

PrimeNet -- Meson Physics in Low energy QCD

A network within Hadron Physics2

PrimeNet will have a special focus on η and η' since they are unique mesons in the sense that their decays are perfectly suited to study **symmetries and symmetry breakings** in QCD.

In fact, the simultaneous treatment of both the η and the η' imposes tighter constraints on theoretical approaches than just the η . The present plan to move into the η' sector is therefore highly motivated.

Quark masses $\eta, \eta' \rightarrow 3\pi; \eta' \rightarrow \eta 2\pi$

Chiral anomaly $\pi^0, \eta, \eta' \rightarrow 2\gamma$ or $\pi\pi\gamma$

ChPT $\eta \rightarrow \pi^+\pi^-\pi^0, \eta \rightarrow \pi^0\gamma\gamma$

E.M Form Factor $\eta \rightarrow e^+e^-\gamma, \eta \rightarrow e^+e^-\mu^+\mu^-$

C invariance $\eta, \eta' \rightarrow \pi^0\pi^0\gamma$

CP invariance $\eta, \eta' \rightarrow 2\pi, 4\pi$

Moreover, **η, η' interactions** with nucleons, few body systems and in the nuclear medium, as well as **nucleon resonance** production will be studied.

Scalar mesons can be studied from the rare decay $\phi \rightarrow (f_0, a_0)\gamma \rightarrow K\bar{K}\gamma$ and $\phi \rightarrow \pi\pi\gamma$ for the σ .

Isospin violation in $dd \rightarrow {}^4\text{He} + \pi^0$

PrimeNet institutions

A total number of **32** institutions, from 11 different European countries, participate in this network. In addition there are 2 associated institutions from Japan and USA.

The organizations marked by red in the table were not involved in the previous EtaMesonNet.

Participant number	Organization legal name	Short name	Activity leaders (in <i>bold</i> the spokesperson)	Person-months (total)
48	Uppsala universitet <i>Uppsala universitet</i>	UU <i>UU</i>	B. Höistad	384 384
1	Istituto Nazionale di Fisica Nucleare <i>INFN Laboratori Nazionali di Frascati</i> <i>INFN Sezione di Pavia</i> <i>INFN Sezione di Roma 1</i> <i>INFN Sezione di Roma 2</i>	INFN <i>INFN-LFN</i> <i>INFN-PV</i> <i>INFN-RM1</i> <i>INFN-RM2</i>	<i>C. Bloise</i> <i>P. Pedroni</i> <i>G. De Zorzi</i> <i>R. Messi</i>	403 240 67 72 24
7	Forschungszentrum Jülich GmbH <i>Forschungszentrum Jülich</i>	FZJ <i>FZJ</i>	<i>D. Grzonka</i>	288 288
13	Ruhr- Universität Bochum	RUB	U. Wiedner	48
14	Rheinische Friedrich-Wilhelms-Universität Bonn <i>Rheinische Friedrich-Wilhelms-Universität</i>	UBO <i>UBO</i>	<i>R. Beck</i>	144 144

18	Justus Liebig Universität Giessen	PIG-JLU	V. Shklyar	96
20	Johannes Gutenberg Universität Mainz <i>University of Mainz</i>	UMainz <i>UMainz</i>	<i>M. Ostrick</i>	144 <i>144</i>
21	Westfälische Wilhelms-Universität Münster	WWU	A. Khoukaz	96
25	Universitat de Barcelona	UB	R. Escibano	24
27	Universitat de València	UVEG	E. Oset	10
32	Institut Ruđer Bošković	RBI	A. Svarc	58
41	Jagiellonian University	UJ	P. Moskal	240
46	Lund universitet <i>Lund universitet</i>	ULUND <i>ULUND</i>	<i>J. Bijnens</i>	10 <i>10</i>
47	Stockholms universitet	SU	P-E. Tegner	72

Other involved institutions	Activity leaders	Person-months
University of Innsbruck (Austria)	S. Bass	24
Basel University (Switzerland)	B. Krusche	240
University Duisburg-Essen (Germany)	H. Machner	24
Eberhard Karls Universität Tübingen (Germany)	H. Clement	240
Università e Sezione INFN di Napoli (Italy)	F. Ambrosino	34
Università e Sezione INFN di Roma 3 (Italy)	A. Passeri	48
Nara Woman's University (Japan)	S. Hirenzaki	24
University of Kyoto (Japan)	D. Jido	24
Lodz IPJ (Poland)	J. Zabierowski	14
Warsaw IPJ (Poland)	J. Stepaniak	29
Instituto Superior Técnico, Lisbon (Portugal)	T. Pena	10
Institute for Theoretical and Experimental Physics (ITEP), Moscow (Russia)	V. Sopov	36
Budker Institute of Nuclear Physics, Akademgorodok (Russia)	B. Shwartz	24
London University College (United Kingdom)	C. Wilkin	14
University of California, Los Angeles (USA)	B Nefkens	48
University of Georgia, Athens (USA)	K. Nakayama	24

In the final decision from EC, the Hadron Physics 2 program was approved 10 MEUR.

(This was the maximum amount formally approvable for this type of activity in FP7)(17.4 MEUR in FP6)

In the final approval PrimeNet got **220 kEUR**. Compare with the 445 kEUR approved for EtaMesonNet.

However, the time period for HP2 is shortened from 48 months to 30 months

WP5: PrimeNet Meson Physics in Low-Energy QCD								OVERHEADS
REQUESTED EC CONTRIBUTION PER BUDGETARY ITEM AND PER BENEFICIARY								
Contr. No	Contractor Acronym	Personnel (EUR)	Consumables (EUR)	Travel and workshops (EUR)	Total direct costs (EUR)	Indirect costs (EUR) (7%)	Requested EC contribution (EUR)	
1	INFN	0	0	37 000	37 000	2 590	39 590	
	INFN-LNF	0	0	37 000	37 000	2 590	39 590	
7	FZJ	0	0	37 000	37 000	0	37 000	
14	UBO	0	0	18 000	18 000	1 260	19 260	
20	UMainz	0	0	18 000	18 000	1 260	19 260	
48	UU	23 028	0	75 000	98 028	6 862	104 890	
	TOTAL	23 028	0	185 000	208 028	11 972	220 000	

Approximately 40 000 EUR is budgeted for the two main workshops

The grant money is distributed to a few institutions only because of ease in administrative handling. It would have been impossible with hundreds of contractors within HP2.

That means in effect that participants from the other institutes should receive financial contribution from the money receiving institutes (contractors).

TASK DESCRIPTIONS

Task 1: A coordination of the experimental programs at these facilities. In particular, experimental projects will be planned and optimized by utilizing the variety of capabilities of the facilities including their detector systems.

Task 2: Evaluation of experimental techniques as well as the tools for data analysis and simulations. Assessment of the experimental uncertainties in all experimental data from the detectors Crystal Ball (MAMI), Crystal Barrel (ELSA), KLOE2 (DAΦNE2) and WASA (COSY).

Task 3: Establishment of a common database for all experimental results.

Task 4: Development of theoretical models establishing the links between different data and their relationship to basic concepts of hadron physics. Extraction of information from the data concerning properties of resonances, chiral dynamics and the nature of some resonances as well as different light mesons. A coordination of the theoretical model developments.

Task 5: Establishing the interaction of the η and η' with nucleons and nuclei and the possibility to have η bound states in nuclei. The interaction between other light mesons and nucleons should also be considered.

Task 6: Extension of the techniques of chiral perturbation theory and chiral Lagrangians from a thorough investigation of the η decay modes.

Task 7: Two main workshops involving all participants in the network.

Task involvements as stated in the proposal.

Task	Participants	Task leader
1 Experimental program coordination	Basel U., UBonn, Duisburg-Essen U., INFN-LNF, INFN-PV, INFN-RM1, INFN-RM2, FZJ, Lodz IPJ, UMainz, WWU, Tübingen U., UU, Warsaw IPJ	A. Kupsc (UU)
2 Data analysis	Basel U., RUB, UBonn, Duisburg-Essen U., INFN-LNF, INFN-PV, INFN-RM1, INFN-RM2, UJ, FZJ, Lodz IPJ, UMainz, WWU, Tübingen U., UU, Warsaw IPJ	P. Moskal (UJ)
3 Database	Basel U., UBonn, Duisburg-Essen U., INFN-LNF, INFN-PV, INFN-RM1, INFN-RM2, UJ, FZJ, Lodz IPJ, UMainz, WWU, Tübingen U., UU, Warsaw IPJ	PrimeNet Post Doc (UU)
4 Theory models	UB, PIG-JLU, Innsbruck U., FZJ, Lisbon IST, London UC, ULUND, UVEG, Zagreb RBI,	T. Peña (Lisbon IST)
5 Meson – nucleon/nuclei interactions	UB, UBonn, PIG-JLU, Innsbruck U., UJ, FZJ, Lisbon IST, London UC, ULUND, SU, UU, UVEG, RBI	C. Hanhart (FZJ)
6 Techniques for ChPT	UB, PIG-JLU, Innsbruck U., FZJ, ULUND, UVEG, RBI	J. Bijnens (Lund) (B. Borasoy) (UBonn)
7 Main workshops	All	B. Höistad (UU)

Del. no.	Deliverable
WP5.1	<i>Experimental proposals</i> . Experimental proposals will be submitted to the Program Advisory Committees for COSY, DAPHNE, ELSA and MAMI as a result of the co-ordination of the experimental programs at these research infrastructures.
WP5.2	<i>Internal reports</i> . Internal reports will be published that summarize the results of the evaluations of the experimental techniques, data analysis and simulation tools, and simulations.
WP5.3	<i>Web based database</i> . A publicly accessible database with relevant production cross sections, decay branching ratios and extracted physics parameters will be created. It will be continuously updated.
WP5.4, 5,6	<i>Publications and conference presentations</i> . The coordinated theoretical efforts on well targeted topics related to the experimental activities (Del. no.1) will result in a continuous delivery of publications and conference presentations/proceedings.

Time frame for the 7 different tasks

TASKS/Subtasks	2009				2010				2011				2012			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. EXPERIMENTAL PROGRAM COORDINATION				1				1								
2. DATA ANALYSIS AND EVALUATIONS								2								
3. COMMON DATABASE																
4. DEVELOPMENT OF THEORY MODELS																
5. ESTABLISHING THE INTERACTION OF THE ETA-MESONS AND OTHER LIGHT MESONS WITH NUCLEONS AND NUCLEI																
6. DEVELOPING TECHNIQUES OF CHIRAL PERTURBATION THEORY																
7. MAIN WORKSHOPS					3					3						

Milestones	
1	Presentation of proposals
2	Analysis report
3	Workshop

General organization

Establish a core group in PrimeNet:

Contractors: Micheal Ostric, Reinhard Beck, Dieter Grzonka, Simona Giovannella, Bo Höistad

Task leaders: Andrzej Kupsc, Pawel Moskal, Teresa Pena, Christoph Hanhart, Johan Bijnens

Previous workshop organizers: Eulogio Oset

Any other interested ?

Planning of activities

The present meeting is a first start up meeting presenting the status of the etapprime program at our facilities.

Laboratory meetings. A first visit to Crystal Barrel at Elsa would be appropriate since Bonn is now a new contractor in PrimeNet .

Task meetings could be arranged either separately in time or adjacent to a main workshop or general group meetings.

Exchange visits can be initiated by anyone. Should preferably be done in the context of some of the tasks.

Two main Workshops. The first one to be hosted by Teresa Pena.

Task 1: A coordination of the experimental programs at these facilities. In particular, experimental projects will be planned and optimized by utilizing the variety of capabilities of the facilities including their detector systems.

A. Kupsc

Comments... ideas...

Task 2: Evaluation of experimental techniques as well as the tools for data analysis and simulations. Assessment of the experimental uncertainties in all experimental data from the detectors Crystal Ball (MAMI), Crystal Barrel (ELSA), KLOE2 (DAΦNE2) and WASA (COSY).
P. Moskal

Comments... ideas...

Task 3: Establishment of a common database for all experimental results.

Will be taken care of by Uppsala...

Task 4: Development of theoretical models establishing the links between different data and their relationship to basic concepts of hadron physics. Extraction of information from the data concerning properties of resonances, chiral dynamics and the nature of some resonances as well as different light mesons. A coordination of the theoretical model developments.
T. Peña

Comments... ideas...

Task 5: Establishing the interaction of the η and η' with nucleons and nuclei and the possibility to have η bound states in nuclei. The interaction between other light mesons and nucleons should also be considered.

C. Hanhart

“Clearly the most pressing issue in η physics currently is the structure in the $\gamma + n \rightarrow \eta + n$ reaction observed at both MAMI and ELSA ... Polyakov is sure this is a narrow baryon resonance ... one should think about other reactions to either confirm or disconfirm this ... can WASA contribute to this??

What I think is also an issue still to be understood is what is the value of the η - ^3He scattering length: there is still a significant scatter between the ANKE and the COSY11 value (maybe Pavel can add something to this) ... here, however, I am not sure if one can improve further. “

Task 6: Extension of the techniques of chiral perturbation theory and chiral Lagrangians from a thorough investigation of the η decay modes.

J. Bijnens

Comments... ideas...

Task 7: Two main workshops involving all participants in the network.

First main workshop:

Host Teresa Pena. Assisted by a program committee: The PrimeNet core group ?

Place ? Date ? Format ? Length ? Max number of participants ? Budget ~ 20 kEuro

Scientific program ? Proceeding ?

Program for the ETA07 workshop in Peniscola, May 10-11, 2007.

Thursday May 10

8:45-9:00 General welcome (5) Bo Höistad

Local welcome and information (10), Eulogio Oset

η and η' decays, meson structure and η mass measurement, Chairperson Eulogio Oset

9:00-9:30 Bugra Borasoy Theoretical overview on η and η' decays. (30)

9:30- 10:00 Luis Roca Radiative η and ϕ decays (theory). (30)

10:00 -10:30 Fabio Ambrosino KLOE: Dalitz plot analysis of the $\eta \rightarrow \pi^0 \pi^0 \pi^0$ and $\eta \rightarrow \pi^+ \pi^- \pi^0$ decays. (30)

10:30–10:50 Aleksandr Starostin Recent results on η' yield from MAMI-C with Crystal Ball and recent analysis of the decays $\eta \rightarrow \pi^0 \pi^0 \pi^0$ and $\eta \rightarrow \pi^0 \gamma \gamma$. (20)

10:50-11:15 *Coffe break* (25)

η and η' decays cont. Chairperson Caterina Bloise

11:15-11:35 Roberto Versaci KLOE: Radiative η decays. (20)

11:35-11:55 Marcin Berlowski Leptonic η decays from WASA experiments at CELSIUS. (20)

11:55-12:15 Robin Nissler Theoretical calculation of the $\eta' \rightarrow \pi^+ \pi^- l^+ l^-$ decays. (20)

12:15-12:45 Biagio Di Micco KLOE: The $\eta \rightarrow \pi^0 \gamma \gamma$ branching ratio and the η mass measurement. (30)

12:45-13:05 Alexander Nikolaev The η - mass measurement. (20)

13:05-16:30 *Afternoon break*

η and η' decays cont. Chairperson Michael Ostrick

16:30-17:00 Magnus Wolke Status report on the experiments with WASA at COSY. (30)

17:00-17:20 Fabio Ambrosino η - η' mixing. (20)

17:20-17:50 Paulo Gauzzi The study of light scalars at KLOE . (30)

17:50-18:10 Rafel Escribano Radiative decay of the ϕ (theory). (20)

18:10-18:30 Christoph Hanhart Scalar meson issues (theory). (20)

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18:30-18:50 *Coffe break* (20)

Meson photo production Chairperson Reinhard Beck

18:50-19:10 Lothar Tiator η and η' photo- and electro production (theory). (20)

19:10-19:30 Ulrike Thoma The $\gamma p \rightarrow \pi^0 \pi^0 p$ reaction. (20)

19:30-19:50 Mariana Nanova Investigation of $\gamma p \rightarrow p \pi^0 \eta$ and related reactions with

CBELSA/TAPS. (20)

19:50-20:10 Michael Doering Theoretical aspects of $\gamma p \rightarrow p \eta \pi^0$ and related reaction. (30)

20:10-20:30 Vitaliy Shklyar η photo production in the nucleon resonance region. (20)

20:30-20:50 Alexander Sibirtsev η photo production from heavy nuclei (theory). (20)

Friday May 10

Interaction of η and η' with nucleons and nuclei, Chairperson Christoph Hanhart

9:00-9:30 Bernd Krusche η -N and η -Nucleus bound states. (30)

9:30-10:00 Satoru Hirenzaki Theoretical aspects of η mesic nuclei and formation reactions. (30)

10:00-10:20 Alfons Khoukaz $p d \rightarrow {}^3\text{He} \eta$ and the η -He scattering length. (20)

10:20-10:40 Mariola Lesiak Study of the $d+d \rightarrow \alpha + \eta$ reaction with polarized beam, and search for bound η -nucleus states. (20)

10:40-11:00 *Coffee break* (20)

Interaction of η and η' , cont. Chairperson Susan Schadmand

11:00-11:30 Hartmunt Machner Search for bound η -nucleus states and a study of the reaction ${}^6\text{Li} + p \rightarrow \eta + {}^7\text{Be}$. (30)

11:30-11:50 Carmen Garcia-Recio Theoretical study of η bound states in light nuclei. (20)

11:50-12:10 Hideko Nagahiro η - and η' - mesic nuclei in NJL model. (20)

12:10-12:30 Teresa Pena The η -d system. (20)

12:30-12:50 Pawel Klaja Comparative study of the proton - η and proton- η' interactions via the pp and p-meson invariant mass distributions. (20)

12:50-13:05 Kalle Lindberg Search for η bound states using recoilless ${}^{12}\text{C}(d, {}^3\text{He}) {}^{11}\text{B} \eta$ reactions at GSI. (15)

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1305:-16:30 *Afternoon break*

Meson Production, Chairperson Pawel Moskal

16:30-16:50 Kanzo Nakayama Production mechanisms for η and η' (theory). (20)

16:50-17:10 Joanna Przerwa Isospin dependence of η' production in the collisions of nucleons. (20)

17:10-17:30 Eryk Czerwinski Direct determination of the width of η' . (20)

17:30-17:50 Jerzy Smyrski High statistics production of π^0 and η via deuteron- proton reactions close to the η production threshold at COSY-11. (20)

17:50-18:10 Colin Wilkin Hadronic production of eta mesons: Spin degrees of

freedom. (20)

18:10-18:40 *Coffee break* (30)

Meson Production cont. Chairperson *Walter Oelert*

18:40-19:00 Daisuke Jido The $A_{1/2}$, $S_{1/2}$ form factors of the $S_{11}(1535)$ as a dynamically generated resonance. (20)

19:00-19:20 Alfred Svarc The singularity structure of the η -nucleon scattering matrix (theory). (20)

19:20-19:40 Karin Schönning Omega production in pd collisions. (20)

19:40-20:00 Kanchan Khemchandani Omega production in pd collisions (theory). (20)

20:00-20:20 Mikhail Bashkanov Double Pionic Fusion - towards an understanding of the ABC puzzle by exclusive measurements. (20)

20:20-20:40 Tatiana Skorodko The Roper Resonance - its static and dynamic properties from single and double pion production. (20)

20:40-20:50 Bo Höistad EtaMesonNet, continuation plans for FP7