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Validation of excited tau-lepton signal samples

This page describes basic steps made towards production of the Monte Carlo (MC) samples for excited tau-lepton signal. This analysis searches for excited tau-leptons in proton-proton collisions at a center-of-mass energy of 13 TeV.

Benchmark model

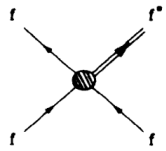
The excited lepton production by contact interaction described by four-fermion Lagrangian as introduced by U. Baur, M. Spira, and P. M. Zerwas (Phys.Rev. D42(1990) 815, Excited-quark and -lepton production at hadron colliders).

MC Generator

The MC generator of use is Pythia 8 with the version 8.243p and EvtGen (v.1.7.0) using the NNPDF23LO PDF set and the A14 underlying event tune. This Pythia 8 version includes correct mass suppression for excited fermion three-body decays *F* -> F Fbar f*, primarily for excited lepton decays with top-quarks in the final state (*F* = *t*).

Excited tau-lepton production

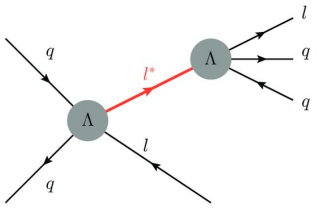
The single production of excited tau-leptons via four-fermion contact interaction (CI) is considered.



Strength of the SU(2), U(1) coupling, and SU(3) couplings are supposed to be unity (1.).

Excited tau-lepton decay

Generated excited tau-leptons decay via CI to a SM tau-lepton and a quark-antiquark pair.



Exclusive mode "tau* -> tau + b + bbar" might be added to the analysis later on.

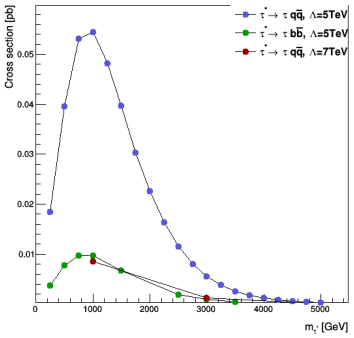
Mass range and scan points

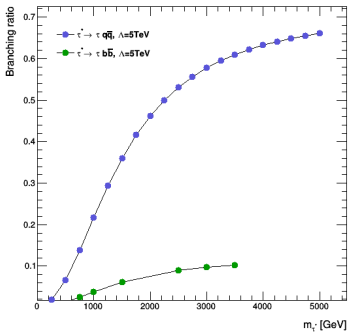
For the compositeness scale Lambda = 5 TeV, excited tau-lepton mass was assumed to lay in the range [250, 5000] GeV with a step 250 GeV.

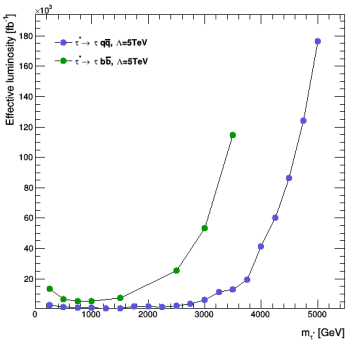
For the compositeness scale Lambda = 7 TeV, excited tau-lepton mass was assumed to be one of the following values {1000, 3000, 5000, 5500, 6000, 6500, 7000} GeV.

Additionally, samples at m_tau* = Lambda for {1000, 2000, 3000, 4000} GeV were produced.

Cross section, BR, effective luminosity







Athena commands

EVNT containers were produced with Athena branch 21.6 intended purposefully for event generation:

asetup AthGeneration, 21.6.12,here

An example if the command is given below:

```
Generate_tf.py --ecmEnergy=13000 --maxEvents=200000 --firstEvent=1 --randomSeed=0897557
--localPath=/afs/cern.ch/work/k/kpetukho/ExcTau/Generators/MC15JobOptions
--jobConfig=421111/mc.Py8_A14_NNPDF23LO_excited_tau_CI_mtau_250_lam5000.py
--runNumber=08973427 --outputEVNTFile=CI_tau_250_5000_200000evt.pool.root >
log_CI_1000_5000_50000evt.generate
```

EVNT files were converted into xAOD for an analysis at truth level with Athena release 21.2:

```
asetup 21.2.86.0,AthDerivation
```

To check performance limitations, several samples are going to be checked at RECO level (ATLFastIISimulation and AOD derivation is being performed).

An example of the command is given below:

Reco_tf.py --inputEVNTFile evnt.pool.root --outputDAODFile test.pool.root --reductionConf TRUTH3

Spreadsheet

MC production spreadsheet can be found at Google Docs.

Plots with kinematic distributions

DSIS to be set after MC request approval.

DSID	m_tau* [GeV]	Lambda [TeV]	N_events	BR	Cross section [pb]	Luminosity [inv. fb]	Job option	Supporting plots
	250	5000	200,000	0.0193439	1.85E-02	1.081081E+04	JO example on gitlab	Validation plots

	500	5000	200,000	0.066282	3.955E-02	5.05689E+03	JO example on gitlab	Validation plots
	750	5000	200,000	0.1378238	5.271E-02	5.352685E+02	JO example on gitlab	
	1000	5000	50,000	0.217389	5.441E-02	9.189487E+02	JO example on gitlab	Validation plots
	1250	5000	50,000	0.2930013	4.812E-02	5.305278E+02	JO example on gitlab	
	1500	5000	50,000	0.3594063	3.969E-02	6.452255E+02	JO example on gitlab	
	1750	5000	50,000	0.4153779	3.033E-02	1.648532E+03	JO example on gitlab	
	2000	5000	50,000	0.4616152	2.26E-02	1.739071E+03	JO example on gitlab	Validation plots
	2250	5000	50,000	0.4995065	1.633E-02	1.575628E+03	JO example on gitlab	
	2500	5000	50,000	0.5305279	1.151E-02	2.164466E+03	JO example on gitlab	
	2750	5000	50,000	0.5560033	8.027E-03	3.431793E+03	JO example on gitlab	
	3000	5000	50,000	0.5770356	5.58E-03	6.079032E+03	JO example on gitlab	
	3250	5000	50,000	0.5945127	3.821E-03	1.12324E+04	JO example on gitlab	
	3500	5000	50,000	0.6091368	2.609E-03	1.277041E+04	JO example on gitlab	
	3750	5000	50,000	0.6214611	1.765E-03	1.925836E+04	JO example on gitlab	
	4000	5000	50,000	0.6319198	1.214E-03	4.119944E+04	JO example on gitlab	Validation plots
	4250	5000	50,000	0.6408556	8.348E-04	6.008717E+04	JO example on gitlab	
	4500	5000	50,000	0.6485395	5.89E-04	8.62735E+04	JO example on gitlab	Validation plots
	4750	5000	50,000	0.6551873	4.214E-04	1.242164E+05	JO example on gitlab	
	5000	5000	50,000	0.6609715	3.12E-04	1.76481E+05	JO example on gitlab	
	1000	7000	50,000	0.1305925	8.523E-03	5.866479E+03	JO example on gitlab	Validation plots
	3000	7000	50,000	0.4854073	1.218E-03	4.10509E+04	JO example on gitlab	
	5000	7000	50,000	0.6131864	5.765E-05	8.7063E+05	JO example on gitlab	
	5500	7000	50,000	0.6293402	2.869E-05	1.83739E+06	JO example on gitlab	
	6000	7000	50,000	0.6422108	1.619E-05	3.436359E+06	JO example on gitlab	
	6500	7000	50,000	0.6526012	1.059E-05	6.129468E+06	JO example on gitlab	
	7000	7000	50,000	0.6610913	8.041E-06	1.148319E+07	JO example on gitlab	

	1000	1000	50,000	0.6482211	9.622E+01	5.196425E-01	JO example on gitlab	
	2000	2000	50,000	0.6581329	1.194E+00	4.187605E+01	JO example on gitlab	
	3000	3000	50,000	0.6601056	4.922E-02	1.015988E+03	JO example on gitlab	
	4000	4000	50,000	0.660733	3.343E-03	1.512976E+04	JO example on gitlab	

Analysis milestones

The kick-off meeting 06.07.2020 Weekly meeting of the Exotics: Lepton + X subgroup

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This topic: Sandbox > TestTopic11111254
Topic revision: r6 - 2020-07-31 - KrystsinaPetukhova