



**LUND**  
UNIVERSITY



# The Lund-Oslo Node

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# Where are we?



-  core teams
-  participants
-  subcontractors

Here we are

**Lund:**  
Department of  
Theoretical Physics  
Lund University

**Oslo:**  
Department of  
Physics  
University of Oslo

# People

## Senior

Johan Bijmens, Lund

Jan Olav Eeg, Oslo

## Postdoc

Edisher Lipartia, Lund, until 30/9/2003

Timo Lähde, Lund ([Young Researcher](#)) 1/10/2003-30/9/2005

## Ph.D. Students

Aksel Hiorth, Oslo, PhD May 2003

Pierre Dhonte, Lund, PhD June 2004

Fredrik Borg (Persson), Lund, PhD January 2005

Niclas Danielsson, Lund, from 1/9/2003

Karim Ghorbani, Lund, from 1/9/2003

## Master Students

Olof Strandberg, Lund, Thesis February 2003

Anders Pinzke, Lund, Thesis June 2004

Kjetil Eide, Oslo, ongoing

Jon Atle McDonald Sørensen, Oslo, ongoing

# International Collaboration (2000-present)

Blue = network

## Lund

Granada  
Barcelona  
Karlsruhe  
Bern  
Vienna  
ECT\*  
Glasgow

## Oslo

CERN  
Trieste  
Zagreb  
Ljubljana

**Note:** and many discussions on topics of common interest with Paris, Valencia, Marseille, Amherst, Caltech, Rome, Bonn, Uppsala, . . .

# Main Strengths

## ● Lund

- Chiral Perturbation Theory at High Order
- Nonleptonic Weak Decays (light quarks)
- Various nonperturbative methods in matching long and short-distance effects for light quark physics

## ● Oslo

- Nonperturbative Aspects of heavy Quark Physics
- In particular: Heavy-light Chiral Quark Model

# Main Achievements

## ● Chiral Perturbation Theory (ChPT)

- $K_{\ell 3}$  at two loops (Lund-Barcelona)
- Scalar Form Factors,  $\pi\pi$  and  $\pi K$  at two loops also in three flavour ChPT (Lund, Lund-Barcelona)
- ChPT and Lattice QCD  $\implies$  Timo Lähde (Lund Young Researcher)
- Isospin Breaking in  $K \rightarrow 3\pi$  Decays (Lund)

These calculations play a role in many aspects of the network activity and interact strongly with the work done at many other nodes.

Paris: Spontaneous symmetry Breaking:  $2 \leftrightarrow 3$  light quarks  
Vienna, Rome, Valencia, ... Precise determination of  $V_{us}$

Rome:  $K \rightarrow 3\pi$  experiment and theory

Bern, Vienna: Predictions for  $\pi K$  atoms

Bern, Paris: Dispersive work on  $\pi\pi$ ,  $\pi K$

# Main Achievements

## ● Nonleptonic Weak Decays (light quarks)

- $K \rightarrow 3\pi$ : see above
- $B_K$  and other weak matrix-elements: see below

## ● Nonperturbative Matching

- Ladder resummation approximation ([Lund-Granada](#))
- Conflicts Short-distance Constraints  $\Leftrightarrow$  resonance saturation approaches ([Lund-Granada](#))
- Updates on  $B_K$  and some QCD higher order corrections in the relevant matrix elements ([Lund-Granada](#))
- Some work on electromagnetic matrix elements (Lund)

Again these play a role in many aspects of the network activity and interact strongly with the work done at many other nodes.

[Barcelona](#), [Marseille](#), [Valencia](#), [Paris](#)

# Main Achievements

## ● Heavy Quark Physics

- Heavy-Light Chiral Quark Model (Oslo)
- Applications to various Decays (Oslo-Zagreb)
- Estimates of nonfactorizable contributions (Oslo-Ljubljana-Zagreb)

Again these play a role in many aspects of the network activity and interact with the work done at many other nodes.

Rome, Paris



## ● Training

The training has several aspects

- Young Researcher: Benefits both ways: institute plus researcher
- PhD: Collaboration Meetings provide good place to meet students working on similar topics. I.e. only theory group in Sweden/Norway working in this part of phenomenology. Also provides an overview of what happens in Europe in this area.
- PhD, Master: School: More introductory version of above
- PhD: Often first talk in international meeting

Visits to collaboration meetings or schools by:

T. Lähde, F. Borg, P. Dhonte, E. Lipartia, K. Eide,  
J.A. McDonald Sørensen, N. Danielsson

# Networking

## ● **Research/Collaboration inside network**

- J. Prades and E. Gámiz (Granada) to Lund (frequently)
- G. Ecker (Vienna), A. Pich (Valencia) to Lund
- T. Lähde (Lund) to Helsinki ([network](#))
- J. Bijmens to Oslo, Berne, Granada

Mainly paid from other sources

- Collaboration Meetings: Attended by the two seniors and several younger ones every time.
- Provide an opportunity to meet collaborators, others working in the same area on a regular and more specialized basis than otherwise possible.

Consumes the networking part of the budget plus supplementary funds.

# Overview

## Budget:

Young researcher	59500	13 months, will get 24
Networking	21450	10750 (Lund) 10700 (Oslo)
Overhead	14050	
Total	95000	

## Benefits:

Very difficult to get young researcher otherwise

Very important for our small group to stay well connected

Travel supplemented by other funds shows the importance

## Problems:

EU administration versus Swedish administration:

bookkeeping/reports take quite some time

Constant battle for overhead: faculty/central take all  
sometimes indirectly more

Extra costs due to money arrival often after spending

# Publications

1. **Eta Decays at and Beyond  $p^4$  in Chiral Perturbation Theory**, J. Bijnens and J. Gasser, Phys.Scripta T99 (2002) 34 **Lund-Berne**
2. **Production, Interaction and Decay of the eta Meson**, J. Bijnens, (ed.), G. Faldt, (ed.) and B.M.K. Nefkens, (ed.), Phys. Scr. T99 (2002) 1-182
3. **Ground State Energy of Pionic Hydrogen to One Loop**, J. Gasser, M.A. Ivanov, E. Lipartia, A. Rusetsky, Eur.Phys.J.C26 (2002) 13, hep-ph/0206068 **Lund-Berne**
4. **Exploring Light Cone Sum Rules for Pion and Kaon Form-factors**, J. Bijnens, A. Khodjamirian, Eur.Phys.J.C26 (2002) 67 **Lund-Karlsruhe**
5.  **$K \rightarrow 3\pi$  Decays in Chiral Perturbation Theory**, J. Bijnens, P. Dhonte and F. Persson, Nucl. Phys. B648 (2003) 317
6. **Matching the Electroweak Penguins  $Q_7$  and  $Q_8$**  E. Gámiz, J. Prades and J. Bijnens hep-ph/0209089 Invited talk given by J.P. at XIV Rencontres de Blois, "Matter Anti-Matter Asymmetry", 18-24 June 2002, and by E.G. at QCD 2002, Montpellier, 2-9 July 2002, to be published in the proceedings **Lund-Granada**
7.  **$K_{\ell 3}$  decays in Chiral Perturbation Theory**, J. Bijnens and P. Talavera, hep-ph/0303103, Nucl.Phys.B669 (2003) 341, **Lund-Barcelona**
8. **QCD Short-distance Constraints and Hadronic Approximations**, J. Bijnens, E. Gámiz, E. Lipartia and J. Prades, hep-ph/0304222, JHEP 04(2003)055 **Lund-Granada**

# Publications

9. **Chiral Perturbation Theory at Two Loops and the Measurement of  $V_{us}$** , J. Bijnens, LU TP 03-19, hep-ph/0304284, Talk given at 38th Rencontres de Moriond on QCD and High-Energy Hadronic Interactions, Les Arcs, Savoie, France, 22-29 Mar 2003.
10. **Scalar Form Factors in  $SU(3)$  Chiral Perturbation Theory**, J. Bijnens and P. Dhonte, JHEP 10(2003)061
11. **Chiral Dynamics in the Meson Sector at two Loops**, J. Bijnens, LU TP 03-33, hep-ph/0307082, Talk presented at CIPANP 2003, Conference on the Intersections of Particle and Nuclear Physics, New York, May 19-24, 2003 **Lund-Granada**
12. **Summary of the Goldstone Boson Working group**, J. Bijnens and A. Farilla, -, -, Presented at CHIRAL DYNAMICS 2003 Theory and Experiment Bonn/Germany, September 8-13, 2003, published in the proceedings.
13.  **$K \rightarrow 3\pi$  in Chiral Perturbation Theory**, J. Bijnens, F. Borg and P. Dhonte, -, -, Presented at CHIRAL DYNAMICS 2003 Theory and Experiment Bonn/Germany, September 8-13, 2003, published in the proceedings.
14.  **$K_{\ell 3}$  at two loops in ChPT**, J. Bijnens and P. Talavera, -, -, Presented at CHIRAL DYNAMICS 2003 Theory and Experiment Bonn/Germany, September 8-13, 2003, **Lund-Barcelona**
15. **Scalar Form Factors to  $\mathcal{O}(p^6)$  in  $SU(3)$  Chiral Perturbation Theory**, J. Bijnens and P. Dhonte, -, -, Presented at CHIRAL DYNAMICS 2003 Theory and Experiment Bonn/Germany, September 8-13, 2003, published in the proceedings.

# Publications

16.  $\pi\pi$  Scattering in Three Flavour ChPT, J. Bijnens, P. Dhonte and P. Talavera, LU TP 04-02, hep-ph/0401039, JHEP 0401(2004)050, Lund-Barcelona
17.  $\pi K$  Scattering in Three Flavour ChPT, J. Bijnens, P. Dhonte and P. Talavera, LU TP 04-19, hep-ph/0404150, JHEP 0405(2004)036, Lund-Barcelona
18. Isospin Breaking in  $K \rightarrow 3\pi$  Decays I: Strong Isospin Breaking, J. Bijnens and F. Borg, LU TP 04-20, hep-ph/0405025, Nucl. Phys. B697 (2004) 319-342.
19. Estimating the Electromagnetic Chiral Lagrangian Coefficients, A. Pinzke, LU TP 04-22, hep-ph/0406107, Master thesis.
20. The Pseudoscalar Meson Mass to Two Loops in Three-Flavor Partially Quenched  $\chi$ PT, J. Bijnens, N. Danielsson and T.A. Lähde, LU TP 04-26, hep-lat/0406017, to be published in Phys. Rev. D.
21. Isospin Breaking in  $K \rightarrow 3\pi$  decays, F. Borg, Contributed to DAFNE 2004: Workshop on Physics at Meson Factories, Rome, Frascati, Italy, 7-11 Jun 2004. e-Print Archive: hep-ph/0408350
22. Chiral Meson Physics at Two Loops, J. Bijnens, LU TP 04-30, hep-ph/0409068, Invited plenary talk presented at the 19th European Few-Body conference, Groningen, The Netherlands, August 23-27, 2004.
23. Isospin Breaking in  $K \rightarrow 3\pi$  Decays II: Radiative Corrections, J. Bijnens and F. Borg, LU TP 04-37, hep-ph/0410333, to be published in Eur. Phys. J. C.

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24. **A heavy light chiral quark model**, A. Hiorth and J.O. Eeg, hep-ph/0206158 Phys. Rev. D 66 (2002) 074001.
25. **Nonfactorizable effects in  $B - \bar{B}$  mixing**, A. Hiorth, J.O. Eeg, hep-ph/0301118 Eur. Phys. J. direct C 30 (2003) 006.
26. **On the short distance part of the QCD anomaly contribution to the  $b \rightarrow s\eta'$  amplitude**, Jan.O. Eeg, Krešimir Kumerički, and Ivica Picek, hep-ph/0304274 Phys. Lett. B 563 (2003) 87-92.
27. **Nonfactorizable contributions in  $\bar{B}^0 \rightarrow D_s^+ D_s^-$  and  $\bar{B}_s^0 \rightarrow D^+ D^-$  decays**. Jan.O. Eeg, Svjetlana Fajfer, and A. Hiorth, hep-ph/0304112 Phys. Lett. B 570 (2003) 46-52.
28. **The beta-term for  $D^* \rightarrow D\gamma$  within a heavy light chiral quark model**, A. Hiorth and J.O. Eeg, *Eur.Phys.J.C. direct* (2004) DOI 10.1140/epjcd/s2004-01-003-1
29. **On the colour suppressed decay modes to  $\bar{B}_d^0 \rightarrow D_s^+ D_s^-$  and  $\bar{B}_s^0 \rightarrow D^+ D^-$** , J.O. Eeg, S. Fajfer, A. Hiorth, *Phys. Lett. B* 570 (2003) 46-52
30. **B decays and  $B\bar{B}$  mixing within a heavy light chiral quark model**, J.O. Eeg, . WQCD-2003-024, Oct 2003. . Talk given at QCD @ Work 2003: 2nd International Workshop on Quantum Chromodynamics: Theory and Experiment, Conversano, Italy, 14-18 Jun 2003. Published in *eConf C 030614* (2003) 024; Also in \*Conversano 2003, QCD at work 2003\* 171-178. (hep-ph/0310179)
31. **On the singlet penguin in  $B \rightarrow K\eta'$  decay**, J.O. Eeg, K. Kumericki, I. Picek, Proceedings of 9th Adriatic Meeting, Dubrovnik, Croatia,

# Publications

32. **A Heavy-Light Chiral Quark Model applied to  $B - \bar{B}$  mixing,  $B \rightarrow D\eta'$ ,  $B \rightarrow D\bar{D}$ , and  $D^* \rightarrow D\gamma$ .** Jan O. Eeg, Invited talk at “QCD@work”, Conversano, Italy june 2003, to appear in the proceedings.
33. **Non-factorizable contributions to  $\bar{B}_d^0 \rightarrow D_s^{(*)} \bar{D}_s^{(*)}$ ,** J.O. Eeg, S. Fajfer, A. Hiorth, A. Prapotnik, hep-ph/0408298. Based on talk given by J.O. Eeg at BEACH2004, 6th international conference on Hyperons, Charm and Beauty Hadrons, Illinois Institute of Technology, june 27.-july 3., Chicago, 2004.
34. **Chiral quark models and their applications,** J.O. Eeg and A. Hiorth, hep-ph/0411393.
35. **Isospin Breaking in  $K \rightarrow 3\pi$  Decays III: Bremsstrahlung and Fit to Experiment,** J. Bijnens and F. Borg LU TP 04-40, hep-ph/0501163
36. **Decay Constants of Pseudoscalar Mesons to Two Loops in Three-Flavor Partially Quenched  $\chi$ PT,** J. Bijnens and T.A. Lähde LU TP 05-1, hep-lat/0501014
37. **The  $B_K$  Kaon Parameter in the  $1/N_c$  Expansion,** J. Prades, J. Bijnens and E. Gámiz, LU TP 05-3, hep-ph/0501177, Invited talk given by J.P. at “Large  $N_c$  QCD Workshop”, 5-9 July 2004, Trento, Italy