

Proposal for a (European) Collaboration Workshop

[To be held at the ECT* (Trento)]

TNET: The EURONS European Theory Network

1. Proposed dates/duration of the Workshop

Very strong preference is for a five working day workshop in the period 7th - 11th January 2008, or in the period of 17th March - 11th April 2008. These dates are chosen to avoid most University teaching semesters and to maximise the availability and participation of University-based researchers. The January dates are requested in particular as the best suited for discussions among this section of the theory community as a component in shaping and sharpening of FP7 input.

2. Organisation and Contacts

Jeff Tostevin, University of Surrey, GB, Co-ordinator

Jan Vaagen, University of Bergen, NO, Organiser

Antonio Sa Fonseca, Universidade de Lisboa, PT, Organiser

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3. Scientific basis for the Workshop Proposal

The science of exotic and unstable nuclei at the extremes of stability, spin and/or isospin is providing theoretical challenges and insight into the nuclear many-body system, by exploiting the additional degree of freedom provided by significant neutron-proton asymmetry. The associated experimental advances are supported by European and international investment. Well informed, integrated and accessible theoretical capability and strength will be key to the planning, proposal and interpretation phases of the new generation of physics and experiments at these major European facilities, e.g. GSI/FAIR, GANIL/SPIRALII, CERN/ISOLDE and related world-wide initiatives, e.g. RIKEN/RIBF, TRIUMF/ISAC, NSCL/ISF. The theoretical demands span reaction and dynamical effects from keV per nucleon through 1 GeV per nucleon incident energies, with related demands on the predictive power of nuclear structure models and of nuclear reactions and responses. Whether the individual physical motivations are the study of astrophysical reactions rates, of nuclear spectroscopy, or of nuclear dynamics, etc., they are underpinned by a common base of microscopic, fully-quantum, semi-classical, and effective few- and many-body theoretical approaches. The development of these physical approaches for fundamental and applied applications motivates this workshop proposal.

There have been very significant successes in developing theoretical methodologies for the subsets of experimental observables (often inclusive) that have been accessible during the decade or more of experiments on the best existing radioactive beams facilities. The new facilities, however, will bring data in entirely new mass and charge (A, Z) regions. The higher quality, intensity and diversity of secondary beams will also result in data of unprecedented precision and energy resolution, of more exclusive observables, and on weaker reaction channels. These will pose new challenges for our *ab-initio* and semi-empirical theoretical models of nuclear structures and reaction dynamics. As never before, analyses require better integration of the structural and reaction dynamical descriptions, which

must be applied with comparable precision. These are areas in which European nuclear theory is relatively strong, but where the expertise is distributed among several relatively small centres. A requirement is for this knowledge and excellence in the different areas to be well informed and able to meet, exchange experience and collaborate effectively. A discussion of the forward look, physics themes, and the shape and budget of proposals to take an integrated European theory effort forward under FP7, is also a timely objective of the proposed meeting.

The proposed Collaborative Workshop, under the auspices of the ECT* (and as a part of the TNET Theory Network N08 activity of the EURONS FP6 Project) is one component of this strategy. Key to the proposal is to bring together (a) the diverse nuclear structures and reactions expertise, (b) both few- and many-body nuclear structure and reactions practitioners, and (c) those working in the interface areas. Important themes include *microscopic*, *cluster*, and *beyond nuclear mean field* approaches, single-nucleon, cluster- and few-body overlap functions, etc. Experience over the last decade has clarified that emphasis must be on methods that are both (i) intrinsically non-perturbative, and (ii) able to include the most important nucleon-nucleon correlations. The involvement of selected experimentalists, particularly those with a track record of effective engagement with theoreticians, will also be important for providing input on the expected capabilities of new facilities and tools. The involvement of high calibre young European researchers, including those currently in postdoc posts overseas, will also be strongly encouraged.

The aims of the workshop are primarily:

- (1) To bring a specific theoretical community together (of circa 40-45 members), following-up on the first TNET Workshop (held at Surrey in April 2006), to share knowledge and foster research on topical problems of theoretical nuclear structure and reactions physics.
- (2) To review recent theoretical advances and understanding and gain a deeper appreciation of new experimental capabilities (to strengthen theoretical and experimental interactions) and so to flag possible new research projects (including use of PhD training manpower) in relevant areas.
- (3) To allow exposure to the state-of-the-art theoretical tools, and of open questions, to talented young scientists, and to foster future collaborative activities and foster younger researcher networks.
- (4) To make an assessment of available intellectual capital and human resources, in particular concerning reaction theory, including expertise relevant for future fast reactors and accelerator driven systems.
- (5) To enable this part of the European theory community to make additional input into integrated European theory proposals under FP7 as part of a forward look and need for renewal and strengthening of the European reaction community.

4. Outline Scientific Program, Speakers and Key Participants

The aims of the Workshop require the participation of the European nuclear theory groups, most of whom are part of the TNET (EURONS) Network. Other potential invitees are indicated for specific theoretical and/or experimental expertise. The aims (and size) of the Workshop demand that our emphasis is biased heavily toward Europe-based participation. Other participants and speakers, in addition to the European-based researchers of Table I, will include young postdocs currently outside Europe, e.g. Drs J Rotureau and G Hagen, (currently ORNL) and N Michel (currently Kyoto) for input on density matrix renormalization group methods for the Gamow Shell Model, coupled-cluster, three-body forces and weakly bound systems, and developments of Hartree-Fock theory for resonances, respectively.

5. Other Financial Support

TNET has some EU (FP6) funds available to support (in part) the costs of several EU participants and (in part) those from the EURONS (TNET) member institutions.

Speaker/Participant	Home Institute	Proposed topic/area of the presentation
P. Stevenson J. Tostevin M. Oi N. Timofeyuk R.C. Johnson	University of Surrey, UK	Beyond-mean field methods and giant resonances Few-body reaction theories for spectroscopy Collective and chiral degrees of freedom Reactions for astrophysics – mirror system decays Reaction methodologies, multiple scattering
J. Vaagen Øyvind Jensen,	University of Bergen, NO	Interplay of bound and continuum states Recoil effects in halo systems
D. Baye P. Descouvemont C. Leclercq-Willain	University Libre Bruxelles, BE	The many-body/few-body model interface
M. Zhukov B. Jonson	University of Göteborg, SE	Experimental perspectives/new capabilities
J. Gomez-Camacho A. Moro	University of Sevilla, ES	Coupled channels capabilities, few-body reactions
H. Wolter	LMU, Munchen, DE	TBA
R. Wyss R. Liotta	KTH Stockholm, SE	TBA
I. Martel	University of Huelva	Experimental perspectives/ new capabilities
N. Walet	University of Manchester, UK	Light nuclei – many body approaches
M. Ploszajczak P. Van Isacker N. Orr	GANIL, Caen, FR LPC Caen	Continuum shell model – unification of structure and reaction calculations. Multi-nucleon transfers – theoretical motivations Experimental perspectives/new capabilities
M. Hjorth-Jensen Maxim Kartamychev	University of Oslo, SE	Many-body quantal systems. Modern shell model interactions and capabilities How three-body forces affect nuclear spectra
N. Van Giai P. Schuck	IPN, Orsay, FR	Many-body methods – quasiparticle RPA Clusters and condensates
H. Leeb	TU Wein, AIAU, AU	TBA
H. Feldmeier T. Aumann	GSI, Darmstadt, DE	Correlated many-body approaches Experimental perspectives/ new capabilities
A. Sa Fonseca M. Rodriguez-Gallardo A. Deluva R. Crespo	Universidade de Lisboa, PT Instituto Superior Tec., Lisboa	Exact versus approximate few-body approaches Four-body dynamical CC calculations <i>Ab initio</i> few-nucleon reactions Multiple Scattering approaches to reactions
D. Riska	HIP, Helsinki, FI	TBA
J. Adam	CAS, Prague, CS	TBA
M. Viviani	INFN, Pisa, IT	TBA
J. Carbonell	LPSC, Grenoble, FR	TBA
G. Orlandini	University of Trento, IT	TBA
A. Gade/other	Michigan State Univ., USA	Experimental perspectives/ new capabilities
T. Motobayashi/other	RIKEN, Tokyo, JP	Experimental perspectives/ new capabilities
R. Lemmon	Daresbury Laboratory, UK	Experimental perspectives/ new capabilities
TBA	CERN/ISOLDE, CH	Experimental perspectives/ new capabilities

TABLE I: Proposed initial list of speakers and/or participants at the Collaboration Workshop. Organisers are shown in **bold**.