# Applications of chiral nuclear forces up to N³LO to nuclear matter and neutron stars

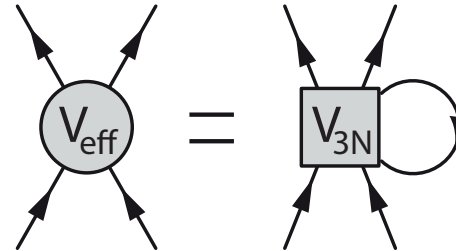**C. Drischler, A. Carbone, K. Hebeler, T. Krüger, and A. Schwenk**
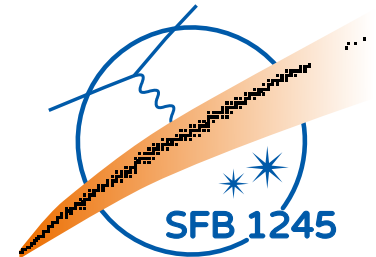
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## 0 Improved Normal-Ordering Method

» **include dominant 3N contributions**

» **effective NN potentials – now at N³LO**

» **applicable to all nuclear forces**

$$V_{eff} = V_{3N}$$

**towards *consistent* N³LO calculations**

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## 1  Isospin-Asymmetric Matter

» MBPT calculation of 11 proton fractions

» N³LO NN and N²LO 3N forces

» constrains astrophysical quantities

Phys. Rev. C **93**, 054314

## 2  Many-Body Convergence ?

» N³LO NN+3N forces beyond HF

» MBPT (third order) vs. SCGF method

» normal-ordering at finite-temperatures

arXiv:1608.05615 (PRC in press)

## 3  BCS Pairing Gap

» neutron matter, $^1S_0$ and $^3P_2-^3F_2$

» new uncertainties

» new (semi-)local NN potentials

(arXiv:1610.05213)