\[ p \leq (\text{Maximum fermion momentum}) \]

\[ \rightarrow \text{filling of momentum space} \]

\[ E_{\text{kin}} = \frac{p^2}{2m} \rightarrow E_{\text{kin}} \propto p^2 \sim \frac{1}{R^2} \quad \text{(classical)} \]

\[ E_{\text{kin}} \propto \frac{1}{R} \]

\[ E^2 = p^2 c^2 + m^2 c^4 \quad \text{(special relativity)} \]

\[ E_{\text{kin}} = \sqrt{p^2 c^2 + m^2 c^4} - mc^2 \]

\[ mc^2 + \frac{p^2}{2m} + \ldots \quad \text{for very small } p \]

\[ E_{\text{kin}} \approx pc \quad \text{for extremely large } p \]

\[ \begin{array}{c}
E_{\text{kin}} \\
\downarrow \\
p
\end{array} \]
For Sirius B:

\[ t_I = 6 \times 10^9 \ \text{years} \]

\[ m_e c^2 = 5.11 \times 10^{-13} \ \text{eV} \]

...could end up in situation where Fermi pressure does not balance gravity if relativistic terms are taken into account...

Chandrasekhar limit (white dwarf) \( \approx 1.4 \times M_{\odot} \) as mass increases, \( R \) decreases

Type Ia Supernova:

- White dwarf accumulates mass from giant companion and exceeds Chandrasekhar limit, goes supernova.

Supernova for Supergiants:

Fusion for Super giants

- Orion (25 M\( \odot \))

...various elements form layers that burn at different times...

As core collapses, energy is released, enough to separate elements into nucleons and collapse \( p + e^- \to n + \nu \) and product neutron star