# Reggeisation of “Barger-Phillips” formula

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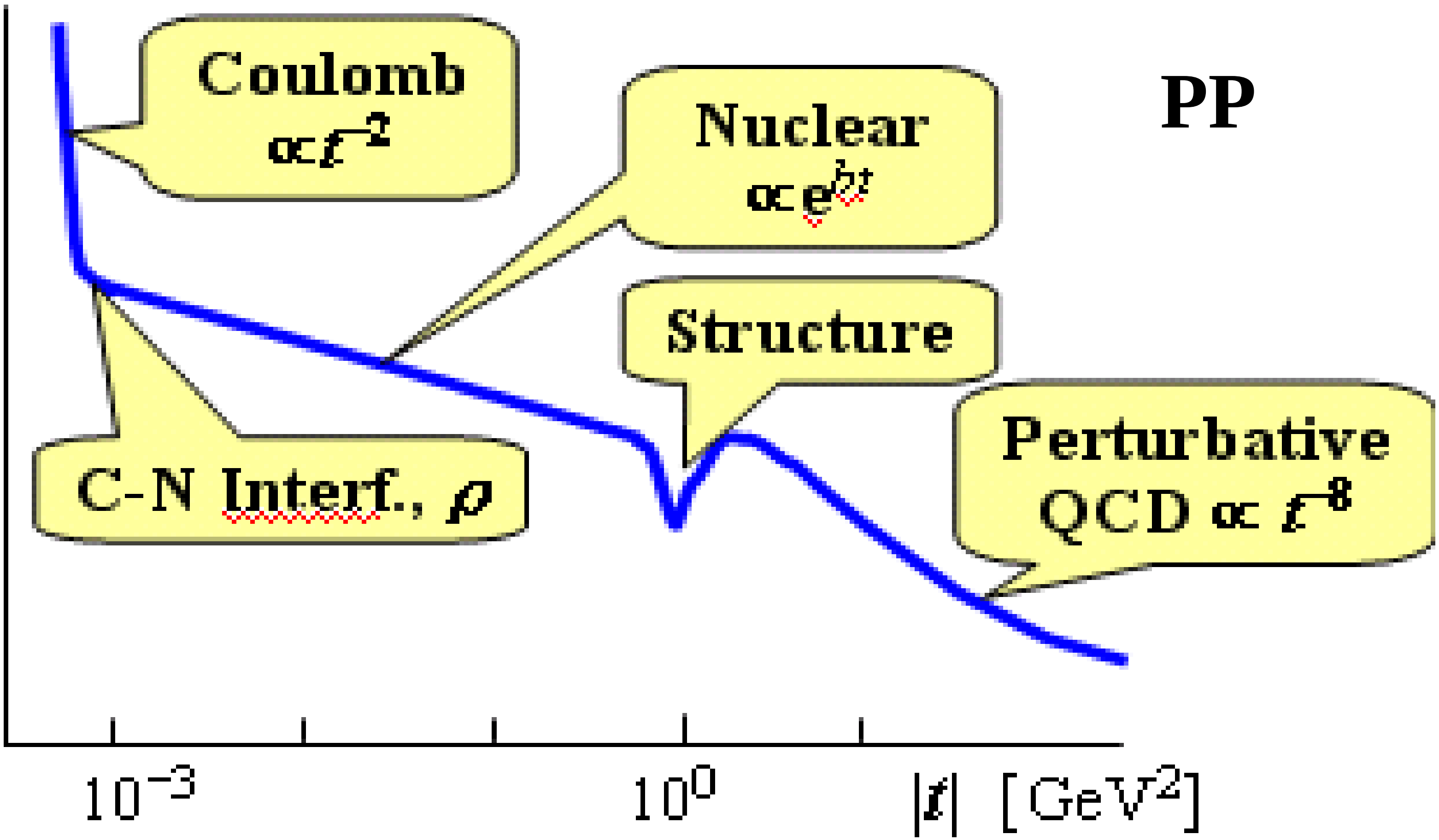
- **Features of elastic scattering cross sections**
- **Towards “reggeisation” of BP formula**
- **Fits to the data**

# Key features of elastic scatteing



# Barger-Phillips[1] parameterisation

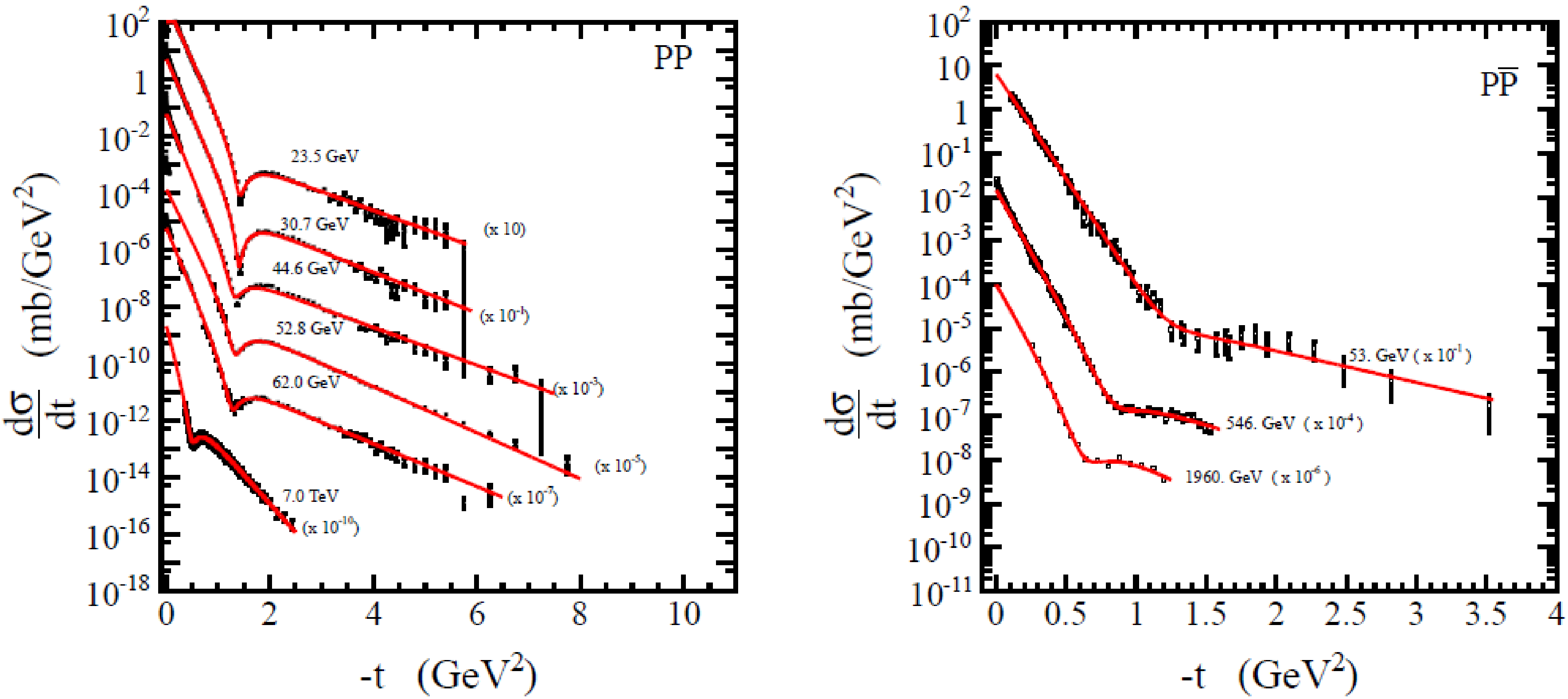
- Simple parameterisation of $d\sigma/dt$

$$\frac{d\sigma}{dt} = \left| \sqrt{A} \exp\left(\frac{1}{2}Bt\right) + \sqrt{C} \exp\left(\frac{1}{2}Dt + i\phi\right) \right|^2$$

- A, B, C, D, φ – separate set of parameters for each √s
- Valid for both $pp$ and $p\bar{p}$
- "Magically" effective way of describing $d\sigma/dt$ cross section

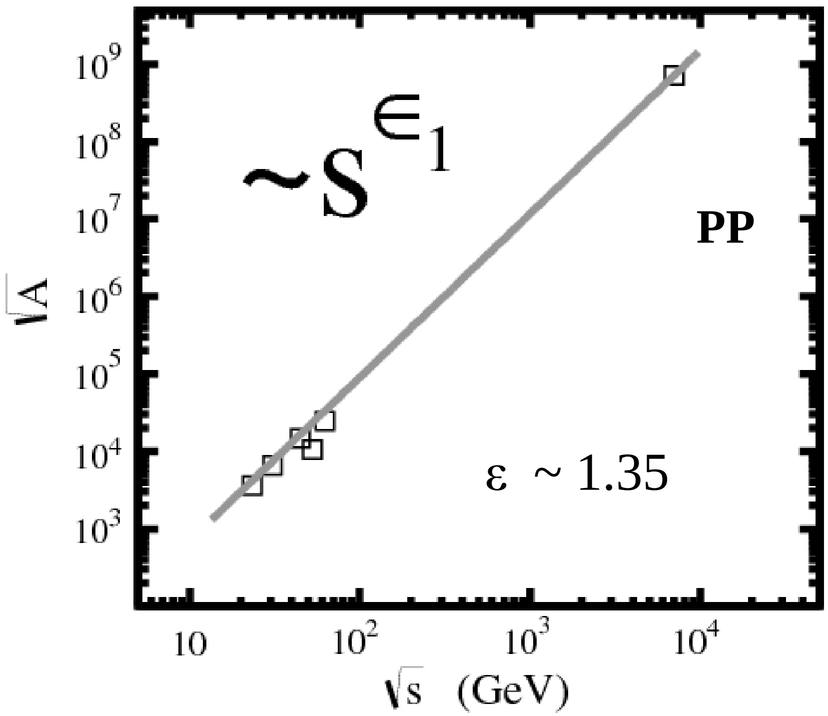
[1] **Phys. Lett. B 46, 412 (1973)**

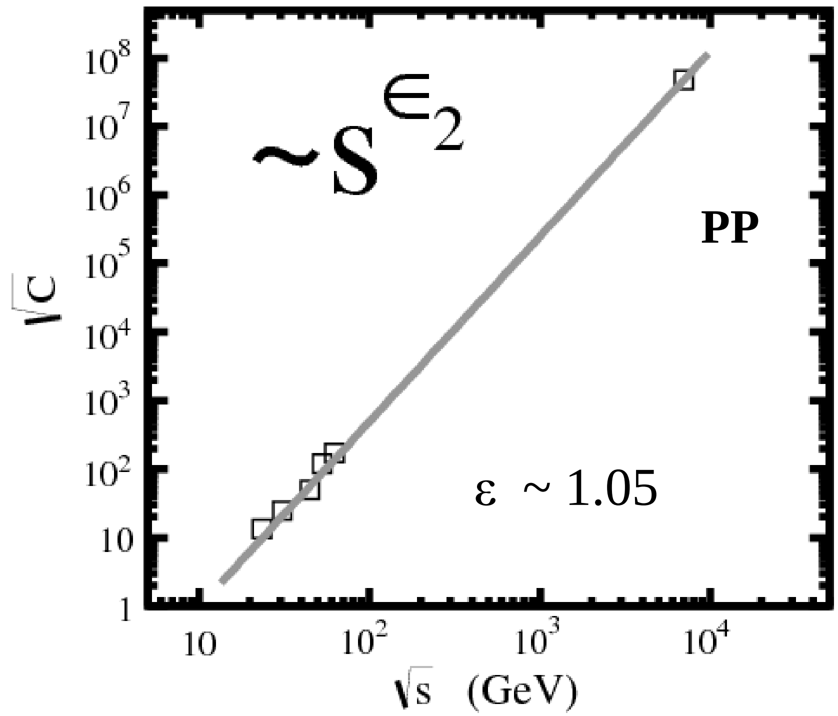
# Fits to the data. BP formula




- BP parameterisation adequately describes key features of the data

# Energy dependence of the fit parameters

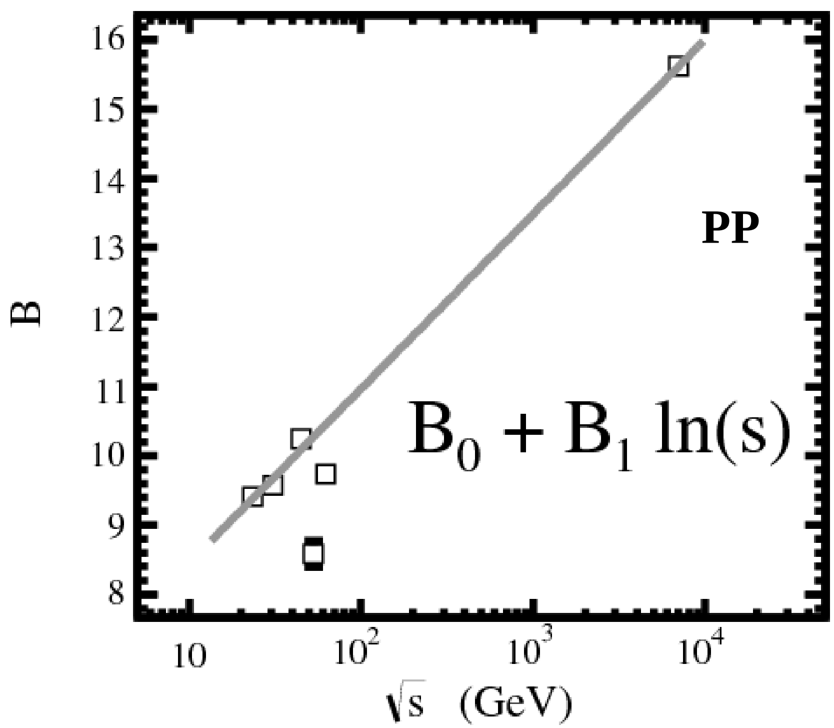


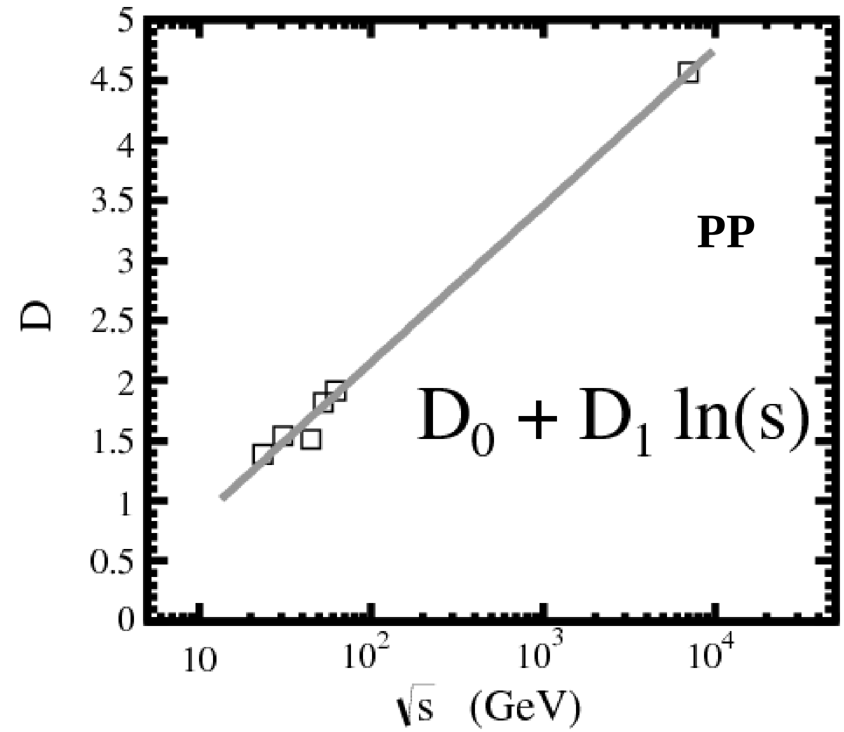




- Energy dependence of A and C parameters can be approximated by a power function

*dimensionless $s/1GeV^2$

# Energy dependence of the fit parameters

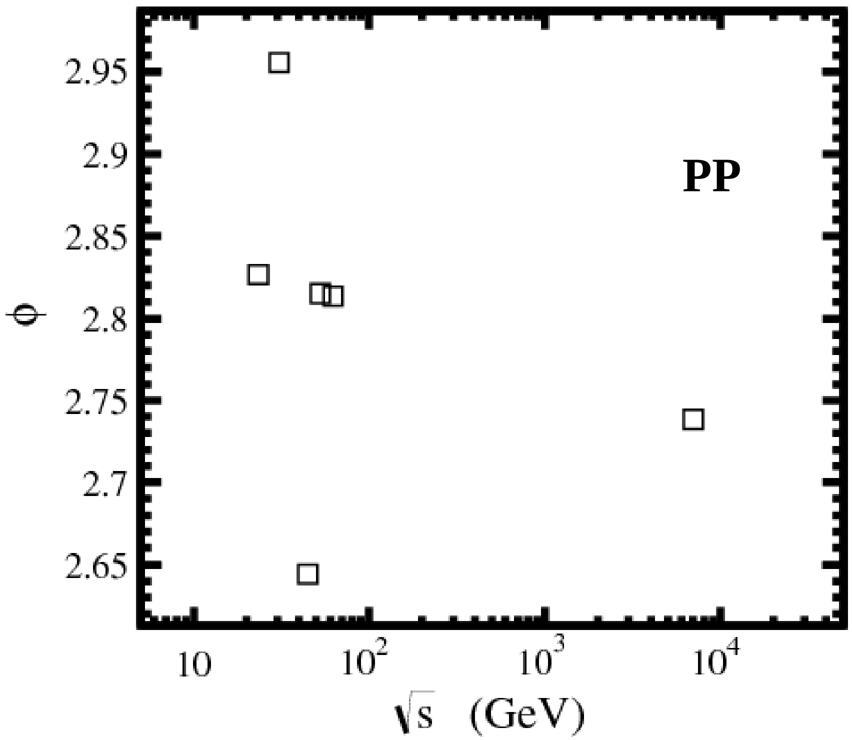



- Energy dependence can de approximated by a logarithmic function

*dimensionless $s/1GeV^2$

# Energy dependence of the fit parameters




- No evident energy dependence of the phase

# Towards "reggeisation" of BP

$$\frac{d\sigma}{dt} = \left| \sqrt{A} s^{\varepsilon_1/2} \exp\left[\frac{1}{2}\left(B_0 + B_1 \ln s\right) t\right] + \sqrt{C} s^{\varepsilon_2/2} \exp\left[\frac{1}{2}\left(D_0 + D_1 \ln s\right) t + i\phi\right]\right|^2$$

$$\sqrt{A} \to \sqrt{A(s)} = \sqrt{A} s^{\varepsilon_1/2},$$

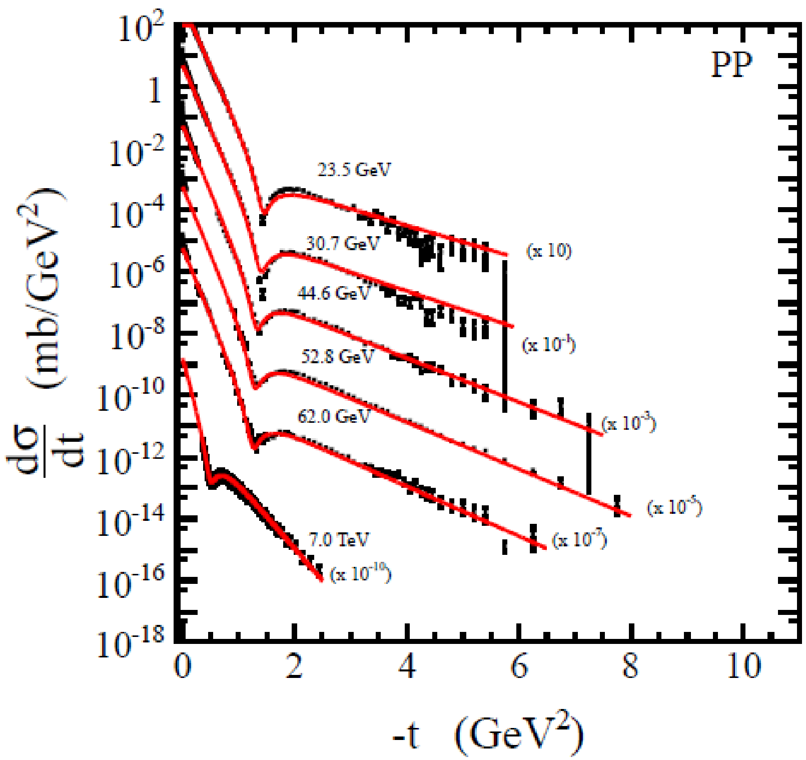
$$\sqrt{C} \to \sqrt{C(s)} = \sqrt{C} s^{\varepsilon_2/2},$$

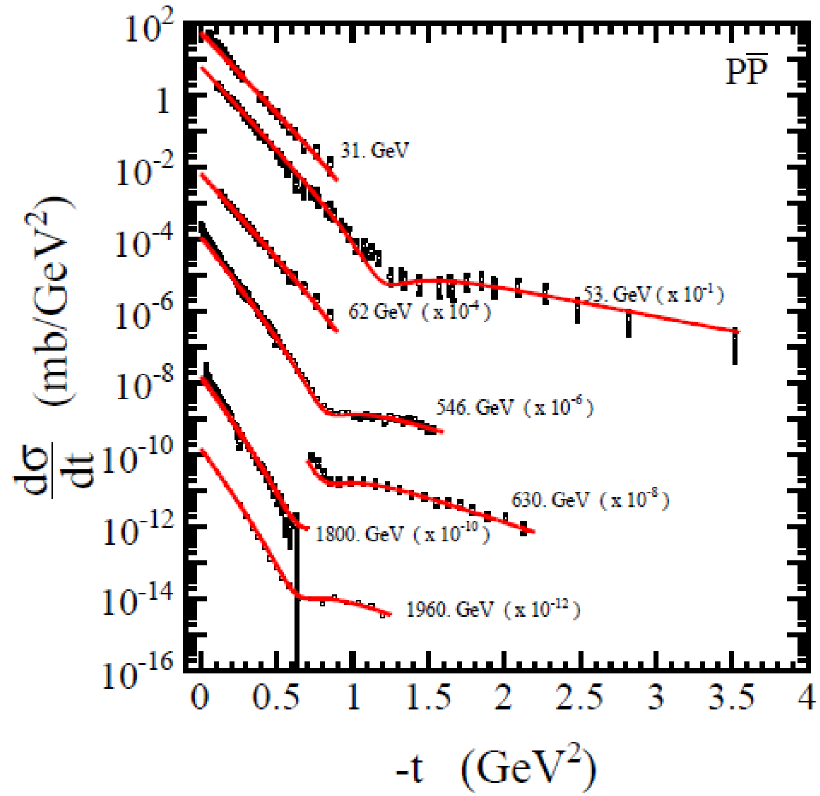
$$B \to B(s) = B_0 + B_1 \ln s,$$

$$D \to D(s) = D_0 + D_1 \ln s,$$

φ → variable parameter

# Fits to the data. BP modification 1




- Reasonable description of the data holds after introduction of energy dependence

# Model ansatz

$$\frac{d\sigma}{dt} = \frac{\pi}{s^2} \left| A(s,t) \right|^2 \text{ and } \sigma_{tot} = \frac{4\pi}{s} \Im A(s,t) \Big|_{t=0}$$

$$A = A_{sec} + A^{(h)} + A^{(s)}$$

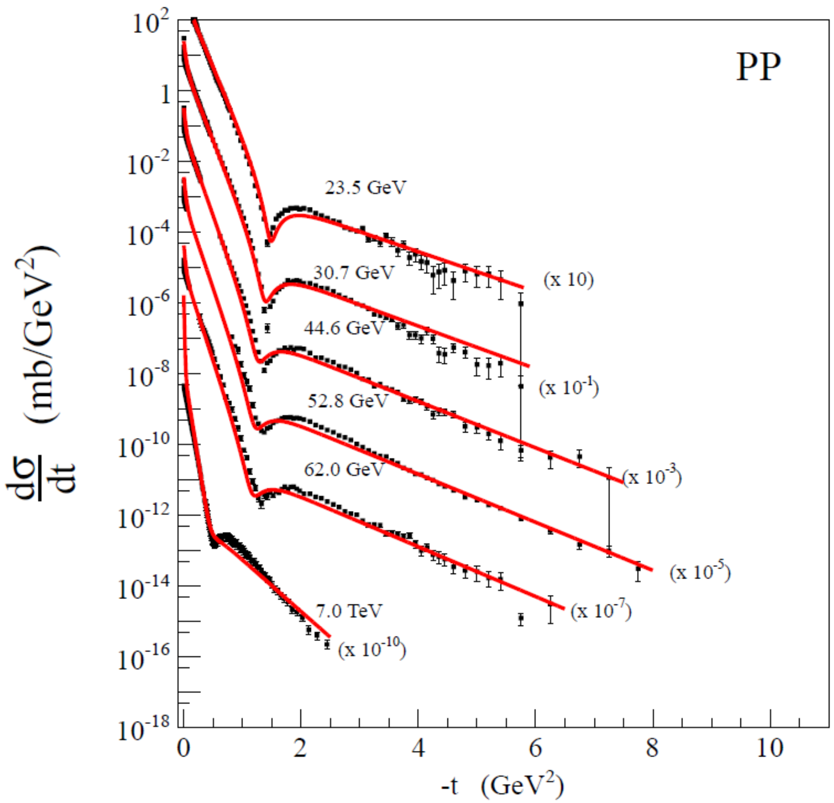
$$A_{\text{sec}}(s,t) = a_{\text{sec}} e^{-i\pi\alpha_{\text{sec}}(t)/2} \left(\frac{s}{s_0}\right)^{\alpha_{\text{sec}}(t)},$$

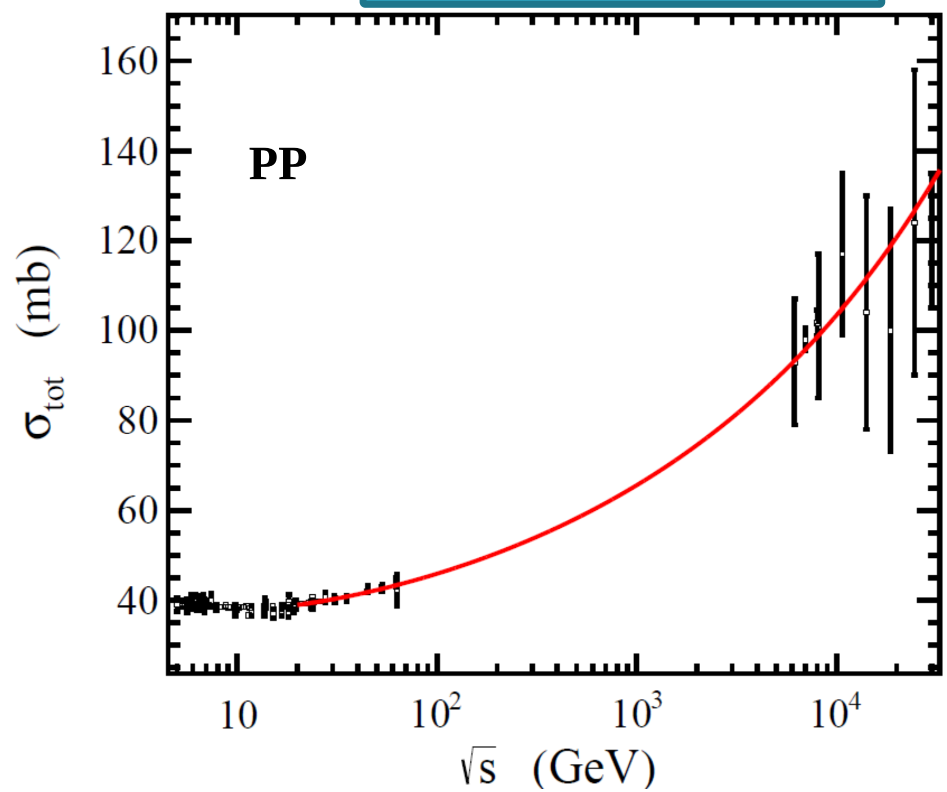
$$A^{(h)} = a_h \exp\left(b_h + k_h L^{p_h}\right) \alpha_h(t),$$

$$A^{(s)} = a_s \exp\left(b_s + k_s L^{p_s} - i\frac{\pi}{2}\right) \alpha_s(t).$$

# Fits to the data. BP modification 2

Work in progress




- Regge-like modification of the parameterisation is able to describe lower energy PP data qualitatively

# Summary

*Third Law:* You may use any degrees of freedom you like to describe a physical system, but if you use the wrong ones, you'll be sorry.[1]

Steven Weinberg, 1983

- Fits to the data of various variants of the BP formula were presented.
- The BP formula adequately describes highest energy elastic scattering data.
- Regge-like modification of BP qualitatively reproduces features of the lower energy measurements.