# Neutron stars to NMPs : A direct mapping

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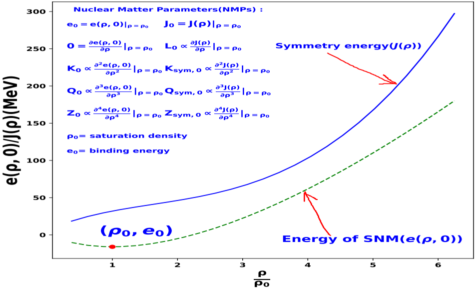
# Equation of State

The energy per nucleon for neutron star matter $\varepsilon(\rho,\delta)$ at a given total nucleon density $\rho$ and asymmetry $\delta = (\frac{\rho_n - \rho_p}{\rho_n + \rho_p})$ can be decomposed,

$$\varepsilon(\rho,\delta) = \varepsilon(\rho,0) + J(\rho)\delta^2 + ...,$$




$$\boxed{\varepsilon(\rho,\delta) = \sum_{n=2}^{6} (a_n + b_n\delta^2)(\frac{\rho}{\rho_0})^{n/3}}$$

$a_n$, $b_n$ are the linear combination of NMPs.

# Isolating important NMPs

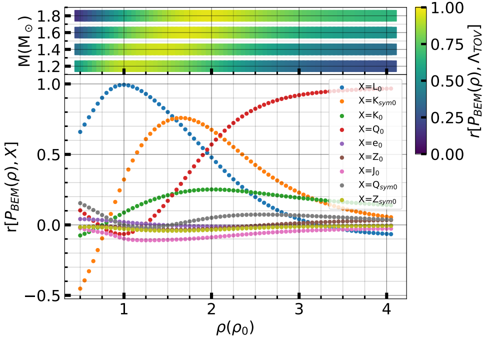



Figure: r[a,b] is the Pearson correlation coefficient between a and b.
$P_{BEM}$=Pressure of beta-equilibrated matter,
$\Lambda_{TOV}$ = Tidal deformability of neutron star of mass M,
X = nuclear matter parameter

# Analytical expression for Tidal deformability

$$\Lambda_{L_n} = c_0 + \sum_{i=1}^{n} c_i(x_i - \hat{x}_i)$$

$x_i$ : NMPs; $\hat{x}_i$ : median value of NMPs

# model prediction

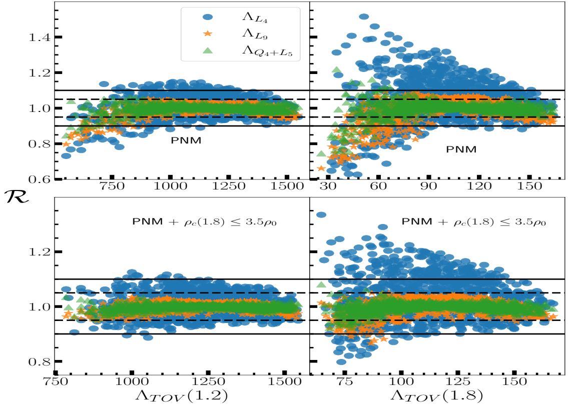



Figure: The ratio $\mathcal{R} = \frac{\Lambda_{func}}{\Lambda_{TOV}}$ at a given NS mass M