

# WP4 – QCDnet

Hadron physics in non-perturbative QCD

Ulf-G. Meißner, Univ. Bonn & FZ Jülich

*[www.itkp.uni-bonn.de/](http://www.itkp.uni-bonn.de/) ~ QCDnet/*

# CONTENTS

- Objectives of the network
- Network projects and structure
- Involved laboratories and scientists
- First achievements

# OBJECTIVES

- Strong interactions at low & intermediate energies: **strong QCD**  
from light to heavy quark systems, from strong to perturbative QCD
- Manifestation of QCD in hadrons and systems made thereof:  
symmetry breaking and restoration, isospin violation, flavor physics,  
few-nucleon and hypernuclear physics, medium modifications, ...
- Provide improved theoretical tools:  
effective field theories, chiral extrapolations, dispersive techniques, ...
- Detailed analysis of experimental results: Phenomenology & Exp. proposals
- New facilities = new opportunities:  
**FAIR (Darmstadt)**, J-PARC (Tokai), JLAB12 (Newport News), ...

⇒ **QCDnet: Hadron physics with light and heavy quarks**

# NETWORK PROJECTS

- 4 main research areas w/ specific tasks (deliverables)

## P1 Hadron dynamics with light quarks (WP1, WP2, WP3, WP5)

Chiral symmetry and hadron properties, structure and dynamics of mesons, structure and dynamics of baryons, hadronic molecules and exotic states, quark model studies of hadrons, hadron-hadron interactions, GPDs, . . .

## P2 Hadron dynamics with heavy quarks (WP2, WP4, WP6)

Strong interaction corrections to weak decays, charm quark physics, bottom quark physics, final-state interactions and light quark dynamics, from strong to perturbative QCD

## P3 Hadrons in nuclei (WP3, WP4, WP5)

Precision calculations for few-nucleon systems, hypernuclear physics, hadrons with charm quarks, medium modifications of hadrons in nuclei, meson production off nuclei, hadronic atoms and fundamental interactions

## P4 EFT methods for continuum and discrete QCD (WP1, WP5, WP7)

combining chiral perturbation theory with dispersion relations, unitary extensions of CHPT, chiral extrapolations for hadron properties and interactions, finite volume effects and hadron resonances, RG methods in hadronic systems



## SUMMARY of OBTAINED RESULTS

- 51 papers published (PRL, PRD, PRC, EPJA, EPJC, JHEP, NPA, NPB, ...)
- 57 papers submitted to peer reviewed journals
- 29 talks at conferences/workshops submitted to the arXives
- sponsored conferences
  - “Problems in Few-Body Physics 19,” Bonn, Aug. 31 - Sept. 5, 2009
  - “TROIA09 Hadron Physics,” Canakkale, Turkey, Sept. 10-14, 2009
  - “Frontiers in Nuclear Physics,” Bad Honnef, June 18-20, 2009
- proceedings and large reports:
  - “Flavor Physics in the Quark Sector,” M. Neubert et al., arXiv:0907.5386
  - “Physics Performance for PANDA,” M.F.M. Lutz et al., arXiv:0903.3905
  - “Frontiers in Nuclear Physics,” E. Epelbaum et al., arXiv:0907.1778

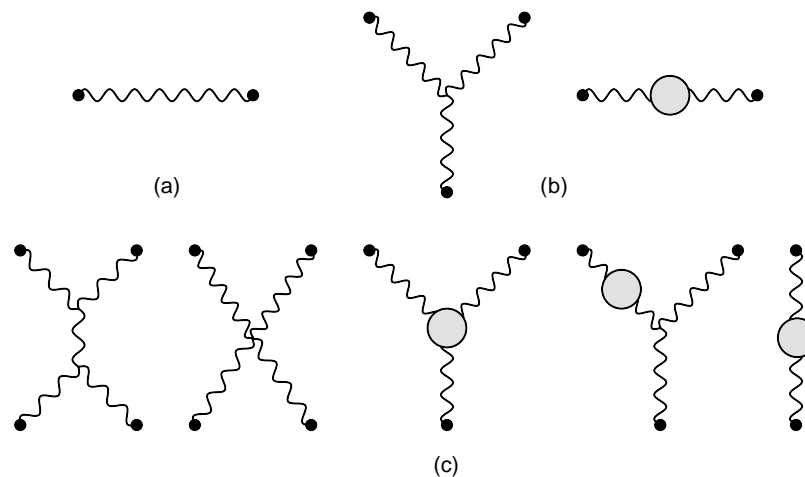
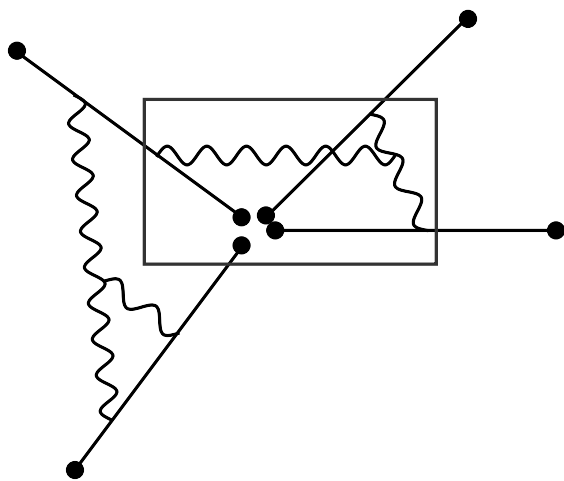




# A FEW SELECTED HI-LITES III

- “Infrared singularities of scattering amplitudes in perturbative QCD,” T. Becher, M. Neubert, Phys. Rev. Lett. **102** (2009) 162001.

Derivation of an exact formula for the infrared singularities of dimensionally regularized scattering amplitudes in massless QCD with an arbitrary number of legs, valid at any number of loops.



⇒ *much more to come ...*

