Dalitz Analysis of $B^+ \to K^0_S\pi^+\pi^0$ Decays at Belle II

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1 The Belle II Experiment

The Belle II experiment at the SuperKEKB collider in Tsukuba, Japan, is at the forefront of flavor physics, focusing on precision measurements to search for potential new physics beyond the Standard Model. This experiment records electron-positron (e^-e^+) collisions at a center-of-mass energy of 10.58 GeV, corresponding to the resonance peak of the $\Upsilon(4S)$ particle. The $\Upsilon(4S)$ predominantly decays into B meson pairs, making Belle II an ideal platform for studying B-physics.
Belle II currently holds the world record for achieved instantaneous luminosity of $4.7 \times 10^{34}\text{cm}^{-2}\text{s}^{-1}$. In addition to the resulting large dataset, the experiment benefits from highly controlled initial collision conditions, featuring a single collision per event with a low track and cluster multiplicity in the detector. These characteristics enable the precise reconstruction of missing energy and improve the detection and reconstruction of neutral final state particles, which are critical for conducting precise measurements of the standard model.

2 Dalitz Analysis of the Decay $B^+ \to K^0_S\pi^+\pi^0$

While Belle II will restart data-taking in October 2024, the data of the first run from 2019-2022, which corresponds to 362fb^{-1} of on-resonance data, is already used for world leading physics analysis. My project is the a analysis of the decay $B^+ \to K^0_S\pi^+\pi^0$ on this first dataset. In this analysis, I plan to measure branching fractions and CP asymmetries of resonance states which result in the desired final state particles, like $B^+ \to K^*(892)^+[\to K^0_S\pi^+]\pi^0$, as well as the inclusive branching fraction of the decay. The resonance states form resonance bands around the mass of the intermediate particle in the combined mass system of their decay products. The branching fraction and CP asymmetry of the corresponding resonance state can be extracted from a fit to this resonance structure. Due to energy and momentum conservation, the decay dynamics including multiple resonance states are fully described by two squared mass combinations of the final state particles. Consequently, a fit in the plane of these two variables, the so-called Dalitz plane allows for the extraction of the branching fraction and CP asymmetry of all possible resonance states. Of special interest for me are the results for the K^* resonances. The measured values can be combined with the results from a Dalitz analysis of the decay $B^0 \to K^+\pi^-\pi^0$ to perform a direct test on the standard model.