Kaon experiments worth a great journey

$K^+ \rightarrow \pi^+\nu\nu$

Br[SM] = 8 X 10^{-11}

Several events seen in BNL E787/949 (17±11) x 10^{-11}

Decay at rest experiment. 600 MeV/c Separated beam

CKM @Fermilab aimed at ~100 events (DOA 2005)

Decay in flight experiment. 22 GeV Separated beam

NA62 @ Cern aims for ~100 events. In flight, 75 GeV/c unseparated beam

$K^0_L \rightarrow \pi^0\nu\nu$

Br[SM] = 3 X 10^{-11}

Br< 2 X 10^{-7} from KEK E391a

KOPIO @ BNL aimed at ~100 events (DOA Aug 05)

E391a moving to Jpark to make a measurement

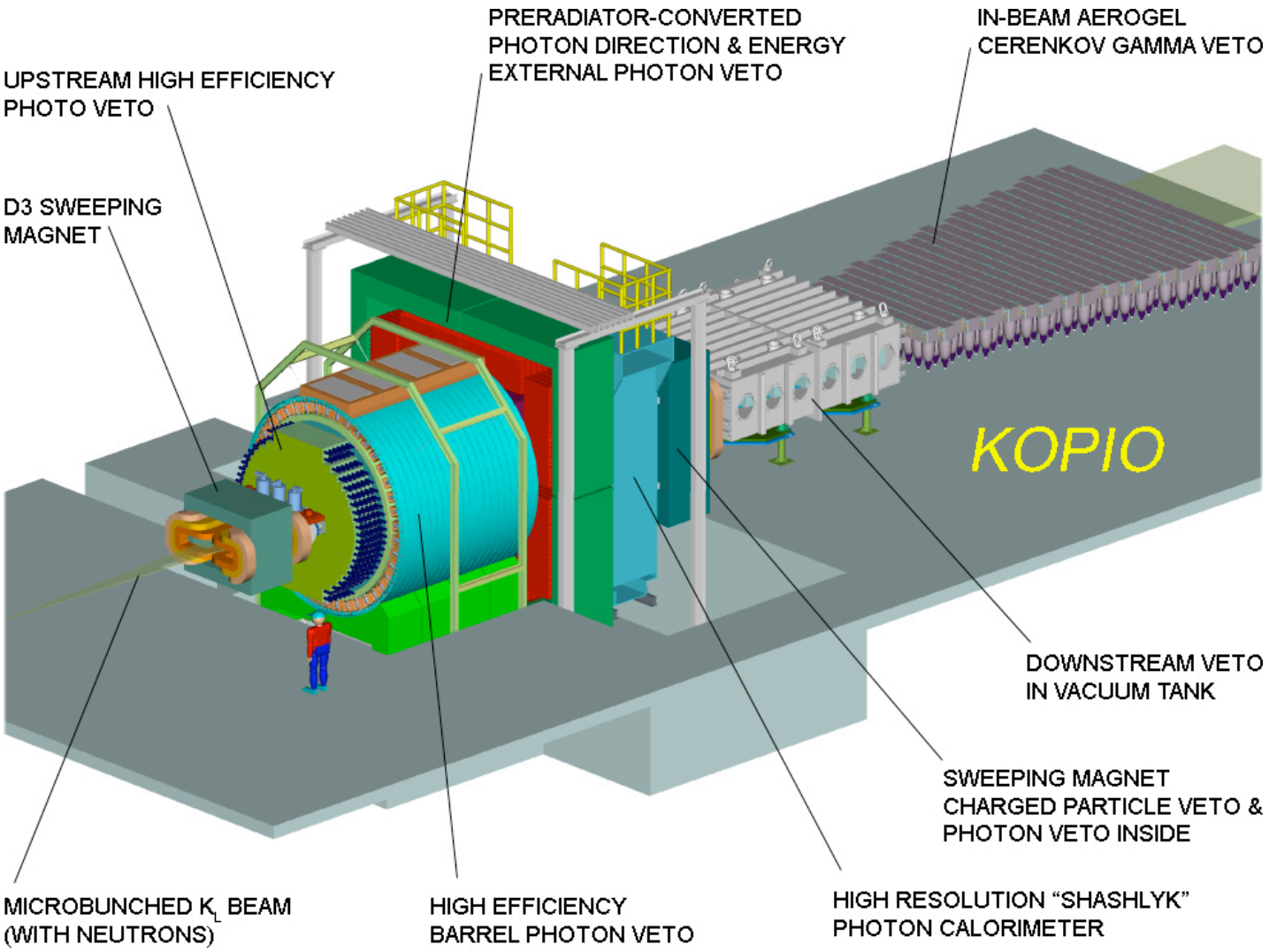
These ultra-rare branching ratio measurments are sensitive to new physics at up to the 10 TeV scale.

AGS Requirements for KOPIO Beams

- Primary Proton Beam Momentum 25.5 GeV/c
- Beam intensity 100 TPPP
- Neutral Beam Angle 42.5 degrees
- Neutral Beam Aspect Ratio 100 mr x 4 mr
- Spill length of ~5.5 seconds, Interspill = 2.3 seconds
  - Yields ~0.25 K_L decay per microbunch in the decay range 10 < Z < 14 meters
- Microbunch separation 40 ns.
- Microbunch width rms < 300 ps (goal 200 ps).
- Interbunch Extinction < 10^{-3} (± 1 nsec)
- Minimize hyperons, neutrons and Gammas in neutral beam.

With this set of parameters our simulations indicate KOPIO can achieve the goals of measuring

KOPIO Experiment at BNL (killed 11 Aug 2005)



Kaon experiments with a 2 GeV proton linac

associated production $pN \rightarrow p\Lambda^0 K^0_L$

Λ^0 is a tag for kaon production (charged off a proton, neutral off a neutron)

$\Lambda^0 \rightarrow n\,\pi^0$ 36% photons with EM calorimeter, n by TOF

Gives Λ^0 decay time which is very close to interaction time ($\tau[\Lambda^0]$ = 0.26 nsec)

So reconstruct the Λ^0 and you can get the K^0_L mometum well (<1%) from TOF

No proton beam structure required

Enormous Kaon rates possible ~ 4 x 10^{-4} K^0_L/P 10μa x 10^{-2} x 4x10^{-4} = 250MHz

KOPIO on steriods

One ping in 50 of 1 ma beam on a thicker target to make KOPIO like beam
With ~1psec ping width from linac RF.

Forward direction likely more promising than 45 degrees.
Studies underway.

Estimated pN particle multiplicities (K. Gudima)

Particle	pid	pid	p	n	He4	Li6	Be9	C12	Ne10
p	7	1120	1.56E+00	1.00E+00	1.51E+00	1.48E+00	1.60E+00	1.86E+00	2.12E+00
n	8	1220	4.43E-01	9.95E-01	1.04E+00	9.83E-01	1.25E+00	1.42E+00	1.71E+00
PI+	1	120	4.95E-01	2.38E-01	4.89E-01	4.56E-01	4.80E-01	5.62E-01	6.13E-01
PI-	2	-120	5.23E-02	2.43E-01	2.33E-01	2.11E-01	2.78E-01	3.10E-01	3.64E-01
pi0	3	110	2.81E-01	4.53E-01	5.19E-01	4.65E-01	5.38E-01	5.94E-01	6.51E-01
K+	4	130	4.40E-04	8.54E-04	5.84E-04	3.69E-04	7.09E-04	1.11E-03	1.67E-03
K-	5	-130			6.00E-06		8.00E-06	6.00E-06	1.20E-05
K0	6	230	9.20E-05	8.18E-04	3.26E-04	2.47E-04	4.95E-04	7.94E-04	1.12E-03
L	9	2130	4.19E-04	1.38E-03	5.88E-04	4.07E-04	7.71E-04	1.26E-03	1.80E-03
S+	10	1130	1.13E-04	1.51E-04	1.76E-04	1.18E-04	2.12E-04	3.70E-04	5.02E-04
S-	11	2230		1.43E-04	9.40E-05	6.40E-05	1.53E-04	1.92E-04	3.34E-04
S0	12	1230			3.70E-05	2.50E-05	5.60E-05	7.00E-05	1.23E-04
Ap	13	-1120							
N			1.99945	1.99837	2.54130	2.46154	2.84920	3.27850	3.83200
pi			0.82844	0.93376	1.24139	1.13217	1.29699	1.46616	1.62819
K			0.00053	0.00167	0.00092	0.00062	0.00121	0.00191	0.00280
Hyp			0.00053	0.00167	0.00090	0.00061	0.00119	0.00189	0.00276
Total			2.82895	2.93547	3.78450	3.59494	4.14859	4.74846	5.46574
Pi0/K0			3056	554	1591	1884	1087	749	584
K+/K0			4.78	1.04	1.79	1.49	1.43	1.40	1.49

Questions ?