On way to preparation of (coherent) experimental program for New Physics searches in B-decays at LHC, ATLAS

M.Smizanska, ATLAS,
Lancaster, UK

ATLAS studied several B channels (see table) expected to be sensitive to "New Physics" (NP) and set constraints to various types of 'observables' calculated in TH publications.

Channels sensitive to NP studied since far in ATLAS	Signature, sensitivity after trigger, offline, normally for $3y$ @10^{33}cm^{-2}s^{-1}	Some Models were used for simulation of events. In other cases model calculation of observables were compared with obtained experimental sensitivities.
$B_s \rightarrow \mu\mu$	$27/\sqrt{93}$ 3y @10^{33}cm^{-2}s^{-1} $92\sqrt{660}$ 1y @10^{34}cm^{-2}s^{-1}	A.Ali , C.Greub, T.Mannel, Preprint DESY-93-016.
$B_d \rightarrow \mu\mu$	$3 *10^{-10}$ 95%CL (1y @10^{34}cm^{-2}s^{-1})	A.Ali , C.Greub, T.Mannel, Preprint DESY-93-016.
$B_{d,s} \rightarrow \mu\mu\gamma$,	Not finished	ME&FF: D.Melikhov, N.Nikitin, PRD70, 114028, 2004 (used in simulations); F.Kruger, D.Melikhov, PRD67,034002,2003 WC: SM A.Buras, M.Munz, PRD52, 186, 1995.

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$B_d \to K^{0*}\mu\mu$ $B_s \to \phi\mu\mu$	$2600/\sqrt{290}$ 1700	ME&FF: D.Melikhov, N.Nikitin, S.Simula, PRD57, 6814, 1998; D.Melikhov, B.Stech, PRD62, 014006, 2000 (used in simulation) WC: SM A.Buras, M.Munz, PRD52, 186, 1995; MSSM P.Cho, M.Misiak, D.Wyller, PRD54, p.3329, 1996.
$B_d \to \pi^0\mu\mu$	Not finished	ME&FF: D.Melikhov, N.Nikitin, S.Simula, PRD57, 6814, 1998 (used in simulation); D.Melikhov, B.Stech, PRD62, 014006, 2000. WC: SM A.Buras, M.Munz, PRD52, 186, 1995.
$B_d \to K^{0*}\gamma$ $B_s \to \phi\gamma$	8500 , $S/\sqrt{BG}>5$ 3200 , $S/\sqrt{BG}>7$	ME&FF: A.Ali, V.M.Braun, H.Simma, Z.Phys.C63:437,1994; D.Melikhov, B.Stech, PRD62, 014006, 2000 (used in simulation); WC: SM A.Buras, M.Munz, PRD52, 186, 1995.
$\Lambda_b \to \Lambda\mu\mu$	1800	NP: Chen, Geng, PRD64,2001 and Aliev NPB649,2003 (used in simulation).
$B_s \to J/\psi \, \phi$	$300000/\sqrt{45000}$	SM: Fleisher CERN-TH-2000-101, 2000 (used in simulation), Left-Right Symmetric Model: Ball, Fleisher, Phys.Lett.B475:111-119,2000

- Problem1: Availability of NP Models for B-physics at LHC:
  - Many published NP calculations are for B_d-decays relevant for B-factories.
  - Inclusive channels are still more frequent in TH publications than exclusive.
  - Much less calculations can be found for B_s and even less for Λ_b decays.
  - Often we are happy to find at least something … as a consequence there is hardly any systematics in our choice of NP Models and thus different experimental-feasibility studies done with the aim of testing a sensitivity to NP are isolated from each other and give a small return to theory.

- Suggestion-1a: Creation of 'Set Reference NP Models for LHC B-physics' ??
  - with agreed set of free parameters
  - with several agreed reference points in parameter space.
  - Something like this was done in SUSY LHC groups.
  - This would be mainly a task for TH community, however iterations with exp community needed.

- Suggestion-1b: "Common set of reference NP Models for SUSY groups and B-physics groups at LHC"
  - In addition to previous suggestion, an interest was expressed by both ATLAS SUSY and ATLAS B-phys groups about a creation of some 'Common set of NP Models for SUSY and B-physics groups', in order to investigate a possible complementarity in measurements of both.
  - This highly un-trivial task needs a lot of TH work and systematic collaboration between TH and Exp sides.
  - My personal feeling is that Suggestion1 should be accomplished prior to Suggestion2, because 1 is important for building a B-physics program.

- Problem2: more B-channels sensitive to NP needed.
  - Even if we call for a comprehensive sets of Models (Suggestions1,2) –more urgent is to have any new TH ideas: new B-channels for LHC - even if not perfectly TH calculated.
  - This is urgent because a preparation of triggers requires time. In ATLAS/CMS B-physics will be first to run, even if certain channels can be carried up to full luminosity…
- Q: 'Why experimentalists need TH models at all? They should measure 'what-ever' is possible and theory will explain later'.
  - Answer: not at LHC. At initial luminosity 10^{33}cm^{-2}s^{-1} bb pairs are produced with $5 \cdot 10^{5}$ Hz, the output to permanent store - 10Hz, which is 10^{8} bb per/y.
  - Trigger strategy should be aware of what we want to measure if we want to achieve extremal sensitivities.

- Suggestion2a: Overview document of currently understood LHC experimental limits
  - Some TH models predict B channels with probabilities of 10^{-15} - there is nothing we can do for them at LHC. In order to make easier for TH community to have a feeling of 'what is measurable and what not' we can provide an overview document summarizing LHC experimental limits in channels studied since far.
- Suggestion 2b: consequences for theory
  - In return it will be good to have some theory overview document showing how these experimental limits constrain already known models. It maybe a first step towards 1.a.

- **How we work with TH Models.**
  - LHC experiments have a good Tool for implementing TH Models into event simulation: EvtGen. It accepts complex amplitudes as well as probabilities. We already implemented several TH models.
  - The decision about a choice of TH Model and parameters is difficult if there are several available. Detector simulation, reconstructions etc is expensive and cannot be done for several Models.
  - The choice may be easier once a 'Reference Models' will exist.
  - Currently we have a pragmatic rule: the best documented TH models, a good contact with TH authors (in some cases members of ATLAS).
  - Other Models or variations are tested at the level of 'toy' MC combining an exact MC generation in space of variables and a simplified detector response (fast simulation) and maximum-likehood fit to parameters of a model.

- Summary
  - A 'Set of Reference NP Models for LHC B-physics' would allow a coherent experimental program, different B-physics studies will not be isolated as are now. Return to TH will be improved.
  - As a first step towards the previous, a Document can be created: summarizing currently known experimental LHC limits and consequent implications for TH models.
  - 'Common set of reference NP Models for SUSY groups and B-physics groups at LHC' will allow the same as above - in context of SUSY and B-physics communities.
  - More urgent is however to have any new TH ideas on new B-channels for LHC sensitive to NP - even if not perfectly TH calculated. Trigger strategies must be prepared in time.