forward regions $|y| < 4.5$ and $p_T > 35$ GeV
- 1 b-tagged jet

SR 2j1b and 6 CR are defined

- MC is used to estimate backgrounds
- One CR for each background process
- Non-prompt background estimated (tHq and Z+jets) with MC samples enriched using ‘b-jet replacement’ method

Systematic uncertainties

- Document uncertainties for each variable
- Total uncertainty quoted

Signal enriched plots

- ATLAS: first evidence in 2017, 4.2 σ using 36.1 fb$^{-1}$
- CMS: first observation in 2018 using 77.4 fb$^{-1}$
- ATLAS observation using the full Run 2 data, i.e. 139 fb$^{-1}$

$\sigma_{tllq} = 97 \pm 13\text{(stat.)} \pm 7\text{(syst.)}\text{fb}$