



南开大学

Search for new physics with charm rare decays at BESIII

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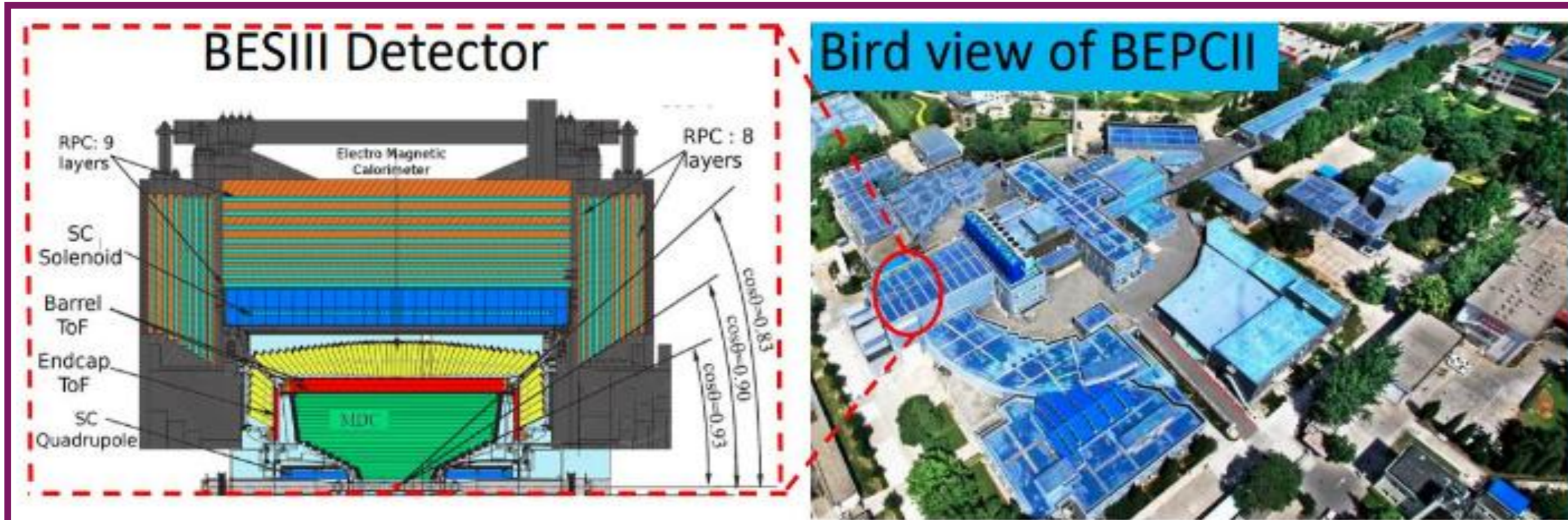
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Abstract

The BESIII experiment has collected 2.7 billion psi(3686) events, 10 billion J/psi events, 20 fb⁻¹ D meson pairs at 3.773 GeV, and 7.33 fb⁻¹ D_sD_s^{*} events from 4.128 to 4.226 GeV. With the huge charm data samples, we can search for new physics with rare processes in charm hadron decays.

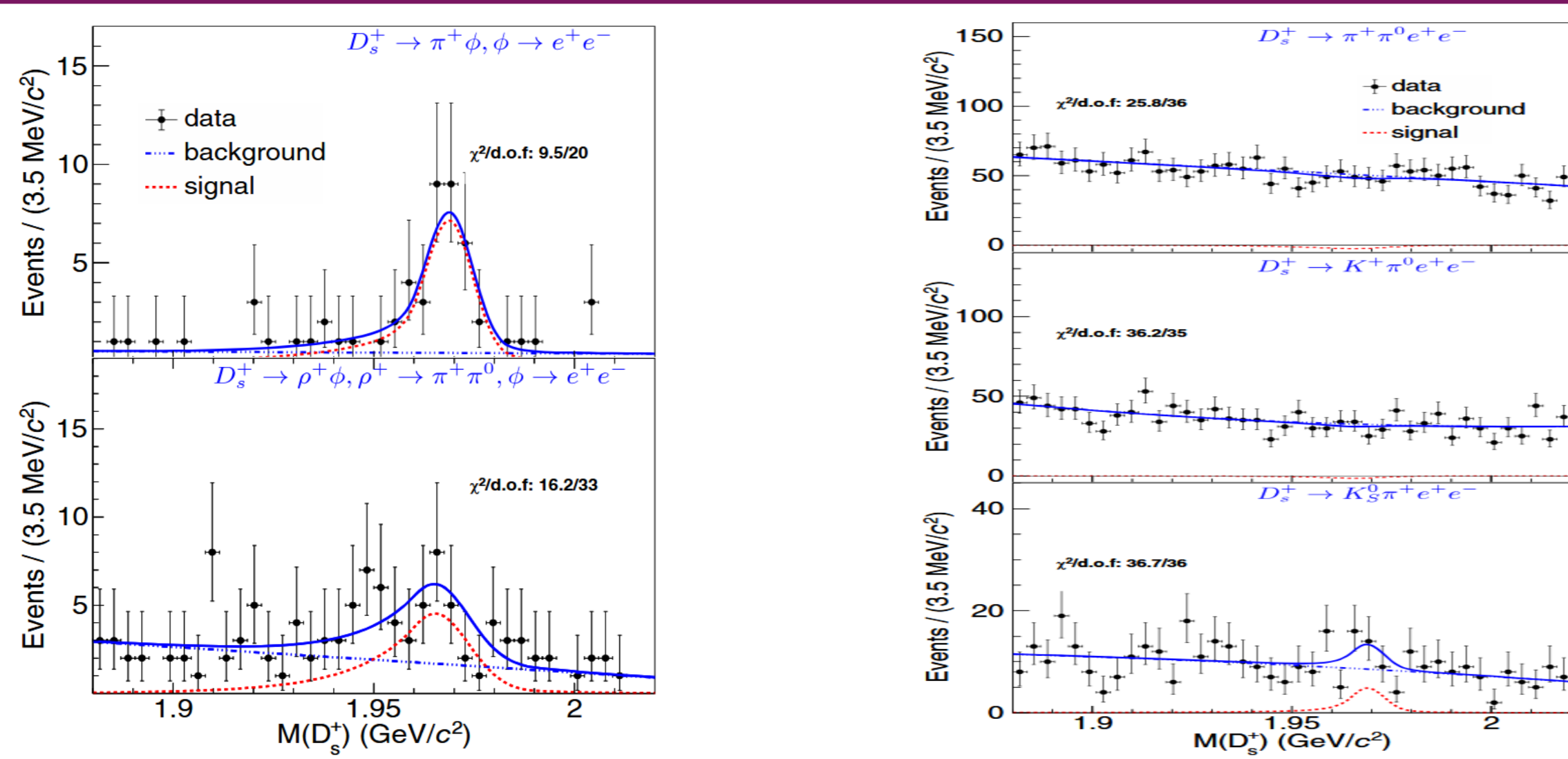
In this talk, we report the search for flavor-changing neutral-current (FCNC) decay, lepton number violation (LNV) process and J/psi weak decays containing D meson.

BESIII introduction



BESIII detector^[1] records symmetric e⁺e⁻ collisions provided by the BEPCII storage ring in the center of mass energy range from 1.84 to 4.95 GeV, with a peak luminosity 1.1 × 10³³ cm⁻²s⁻¹ achieved at √s = 3.773 GeV.

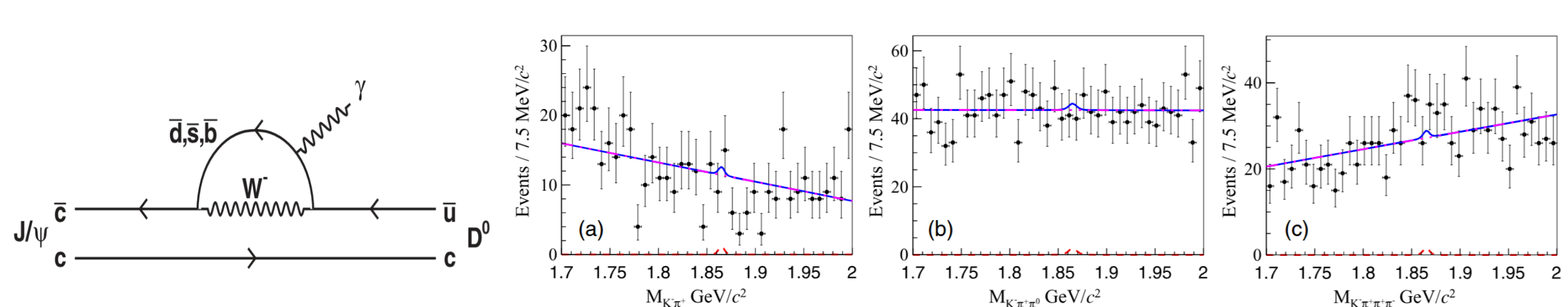
Search for FCNC decay in D_s⁺ → h(h')e⁺e⁻



Decay	N _{sig}	ε (%)	B(×10 ⁻³)
D _s ⁺ → π ⁺ φ, φ → e ⁺ e ⁻	38.2 ^{+7.8} _{-6.8}	25.1	1.17 ^{+0.23} _{-0.21} ± 0.03
D _s ⁺ → ρ ⁺ φ, φ → e ⁺ e ⁻	37.8 ^{+10.3} _{-9.6}	12.1	2.44 ^{+0.67} _{-0.62} ± 0.16
D _s ⁺ → π ⁺ π ⁰ e ⁺ e ⁻	...	7.4	<7.0
D _s ⁺ → K ⁺ π ⁰ e ⁺ e ⁻	...	5.3	<7.1
D _s ⁺ → K _S ⁰ π ⁺ e ⁺ e ⁻	...	6.7	<8.1

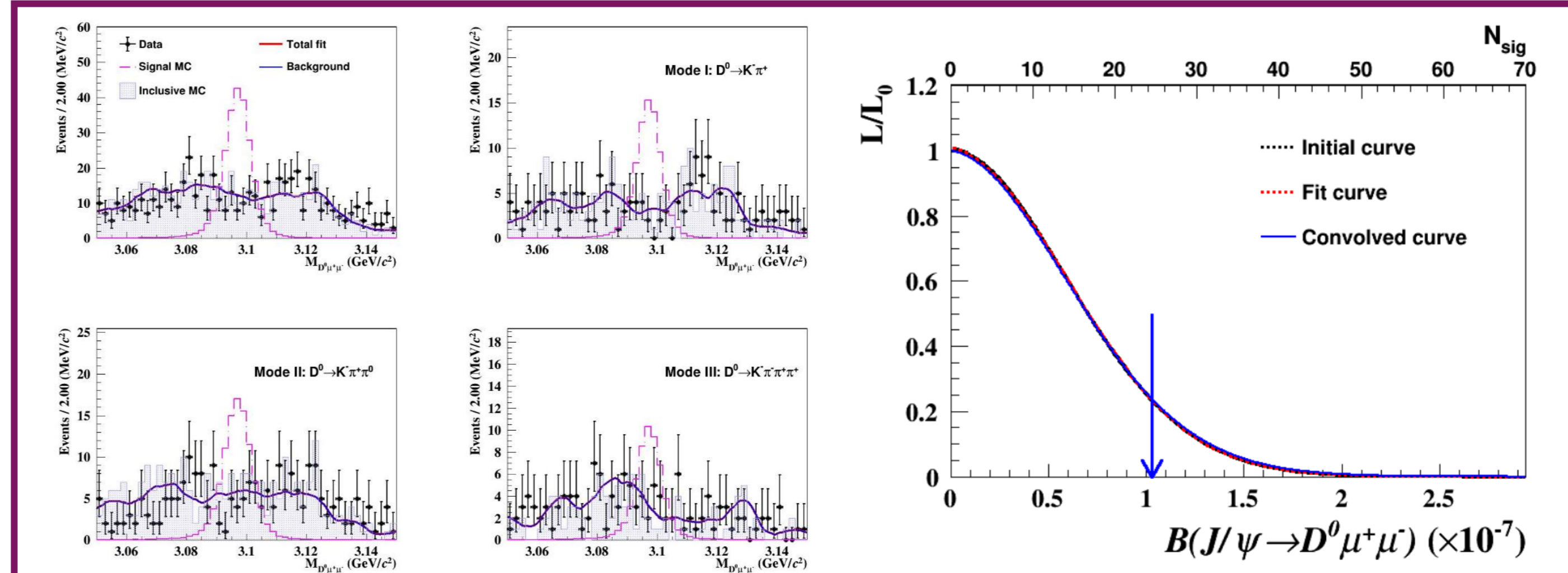
- Using 7.33 fb⁻¹ data from 4.128 to 4.226 GeV, BESIII search for the rare decays D_s⁺ → h(h')e⁺e⁻^[2].
- The D_s⁺ → π⁺φ (e⁺e⁻) is firstly observed with 7.8σ. The evidence of D_s⁺ → ρ⁺φ (e⁺e⁻) is firstly found with 4.4σ. Both BF's (Branching fractions) are consistent with others results but with higher precision.
- No significant signal of four-body rare decays is observed. The upper limits are set at 90% C.L. .

Search for rare J/ψ → γD⁰ + c. c. process



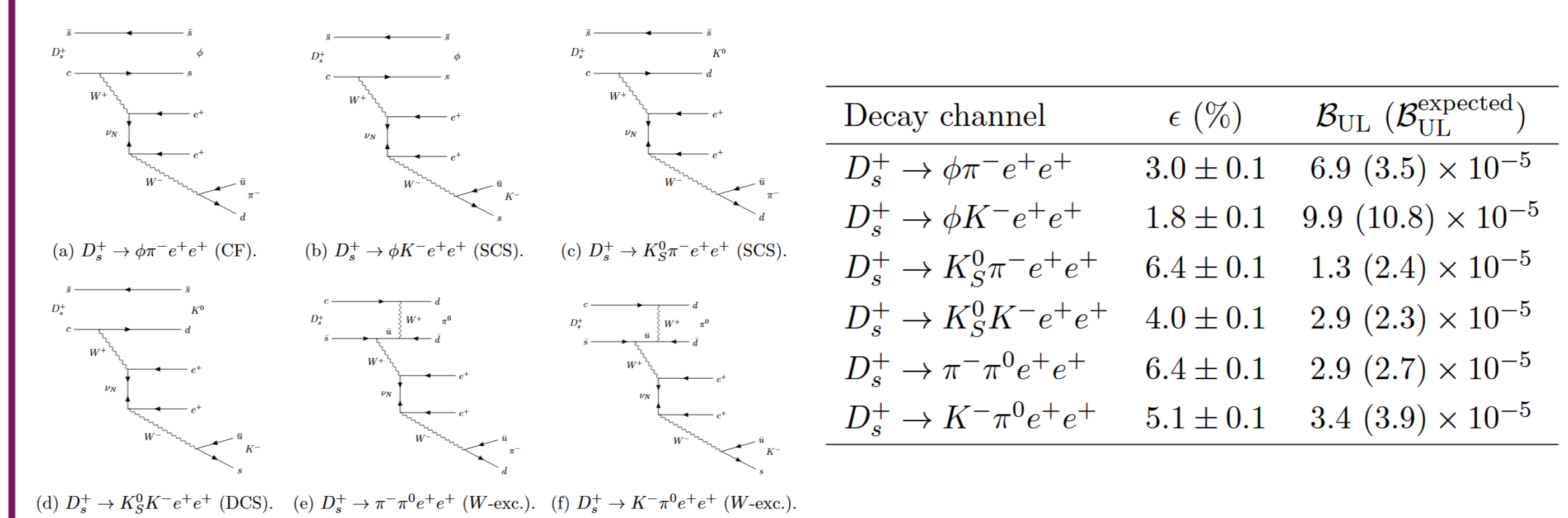
- Using (10087 ± 44) × 10⁶ J/ψ data samples, BESIII search for the rare decay J/ψ → γD⁰ + c. c. for the first time^[3].
- No significant signal is observed. The upper limit is set as: ℬ(J/ψ → γD⁰ + c. c.) < 9.1 × 10⁻⁸ at 90% C.L., which provides reference for studying NP.

Search for FCNC decay J/ψ → D⁰μ⁺μ⁻ + c. c.



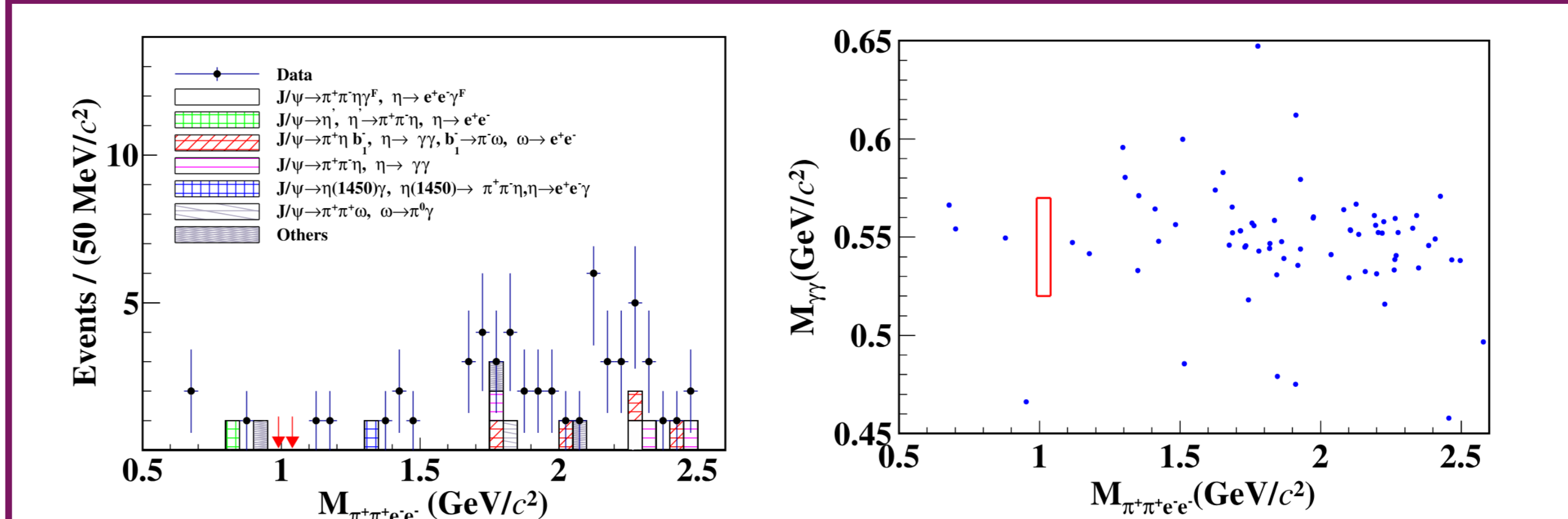
- Using (10087 ± 44) × 10⁶ J/ψ data samples, BESIII search for the rare decay J/ψ → D⁰μ⁺μ⁻ + c. c. for the first time^[4].
- No significant signal is observed. The upper limits is set to be ℬ(J/ψ → D⁰μ⁺μ⁻ + c. c.) < 1.1 × 10⁻⁷ at 90% C.L., provide useful reference.

Search for LNV decay D_s⁺ → h⁻h⁰e⁺e⁺



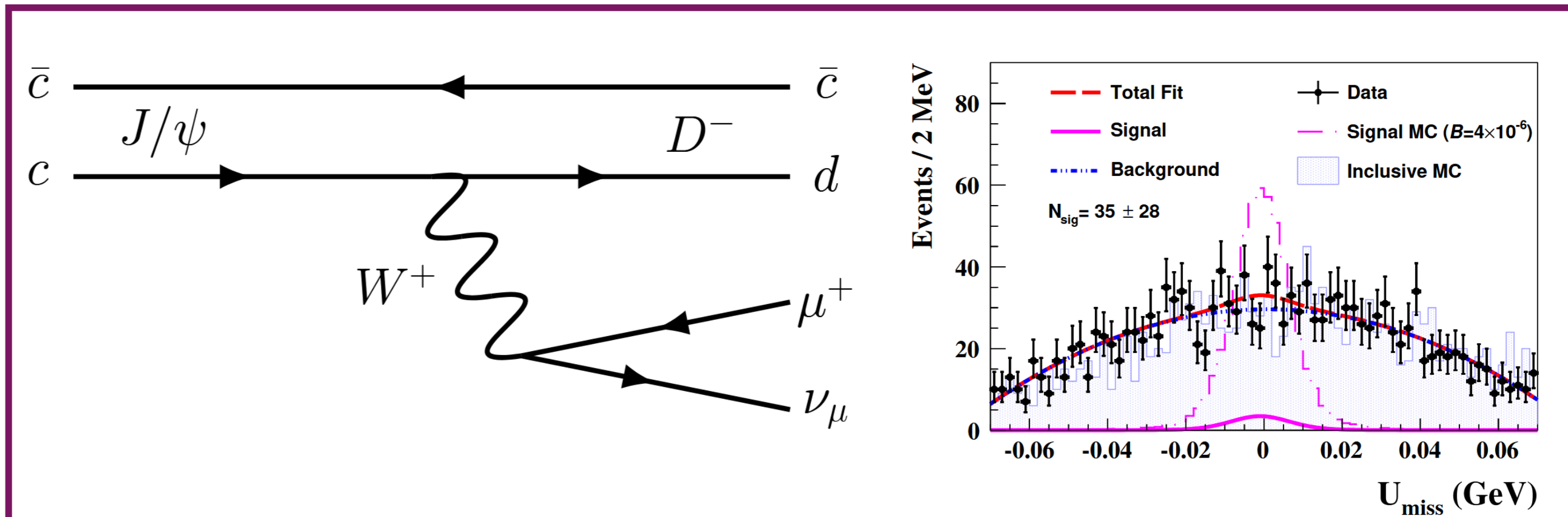
- Using 7.33 fb⁻¹ data samples from 4.128 to 4.226 GeV, BESIII search for the LNV decay D_s⁺ → h⁻h⁰e⁺e⁺ for the first time^[5].
- No significant signal is observed. The upper limits of each decays mode are set at 90% C.L. .

Search for LNV decay φ → π⁺π⁺e⁻e⁻



- Using (10087 ± 44) × 10⁶ J/ψ data samples, BESIII search for the LNV decay φ → π⁺π⁺e⁻e⁻ via J/ψ → φη' for the first time^[6].
- No significant signal is observed. The upper limit is set to be ℬ(φ → π⁺π⁺e⁻e⁻) < 1.3 × 10⁻⁵ at 90% C.L.

Search for J/ψ → D⁻μ⁺ν_μ + c. c.



- Using (10087 ± 44) × 10⁶ J/ψ data samples, BESIII search for the J/ψ weak decay J/ψ → D⁻μ⁺ν_μ + c. c. for the first time^[7].
- No significant signal is observed. The upper limit is set to be ℬ(J/ψ → D⁻μ⁺ν_μ + c. c.) < 5.6 × 10⁻⁷ at 90% C.L..

Summary

Using 2.7 billion psi(3686) events, 10 billion J/psi events, 20 fb⁻¹ D meson pairs at 3.773 GeV, and 7.33 fb⁻¹ D_sD_s^{*} events from 4.128 to 4.226 GeV, BESIII has search for FCNC, LNV and others NP processes. No significant NP signals are observed.

[1]: Nucl. Instrum. Methods Phys. Res., A 614, 345 (2010). [2]: Phys.Rev.Lett 133,121801 (2024). [3]: Phys.Rev.D 110,112012 (2024). [4]:JHEP 04 (2025) 061. [5]: JHEP 01 (2025) 109. [6]: Chin.Phys.C 49,4 (2024) 043001. [7]:JHEP 01 (2024) 126.