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## Outline

- \* Analysis purpose
- \* Summary of previous studies
- \* Current analysis strategy
- \* Results on
  - B+B-\_generic sample
  - B0B0bar\_generic samples
- \* Conclusions



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## Bkg characterization and next production

- \* need a high statistic sample for physics (Eextra shape in generic MC) and DG purposed
- \* generating enough generic samples: too time- and resource- consuming
- \* need to find "smart" samples which affect the physics results as little as possible

• F	BaBar	(sig+reco)	efficier	ncies for	$B \rightarrow K^{*}$	* <sup>0</sup> VV	cut and	l count	analys	is:

Table 14: Cu	Table 14: Cumulative efficiencies $(\times 10^{-4})$ for $K^{*0} \rightarrow K\pi$ decay mode.						
	signal MC	$B^+B^-$	$B^0\overline{B}^0$	cē	uds	$\tau^+\tau^-$	data
R <sub>2</sub>	3.1834	0.0036	0.0150	0.0060	0.0019	0	0.0043
$\cos \theta_{\text{thrust}}$	2.8091	0.0027	0.0126	0.0016	0.0006	0	0.0025
$m_K$ - GeV/ $c^2$	2.6026	0.0021	0.0104	0.0013	0.0005	0	0.0021
$\cos \theta^*_{miss}$	2.5416	0.0018	0.0086	0.0009	0.0003	0	0.0017
$E_{miss}^* + p_{miss}^* > 4.5 \text{ GeV}$	2.24868	0.00020	0.00154	0.00003	0	0	0.00019
E <sub>extra</sub> GeV	1.73731	0.00006	0.00081	0.00002	0	0	0.00010

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## Summary of previous studies (I)

- According to Matteo's suggestion:
  - "A) study of the bkg composition when the tag side (SL or HAD) is selected, independently on the signal selected in the other side."
  - "B) study of the bkg composition when a specific signal is reconstructed."

- mc truth variable implemented in PacHadRecoilUser: YTagB\_mc\_decayMode
  - look at the MC decay tree and count the number of K, pi, Ks, pi0
  - check the compatibility with one of the >1100 Breco modes
  - assign YTagB\_mc\_decayMode=XXXYY (XXX=D dec mode, YY=B dec mode)

(no infos on modes not included in the Breco mode list)



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## Summary of previous studies (II) purity cut (from 50% to 80%) changes bkg composition:

pur >	reco modes	max trk muliplicity	$\max \pi 0$ multiplicity
50%	194	9	3
80%	17	7	2

- $\rightarrow$  (1) may cut on purity help? Probably not, too "clean" sample
- not matched events: at Breco selection stage, most of the contamination \* comes from hadronic modes (50% in the breco mode list – 50% other breco modes)

 $\rightarrow$  (2) may a hadronic cocktail be suitable? Try to answer today

- applied few cuts on the signal selection list
  - not matched Breco are in the breco list or other had modes
  - $\rightarrow$  need to study their multiplicity
  - $\rightarrow$  (3) may "B generic vs low muliplicity B modes" be suitable? Need further investigation (apply signal side selection)

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### Current Analysis strategy (I)

\* Sample used: February production ntuples, BBbar generic with bkg mixing, DG4 configuration

B+B- generics	5,200,000 evts
B0B0bar_generics	6,230,000 evts

- \* Characterize background applying a selection on Breco properties
  - purity>50%
  - $5.27 \le mES \le 5.288 \text{ GeV/c}^2$
  - $-0.09 \le \Delta E \le 0.05 \text{ GeV}$
- \* Identify true Breco:
  - loop over reconstructed Breco daus, identify a track (K $^{\pm}$  or p $^{\pm}$ ) and look for its true B ancestor
  - loop over reconstructed D daus ( $B \rightarrow D$  or  $B \rightarrow D^* \rightarrow D$ ), identify a track ( $K^{\pm}$  or  $p^{\pm}$ ) and look for its true B ancestor
  - if the two tracks come from the same true B, choose it as true Btag and analyze the event

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## Current Analysis strategy (II)

Classify the true B mode according to the following categories

- SemiLeptonic Dlnu
- Semileptonic non-Dlnu
- Hadronic
- \* NB: only non Self Cross Feed events are analyzed (the B dau and D dau tracks are associated to the same true B)

	SCF evts (fraction)	non SCF evts (fractions)
B+B- generics	6,374 (18.8%)	27,562 (81.2%)
B0B0bar_generics	8,759 (27.6%)	22,952 (72.4%)

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## B+B-\_generic sample : SL modes

#### \* SemiLeptonic Dlnu Decays

	fraction	BF (as in DECAY.DEC)
DXev	0.95%	10.9%
DXμν	1.60%	10.9%
ΟΧτν	1.27%	2.8%
DXlv	2.68%	24.6%

#### \* SemiLeptonic non-Dlnu Decays

	fraction	BF (as in DECAY.DEC)
Xev	0.015%	0.19%
Χμν	0.010%	0.19%
Χτν	0%	-
Xlv	0.025%	0.39%

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# B+B-generic sample: Had modes (I)

- 227 modes with at least 5 events

- in the table: only modes corresponding to a fraction > 0.5%

2Daus modes (45 modes)	fraction	BF (as in DECAY.DEC)
B+> anti-D0 pi+	21.34%	0.50%
B+> anti-D0 rho+	11.90%	1.34%
B+> anti-D*0 pi+	11.58%	0.46%
B+> anti-D*0 rho+	9.89%	0.98%
B+> a_1+ anti-D*0	6.98%	1.60%
B+> a_1+ anti-D0	1.79%	0.89%
B+> D_s+ anti-D0	1.69%	1.29%
B+> D_s*+ anti-D*0	1.41%	2.78%
B+> D_s+ anti-D*0	1.32%	1.24%
B+> D_s*+ anti-D0	0.83%	1.11%
B+> anti-D0 K+	0.62%	0.04%
B+> anti-D*0 K+	0.60%	0.04%

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## B+B-\_generic sample: Had modes (II)

3Daus modes (85 modes)	fraction	BF (as in DECAY.DEC)
B+> anti-D0 rho+ pi0	0.72%	not in the DECAY.DEC
B+> anti-D0 omega pi+	0.64%	not in the DECAY.DEC
4Daus modes (55 modes)		
B+> D*- pi+ pi+ pi0	2.21%	1.50%

- \* higher multiplicity modes (fraction < 0.5%)
  - 29 5Daus modes
  - 10 6Daus modes
  - 27Daus modes

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## B+B-\_generic : summary

	fraction	BF (as in DECAY.DEC)
SL Dlnu	2.68%	24.6%
SL non-Dlnu	0.03%	0.39%
Had (single mode fraction>0.5%)	73.48%	13.77% (2 modes not in DECAY.DEC)
(All Had modes	97.29%	)

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## B0B0bar\_generic sample : SL modes

#### \* SemiLeptonic-Dlnu Decays

	fraction	BF (as in DECAY.DEC)
DXev	1.00%	10.1%
DXμν	1.94%	10.1%
DXτν	0.22%	3.0%
DXlv	3.16%	23.2%

\* NO SemiLeptonic non-Dlnu Decays

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# B0B0bar\_generic sample: Had modes (I) Hadronic Decays

- 271 modes with at least 5 events
- in the table: only modes corresponding to a fraction > 0.5%

2Daus modes (48 modes)	fraction	BF (as in DECAY.DEC)
B0> a_1+ D*-	12.23%	1.20%
B0> D*- rho+	9.23%	0.68%
B0> D*- pi+	8.74%	0.28%
B0> D- pi+	8.05%	0.28%
B0> $D_s^* + D^*$ -	5.37%	0.24%
B0> D_s+ D*-	4.38%	1.26%
B0> D- rho+	1.58%	0.77%
B0> D_s+ D-	1.06%	0.90%
B0> D_s1+ D*-	0.68%	0.98%
B0> a_1+ D-	0.64%	0.83%
B0> D*- K+	0.64%	0.017%
B0> D_1- pi+	0.59%	0.06%
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## B0B0bar\_generic sample: Had modes (II)

3Daus modes (98 modes)	fraction	BF (as in DECAY.DEC)
B0> D*- omega pi+	3.10%	not in the DECAY.DEC
B0> D*- eta pi+	1.25%	not in the DECAY.DEC
B0> D*- pi+ pi0	1.09%	0.08%
B0> D*0 D*- K+	1.00%	1.00%
B0> D*- rho+ rho0	0.74%	not in the DECAY.DEC
<b>B</b> 0> <b>D</b> *- <b>K</b> + anti- <b>K</b> *0	0.68%	0.01%
B0> D*- pi+ rho0	0.66%	not in the DECAY.DEC
B0> D*- K+ anti-K0	0.63%	not in the DECAY.DEC
B0> D- omega pi+	0.53%	not in the DECAY.DEC

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## B0B0bar\_generic sample: Had modes (III)

4Daus modes (74 modes)	fraction	BF (as in DECAY.DEC)
B0> D*- rho+ pi+ pi-	1.16%	not in the DECAY.DEC
B0> D*- pi+ rho0 pi0	0.91%	not in the DECAY.DEC
B0> D*- rho- pi+ pi+	0.58%	not in the DECAY.DEC
<b>B</b> 0> <b>D</b> *- omega pi+ pi0	0.52%	not in the DECAY.DEC

\* higher multiplicity modes (fraction < 0.5%)

- 36 5Daus modes
- 16 6Daus modes
- 3 7Daus modes

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## B0B0bar\_generic : summary

	fraction	BF (as in DECAY.DEC)
SL-Dln	3.16%	23.2%
SL-nonDln	-	-
Had (single mode fraction>0.5%)	66.04%	7.70% (10 modes not in DECAY.DEC)
(All Had modes	96.84%	)

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## What's in the BaBar Breco cocktails

ProdDecayFiles/B0B0bar\_Breco\_DX+DstarX\_cocktail.dec

ProdDecayFiles/B+B-\_Breco\_Dpi+Dstarpi\_cocktail.dec

Decay MyBO
0.123 MyD*-pi+ SVS;
0.303 rho+ MyD*- SVV_HELAMP;
0.285 MyD*- Mya_1+ SVV_HELAMP
0.063 MyD- pi+ PHSP;
0.164 rho+ MyD- SVS;
0.062 Mya_1+ MyD- SVS;
Enddecay
#
Decay Myanti-BO
0.123 MyD*+pi- SVS;
0.303 rho- MyD*;
0.285 MyD*+ Mya_1;
0.063 MyD+ pi- PHSP;
0.164 rho-MyD+ SVS;
0.062 Mya_1-MyD+ SVS;
Enddecay
corresponding fraction in B+Bgeneric

Decay MyB+ 0.535 Myanti-DO pi+ PHSP; Myanti-D\*0 pi+ SVS; 0.465 Enddecay # Decay MyB-0.535 MyD0 pi-PHSP; 0.465 MyD\*0 pi-SVS; Enddecay corresponding fraction in B+B-\_generic (p9) = 32.92% (BF=0.96%) 17

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(p13) = 40.47% (BF=4.19%)

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## Conclusions and outlook (I)

- <sup>\*</sup> Performed MC truth studies to identify a class of decays which survive the Breco selection and may be representative of the whole sample
- \* At Breco selection stage
  - fraction of SL modes negligible, Had modes contribute up to the 97%
  - considering modes whose contribution is higher than 0.5%, two lists of charged and neutral **B** decays have been identified
- \* B+B-\_cocktail (p 9-10):
  - 73.48% of total selected events
  - BF = 13.77% (2 modes not in DECAY.DEC)
  - 15 modes
- \* B0B0bar\_cocktail (p 13-14-15):
  - 66.04% of selected events
  - BF = 7.70% (10 modes not in DECAY.DEC)
  - 25 modes

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## Conclusions and outlook (II)

- BaBar cocktails probably are not enough and will need to add more modes
- \* Next steps

- finalize study on the Breco side and implement the code to generate the cocktail which allows to perform Breco properties (DG studies)
- apply Bsig selection (Bbbar generic without bkg mixing) and found a dedicated set of modes to study signal and event properties (Eextra + other DG studies)

(Thanks to Alejandro for providing the code)



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## To do list

#### \* DGWG related items

- further investigation on bkg characterization
- PID studies comparing DG\_3/DG\_4 and loose/tight kaon PID

#### \* code related items

- fix duplicate Breco bug
- understand some FastSim/FullSim disagreement
- refine and commit validation code
- wiki documentation (I've easily started writing it)