# Charlotte Elster

## JUSTIPEN supported visit to RIKEN, June 22 - July 12, 2008

**Research Interests:**

My general research interests involve the theoretical study of reactions involving few-nucleon systems. There are plans at RIKEN to construct a deuteron beam line for experiments (d,p) in inverse kinematics (K. Sekeguchi). Since the available energy per nucleon is going to be roughly 440 MeV per nucleon, this will allow to study (d,p) reactions at energies where one should see clear differences between a relativistic and nonrelativistic description of the reaction mechanism. Poincaré invariant Faddeev calculations can be carried out at those energies, at present only with simple interactions, however this will change. A further, at present not considered aspect of (d,p) reactions at these energies is the incorporation of pion-production into the evaluation of the experiment as well the theoretical description. The energy of the RIKEN deuteron beam is such, that only the single-pion production channel is energetically possible. This can give the opportunity to learn how to incorporate inelastic channels into few-body reactions.

A second topic of interest was the discussion on planned experiments at RIKEN on scattering of $^6$He and $^8$He off a polarized proton target at energies up to 350 MeV. The currently available experiments at 71 MeV are at the lower limit of applicability of the 'full-folding' techniques for constructing microscopic optical potentials. My previous work showed that 'full-folding' optical potentials (generated by folding an off-shell nuclear density matrix with an off-shell nucleon-nucleon t-matrix) in the first order Watson formulation were describing closed shell nuclear quite well at 200 MeV and higher. Medium modification formulated as propagator modification due to the nuclear mean field allowed to extend the formulation to energies as low as 100 MeV. The planned differential cross section and polarization measurements for scattering of $^6$He and $^8$He off protons at 200 MeV or higher, would allow to apply our formulation of the reaction mechanism to those nuclei, and use the structure information as input.

Extended discussion about those topics took place during my stay.

**Manuscript:**

During my stay I completed a manuscript entitled
'A New Approach to the 3D Faddeev Equation for Three-Body Scattering', Ch. Elster, W. Glöckle, H. Witala, arXiv:0805.2010 [nucl-th].

Here we propose a novel approach to solve the Faddeev equation for three-body scattering at arbitrary energies. This approach disentangles the complicated singularity structure of the free three-nucleon propagator leading to the moving and logarithmic singularities

in standard treatments. As a consequence the three-body scattering equation can be solved with techniques similar to solving two-body Lippmann-Schwinger equations. The manuscript is submitted to Few-Body Systems and acknowledges the partial support by JUSTIPEN.

**Travel within Japan:**

I visited Prof. Taksu Cheon, a former collaborator, now at Physics Department at Kochi University of Technology, gave a colloquium and discussed some work on optical potentials, we carried out when postdoctoral associates at the U. Maryland.

**Seminars:**

During my stay I gave the following seminars:

1. RIKEN Nishina Center, RIKEN, Japan, June 25, 2008:
   'Poincaré Invariant Three-Body Scattering'
2. Center for Nuclear Science, U. Tokyo (Hongo), Japan, June 23, 2008:
   'Poincaré Invariant Three-Body Scattering at Intermediate Energies'
3. RIKEN Nishina Center, RIKEN, Japan, July 1, 2008:
   'Faddeev and Glauber Calculations for n+d Scattering at Intermediate Energies'
4. Kochi University of Technology, Kochi, Japan, July 7, 2008:
   'Challenges in Few Nucleon Physics'
5. Hosei University, Tokyo, Japan, July 10, 2008:
   'Challenges for the Nucleon-Nucleon Force in the Second Resonance Region'
6. RIKEN Nishina Center, RIKEN, Japan, July 11, 2008:
   'Challenges for the Nucleon-Nucleon Force in the Second Resonance Region'

I appreciate the JUSTIPEN support and thank for the productive time spent at RIKEN.