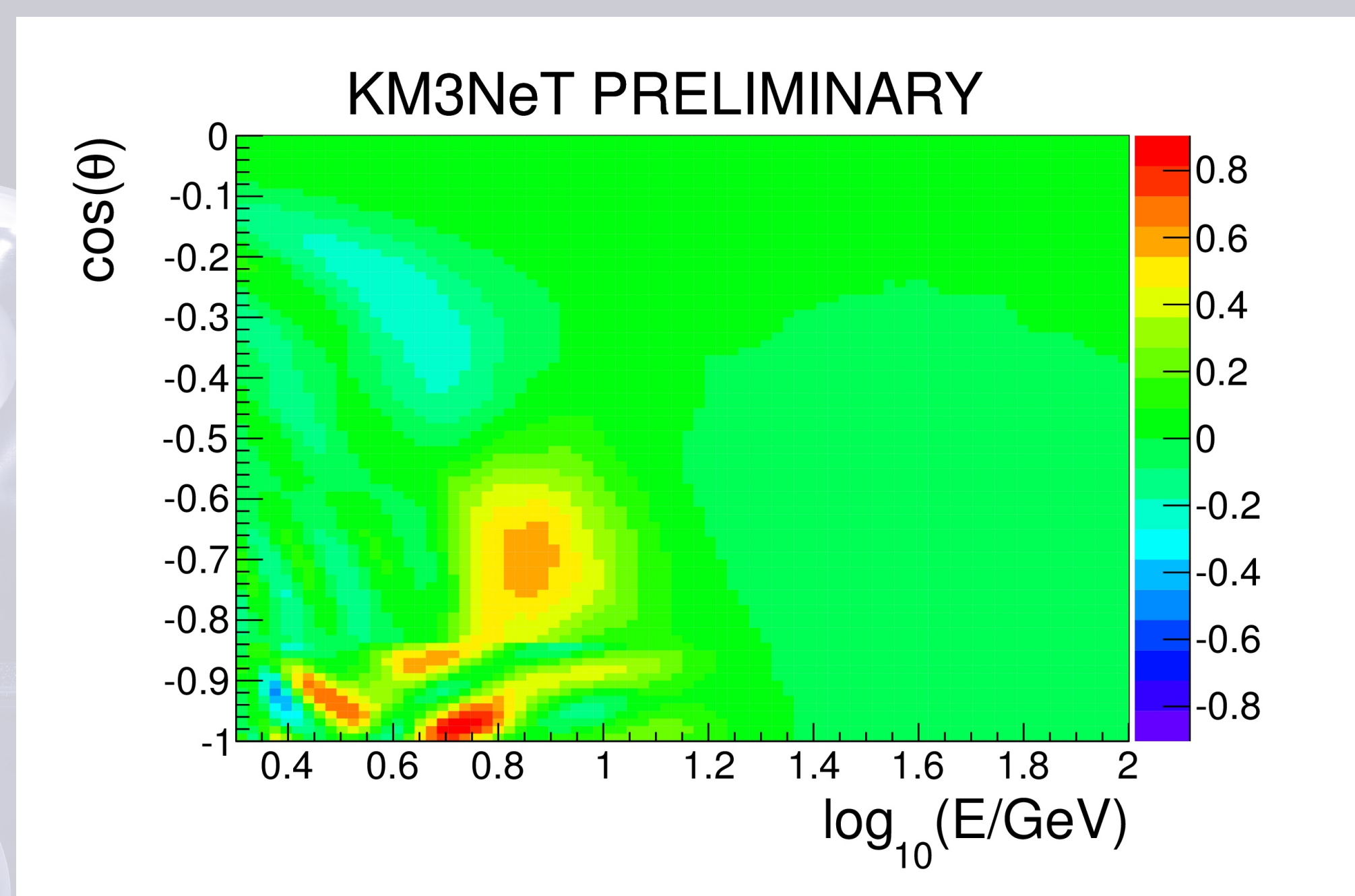# KM3NeT/ORCA
Studying Neutrino Oscillations in the Abyss

Martijn Jongen on behalf of the KM3NeT collaboration

Introduction

ORCA will measure the neutrino mass hierarchy by detecting atmospheric neutrino interactions deep below the surface of the mediterranean sea.

I have studied the effect of systematics on the mass hierarchy measurement.

Mass hierarchy signature in one of the channels for an ideal detector.

Experiment

KM3NeT uses an extensive array of Digital Optical Modules (DOMs) to detect Cherenkov light from neutrino interactions. Each DOM houses 31 photomultiplier tubes.

Mass Hierarchy Sensitivity

ORCA's sensitivity is calculated using a log-likelihood ratio (LLR) approach. We simulate pseudo-experiments and then fit the best-matching parameter values assuming NH and assuming IH. The ratio of the best-fit likelihoods is the discriminating variable.
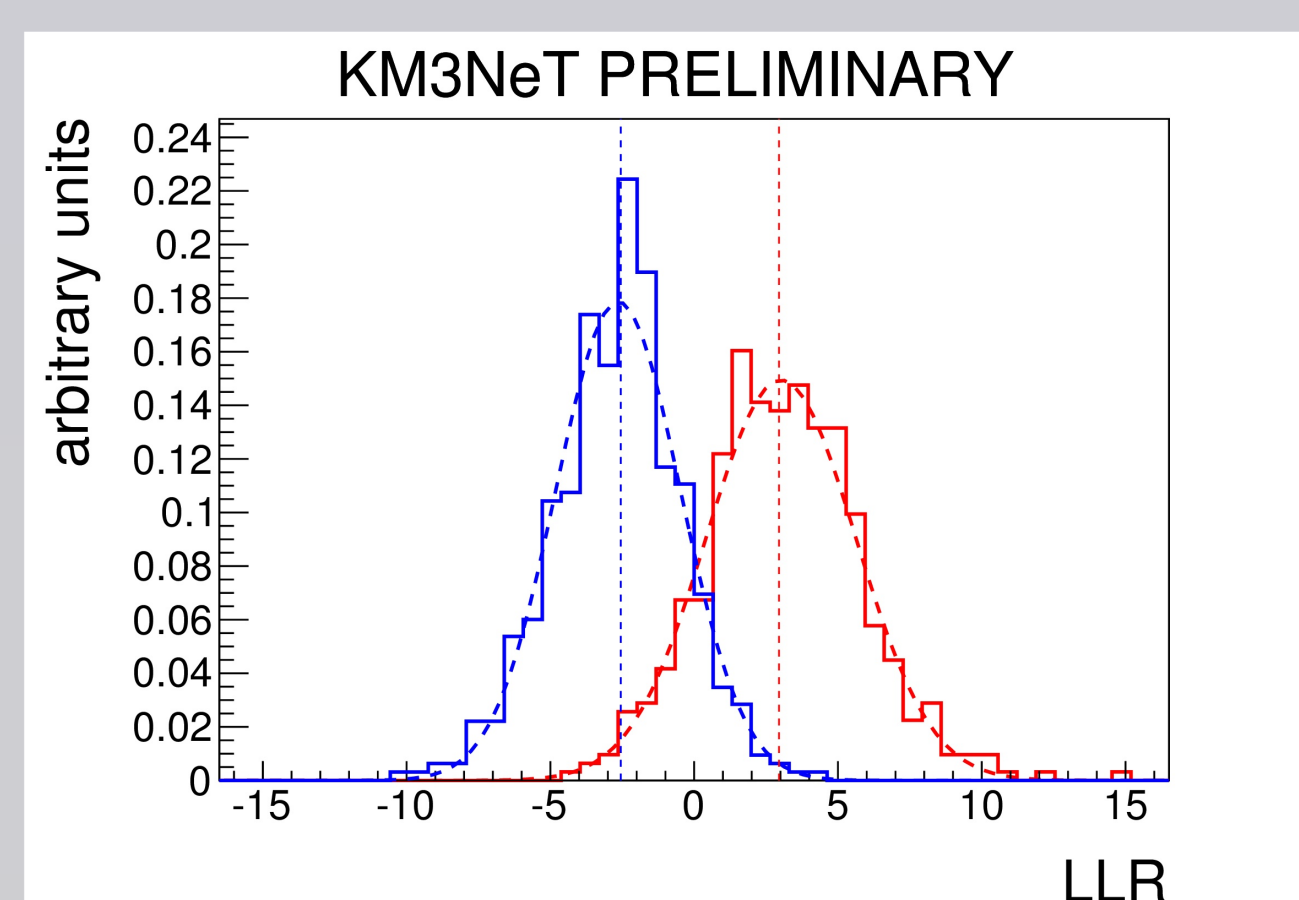
*Example LLR distributions for NH (red) and IH*
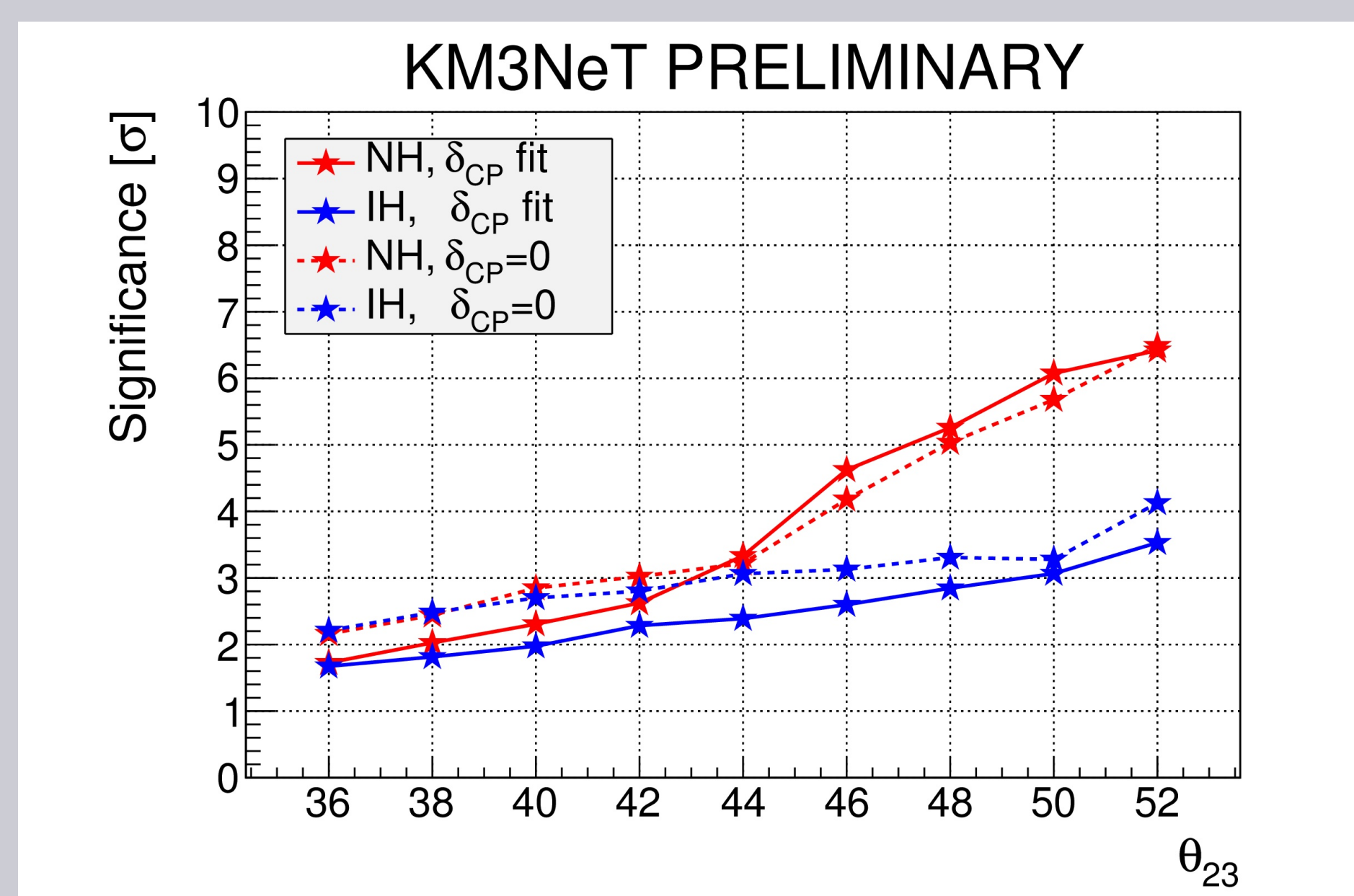
Systematics

The following systematics are included:
1) an overall factor in the number of events
2) the neutrino/antineutrino ratio
3) the ratio muon/electron-flavour ratio
4) a scaling of the neutral current contamination
5) the slope of the atmospheric neutrino energy spectrum
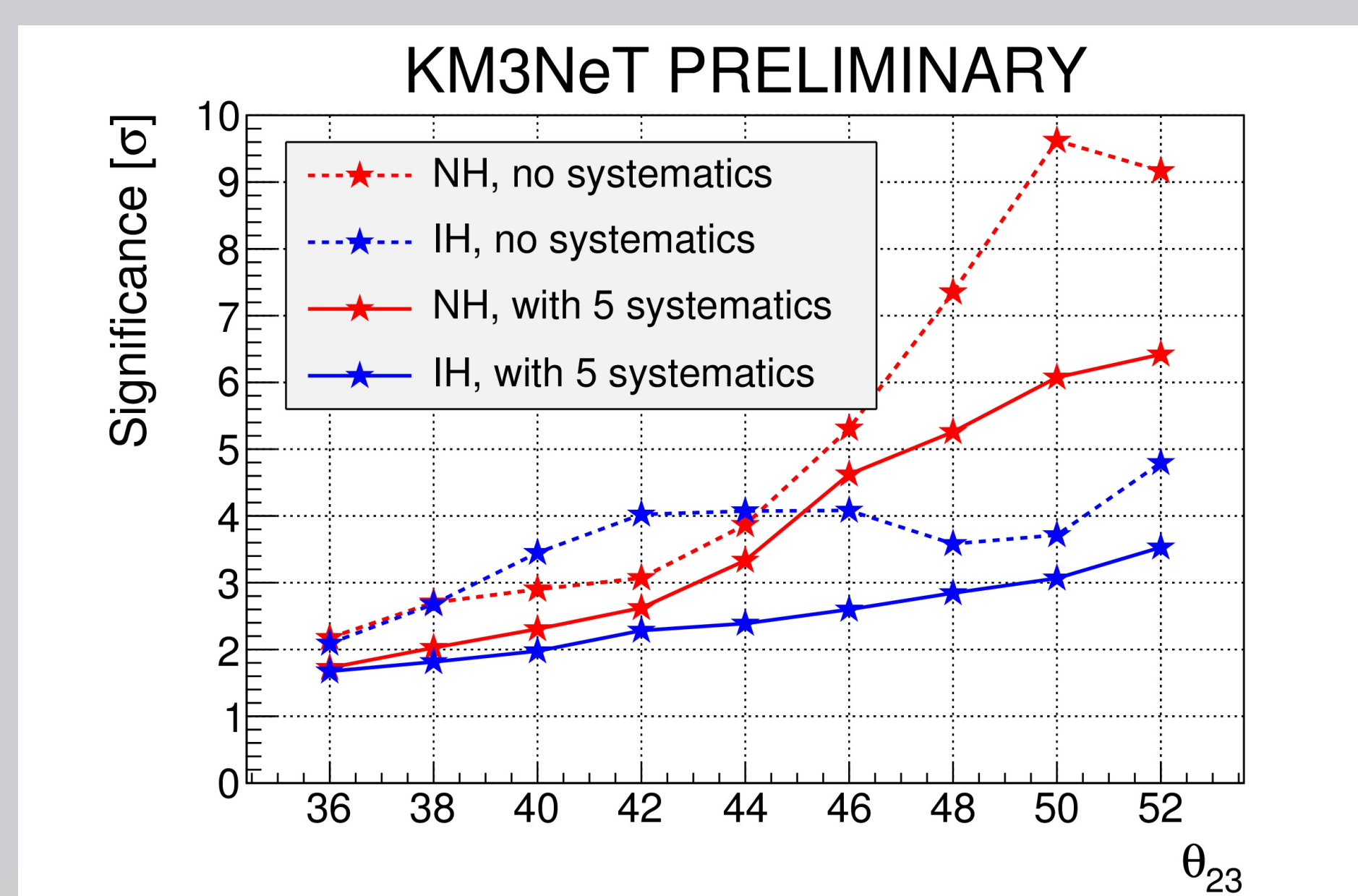
Results

The simultaneous fit of the systematics and oscillation parameters works very well without the need to add priors based on best-fit world values.
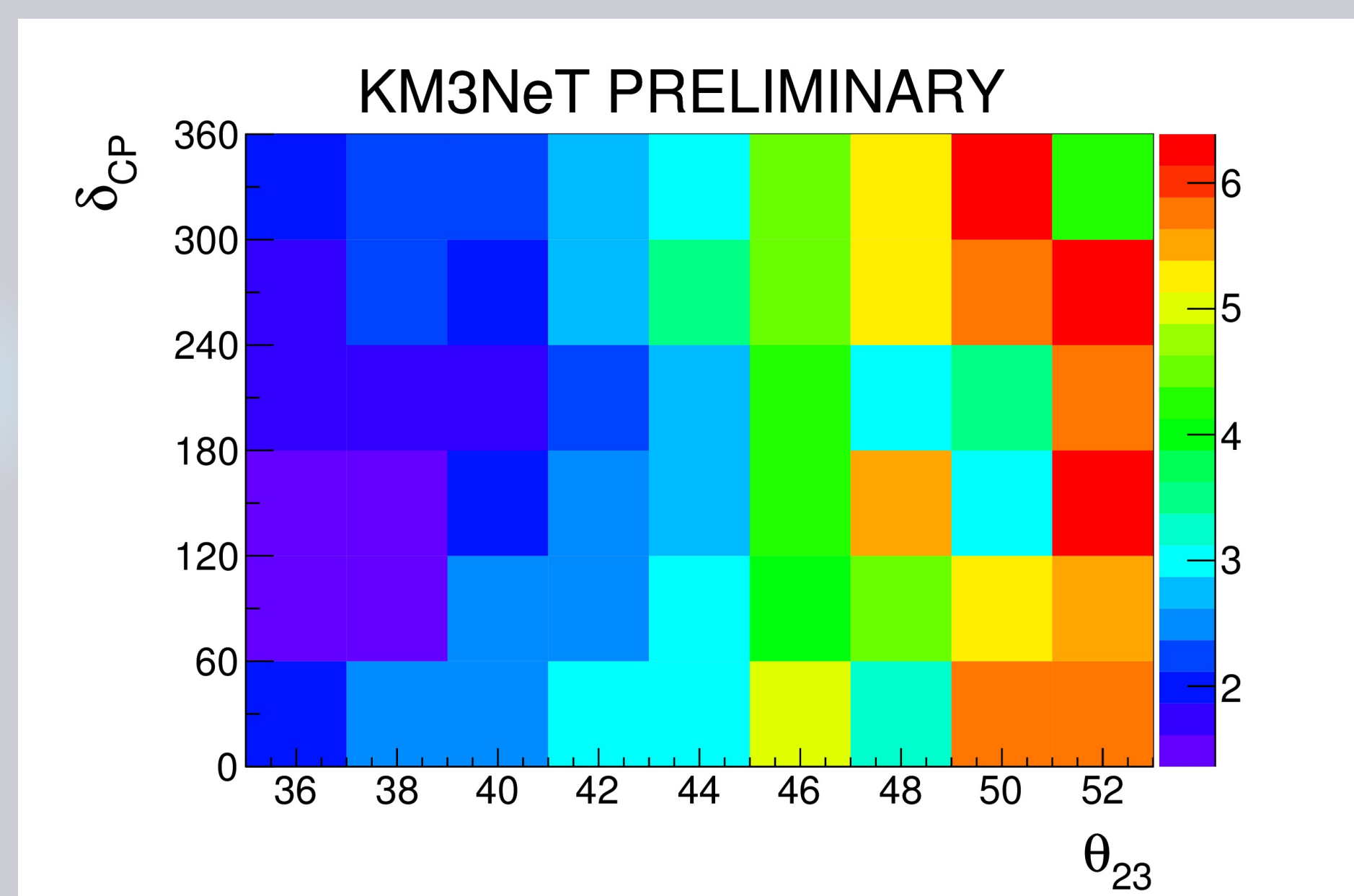
The significance as a function of θ_{23} and δ_{CP} for NH, with systematics.

The significance with systematics after 3 years.

The significance after 3 years, including a fit of δ_{CP}

Conclusions

Systematics have a very strong effect on ORCA's ability to measure the neutrino mass hierarchy. Assuming normal hierarchy, a θ_{23} of 42 degrees, and fixing δ_{CP} to 0, ORCA is expected to determine the hierarchy with 3σ significance within 3 years, although the sensitivity is lower when a fit of δ_{CP} is included.