

Curriculum Vitae et Studiorum - Paolo Finelli

NAME Dr. Paolo Finelli

PERSONAL INFORMATION Birth Date : 01/03/1975
Birth Place: Bologna (Italy)
Nationality: Italian

ADDRESS

Home:
Via di Villa Pardo 4,
Bologna, 40134 (BO)
Italy

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WEBSITE

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<https://github.com/paolofinelli>

RESERCH AND
EXPERIENCE

Researcher (Ricercatore Confermato)
Abilitazione scientifica (ASN) 2014-2023

Department of Physics and Astronomy
University of Bologna
October 2005 – Now

Post-Doc Position, T39 Theory Group

Department of Physics
Technical University of München
October 2004 – October 2005

Post-Doc Position

ECT, European Center for*
Theoretical Nuclear Physics
April 2003 – October 2004

EDUCATION

Ph. Degree in Physics, March 2003.

From a relativistic mean-field approach towards a nuclear structure description constrained by QCD and chiral symmetry

Supervisors: Prof. Giovanni Carlo Bonsignori and Prof. Dr. Dario Vretenar
University of Bologna, Italy

M. Sc. Degree in Physics, December 1999.

Violazione della parità nella diffusione di elettroni e misura della distribuzione dei neutroni nei nuclei esotici

(Parity violation effects in polarized elastic electron scattering and measure of neutron density distributions in exotic nuclei)

Supervisors: Prof. Giovanni Carlo Bonsignori, Prof. Dr. Dario Vretenar and Dr. Alberto Ventura
University of Bologna, Italy

TEACHING

Teaching Assistant for the following courses at the Department of Electrical Engineering of the University of Bologna

- **2000/2001:** *Classical Mechanics*
- **2001/2002:** *Electrodynamics*
- **2002/2003:** *Classical Mechanics and Electrodynamics*

Teaching Assistant for the following courses at the Department of Physics of the University of Bologna

- **2005/2006:** *Nuclear Physics* (first semester), *Introduction to Nuclear and Subnuclear Physics* (second semester)
- **2006/2007:** *Nuclear Physics* (first semester)

Since **2008** I was in charge of the following courses (see <https://iol.unibo.it/> for more informations on recent courses):

Academic year **2008/2009:** *Theory of Nuclear Forces* (italian language, 6 credits/48 hours).

Academic year **2009/2010:** *Theory of Nuclear Forces* (italian language, 6 credits/48 hours).

Academic year **2010/2011:** *Theory of Nuclear Forces* (italian language, 6 credits/48 hours).

Academic year **2011/2012:** *Theory of Nuclear Forces* (italian language, 6 credits/48 hours) and *Nuclear physics* (italian language, 3 credits/24 hours).

Academic year **2012/2013:** *Nuclear physics* (italian language, 6 credits/52 hours).

Academic year **2013/2014:** *Nuclear physics* (italian language, 6 credits/52 hours).

Academic year **2014/2015:** *Nuclear physics* (italian language, 6 credits/52 hours) and *Principle and Applications of Nuclear and Subnuclear physics* (italian language, 3 credits/24 hours)

Academic year **2015/2016:** *Nuclear physics* (italian language, 6 credits/52 hours) and *Principle and Applications of Nuclear and Subnuclear physics* (italian language, 3 credits/24 hours)

Academic year **2016/2017:** *Nuclear physics* (italian language, 6 credits/52 hours) and *Principle and Applications of Nuclear and Subnuclear physics* (italian language, 3 credits/24 hours)

Academic year **2017/2018:** *Nuclear physics* (italian language, 6 credits/52 hours)

Academic year **2018/2019:** *Nuclear physics* (english language, 4 credits/36 hours) and *Theoretical and Numerical Aspects of Nuclear Physics* (english language, 6 credits/48 hours)

Academic year **2019/2020:** *Nuclear physics* (english language, 4 credits/36 hours), *Theoretical and Numerical Aspects of Nuclear Physics* (english language, 6 credits/48 hours) and *Applications of Nuclear Physics* (english language, 3 credits/24 hours)

THESIS
SUPERVISOR

Supervisor for the following dissertations (Bachelor's degree)

- **2006** Emanuele Poggioli, *Nucleosintesi di elementi con $A \leq 60$,*
- **2007** Matteo Vorabbi, *Applicazioni di modelli di campo medio relativistico alla fisica dei nuclei esotici,*
- **2008** Alessandro Marani, *Stelle di neutroni,*
- **2016** Luca Moretti, *Modello di Skyrme-Hartree-Fock,*
- **2017** Daniele Massaro, *Introduzione al modello a bosoni interagenti,*
- **2018** Rebecca Cenzato, *Analisi e Soluzione Numerica dell'Equazione di Lippmann-Schwinger*
- **2019** Camillo Bussolati, *Il decadimento β all'interno delle stelle*

and (Master Science's degree)

- **2009** Nicoló Masi, *Applicazioni di dinamica chirale nel mezzo nucleare,*
- **2011** Matteo Vorabbi, *Modelli fenomenologici per lo studio del diagramma di fase dell'interazione forte,*
- **2013** Stefano Maurizio, *Nuclear superconductivity from realistic forces,*
- **2015** Simone Casadei, *Stato di Hoyle e principio antropico*
- **2020** (ongoing, in collaboration with R. Casadio) Federico Venta, *Bound states in a quantum description for bootstrapped newtonian stars and black holes*
- **2020** (ongoing, in collaboration with C. Massimi) Raul Zannoni, *Proposed study of the neutron-neutron interaction at the CERN nTOF facility*

Elastic and Quasi-elastic Electron Scattering. I investigated the role of electrons as a probe to determine neutron/proton densities in finite nuclei both in the elastic and quasi-elastic regime, with a particular emphasis on the role of parity violation contributions for polarized beams (PREX experiment at JLab).

- 1 D. Vretenar, P. Finelli, A. Ventura, G. A. Lalazissis, and P. Ring, “Parity violating elastic electron scattering and neutron density distributions in the relativistic Hartree–Bogoliubov model”, *Phys. Rev. C* **61**, 64307 (2000).
35 citations.
- 2 D. Vretenar, P. Finelli, A. Ventura, G. A. Lalazissis, and P. Ring, “Parity violating elastic electron scattering and neutron density distributions in the Relativistic Hartree–Bogoliubov model”, Conference Proceedings, *Bologna 2000: Structure of the Nucleus at the Dawn of the Century*, 93, *World Scientific* (2001).
- 3 A. Meucci, C. Giusti, F. D. Pacati, M. Vorabbi, and P. Finelli, “Elastic and quasi-elastic electron scattering off nuclei with neutron excess”, *Phys. Rev. C* **87**, 054620 (2013).
25 citations.
- 4 A. Meucci, M. Vorabbi, C. Giusti, F. D. Pacati, and P. Finelli, “Elastic and quasi-elastic electron scattering on the $N = 14, 20,$ and 28 isotonic chains”, *Phys. Rev. C* **89**, 034604 (2014).
12 citations.
- 5 A. Meucci, M. Vorabbi, C. Giusti, and P. Finelli, “Neutron density distribution and neutron skin thickness of ^{208}Pb ”, *Phys. Rev. C* **90**, 027301 (2014).
5 citations.
- 6 A. Meucci, M. Vorabbi, C. Giusti, F. D. Pacati, and P. Finelli, “Elastic and quasi-elastic electron scattering off isotopic and isotonic chains”, *J. Phys. Conf. Ser.* **527**, 012024 (2014).
- 7 M. Vorabbi, A. Meucci, C. Giusti, and P. Finelli, “Parity-Violating Asymmetry for ^{208}Pb ”, Conference Proceedings, *PAVI14, J. Phys. Conf. Ser.*, accepted (2016).
- 8 P. Arthuis, C. Barbieri, M. Vorabbi and P. Finelli, “Ab initio computation of charge densities for Sn and Xe isotopes”, e-Print: 2002.02214 [nucl-th], submitted to *Phys. Rev. Lett.*
2 citations.

Mean Field Models. I investigated several aspects of mean-field models both from a conceptual and a computational point of view. I developed one of the most successful connections between the density functional approach and microscopic calculations in terms of realistic NN potentials. Both ground state and excited states have been described with the goal to understand the role of pions in finite nuclear systems.

- 9 T. Nikšić, D. Vretenar, P. Finelli, and P. Ring, “Relativistic Hartree–Bogoliubov model with density-dependent meson–nucleon couplings”, *Phys. Rev. C* **66**, 24306 (2002).
258 citations.
- 10 D. Vretenar, P. Ring, G. A. Lalazissis, T. Nikšić, P. Finelli, and N. Paar, “Relativistic mean field and RPA description of exotic nuclear structure”, Conference Proceedings, *Frontiers of Nuclear Structure*, 211, *APS* (2002).

- 11 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “Nuclear many-body dynamics constrained by QCD and chiral symmetry”, *Eur. Phys. J.* **A17**, 573 (2003).
42 citations.
- 12 P. Finelli, D. Vretenar, N. Kaiser, e W. Weise, “Nuclear many-body dynamics constrained by QCD and chiral symmetry”, Conference Proceedings, *IX Convegno su Problemi di Fisica Nucleare Teorica*, 223, *World Scientific* (2003).
- 13 D. Vretenar, T. Nikšić, P. Ring, N. Paar, G. A. Lalazissis, and P. Finelli, “Relativistic Hartree-Bogoliubov and QRPA description of exotic nuclear structure”, *Eur. Phys. J.* **A20**, 75 (2004).
3 citations.
- 14 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “Relativistic nuclear point-coupling model constrained by QCD and chiral symmetry”, *Nucl. Phys.* **A735**, 449 (2004).
72 citations.
- 15 P. Finelli, D. Vretenar, N. Kaiser, and W. Weise, “Nuclear density functional constrained by low-energy QCD”, Conference Proceedings, *X Convegno su Problemi di Fisica Nucleare Teorica*, 045, *World Scientific* (2005).
1 citation.
- 16 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “Relativistic nuclear energy density functional constrained by low-energy QCD”, *Nucl. Phys.* **A770**, 1 (2006).
62 citations.
- 17 P. Finelli, “Description of spin and isospin collective excitations with a nuclear energy density functional constrained by low-energy QCD”, *Nucl. Phys.* **A788**, 284 (2007).
2 citations.
- 18 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “Chiral pion-nucleon dynamics in finite nuclei: Spin-isospin excitations,” *Nucl. Phys.* **A791**, 57 (2007).
19 citations.
- 19 G. Co’, V. De Donno, P. Finelli, M. Grasso, M. Anguiano, A. M. Lallena, C. Giusti, A. Meucci, and F. D. Pacati, “Mean-field calculations of exotic nuclei ground states”, *Phys. Rev.* **C85**, 024322 (2012).
12 citations.
- 20 Brett V. Carlson, P. Finelli, and A. Ventura, “Self-consistent single-particle approximation to nuclear state densities at high excitation energy”, *Nuovo Cimento C* **42**, 108 (2019).

Hypernuclei. I proposed a novel description of hypernuclei with, for the first time, a self-consistent mechanism to include Λ -N spin-orbit interaction without any *ad hoc* phenomenological input.

- 21 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “In-medium chiral SU(3) dynamics and hypernuclear structure”, *Phys. Lett.* **B658**, 90 (2007).
18 citations.
- 22 P. Finelli, “Hypernuclei and in-medium chiral dynamics”, *Eur. Phys. J. Special Topics* **156**, 183 (2008).
3 citations.

- 23 P. Finelli, “Applications of in-medium chiral dynamics to nuclear structure”, Conference Proceedings, *Recent Progress in Many-Body Theories 14*, 176, *World Scientific (2008)*.
- 24 P. Finelli, “Applications of in-medium chiral dynamics to nuclear structure”, Conference Proceedings, *Zakopane 2008, Acta Phys. Pol. B40*, 665 (2009).
- 25 P. Finelli, “Relativistic models for nuclear structure and low-energy QCD”, Conference Proceedings, *XI Convegno su Problemi di Fisica Nucleare Teorica, J. Phys. Conf. Ser. 168*, 012010 (2009).
- 26 P. Finelli, “Applications of in-medium SU(3) chiral dynamics: hypernuclear structure”, Conference Proceedings, *Particles and Nuclei International Conference 18*, 423, *Elsevier (2009)*.
- 27 P. Finelli, “Recent Developments about Lambda-N spin-orbit interaction in hypernuclei”, Conference Proceedings, *Nuclear and Structure Dynamics 09*, 275, *AIP (2009)*.
- 28 P. Finelli, N. Kaiser, D. Vretenar, and W. Weise, “Hypernuclear single particle spectra based on in-medium chiral SU(3) dynamics”, *Nucl. Phys. A831*, 163 (2009).
19 citations.
- 29 P. Finelli, “Hypernuclear spectra from in-medium chiral dynamics: a refined fit analysis”, *Nucl. Phys. A835*, 418 (2010).
1 citation.

Pairing in nuclear systems. I investigated how nuclear pairing arises from realistic NN forces in infinite and finite systems. We proposed robust predictions for pairing gaps for all the relevant partial-waves. I also studied the role of BCS-BEC crossover for nuclear interactions.

- 30 P. Finelli, T. Nikšić, and D. Vretenar, “Nuclear Pairing from Chiral Pion-Nucleon Dynamics: Applications to Finite Nuclei”, *Phys. Rev. C86*, 034327 (2012).
- 31 P. Finelli, “Nuclear Pairing from Chiral Pion-Nucleon Dynamics: latest results and relevant issues”, *PTP Supplement 196*, 421 (2012).
- 32 P. Finelli, “Nuclear Pairing From Bare Interaction: Two and Three-Body Chiral Forces”, Conference Proceedings, *Nuclear and Structure Dynamics 12*, 250, *AIP (2012)*.
- 33 S. Maurizio, P. Finelli, and J.W. Holt, “Nuclear pairing from microscopic forces: singlet channels and higher-partial waves”, *Phys.Rev. C90*, 044003 (2014).
30 citations.
- 34 S. Maurizio, J.W. Holt and P. Finelli, “Numerical Analysis of the 1S0 Pairing Gap in Neutron Matter”, Conference Proceedings, *INPC2014*, DESY-PROC-2014-04/66
- 35 P. Finelli, S. Maurizio, and J.W. Holt, “Nuclear Pairing from Two-body Microscopic Forces: Analysis of the Cooper Pair Wavefunctions”, Conference Proceedings, *ICNFP2014*, EPJ Web Conf. **95**, 04021 (2015).
2 citations.
- 36 P. Finelli, “Nuclear pairing from microscopic forces: singlet channels and higher-partial waves”, Conference Proceedings, *The Modern Physics of Compact Stars 2015, POS (2016)*.

Microscopic optical potentials. I started the development of a consistent framework to derive optical potentials from realistic NN potentials. A first application to finite nuclei showed a remarkable agreement with experimental data, in some cases with performances comparable to the best phenomenological approaches. Very recently our approach has been extended to the antiproton case. Work is in progress towards the description of inelastic channels and fragmentation of targets.

- 36 M. Vorabbi, P. Finelli, and C. Giusti, “Theoretical optical potential derived from nucleon-nucleon chiral potentials”, *Phys. Rev. C* **93**, 034619 (2016).
19 citations.
- 37 M. Vorabbi, P. Finelli, and C. Giusti, “Theoretical Optical Potential Derived From Chiral Potentials”, Conference Proceedings, *35-th International Workshop on Nuclear Theory (IWNT-35)*, *Nucl. Theory* **35**, 93 (2016).
- 38 M. Vorabbi, P. Finelli, and C. Giusti, “Optical potentials derived from nucleon-nucleon chiral potentials at N4LO”, *Phys. Rev. C* **96**, 044001 (2017).
4 citations.
- 39 P. Finelli, M. Vorabbi, and C. Giusti, “Chiral Nucleon-Nucleus Potentials at N3LO”, Conference Proceedings, *Theoretical Nuclear Physics in Italy*, *J. Phys. Conf. Ser.* **981**, 012002 (2018).
- 41 M. Vorabbi, P. Finelli, and C. Giusti, “Proton-Nucleus Elastic Scattering: Comparison between Phenomenological and Microscopic Optical Potentials”, *Phys. Rev. C* **98**, 064602 (2018).
2 citations.
- 41 C. Giusti, M. Vorabbi, and P. Finelli, “Microscopic optical potential derived from NN chiral potentials”, Conference Proceedings, *15th International Conference Nuclear Reaction Mechanics, CERN-Proceedings-2019-001*, 203 (2019).
- 42 P. Finelli, M. Vorabbi, and C. Giusti, “Optical Potentials: Microscopic vs. Phenomenological Approaches”, *EPJ Web of Conferences* **223**, 01015 (2019).
- 43 M. Vorabbi, M. Gennari, P. Finelli, C. Giusti, and Petr Navrátil, “Elastic Antiproton-Nucleus Scattering from Chiral Forces”, *Phys. Rev. Lett.* **124**, 162501 (2020).
- 44 M. Vorabbi, R. Machleidt, P. Finelli, C. Giusti, and Petr Navrátil, “Impact of three-body forces on elastic scattering observables”, to be submitted to *Phys. Rev. C*.

SCHOOLS AND
CONFERENCES

1. *Bologna 2000: Structure of the Nucleus at the Dawn of the Century*
Bologna (Italy), 29 May - 3 June 2000
Poster
2. Nato Advanced Research Workshop: *The Nuclear Many-Body Problem*
Brijuni National Park (Croatia), 2 - 5 June 2001
3. *ECT* Workshop: Current Theoretical and Experimental Investigations of the Nuclear Many-Body Problem and Applications*
Trento (Italy), 24 September - 3 October 2001
Talk
4. CINECA course, *Introduction to C++*
Bologna (Italy), 26 - 30 November 2001
5. Varenna Summer School (CLIII course): *From Nuclei and Their Constituents to Stars*
Varenna (Italy), 6 - 16 August 2002
6. *3rd International Balkan School on Nuclear Physics*
Thessaloniki (Greece), 18 - 24 September 2002
Talk
7. *IX Convegno su Problemi di Fisica Nucleare Teorica*
Cortona (Italy), 9 - 12 October 2002
Talk
8. 307 WE-Heraeus-Seminar: *Relativistic Structure Models for the Physics of Radioactive Nuclear Beams*
Bad Honnef (Germany), 12 - 16 May 2003
Talk
9. *ECT* Doctoral Training Programme: Nuclear Structure*
Trento (Italy), May - October 2003
Talks
10. *ECT* Workshop: Role of Pions and Deltas in Nuclear Many-Body Dynamics (collaboration meeting)*
Trento (Italy), 10 - 15 November 2003
Talk
11. *DPG Nuclear Physics Spring Meeting*
Köln (Germany), 8 - 12 March 2004
Talk
12. *ECT* Doctoral Training Programme: Neutrino Physics*
Trento (Italy), May - October 2004
13. *ECT* Workshop: International Workshop on Novel Approaches to the Nuclear Many-Body Problem*
Trento (Italy), 6 - 17 September 2004
Talk
14. *INT Workshop on Relativistic Density Functional Theory for Nuclear Structure*
Seattle (USA), 20 - 24 September 2004
Talk
15. *X Convegno su Problemi di Fisica Nucleare Teorica*
Cortona (Italy), 6 - 9 October 2004
Talk
16. *DPG Nuclear Physics Spring Meeting*
Berlin (Germany), 4 - 9 March 2005
Talk
17. *INT Workshop: Towards a Universal Density Functional for Nuclei*
Seattle (USA), 20 - 25 September 2005
Talk
18. *DPG Nuclear Physics Spring Meeting*
München (Germany), 20 - 24 March 2006
Talk

19. *COMEX 2, Collective Motion in Nuclei under Extreme Conditions*
Sankt Goar (Germany), 20 - 23 June 2006
Talk
20. *IX International Conference on Hypernuclear and Strange Particle Physics*
Mainz (Germany), 10 - 14 October 2006
Talk
21. *DPG Nuclear Physics Spring Meeting*
Giessen (Germany), 12 - 16 March 2007
Talk
22. *Theoretical Nuclear Physics School: "Exotic Nuclei: New Challenges"*
Les Houches (France), 7 - 18 May 2007
Invited Talk
23. *Scuola di Fisica Nucleare, Raimondo Anni*
Otranto (Italy), 28 May - 2 June 2007
Invited Lectures
24. *14th International Conference on Recent Progress in Many-Body Theories*
Barcelona (Spain), 16 - 20 July 2007
Poster
25. *DPG Nuclear Physics Spring Meeting*
Darmstadt (Germany), 10 - 14 March 2008
Talk
26. *Zakopane Conference on Nuclear Physics*
Zakopane (Poland), 1 - 7 September 2008
Talk
27. *XII Convegno su Problemi di Fisica Nucleare Teorica*
Cortona (Italy), 8 - 10 October 2008
Talk
28. *International Conference on Particles and Nuclei (PANIC08)*
Eilat (Israel), 9 - 14 November 2008
Talk
29. *European Nuclear Physics Conference*
Bochum (Germany), 16 - 20 March 2009
Invited Talk
30. *Nuclear Structure and Dynamics*
Dubrovnik (Croatia), 4 - 8 May 2009
Talk
31. *ECT* Workshop: The Lead Radius Experiment and Neutron Rich Matter in Astrophysics and in the Laboratory*
Trento (Italy), 3 - 7 August 2009
Talk
32. *X International Conference on Hypernuclear and Strange Particle Physics*
Tokai (Japan), 14 - 18 September 2009
Talk
33. *Elba XI Workshop Electron-Nucleus Scattering*
Elba (Italia), 21 - 25 June 2010
Invited Talk
34. Ψ_k 2010
Berlin (Germany), 12 - 16 September 2010
35. *SPS Joint Annual Meeting*
Lausanne (Switzerland), 15 - 17 June 2011
36. *YKIS2011 Symposium: Frontier Issues in Physics of Exotic Nuclei*
Kyoto (Japan), 11 - 15 October 2011
Talk

37. *Nuclear Structure and Dynamics II*
Opatija (Croatia), 9 - 13 July 2012
Talk
38. *XI International Conference on Hypernuclear and Strange Particle Physics*
Barcelona (Spain), 1 - 5 October 2012
39. *INPC2013*
Florence (Italy), 2 - 7 June 2013
Talk
40. *EuroSciPy*
Bruxelles (Belgium), 21 - 24 August 2013
41. *Selected Topics in Nuclear and Atomic Physics*
Fiera di Primiero (Italy), 30 September 30 - 4 October 2013
Invited Lectures
42. *3rd International Conference on New Frontiers in Physics*
Crete (Greece), 28 July - 6 August 2014
Talk
43. *International Conference on Particles and Nuclei (PANIC14)*
Hamburg (Germany), 25 - 29 August 2014
Talk
44. *The Modern Physics of Compact Stars and Relativistic Gravity*
Yerevan (Armenia), 30 September - 03 October 2015
Talk
45. *TNPI2016 - XV Conference on Theoretical Nuclear Physics in Italy*
Pisa (Italy), 20 - 22 April 2016
Talk
46. *Compact Stars in the QCD phase diagram V*
GSSI and LNGS (Italy), 23 - 27 May 2016
47. *International Symposium on Neutron Star Matter*
Sendai (Japan), 21 - 24 November 2017
Talk
48. *European Nuclear Physics Conference*
Bologna (Italy), 2 - 7 September 2018
Talk
49. *Nuclear Structure and Dynamics 2019*
Venezia (Italy), 13 - 17 May 2019
Talk
50. *Antiproton-nucleus interactions and related phenomena*
Trento (Italy), 17 - 21 June 2019
Invited Talk

MORE
INFORMATIONS

- Referee for *Eur. Phys. J. A*, *Phys. Rev. C*, *Int. Journal Mod. Phys. E*, *Nucl. Phys. A*
- Local Reference for the INFN collaborations MANYBODY and MONSTRE
- Winner of a grant for *Scientific, Cultural and Technological cooperation between Italy and Croatia*, 2009-2010
- Popularization activity: talks for high school students and participation to “Pint of Science 2019” initiative (INFN)

VISITING SCIENTIST

- Department of Physics, Technical University of Munich, Germany
 - **2006**: from 01/01 to 31/07 (not continuously)
 - **2008**: from 15/04 to 15/07 (Marco Polo grant)
 - **2010**: from 01/06 to 31/07
- Institut de Physique Nucleaire (Orsay) **2009**: from 01/03 to 30/06
- Lausanne/Bern, Department of Physics (Switzerland) **2011**: from 01/02 to 30/06