

On the relation between K_s^0 and charged kaon yields in p-p, p-A and A-A collisions.

Damian Pszczel

National Centre for Nuclear Research, Warsaw, Poland

Bormio, January 22th 2024



Relation between neutral and charged kaon production

- Isospin symmetry: equivalence of QCD w.r. to u and d quarks,
- $K^+ \equiv u\bar{s}$, $K^0 \equiv d\bar{s}$, $\bar{K}^0 \equiv s\bar{d}$, $K^- \equiv s\bar{u}$,
- $\langle K^+ \rangle = \langle K^0 \rangle$ and $\langle K^- \rangle = \langle \bar{K}^0 \rangle$,
- $\langle K_S^0 \rangle = \langle K_L^0 \rangle = \frac{1}{2}\langle K^0 \rangle + \frac{1}{2}\langle \bar{K}^0 \rangle$,
- Therefore one expects $\langle K_S^0 \rangle = \frac{1}{2}\langle K^+ \rangle + \frac{1}{2}\langle K^- \rangle$.

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- A compilation of p+p data → **discrepancy** between K_S^0 yield and the average number of charged kaons.
- p+p: 4u and 2d valence quarks,
- $K^+(u\bar{s})$, $K^-(s\bar{u})$ $\implies \neq$ production.

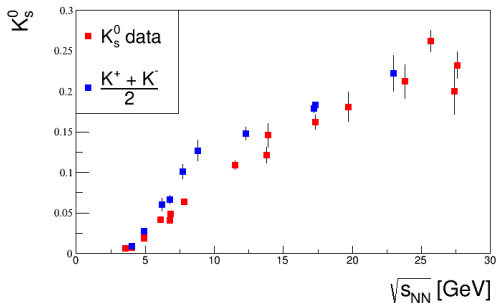
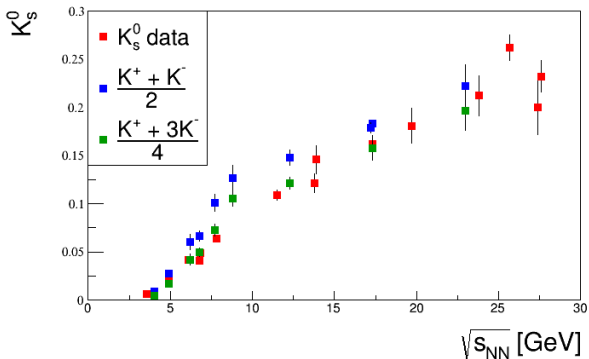


Figure: Multiplicity per event of neutral kaons K_S^0 and charged kaons $\frac{K^+ + K^-}{2}$ in inelastic $p + p$ interactions as a function of collision energy in the center of mass reference frame.

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- $K^+ = u_v \bar{s}_s + u_s \bar{s}_s$, $K^- = \bar{u}_s s_s$, $K_S^0 = (d_v \bar{s}_s + d_s \bar{s}_s + \bar{d}_s s_s)$,

- In case of p+p: $K_S^0 = \frac{K^+ + 3K^-}{4}$



Summary

- The relation $K_S^0 = (K^+ + K^-)/2$ doesn't hold neither for p+p data nor for A+A data (see NA61/SHINE collaboration Ar+Sc data in arXiv:2312.06572).
- We have shown that a better agreement with world p+p data for a wide energy range is obtained if one uses a relation derived from simple considerations about the quark structure of kaons and nucleons.

Thank You!

Acknowledgments

- Scientific project of NA61/SHINE Consortium - GRIEG - nr 2019/34/H/ST2/00585 - "Study of charm production in heavy ion collisions".
- Scientific project nr 2021/WK/10. Ministry of Science and Education. NA61/SHINE experiment at CERN