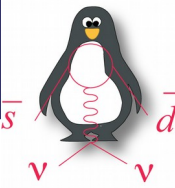


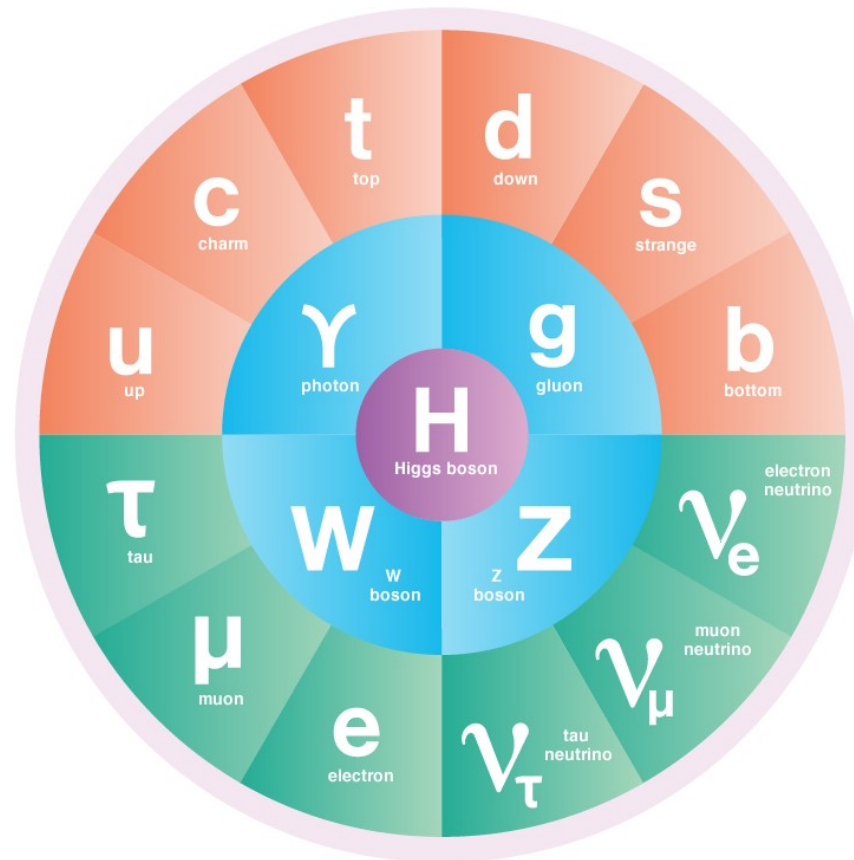
The NA62 experiment



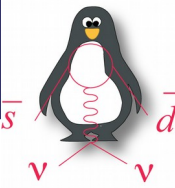
LLN 2019, 10th May



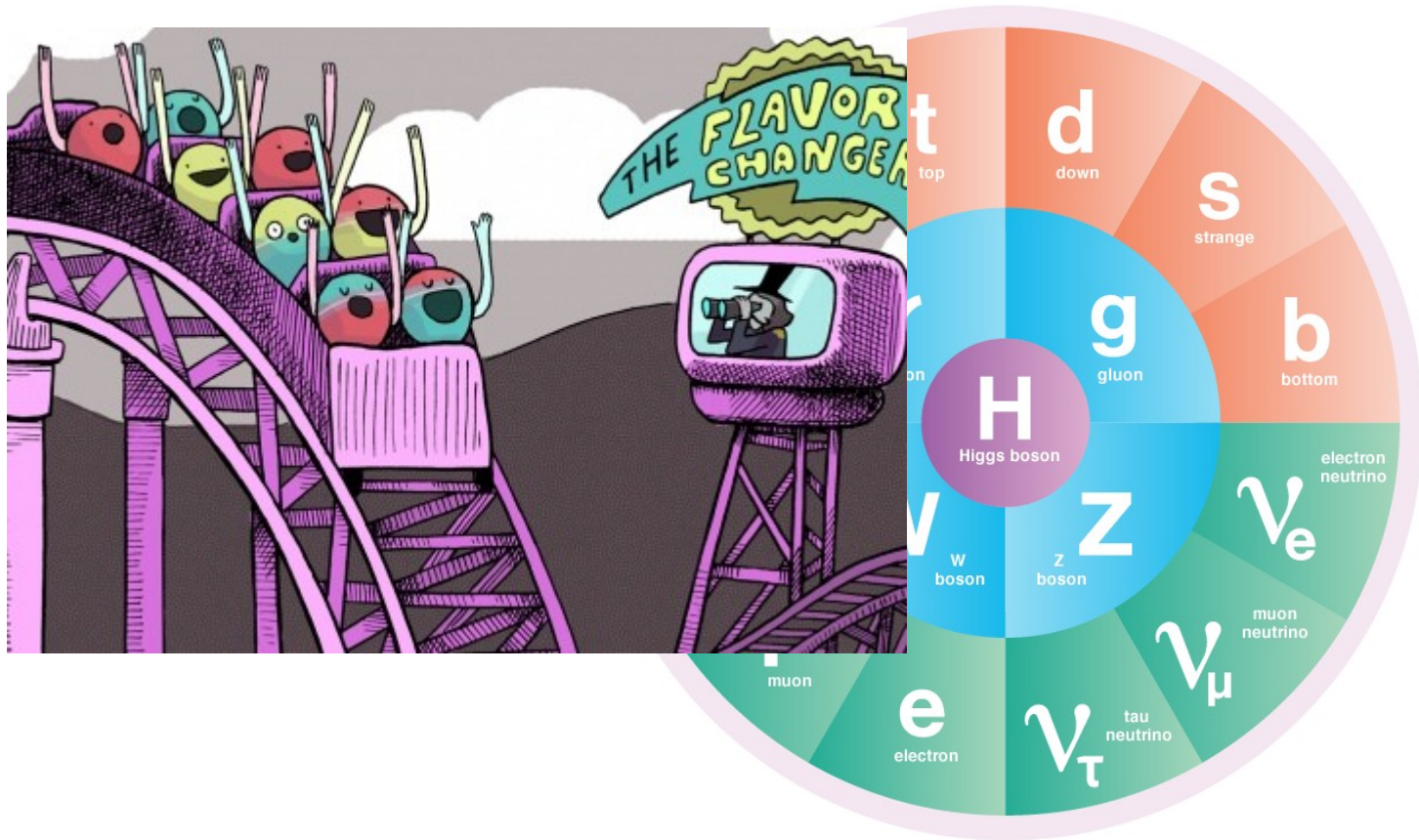
The Standard Model



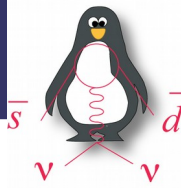
With the discovery of the Higgs boson all SM puzzle pieces were found



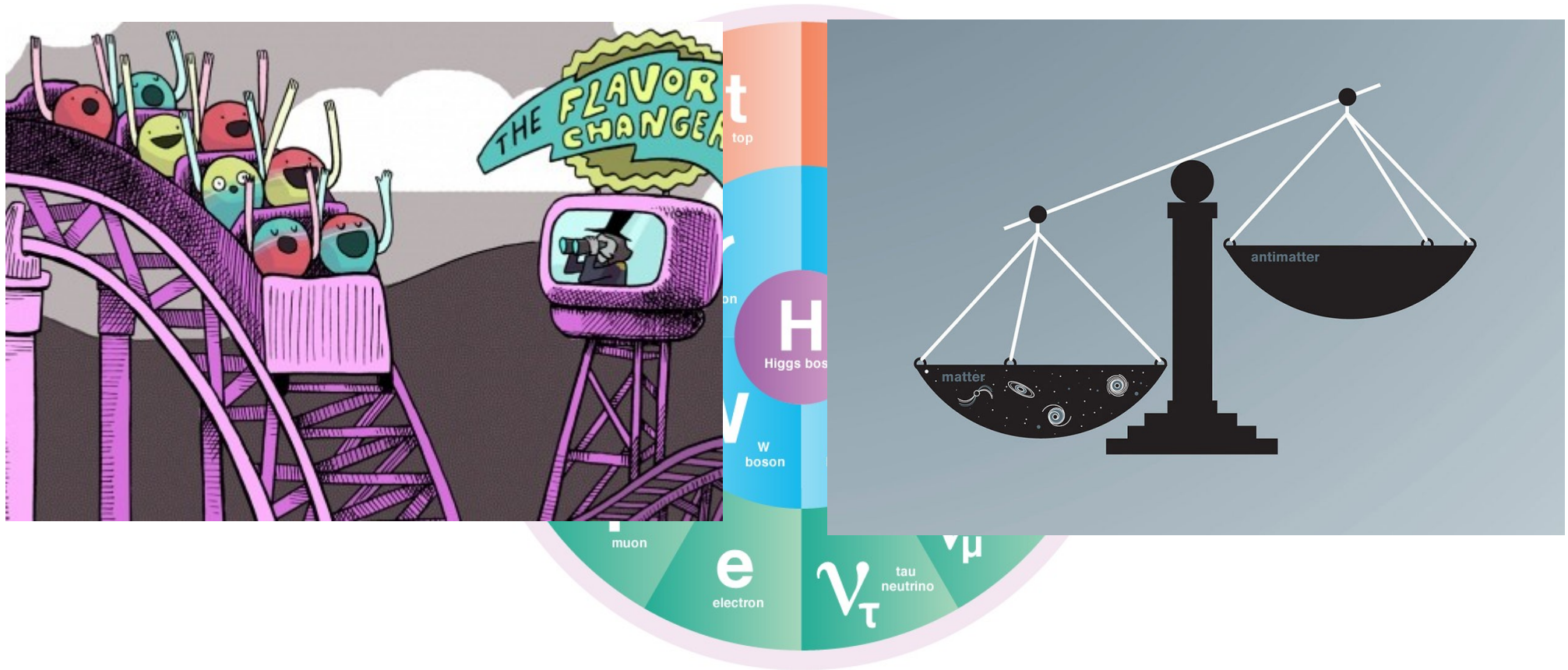
The Standard Model



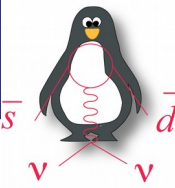
With the discovery of the Higgs boson all SM puzzle pieces were found



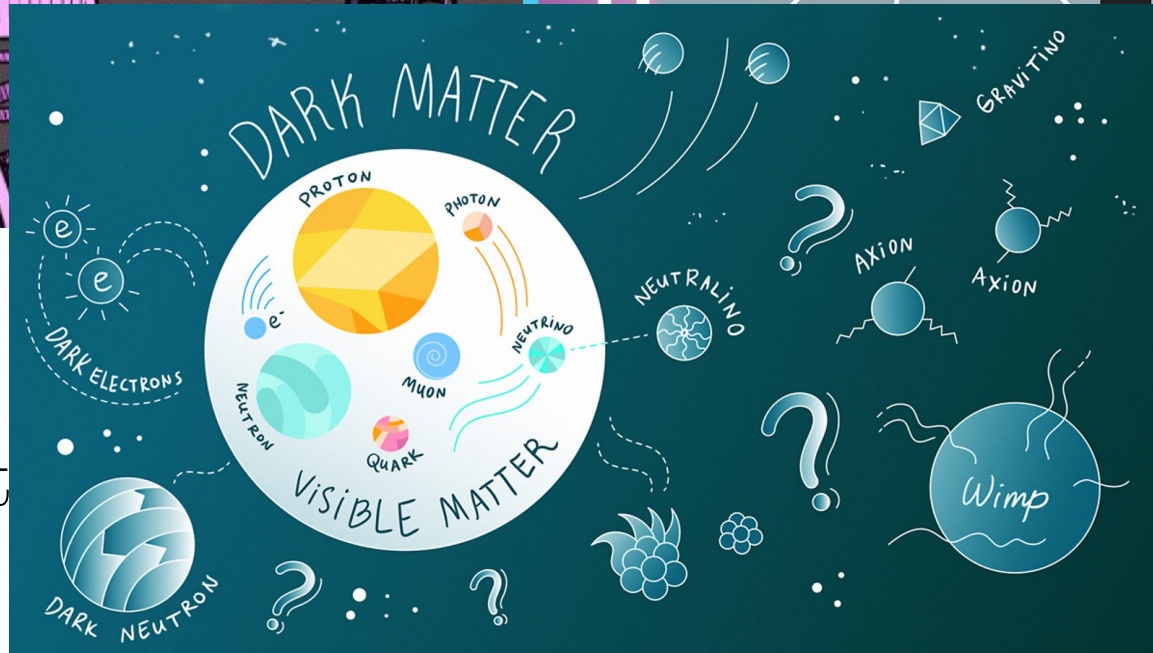
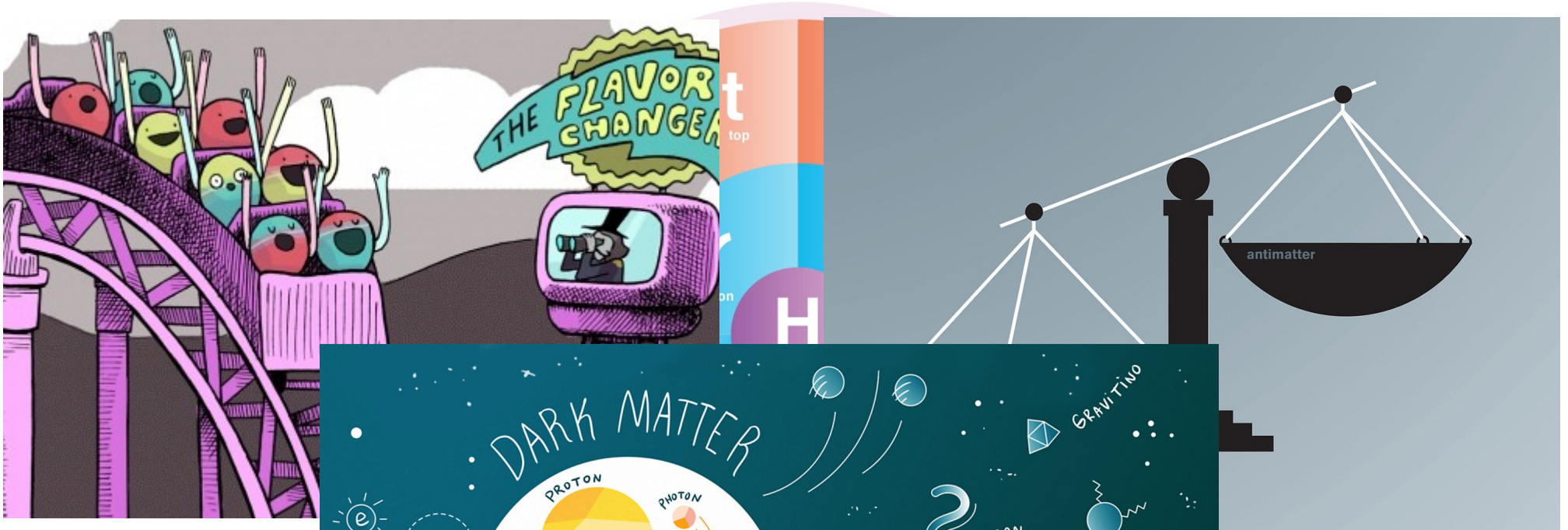
The Standard Model



With the discovery of the Higgs boson all SM puzzle pieces were found

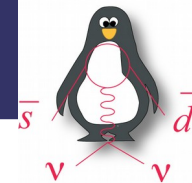


The Standard Model

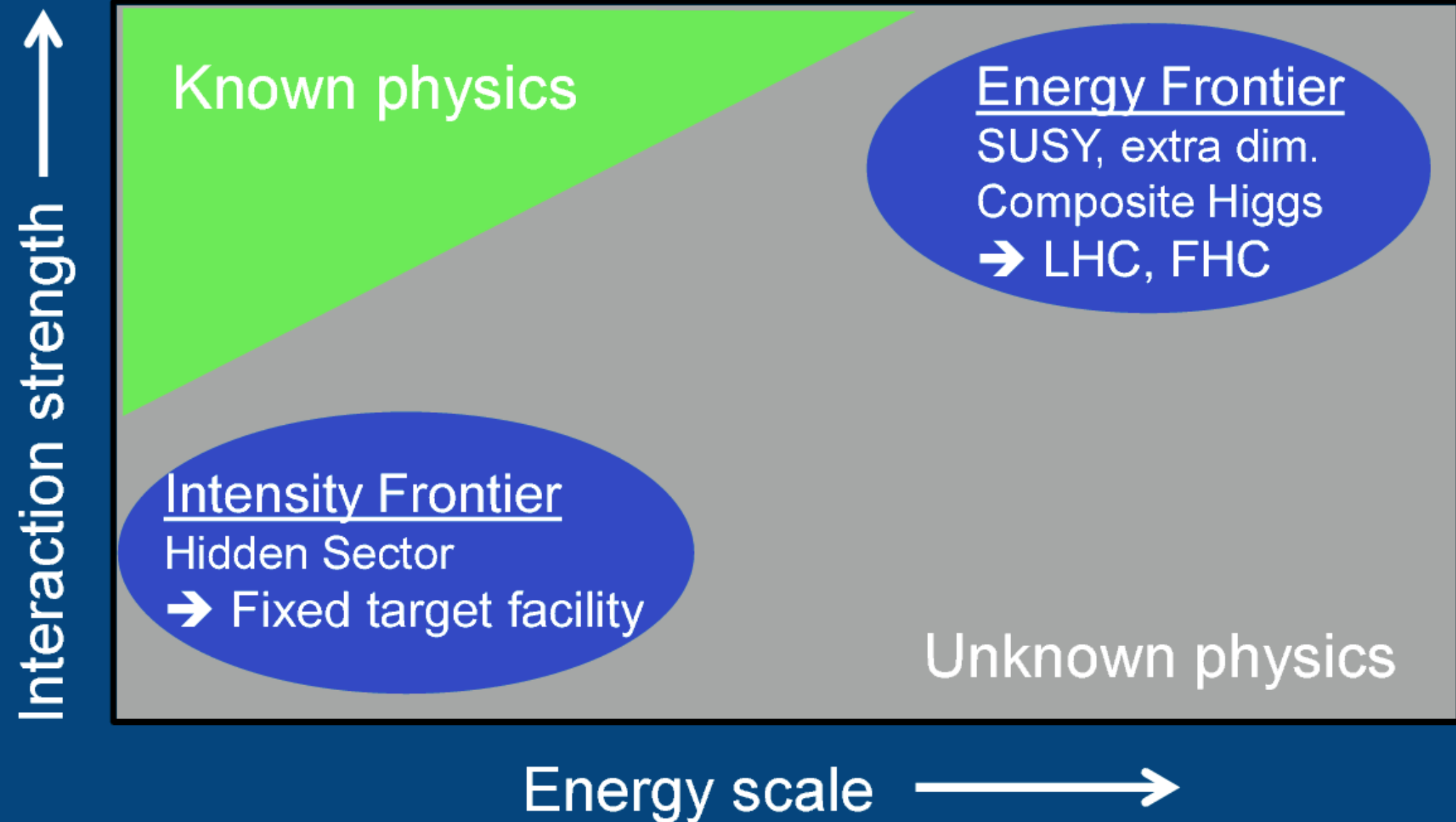


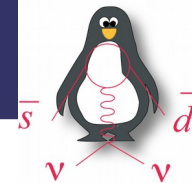
With t

n all SM



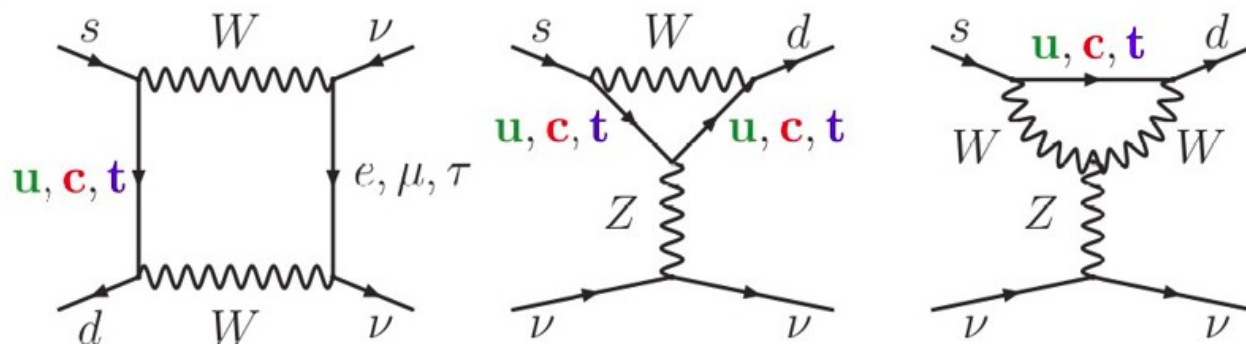
Where to look for New Physics?





New Physics with $K \rightarrow \pi \nu \bar{\nu}$

Flavor-changing neutral current – extremely suppressed in the SM



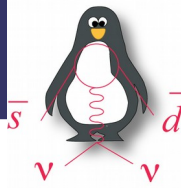
Precise theoretical prediction ($\sim 2\%$ of intrinsic theory uncertainty)

$$\mathcal{B}(K^+ \rightarrow \pi^+ \nu \bar{\nu}) = (8.4 \pm 1.0) \times 10^{-11}$$

[Buras et al., JHEP11(2015)033]

$$\mathcal{B}(K^+ \rightarrow \pi^+ \nu \bar{\nu}) = (17.3_{-10.5}^{+11.5}) \times 10^{-11}$$

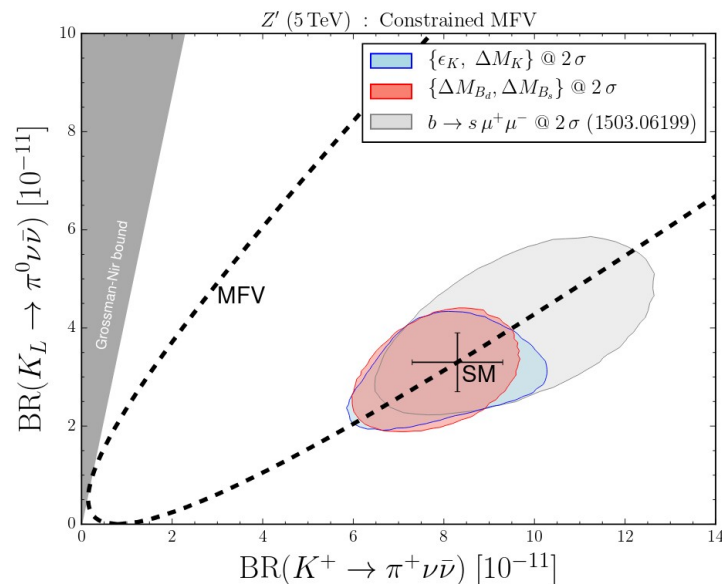
[Phys. Rev D 79, 092004 (2009)]



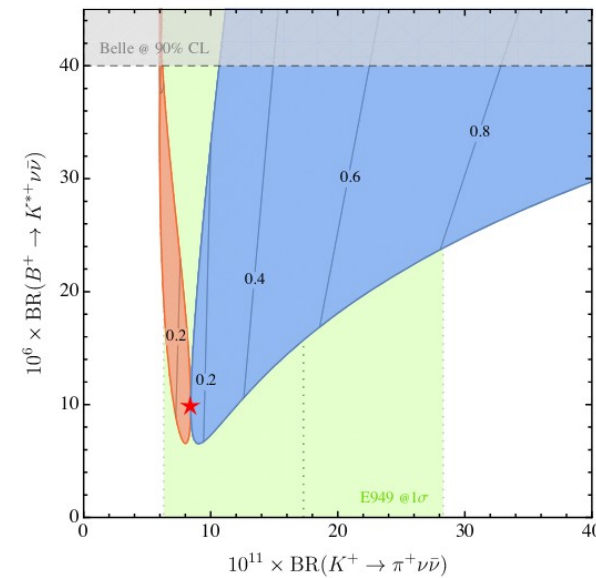
NP searches with $K \rightarrow \pi \nu \bar{\nu}$

- Simplified Z, Z' models [Buras, Buttazzo, Kneijens, JHEP11(2015)166]
- Custodial Higgs-Sundrum [Blanke, Buras, Doring, Gorbunov, JHEP 0903 (2009) 108]
- MSSM [Blazek, Matak, Int.J.Mod.Phys. A24(2009)27]
- LFU violation models [Isidori et al., Eur. Phys. J. C (2017) 77: 618]

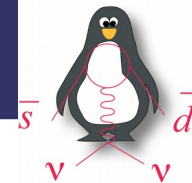
Multiple new physics models



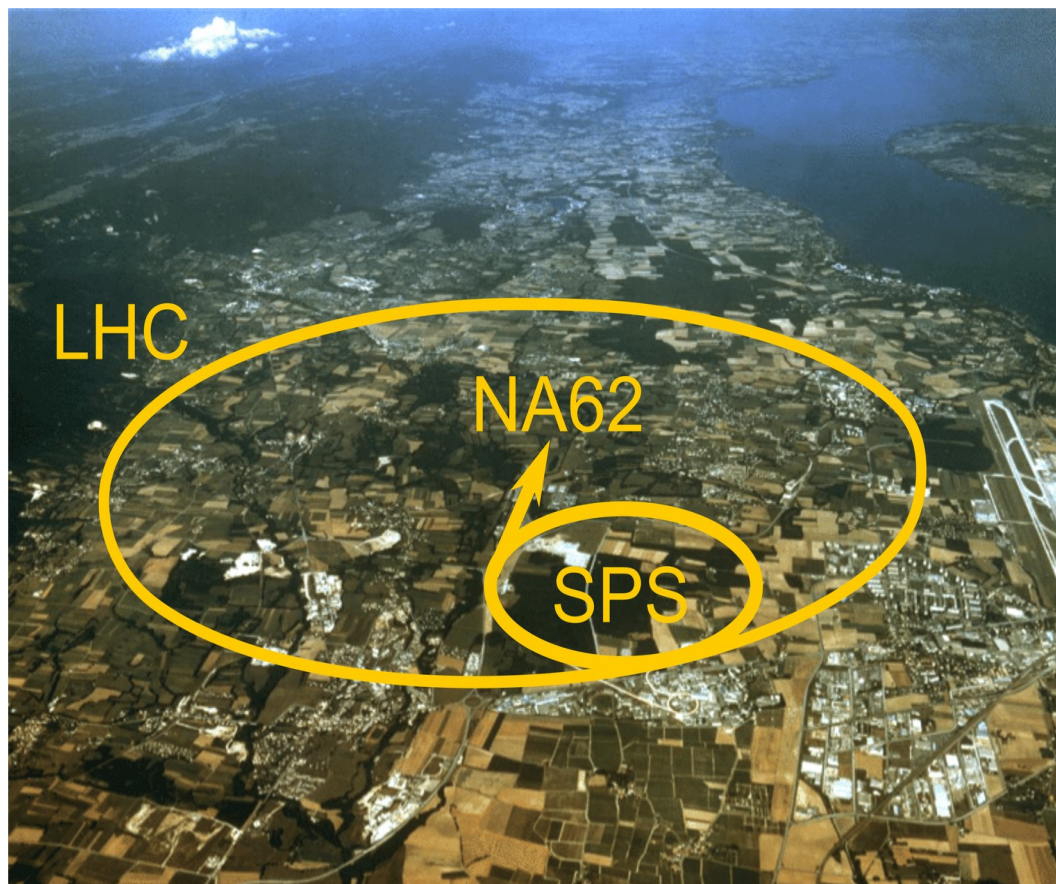
Z' model (Z'=5TeV)



LFU violation



NA62

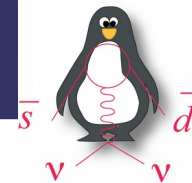


NA62 – fixed target kaon experiment at CERN SPS

Main goal: measurement of the $\text{BR}(\text{K}^+ \rightarrow \pi^+ \nu \bar{\nu})$ with **10%** precision using novel **kaon-in-flight** technique.

Time scale:

- **2014** – Pilot run
- **2015** – Commissioning run: ~1% of design intensity, no beam tracker
- **2016** - Commissioning run + Physics run (30 days)
- **2017** – Physics run (161 days)
- **2018** – Physics run (217 days)
- **2019-2020** – LS2



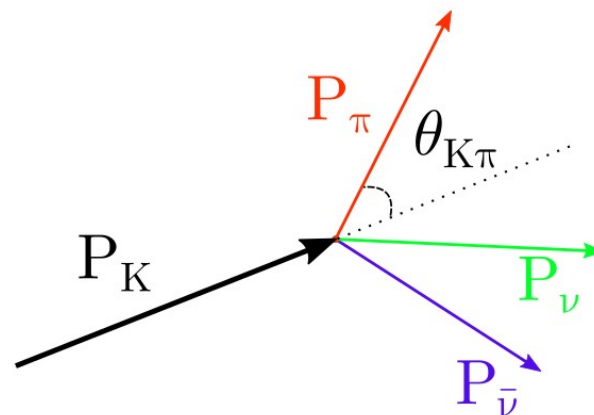
How do we measure it?

Kaon decays in flight

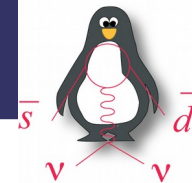
Signal: K^+ associated to π^+ and missing energy

Most discriminating variable:

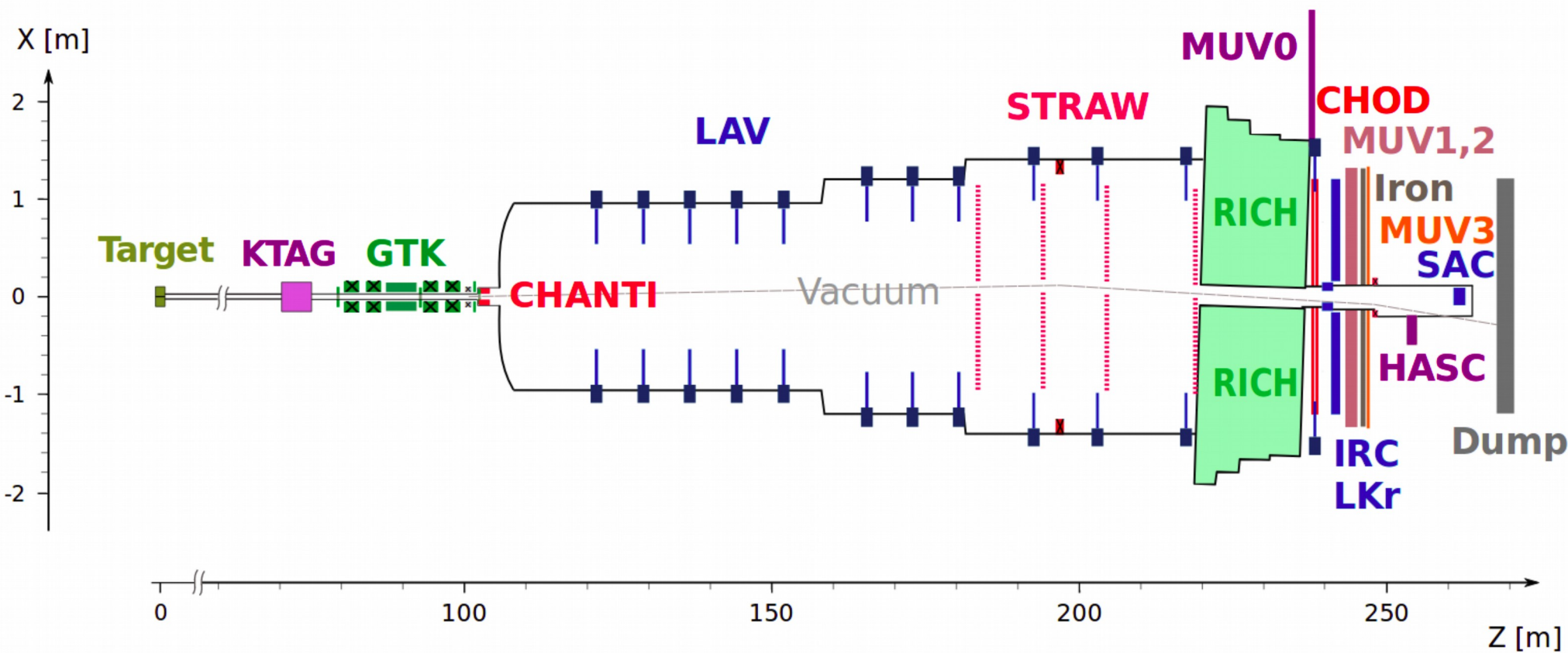
$$m_{miss}^2 = (P_{K^+} - P_{\pi^+})^2$$

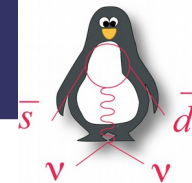


| Decay | BR | Main rejection tools |
|---------------------------------------|-----|-----------------------------|
| $K^+ \rightarrow \mu^+ \nu(\gamma)$ | 63% | μ -ID + kinematics |
| $K^+ \rightarrow \pi^+ \pi^0(\gamma)$ | 21% | γ -veto + kinematics |
| $K^+ \rightarrow \pi^+ \pi^+ \pi^-$ | 6% | multi-track + kinematics |
| $K^+ \rightarrow \pi^+ \pi^0 \pi^0$ | 2% | γ -veto + kinematics |
| $K^+ \rightarrow \pi^0 e^+ \nu_e$ | 5% | e-ID + γ -veto |
| $K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$ | 3% | μ -ID + γ -veto |

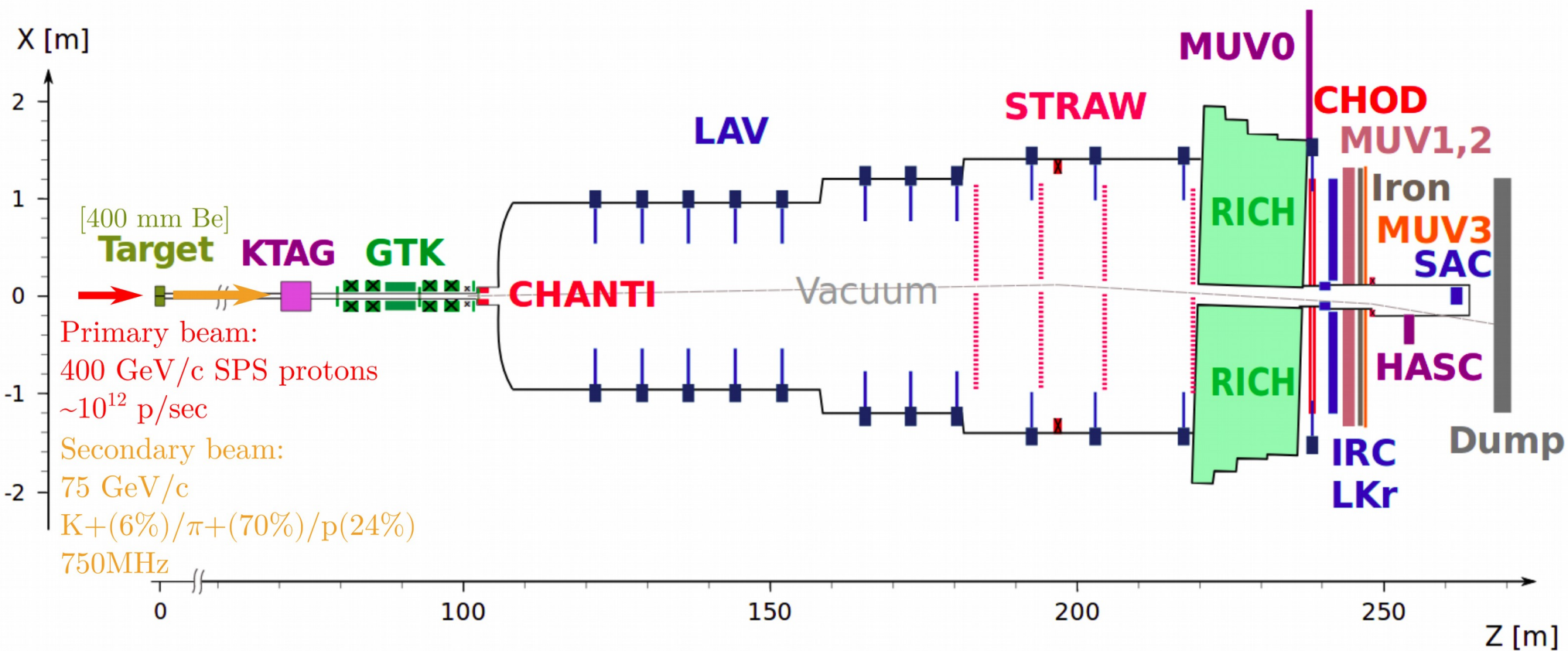


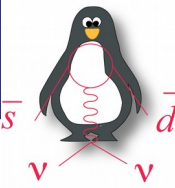
Detector overview





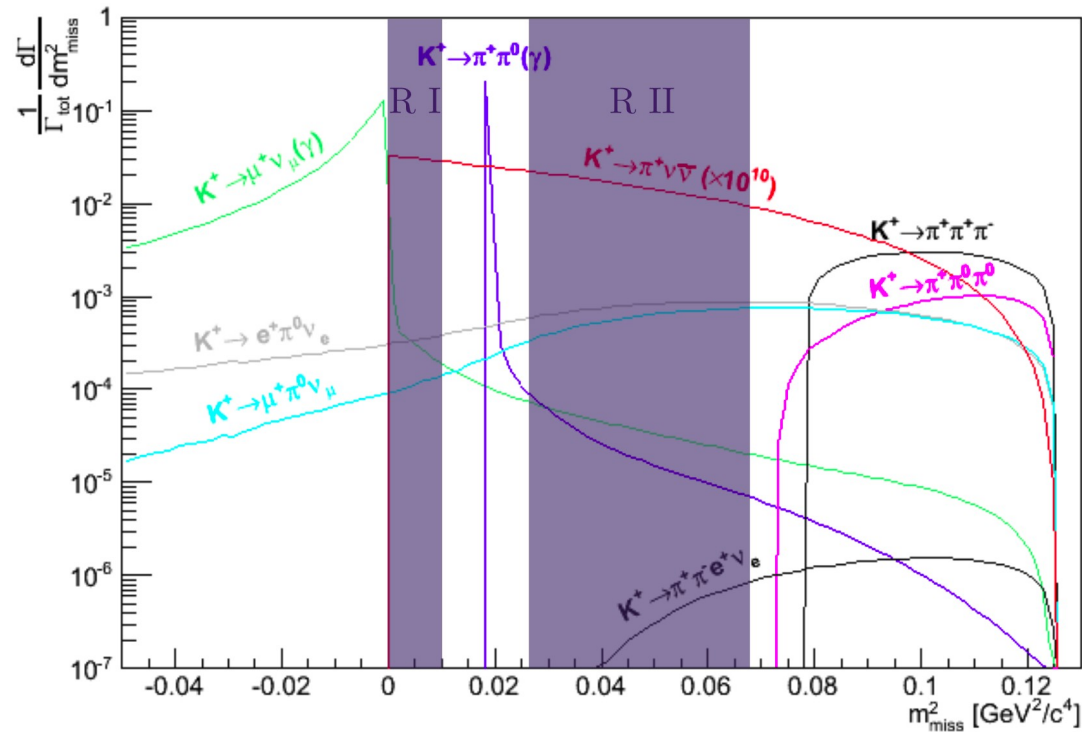
Beam

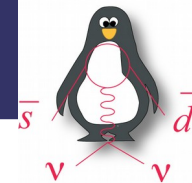




Kinematics

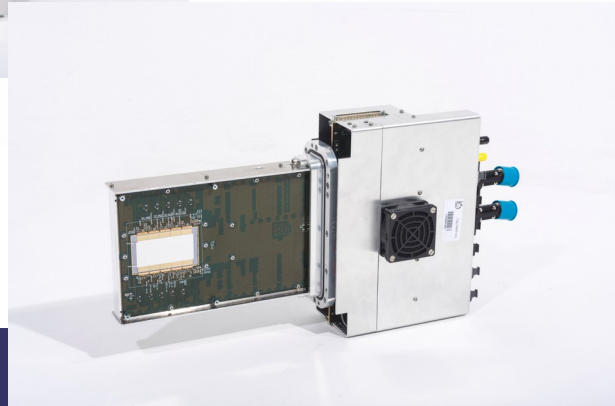
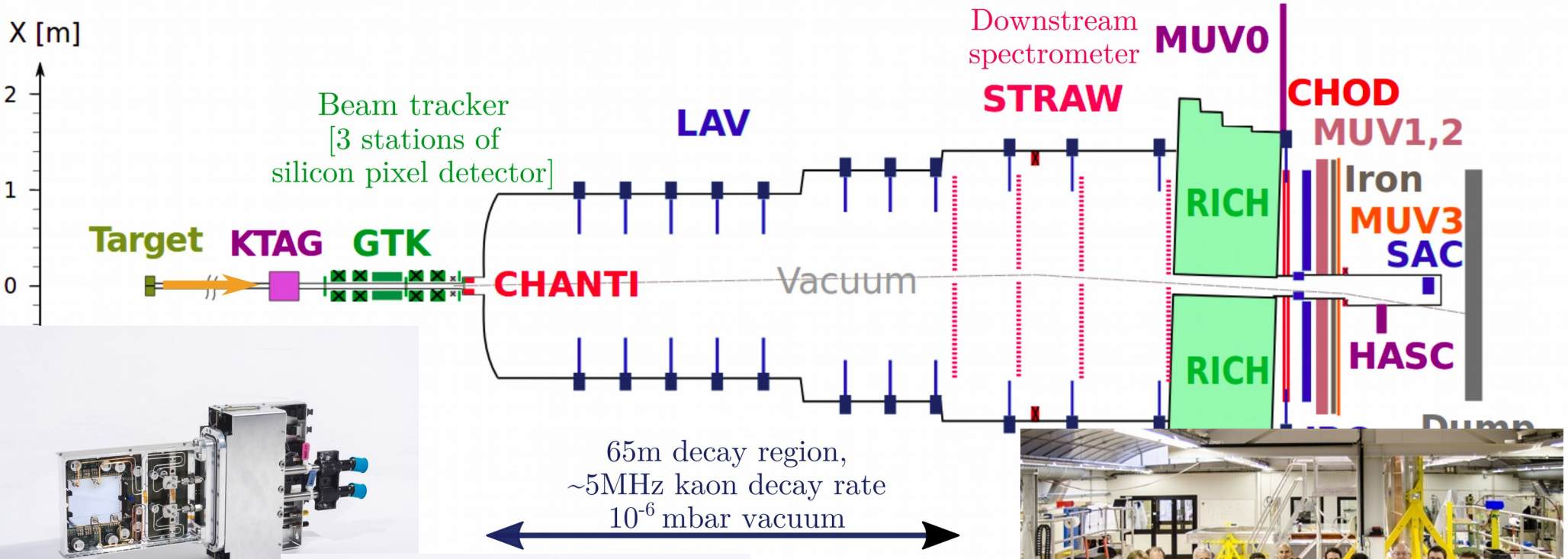
$$m_{miss}^2 = (P_{K^+} - P_{\pi^+})^2$$

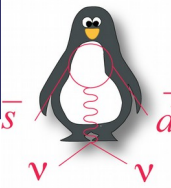




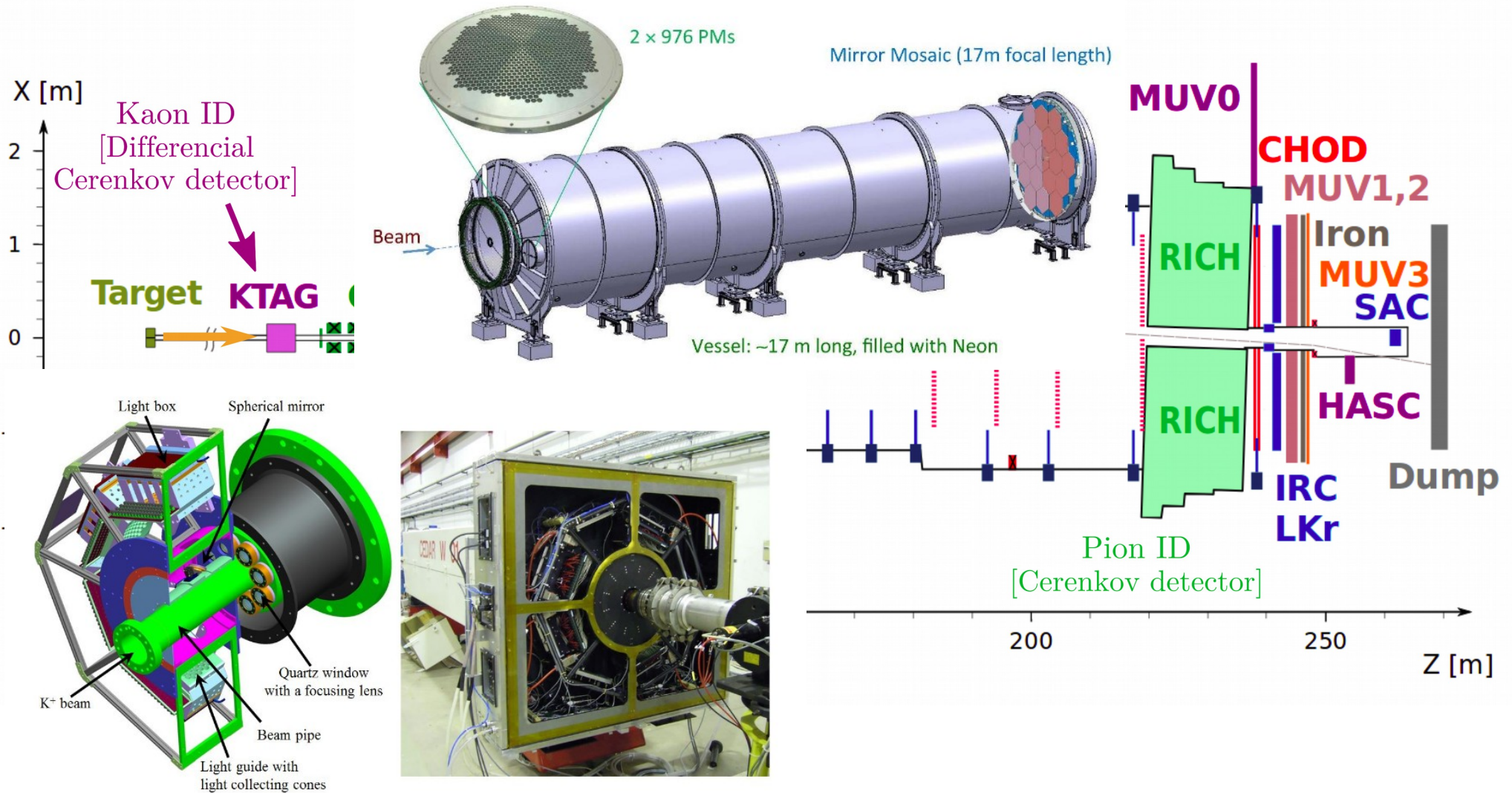
Kinematics

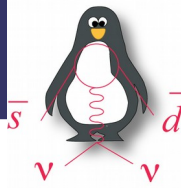
$$m_{miss}^2 = (P_{K^+} - P_{\pi^+})^2$$



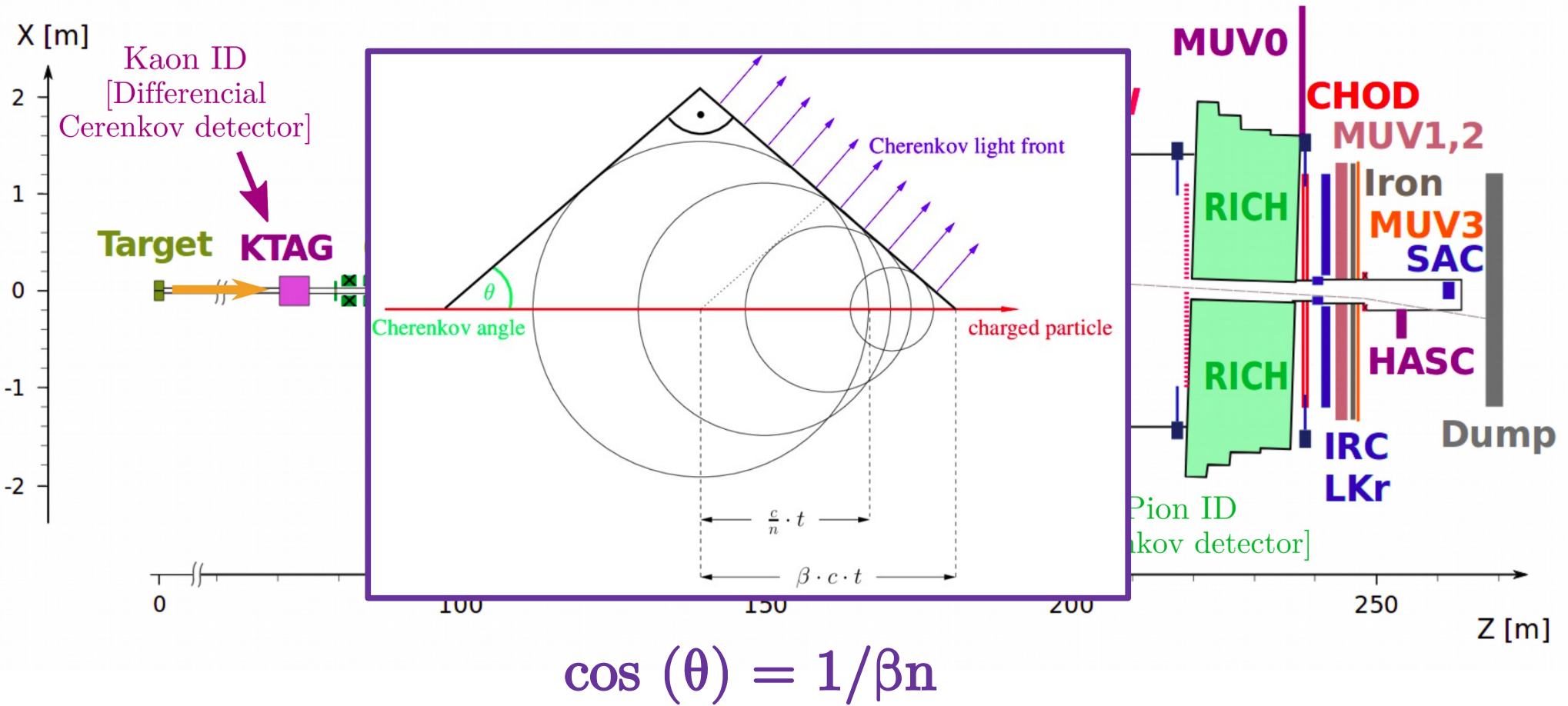


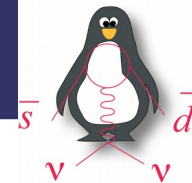
Particle identification



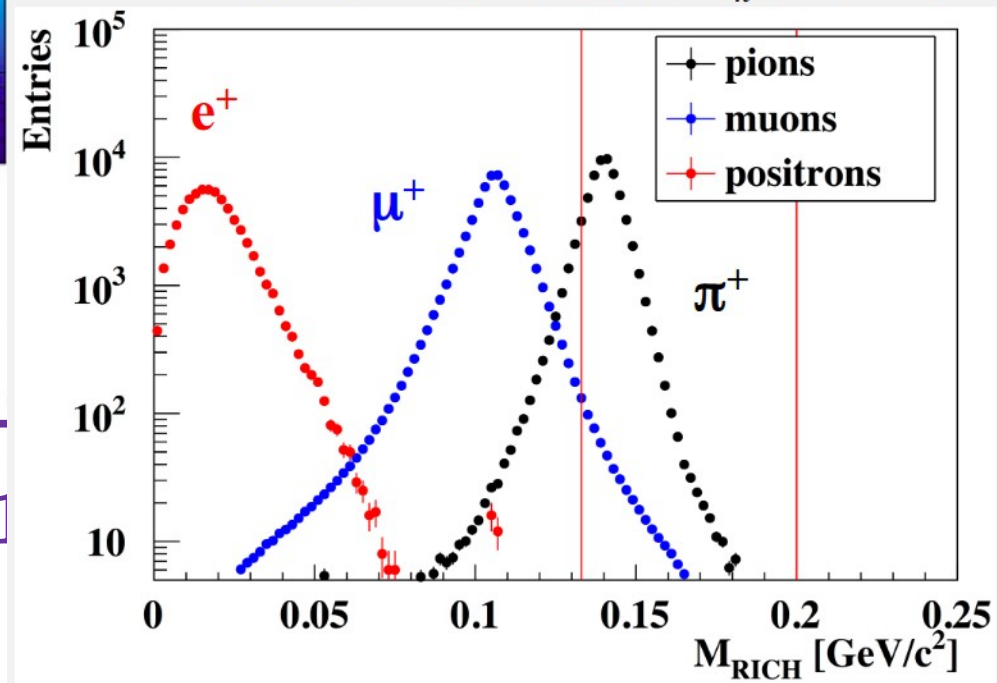
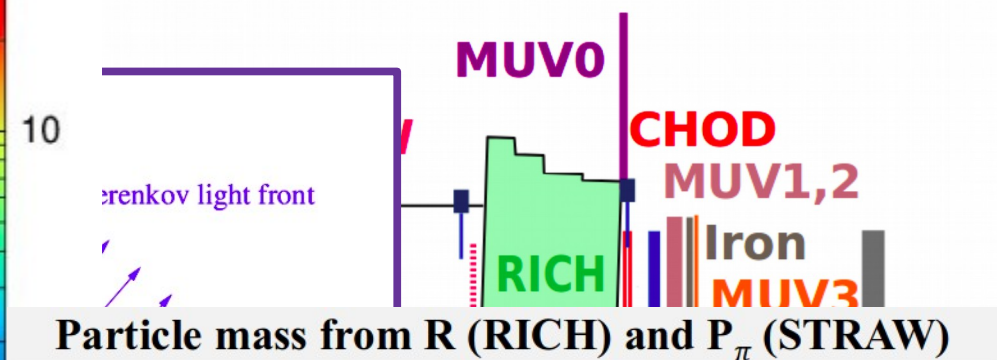
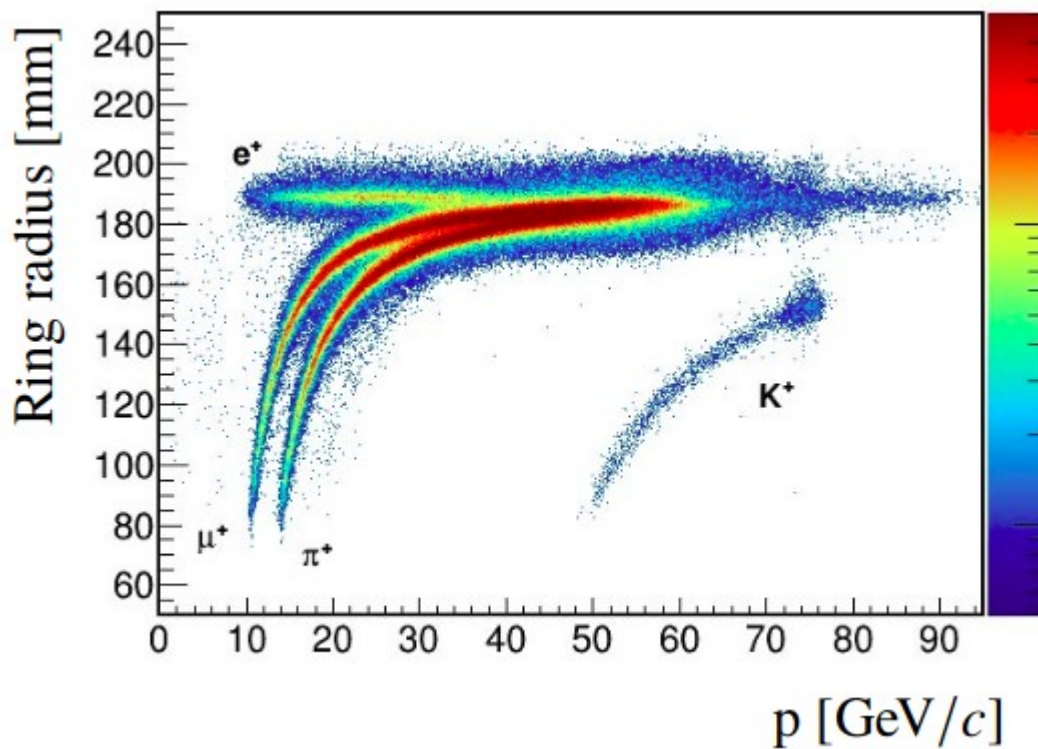


Particle identification

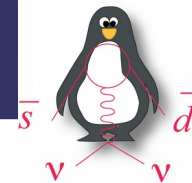




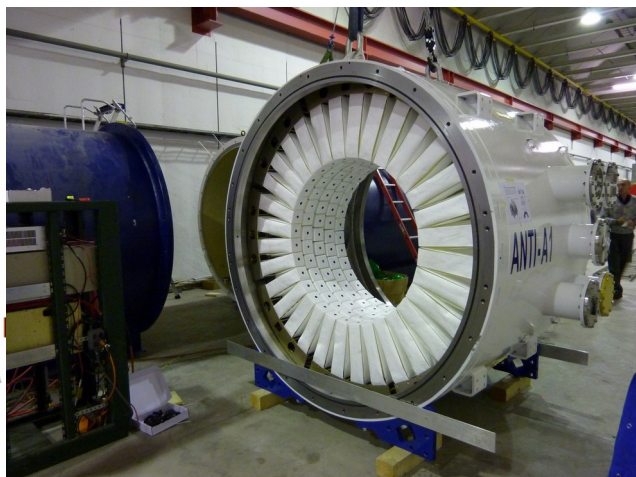
Particle identification



$$\cos(\theta) = \frac{p_z}{p} = \frac{p_z}{\beta \gamma m} = \frac{p_z}{\beta \gamma m} = \frac{p_z}{\beta \gamma m}$$



Veto



Large angle photon veto
[EM calorimeters]

LAV

STRAW

MUVO

CHOD Muon veto
MUV1,2

Iron
MUV3

SAC

HASC

Dump

Photon veto
[EM calorimeters]

Target KTAG GTK

CHANTI Vacuum

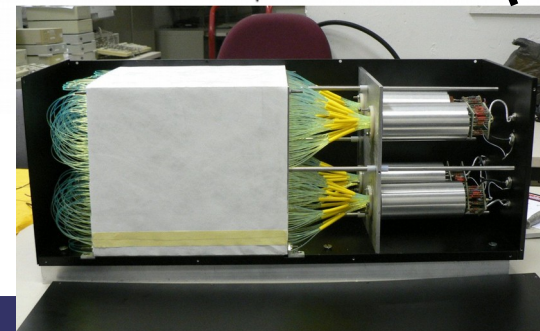
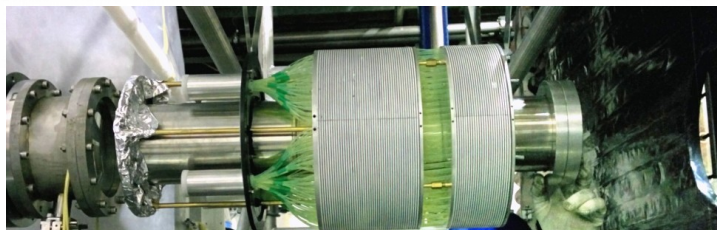
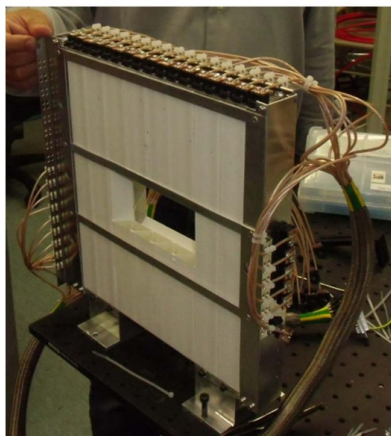
Beam guard ring

65m decay region,
~5MHz kaon decay rate
 10^{-6} mbar vacuum

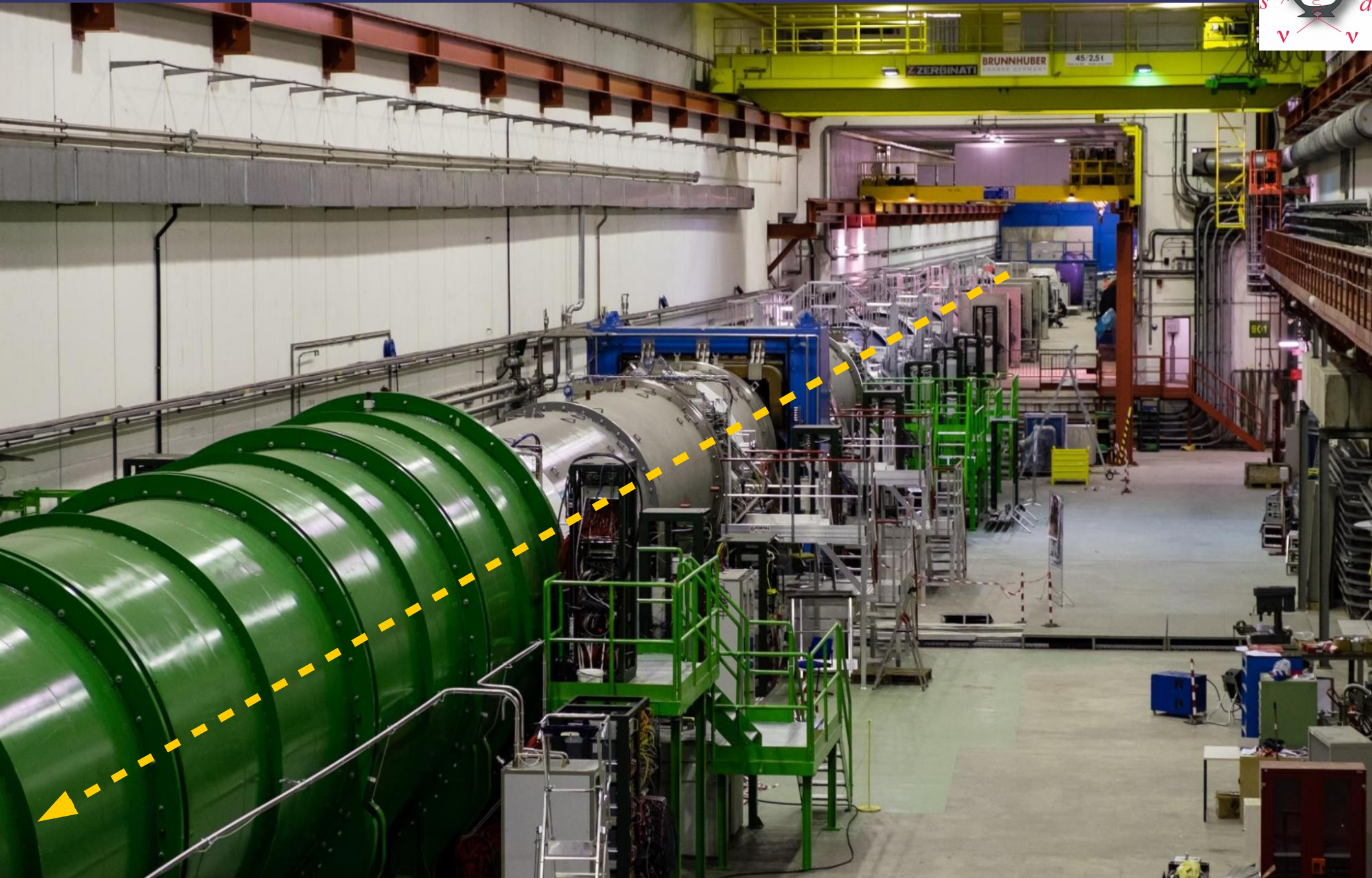
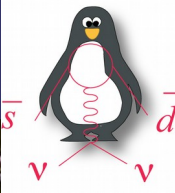
100

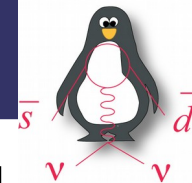
150

200



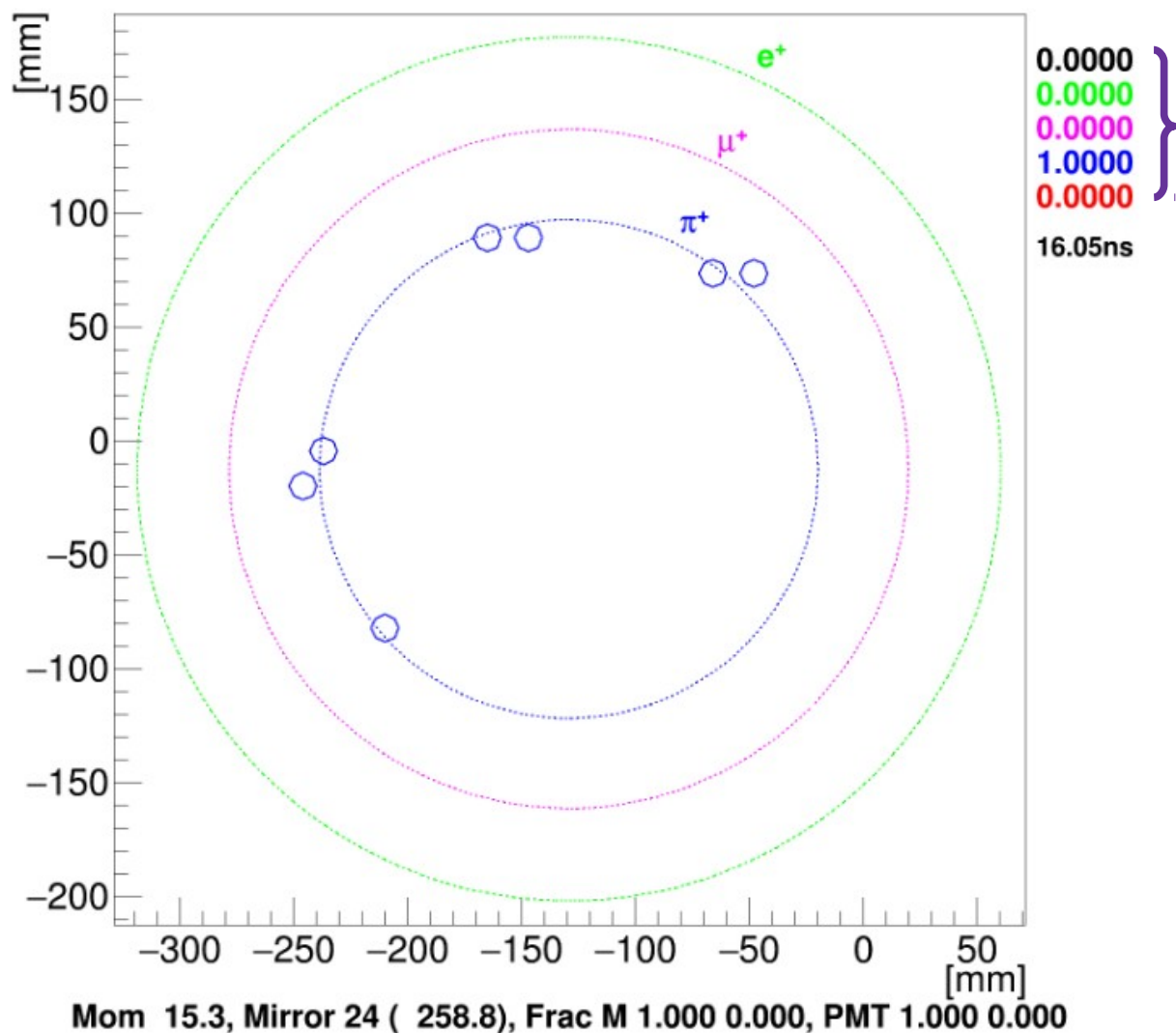
NA62

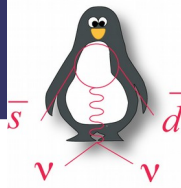




Our first Results: RICH ring for the event

Run 6646, Burst 953, Event 543854, Track 1

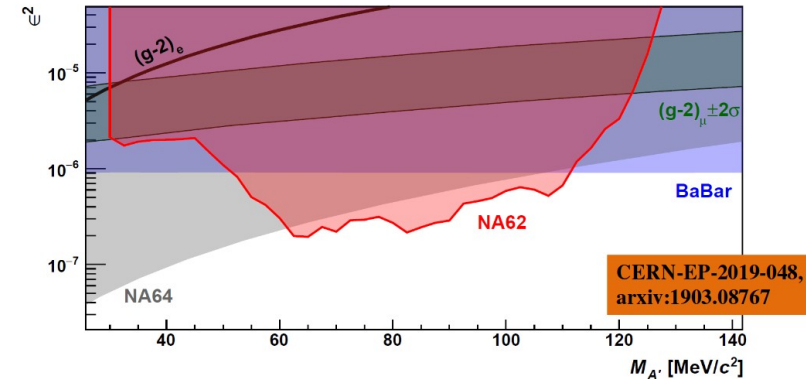
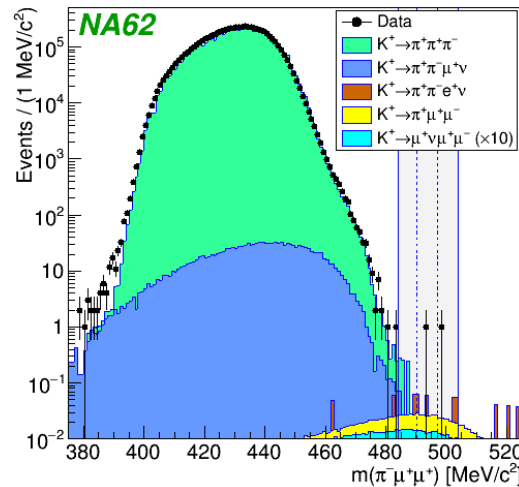
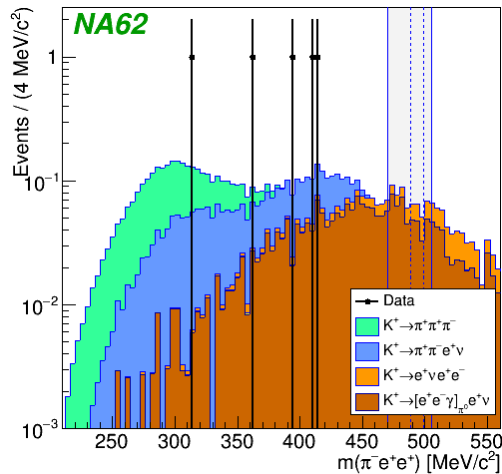
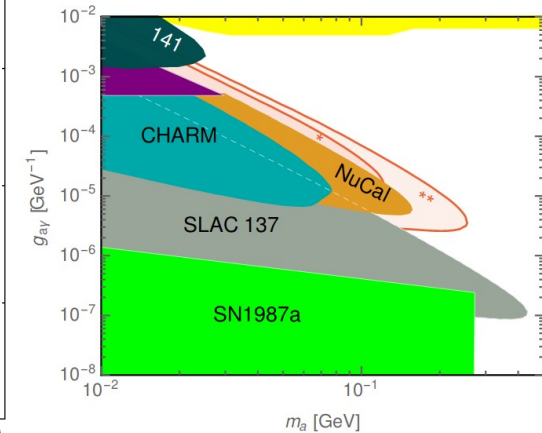
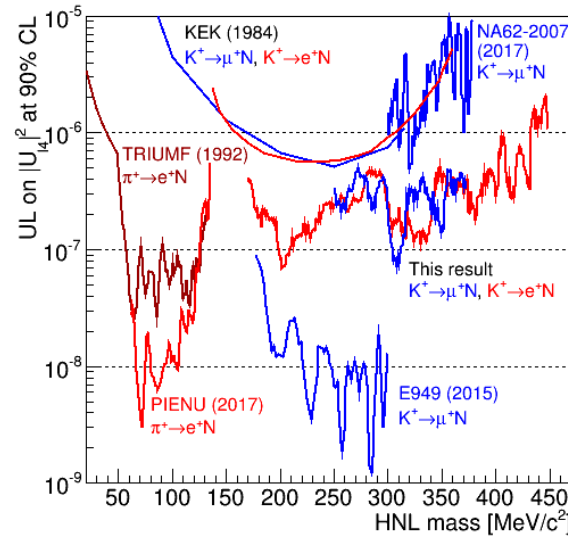


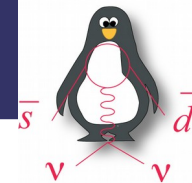


Not only kaon factory

Ongoing NP searches at NA62:

- Heavy Neutral Leptons
- Axion like particles
- LN/LF violation in kaon decays
- Dark photon





Questions?

