BESIII experiment: Search for new physics in charm energy region, progress and prospect

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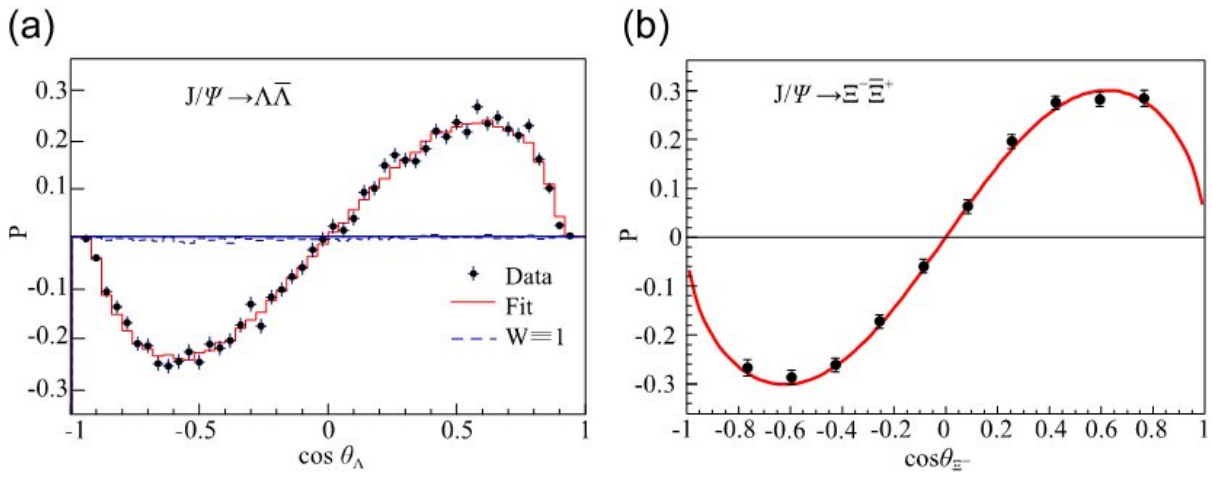

The polarization of hyperon vs its polar angle for a) the Lambda hyperon and b) the Xi hyperon. Credit: Science China Press

In a recent review article published online in *National Science Review*, Prof. Shenjian Chen (Nanjing University) and Prof. Stephen Olsen (University of Chinese Academy of Sciences) review the major progress of the BESIII experiment in searching for new physics in Charm physics energy region, and prospect the potential of new physics search in the future.

Based on the data collected by the BESIII detector, the collaborators have searched for new physics from different angles:

1) Searching for the standard model rare processes, including the flavor changing neutral current of charm meson and the weak decay of charmonium;

2) Precisely measuring the processes allowed by the standard model, especially the purely leptonic and semileptonic decays of charm hadrons, testing lepton flavor universality and CKM matrix unitary, and searching for evidence that deviates from the standard model prediction such as the quark mixing Cabibbo angle anomaly;

3) Measuring the polarization parameter of hyperons, and searching for non-standard model sources of parity and charge conjugate symmetry breaking;

4) Probing for the standard model forbidden processes, including charged lepton flavor violation, lepton number and baryon number violation, and parity or charge conjugation break electromagnetic processes;

5) Looking for exotic phenomena completely beyond the standard model , such as dark photons and light dark matter, as well as the invisible decay of quarkonium.

Some of these BESIII results reflected the first measurements in the world, and many of them are several times to several orders of magnitude better than previous measurements. So far, no sign of new physics has been found in the existing data, the fact of which set up the exclusion limits of new physics. Meanwhile, these physics results impose more stringent constraints on some new physics models and parameter spaces, and provide guidance and reference for future work in BESIII or

similar experiments.

More information: Shenjian Chen et al, New physics searches at the BESIII experiment, *National Science Review* (2021). DOI: 10.1093/nsr/nwab189

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