TSIM and software status

Junhao Yin

Update plan for release-07

- Main targets are listed in BII-9073

Sub-Tasks

1.	KLM TSIM update	OPEN	Richard Peschke
2.	CDC TSIM update	OPEN	Ping Ni
3.	Keep GRL up to date	CLOSED	Junhao Yin
4.	TRG GRL neural net	IN PROGRESS	Junhao Yin
5.	Data/MC consistency	OPEN	Christopher Hearty
6.	Automatic check of GT	OPEN	Giacomo De Pietro
7.	Documentation of TSIM for release-07	OPEN	Giacomo De Pietro

Update plan for release-07

1. KLM TSIM update — OPEN — Richard Peschke

related PR:
https://stash.desy.de/projects/B2/repos/basf2/pull-requests/1131/overview

PR is currently not able to be merged.
Richard is still working on this.

Update plan for release-07

2. CDC TSIM update — OPEN — Taichiro Koga

Branch is created but PR is not ready

CDC NN update:
https://stash.desy.de/projects/B2/repos/basf2/pull-requests/1180/overview
Could not be merged because of conflicts as well as authors further work.

Update plan for release-07

3. Keep GRL up to date — CLOSED — Junhao Yin

New tau trigger bits are added.

Update plan for release-07

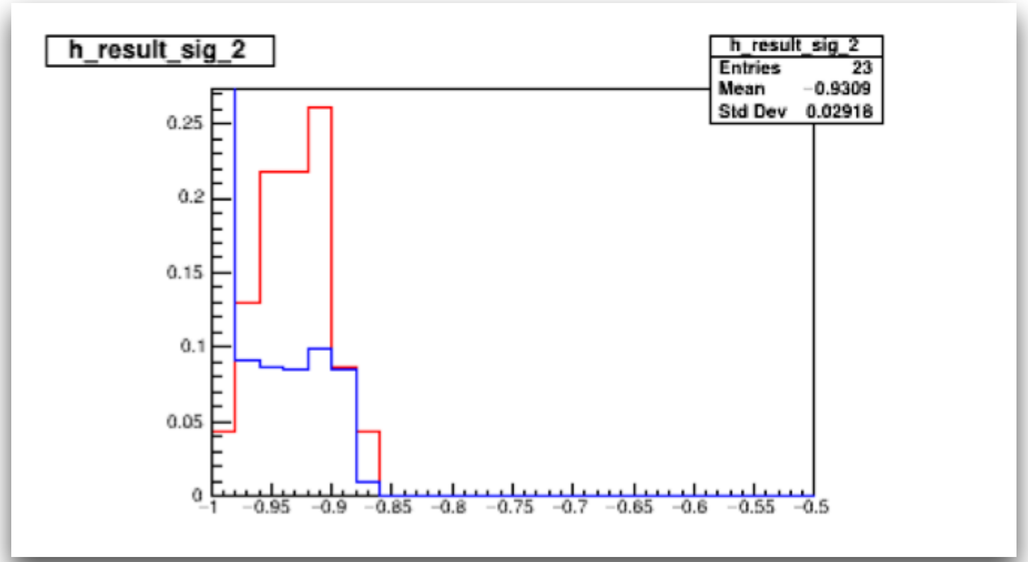
4. TRG GRL neural net — IN PROGRESS — Junhao Yin

Framework:

1. Select signal with offline selections
2. Input variables: CDC full/inner/short tracks, ECL energy/theta/phi
3. Training (ongoing)

```
stdc.stdPi(listtype='all', path=main)
ma.cutAndCopyList('pi+:cool', 'pi+:all', cut='dr < 1.0 and dz < 3.0', path=main)
ma.buildEventShape(foxWolfram=True, cleoCones=False, jets=False, harmonicMoments=False,
                   allMoments=False, collisionAxis=False, sphericity=False, thrust=True, path=main)
ma.buildEventKinematics(path=main)
ma.reconstructDecay(decayString='tau+:sig1 -> pi+:cool', cut='', dmID=1, path=main)
ma.reconstructDecay(decayString='tau+:sig2 -> pi+:cool pi-:cool pi+:cool', cut='', dmID=2, path=main)
copyLists('tau+:sig', ['tau+:sig1', 'tau+:sig2'], path=main)
ma.reconstructDecay(decayString='vpho:sig -> tau+:sig tau-:sig',
                    cut='thrust > 0.85 and visibleEnergyOfEventCMS < 11.5 and  \
                         0.52<missingMomentumOfEventCMS_theta<2.8 and \
                         1<missingMass2OfEvent<49 and isbha!=1',
                    path=main)
```

```
StoreObjPtr<ParticleList> vpholist("vpho:sig");
int Nsig = vpholist -> getListSize(true);
B2INFO("Number of signal: " << Nsig);
if (Nsig > 0) {
  accepted_signal = true;
  accepted_bg = false;
} else {
  accepted_signal = false;
  accepted_bg = true;
}
```



Update plan for release-07

5. Data/MC consistency — OPEN — Christopher Hearty

Check Xuyang Gao's presentation on $e^+e^- \to \gamma\mu^+\mu^-$

Preliminary result with $e^+e^- \to 2(\pi^+\pi^-\pi^0)$; Need further study.

	base	hie	c4	lml1	lml10
N_data	**3552**	3523	3264	2424	768
eff_data	-	(99.2+-0.2)%	(91.9+-0.5)%	(68.2+-0.8)%	(21.6+-0.7)
N_MC	**16592**	16460	16395	7892	3901
eff_MC	-	99.2%	98.9%	47.6%	23.5%

	base(CDC/ECL trigger)	hie||c4||lml1||lml10	fff||fyo||cdcklm2
N_data	**3744/3784**	3732	3512
eff_data	-	99.9%	98.1%
N_MC	**16592**	16482	16138
eff_MC	-	99.3%	97.3%

Update plan for release-07

6.	Automatic check of GT		OPEN	Giacomo De Pietro

A tool is designed:
https://gitlab.desy.de/giacomo.depietro/print_trigger/-/blob/main/print_trigger.py

Update plan for release-07

7. Documentation of TSIM for release-07 OPEN

Update documentation of TRG:
https://agira.desy.de/browse/BII-9086
https://agira.desy.de/browse/BII-9036

23. TRG

This package contains code relevant for the Level 1 (L1) trigger.

23.1. Trigger and TSIM

TSIM (Trigger SIMulation) is a simulation of the L1 trigger system at Belle II, which is based on several combinations of FPGA based electric circuits. TSIM simulates the firmware logic on the FPGA with C++ source code. By default, TSIM is performed event by event ("fast simulation" mode), and clock by clock behavior is not perfectly simulated ("full simulation" mode).

23.1.1. Trigger Bits

Trigger bits are pre-defined selection criteria implemented in the trigger system. Thus only 1 (fired) or 0 (not fired) could be assigned to each trigger bit. Details of the trigger bit definitions could be found on the dedicated Confluence page or the dedicated Belle II notes.

Analysis variables

Trigger

Here is a list of trigger variables:

L1FTDL(*name*)

[Eventbased] Returns the FTDL (Final Trigger Decision Logic, before prescale) status (1 or 0) of the output trigger bit with the given name. Output bits are the outputs of GDL, combining different input trigger bits for final decision. For example, `ty_0/1/2/3` is one of the input trigger bits meaning the number of neuro 3D tracks is one/two/three/more than three. While `yyy` is one of the output trigger bits meaning `(ty_2 or ty_3) and !veto`. Please check on the dedicated Confluence page or or the dedicated Belle II notes to find out the definition of trigger bits.

L1FTDLBit(*i*)

[Eventbased] Returns the FTDL (Final Trigger Decision Logic, before prescale) status (1 or 0) of i-th trigger bit.

Warning

It is recommended to use this variable only for debugging and to use `L1FTDL` with the explicit trigger bit name for physics analyses or performance studies.

https://software.belle2.org/development/sphinx/

Further plan

1. Documentation
   - Request from analysts?
2. Validation
   - A simple script for trigger validation in different versions
   - Focus on main physics bits?
   - TRG bit menu check
3. Comment in source code
   - Lots of comments are needed in the algorithm. People may not understand the details once main author is left.
4. Algorithm consistent with coding conventions
   - https://agira.desy.de/browse/BII-9016

Thanks