Weekly reading and work

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Deeply Inelastic Scattering

Settings:

1. Initial electron 4-momentum, **k**
2. Finial electron 4-momentum, **k'**
3. Initial proton 4-momentum, **P**
4. The electron interact with the proton by exchanging a photon which has a 4-momentum, **q**

In the experiment, only the outgoing electron is detected.

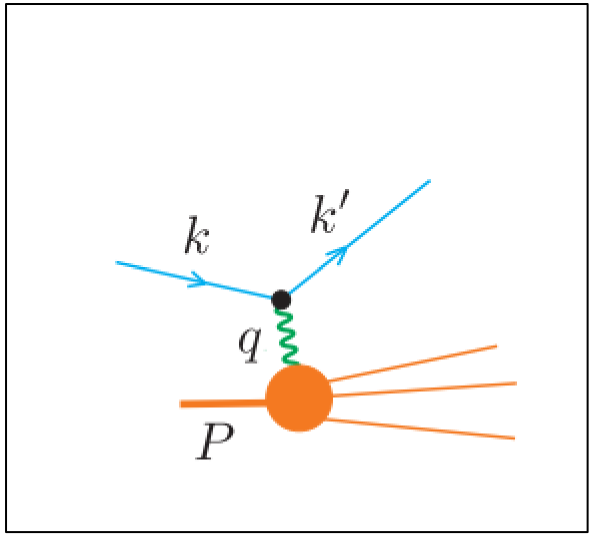


FIG. 1. Amplitude for e + p → e + X. Only the outgoing electron is detected.

Deeply Inelastic Scattering

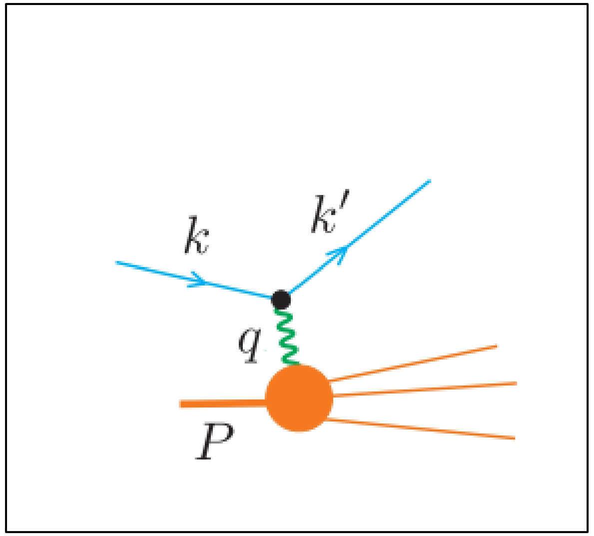
1. As mentioned above, we can know:

$$\boldsymbol{q} = \boldsymbol{k} - \boldsymbol{k}'$$

2. e + p → e + X, X stands for any final state particles, which are not measured, and of course the X 4-momentum is $\boldsymbol{P} + \boldsymbol{q} = \boldsymbol{W}$

$$W^2 = (P+q)^2 = {m_p}^2 + \frac{1 - x_{bj}}{x_{bj}} Q^2 \qquad x_{bj} = \frac{Q^2}{2P \cdot Q} \qquad Q^2 = -q^2$$

In the formula above, W^2 must be greater than ${m_p}^2$, we conclude that $x_{bj} \leq 1$



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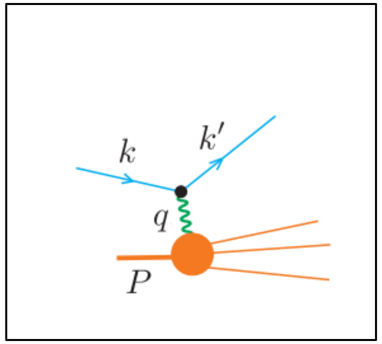


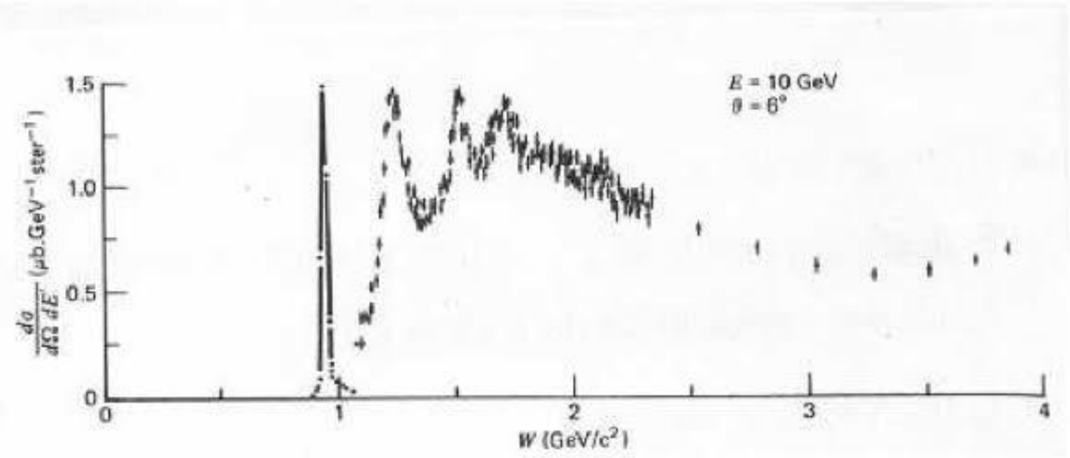
FIG. 1. Amplitude for e + p → e + X.
Only the outgoing electron is detected.

For small $Q^2, W^2 \cong {m_p}^2$,
the excited state of proton can be produced.

For large Q^2 and $x_{bj} < 1$, resonance peaks were not expected.

Question: what does "resonance" mean?

Why the peak disappear if the scattering occur?



Deeply Inelastic Scattering

- In 1969, SLAC published a result, before this physicist had know that:

$$d\sigma = \frac{4\alpha^2}{s}\frac{d^3\vec{k}'}{2|\vec{k}'|}\frac{1}{(q^2)^2}\,L^{\mu\nu}(k,q)\,W_{\mu\nu}(P,q)\,.$$

- In 1969, one could say little about $W_{\mu\mathrm{V}}$, physicists expanded it with some invariance and conservations to the form:

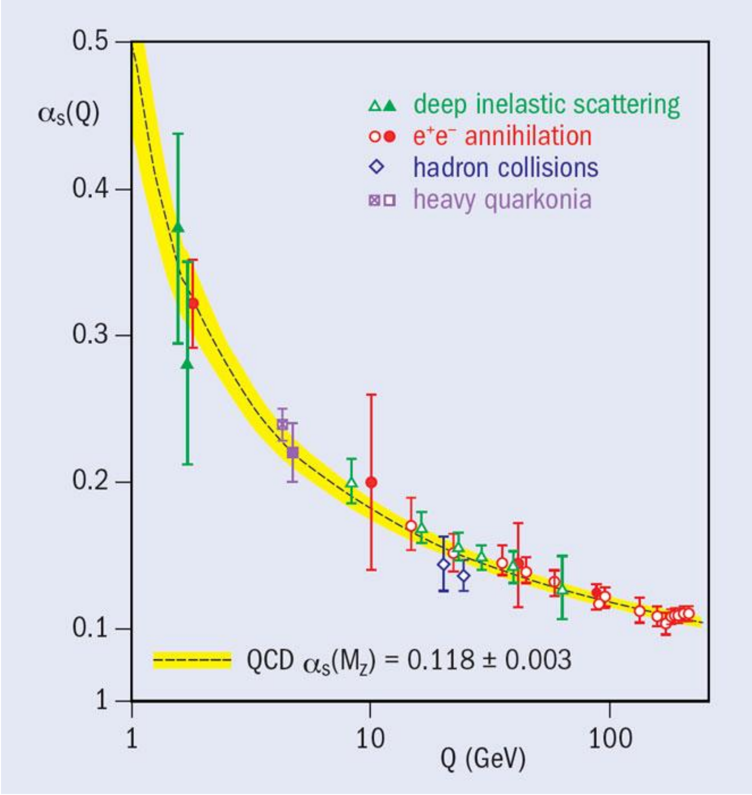
$$W_{\mu\nu} = -\left(g_{\mu\nu} - \frac{q_\mu q_\nu}{q^2}\right)F_1(x_{\mathrm{bj}},Q^2) + \left(P_\mu - q_\mu\frac{P\cdot q}{q^2}\right)\left(P_\nu - q_\nu\frac{P\cdot q}{q^2}\right)\frac{1}{P\cdot q}\,F_2(x_{\mathrm{bj}},Q^2)\,.$$

In SLAC, F_1 and F_2 can be measured, but no prediction.

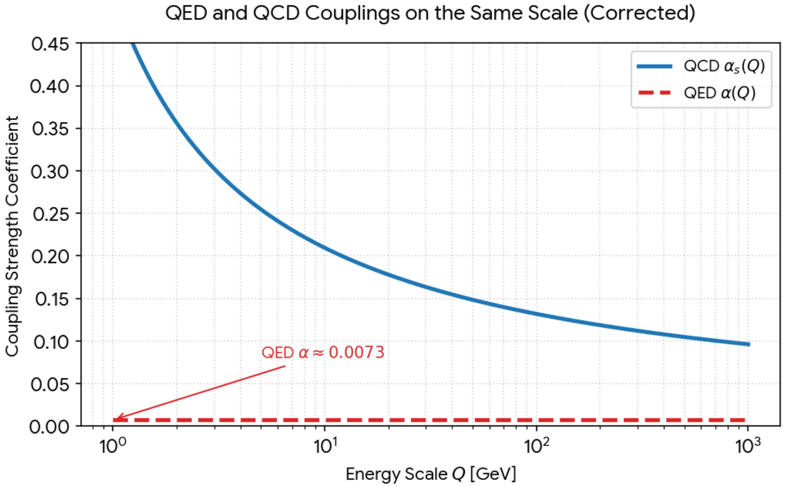
Deeply Inelastic Scattering

After the SLAC result in 1969, physicists start to research the strong interaction.

Once they used the way of QED theory which is a successful theory to try to explain the behavior of strong interaction, but it been fail of using the perturbative expansion.



The coupling coefficient α_s of the strong interaction by Q



The coupling coefficient of strong interaction, α_s is much bigger than the coupling coefficient of QED, So the high-order product been dominant.

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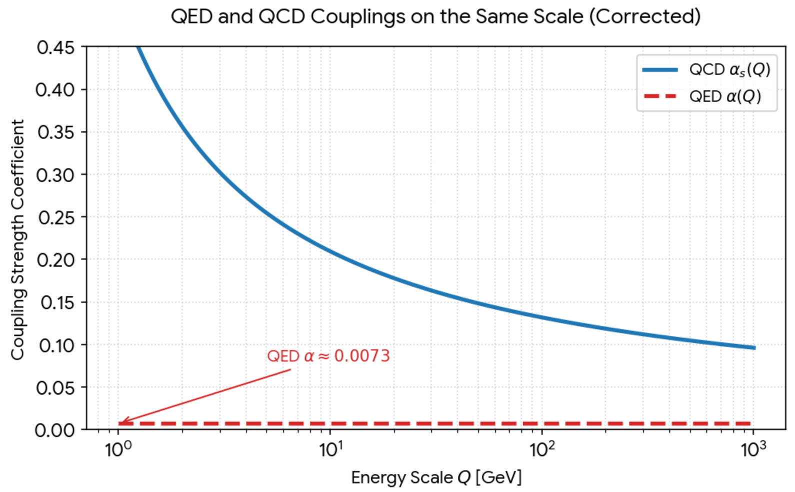

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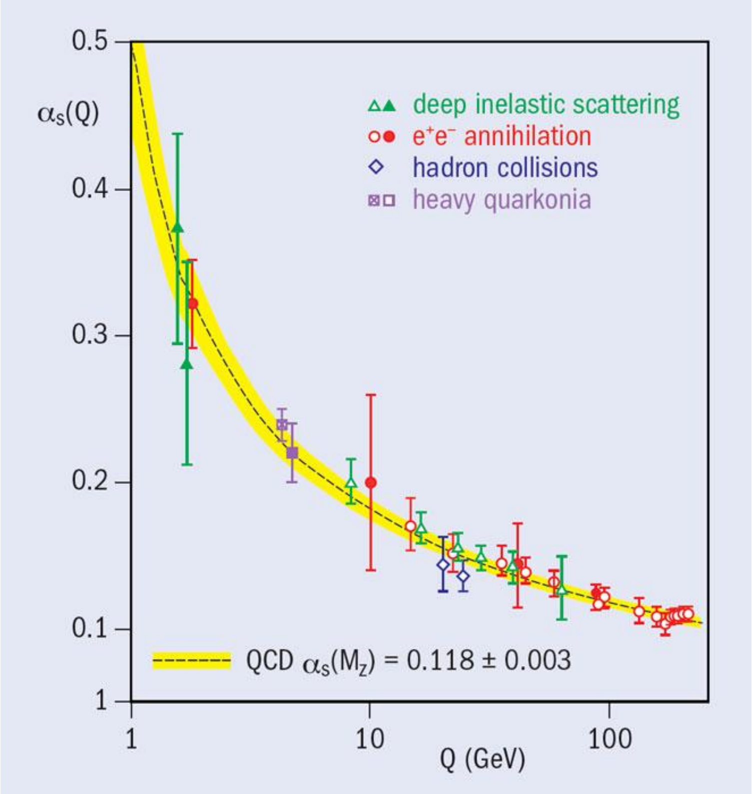


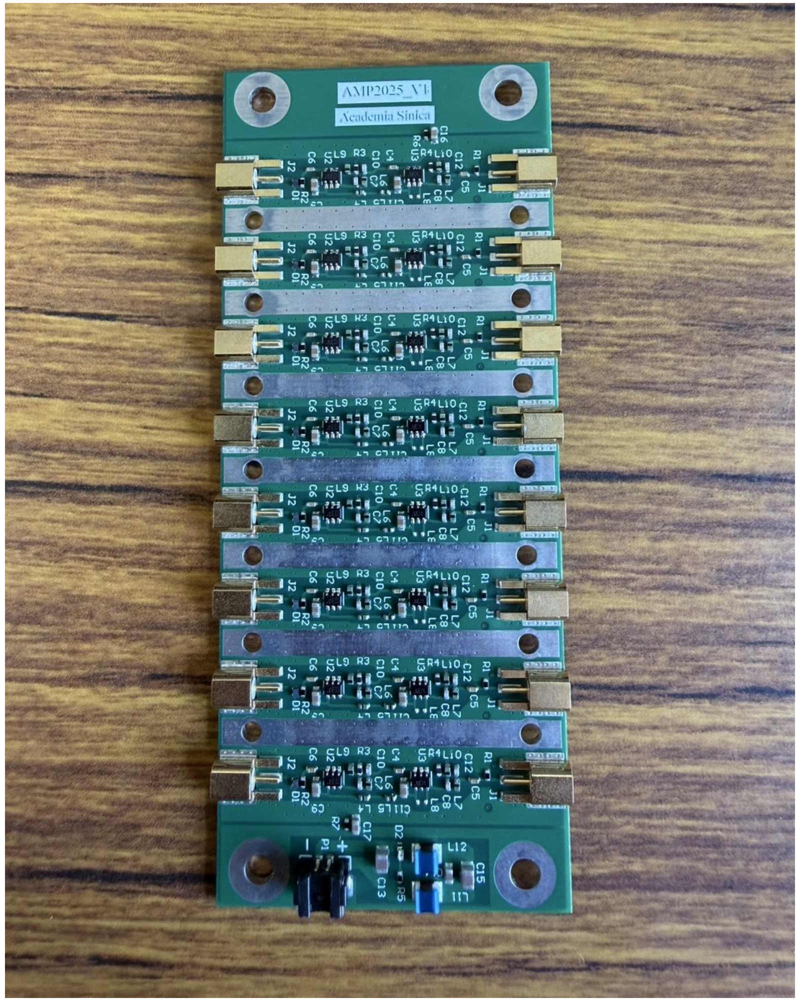
The coupling coefficient α_s of the strong interaction by Q

As mentioned above, physicists faced some difficulty and than the Parton Model and QCE was going to be emerge.

Amplifier Test

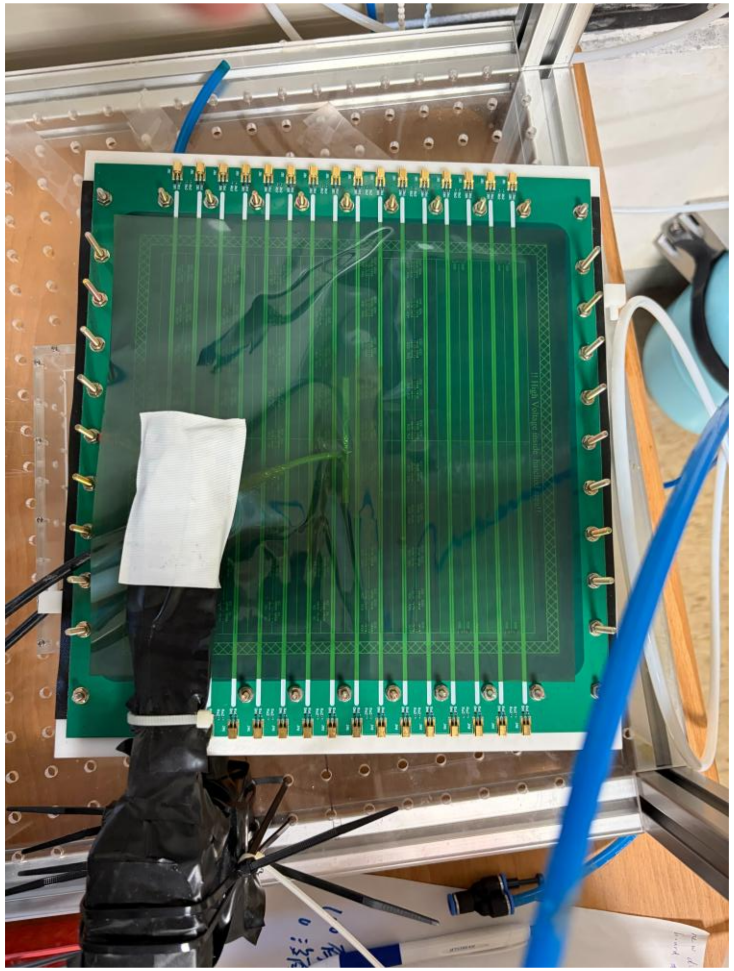
In 30 pieces of amplifier, all the channel works

But few of these channels behave unstable. Like pulling the string may cluse it be unfunctional.



New RPC Test

The new RPC is still being setting.



To-do

- The discriminator control code
- Test new RPC