Summary (autoreferat)

1 Name

Tobias Fischer

2 Scientific degrees

Dates	Degree	Department/University
10.2009	Ph. D. (**summa cum laude**), title: *Neutrino radiation hydrodynamics in hot and dense nuclear matter and the role of microphysics in simulations of massive stars*, (supervision: M. Liebendörfer, F.-K. Thielemann, J. Schaffner-Bielich)	Department of Physics and Astronomy, University of Basel (Switzerland)
03.2006	Master of Science in quantum physics, title: *The evolution of galactic nuclei under numerical N-body simulations* (supervision: B. Gustafsson, T. Ohlsson)	Royal Institute of Technology, Stockholm (Sweden)
11.2003	Diploma in theoretical physics, title: *Investigations of axially symmetric and stationary spacetime using algebraic-geometric methods* (supervision: O. Richter, G. Rudolph)	Department of Physics and Earth Science, University of Leipzig (Germany)

3 Academic appointments

Dates	Type of appointment and Organization	Position
07.2013 – present	Research assistant and lecturer, Institute for Theoretical Physics, University of Wrocław, Poland	adjunct
07.2011 – 06.2013	Research assistant, GSI, Helmholtzzentrum für Schwerionenforschung GmbH and University of Darmstadt, Germany	post doctoral
05.2010 – 06.2011	Teaching and research assistant, GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany	post doctoral
11.2009 – 04.2010	Teaching and research assistant, University of Basel, Switzerland	post doctoral

4 Scientific achievements

H-1 **T. Fischer**,
”Medium modifications for the neutrino-pair emission from nucleon-nucleon Bremsstrahlung – Role for the protoneutron star deleptnoization”
Astronomy & Astrophysics **593**, A103 (2016)

H-2 **T. Fischer**,
”Constraining the supersaturation density equation of state from core-collapse supernova simulations?”
European Physical Journal **A52**, 54 (2016)

H-3 G. Martínez-Pinedo, **T. Fischer**, and L. Huther,
”Supernova neutrinos and nucleosynthesis”
Journal of Physics G: Nuclear and Particle Physics **41**, 044008 (2014)

H-4 **T. Fischer**, M. Hempel, I. Sagert, Y. Suwa, and J. Schaffner-Bielich,
”Symmetry energy impact in simulations of core-collapse supernovae”
European Physical Journal **A50**, 46 (2014)

H-5 **T. Fischer**, K. Langanke, and G. Martínez-Pinedo,
”Neutrino-pair emission from nuclear de-excitation in core-collapse supernova simulations”
Physical Review **C88**, 065804 (2013)

H-6 A. W. Steiner, M. Hempel, and **T. Fischer**,
”Core-collapse supernova equations of state based on neutron star observations”
The Astrophysical Journal **774**, 10 (2013)

H-7 G. Martínez-Pinedo, **T. Fischer**, A. Lohs, and L. Huther,
”Charged-current weak interaction processes in hot and dense matter and its impact on the spectra of neutrinos emitted from proto-neutron star cooling”
Physical Review Letters **109**, 251104 (2012)

H-8 **T. Fischer**, G. Martínez-Pinedo, M. Hempel, and M. Liebendörfer,
”Neutrino spectra evolution during proto-neutron star deleptonization”
Physical Review **D85**, 083003 (2012)

H-9 M. Hempel, **T. Fischer**, J. Schaffner-Bielich, and M. Liebendörfer,
”New equations of state in core collapse supernova simulations”
The Astrophysical Journal **748**, 70 (2012)

H-10 **T. Fischer**, S. C. Whitehouse, A. Mezzacappa, F.-K. Thielemann, and M. Liebendörfer,
”Protoneutron star evolution and the neutrino driven wind in general relativistic neutrino radiation hydrodynamics simulations”
Astronomy and Astrophysics **517**, 80 (2010)

Summary of the above listed articles

Research summary

- Novel insights in the formation and evolution of (proto)neutron stars – from their birth in core collapse supernovae towards young neutron stars: I was the first to predict the complete evolution and neutrino signal from core-collapse supernovae using state-of-the-art neutrino transport and input physics as well as a modern (nuclear) equation of state, based on consistent simulations of the entire evolution starting from the stellar progenitor core collapse up to the formation of the nascent cold and lepton-free neutron star **(H-1, H-10)**.

- Elementary understanding of the neutrino signal from the deleptonization of young (proto)neutron stars – novel analysis at the level of the neutrino opacity, understanding the increasing similarity among the different neutrino flavors **(H-8)**.
- Emended treatment of neutrino-matter interactions consistent with the description of the hot and dense nuclear medium: for the first time we pointed out the inconsistent implementation of weak interaction processes and equation of state in all current supernova models **(H-7)**.
- *Still* no r process associated with massive star explosions – about their connection has long been argued: together with G. Martínez-Pinedo from the University of Darmstadt we were the first to rule out unambiguously canonical massive star explosions as the astrophysical origin for the production of heavy neutron-capture elements associated with the main component of the r process **(H-3)**.
- Design of a new class of equations of state for astrophysics applications – exploring their role in core-collapse supernova simulations **(H-2, H-4, H-6, H-9)**.
- New source of heavy-lepton flavor neutrinos: probing nuclear structure physics with the neutrino signal from stellar collapse **(H-5)**.

Nuclear astrophysics theory – state-of-the-art

Subject of my research is computational stellar astrophysics related to relativistic astrophysics modeling and nuclear astrophysics theory input. A particular focus is on stellar explosions of stars more massive than about 8 times the mass of our sun ($M_\odot$), known as core-collapse supernovae (SN). They are triggered from the initial implosion of the stellar core where all nuclear burning processes cease and pressure loss occurs when degenerate electrons are captured on protons bound in nuclei. It also deleptonizes the stellar core. Core collapse SNe become optically visible only when the explosion, which develops deep inside the stellar core, reaches the star's surface. Thereby the central happenings are of fundamental importance for the understanding of the explosion mechanism. It is directly observable only via gravitational waves and neutrinos, like SN1987A (Feb. 23rd, 1987), for a Cosmic event within our Galaxy due to current detector limitations.

Theoretical studies of massive star explosions have long been related to the formation of a hydrodynamics shock wave. It forms when the collapsing stellar core reaches very high density, where the strong short-range repulsive nuclear force counterbalances gravity such that the collapse halts and the stellar core bounces back. The central object which forms at core bounce is the proto-neutron star (PNS). It is hot and lepton rich in which aspects it differs from the commonly known neutron star, the final SN explosion remnant. The supernova shock wave stalls during the initial propagation out of the central core due to energy losses, turning into a standing accretion shock. Its evolution is determined by **(i)** mass accretion from the still gravitationally collapsing outer layers of the stellar core and **(ii)** the energy deposition in the dissociated material behind the shock. The *supernova mechanism* is then related to the energy transfer from the PNS interior ($3 - 6 \times 10^{53}$ erg gravitational binding energy gain) into a thick layer of accumulated material at the PNS surface, resulting in the continuous shock expansion to increasingly larger radii, i.e. the onset of the supernova explosion, and finally the ejection of the stellar mantle. Such scenario refers to the so-called "delayed-explosions" mechanism. This is currently considered the standard case. It excludes the "prompt scenario" in which case the initially expanding shock wave does not stall. Successful mechanisms of energy liberation and shock revival are: magneto-rotational (LeBlanc & Wilson 1970), dumping of acoustic energy (Burrows et al. 2006) and the standard scenario due to neutrino heating (Bethe & Wilson 1985).

Modeling core-collapse SNe has a long history with pronounced success story in spherical symmetry (cf. Wilson & Mayle 1993; Mezzacappa & Bruenn 1993). The big advantage of such spherically symmetric models is the accurate treatment of all relevant input physics: *(a)* general relativistic neutrino radiation hydrodynamics, *(b)* microscopic nuclear equation of state (EOS), and *(c)* angle- and energy-dependent three-flavor Boltzmann neutrino transport *(d)* including a 'complete' set of weak processes. The latter is subject of continuous development (Bruenn 1985; Reddy et al. 1998; Horowitz 2002). However, in spherical symmetry so far neutrino-driven explosions could only be obtained for low-mass progenitor stars between about $8-10$ $M_\odot$ (cf. Kitaura et al. 2006; Melson et al. 2015b). Such progenitor stars have a tiny core with a very steep density gradient separating stellar core and envelope. They may result from single-star evolution at the transition from O-Ne white dwarfs to electron-capture supernova propgenitors (Jones et al. 2013) or of a binary-star evolution (Tauris et al. 2015). The latter receives increasing attention recently due to improved computer modeling; it is a still rather poorly explored branch of stellar evolution, though it represents an interesting physical case since about 1/3 of all massive stars host in a binary system. More massive stars (> 12 $M_\odot$) that result from a single-star evolution scenario develop a stellar core composed of iron-group nuclei surrounded by an extended silicon-layer; this results in a much more shallow density gradient compared to the previously mentioned exceptions. For such massive stars neutrino-heating fails to revive the standing bounce shock in spherical symmetric models. It requires multi-dimensional SN simulations where the neutrino-heating efficiency increases in the presence of convection and the development of hydrodynamic instabilities (see e.g. Miller et al. 1993; Herant et al. 1994; Burrows et al. 1995; Janka & Mueller 1995; Marek & Janka 2009; Müller et al. 2012; Suwa et al. 2013; Bruenn et al. 2013; Melson et al. 2015b; Müller & Janka 2015). Recently in Melson et al. (2015a) the connection was established for the first time between supernova explosions and the role of nuclear (or better hadron) physics taking into account the strangeness contents of the proton and the role for the axial-vector coupling for weak interactions.

Massive star explosions have also long been explored as the main site for the synthesis of heavy neutron-capture elements in the Galaxy Woosley et al. (1994), in addition to neutron star mergers (for recent works, cf. Korobkin et al. 2012; Just et al. 2015). In particular the production of the heaviest elements, e.g., barium, europium, lead, and gold is associated with the main component of the r process with the nucleosynthesis up to mass number $A = 195$ (Thielemann et al. 2011). Traces of these elements can be found even in iron-poor or in general metal-poor stars[1] (for details, cf. Sneden et al. 2008; Roederer et al. 2009, 2014) that are associated with the early evolution of the Galaxy. Despite their success as r-process site neutron star mergers occur not frequent enough and they start to contribute too late to the chemical evolution of the Galaxy (cf. Argast et al. 2004). It leaves events associated with massive star explosions as the main site for the production of heavy elements in the Galaxy, i.e. at low metallicity. Moreover, the nucleosynthesis of current standard SN models fails to yield these heaviest elements up to mass number $A \simeq 195$ (further details will be given in the next section) – the mass flow cannot proceed beyond elements heavier than Zr and Mo with charge numbers $38 < Z < 45$. Hence, the hunt for the main site for the r process still continues. It points, in particular, to few very rare events that are responsible for the heavy r-process elemental enrichment at low metallicity.

Scientific contributions

(H-10) – Neutrinos will be observed for about 30 seconds from the next stellar explosion within our Galaxy; the limit is set by the continuously reducing neutrino flux and energy reaching at some stage below the detector limit of currently about 5 MeV. Thereby, only the first second will provide insights into the explosion mechanism. The long-term signal is related to the *deleptonization of the nascent proto-neutron star*. It is known as Kelvin-Helmholtz cooling phase during which the proto-neutron star emits neutrino of all flavors and cools on a timescale on the order of 10 seconds, developing towards the final neutron star being cold and neutrino less. This phase is mildly independent from details of the supernova explosion and can be studied in spherical symmetry (Pons et al. 1999). Essential for a reliable prediction of the neutrino signal is accurate three-flavor Boltzmann neutrino transport, based on which I was the first to study this phase consistently for a selection of massive progenitor stars in **(H-10)** within fully general relativistic neutrino radiation hydrodynamics (Liebendörfer et al. 2004). My results were confirmed by other groups independently quickly after my discovery (Hüdepohl et al. 2010). It was a major break through of the field and many follow-up studies are based on my results, e.g., ruling out collective neutrino flavor oscillations in Chakraborty et al. (2011b,a), probing the neutrino mass hierarchy with the neutrino signal risetime in Serpico et al. (2012), deducing the diffuse SN neutrino background in Lunardini (2016), and for neutrino detection at Earth for currently

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[1] metallicity as measure of the Galactic age

operating and future planned facilities in Wu et al. (2015).

(H-8) – Based on the simulation results of **(H-10)** it was identified that all neutrino flavors become increasingly similar during the PNS deleptonization. Following the argumentation of Raffelt (2001) these findings could not be understood a priori. The subsequent detailed and novel analysis of **(H-8)**, at the level of the neutrino opacity for all the different weak interaction channels, revealed the corresponding origin: It is related to the weak processes that drive the neutrino signal at the neutrino decoupling located at the PNS surface. Thereby at some late stage during the Helmholtz-cooling phase all neutrino flavors are dominated by the same weak reaction, i.e. scattering on neutrons, which does not distinguish between different neutrino flavors.

(H-7) – The findings of **(H-10, H-8)** were based on the inconsistent implementation of weak processes and nuclear equation of state. In **(H-7)** we were the first to point out this important deficit and, moreover, that also all present supernova models suffer from this inconsistency. We corrected for this inconsistency based on the mean-field treatment of Reddy et al. (1998) and we demonstrated the subsequent impact of the nuclear equation of state on the neutrino signal. Now, due to these novel insights it has become clear that the magnitude of spectral differences between ν_e and $\bar{\nu}_e$ depends on details of the nuclear medium properties, in particular on the nuclear symmetry energy, which is currently highly uncertain under supernova conditions. Our results were soon after our discovery confirmed by other groups independently (Roberts et al. 2012a; Horowitz et al. 2012).

(H-3) – A very important general property, related to the spectral difference between ν_e and $\bar{\nu}_e$, $\triangle = \langle E_{\bar{\nu}_e} \rangle - \langle E_{\nu_e} \rangle$, defines the nucleosynthesis of the *neutrino-driven wind* (Woosley et al. 1994). The latter is a low-mass ($\sim 10^{-4}$ M$_\odot$) outflow ejected from the PNS surface via continuous neutrino heating during the deleptonization, i.e. after the supernova explosion has been launched. In general, in Qian & Woosley (1996) the relation between neutrino properties and the nucleosynthesis relevant conditions, e.g., the proton-to-baryon ratio given by the electron fraction Y_e and entropy per baryon has been established. In particular, it has been shown when $\triangle > 4 - 5$ MeV neutron-rich conditions are favored while otherwise matter becomes proton rich. In case of neutron excess the neutrino-driven wind is a potential site for the *r* process. For neutron deficient matter it is a potential site for the νp process (cf. Fröhlich et al. 2006) with $Z > 42$ ($A > 92$). In **(H-3)** novel SN simulations with updated input physics were performed and analyzed, including a details integrated nucleosynthesis study of the material ejected in the neutrino-driven wind. We found that spectral differences are generally too small, $\triangle \simeq 4$ MeV, in order to result in the production of neutron-capture elements beyond Zr and Mo ($38 < Z < 45$). We also pointed out that the magnitude of spectral differences between ν_e and $\bar{\nu}_e$ is determined by the nuclear symmetry energy, for which it becomes evident to have better constraints under supernova conditions. Our nucleosynthesis findings are consistent with metal-poor star observations that are deficient in heavy neutron-capture elements (cf. Honda et al. 2006). We also acknowledged that towards later times during the PNS deleptonization spectral differences always reduce and that the ejecta will eventually turn proton rich where low (anti)neutrino luminosities prevent a strong νp process. These findings exclude the neutrino-driven wind from PNSs as site for the main component of the *r*-process (with the synthesis of elements up to mass number $A \simeq 195$), and the search for the main component of the *r* process continues.

(H-1) – For the weak input physics in SN models that involves nuclear interactions beyond the mean field approximation, e.g., nucleon-nucleon bremsstrahlung and the associated neutrino pair processes are always treated at the vacuum level. In **(H-1)** I was the first to study the impact from lowest order corrections of the vacuum treatment, i.e. vertex modifications via a simple but powerful parametrization related to the nuclear medium. It was then implemented in SN simulations and explored during the PNS deleptonization, with particular focus on modifications of the neutrino signal and the associated consequences, e.g., with respect to the nucleosynthesis relevant conditions. This novel study points to the essential demand of a better understanding of weak processes and in particular the influence of the nualear medium for the modeling of SN explosions.

(H-6, H-9) – The role of the nuclear equation of state in core-collapse supernovae has long been studied in spherical symmetric simulations (Sumiyoshi et al. 2006; Fischer et al. 2009; O'Connor & Ott 2011) and even in the multi-dimensional framework (Marek et al. 2009; Suwa et al. 2013). In the context of the PNS deleptonization studies have mostly been focused on the impact of exotic matter such as quark matter or strangeness in hadrons (cf. Pons et al. 2001) and recently exploring the role of convection in (Roberts et al. 2012b). Before the studies of **(H-6, H-9)** there were only two supernova equations of state available to the community (Lattimer & Swesty 1991; Shen et al. 1998); both of which are currently considered in violation with a number of constraints from nuclear theory, experiments and astrophysics, which has been summarized in parts in **(H-4)**. Therefore, we saw the absolute need to provide a novel supernova equation of state being consistent with *all* constraints and with a "good" description of the nuclear medium under SN conditions, for which the modified nuclear statistical approach for nuclei of Hempel & Schaffner-Bielich (2010) was employed. It resulted in a new catalogue presented in **(H-9)**, available for a variety of relativistic mean field parametrizations, and further updated in **(H-6)** based on observational constraints. Parameters of the equation were designed to be in agreement with the analysis of observations of low-mass X-ray binary neutron star systems of Steiner et al. (2010). These catalogues are being continuously updated.

(H-4) – One of the highly uncertain nuclear matter properties, also with great impact on weak interaction physics, is the nuclear symmetry energy and in particular its density dependence. Based on a well selected reference nuclear model, a novel parameter study was conduced in **(H-4)** with large variations of the symmetry energy with increasing density, however, being still consistent with nuclear and observational constraints (Lattimer & Lim 2013). From this study it became clear that, despite initial expectations, the symmetry energy plays only a marginal role for core-collapse supernovae. Instead we found that the SN evolution is dominated by the symmetric part of the equation of state due to the high temperatures on the order to tens of MeV reached. The latter also determines the stiffness/softness of the nuclear matter, i.e. (in)compressibility modulus, which is again particularly poor constrained at high density from experiments.

(H-2) – In an attempt to constrain the supersaturation density equation of state with simulations of core-collapse supernovae, in **(H-2)** two extreme variations of the same nuclear model were employed; with very soft and stiff supersaturation density behavior. However, the neutrino signal which was thought to be used as signal in order to deduce the constraint as potential observable form the next Galactic event, is emitted form the surface layer of the PNS at low densities. It was found that the neutrino signal is robustly insensitive to variations of the high-density phase of the PNS and the associated fast/slow contraction, as long as no phase transition occurs (Sagert et al. 2009; Fischer et al. 2011). It significantly limits core-collapse supernovae as laboratories to probe the state of matter at supersaturation densities.

(H-5) – In core-collapse supernovae temperatures on the order of several MeV are typically obtained; the corresponding energy scale enables nuclear structure physics corresponding to nuclear transitions which excites nuclei above their ground state configuration. About the role of the associated nuclear de-excitations and the subsequent emission of neutrino-antineutrino pairs of all flavors has long been speculated (cf. Fuller & Meyer 1991). In **(H-5)** we were the first to include such novel weak process in stellar collapse simulations. We find that nuclear de-excitations are the leading source of heavy lepton flavor neutrinos, at low neutrino energies, depending sensitively on the theoretical nuclear (de)excitation model. We estimate that from the future observation of the neutrino signal risetime during the stellar collapse onset it may be possible to deduce nuclear structure physics at energies (or temperatures) which are inaccessible in current nuclear experiments.

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5 Other acomplishments

Outstanding publications[2]

200+ citations:

T. Fischer et al.,(2010), *Astronomy & Astrophysics*, **517**, 25

100+ citations:

M. Wurm, et al., (2012), *Astroparticle Physics*, **35**, 685 (LENA collaboration white paper)
I. Sagert and T. Fischer, et al., (2009), *Physical Review Letters*, **102**, 081101

Publication summary[2,3]

Number of papers	64 (50)
Total citations	1704 (1693)
Average citations	21.8 (33.8)
h-index	22 (22)

Grants received as principle investigator

2014 – present	Fellowship of the Polish National Science Foundation (NCN) Grant NCN SONATA 6 UMO-2013/11/D/ST2/02645 *Probing supernova matter with neutrinos*
2011 – 2013	Young Investigator Fellowship grant of the Swiss National Science Foundation; *The importance of sophisticated microphysics in core-collapse supernova models and the explosion mechanism of massive stars*

Refereeing

since 2016	Polish National Science Foundation (NCN)
since 2015	European Physical Journal
since 2013	Revista Mexicana de Astronomía y Astrofísica
since 2010	The Astrophysical Journal

Research network activities

since 2016	Board member of CSQCD (Compact stars in the QCD phase diagram), international research network
since 2015	Nuclear Astrophysics Virtual Institute (NAVI) of the Helmholtz association - Polish representative at the University of Wroclaw

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[2] source: NASA ADS June 2016, available at http://ift.uni.wroc.pl/~fischer/publications.html

[3] values in parenthesis refer to refereed only articles

since 2014	Participating member of new-COMPSTAR; ESF-funded COST Action MP1304
since 2012	Participating member of the LENA - Low Energy Neutrino Astronomy - collaboration; Neutrino astro- and particle physics research networking program
2010 – 2013	Participating member of MASCHE; EuroGenesis Coordinated Research Project "Massive Stars as Agents of Chemical Evolution"
2011 – 2012	Participating member of the Collaborative Research Center (CRC) 634, TU Darmstadt, Germany; ”Kernstruktur, nukleare Astrophysik und fundamentale Experimente bei kleinen Impulsüberträgen am supraleitenden Darmstädter Elektronenbeschleuniger S-DALINAC”
2008 – 2013	Participating member of COMPSTAR; research networking program funded by the ESF

Teaching experience

Winter semester 2015/2016	monochromatic lecture: ”Introduction to nuclear astrophysics” University of Wroclaw, Poland
Winter semester 2010/2011	teaching assistance: introduction to astrophysics University of Darmstadt, Germany
2005 – 2010	temporary lecturing: classical mechanics, electromagnetism, relativity, statistical physics, thermodynamics University of Basel, Switzerland
Summer semester 2010	teaching assistance: statistical physics and thermodynamics University of Basel, Switzerland
Winter semester 2009/2010	teaching assistance: classical mechanics University of Basel, Switzerland
Winter semester 2007/2008	teaching assistance: computational astrophysics University of Basel, Switzerland
Summer semester 2007	teaching assistance: classical electrodynamics University of Basel, Switzerland
Winter semester 2006/2007	teaching assistance: classical mechanics University of Basel, Switzerland
Summer semester 2006	teaching assistance: statistical physics and thermodynamics University of Basel, Switzerland
Winter semester 2005/2006	teaching assistance: computational astrophysics University of Basel, Switzerland

Summer Semester 2003	teaching assistance: classical electrodynamics University of Leipzig, Germany
Winter Semester 2002/2003	teaching assistance: classical mechanics University of Leipzig, Germany

Invited lecturer/graduate school teaching

2014	*Role of microphysics in core collapse supernova simulations* ”Dubna International Advanced School of Theoretical Physics”, July 2014
2013	Institute’s seminar, Institute for Theoretical Physics, Faculty of Physics and Astronomy, University of Wrocław (Poland), October 2013
2012	Institute’s seminar, Observatory Geneva (Switzerland), December 2012
	Astrophysics seminar at the University of Würzburg (Germany), July 2012
	Theory seminar at the Argelander-Institut for Astronomy, University of Bonn, Bonn (Germany), April 2012
	Theory seminar at the Department of Astronomy, University of Uppsala, Uppsala (Sweden), February 2012
	The EOS in astrophysics and core-collapse supernova simulations ”CompStar School 2012” in Zadar (Croatia), September 2012
2010	*Core collapse supernovae in the QCD phase diagram* ”Dense QCD Phases in Heavy-Ion Collisions”, HIC-for-FAIR School, Joint Institute for Nuclear Research (JINR), Dubna, Russia, August 2010

Conference organization

2016	International conference CPOD - Critical point and onset of deconfinement - and Working Group Meeting of COST Action MP1304, May 31 - June 4, 2016, Wrocław, Poland
2014	International conference CSQCD - Compact Stars in the QCD Phase Diagram - IV and Working Group Meeting of COST Action MP1304, September 26 - 30, 2014, Prerow, Germany
	HECOLS workshop and XXXII Max-Born Symposium, ”Thee days of phase transitions in compact stars, heavy-ion collisions and supernovae”, February 17 - 19, 2014, Wrocław, Poland

International Conferences

Invited talks

1. Zakopane conference on nuclear physics – Extremes of the nuclear landscape, Zakopane (Poland), September 2016

”Origin of the heavy elements in the universe - contributions from massive star explosions”

2. INT program INT-16-2b – The phases of dense matter, Seattle (USA), July-August 2016
3. OMEG13 - Origin of matter and evolution of the galaxy, Beijing (China), June 2015
   ”Role of neutrinos for the nucleosynthesis of heavy elements from core-collapse supernova explosions”
4. NDM2015 - Neutrinos and dark matter, Jyväskylä (Finland), June 2015
   ”Proto-neutron star deleptonization – weak processes and neutrino signal”
5. NIC - Nuclei in the Cosmos - XIII, Debrecen (Hungary), July 2014
   ”Role of neutrinos for the nucleosynthesis of heavy elements beyond iron in explosions of massive stars”
6. Trento workshop on Simulating the Supernova Neutrinosphere with Heavy Ion Collisions, Trento (Italy), April 2014
   ”Neutrino signal from massive-star explosions – Role of the nuclear physics input”
7. XXXI Max Borm Symposium and HIC for FAIR workshop, Three days of critical behaviour in hot and dense QCD, University of Wrocław, Wrocław (Poland) June 2013
   ”Deconfinement phase transition to (strange) quark matter in core-collapse supernova simulations”
8. HIC for FAIR meeting of the expert group 2, Physics Day, Darmstadt (Germany) June 2012
   ”Neutrino emission and importance of charged-current processes in supernova explosions – current developments”
9. Trento workshop on The origin of the elements, Trento (Italy), May 2011
   ”(Proto)Neutron star deleptonization and neutrino-driven winds”
10. OMEG10 - Origin of matter and evolution of the galaxy, Osaka (Japan), March 2010
    ”Core collapse supernova simulations and the neutrino driven wind in general relativistic radiation hydrodynamics”
11. HIC for FAIR workshop on Dense QCD phases in HIC and supernovae, Prerow (Germany), October 2009
    ”Quark matter in supernova explosions”

Contributed talls

1. 1. MICRA - Microphysics in relativistic astrophysics, Stockholm (Sweden), August 2015
   ”Role of light nuclear clusters in core-collapse supernovae and PNS deleptonization”
2. Cluster workshop, Rostock University, Rostock (Germany), August 2015
   ”Simulations of massive star explosions – weak processes and neutrino signal”
3. Annual NAVI meeting, GSI Darmstadt (Germany), February 2015
   ”Role of neutrinos for the nucleosynthesis of heavy elements from massive-star explosions”
4. NEOS, Frankfurt University and FIAS, Frankfurt (Germany), December 2014
   ”Role of the nuclear symmetry energy in simulations of core-collapse supernovae”
5. MICRA - Microphysics in relativistic astrophysics, Trento (Italy), September 2013
   ”Modeling the early (proto)neutron star evolution – state of the art and current frontiers”

6. Nuclear Physics in Astrophysics VI, 26th Nuclear Physics Divisional Conference of the European Physical Society, Lisbon (Portugal), May, 2013
   ”Impact of the nuclear symmetry energy on weak processes in core-collapse supernovae”
7. ESF workshop on Open problems and future directions in heavy element nucleosynthesis, ATOMKI Debrecen (Hungary), April 2013
   ”Nucleosynthesis relevant conditions in simulations of the neutrino driven wind from massive star explosions”
8. ESF/EuroGenesis workshop on Observational Constraints on Sources of Nucleosynthesis, Garching (Germany), March 2013
   ”Nucleosynthesis from current core-collapse supernova modeling”
9. International workshop on Gross Properties of Nuclei and Nuclear Excitations, Astrophysics and Nuclear structure, Hirschegg, Kleinwalsertal (Austria), January 2013
10. Mini-Symposium on Dynamics of Correlations in Dense Hadronic Matter, University of Wrocław, Wrocław (Poland), December 2012
    ”Role of the supernova equation of state on the nucleosynthesis of heavy elements”
11. NAVI workshop at the MSU, Lansing MI (US), November 2012
    ”Massive star explosions”
12. Bonn workshop on Formation and evolution of neutron stars, Bonn (Germany), February 2012
    ”Massive star explosions and the birth of neutron star progenitors”
13. EuroGenesis workshop on Chemical Evolution: Massive-Star Action and First-Star Signals, University of Basel, Basel (Switzerland), November 2011
    ”Core-collapse supernova explosions – Nucleosynthesis-relevant conditions”
14. Workshop supported by the SCOPES program (SNF) and NLTE effects on Heavy elements in galactic chemical evolution, Odessa (Ukraine), September 2011
    ”Long-term simulations of massive star explosions”
15. COMPOSE meeting, Rostock University, Rostock (Germany), December 2010
    ”Quark matter in core-collapse supernovae: from protoneutron stars to solar mass black holes”
16. EMMI-EFS workshop on Neutron-Rich Nuclei, Riken, Wako-city (Japan), June 2010
    ”The search for the r-process in explosions of massive stars”
17. Meeting of the Swiss Physical Society, University of Basel, Basel (Switzerland), June 2010
    ”Quark matter in supernova explosions and the possible site for the nucleosynthesis of the elements”
18. Conference on Compact stars in the QCD phase diagram II, KIAA, Peking University, Beijing (China), May 2009
    ”Exploring the QCD phase transition in core collapse supernova simulations”
19. Meeting of the Swiss Society of Astronomy and Astrophysics, Zürich (Switzerland), December 2008
    ”Exploring the possibility of the QCD phase transition in core collapse supernovae”
20. Workshop on The physics of neutron star, St. Petersburg (Russia), July 2008
    ”Exploring the possibility of a phase transition from Hadronic matter to quark matter in core collapse supernovae”
21. OMEG7 - Origin of matter and evolution of the galaxy, Sapporo (Japan), December 2007
    ”The accretion phase of core-collapse supernovae”

22. XXIX Spanish Relativity Meeting E.R.E., Majorca (Spain), September 2006
"The expected neutrino signal from the formation of black holes via protoneutron star collapse"

23. 13th Workshop on Nuclear Astrophysics, Ringberg Castle (Germany), March 2006
"Neutrino-electron(positron) scattering in core collapse supernovae"