Run 2 MC FullSim Validation

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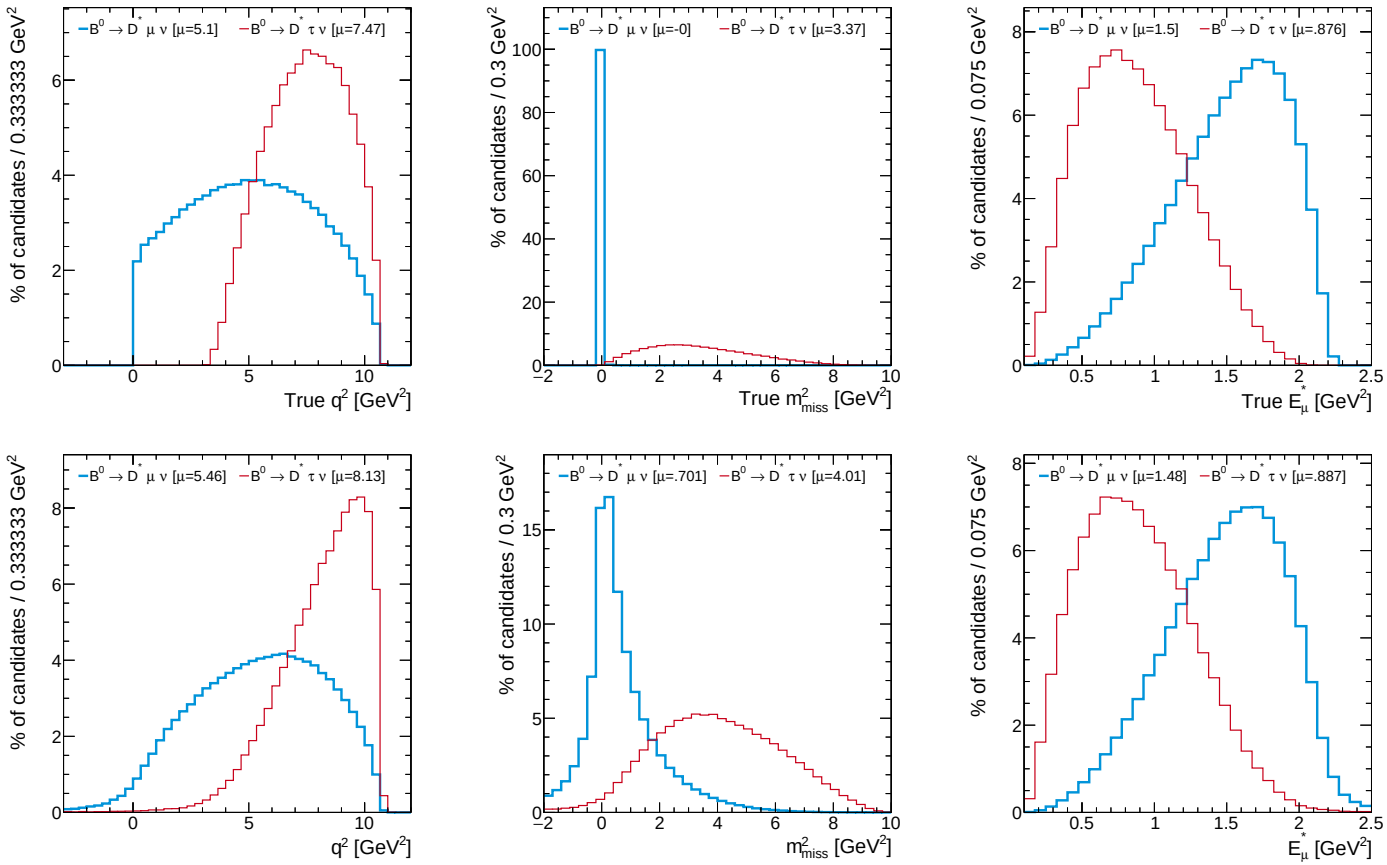
Cuts/Selection

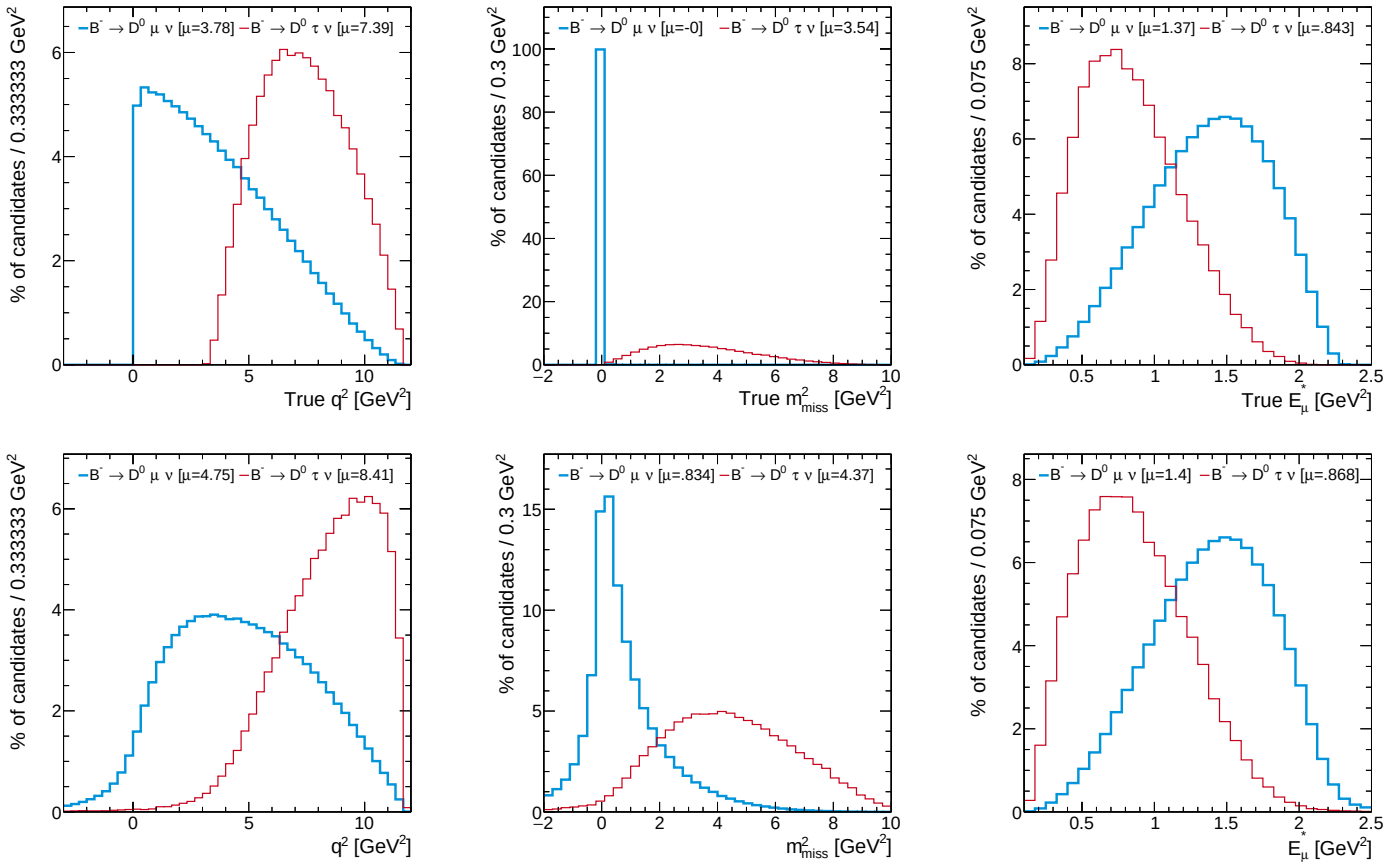
- Filtering- see "Run 2 proposed" on slide 3 here
- HLT2- Hlt2XcMuXForTauB2XcMu, see slide 5 of same presentation
- Stripping line 28r2 b2D0MuXB2DMuForTauMuLine not applied, but all cuts except PID are applied in reco script (again, see slide 5 of same presentation)
- Additional cuts from reco script: see third column of table in slide 10 in this (other) presentation
    - Notably: upstream slow pions are cut
- Multiple Candidates kept
- *Some* truth matching done, as well as other cuts Phoebe uses in redoHistos_Dst.C (variables from AddB.C) and redoHistos_D0.C (variables from AddD0B_temp.C)) to select individual decays. Individual slides contain more info.
    - Overall cuts for TupleB0: D^{*+} bkgcat=0 (or =50 and D^0 bkgcat=50), D^{*+} mom or gdmom or gdgdmom=B^0, μ trueID=μ
    - Overall cuts for TupleBminus: $|m_{D^0} - < m_{D^0} > | < 23.4$MeV, μ trueID=μ
    - Efficiency of these truth matching selections will be manually noted on each slide

$B^0 \to D^{*+}(\mu/\tau)\bar{\nu}$: q^2, m^2_{miss}, E^*_μ



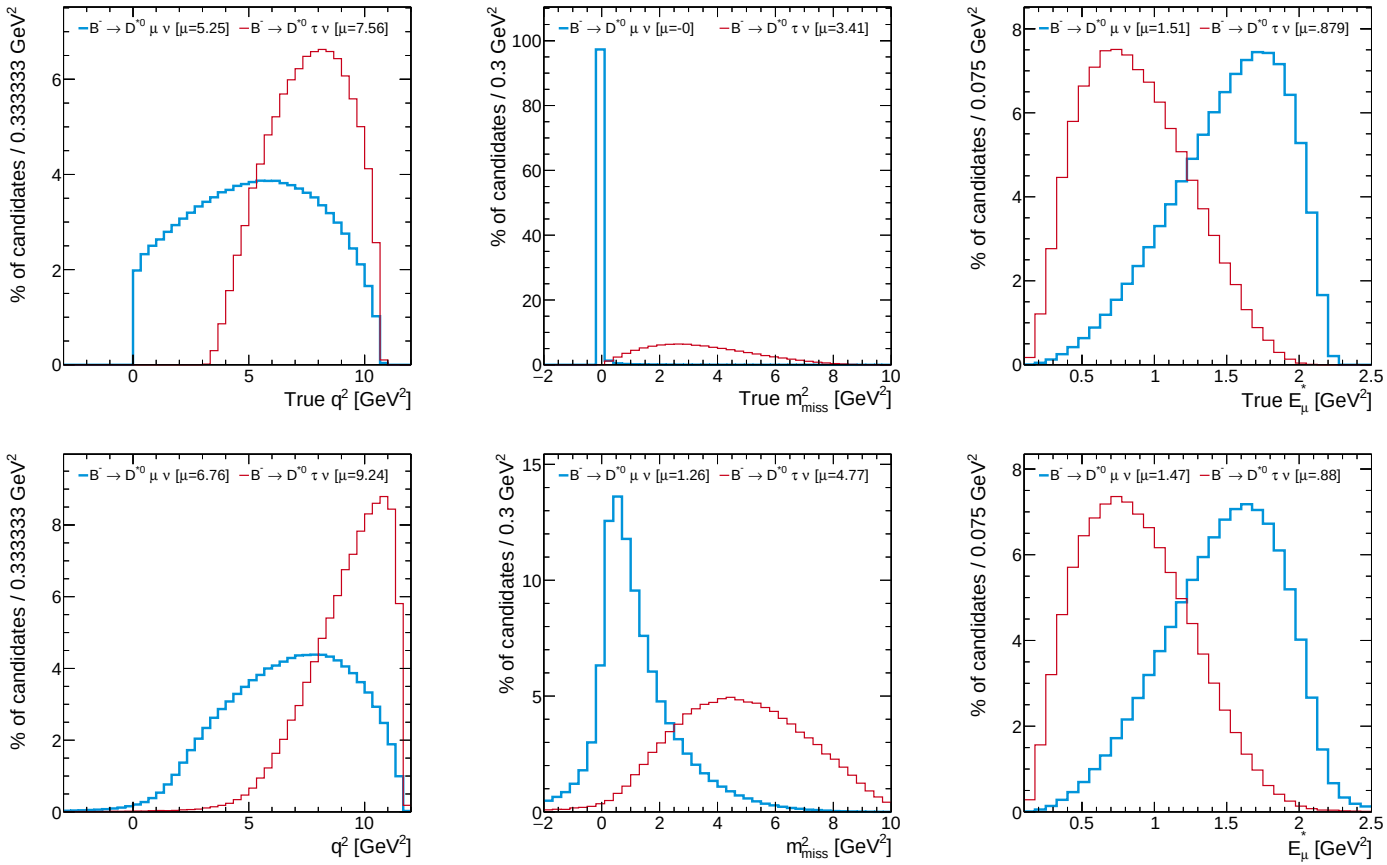
- Normalization Selection: μ mom=B^0, D^{*+} mom=B^0, B^0 bkgcat=0. Truth matching selection efficiency: 0.912
- Signal Selection: μ mom=τ, μ gdmom=B^0, D^{*+} mom=B^0. Truth matching selection efficiency: 0.971
- $q^2 = (p_B - p_{D*})^2$, $m^2_{miss} = (p_B - p_{D*} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^- \to D^0(\mu/\tau)\bar{\nu}$: q^2, m^2_{miss}, E^*_μ



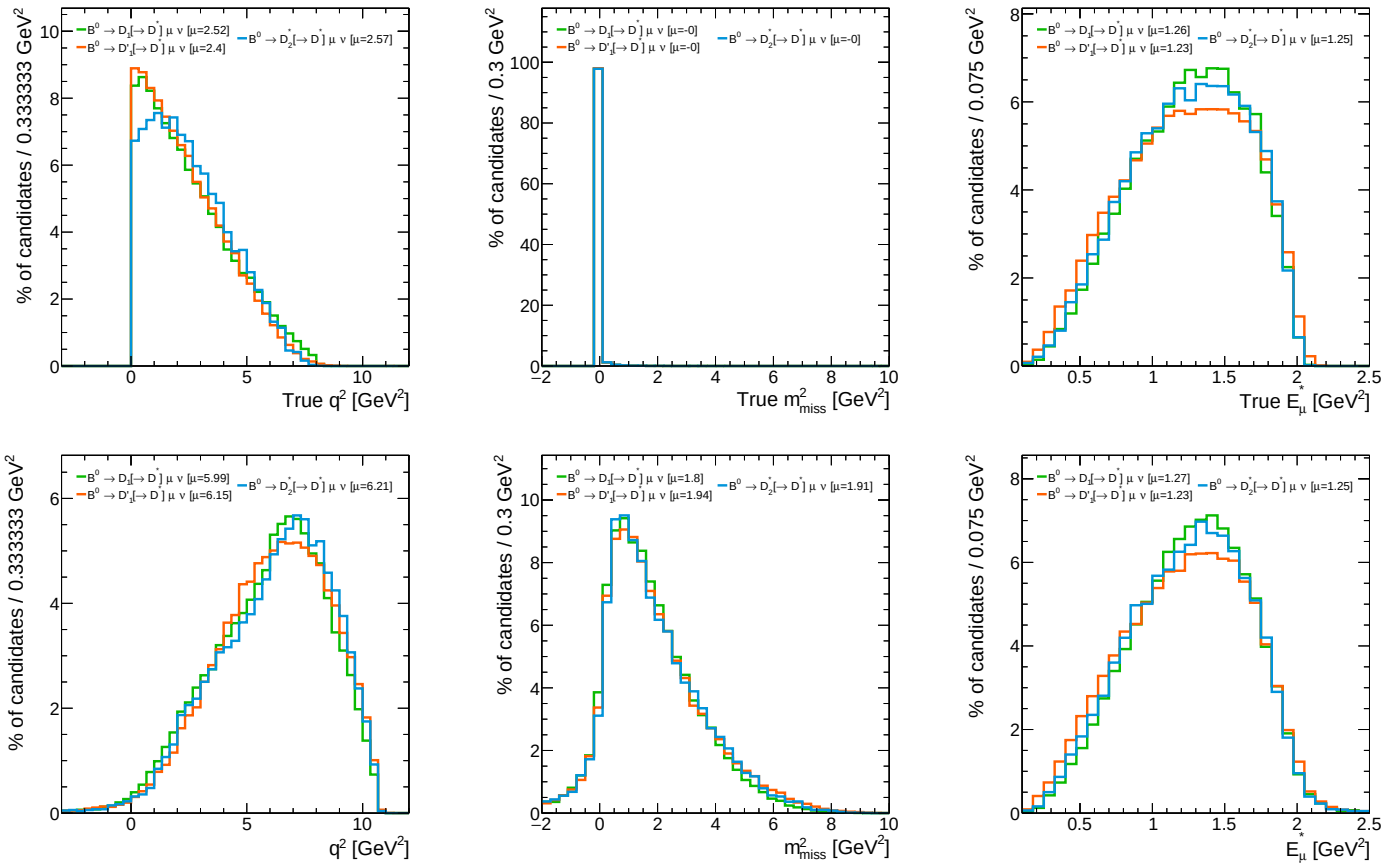
- Normalization Selection: μ mom=B^-, D^0 mom=B^-, B^- bkgcat=0. Truth matching selection efficiency: 0.892
- Signal Selection: μ mom=τ, μ gdmom=B^-, D^0 mom=B^-, B^- bkgcat=10. Truth matching selection efficiency: 0.908
- $q^2 = (p_B - p_{D^0})^2$, $m^2_{miss} = (p_B - p_{D^0} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D^{*0}(\mu/\tau)\bar{\nu}$: q^2, m^2_{miss}, E^*_μ



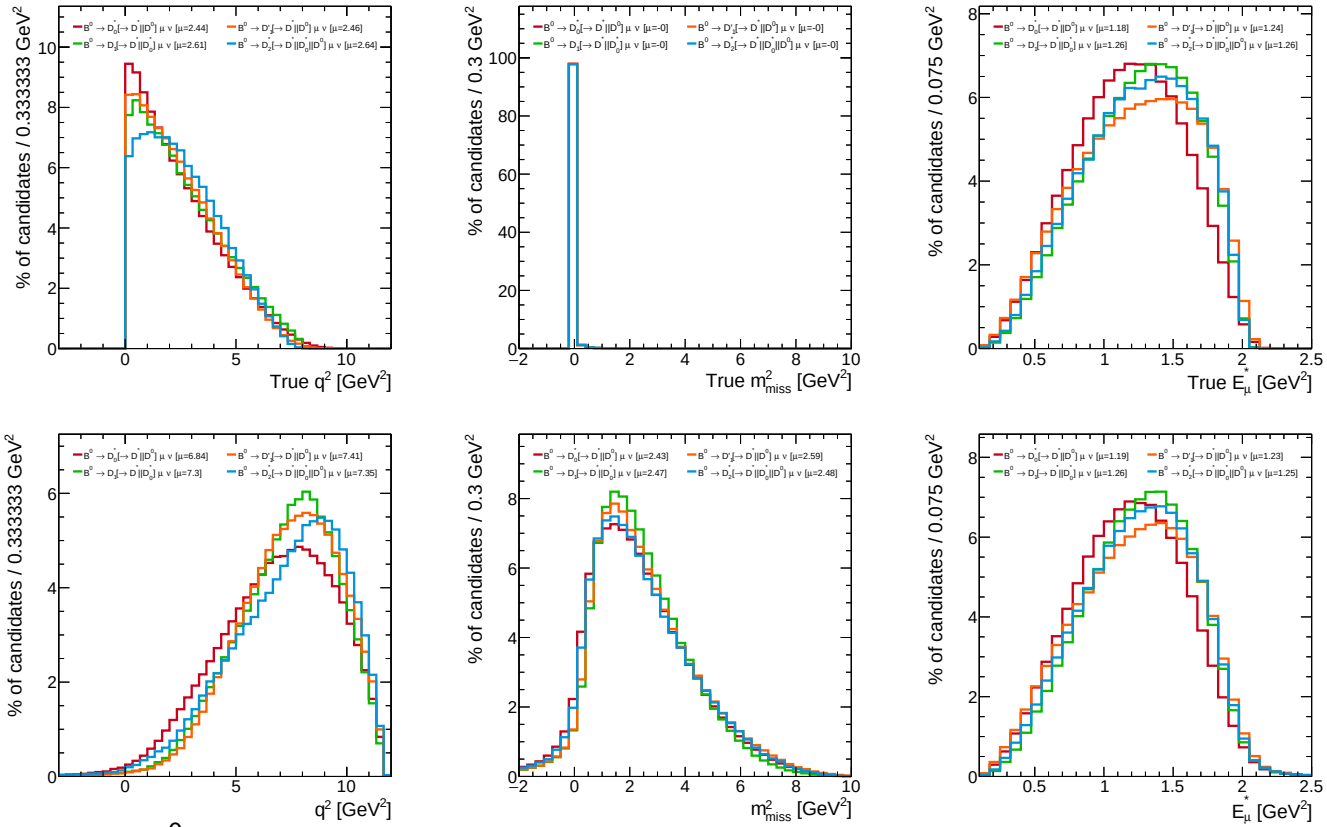
- Normalization Selection: μ mom=B^-, D^0 gdmom=B^-, D^0 mom=D^{*0}. Truth matching selection efficiency: 0.939
- Signal Selection: μ mom=τ, μ gdmom=B^-, D^0 gdmom=B^-, D^0 mom=D^{*0}. Truth matching selection efficiency: 0.940
- $q^2 = (p_B - p_{D^{*0}})^2$, $m^2_{miss} = (p_B - p_{D^{*0}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D^{**+}\mu\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



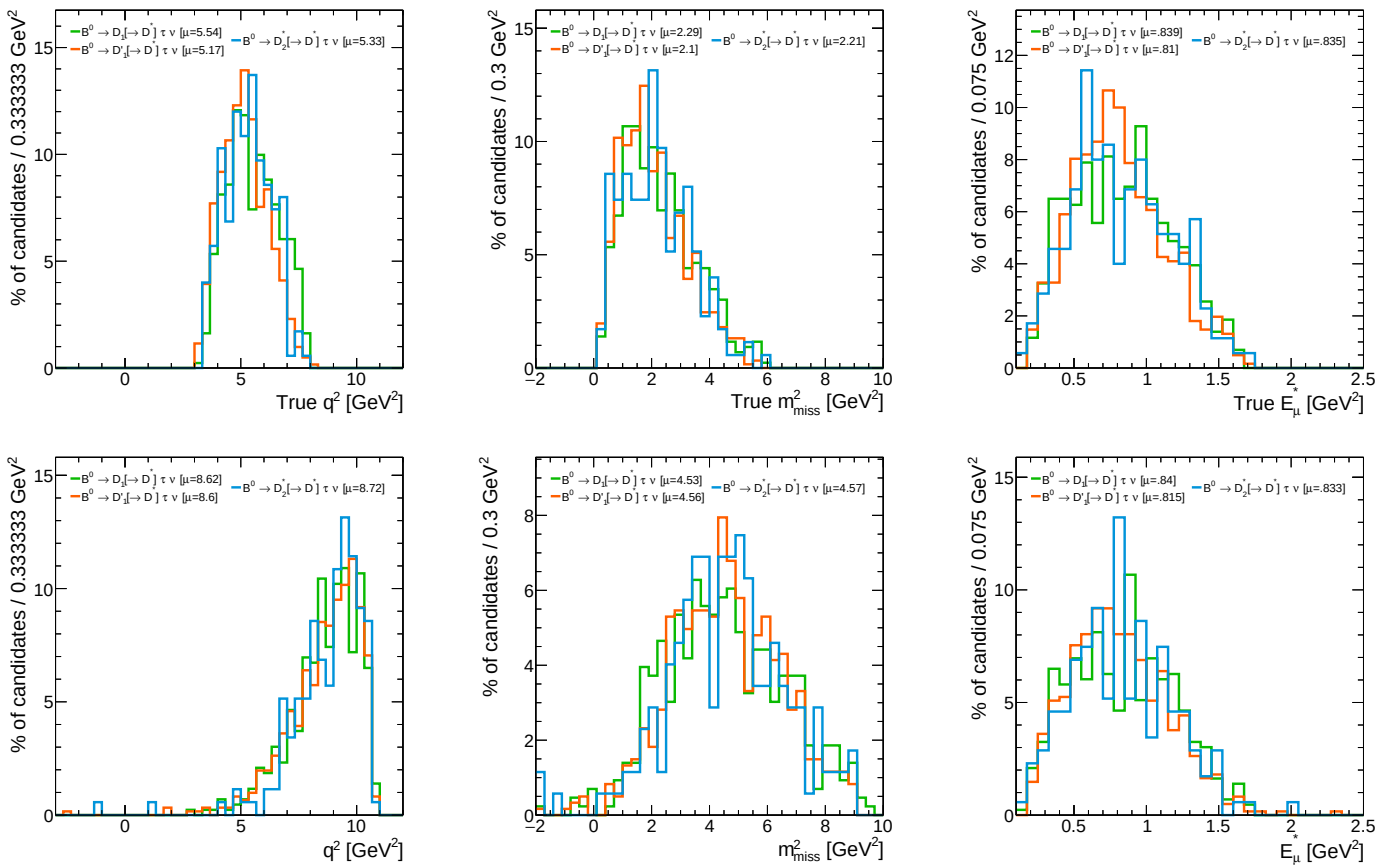
- Selections: μ mom=B^0, $\sqrt{(p_{D^{**}} - p_{D^*})^2} < 250$MeV
- D^{**} Selections: D^{*+} mom=D_1^+, gdmom=B^0, D^{*+} mom=$D_1^{'+}$, gdmom=B^0, D^{*+} mom=D_2^{*+}, gdmom=B^0
- Truth-matching selection efficiency (sum of 3 components vs no truth matching selections): 0.749
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^0 \to D^{**+}\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



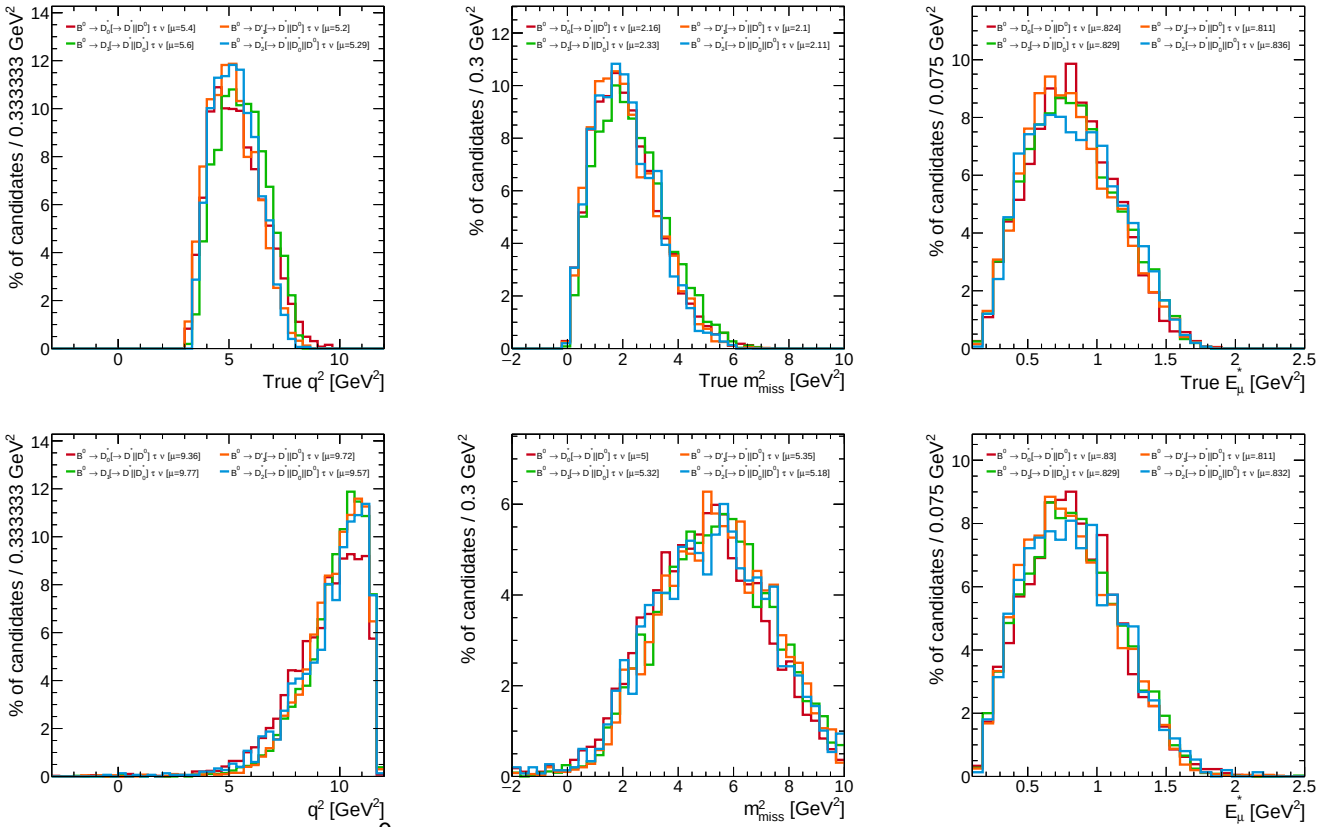
- Selections: μ mom=B^0
- D^{**} Selections: require D^0 truth ancestry be $B^0 \to D_0^{*+} \to D^0$ or $B^0 \to D_0^{*+} \to X \to D^0$, $B^0 \to D_1^{+} \to X \to D^0$ or $B^0 \to D_1^{+} \to X \to X \to D^0$, $B^0 \to D_1^{\prime +} \to D^0$ or $B^0 \to D_1^{\prime +} \to X \to D^0$, $B^0 \to D_2^{*+} \to D^0$ or $B^0 \to D_2^{*+} \to X \to D^0$ or $B^0 \to D_2^{*+} \to X \to X \to D^0$
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.939
- $q^2 = (p_B - p_{D**})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D**} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D^{**+}\tau\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



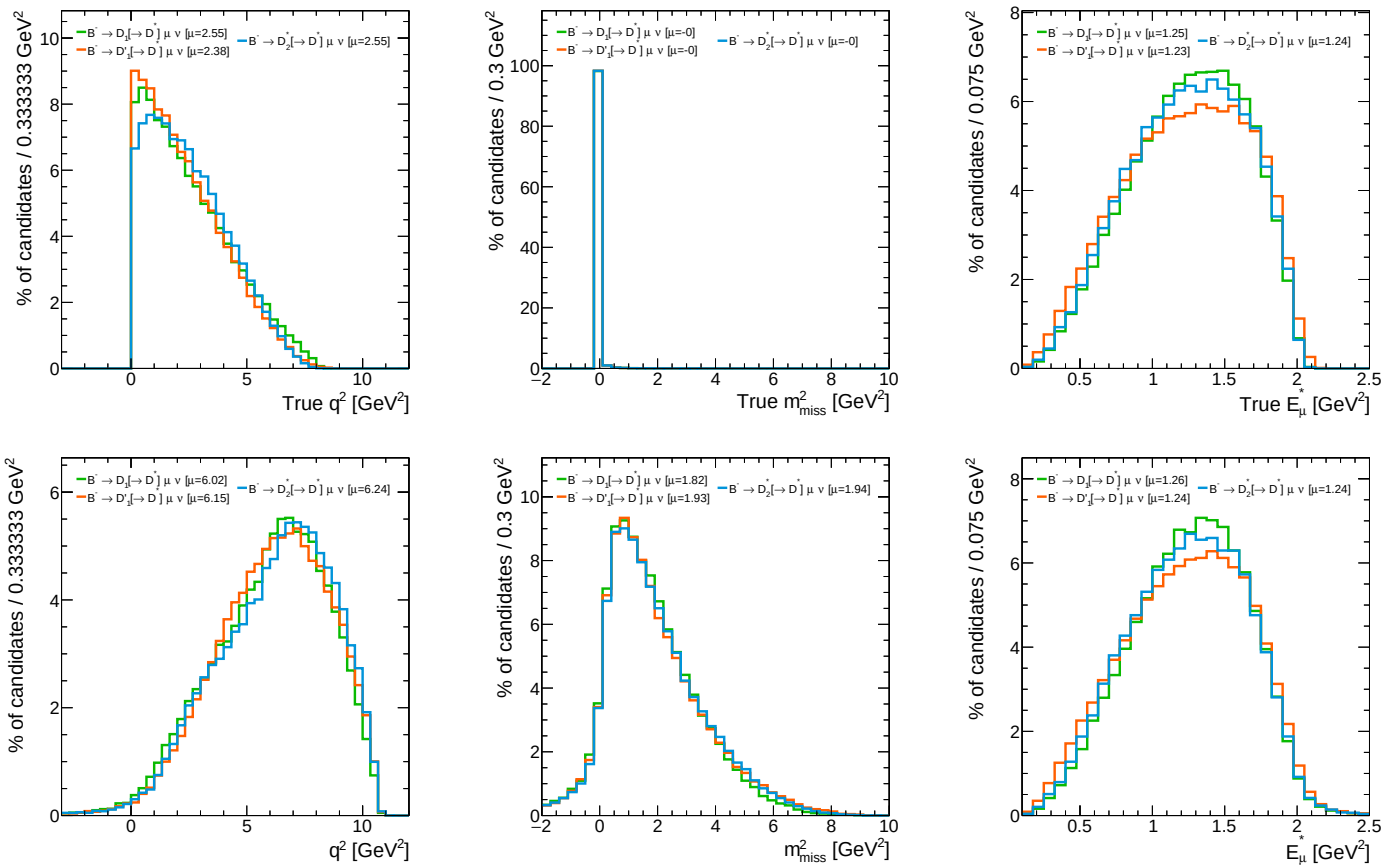
- Selections: μ mom=τ, μ gdmom=B^0, $\sqrt{(p_{D^{**}} - p_{D^*})^2} < 250\text{MeV}$
- D^{**} Selections: D^{*+} mom=D_1^+, gdmom=B^0, D^{*+} mom=$D_1^{'+}$, gdmom=B^0, D^{*+} mom=D_2^{*+}, gdmom=B^0
- Truth-matching selection efficiency (sum of 3 components vs no truth matching selections): 0.731
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^0 \to D^{**+}\tau\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



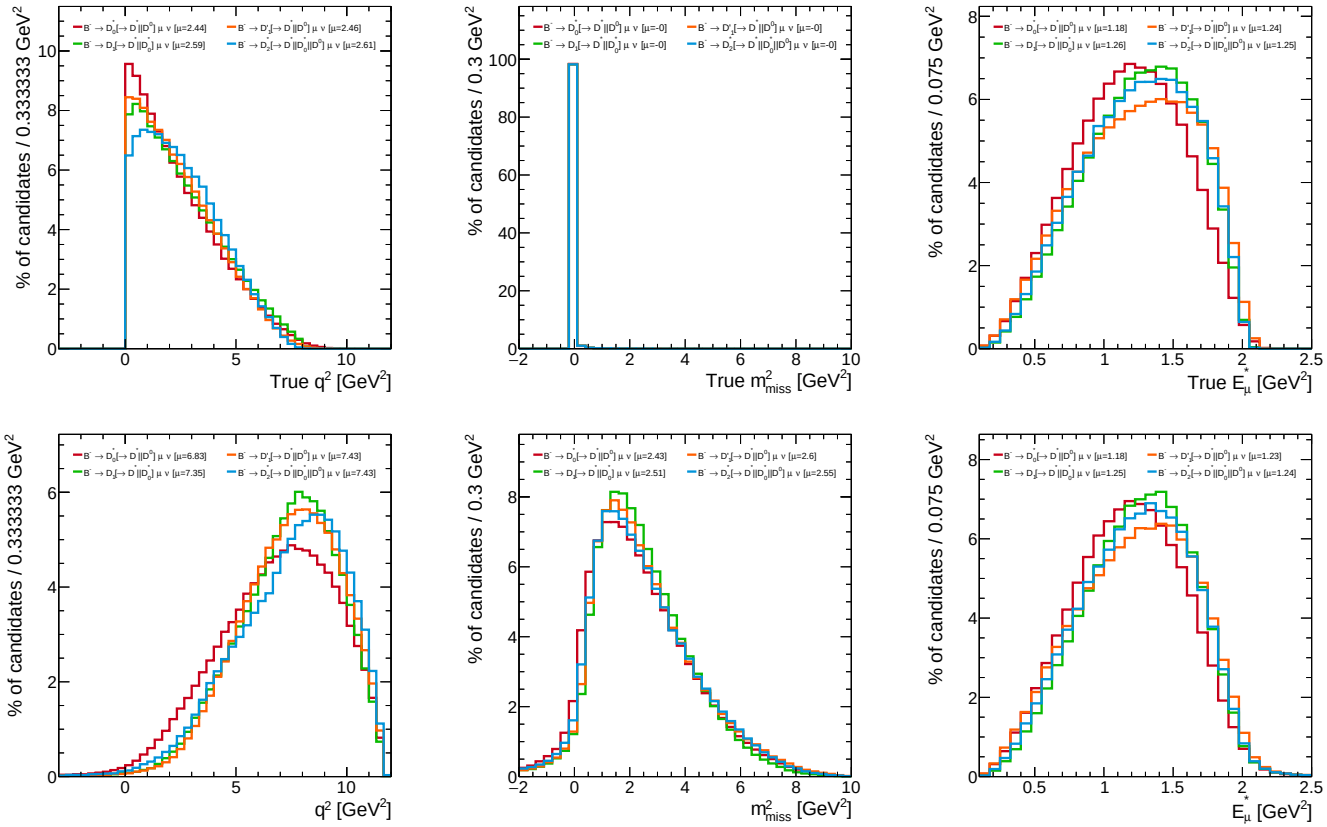
- Selections: μ mom=τ, μ gdmom=B^0
- D^{**} Selections: require D^0 truth ancestry be $B^0 \to D_0^{*+} \to D^0$ or $B^0 \to D_0^{*+} \to X \to D^0$, $B^0 \to D_1^{+} \to X \to D^0$ or $B^0 \to D_1^{+} \to X \to X \to D^0$, $B^0 \to D_1^{'+} \to D^0$ or $B^0 \to D_1^{'+} \to X \to D^0$, $B^0 \to D_2^{*+} \to D^0$ or $B^0 \to D_2^{*+} \to X \to D^0$ or $B^0 \to D_2^{*+} \to X \to X \to D^0$
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.943
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D^{**0}\mu\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



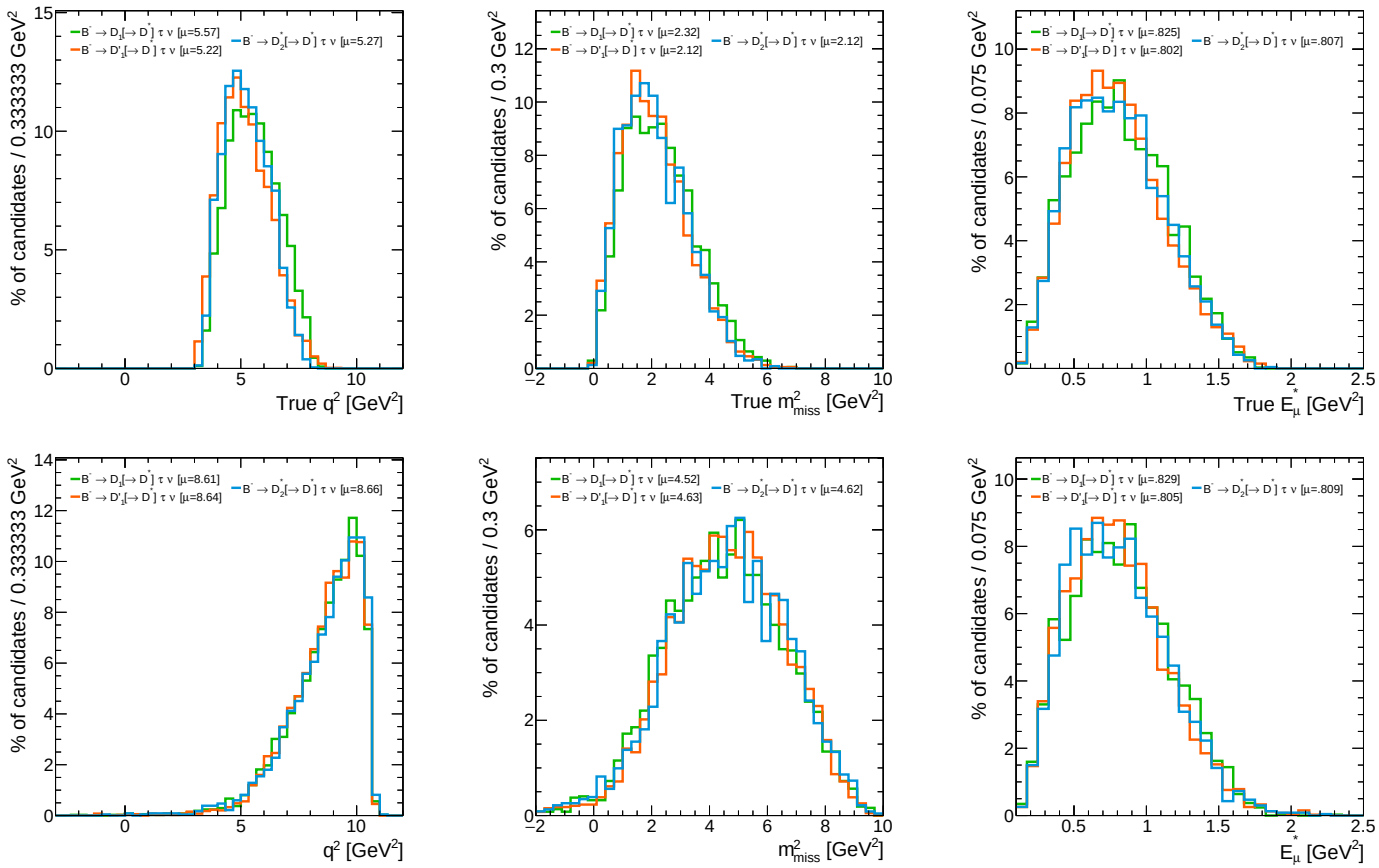
- Selections: μ mom=B^-, $\sqrt{(p_{D^{**}} - p_{D^*})^2} < 250$MeV
- D^{**} Selections: D^{*+} mom=D_1^0, gdmom=B^-, D^{*+} mom=$D_1^{'0}$, gdmom=B^-, D^{*+} mom=D_2^{*0}, gdmom=B^-
- Truth-matching selection efficiency (sum of 3 components vs no truth matching selections): 0.862
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^- \to D^{**0}\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



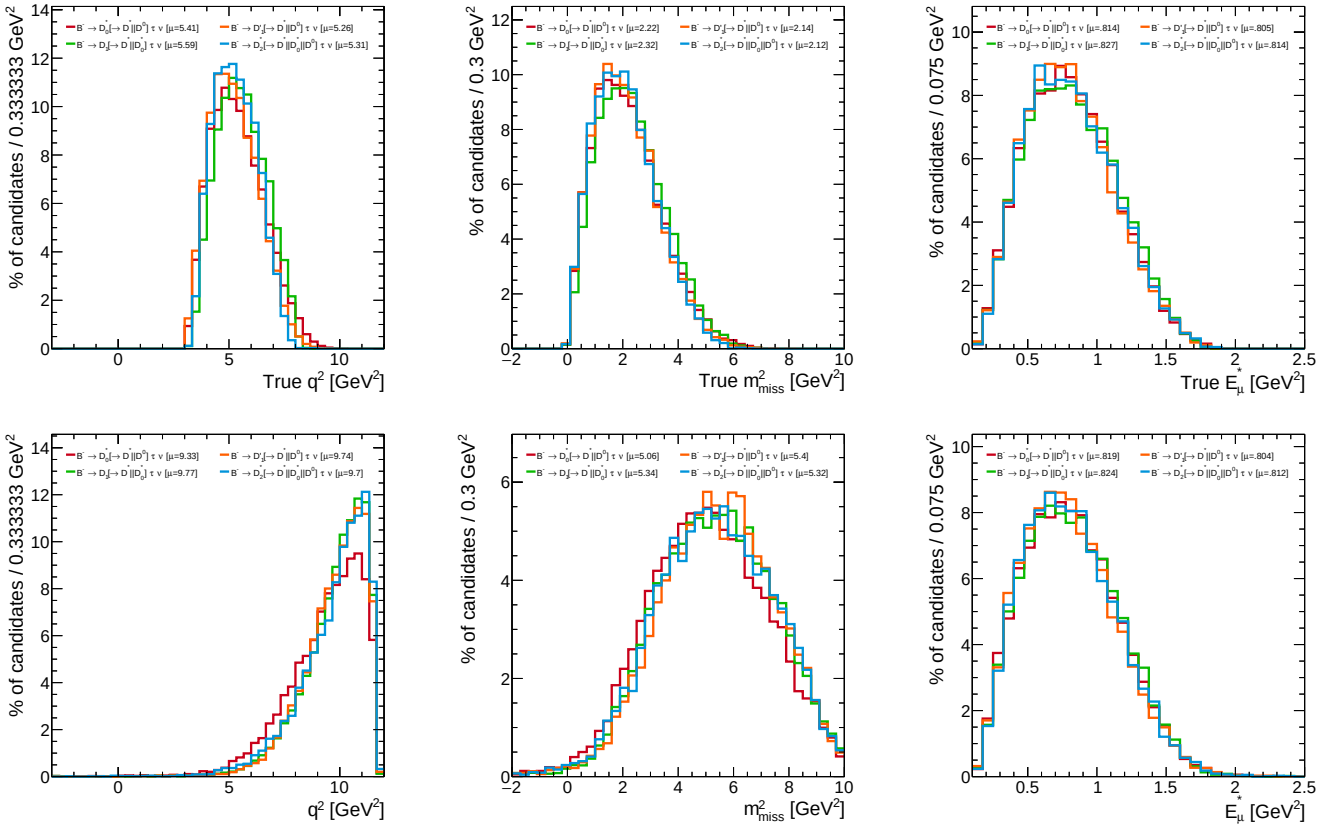
- Selections: μ mom=B^-
- D^{**} Selections: require D^0 truth ancestry be $B^- \to D_0^{*0} \to D^0$ or $B^- \to D_0^{*0} \to X \to D^0$, $B^- \to D_1^0 \to X \to D^0$ or $B^- \to D_1^0 \to X \to X \to D^0$, $B^- \to D_1^{'0} \to D^0$ or $B^- \to D_1^{'0} \to X \to D^0$, $B^- \to D_2^{*0} \to D^0$ or $B^- \to D_2^{*0} \to X \to D^0$ or $B^- \to D_2^{*0} \to X \to X \to D^0$
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.936
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D^{**0}\tau\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



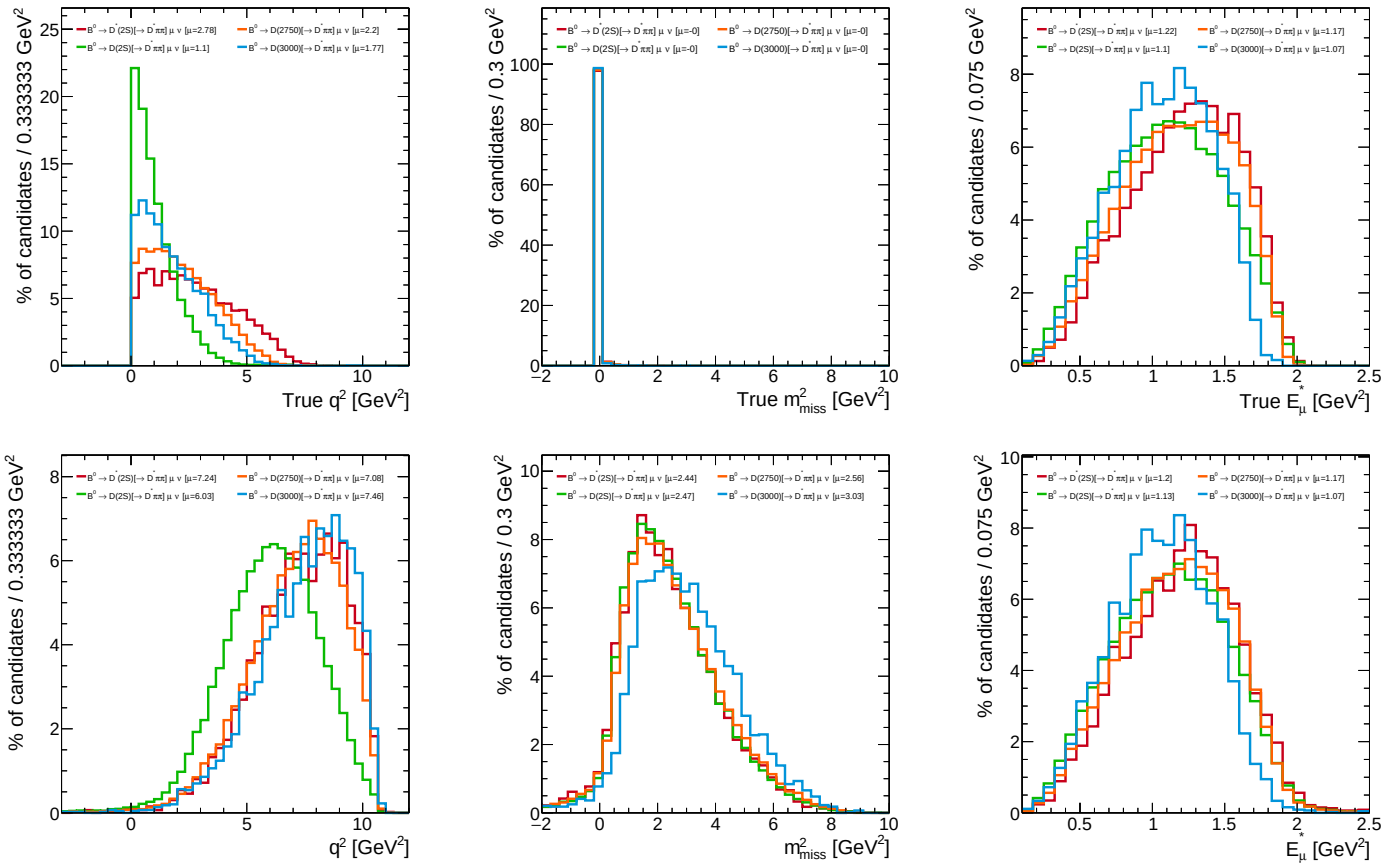
- Selections: μ mom=τ, μ gdmom=B^-, $\sqrt{(p_{D^{**}} - p_{D^*})^2} < 250$MeV
- D^{**} Selections: D^{*+} mom=D_1^0, gdmom=B^-, D^{*+} mom=$D_1^{'0}$, gdmom=B^-, D^{*+} mom=D_2^{*0}, gdmom=B^-
- Truth-matching selection efficiency (sum of 3 components vs no truth matching selections): 0.855
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^- \to D^{**0}\tau\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



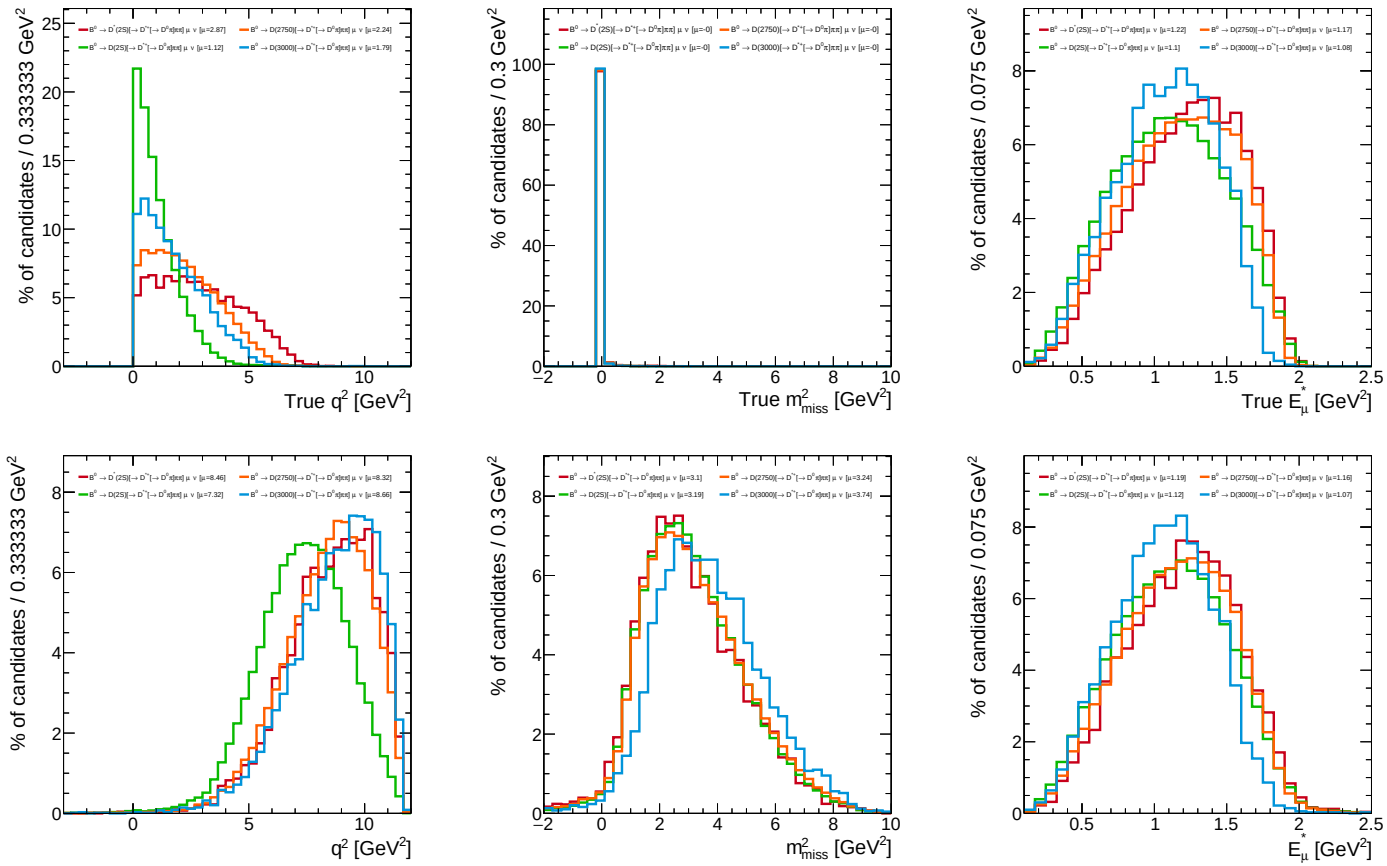
- Selections: μ mom=τ, μ gdmom=B^-
- D^{**} Selections: require D^0 truth ancestry be $B^- \to D_0^{*0} \to D^0$ or $B^- \to D_0^{*0} \to X \to D^0$, $B^- \to D_1^0 \to X \to D^0$ or $B^- \to D_1^0 \to X \to X \to D^0$, $B^- \to D_1^{'0} \to D^0$ or $B^- \to D_1^{'0} \to X \to D^0$, $B^- \to D_2^{*0} \to D^0$ or $B^- \to D_2^{*0} \to X \to D^0$ or $B^- \to D_2^{*0} \to X \to X \to D^0$
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.940
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D_H^{**+}[\to D^{*+}\pi\pi]\mu\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



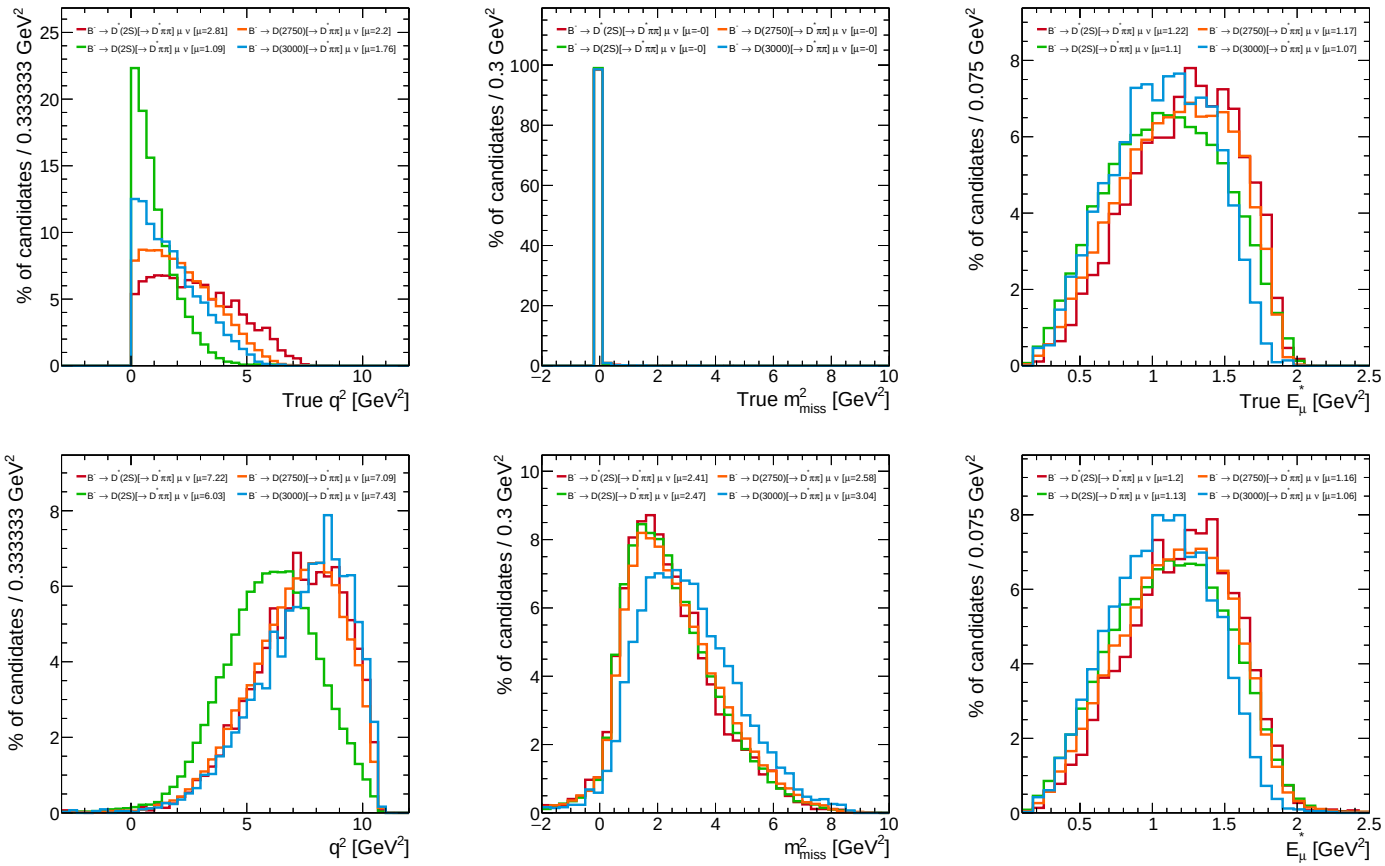
- Selections: μ mom=B^0, D^{*+} gdmom=B^0
- D^{**} Selections (My Own, Phoebe Combined Components): D^{*+} mom=$D^*(2S)$, $D(2S)$, $D(2750)$, $D(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.938
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^0 \to D_H^{**+}[\to D^{*+}[\to D^0\pi]\pi\pi]\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



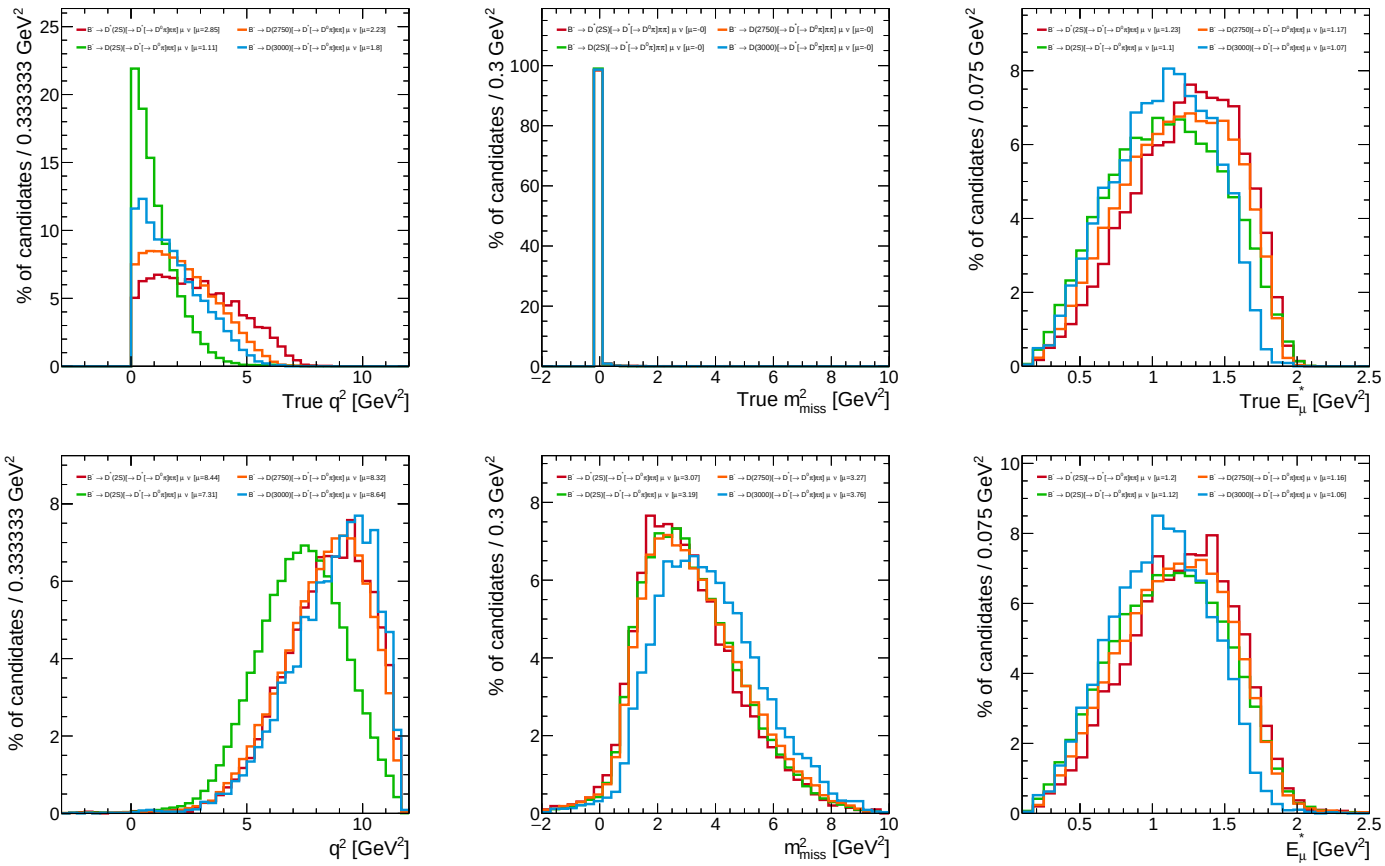
- Selections: μ mom=B^0, D^0 mom=D^{*+}, D^0 gdgdmom=B^0
- D^{**} Selections (My Own, Phoebe Combined Components): D^0 gdmom=$D^*(2S)$, $D(2S)$, $D(2750)$, $D(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.937
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D_H^{**0}[\to D^{*+}\pi\pi]\mu\bar{\nu}$, D^* Sample: q^2, m^2_{miss}, E^*_μ



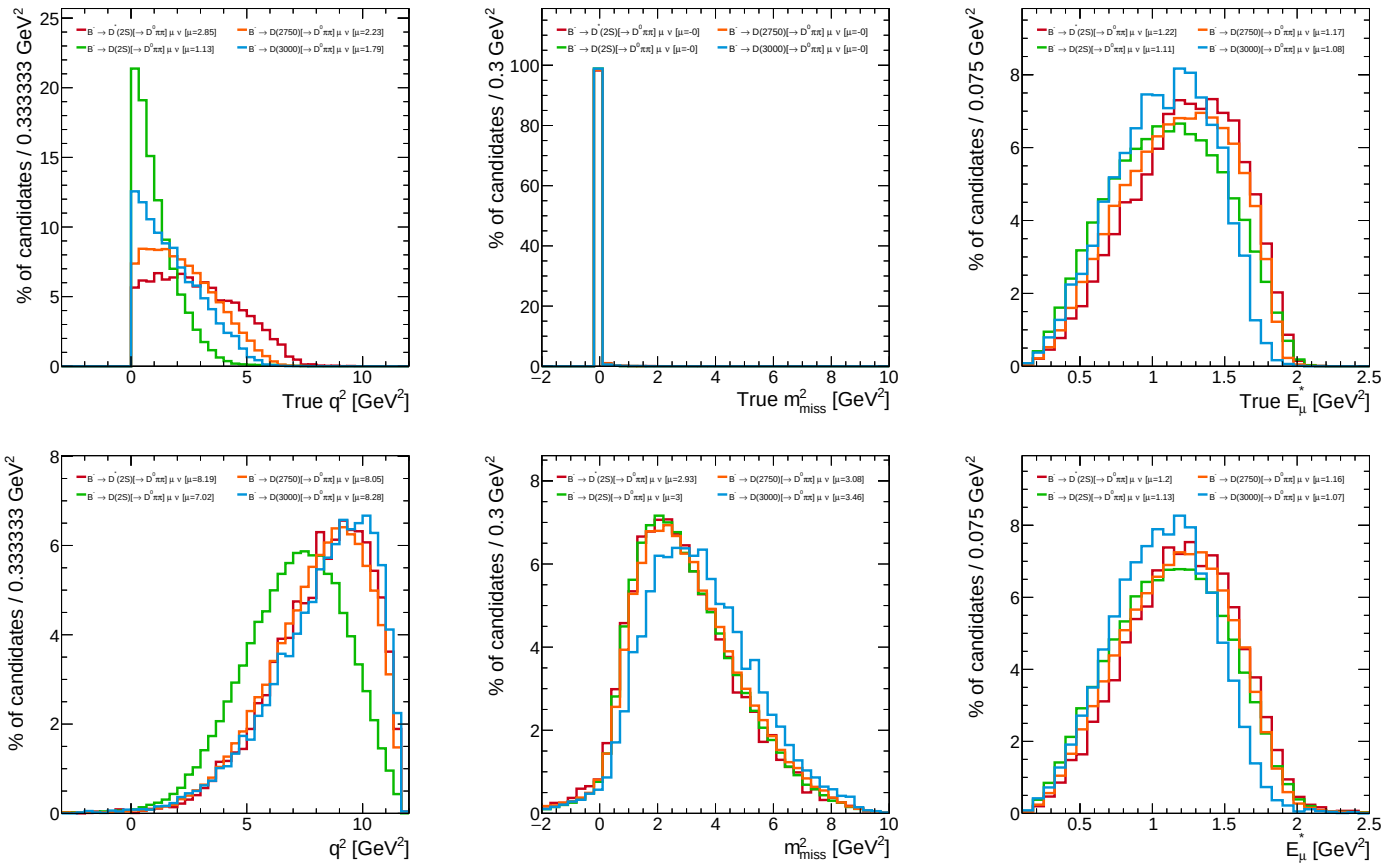
- Selections: μ mom=B^-, D^{*+} gdmom=B^-
- D^{**} Selections (My Own, Phoebe Combined Components): D^{*+} mom=$D^{*0}(2S)$, $D^0(2S)$, $D^0(2750)$, $D^0(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.961
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

$B^- \to D_H^{**0}[\to D^{*+}[\to D^0\pi]\pi\pi]\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



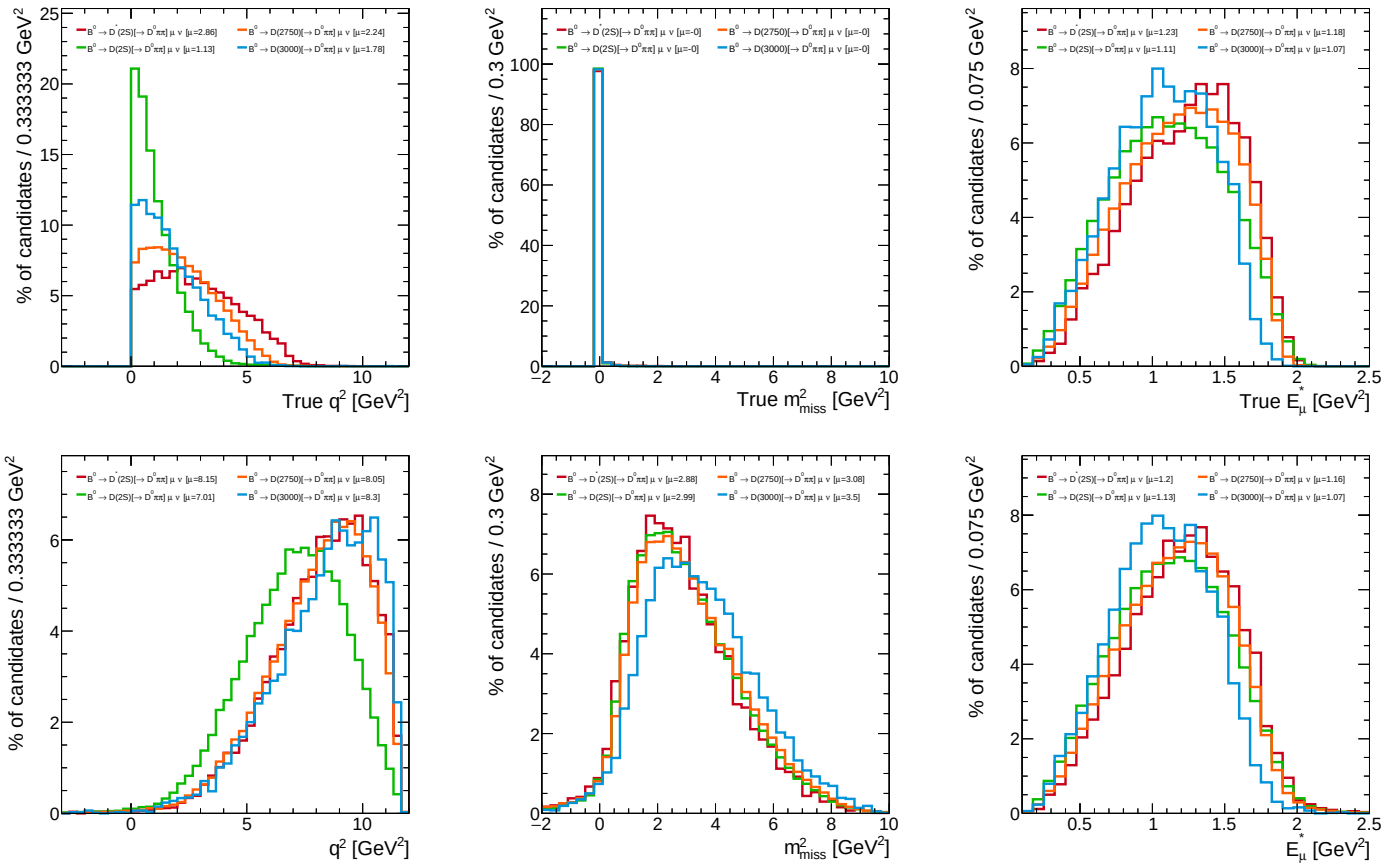
- Selections: μ mom=B^-, D^0 mom=D^{*+}, D^0 gdgdmom=B^-
- D^{**} Selections (My Own, Phoebe Combined Components): D^0 gdmom=$D^{*0}(2S)$, $D^0(2S)$, $D^0(2750)$, $D^0(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.936
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D_H^{**0}[\to D^0\pi\pi]\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



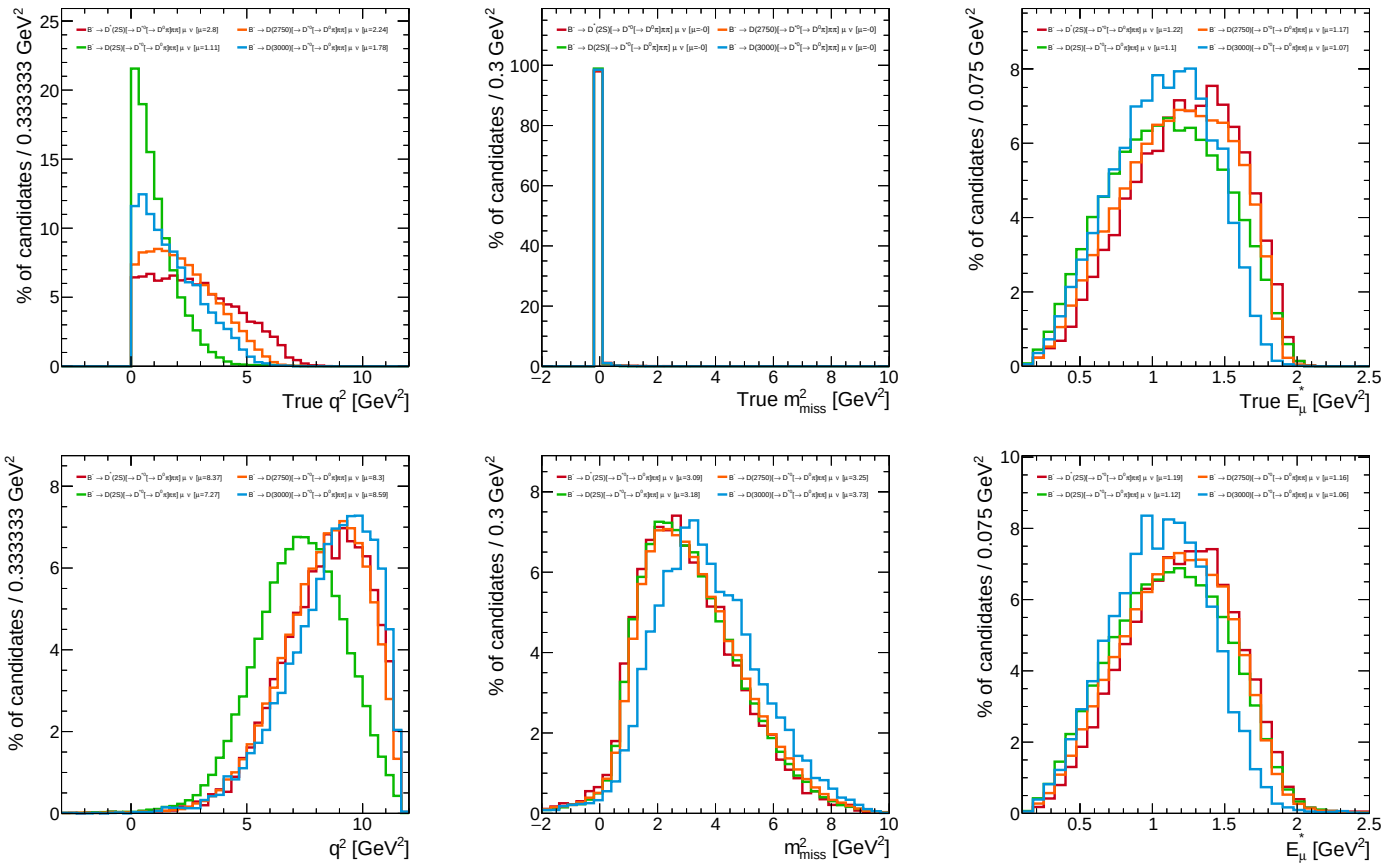
- Selections: μ mom=B^-, D^0 gdmom=B^-
- D^{**} Selections (My Own, Phoebe Combined Components): D^0 mom=$D^{*0}(2S)$, $D^0(2S)$, $D^0(2750)$, $D^0(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.933
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D_H^{**+}[\to D^0\pi\pi]\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



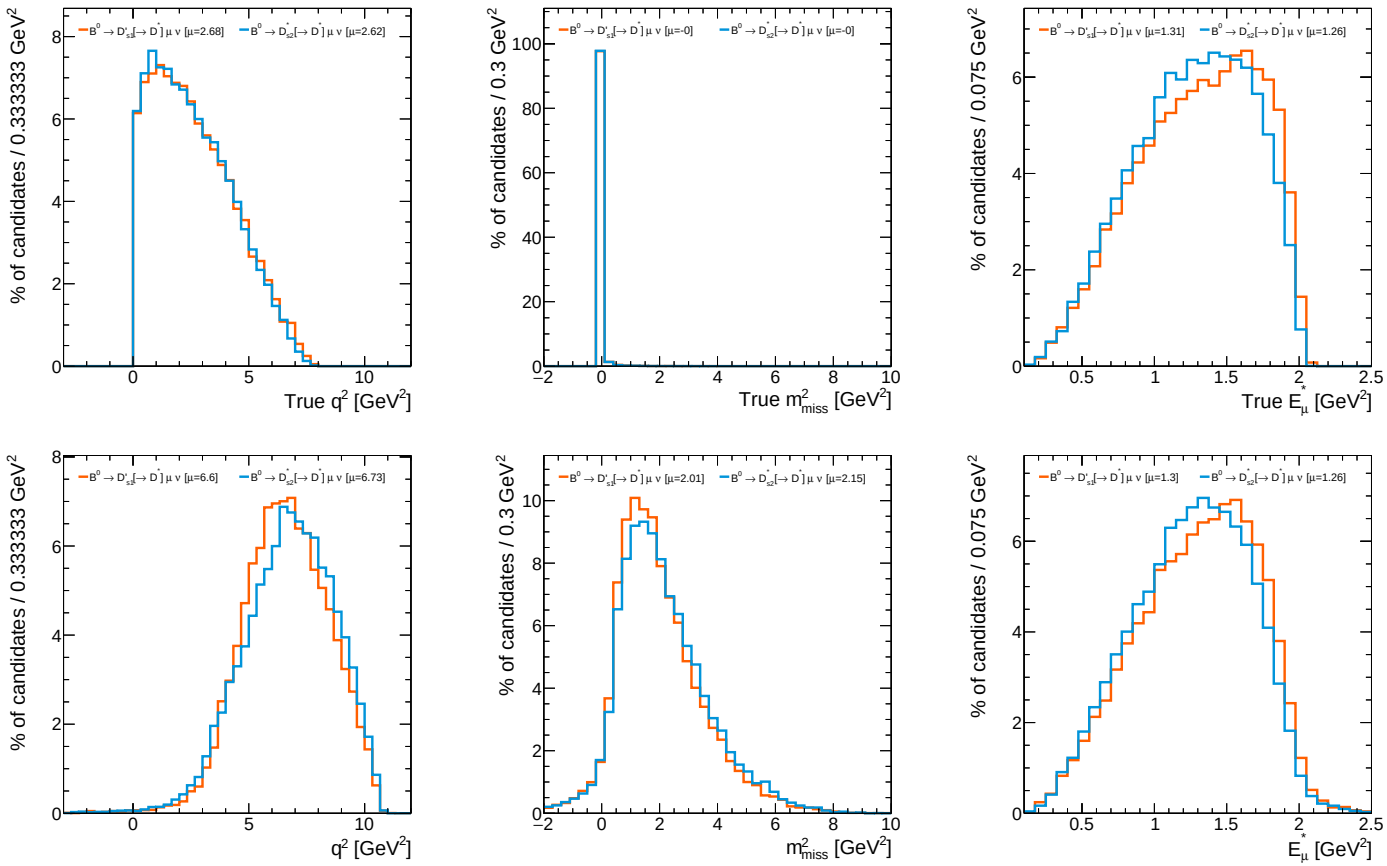
- Selections: μ mom=B^0, D^0 gdmom=B^0
- D^{**} Selections (My Own, Phoebe Combined Components): D^0 mom=$D^*(2S)$, $D(2S)$, $D(2750)$, $D(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.940
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^- \to D_H^{**0}[\to D^{*0}[\to D^0\pi]\pi\pi]\mu\bar{\nu}$, D^0 Sample: q^2, m^2_{miss}, E^*_μ



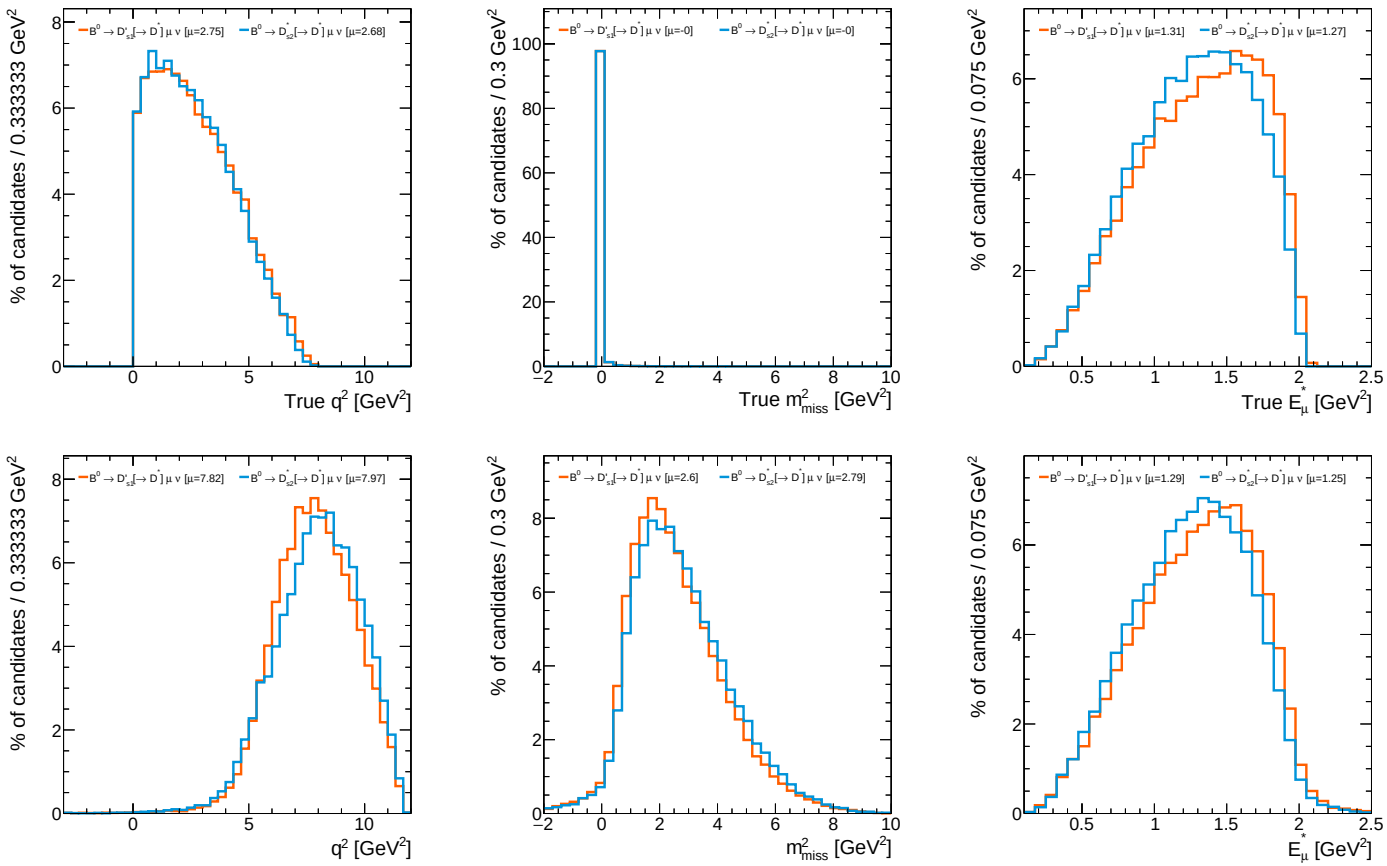
- Selections: μ mom=B^-, D^0 mom=D^{*0}, D^0 gdgdmom=B^-
- D^{**} Selections (My Own, Phoebe Combined Components): D^0 gdmom=$D^{*0}(2S)$, $D^0(2S)$, $D^0(2750)$, $D^0(3000)$ (respectively)
- Truth-matching selection efficiency (sum of 4 components vs no truth matching selections): 0.935
- $q^2 = (p_B - p_{D^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B_s^0 \to D_s^{**+}[\to D^{*+}K^0]\mu\bar{\nu}$, D^* Sample (D'_{s1}, D^*_{s2}): q^2, m^2_{miss}, E^*_μ



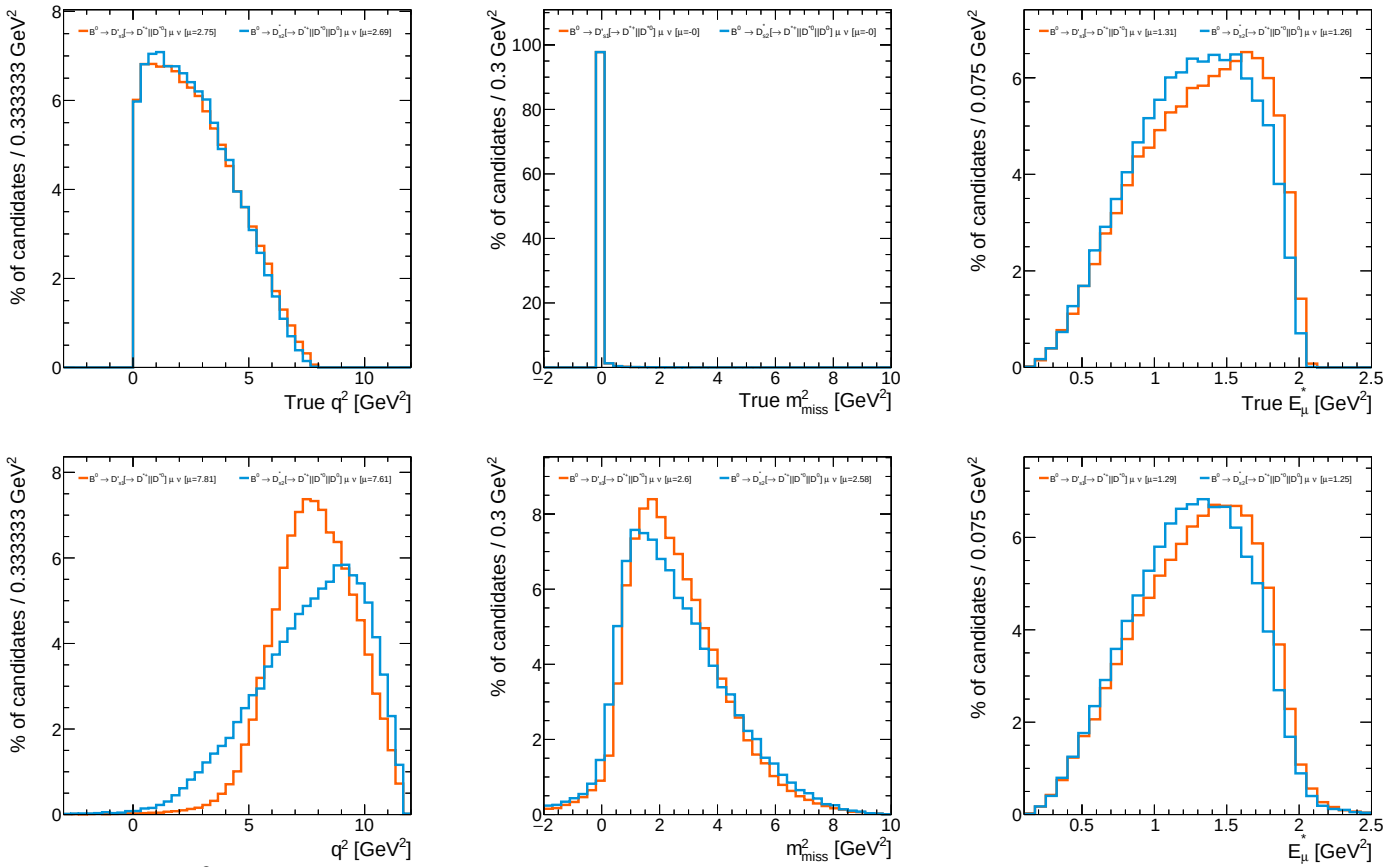
- Selections: μ mom=B_s^0, D^{*+} gdmom=B_s^0
- D_s^{**} Selections: D^{*+} mom =D'_{s1}, D^*_{s2} (for respective component)
- Truth-matching selection efficiency (sum of 2 components vs no truth matching selections): 0.973
- $q^2 = (p_B - p_{D_s^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D_s^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi_s^+]\mu$

$B_s^0 \to D_s^{**+}[\to D^{*+}[\to D^0\pi^+]K^0]\mu\bar{\nu}$, D^0 Sample (D'_{s1}, D^*_{s2}): q^2, m^2_{miss}, E^*_μ



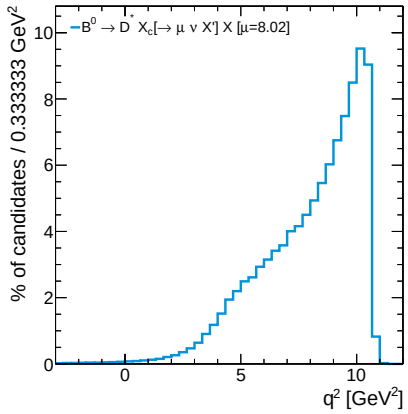
- Selections: μ mom=B_s^0, D^0 gdgdmom=B_s^0
- D_s^{**} Selections: D^0 gdmom=D'_{s1}, D^*_{s2} (for respective component)
- Truth-matching selection efficiency (sum of 2 components vs no truth matching selections): 0.940
- $q^2 = (p_B - p_{D_s^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D_s^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

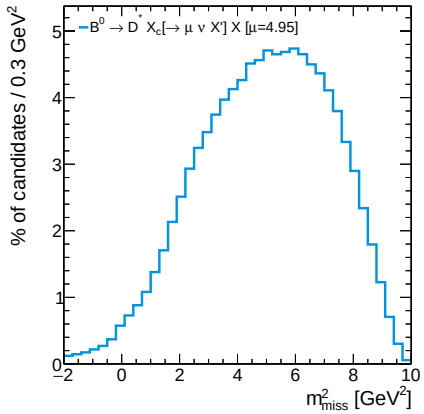
$B_s^0 \to D_s^{**+}[\to (D^{*+,0}, D^0)K]\mu\bar{\nu}$, D^0 Sample (D'_{s1}, D^*_{s2}): q^2, m^2_{miss}, E^*_μ

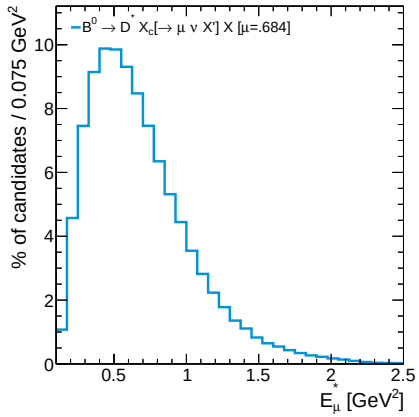


- Selections: μ mom=B_s^0
- D_s^{**} Selections: D^0 gdmom=D'_{s1} and gdgdmom=B_s^0, (D^0 gdmom=D^*_{s2} and gdgdmom=B_s^0) or (D^0 mom=D^*_{s2} and gdmom=B_s^0) (for respective component)
- Truth-matching selection efficiency (sum of 2 components vs no truth matching selections): 0.941
- $q^2 = (p_B - p_{D_s^{**}})^2$, $m^2_{miss} = m^2_{\bar{\nu}} = (p_B - p_{D_s^{**}} - p_\mu)^2$, $E^*_\mu = E_\mu$ boosted to B rest
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D^{*+} X_c[\to \mu \bar{\nu} X']X$: q^2, m^2_{miss}, E^*_μ

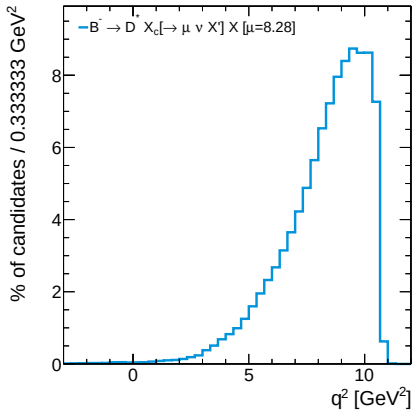


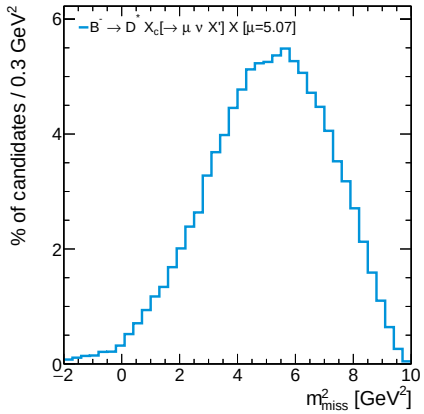


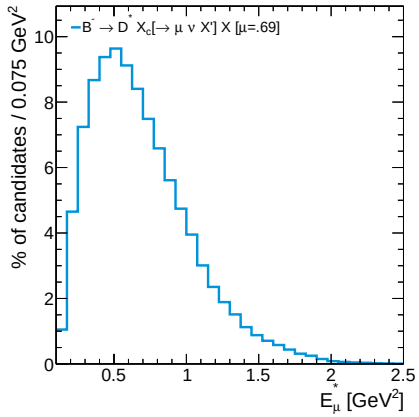


- Selections: D^{*+} mom or gdmom or gdgdmom=B^0, (D^{*+} mom=B^0 and μ gdgdmom=D^+_{s1} or D'^+_{s1}) or (μ mom is D^0 or D^+ or D^0_s), !(μ mom=τ and μ gdmom=D^0_s)
- Truth-matching selection efficiency: 0.954
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^- \pi^+]\pi^+_s]\mu$

$B^+ \to D^{*+} X_c[\to \mu \bar{\nu} X']X$: q^2, m^2_{miss}, E^*_μ

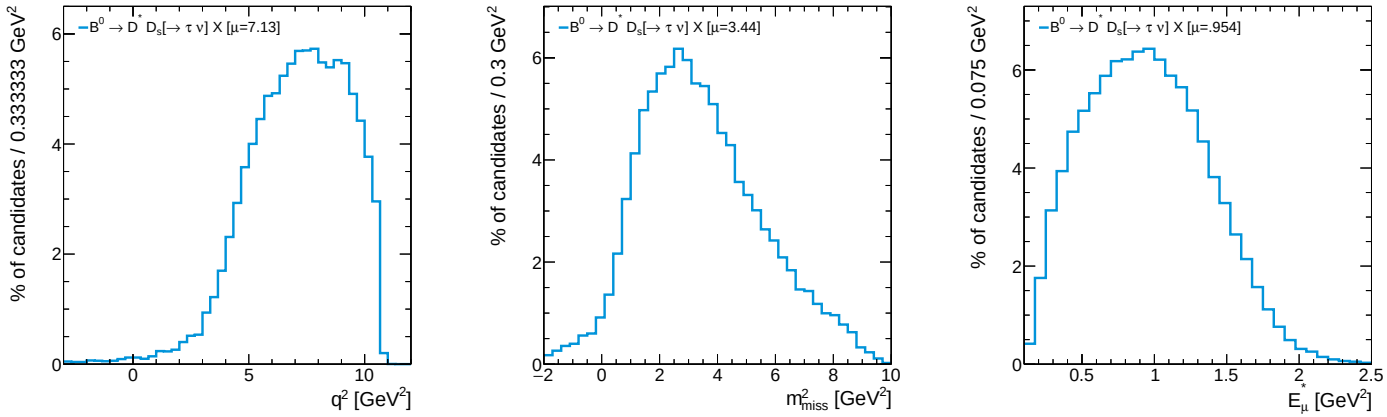






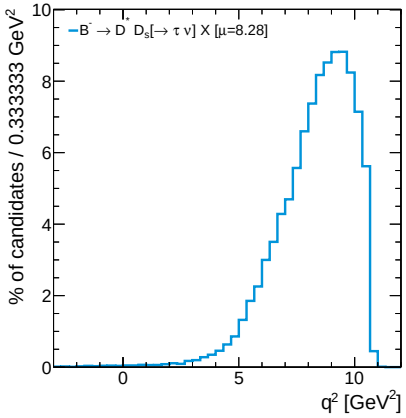
- Selections: D^{*+} mom or gdmom or gdgdmom=B^+, (D^{*+} mom=B^+ and μ gdgdmom is D^+_{s1} or D'^+_{s1}) or (μ mom is D^0 or D^+ or D^0_s), !(μ mom=τ and μ gdmom=D^0_s)
- Truth-matching selection efficiency: 0.937
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi^+_s]\mu$

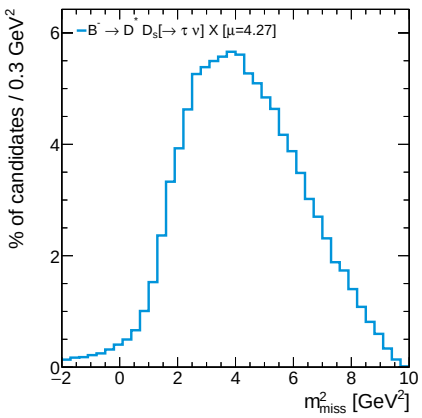
$B^0 \to D^{*+} D_s[\to \tau\bar{\nu}]X$: q^2, m^2_{miss}, E^*_μ

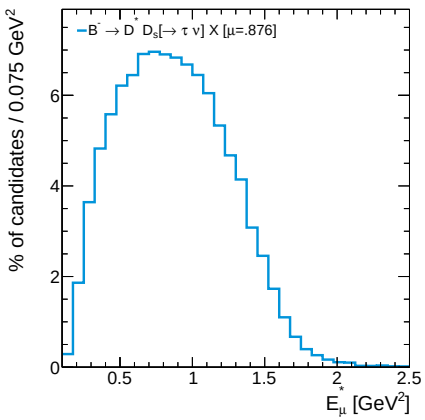


- Selections: D^{*+} mom or gdmom or gdgdmom=B^0, μ mom=τ and μ gdmom=D_s^0
- Truth-matching selection efficiency: 0.954
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi_s^+]\mu$

$B^+ \to D^{*+} D_s[\to \tau\bar{\nu}]X$: q^2, m^2_{miss}, E^*_μ

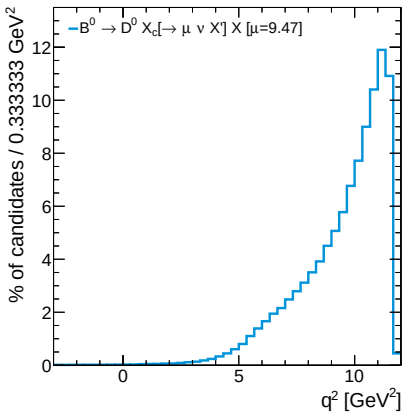


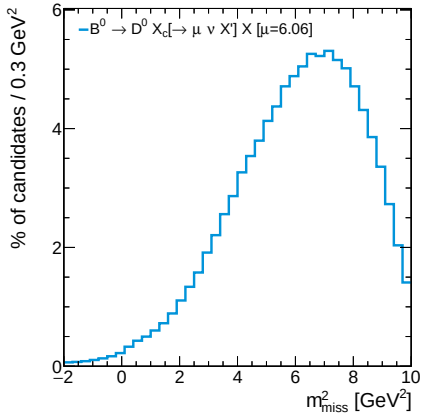


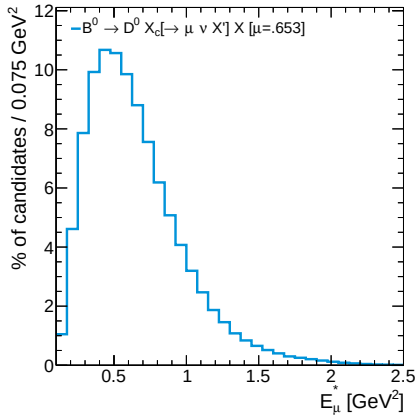


- Selections: D^{*+} mom or gdmom or gdgdmom=B^+, μ mom=τ and μ gdmom=D_s^0
- Truth-matching selection efficiency: 0.930
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi_s^+]\mu$

$B^0 \to D^0 X_c[\to \mu\bar{\nu}X']X$: q^2, m^2_{miss}, E^*_μ

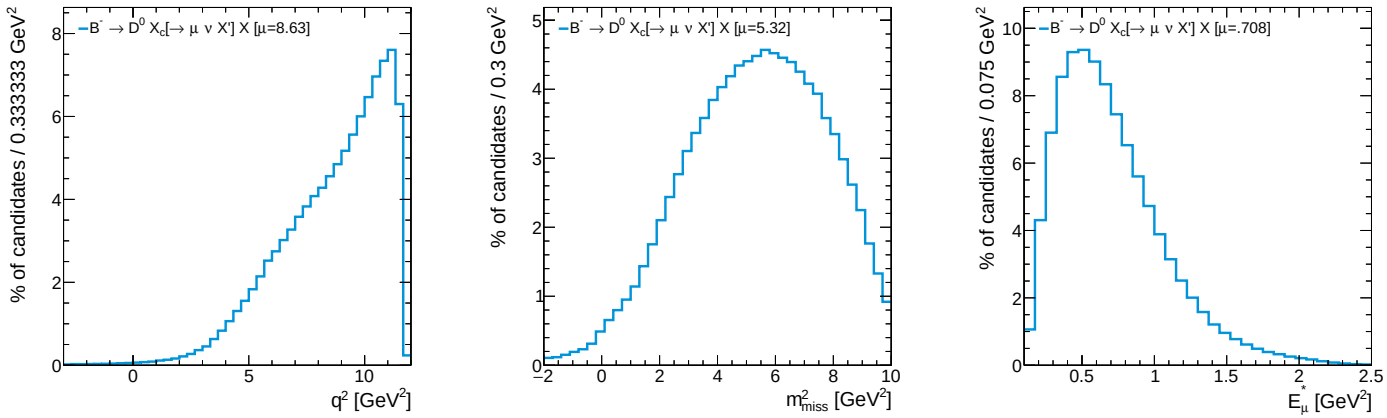






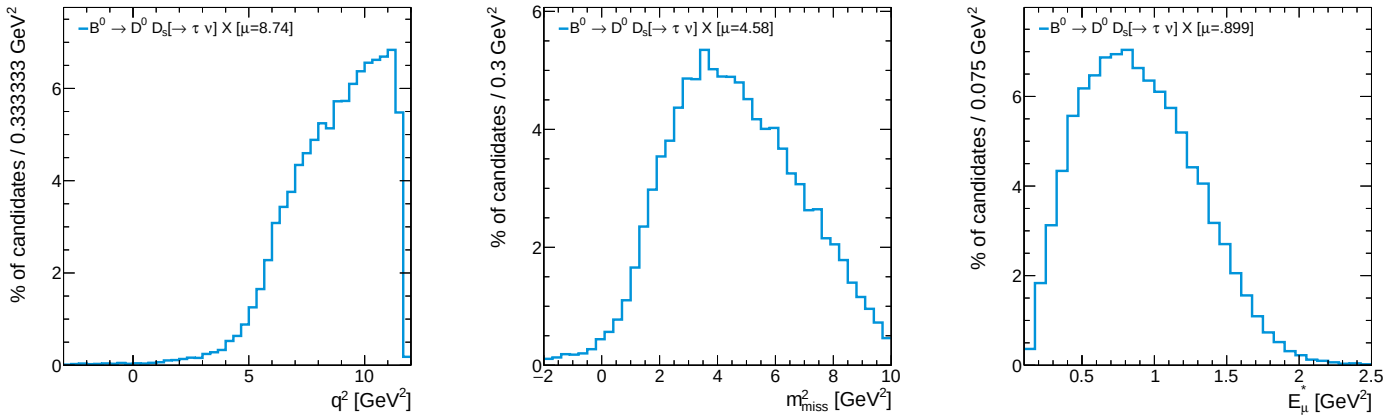
- Selections: D^0 mom or gdmom or gdgdmom=B^0, μ mom is D^0 or D^+ or D_s^0, !(μ mom=τ and μ gdmom=D_s^0)
- Truth-matching selection efficiency: 0.928
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^+ \to D^0 X_c[\to \mu\bar{\nu}X']X$: q^2, m^2_{miss}, E^*_μ



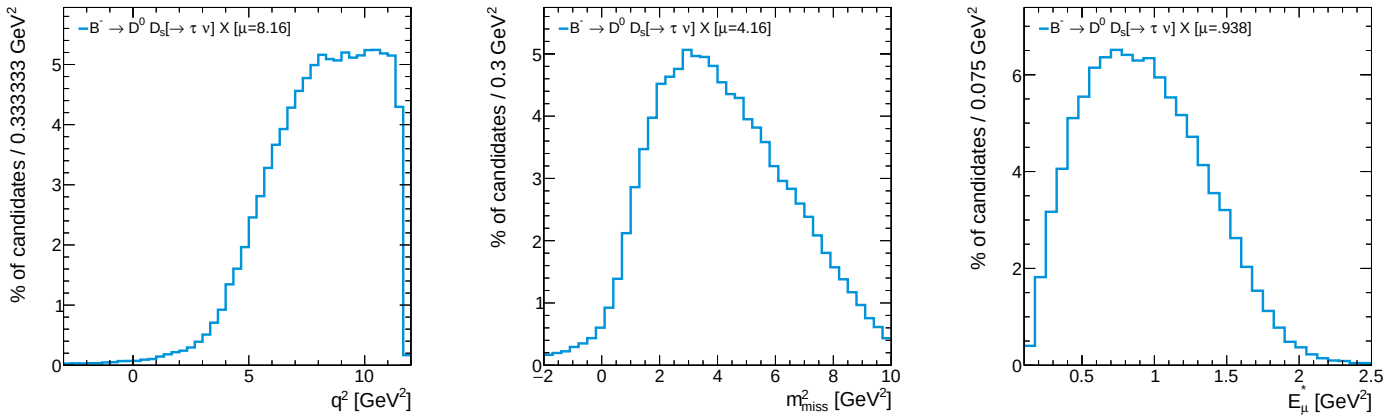
- Selections: D^0 mom or gdmom or gdgdmom=B^+, μ mom is D^0 or D^+ or D^0_s, !(μ mom=τ and μ gdmom=D^0_s)
- Truth-matching selection efficiency: 0.924
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^0 \to D^0 D_s[\to \tau\bar{\nu}]X$: q^2, m^2_{miss}, E^*_μ



- Selections: D^0 mom or gdmom or gdgdmom=B^0, μ mom=τ and μ gdmom=D_s^0
- Truth-matching selection efficiency: 0.918
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

$B^+ \to D^0 D_s[\to \tau\bar{\nu}]X$: q^2, m^2_{miss}, E^*_μ



- Selections: D^0 mom or gdmom or gdgdmom=B^+, μ mom=τ and μ gdmom=D_s^0
- Truth-matching selection efficiency: 0.919
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

B Decays in $B^0 \to D^{**+}(\mu/\tau)\nu$ Samples

Sample	Decay	Reco $\frac{\Gamma_{\text{decay}}}{\Gamma_{\text{sample total}}}$	Dec File $\frac{\Gamma_{\text{decay}}}{\Gamma_{\text{sample total}}}$
$B^0 \to D^{**+}\mu\nu$	$B \to D_1'\mu\nu$	0.3039	0.3069
$B^0 \to D^{**+}\mu\nu$	$B \to D_0^*\mu\nu$	0.2960	0.2970
$B^0 \to D^{**+}\mu\nu$	$B \to D_1\mu\nu$	0.2800	0.2772
$B^0 \to D^{**+}\mu\nu$	$B \to D_2^*\mu\nu$	0.1201	0.1188
$B^0 \to D^{**+}\tau\nu$	$B \to D_1'\tau\nu$	0.3071	0.3069
$B^0 \to D^{**+}\tau\nu$	$B \to D_0^*\tau\nu$	0.2972	0.2970
$B^0 \to D^{**+}\tau\nu$	$B \to D_1\tau\nu$	0.2806	0.2772
$B^0 \to D^{**+}\tau\nu$	$B \to D_2^*\tau\nu$	0.1151	0.1188

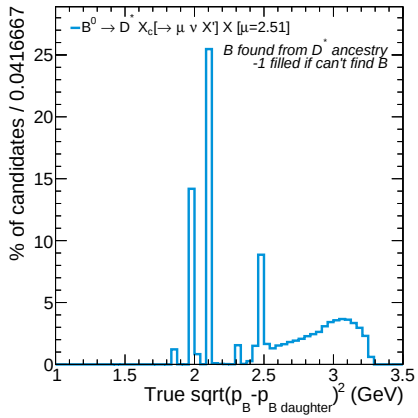
- Selections: Same as before ($B^0 \to D^{**+}\mu\nu$, $B^0 \to D^{**+}\tau\nu$)
- Reconstructed using TupleBminus: $B^- \to D^0[\to K^-\pi^+]\mu$

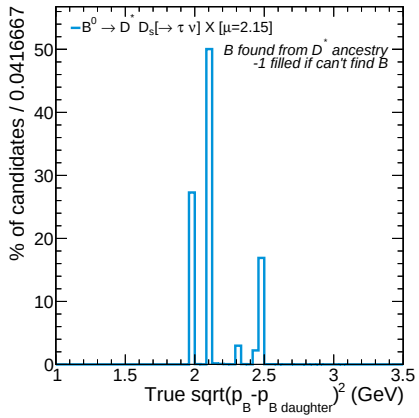
B Decays in $B^- \to D^{**0}(\mu/\tau)\nu$ Samples

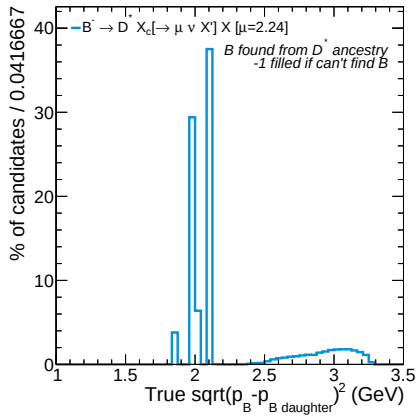
Sample	Decay	Reco $\frac{\Gamma_{\text{decay}}}{\Gamma_{\text{sample total}}}$	Dec File $\frac{\Gamma_{\text{decay}}}{\Gamma_{\text{sample total}}}$
$B^- \to D^{**0}\mu\nu$	$B \to D_1'\mu\nu$	0.2616	0.2647
$B^- \to D^{**0}\mu\nu$	$B \to D_0^*\mu\nu$	0.2958	0.2941
$B^- \to D^{**0}\mu\nu$	$B \to D_1\mu\nu$	0.2942	0.2941
$B^- \to D^{**0}\mu\nu$	$B \to D_2^*\mu\nu$	0.1483	0.1471
$B^- \to D^{**0}\tau\nu$	$B \to D_1'\tau\nu$	0.2623	0.2647
$B^- \to D^{**0}\tau\nu$	$B \to D_0^*\tau\nu$	0.2983	0.2941
$B^- \to D^{**0}\tau\nu$	$B \to D_1\tau\nu$	0.2931	0.2941
$B^- \to D^{**0}\tau\nu$	$B \to D_2^*\tau\nu$	0.1463	0.1471

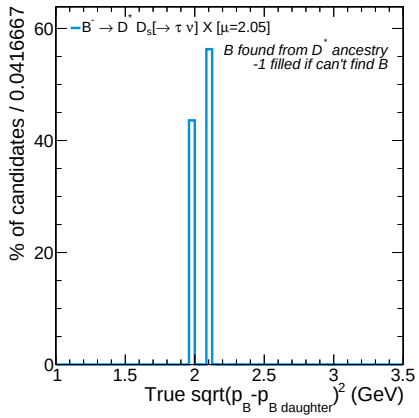
- Selections: Same as before ($B^- \to D^{**0}\mu\nu$, $B^- \to D^{**0}\tau\nu$)
- Reconstructed using TupleBminus: $B^- \to D^0[\to K^-\pi^+]\mu$

$B \to D^*(X_c[\to \mu\bar{\nu}X']||D_s[\to \tau\bar{\nu}])X$: $(p_B - p_{B_{\text{daughter}}})^2$



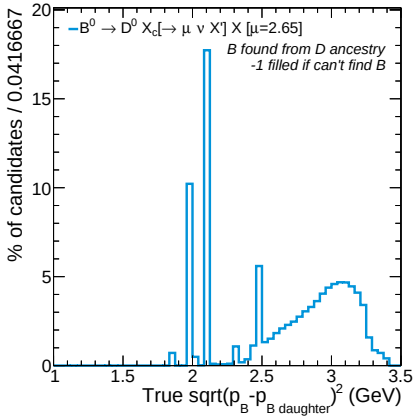


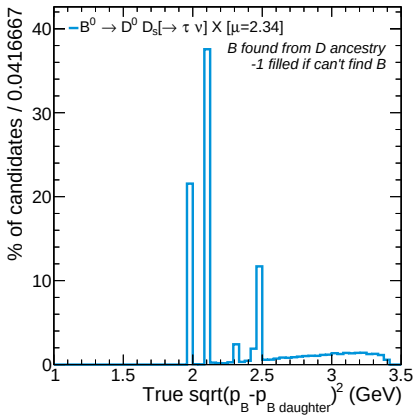


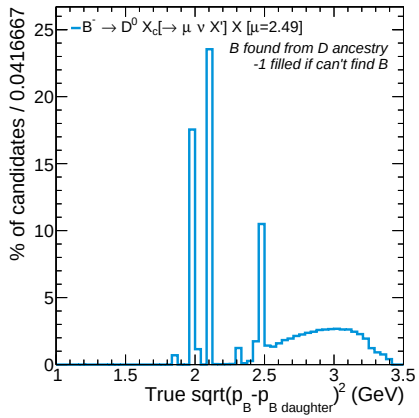


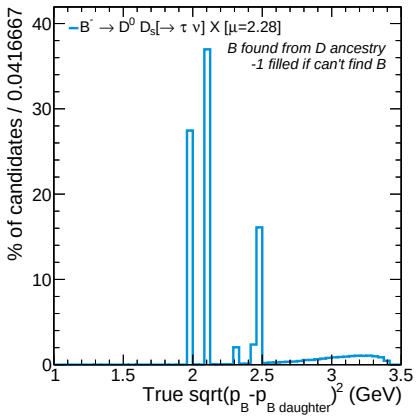
- Selections: same as before ($B^0 \to D^* X_c[\to \mu\nu X']X$, $B^0 \to D^* X_c[\to \tau\nu]X$, $B^- \to D^* X_c[\to \mu\nu X']X$, $B^- \to D^* X_c[\to \tau\nu]X$)
- Plotting truth variables $|p_B - p_{B_{\text{daughter}}}|$, where B is found from the truth ancestry of the particle reconstructed as D^{*+}, and its daughter in this ancestry is "B_{daughter}"
- Plotted using TupleB0: reconstructed as $B^0 \to D^{*+}[\to D^0[\to K^-\pi^+]\pi_s^+]\mu$

$B \to D(X_c[\to \mu\bar{\nu}X']||D_s[\to \tau\bar{\nu}])X$: $(p_B - p_{B_{\text{daughter}}})^2$









- Selections: same as before ($B^0 \to DX_c[\to \mu\nu X']X$, $B^0 \to DX_c[\to \tau\nu]X$, $B^- \to DX_c[\to \mu\nu X']X$, $B^- \to DX_c[\to \tau\nu]X$)
- Plotting truth variables $|p_B - p_{B_{\text{daughter}}}|$, where B is found from the truth ancestry of the particle reconstructed as D^0, and its daughter in this ancestry is "B_{daughter}"
- Plotted using TupleBminus: reconstructed as $B^- \to D^0[\to K^-\pi^+]\mu$

Questions

Questions (cont'd)

Observations

- Phoebe's truth-matching selections for D^{**} modes for the D^0 sample seem to be markedly different from the D^* sample; in particular, she does NOT require that a decay NOT have two D^{**} (eg. not cutting out $B \to D^{**} \to D^{**} \to D^*$), and she doesn't cut out $D^{**} \to D^{(*)}\pi\pi$ events here, like she did for D^* sample. For now, it's fine to live with just copying what Phoebe does, but in the future, it will be important to think more crtically about these selections (and perhaps get updated code from Phoebe to see what she did for her templates in the end)

TODO

- It is likely worth checking over selections for the "normal" D^{**} samples and DD samples again, just to be sure.
- Remake (in addition) q^2 plots to have binnings match Phoebe, for comparison
- Remake this presentation, but using tracker-only instead of fullsim (is only Bd2DstMuNu tracker-only sample ready right now? Have to submit other 24 jobs to the GRID?)
- It's odd that the truth-matching selection efficiencies for the $D^{(*)}D_s$ decay modes are so low. It's worth trying to check this out; maybe look at the dec files to start?

Backup Slides