Discussion: A Stopped $K^+ \rightarrow \pi^+\nu\nu$ Experiment for CERN?

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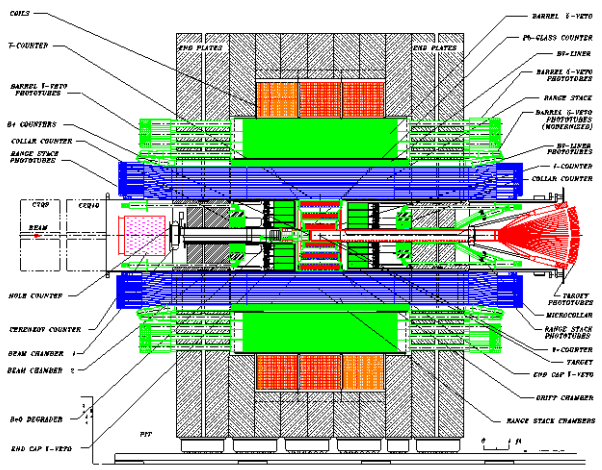
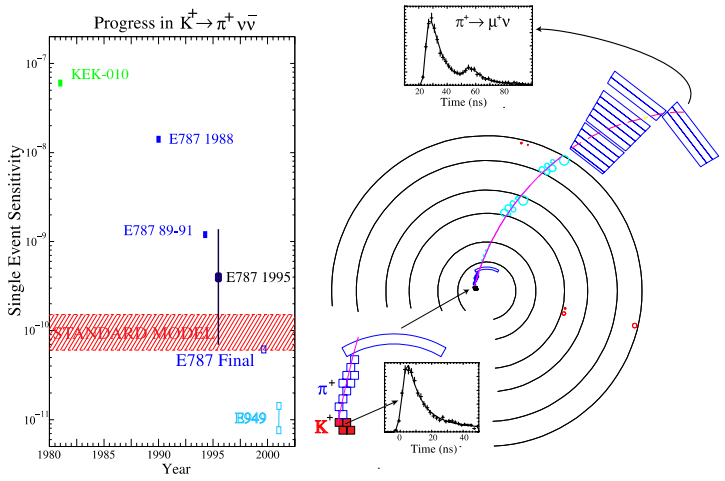
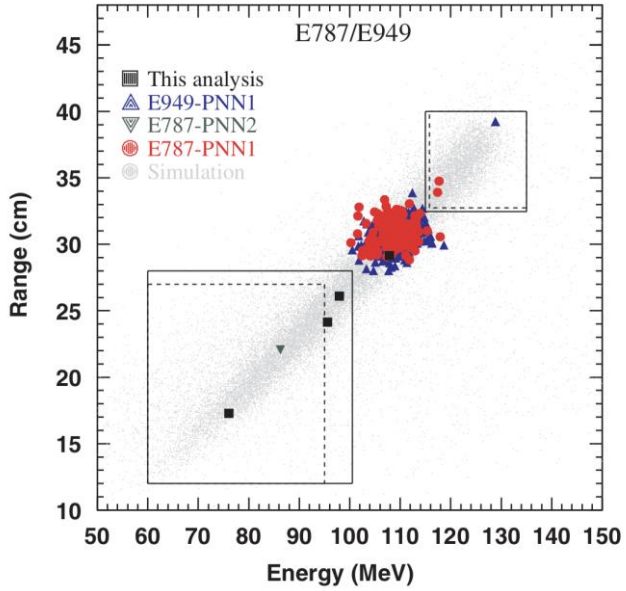
History

- Before NA62, all $K^+ \rightarrow \pi^+\nu\nu$ experiments used stopped K^+ beams.
  - To attempt to do otherwise was to enter into a race between the progress of the stopped experiments and the advance of technology that would make a competitive in-flight experiment feasible.
- The stopped experiment story culminated in the observation of the decay by E787/949 at BNL.

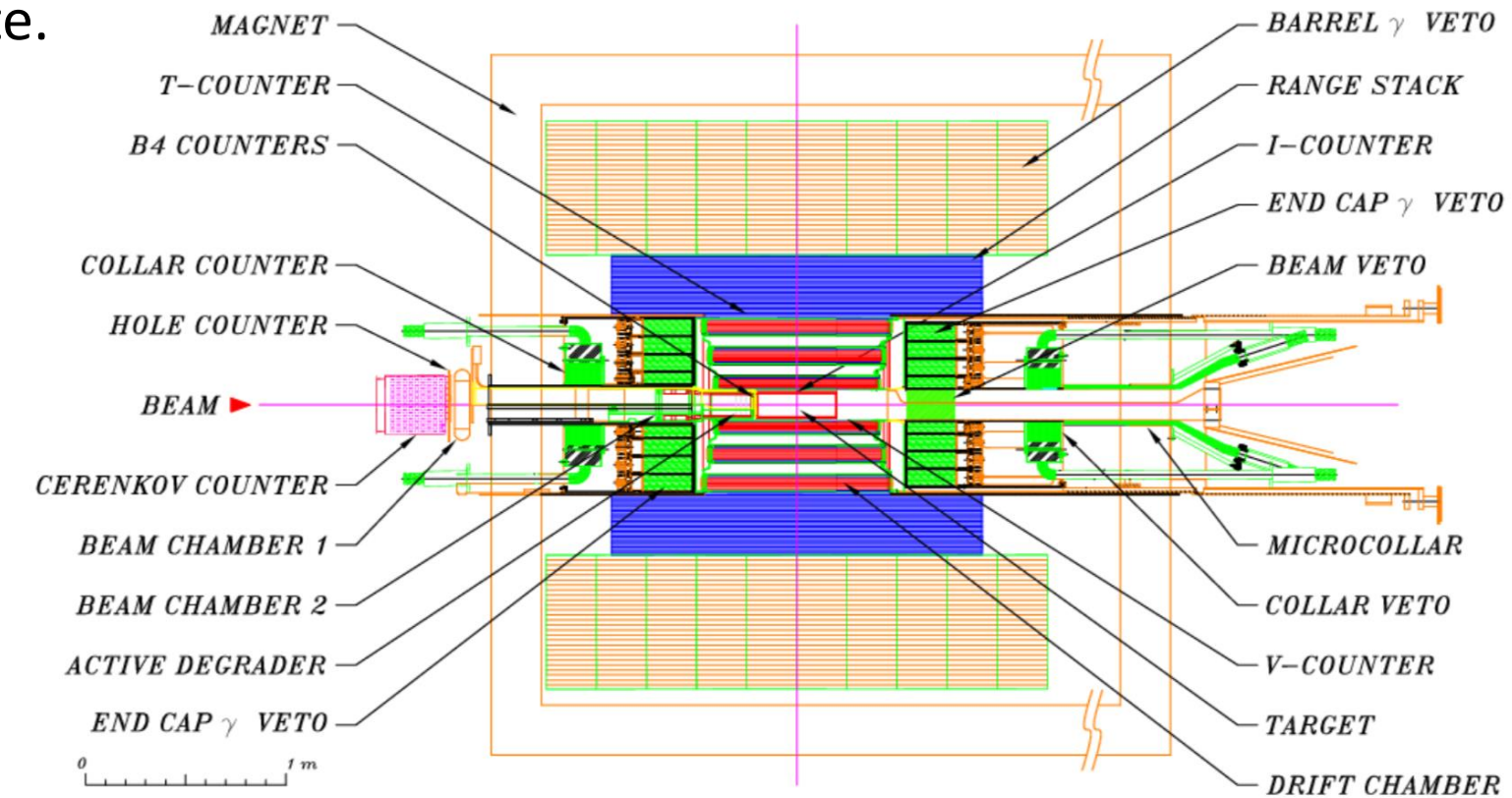






ORKA

- The elements of E787/949 were designed between 35 and 20 years ago.
- ORKA was a 2011 update.
- Same elements
- Same techniques
- More modern versions
- “Safe” extrapolation
- Aim: 200 evts/year
- 5% precision
- How?



How could ORKA expect to do so much better then 787/949?

- Average run length at the BNL AGS ~15 weeks/year, FNAL 3x longer
  - Savings in end effects make it effectively more like 4x
  - However there are other customers for protons at Fermilab
- 74kw average beam power (at 95 GeV) instead of 40kw at the AGS
- Secondary beam shorter with larger acceptance – factor 3.5 more K^+/PoT
  - Shorter beam allows reduction of the moment from 710 to 600 MeV/c – this increases the stopping efficiency.
- Improved photon veto allows better S/B in the low momentum region
- Overall acceptance of E787/949 was a fraction of a percent, so much room for improvement
  - Higher B-field, longer magnet, allows longer, higher-acceptance detector
  - Higher granularity range-stack, better PMTs, better electronics cut losses in π–μ–e chain
  - Brighter, more granular barrel veto will cut random veto losses.
  - More modern trigger/DAQ would reduce dead-time losses.

What could be done at CERN?

- Assumptions – 4 x 10^{13}/pulse every 16 seconds
- At 400 GeV, this gives 160kw of average power, a little more than 2^{ce} the assumption at FNAL.
- If low energy kaon production goes as the power, one can get twice the number of kaons/year as at Fermilab.
- Effective duty cycle about half that assumed for Fermilab, so turn down the wick to get equal instantaneous rates.
- Should give ~ equal performance.

Questions?

- Is this at all practical?
  - Are the above numbers right?
  - Does low energy kaon production really go as the beam power?
  - Could one experiment get ~40% of the total output of the SPS?
  - Could a high-Z target stand that much beam @ 400 GeV
  - Other accelerator/beam related barriers?