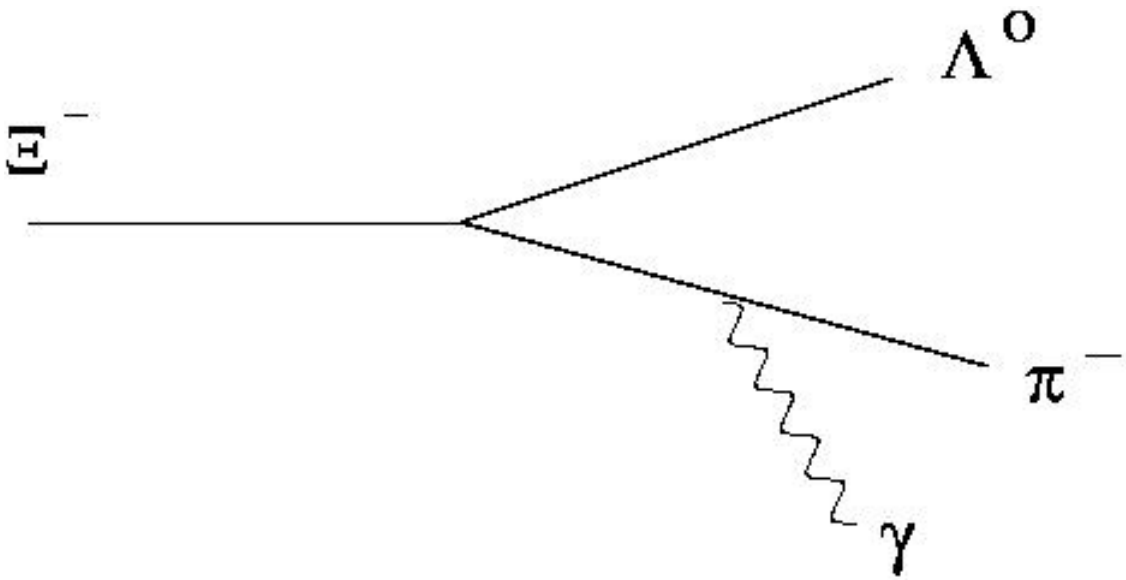
Lessons Learned from

$\Xi^o \rightarrow \Lambda^o \pi^o \gamma$ **(Ping's Thesis)**

All Neutral Decay

1. **The decay B1 → B2 + π is well understood. See PDG for instance.**
2. **If 2 of the 3 particles are charged, inner brems are possible.**
3. **In early 60's Barshay and Behrends calculated all the brem combinations possible and included magnetic dipole radiation from the baryons.**



Internal Bremsstrahlung Diagram

1. **Internal brem rate was 100 to 1000 times magnetic moment radiation.**

2. **All neutral decays have no internal brem, so one might obtain information on mag. moments of baryons by studying these radiative decays.**

3. **Might hope to extend this to heavier hyperon decay to learn unknown mag. moments. e. g.**
   $\Xi_c^o \rightarrow \Lambda K \gamma$

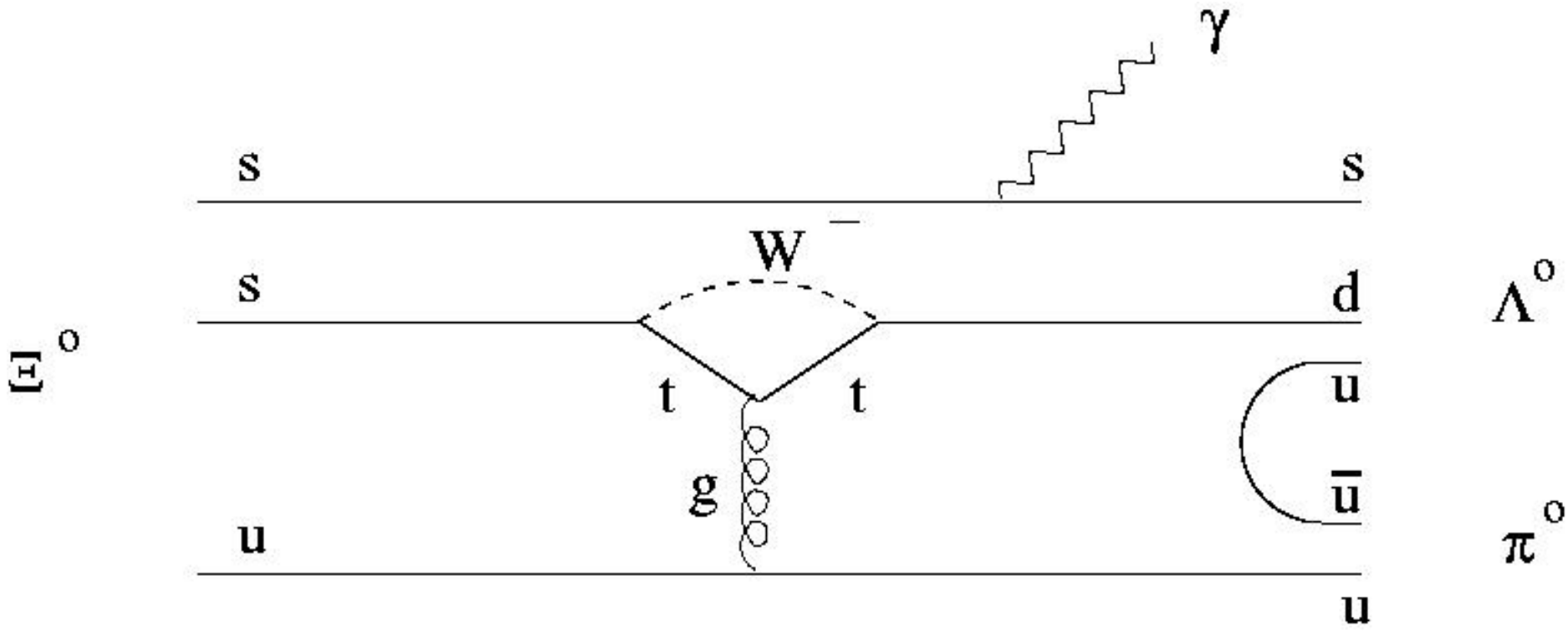
Charlie Goebel at Wisconsin supplied a pure magnetic moment calculation for us, and Ping used it to evaluate a BR for his radiative decay of

BR= 1.82 X E-06

The rate is proportional to sums (S) and differences (D) of the baryon mag. moments:

Prop to Phase Space X

$$2A^2D^2+B^2p^2[(S^2+D^2)+(S^2-D^2)\cos^2\theta]$$

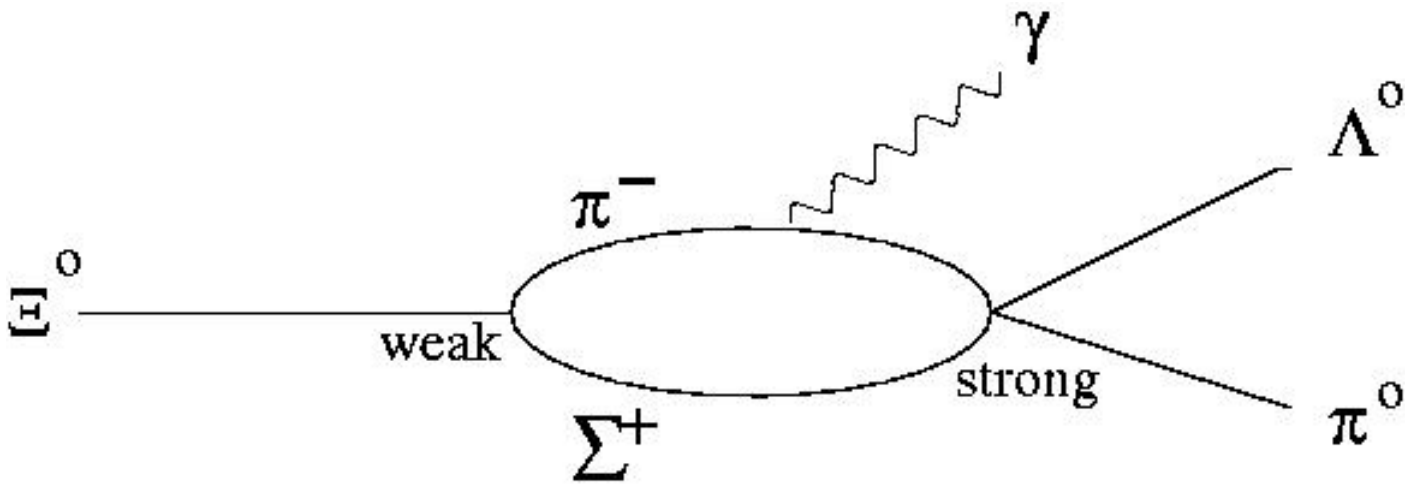


A quark diagram for radiative decay of neutral cascade

One probably does not expect the quark diagram to apply to this Ξ decay because the maximum gamma energy is 62 MeV.

The proton radius is probed at 140 MeV, so 62 MeV isn't likely to probe quark structure.

One might consider a diagram at the particle level, but it would be hard to calculate.



Radiative Neutral Cascade Decay

At Particle Level

A realistic lower limit to the radiative rate can probably be set using a diagram that consists of two known processes:

$\Xi^o \rightarrow \Lambda^o \gamma$

and

$\pi^o \rightarrow \gamma\gamma$

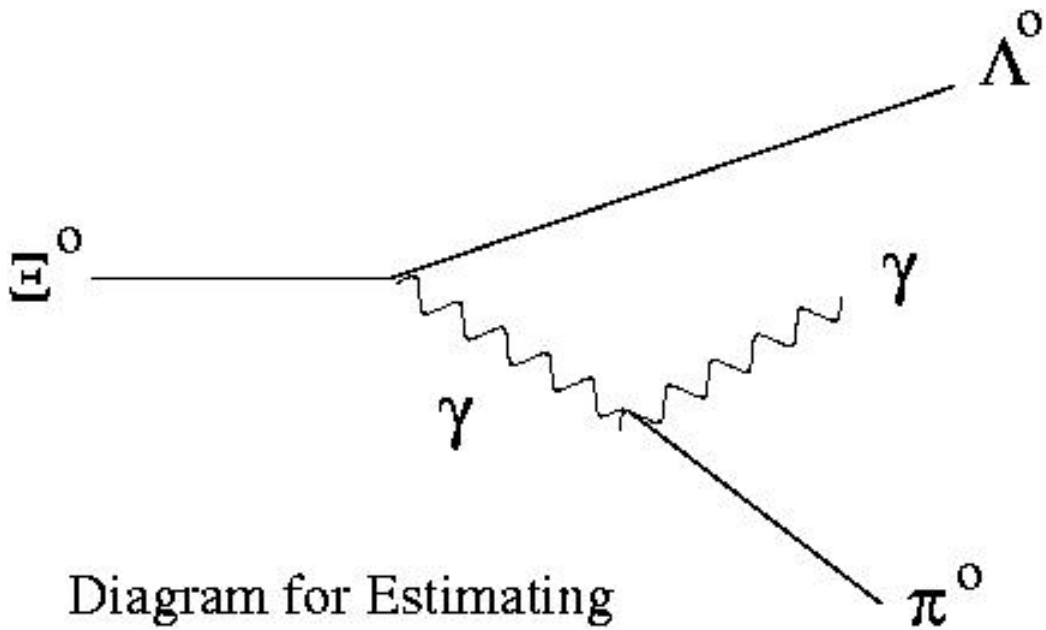


Diagram for Estimating
Lower Limit on
Radiative Decay

The BR for $\Xi^o \rightarrow \Lambda^o \gamma$ is

BR = 1.18 X E-03

One might expect the EM vertex to Reduce this by about 100X.

So we expect a lower limit of about

BR= 1.2 X E-05

for $\Xi^o \rightarrow \Lambda^o \pi^o \gamma$

Ping: BR= $1.67^{+1.16}_{-0.69}$ +/- 0.5 E-05

There are some people who have calculated similar lower limit diagrams. Perhaps one of them can make a better estimate.

Conclusion seems to be that this type of neutral radiative decay is not likely to provide much information on magnetic moments for heavy baryons.