



ПОИСК ТЯЖЕЛЫХ НЕЙТРАЛЬНЫХ ЛЕПТОНОВ В ЭКСПЕРИМЕНТЕ NA62 (CERN)

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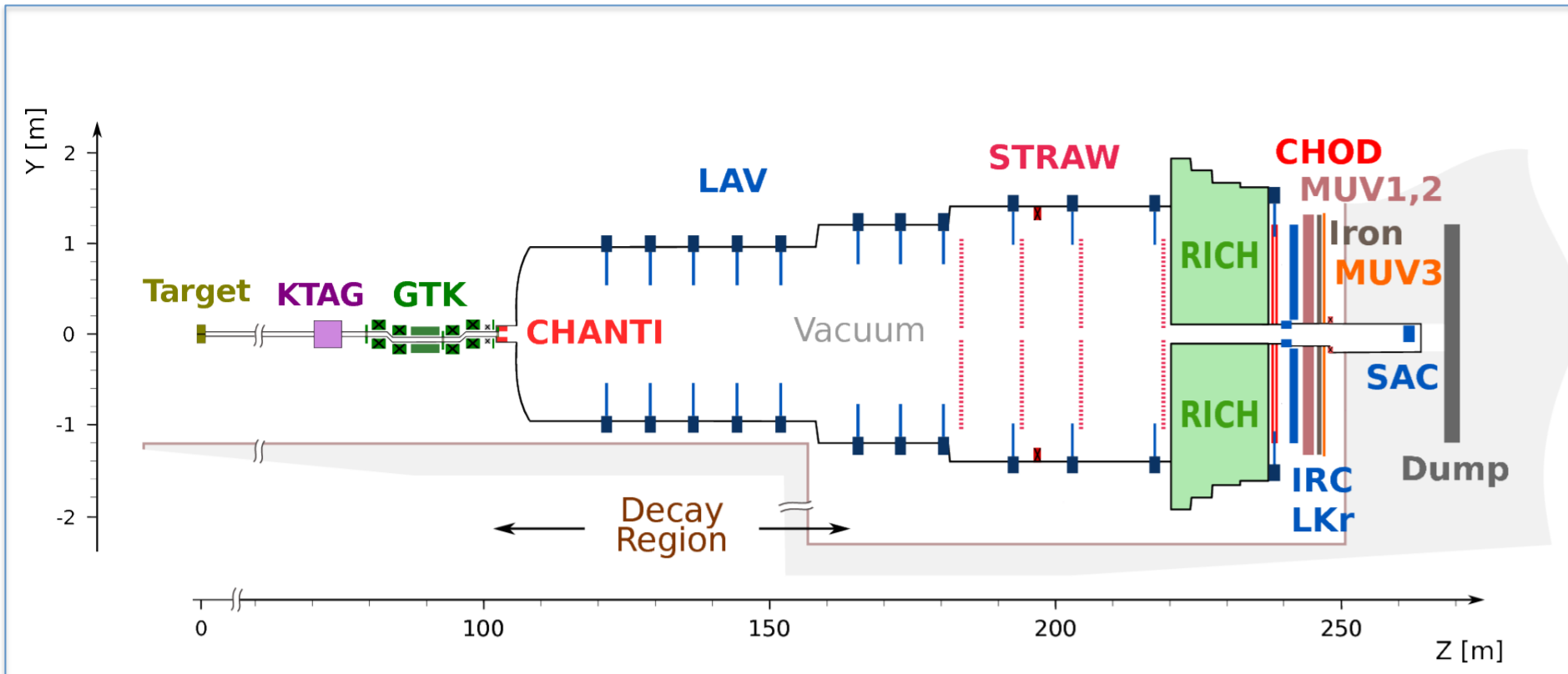
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The NA62 experiment is located at north area of CERN. Protons are extracted from the SPS with momentum $p=400$ GeV/c producing a secondary positively charged hadron beam with a momentum of 75GeV.

Primary beam: p, 400 GeV/c.

Secondary beam: 6% of K^+ (75 GeV/c), 70% of π^+ , 24% of p.

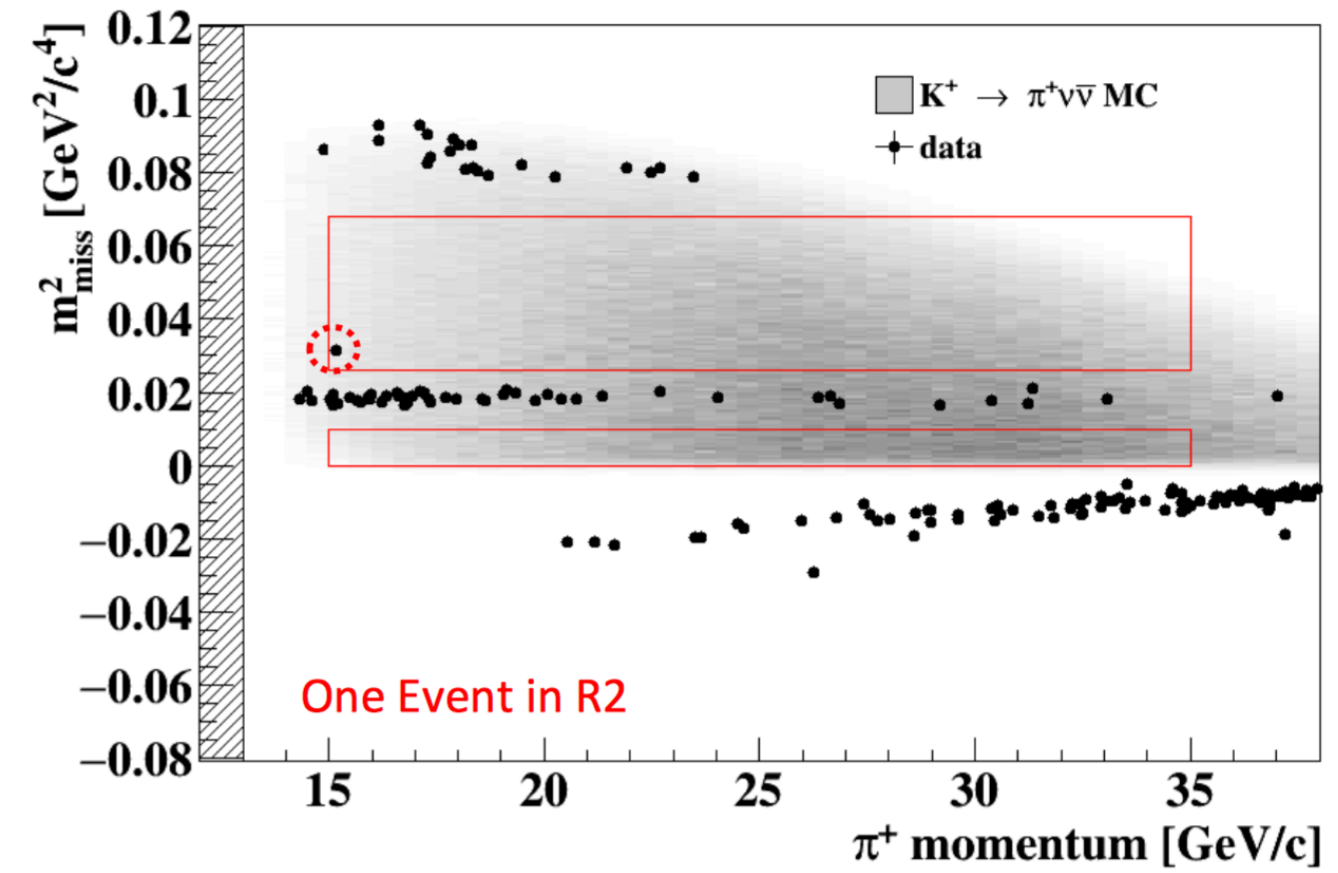
Schematic layout of the experiment Na62



- Differential Cherenkov counter (KTAG), GigaTracker (GTK), Charged ANTI (CHANTI) detector *for Kaon identification and direction*;
- Spectrometer (STRAW), Charged-particle hodoscope (CHOD), Ring-imaging Cherenkov counter (RICH) *for Pion identification and direction*;
- Large angle veto detector (LAV), Liquid Krypton Calorimeter (LKr), Small angle veto detectors (IRC, SAC) – *Photon Veto system*;
- MUV1,2,3 – *Muon Veto Detectors*.

The main goal of the NA62

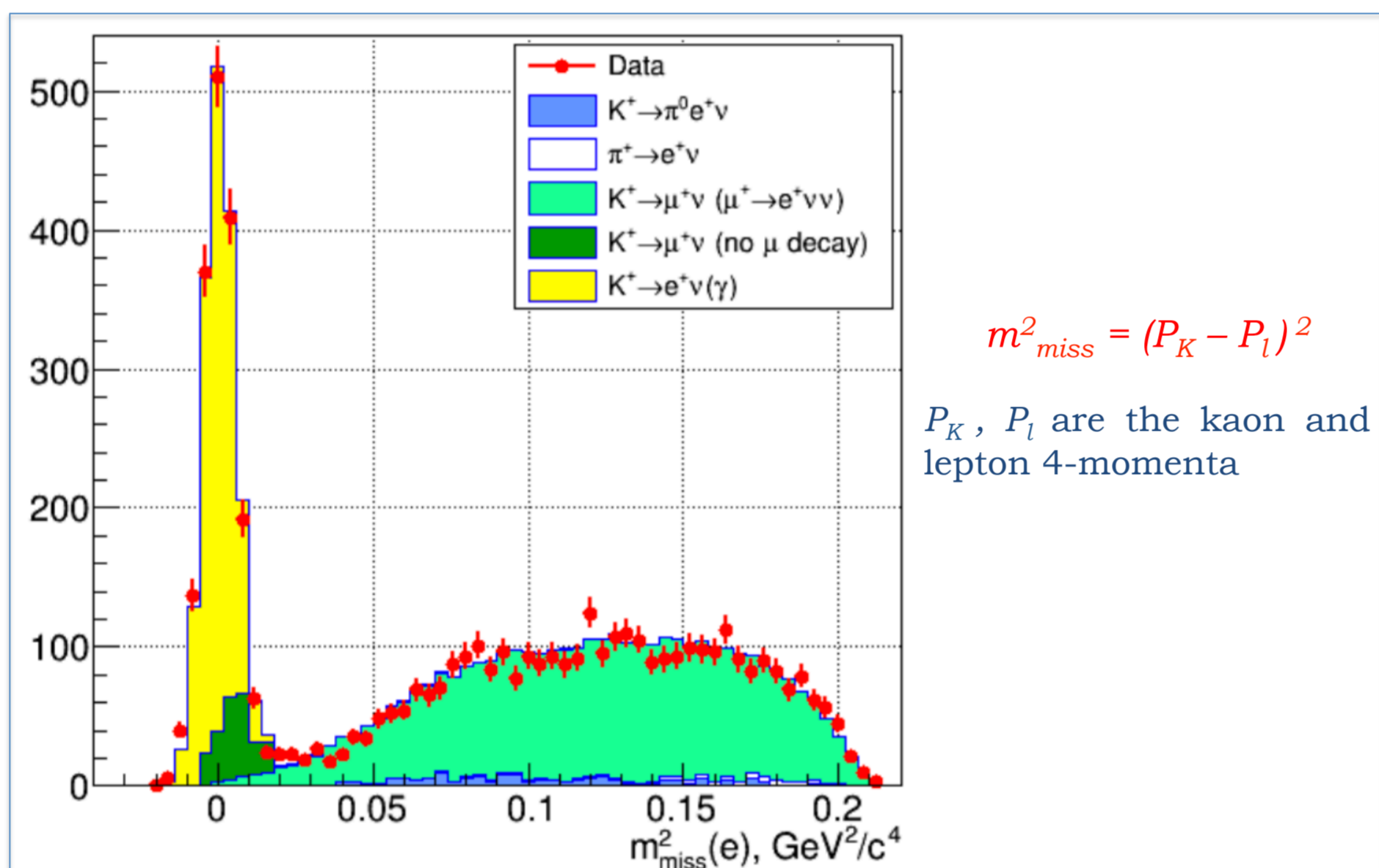
The main goal of the NA62 is to measure the branching ratio (BR) of the $K^+ \rightarrow \pi^+ \nu \nu$ decay with a precision of at least 10 %. In order to achieve this goal the experiment needs to collect about 10^{13} kaon decays of which $O(\text{few} \times 10^{12})$ have already been collected. Single event sensitivity was measured: $\text{SES} = (3.15 \pm 0.01_{\text{stat}} \pm 0.24_{\text{syst}}) \times 10^{-10}$. One event was observed.



Process	Expected events in R1+R2
$K^+ \rightarrow \pi^+ \nu \bar{\nu}$ (SM)	$0.267 \pm 0.001_{\text{stat}} \pm 0.020_{\text{syst}} \pm 0.032_{\text{ext}}$
Total Background	$0.15 \pm 0.09_{\text{stat}} \pm 0.01_{\text{syst}}$

We can find heavy neutral leptons in K^+ -decays: $K^+ \rightarrow e^+ N$. The data sample used for this study comes from collected data at beam intensity varying from 0.4% to 1.3% of the nominal one (as measured from the KTAG count rate) on October 2015. Total number of kaon decays for analysis: $(3.01 \pm 0.11) \times 10^8$.

Distributions of the m^2_{miss}

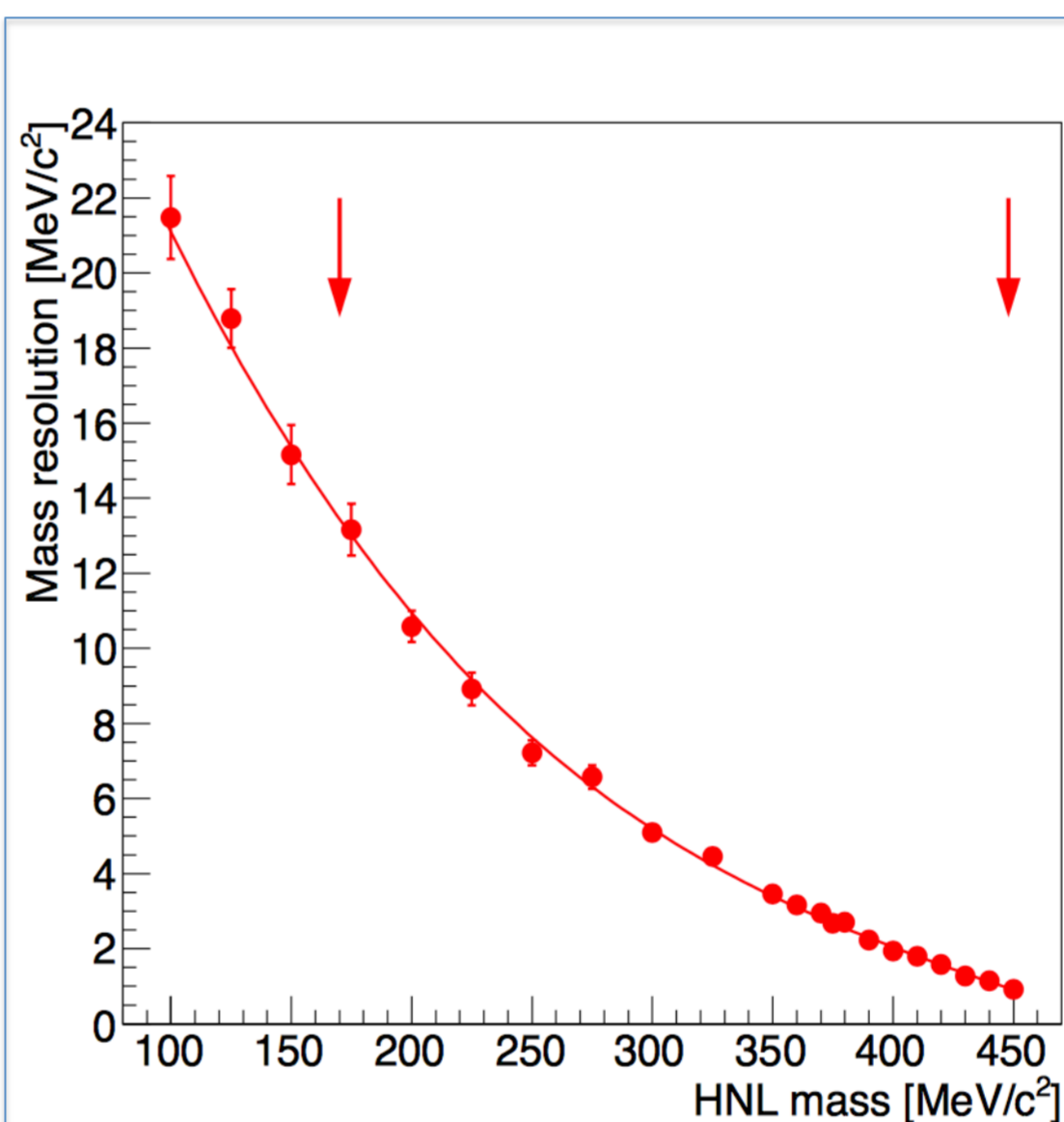


$$m^2_{\text{miss}} = (P_K - P_l)^2$$

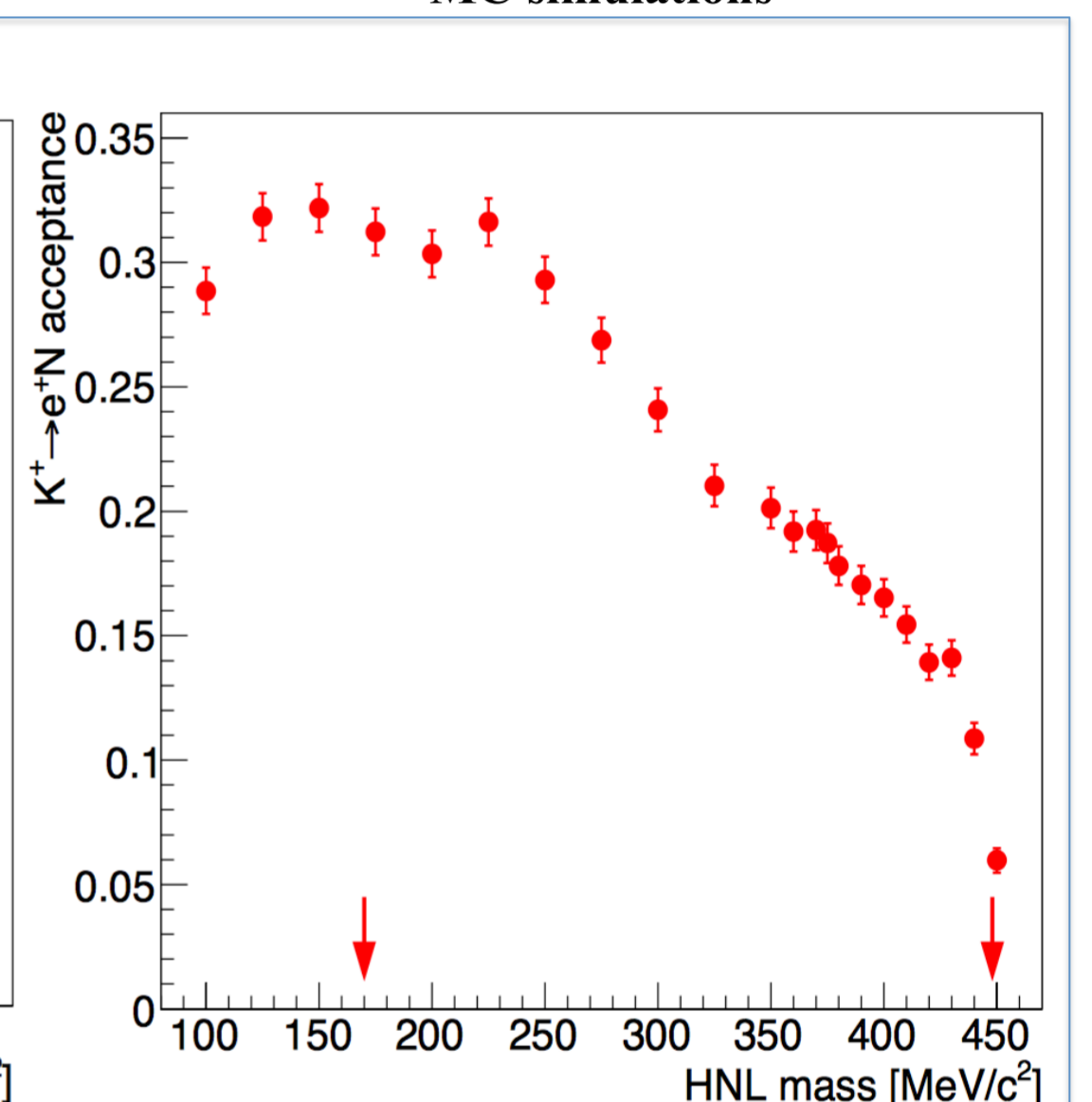
P_K, P_l are the kaon and lepton 4-momenta

Distributions of the m^2_{miss} variable for data and simulated events passing the e^+ -selections. The bin widths are 0.004 GeV^2/c^4 . The HNL signal regions correspond approximately to 0.03 – 0.20 GeV^2/c^4 in m^2_{miss} values in the e^+ .

Missing mass resolution σ evaluated from MC simulation

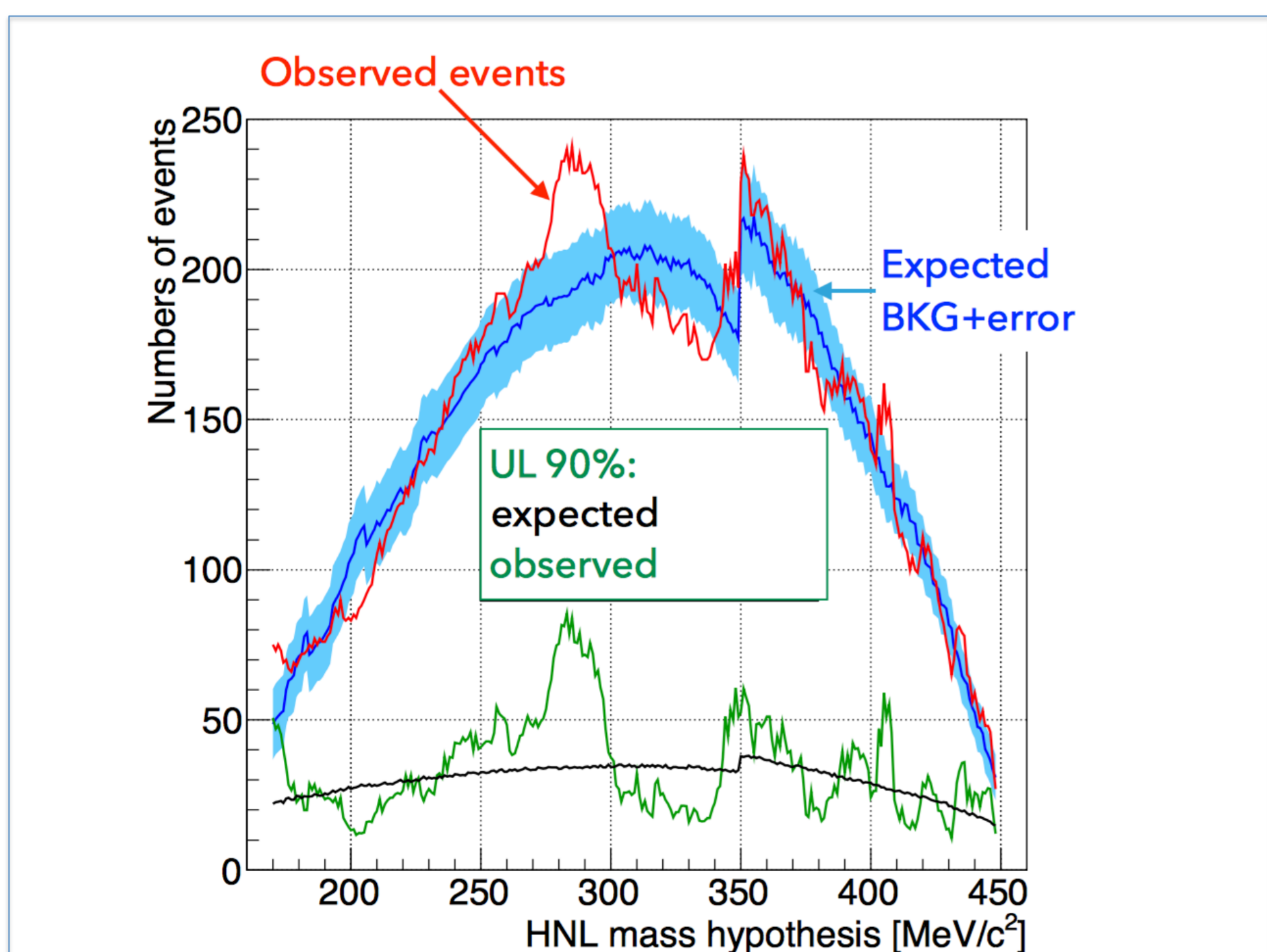


Acceptances of the selections as functions of HNL mass obtained with MC simulations

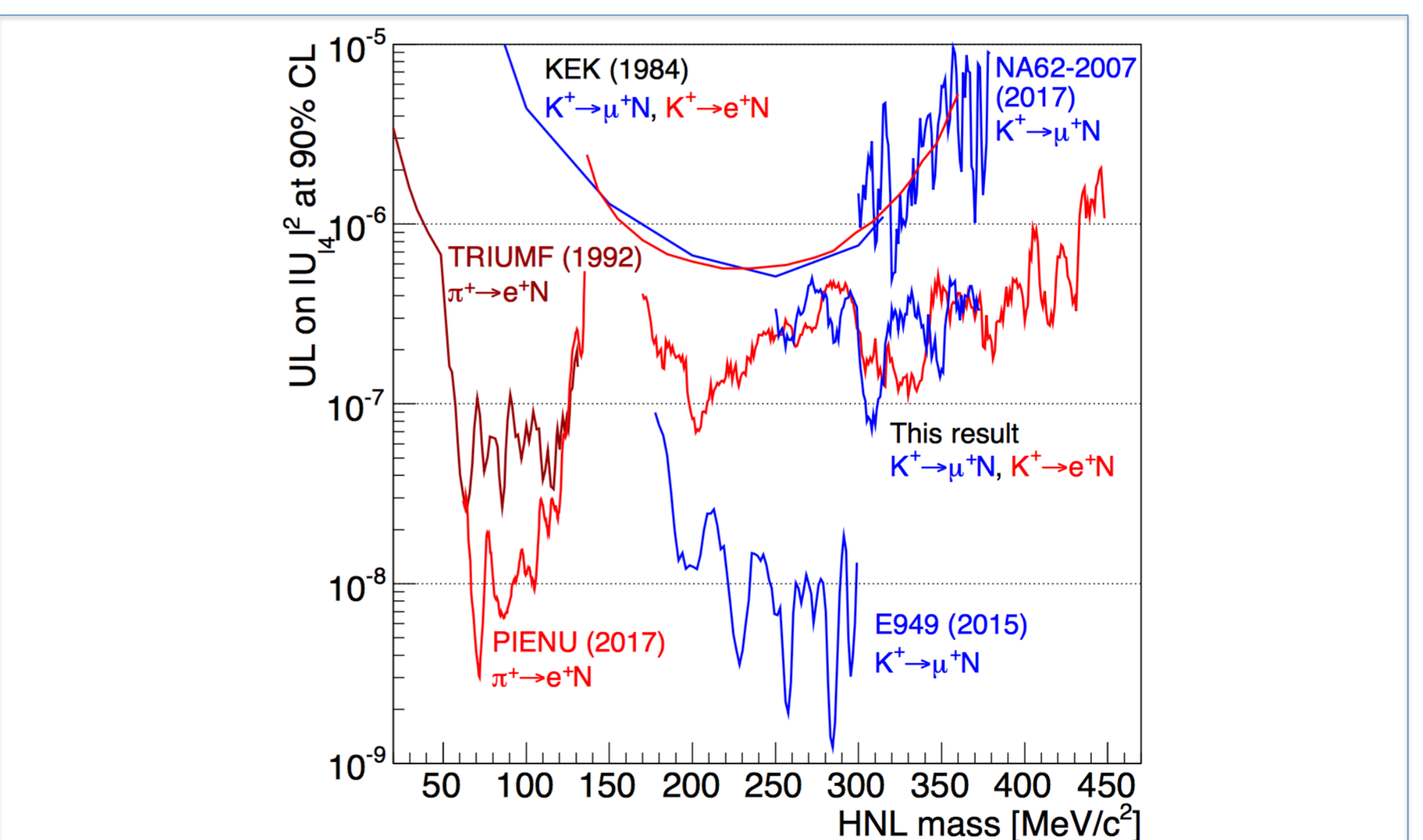


- Mass region for analyze is $170 < m < 448$ MeV/c^2 .
- Mass scans are performed in the HNL signal regions with a step size of 1 MeV/c^2 .
- The reconstructed missing mass should be within $\pm 1.5 \sigma$ of the assumed HNL mass.

Results



For each NHL mass hypothesis, numbers of expected (N_{exp}) and observed (N_{obs}) events, together with the uncertainty on N_{exp} .



Upper limits on $|U_{14}|^2$ obtained for each assumed HNL mass compared to the limits established by earlier HNL production searches in π^+ -decays: TRIUMF (1992), PIENU (2017) and K^+ -decays: KEK (1984), E949 (2015), NA62-2007 (2017).

Conclusion

Event selection was developed, using 2015 data of the experiment NA62. A search for HNL production in $K^+ \rightarrow l^+ N$ decays has been performed. Upper limits on the HNL mixing parameter $|U_{e4}|^2$ in the ranges 170 – 448 MeV/c^2 have been established at the level between 10^{-7} and 10^{-6} . This improves the previous limits from production searches, typically by an order of magnitude.