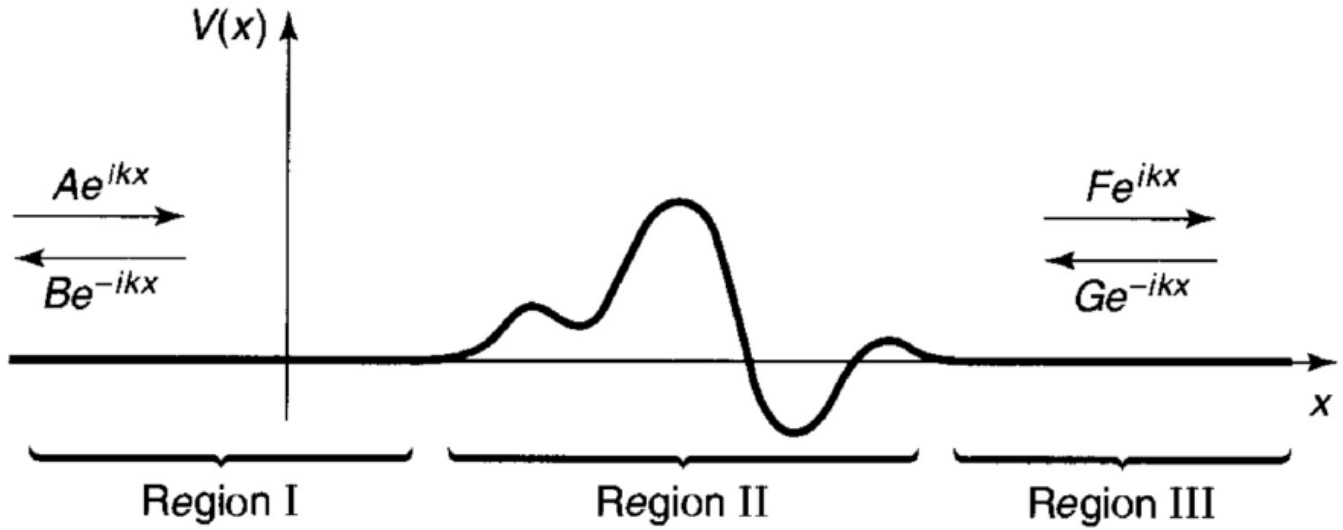
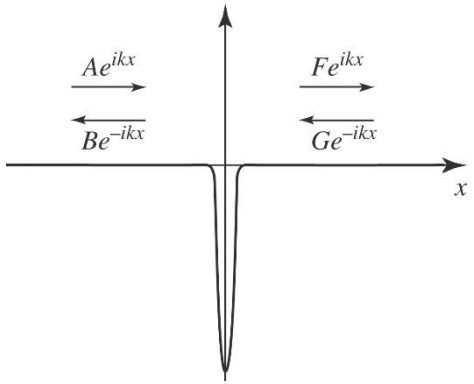
Quantum Scattering in One Dimension



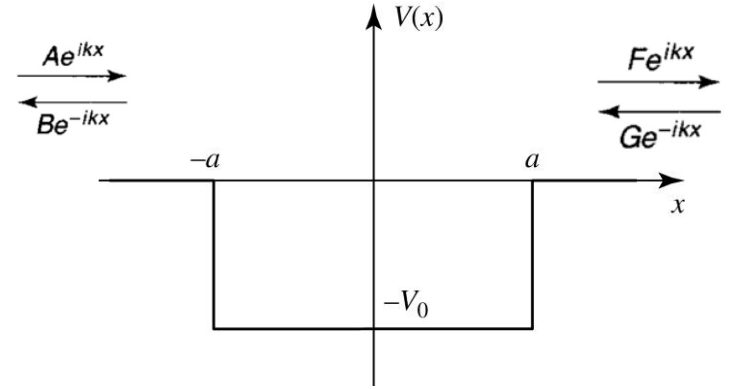
$$\begin{bmatrix} B \\ F \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} A \\ G \end{bmatrix}$$



$$\begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} = \frac{1}{1-i\beta} \begin{bmatrix} i\beta & 1 \\ 1 & i\beta \end{bmatrix}$$

$$\beta = \frac{m\alpha}{\hbar^2 k} \sim \frac{1}{\sqrt{E}}$$

$$V(x) = -\alpha\,\delta(x)$$

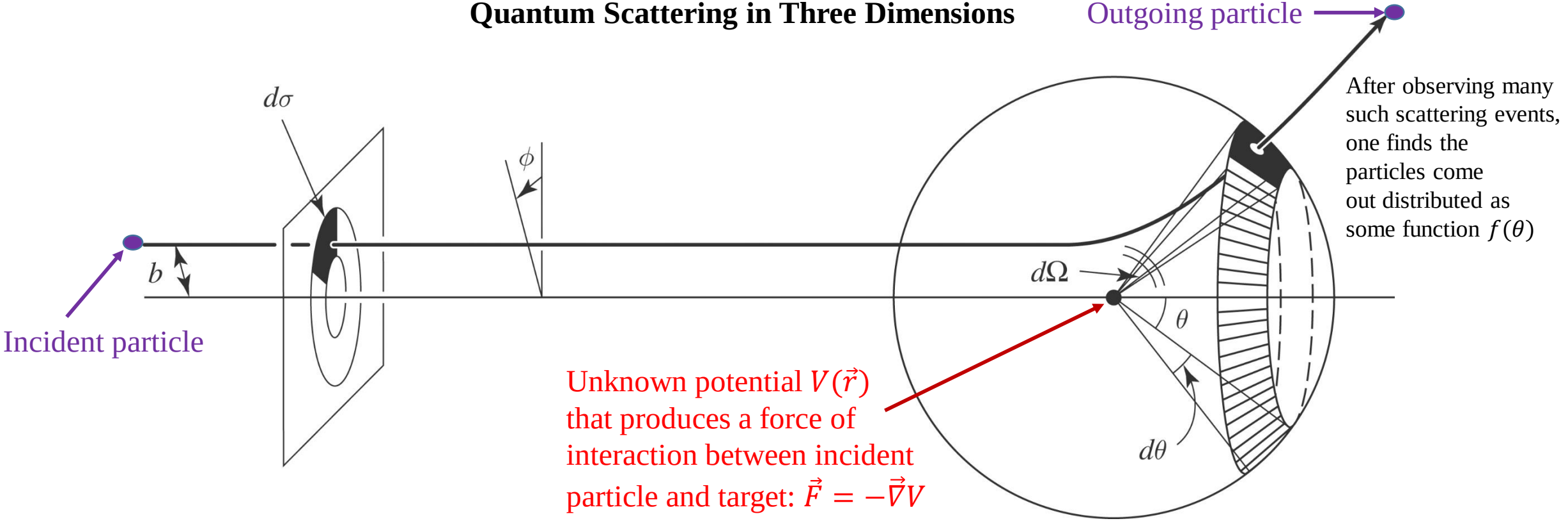


$$S = \frac{e^{-i2ka}}{cos(2la) - i\frac{(k^2+l^2)}{2kl} sin(2la)} \begin{bmatrix} i\frac{sin(2la)}{2kl}(l^2-k^2) & 1 \\ 1 & i\frac{sin(2la)}{2kl}(l^2-k^2) \end{bmatrix}$$

$$k = \frac{\sqrt{2mE}}{\hbar} \quad \text{and} \quad l = \frac{\sqrt{2m(E+V_0)}}{\hbar}$$

Griffiths 3rd Edition, problem 2.53

Quantum Scattering in Three Dimensions



We CONTROL the mass m, energy E, and momentum $\vec{p}$ of the incident particle

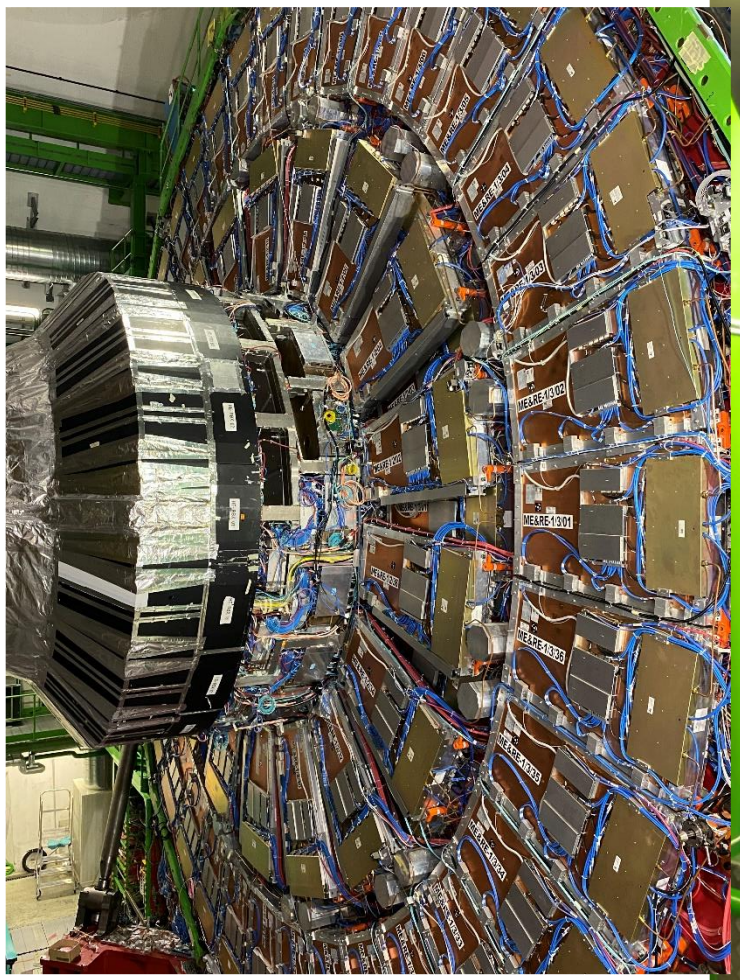
We MEASURE the energy $E' = E$, and momentum $\vec{p'}$ of the outgoing particle (Assume elastic scattering and same particle)

We DO NOT CONTROL the impact parameter b of the incident particle!

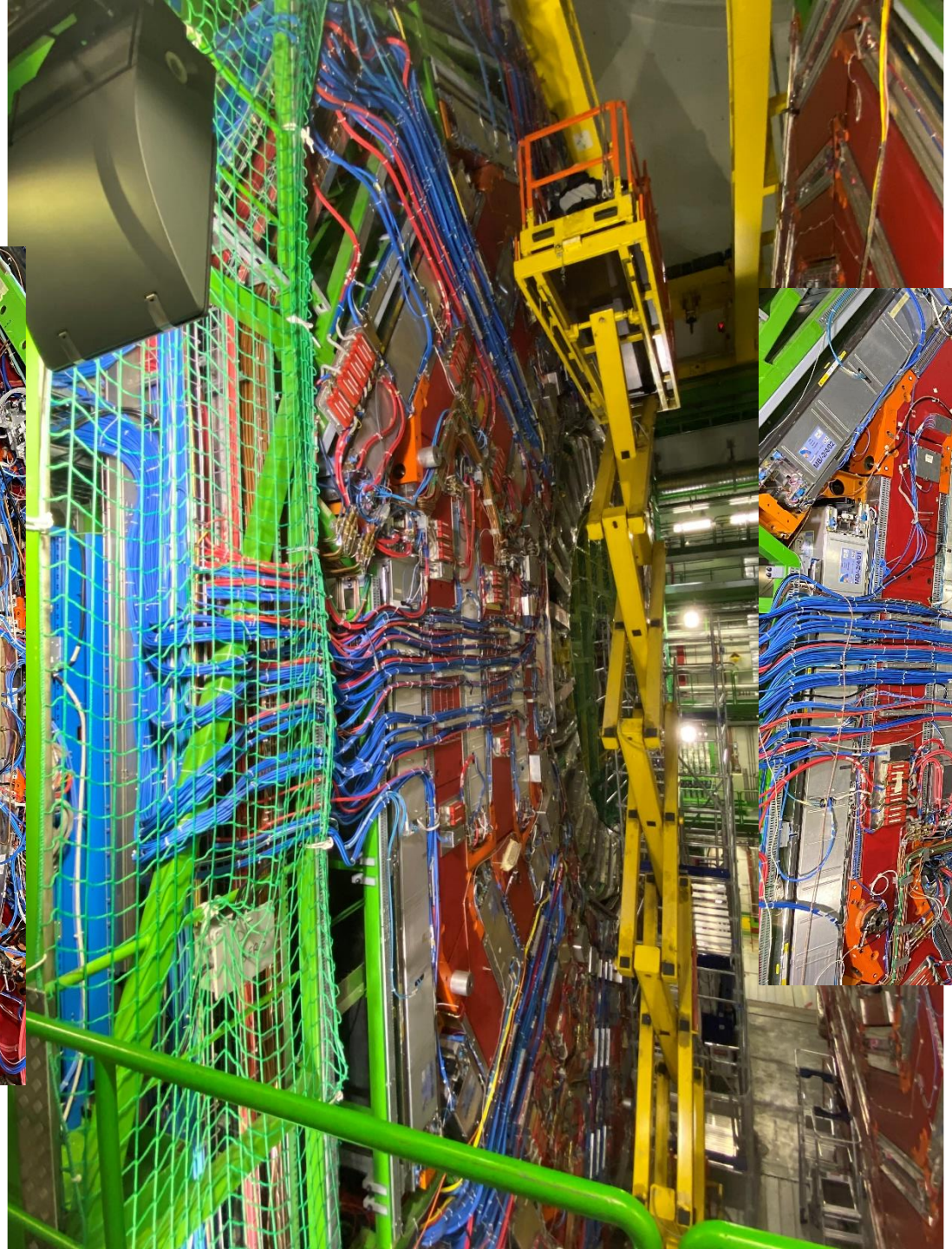
GOAL: Deduce $V(\vec{r})$ from a large number of scattering events (at various b values) measured as a function of E and the $f(\theta)$ of the outgoing particles

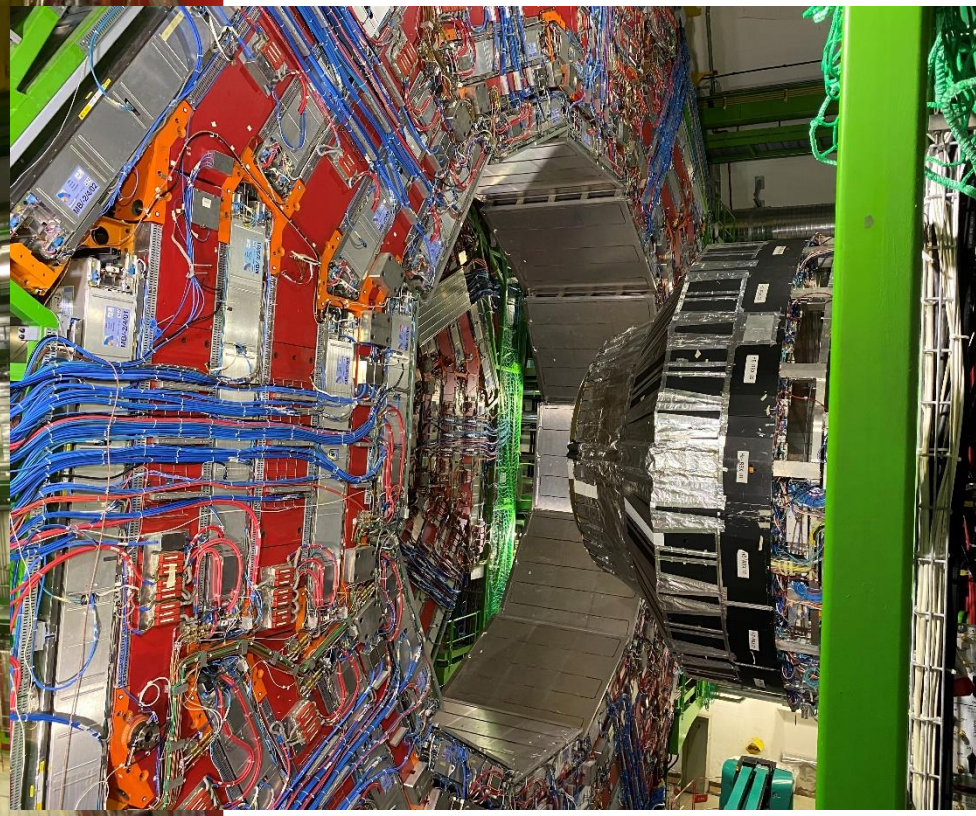
Measuring the E-dependence of the S-matrices on the previous slide allows you to distinguish between the two potentials

The Compact Muon Solenoid (CMS) is a general-purpose detector at the Large Hadron Collider (LHC).



The complete detector is 21 metres long, 15 metres wide and 15 metres high





The CMS detector is built around a huge solenoid magnet. This takes the form of a cylindrical coil of superconducting cable that generates a field of 4 Tesla