

# Annual Report — Research Activity

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We report on the third year of the *Marie Curie Research and Training Network FLAVIA**net*. The report starts with summaries of the research achievements of the 11 nodes in Sect. 1. In Sect. 2 we list the publications of our network. Sect. 3 describes the presentation of our scientific results at international conferences and describes our networking activity. We discuss the economic spin-off of our research activity in Sect. 4. Finally we conclude.

## 1 Research Achievements

In this section we describe the scientific activity of the nodes with emphasis on the relation to the working groups and to milestones defined in Annex I of the *FLAVIA**net* contract.

### **Node No. 1: Spain-V (Universitat de València Estudi General [UVEG])**

The participants node 1 (Valencia, Spain) have worked in the following specific lines of research along the last year :

- We have determined numerical values for some low-energy coupling constants in the chiral lagrangian from inclusive tau data [1–3].
- We have reanalysed the  $\pi$ - $\pi$  phase shifts from  $K \rightarrow \pi\pi$  decays [4].
- We have performed an analysis of the structure of the Yukawa couplings in the Two-Higgs-Doublet model [5].
- We have extended the mechanism of resonance saturation in Chiral Perturbation Theory at next-to-leading order in the expansion  $1/N_C$  [6, 7].
- We have studied the bounds on couplings of the effective field theory beyond the Standard Model in the semileptonic decays of light quarks [8].
- The hadronization procedure of the vector and axial-vector currents in the semileptonic decays of the tau lepton has been thoroughly studied.
- We have worked out explicit constructions of seesaw models with a low scale and minimal flavour violation [9].
- We have performed the first study of finite-size scaling of heavy light mesons.
- We have explored the effects of a flavour symmetry explaining the observed Yukawa couplings on the flavour structures of the soft breaking terms in the MSSM.
- In the MSSM we can have long-lived staus if the mass difference between stau and neutralino is smaller than the tau mass. This offers a nice opportunity to measure lepton flavour violation in the decay of the stau [10].
- We have analysed the sensitivity to the Higgs sector of SUSY-Seesaw Models in the lepton flavour violating  $\tau \rightarrow \mu f_0(980)$  decay [11].

### **Node No. 2: Spain-B (Universitat Autònoma de Barcelona [UAB])**

Hadronic  $\tau$  decays are a providential system to investigate low-energy QCD and to determine fundamental QCD parameters like the strong coupling  $\alpha_s$ , quark masses and QCD condensates. The essential experimental inputs in such an analysis are spectral decay distributions for basic mesonic correlation functions which have in the past dominantly been obtained by the Aleph collaboration and might be remeasured in the future by the B-factory experiments BaBar and Belle. A study of the  $K\pi$  vector form factor has been undertaken [47] as well as the scalar form factor [48] (milestones 1, 2 and 16). Furthermore, we have studied the impact of duality violations (i.e. failure of the Operator Product Expansion to reproduce the spectral function) on the current determinations of  $\alpha_s$  from tau decay (milestone 3 and 16) [49–51]. Concerning duality violations and properties of the Operator Product Expansion, a theoretical study of deep inelastic scattering in the 2-dimensional 't Hooft model has been carried out, with the result that maximal violations of quark-hadron duality have been found, as it is expected for a large  $N_c$  analysis. For the moments, violations of the operator product expansion at next-to-leading order in the  $1/Q^2$  expansion have been explicitly calculated and identified [52]. We have also used the mathematical theory of Pade Approximants to complement perturbative calculations of a heavy quark threshold, obtaining the value of a constant at  $\mathcal{O}(\alpha_s^2)$  (milestone 3) which has not been possible to calculate by means of

state-of-the-art ordinary Feynman diagram techniques [53]. We have also computed the ghost-gluon vertex on the lattice and the size of the gauge-dependent dimension-two gluon condensate [54] (milestone 3). Charmed baryon resonances were also analyzed through mechanisms which can generate them dynamically from the s-wave interaction of mesons and baryons in a coupled channel scheme [55]. Moreover, the static heavy quark energy has been evaluated at the highest order ever in perturbation theory [56]. Also, we have calculated at NNLO the nucleon nucleon scattering at low energies in a recently proposed chiral effective theory with dibaryon fields [57] and we have shown the constraints that the effective string theory of QCD puts on lattice data for the subleading potentials [58]. Work has been carried out on the extraction of the  $\eta$ - $\eta'$  mixing angle and the gluonium content of the  $\eta'$  meson from an updated phenomenological analysis of  $V \rightarrow P\gamma$  and  $J/\psi \rightarrow VP$  decays [59]. All the previous processes are of interest for ongoing experimental programs at Frascati, Jülich and Novosibirsk. Concerning Chiral Perturbation Theory, we have determined the  $O(p^6)$  low energy constants appearing in  $\pi$ - $\pi$  scattering [60,61] (milestones 1 and 2). For the physics of baryons on the lattice, we made an extensive high statistics analysis of hadronic correlation functions in order to determine the ground state baryon masses with fully quantified uncertainties that are at or below the 0.2-level in lattice units [62, 63] (milestone 4). A reanalysis of the error associated with the light by light contribution to muon g-2 has been made, where we have produced a critical review of the present knowledge of this quantity together an estimate that has become the standard value used [64–68] (milestone 6). Finally, we have determined  $L_{10}$  at order  $p^4$  and  $C_{87}$  at  $p^6$  using tau data [1–3, 69] (milestones 2 and 16).

### **Node No. 3: UK (University of Durham [UDUR])**

The UK node has contributed to the mission of the Working Groups 1 on kaon physics [76,76–78], 2 on  $B$ -physics [71, 76, 79–81], 3 on tau-charm and quarkonium physics [33, 76, 82–89], analytic approaches to non-perturbative QCD [76, 90–93] and lattice methods [76, 94–97].

The Durham group working with other nodes [80] have studied the rare decay  $B \rightarrow K^* \mu^+ \mu^-$ . This mode is regarded as one of the crucial channels for  $B$ -physics and golden channel for LHCb. The polarization of the  $K^*$  allows a precise angular reconstruction that results in observables that offer important tests of the Standard Model and its extensions. Those observables with the largest impact from New Physics are identified, see also [81]. Constraints on new physics contributions to the CP violating phase  $\phi_d$  in  $B^0$ - $\overline{B}^0$  mixing are deduced in [79], and these are applied to  $B \rightarrow \pi^+ \pi^-$  decay.

An important theoretical development is the application of AdS/CFT correspondence to strongly coupled QCD. Nicotri has applied this to scalar sector to make predications for their masses, decay constants and couplings [93].

The Oxford group has studied exotic hadrons, focussing on methods to determine the nature of various enigmatic hadrons that may be molecules. In particular, in [88] the mixing of  $q\bar{q}$  states with hybrid mesons through meson loops is explored, while in [86] possible explanations of the  $Y(4260)$  and  $Y(4360)$  states is presented by considering how  $\pi$ -exchange can lead to deeply bound hadronic molecules. Crucially tests of this explanation are outlined. In the book *Antimatter* [98] Close explains the fascinating subject of antimatter for the general public.

The Southampton Group have been extending their lattice computations with chiral fermions to

obtain fundamental quantities in flavour physics, in collaboration with physicists from the University of Edinburgh and the USA. Much of this year has been spent on a detailed analysis of a simulation with a finer lattice spacing which is allowing the group to perform the extrapolation to the continuum limit. A number of papers are currently in preparation; the two most important ones include (i) a detailed simultaneous study of the chiral and continuum behaviour and (ii) an improvement of our world-leading result for the  $B_K$  parameter of  $K-\bar{K}$  mixing by reducing the error due to lattice artefacts. These studies implement the new method for the non-perturbative renormalization of lattice quantities which we proposed in [95], which eliminates infra-red effects present in earlier methods by imposing the renormalization conditions only on Green functions with no exceptional momenta. The improvement of our calculations of semileptonic  $K \rightarrow \pi$  form factors for the precise determination of the  $V_{us}$  matrix element continues; the group is currently performing the calculations on the new datasets using the techniques developed in Southampton which do not require interpolations in the momentum transfer; a partial status report is contained in [99]. The Southampton group extended its techniques in applying SU(2) Chiral Perturbation Theory for kaon physics to semileptonic  $K \rightarrow \pi$  form factors [78]. During the course of this work it was realized that the techniques can also be applied to processes with hard external pions, leading to the birth of the so-called *Hard Pion Chiral Perturbation Theory*. Other studies include the determination of low moments of parton distribution amplitudes (a status report was presented in [96] and a draft of the publication is being completed); a calculation of the  $BB^*\pi$  and  $DD^*\pi$  couplings using a non-perturbatively tuned relativistic heavy-quark action; the calculation of the decay constant of the  $B$ -meson and the amplitude for  $B-\bar{B}$  mixing in the static theory (a late draft of the publication is currently being finalised for submission) and a major project on  $K \rightarrow \pi\pi$  decays has been started. The Southampton group has also continued its research in non-lattice flavour physics. In [82] it is demonstrated that resonance effects and the potentially non-perturbative  $c\bar{c}$  threshold region do not invalidate the standard picture of QCD factorization. Semileptonic  $B \rightarrow \rho$  decays were studied in [71] using the Omnès representation to obtain the result  $|V_{ub}| = (2.8 \pm 0.2)10^{-3}$  in tension with the values obtained from inclusive decays. C.Sachrajda is a member of the Flavianet Lattice Averaging Group.

Strong interaction phenomena mask the short distance weak interaction involved in the decay of a charmed particle. A detailed analysis of the highest statistics data on  $D_s$  decay to  $3\pi$  has been published by Pennington with the BaBar collaboration [84] investigating the strong final state interactions.

Two photon production of hadronic resonances is one of the clearest ways of revealing their composition. Studies for the upgrade of the DAΦNE machine with a two photon facility in the KLOE2 detector are under way. As part of this, Pennington [83] produced a report to be published as part of a special issue of European Physics Journal promoting precision low energy two photon production of meson channels. The key to understanding how hadrons are constructed from their constituent quark and gluons is the implementation of a programme to compute hadronic properties in the confinement regime. In the continuum the natural vehicle for such calculations is the system of Schwinger-Dyson, Bethe-Salpeter equations. Pennington reviewed recent progress in [90]. A key ingredient for such studies is the modelling of the interactions in the strong coupling regime ensuring the essential properties of gauge invariance and multiplicative renormalizability are maintained. A guide is provided by building these properties in QED, the study of which has

recently been completed in [91].

#### **Node No. 4: Germany–South (Universität Karlsruhe (TH) [UniKarl])**

In the reporting period the focus of the theoretical work in the node has been on electroweak precision physics, effective field theories and physics beyond the Standard Model. New data on hadroproduction in electron-positron scattering have been used to update predictions on the charm and bottom masses [100] (milestone 3). Related multi-loop results were published in Refs. [101, 102]. An important two-loop calculation for  $b \rightarrow u\ell\nu$  decays has been performed independently at two institutes in the node [103, 104]. Further two-loop calculations have addressed charmless hadronic two-body decays in QCD factorisation [105, 106], completing the next-to-next-to-leading order (NNLO) prediction for the decay rates of  $B \rightarrow \pi\pi$  and  $B \rightarrow \rho\rho$ . Conceptual problems of QCD factorisation related to charm quarks were the topic of Refs. [82, 107]. A large activity was devoted to precision calculations in nonrelativistic QCD, addressing top-antitop production near threshold [108–111]. We have applied QCD light-cone sum rules to  $D$  meson decay constants [112] and semileptonic form factors [113–115] (milestones 5 and 11). The node has increased its activity on physics beyond the Standard Model, mostly studying the Minimal Supersymmetric Standard Model (MSSM): We analysed rare  $b \rightarrow s$  decays (milestones 14 and 15) [80, 116, 117], and performed global analyses of several flavour observables in the MSSM (milestone 19) [118–124]. The MSSM with the boundary conditions of a Grand Unified Theory have been confronted with flavour data in Refs. [125, 126]. An alternative to supersymmetry are little-Higgs models studied in Refs. [127, 128]. We have further performed model-independent studies of new physics [16, 17, 129]. Additional theoretical studies in flavour physics were addressed in Refs. [130–138]. Continuing experimental work of the node has been devoted to B physics analyses at CDF (Fermilab), with publications on spectroscopy (milestone 4) [139, 140]. Further the same experimental group has strengthened its activity in the BELLE experiment, which the group has joined in summer 2008.

#### **Node No. 5: Italy (Istituto Nazionale di Fisica Nucleare [INFN])**

The highlights of the research activity of the node include: **I.** Determination of  $D$  and  $K$  decay form factors from unquenched simulations of  $N_f = 2$  twisted-mass Wilson fermions within the ETM Collaboration [155–158] (milestones n. 8,9,11). The Collaboration has continued the extraction of physical quantities in the pseudo-scalar and vector-meson sector, with unquenched up- and down-quark masses corresponding to pion masses in a range from 250 to 550 MeV. The results have been obtained with statistical errors at the percent level while keeping lattice artifacts and finite volume effects well under control. Exploratory simulations with four unquenched flavours have also been started. **II.** Phenomenological analyses of new-physics effects in low-energy flavour physics observables with particular attention to leptonic  $B$  [25, 138, 159, 160] and  $D$  [161] meson decays. Analysis of the correlations between low-energy processes and high-energy observables in well-motivated supersymmetric [162] and non-supersymmetric [163, 164] extensions of the SM (milestones n. 14-18). **III.** Analysis of recent data collected by KLOE and NA48 on  $K$ ,  $\eta$  and decays [165–169]. (milestones n. 7-8). **IV.** Development of effective field theories of QCD with applications to the physics of heavy quarkonium [56, 170–172] and tau

physics [173] (milestones n. 3,4,5). **V.** Developments of new effective theories to describe in a coherent way the old and the newly observed scalar mesons [92, 174–178] (milestone n. 4).

### **Node No. 6: Poland (University of Silesia [Univ. of Silesia])**

The Polish node concentrated last year on tasks 1,3,4,12,14 and 16.

Tasks 1 and 4: The measurement by the BES collaboration of  $J/\psi \rightarrow \gamma p \bar{p}$  decays indicates an enhancement at the  $p - \bar{p}$  threshold. In another experiment BES finds a peak in the invariant mass of pi-mesons produced in the possibly related decay  $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ . Using a semi-phenomenological potential model which describes all the  $N - \bar{N}$  scattering data, in [190] it was shown that the explanation of both effects may be given by a broad quasi-bound state in the spin and isospin singlet S wave. The structure of the observed peak is due to an interference of this quasi-bound state with a background amplitude and depends on the annihilation mechanism. More details and more complicated bound systems are studied in [191] and [192]. In [193] the features of the Resonance Chiral Theory (RChT) related to the description of the lightest scalar resonances, sigma, f0(980) and a0(980), are discussed. Major attention is paid to the fits of the invariant mass distributions in the radiative decays of the phi(1020) meson. The study of the scalar sector in RChT is motivated by the success of the theory predictive power in numerous processes with other types of resonances. We conclude that RChT is sufficiently flexible to describe these decays, however the further quantitative improvement is required. The technical work-outs and related important questions are outlined.

Task 3: In [194] an analytical calculation of the two-loop QCD corrections to the electromagnetic form factor of heavy quarks. The exponentiation of the heavy-quark form factor was applied to derive new improved three-loop expansions in the high-energy limit.

Task 12: A review of the status of the Monte Carlo event generator PHOKHARA, developed for experiments using the radiative return method was presented in [195]. The four-pion production in electron-positron annihilation and in tau-lepton decays and the narrow resonances studies were described. In [196] the current version of 'carlomat', a program for automatic computation of the lowest order cross sections of multi-particle reactions, is described. The program can be used as the Monte Carlo generator of unweighted events as well. Reduction techniques in calculation of the one loop radiative correction to be used in Monte Carlo generators relevant for low energy flavour physics were developed in [197]. The resulting compact formulae allow both for a study of analytical properties and for efficient numerical programming. They are implemented in Fortran and Mathematica. In [198] PHOTOS was upgraded to allow for simulation of the final state photon(s) emission in decays  $W \rightarrow l\nu$  and  $\gamma^* \rightarrow \pi^+ \pi^-$ . Exact leading order matrix elements were implemented. The second process is of particular interest for the pion form factor measurement. Upgrades of TAUOLA and PHOTOS generators are presented in [199]. For the TAUOLA Monte Carlo generator of tau-lepton decays, automated and simultaneous use of many versions of form-factors for the calculation of optional weights for fits was discussed. New tests for PHOTOS Monte Carlo for QED bremsstrahlung in W decays were shown. Prototype version of the TAUOLA universal interface based on HepMC (the C++ event record) was mentioned. Its tests with the help of MC-TESTER were also discussed.

Task 14: The article [200] contains a description of the main theoretical issues that determine

accuracy of the  $B \rightarrow X_s \gamma$  decay width calculations. One of its central points is a critical discussion of the collinear logarithm resummation by Becher and Neubert in Phys. Rev. Lett. 98 (2007) 022003. That resummation was performed too far from the photon energy endpoint, which resulted in worsening the accuracy rather than improving it.

Task 16: A combined analysis of the electromagnetic pion and kaon form factors in the neighbourhood of  $J/\psi$  and  $\psi(2S)$  and of the strong decay amplitude of these resonances into kaons is presented in [133]. In the presence of a large relative phase between strong and electromagnetic resonance amplitudes the branching ratio, as measured in electron-positron annihilation, receives an additional contribution from the interference between resonance and continuum amplitude neglected in earlier papers. Our study is model independent and does not rely on the  $SU(3)$  symmetry assumptions used in earlier papers. We note that the large relative phase between strong and electromagnetic amplitudes observed in earlier analyses is model dependent and relies critically on the specific assumptions on  $SU(3)$  symmetry and breaking.

### **Node No. 7: Nordic (Lund University [ULUND])**

In this period we have contributed to milestones 2, 4, 9 and 11 which span the working groups 1, 2, 4 and 5.

In the field of Kaon nonleptonic decays we have made two contributions in this period. This showed that off-shell effects can have an effect of about 5% in these decays. In Lund [201] it was shown how even for large Kaon masses chiral predictions are still possible for the pionic logarithms. This was argued to be the case for more general hard processes but shown explicitly for the pionic logarithm in  $K \rightarrow \pi\pi$  decays. This work built strongly on earlier work by the Southampton group of node 3 in the case of  $K_{\ell 3}$ .

In semileptonic  $B$ -decays the chiral corrections for the formfactors in  $B$  to  $D$  transitions were studied [160]. The influence of opposite parity multiplets was found to be comparable to the  $SU(3)$  breaking.

For hadronic spectroscopy in lattice gauge theory the spectrum of excited  $B_s$  mesons was discussed in the PhD thesis which was successfully defended in May 2009 [202].

In standard Chiral Perturbation Theory (ChPT) the work for a new general determination of the Low-Energy-Constants (LECs) enjoyed steady progress. One major question here is to find tests of that are independent of estimates on LECs. This was found to be possible at next-to-next-to-leading order despite the large number of LECs. Discussions can be found in [203–205] and the work was published in [206]. Preliminary results of the new fit for the NLO LECs were presented as well [204, 205]. In this context the reviews on the status of mesonic ChPT are also relevant [205, 207]

The new analysis of pion-nucleon scattering using dispersion relations and partial wave analysis has been going slowly forward in Helsinki. Preliminary results have been presented at the three conferences listed in the presented talks section by M. Sainio. This work will provide much needed background on strong LECs in the nucleon sector.

In Lund, work has been ongoing to study ChPT in a more general setting which might be relevant for future lattice studies of nonperturbative Higgs sectors and methods of generating fermion masses and mixings. We have here been studying higher order corrections in various models

with different patterns of spontaneous symmetry breaking as well as studies for large number of flavours in these models. A first publication solved the massive nonlinear  $O(N)$  model for large  $N$  and obtained the leading logarithms for the mass up to five loop order [208].

### **Node No. 8: France (Centre National de la Recherche Scientifique [CNRS])**

During the time of this report, members of the node 8 have mainly worked on the tasks 1,3,5,6 concerning the strong sector of the Standard Model (SM), the tasks 7,10,11 of the SM electroweak sector and the tasks 14,18,19 for physics beyond SM.

*Light flavours.* A dispersive approach was used to construct fully relativistic model-independent representations of the  $\eta$  and  $K$  to three-pion decays, valid up to and including two-loop corrections [209–211]. In anticipation of new and more precise experimental measurements relevant for  $\pi^0$  decays, chiral and QED corrections to these processes were considered [212, 213]. The robustness of the dispersive parametrization proposed for the scalar and vector  $K\pi$  form factors has been studied. [214]. Using recently published, high-precision  $\pi^+\pi^-$  cross section BABAR data by the BABAR, the lowest order hadronic contribution to the anomalous magnetic moment of the muon was reassessed, reducing the discrepancy between  $e^+e^-$  and  $\tau$ -based results for the dominant two-pion mode [215].

*B decays.* Radiative B decays  $B \rightarrow K\eta\gamma$  were analysed in the region where the emitted photon is energetic and one of the mesons is soft [216]. The issue of soft photons was reassessed for leptonic B decays, showing potential large corrections to the current determinations to the B decay constant from  $B \rightarrow \ell\nu_\ell$  [217]. Several non-perturbative inputs for b decays have been studied either analytically or through lattice simulations: the Isgur-Wise functions at zero recoil  $\tau_{1/2}(1)$  and  $\tau_{3/2}(1)$ , associated to  $B \rightarrow D^{**}$  semileptonic decays [155], the Isgur-Wise functions for the heavy baryon  $\Lambda_b$ , related to the semileptonic decay  $\Lambda_b \rightarrow \Lambda_c\ell\nu$  to be measured with precision at LHCb [218, 219], the 3-parton light-cone distribution amplitudes for heavy-light mesons [220, 221]. Other quantities related to the strong dynamics of heavy-light mesons have been computed from publically available gauge configurations: the coupling  $\hat{g}$ , parameterising in the Heavy Meson Chiral Perturbation Theory the  $H^* \rightarrow H\pi$  transition [222], and the densities of charge, matter and axial charge of heavy-light mesons in the static limit [223].

*CKM matrix and new physics.* The decay constants  $f_K$ ,  $f_D$  and  $f_{D_s}$  have been computed using gauge configurations produced by the ETM Collaboration, in good agreement with the unitarity of the CKM matrix [224]. Concerning global fits to the CKM matrix, models of new physics were investigated either through contributions to  $B^0$ - $\bar{B}^0$  mixing [225], or through charged Higgs contributions to  $\Delta F = 1$  tree processes [159, 226].

*Lattice methods.* New actions and algorithms for lattice QCD with  $N_f = 2 + 1$  flavors of sea quarks were used to to perform an ab initio calculation of light hadron masses [227, 228]. The contribution of excited states to 2-pts correlation functions was shown to be strongly reduced by computing a matrix of correlators and solving a generalised eigenvalue problem [229, 230]. A new approach to extract  $f_B$  and  $m_b$  from lattice simulations is based on the scaling law in  $1/m_H$  of such quantities in the heavy quark limit [179].

*Analytic methods.* The links between perturbative series and non-perturbative corrections in QCD have been investigated using toy-models where the whole (divergent) perturbative series



are known, like zero-dimensional  $\phi^4$  field theory [231]. Techniques for performing asymptotic expansions of perturbative Feynman amplitudes in either large or small ratios of kinematic variables were extended to cases with more than two scales and applied to large-order calculations of the leptonic vacuum polarization contributions to the muon  $g-2$  [232].

*Reviews.* Several reviews have been written in collaboration with other nodes, concerning  $\tau$ -charm physics during the next few years at BES-III [75], flavour physics in the quark sector [33], the status of the theory and measurements of the muon anomalous magnetic moment [68, 233]. Contributions to the activities of the Flavianet Lattice Averaging Group (FLAG) were also made, in particular the synthesis of light quark mass calculations and the writing of the corresponding section in the upcoming FLAG report.

### **Node No. 9: Switzerland (Universität Bern [UBERN])**

The research of the node addressed milestones no. 1,2,3,6,7,10,11,13,14,15, 18 which span the topics of all working groups.

In [250] an analysis of  $K^\pm \rightarrow \pi^\pm e^+ e^- (\gamma)$  decays based on a sample of 7253 candidates with 1% background contamination has been presented. The branching ratio in the full kinematic range was measured, and the shape of the form factor determined. A possible CP violating asymmetry of  $K^+$  and  $K^-$  decay widths was investigated, and a conservative upper limit of  $2.1 \times 10^{-2}$  at 90% CL was established.

In [251] we have analyzed isospin breaking corrections to the  $\pi\pi$  phase shifts extracted from  $K_{e4}$ -decay measurements and shown that these are very important at the level of precision reached by current experiments. Once these are taken into account, the previous discrepancy between NA48/2 data on  $K_{e4}$  decays and the prediction of  $\pi\pi$  scattering lengths disappears. In [252] we have worked out, for the coupling constants which occur at order  $p^6$ , the dependence on the strange quark mass at two-loop accuracy, completing an earlier work on the  $O(p^4)$  constants.

In [253] we derived analytic results for the high invariant mass region of the lepton pair in the inclusive rare decay  $B \rightarrow X_s \ell^+ \ell^-$ . In particular, we calculated the two-loop matrix elements associated with the operator  $O_2$  in this region, using the method of differential equations and the method of regions. In [106] we published the first NNLO prediction for  $B^- \rightarrow \pi^- \pi^0 / \rho^- \rho^0$ . Confronting our results with experimental data we found strong support for QCD-factorization.

In [254] we studied the impact of NNLO corrections on partial decay rates in  $B \rightarrow X_u \ell \bar{\nu}_\ell$  transitions at leading order in the  $1/m_b$  expansion in the shape-function region. We found that these corrections induce significant downward shifts in the central values of these partial decay rates, leading to an increase of  $|V_{ub}|$  by slightly less than 10%. Within the physics workshop on SuperB, specific differences between a  $10 fb^{-1}$  and a  $50 fb^{-1}$  SuperB factory have been analyzed [44]. Bounds on flavour-violating gluino and squark decays have been derived from the present flavour data [255].

Perhaps the clearest evidence for the breaking of chiral symmetry is provided by the condensation of the low modes of the Dirac operator. As shown in [256], many spectral observables are renormalizable and thus provide new opportunities for qualitative and quantitative studies of the chiral regime of QCD in a field-theoretically solid framework. In [257] the low lying spectrum of QCD in the delta-regime has been calculated in chiral perturbation theory up to NNLO order. The

spectrum has a simple form in terms of the pion decay constant  $F$  and a combination of low energy constants. The result should help a precise determination of these parameters to good precision.

In [214] we have built a dispersive representation for the normalized vector form factor and performed a careful analysis of all the hadronic uncertainties. The  $\tau \rightarrow K\pi\nu$  data from BaBar and Belle have been used in this respect. In [33] a summary of the status of quark flavour physics on the theoretical and experimental sides has been done. Within the Kaon working group we have reviewed the determination of the CKM matrix element  $|V_{us}|$  and the stringent tests of the Standard Model which can be performed with kaon decays.

In [147] the CP-violating phenomenology of the MSSM with Minimal Flavor Violation (MFV) in the lepton sector has been revisited and carefully analyzed. In [258] a natural implementation of Dirac neutrinos naturally without the extreme fine-tuning problems within the warped extra-dimensional scenario proposed by Randall and Sundrum was proposed. A generic parameter space where lepton sector constraints are naturally satisfied at the few TeV scale, while simultaneously reproducing the observed lepton mass and mixing patterns has been found.

#### **Node No. 10: Austria (Universität Wien [UNIWIEN])**

The work of this node addressed milestones no. 1,2,7,8,11,18, spanning the topics of working groups 1,2,4,5.

Using more precise experimental data and improved knowledge of low-energy constants, the impact of isospin violation for extracting the  $s$ -wave  $\pi\pi$  scattering phase shifts from  $K \rightarrow \pi\pi$  decays has been re-analyzed [4]. The status of chiral perturbation theory in the meson sector was reviewed in [274], with the main emphasis on recent developments in pion pion scattering, semileptonic decays and nonleptonic kaon decays. A contribution covering  $P_{\ell 2}$  and  $P_{\ell 3}$  ( $P = \pi, K$ ) decays to the extensive review on “Flavor Physics in the Quark Sector” [33] was written. The dispersive approach to chiral perturbation theory was applied in an investigation of cusp effects in  $K \rightarrow 3\pi$  [211] and the  $\eta \rightarrow 3\pi$  decay [210].

The chiral loop corrections to the  $B$  meson decay amplitudes to positive and negative parity charmed mesons were calculated in [160]. It was found that corrections due to states of opposite parity are competitive with the contributions arising from  $K$  and  $\eta$  meson loops.

It was noticed recently that among many scenarios of new physics, leptoquarks might compensate for the disagreement between lattice and experimental results for the charmed strange meson decay constant. The leptoquarks might also modify the flavour changing neutral current charm decays. Studies related to this question were performed in [275] and [161]. Using the most general model independent Lagrangian, possible experimental signals of new physics in  $t \rightarrow c(u)\ell^+\ell^-$  FCNC top decays were investigated [184].

The observed mass pattern of scalar resonances below 1 GeV suggests a tetraquark assignment over the conventional  $\bar{q}q$  assignment for these states. This question was explored in a recent lattice study [276]. No indication for light tetraquarks at the pion mass range 344 MeV – 576 MeV was found. This does, however, not exclude the possibility of finding tetraquarks in a simulation with smaller pion masses or a different interpolator basis.

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Using the maximally twisted mass formulation of lattice QCD, it became possible to obtain a number of important simulation results within the European Twisted Mass Collaboration (ETMC). There have been results on the pion scattering length [280], a new proposal for B-physics has been given [179], Meson masses and decay constants could be determined [281], pseudoscalar decay constants of kaon and D-mesons have been computed [155], precise calculations of low energy constants were obtained [282], the static-light meson spectrum was computed [283]. The eta' meson was studied [284] and simulations with dynamical strange and charm degrees of freedom have been started [34].

Various techniques for future high precision lattice flavour physics computations have been developed [229, 285, 286] and new fermion formulations have been investigated in perturbation theory [287, 288]. In particular the matching of Heavy Quark Effective Theory and QCD has been advanced in the theory with two dynamical flavours [97] and a new computation of the decay rate for  $D_s$  into leptons has been initiated [289, 290]. Also the moving NRQCD formulation for lattice computations of decays of heavy-light mesons was investigated [286, 291]. Dynamical properties of the Hybrid Monte Carlo algorithm, which is used for the Monte Carlo Simulations of lattice gauge theories, were studied [292]. Non-perturbative determinations of relativistic corrections to the inter-quark potential from lattice QCD [293] provide input for working group 3.

The work of [294, 295] opens a promising possibility for the determination of chiral perturbation theory low energy constants (WG1/4).

The papers [296, 297] deal with the use of the effective field theories to analyze the lattice data [296, 297], in particular, the fourth-order ChPT calculation (with explicit  $\Delta$  degree of freedom) of the finite-volume corrections to the spectrum of QCD in the channel with quantum numbers of the  $\Delta$ -resonance [296]. Lüscher approach has been generalized to the two-particle elastic scattering and a method of calculating  $\bar{K}N$  scattering lengths in lattice QCD has been suggested [297]. Hadronic atoms, in particular kaonic deuterium are studied in [263, 298].

The cusp structure of the  $\eta \rightarrow 3\pi$  decay amplitude is investigated up to two loops in the non-relativistic effective field theory [299] and also electromagnetic corrections relevant for the extraction of light quark mass ratios have been calculated [300].

In Ref. [251], it is demonstrated that isospin-breaking corrections play an important role in the extraction of the S-wave  $\pi\pi$  scattering lengths from the experimental data on  $K_{e4}$  decays.

The non-relativistic effective Lagrangian approach has been applied to study the decay  $\eta' \rightarrow \eta\pi\pi$ , investigating the possibility to extract information on  $\pi\pi$  and  $\pi\eta$  threshold parameters [301].

Isospin-breaking corrections to the pion–nucleon scattering lengths, both of strong and electromagnetic origin, are an essential ingredient in particular to the extraction of these quantities from pionic hydrogen; these have been calculated completely to third order in the chiral expansion [302]. Also above threshold, these effects have been shown to remain moderate [303].

Meson–baryon scattering lengths have been calculated in covariant baryon chiral perturbation theory to third order [304]. The matching between the three- and the two-flavor theory has been performed for all dimension-two constants, and new low-energy theorems have been derived for pion–hyperon scattering.

## 2 Publications

The FLAVIANet members wrote the scientific papers listed below during the reporting period. Only papers which are published or submitted for publication are listed. Publications unrelated to the topics mentioned in Annex I of the FLAVIANet contract are not included. Experimental papers are only listed if FLAVIANet members were involved in the presented analyses. We list joint publications involving several FLAVIANet nodes in Sect. 3.3.

- [1] M. González-Alonso, A. Pich, and J. Prades, *Determination of the Chiral Couplings  $L_{10}$  and  $C_{87}$  from Semileptonic Tau Decays*, *Phys. Rev.* **D78** (2008) 116012, [0810.0760].
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- [5] A. Pich and P. Tuzon, *Yukawa Alignment in the Two-Higgs-Doublet Model*, 0908.1554.
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### 3 Conferences, Workshops and General Networking

The FLAVIANet nodes regularly organise several events devoted to common research and scientific exchange. Our major meeting, the annual conference *Euro-Flavour 09*, will take place in November and will be covered in the next annual report. Sect. 3.1 summarises other conferences and workshops organised at one of the nodes, if they were totally or in part devoted to flavour physics. Sect. 3.2 is devoted to other conferences and workshops, at which results from FLAVIANet were presented. In Sect. 3.3 we summarise the individual networking activity related to research. Finally we justify changes to our original schedule.

### 3.1 Conferences and workshops within FLAVIANet

Several conferences and workshops took place in the FLAVIANet nodes. Here we list both genuine FLAVIANet meetings and international conferences and workshops organised by FLAVIANet members at their home institutions.

Node no.	Conference/Workshop
1	<i>PROMETEO I: LHC physics and cosmology</i> , 2nd - 6th March 2009, Valencia (Spain) <a href="http://ific.uv.es/gabriela/miniworkshop.html">http://ific.uv.es/gabriela/miniworkshop.html</a>
1	<i>International Workshop on Effective Field Theories</i> , 2nd - 6th February 2009, Valencia (Spain) <a href="http://ific.uv.es/eft09">http://ific.uv.es/eft09</a>
3	<i>Annual UK Particle Theory Meeting</i> , 18-20 December 2008, Durham (UK) <a href="http://www.ippp.dur.ac.uk/Xmas/08/">http://www.ippp.dur.ac.uk/Xmas/08/</a>
3	<i>Higgs-Maxwell Meeting</i> , 4 February 2009, Edinburgh (UK) <a href="http://www.ippp.dur.ac.uk/Workshops/09/HMW/">http://www.ippp.dur.ac.uk/Workshops/09/HMW/</a>
3	<i>London Workshop on Standard Model discoveries with early LHC data</i> , 30 March-1 April 2009, London (UK) <a href="http://www.hep.ucl.ac.uk/smlhc/Site/">http://www.hep.ucl.ac.uk/smlhc/Site/</a>
3	<i>Workshop on New Physics with SuperB</i> , 14-17 April 2009, Warwick (UK) <a href="http://www2.warwick.ac.uk/fac/sci/physics/research/epp/meetings/superb2009">http://www2.warwick.ac.uk/fac/sci/physics/research/epp/meetings/superb2009</a>
3	<i>Flavour physics in the era of precision neutrino experiments</i> , 9-11 June 2009, Abingdon (UK) <a href="http://www.ippp.dur.ac.uk/Workshops/09/Coseners">http://www.ippp.dur.ac.uk/Workshops/09/Coseners</a>
4	<i>Ringberg Workshop on New Physics, Flavors and Jets</i> , April 27 - May 1, 2009, Ringberg Castle, Rottach-Egern (Germany) <a href="http://indico.mppmu.mpg.de/indico/conferenceDisplay.py?confId=433">http://indico.mppmu.mpg.de/indico/conferenceDisplay.py?confId=433</a>
4	<i>Potential and Prospects for Super Flavour Factories</i> , 31st October - 1st November 2008, Munich (Germany) <a href="http://indico.mppmu.mpg.de/indico/conferenceDisplay.py?confId=341">http://indico.mppmu.mpg.de/indico/conferenceDisplay.py?confId=341</a>
4	<i>Progress and Challenges in Flavour Physics</i> , 29th September - 31st October 2009, Primosten (Croatia) <a href="http://hippo.irb.hr/primosten09/">http://hippo.irb.hr/primosten09/</a>
5	<i>LNF Spring School</i> , 11th - 15th January 2008, Frascati (Italy) <a href="http://www.lnf.infn.it/lnfss09">http://www.lnf.infn.it/lnfss09</a>
5	<i>Rencontres de Physique de la Vallée d'Aoste</i> , 3th - 10th March 2009, La Thuile (Italy) <a href="http://www.pi.infn.it/lathuile">http://www.pi.infn.it/lathuile</a>
5	<i>Summer School on Particle Physics in the LHC ERA</i> , June 2009, ICTP, Trieste (Italy) <a href="http://users.ictp.it/ksumura/WebPage/">http://users.ictp.it/ksumura/WebPage/</a>
6	<i>FLAVIANET TOPICAL WORKSHOP: Low energy constraints on extensions of the Standard Model</i> , 23-27 July 2009 Kazimierz (Poland) <a href="http://cxyz.phys.us.edu.pl">http://cxyz.phys.us.edu.pl</a>
6	<i>XXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions</i> , 11th-16th September 2009 Ustroń (Poland) <a href="http://prac.us.edu.pl/us2009">http://prac.us.edu.pl/us2009</a>

6	<i>The 2009 Europhysics Conference on High Energy Physics</i> , 16-22 July 2009 Kraków (Poland) <a href="http://www.ifj.edu.pl/hep2009/">http://www.ifj.edu.pl/hep2009/</a>
8	<i>SuperB Workshop VIII: New Physics at the Super Flavour Factory SuperB</i> , 15th - 18th February 2009, Orsay (France) <a href="http://events.lal.in2p3.fr/conferences/SuperB09/">http://events.lal.in2p3.fr/conferences/SuperB09/</a>
9	<i>Chiral Dynamics 2009</i> , 6th - 10th July 2009, Bern (Switzerland) <a href="http://www.chiral09.unibe.ch">http://www.chiral09.unibe.ch</a>
9	<i>Joint Physics Meetings of the LHCb Collaboration and the Theory Group</i> 28.11.2008, 27.01.2009, and 29.05.2009, Cern, Geneva (Switzerland)
9	<i>Working group on the interplay of collider and flavour physics</i> 16.-18.12.2009, Cern, Geneva (Switzerland)
10	<i>5th Vienna Central European Seminar on Particle Physics and Quantum Field Theory: Highlights in Computational Quantum Field Theory</i> , 28th - 30th November 2009, Vienna (Austria) <a href="http://www.univie.ac.at/vienna.seminar/2008/">http://www.univie.ac.at/vienna.seminar/2008/</a>
11	<i>Modern perspectives in lattice QCD</i> , summer school, 3-28 Aug 2009, Les Houches (France) <a href="http://julian.tau.ac.il/Houches2009/Houches0809.html">http://julian.tau.ac.il/Houches2009/Houches0809.html</a>
11	<i>LATTICE PRACTICES 2008</i> , summer school, 8-10 Oct 2008, Zeuthen (Germany), <a href="https://indico.desy.de/conferenceDisplay.py?confId=1113">https://indico.desy.de/conferenceDisplay.py?confId=1113</a>
11	<i>"Frontiers in Nuclear Physics," Symposium in honor of Walter Glöckle's 70th birthday</i> , June 18-20, 2009, Bad Honnef (Germany) <a href="http://www.pbh.de">http://www.pbh.de</a>
11	<i>"Charmed Exotics" (447-th Wilhelm and Else Heraeus Seminar)</i> , Aug. 10-12, 2009, Bad Honnef (Germany) <a href="http://www.pbh.de">http://www.pbh.de</a>
11	<i>"Hadron Structure and Dynamics"</i> , Aug. 13-14, 2009, Bad Honnef (Germany) <a href="http://www.pbh.de">http://www.pbh.de</a>
11	<i>19th International IUPAP Conference on Few-Body Problems in Physics "FB 19"</i> , Aug. 31 - Sept. 5, 2009, Bonn (Germany) <a href="http://fb19.hiskp.uni-bonn.de">http://fb19.hiskp.uni-bonn.de</a>
11	<i>International Advisory Committee of the conference "Vth International Conference on Quarks and Nuclear Physics (QNP08/09)"</i> , 2008/2009, Beijing (China) <a href="http://tpcsf.ihep.ac.cn/QNP09/index.htm">http://tpcsf.ihep.ac.cn/QNP09/index.htm</a>
11	<i>International Workshop "Chiral Dynamics VI: Theory and Experiment"</i> , July 6-10, 2009, Bern (Switzerland) <a href="http://www.chiral09.unibe.ch">http://www.chiral09.unibe.ch</a>
11	<i>PrimeNet Workshop</i> , 8th - 9th October, Bonn, Germany, <a href="http://www.itkp.uni-bonn.de/kubis/PrimeNet/Program.html">http://www.itkp.uni-bonn.de/kubis/PrimeNet/Program.html</a>

### 3.2 Other conferences and workshops

Below we list the international conferences and workshops at which FLAVIANet researchers have presented their scientific results. Several of these conferences were attended by a large number of



FLAVIANet members and were used for networking.

Name	Node no.	Conference/Workshop <i>talk title</i>
Paola Ferrario	1	DISCRETE'08: Symposium on Prospects in the Physics of Discrete Symmetries, Valencia, Spain, 11-16 December 2008. <i>Charge asymmetries of top quarks: a window to new physics at hadron colliders.</i>
Oscar Vives	1	16th YKIS: Particle Physics Beyond the Standard Model, Kyoto, Japan, 26-January – 25th March 2009. <i>Flavour symmetries and the SUSY soft-breaking sector at the LHC.</i>
Antonio Pich	1	XXXVII International Meeting on Fundamental Physics, Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, 10 February 2009. <i>The Nobel Prize in Physics 2008: Kobayashi &amp; Maskawa.</i>
Germán Rodrigo	1	Working Group on Radiative Corrections and Generators for Low Energy Hadronic Cross Section and Luminosity, Laboratori Nazionali di Frascati, Italy, 6-7 April 2009.
Oscar Vives	1	Workshop on New Physics with SuperB, Warwick, United Kingdom, 14-17 April 2009. <i>Flavour and CP in general MSSM: implications for tau physics. Taus and Bs versus muons and Ks: where to look for new physics?.</i>
Antonio Pich	1	International Workshop on Light Quark Masses and Hadron Physics (from quarks to Life), Univ. Complutense de Madrid, Madrid, Spain, 2-5 June 2009. <i>Determination of the strange quark mass and <math>V_{us}</math> from tau decays.</i>
Isabella Bierenbaum	1	Les Houches Workshop for TeV Colliders, Les Houches, France, 8-17 June 2009. <i>First attempts to extend the one-loop duality method to two loops.</i>
Germán Rodrigo	1	TOP09: Top quark physics - from the Tevatron to the LHC, CERN, Switzerland, 18-25 June 2009. <i>Resonances in the top quark sector.</i>
Martín González	1	6th International Workshop on Chiral Dynamics, Bern, Switzerland, 6-10 July 2008. <i>Chiral low-energy constants from tau data.</i>
Oscar Vives	1	Low-energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i>Flavour symmetries and SUSY soft-breaking at the LHC.</i>
Martín González	1	Low-energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i>New Physics bounds from the combination of CKM-universality and high energy data.</i>

Paula Tuzón	1	Low-energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i>Yukawa Alignment in the Two-Higgs-Doublet model.</i>
Martin Jung	1	Low-energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i>Is there a non-standard-model contribution in non-leptonic <math>b \rightarrow s</math> decays?.</i>
Antonio Pich	1	Low-energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i><math>\alpha_s</math> determination from tau decays: theoretical status.</i>
Juan Nieves	2	'TROIA'09: IInd International Conference on Hadron Physics, Cannakale, Turkey, September 2009. <i>Heavy quark spin symmetry and charmed baryon resonances</i> The 5-th International Conference on Quarks and Nuclear Physics, Beijing, China, September 2009. <i>Semileptonic decays of hadrons)</i>
Santi Peris	2	International Workshop on Effective Field Theories: from the Pion to the Upsilon, Valencia, Spain, February 2009. <i>On duality violations in hadronic tau decay</i> Quark Confinement and the Hadronic Spectrum, Mainz, Germany, Sept. 2008. <i>On duality violations in hadronic tau decay</i> Approximation and extrapolation of convergent and divergent sequences and series, Marseilles, France, Sept. 2009. <i>Large-<math>N_c</math> Quantum Chromodynamics and rational approximants</i>
Matthias Jamin	2	Chiral Dynamics 09, Bern, Switzerland, 6-10 July 2009. <i>SU(3) breaking in hadronic tau decays</i> QCD Bound States 09, Argonne National Laboratory, USA, 15-19 June 2009. <i>Recent progress in hadronic tau decays</i> New Physics, Flavour and Jets 09, Ringberg Castle, Germany, 26 April - 1 May 2009. <i>Recent progress in hadronic tau decays</i> Low Energy Precision Electroweak Physics in the LHC Era, INT Seattle, USA, 22 September - 5 December 2008. <i><math>\alpha_s</math> and the tau hadronic width</i> Tau 08, Novosibirsk, Russia, 22-25 September 2008. <i><math>\alpha_s</math> and the tau hadronic width</i>
Jose Rodriguez Quintero	2	International workshop on "QCD Bound States: Methods and Properties"; 15-19 June, 2009. <i>A ghost story: the low-momentum of gluon and ghost propagators</i>

Angels Ramos	2	<p>International workshop on "QCD Green's functions, confinement and phenomenology", 7-11 September, 2009; Trento, Italy. <i>Ghost and Gluons beyond the IR of QCD: the Gluon condensate and <math>\Lambda_{QCD}</math></i></p> <p>Workshop on Recent Advances in Strangeness Nuclear Physics and related Subjects, November 18, 2008, Hebrew University, Jerusalem, Israel. <i>A simple analysis of <math>\Lambda p</math> and <math>\Lambda d</math> spectra following <math>K^-</math> absorption in nuclei</i></p> <p>The 5th International Pion-Nucleon PWA Workshop and Interpretation of Baryon Resonances 1-5 June, 2009, ECT*, Trento, Italy. <i>Dynamically Generated Resonances from Vector-Meson Octet-Baryon Interactions</i></p> <p>10th International Conference on Hypernuclear and Strange Particle Physics "Hyp X", 14-18 September, 2009, Tokai, Japan. <i>The <math>(K-, p)</math> reaction on nuclei with in-flight kaons</i></p>
Joan Soto	2	<p>Bound States and Resonances in Effective Field Theories Trento, Italy, September-October 2008. <i>Nucleon-Nucleon Effective Theory with Dibaryon Fields</i></p> <p>International Workshop on Heavy Quarkonia Nara, Japan, December 2008. <i>QED bound states at finite temperature</i></p>
Rafel Escribano	2	<p>Symposium on Meson Physics: extended COSY-11 collaboration meeting. <i><math>\eta</math>-<math>\eta'</math> mixing from <math>V \rightarrow P\gamma</math> and <math>J/\psi \rightarrow VP</math> decays</i></p> <p>KLOE2 Physics Workshop, Frascati (Italia), 9-10/4/2009. <i>Dispersive representation of the <math>K\pi</math> vector form factor and fits to <math>\tau \rightarrow K\pi\nu_\tau</math> and <math>K_{e3}</math> data</i></p> <p>Bosen Students' Workshop, Bosen (Alemania), 30/8-4/9/2009. <i>The <math>\eta</math>-<math>\eta'</math> system: mixing angle, gluonic content and contribution to <math>(g-2)_\mu</math></i></p>
Assumpta Parreño	2	<p>International Workshop on Effective Field Theories: from the pion to the upsilon (EFT09), 1-6 Feb. 2009, Valencia, Spain. <i>Lattice QCD simulations of baryonic interactions</i></p> <p>Sixth International Workshop on Chiral Dynamics", 6-10 July 2009, University of Bern, Switzerland. <i>Lattice QCD simulations of baryon-baryon interactions</i></p> <p>19th International IUPAP Conference on Few-Body Problems in Physics 31.08 - 05.09.2009 - University of Bonn, Germany. <i>Few-body lattice physics</i></p>

Joaquim Prades	2	<p>10th International Conference on Hypernuclear and Strange Particle Physics. "Hyp X". September 14th - 18th, 2009. "RICOTTI" in Tokai, Ibaraki, Japan. <i>YN interaction with Lattice QCD</i></p> <p>2nd User's Conference of the 'Red Espanola de Supercomputacion', September 23rd, 2009. Universidad de Cantabria, Santander, Spain. <i>Study of SubAtomic Interactions through Lattice Quantum Chromo Dynamics on Mare Nostrum (SAIL)</i></p> <p>International Conference on Particles and Nuclei, PANIC 2008", November 9-14, 2008. Eilat, Israel. <i>Low Energy Baryon-Baryon Scattering from Lattice QCD</i></p> <p>Bound States and Resonances in Effective Field Theories", September 29 to October 3, 2008. ECT*, Trento, Italy. <i>Lattice QCD simulations of baryon-baryon interactions</i></p> <p>Topical FLAVIANet Workshop on Low energy Constraints on Extensions of the Standard Model, July 24-26 2009, Kazimierz, Poland. <i>Standard Model Prediction of the Muon Anomalous Magnetic Moment</i></p> <p>Sixth International Workshop on Chiral Dynamics, July 6-10, 2009, Bern, Switzerland. <i>Theory of the Hadronic Light-by-Light Contribution to Muon g-2</i></p>
Antonio Pineda	2	<p>Photon 2009: International Conference on the Structure and Interactions of the Photon: 18th International Workshop on Photon-Photon Collisions and International Workshop on High Energy Photon Linear Colliders, Hamburg, Germany, 11-15 May 2009. <i>The Hadronic Light-by-Light Contribution to Muon g-2: A Short Review</i></p> <p>T(r)opical QCD 2008, Port Douglas, Australia; 2008. <i>Breakdown of the operator product expansion in the 't Hooft model</i></p> <p>International Workshop on Effective Field Theories: from the pion to the upsilon, 2-6 February 2009 Valencia, Spain. <i>Effective Field Theories in Heavy Quarkonium</i></p> <p>Tenth Workshop on Non-Perturbative Quantum Chromodynamics, June 8-12, 2009, Paris. <i>Breakdown of the operator product expansion in the 't Hooft model</i></p> <p>KITPC program "Effective Field Theories in Particle and Nuclear Physics" (Aug 3 - Sep 11, 2009), Beijing, China. <i>Effective Field Theories in Heavy Quarkonium and Renormalons and effective field theories</i></p>

Germán Rodrigo	1	HERA and the LHC: 4th Workshop on the implications of HERA for LHC physics, CERN, Switzerland. May 2008. <i>A duality relation between one-loop and phase-space integrals</i>
P. Ball	3	9th DESY Workshop on Elementary Particle Theory: Loops and Legs in Quantum Field Theory, Sonderhausen, Germany. April 2008. <i>From multileg loops from trees (bypassing Feynman's Tree Theorem)</i> Institute of Physics Meeting on $B$ Physics, Lancaster, UK. 12 November 2008. <i><math>B \rightarrow K^* \mu\mu</math> in the SM and beyond</i> Ringberg Workshop on New Physics, Flavors and Jets, Ringberg, Germany. April-May 2009 <i>Form Factors and Exclusive Decays</i>
F. Close	3	Beauty 2009, 12th International Conference on B Physics at Hadron Machines, Heidelberg, Germany. September 2009. <i><math>B_S</math> mixing and CP violation</i> Workshop on Meson Spectroscopy, Munich, Germany, October 2008. <i>Hybrid Charmonium: Four Questions and an answer</i> Topical Conference on Lattice QCD and the Jefferson Lab Program, Jefferson Lab, USA. November 2008. <i>Strong QCD: Theory to Reality via Lattice and Jefferson Lab</i>
Michael Pennington	3	Workshop on Meson Spectroscopy, Munich, Germany, October 2008. <i>Unitarity constraints on Dalitz analyses</i> EFT09: International Workshop on Effective Field Theories: from the Pion to the Upsilon, Valencia, Spain. February 2009. <i>Strong Coupling QCD in the Continuum</i> KLOE2 Physics Workshop, Frascati, Italy. April 2009. <i>Hadronic structure from two photon collisions</i>
Wolfgang Altmannshofer	4	Europhysics Conference on High Energy Physics 2009, Krakow, Poland, 16-22 July 2009. <i>Probing the MSSM Flavor Structure with Low Energy CP Violation</i> SUSY 09, Boston MA, USA, 5-10 June, 2009. <i>Identifying the Flavor Structure of SUSY Theories Through Low Energy CP Violating Observables</i> Ringberg Workshop on New Physics, Flavors and Jets, Rottach-Egern, April 27 - May 1, 2009. <i>Phenomenology of CP Violation in the MSSM</i> DPG Frühjahrstagung, Munich, Germany, 9-13 March 2009. <i>Phenomenology of CP Violation in a Flavor Blind MSSM</i>

Andreas Crivellin	4	Fifth Workshop on Particle Physics and Cosmology, Warsaw, Poland, 4-7 February, 2009. <i>CP Violating Observables in a Flavor Blind MSSM</i> 44th Rencontres de Moriond, Electroweak Interactions and Unified Theories, La Thuile, Italy, 7-14 Mar 2009. <i>CKM elements from Squark Gluino Loops</i> SUSY09, Boston MA, USA, 5-10 June 2009. <i>Probing Yukawa Unification with K and B Mixing</i>
Joachim Brod	4	DPG Frühjahrstagung, Munich, Germany, 9-13 March 2009. <i>CP violation in the neutral Kaon system</i>
Björn Duling	4	Low Energy Constraints on Extensions of the Standard Model Kazimierz, Poland. July 2009. <i>Predictions for Flavor Observables in a RS Model with Custodial Symmetry</i>
Thorsten Feldmann	4	Progress and Challenges in Flavour Physics, 29 Sep - 3 Oct 2009, Primösten, Croatia. <i>Sequential Flavour Symmetry Breaking</i> Low Energy Constraints on Extensions of the Standard Model, Kazimierz, Poland, July 2009. <i>Neutrinos and Lepton Flavour Violation</i> Ringberg Workshop on New Physics, Flavors and Jets, Rottach-Egern, Germany, April 2009. <i>Minimal Flavour Violation</i>
Jennifer Girrbach	4	Progress and Challenges in Flavour Physics, Primösten, Croatia, 29 Sep - 3 Oct 2009. <i>Lepton Flavour Violation in the MSSM at large <math>\tan \beta</math></i>
Andrè Hoang	4	Top Quark Theory Institute, XXIII Rencontres de Physique, La Thuile, March 2009. <i>What top mass is measured at hadron colliders?</i> International Workshop on Effective Theories: From the Pion to the Upsilon, Valencia, February 2009. <i>Non-relativistic QCD: A Review</i> Top quark theory institute, CERN, Switzerland, June 2009. <i>What top mass is measured at hadron colliders?</i> Progress and Challenges in Flavor Physics, Primösten, Kroatia, October 2009. <i>R-Evolution and the operator product expansion</i>
Lars Hofer	4	2009 Europhysics Conference on High Energy Physics, Krakow, Poland, 16-22 July 2009. <i>The MSSM with large <math>\tan \beta</math> beyond the decoupling limit</i>
Lars Hofer	4	Flavianet Workshop on Low energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009. <i>The MSSM with large <math>\tan(\beta)</math> beyond the decoupling limit</i>

Artyom Hovhannisyan	4	Flavianet Workshop on Low energy constraints on extensions of the Standard Model, Kazimierz, Poland, 23-27 July 2009.	ER
Alexander Khodjamirian	4	<p>Approaches to Quantum Chromodynamics, Oberwölz, Austria, September 2008. <i>QCD Sum Rules: from Quark Masses to Hadronic Form Factors</i></p> <p>SuperB workshop, Orsay, France, February 2009. <i>Comments on hadronic form factors in exclusive B and D decays</i></p> <p>Ringberg Workshop on New Physics, Flavors and Jets, Rottach-Egern, April 27 - May 1, 2009. <i>QCD Sum Rule Predictions for Leptonic and Semileptonic B and D Decays</i></p> <p>Shifmania, Crossing the boundaries: Gauge dynamics at strong coupling”, May 2009, Minneapolis, USA <i>Hadronic Form Factors: Combining QCD Calculations with Analyticity</i></p> <p>Flavianet Workshop “Low energy constraints on extensions of the Standard Model”, Kazimierz, Poland, July 2009 <i>Hadronic Form Factors and <math>V_{CKM}</math> determination</i></p> <p>BEAUTY 2009, Heidelberg, September 2009 <i>Nonperturbative QCD Methods for Flavour Physics: Status and Prospects</i></p> <p>Progress and Challenges in Flavour Physics, Primösten, Croatia, 29 Sep -3 Oct 2009. <i>Hadronic form factors for flavour physics</i></p>	
Johann Kühn	4	<p>4th Meeting of the Radio MonteCarlow-Group, Beijing, China, October 2008. <i>Two-loop hadronic corrections to Bhabha scattering</i></p> <p>ibid. <i>Inclusive and Exclusive Cross Sections at Low Energy <math>e^+e^-</math> Colliders</i></p> <p>MAMI and Beyond Mainz, March 2009. <i>ibid</i></p> <p>Ringberg Workshop on New Physics, Flavors and Jets, Rottach-Egern, April 27 - May 1, 2009. <i>Charm and Bottom Quark Masses and Multi-Loop Results</i></p> <p>FLAVIANet Topical Workshop, Kazimierz, Poland, July 2009. <i>Charm and Bottom Quark Masses: An Update</i></p>	
Thomas Kuhr	4	<p>DIS, Madrid, Spain, 26-30 April 2009. <i>Search for New Physics in the <math>B_s</math> Sector at the Tevatron</i></p> <p>DIS, Madrid, Spain, 26-30 April 2009. <i>New Charmonium-like States at B Factories</i></p> <p>Hints for New Physics in Flavor Decays, KEK, 20 March 2009. <i>Hints for New Physics in <math>B_s</math> Mixing?</i></p>	

Thomas Mannel	4	<p>Quarkonium Workshop, Nara, Japan, 2-5 December 2008. <i>Quarkonium Spectroscopy and Decay Results from CDF</i></p> <p>PANDA Meeting, GSI, Darmstadt December 2008 <i>Charm Physics at PANDA</i></p> <p>International Conference on Flavour Physics and CP Violation (FPCP09), Lake Placid (NY), May 2009. <i>The Golden Modes <math>B_d \rightarrow J/\psi K_s</math> and <math>B_s \rightarrow J/\psi \phi</math></i></p> <p>Workshop on New Physics with SuperB, Warwick (UK), April 2009. <i>The Golden Mode <math>B_d \rightarrow J/\psi K_s</math></i></p> <p>Progress and Challenges in Flavour Physics, 29 Sep - 3 Oct. 2009, Primosten, Croatia. <i>The Theory Status of Semileptonic <math>B \rightarrow X_c \ell \bar{\nu}_\ell</math></i></p>	ESR
Vicent Mateu	4	<p>International Workshop on Effective Theories: From the Pion to the Upsilon, Valencia, February 2009. <i>A Global Fit for Thrust at NNLL: Precision Determination of <math>\alpha_s(M_z)</math></i></p>	ESR
Ulrich Nierste	4	<p>BELLE analysis meeting, Tsukuba, Japan, Sep 2008. <i>Hunting supersymmetric Higgses with B decays and <math>\Upsilon(5S)</math> possibilities: Theory</i></p> <p>Potential and Prospects for Super Flavor Factories, MPI Munich, Germany, October 2008. <i>FCNC Processes and Rare Decays</i></p> <p>LHCb workshop Neckarzimmern, Germany, Februar 2009. <i>New physics in <math>b \rightarrow s</math> transitions?</i></p> <p>CERN flavour workshop, Meyrin, Switzerland, March 2009. <i>Trilinear SUSY-breaking terms as the origin of flavour?</i></p> <p>Ringberg Workshop on New Physics, Flavors and Jets, Rottach-Egern, April 27 - May 1, 2009. <i>The MSSM with large <math>\tan \beta</math> beyond the decoupling limit</i></p> <p>Progress and Challenges in Flavor Physics, Primosten, Croatia, October 2009. <i>Flavour physics: MFV and what else?</i></p>	ESR
Dominik Scherer	4	<p>DPG Frühjahrstagung, Munich, Germany, 9-13 March 2009. <i>Flavour-blind MSSM at large <math>\tan \beta</math></i></p>	ESR
Matthias Steinhauser	4	<p>LHCD-Workshop, Aachen, Germany, November 2008. <i>Top-quark pair production near threshold at LHC</i></p> <p>Flavianet workshop, Kazimierz, Poland, July 2009. <i>Three-loop fermion and gluon form factors</i></p>	ESR
Stefan Recksiegel	4	<p>KEK Super B meeting, Tsukuba, Japan, 7-13 Dec 2008, <i><math>B_{(c)} \rightarrow \tau \nu</math>: Complementarity at SuperB, LHC and LC (+ issues in <math>B \rightarrow \pi K</math>)</i></p>	ESR



		Low Energy Constraints on Extensions of the Standard Model, Kazimierz, Poland, Jul 2009: <i>Flavour Physics in the Littlest Higgs Model with T-Parity: Effects in the K, B<sub>d/s</sub> and D systems</i>	
		Corfu Summer Institute, Corfu, Greece, September 2009: <i>Flavour Physics in the Littlest Higgs Model with T-Parity: Effects in the K, B<sub>d/s</sub> and D systems</i>	
David Straub	4	Workshop Primosten 09, Primosten, Croatia. October 2009. The SUSY CP Problem and the MFV Principle SUSY 09, Boston, USA. June 2009. The SUSY CP Problem and the Principle of Minimal Flavour Violation	
		Workshop on New Physics with SuperB, Warwick, UK. April 2009. <i>Probing New Physics in b → sV transitions at SuperB</i>	
Susanne Westhoff	4	DPG Frühjahrstagung, Munich, Germany, 9-13 March 2009. <i>Probing Yukawa Unification in Supersymmetric GUTs with Kaon Mixing</i> SUSY09, Boston MA, USA, 5-10 June 2009. <i>Probing Yukawa Unification with K and B Mixing</i>	
Pablo Roig Garces	5	Int. Workshop on Effective Field Theories, Valencia, Spain, Feb 2009, <i>Hadronization in three meson channels at tau decays and e<sup>+</sup>e<sup>-</sup> cross-section</i>	ESR
		DPG 2009, Munich, Mar 2009, <i>A framework improving the hadronization of QCD currents</i>	ESR
Jernej Fesl Kamenik	5	Charm 2009, Leimen, Germany, May 2009, <i>Theory of semileptonic decays</i>	ER
		Europhysics Conference on High Energy Physics, Krakow, Poland, Jul 2009, <i>Signatures of Heavy Vectors in Higgsless models</i>	ER
		Low energy constraints on extensions of the Standard Model (Flavianet Topical Workshop), Kazimierz, Poland, Jul 2009 <i>Lepton Flavour Violation in Minimal See-saw Models</i>	ER
Enrico Nardi	5	Int. Workshop Low Energy Precision EW Physics in the LHC Era, Seattle, USA, Oct 2008, <i>Flavour effects in Leptogenesis</i>	
Matthew Moulson	5	New Opportunities in Kaon Physics, Birmingham, UK, Nov 2008, <i>V<sub>us</sub> from kaon decays</i>	
Giancarlo D'Ambrosio	5	Int. Workshop on Effective Field Theories, Valencia, Spain, Feb 2009, <i>Status of Weak ChPT</i>	
Gino Isidori	5	Int. Workshop on Effective Field Theories, Valencia, Spain, Feb 2009, <i>EFT in Flavour Physics</i>	

		6 <sup>th</sup> International Workshop on Chiral Dynamics, Berna, Switzerland, Jul 2009, <i>Effective theories of electroweak symmetry breaking</i>	
		GDR Terascale, Grenoble, France, Mar 2009, <i>Flavour Physics</i>	
		Weak Interactions and Neutrinos, Perugia, Italy, Sep 2009, <i>Status of CKM and CP violation</i>	
Vittorio Del Duca	5	Amplitudes 09, Durham, UK, Apr 2009, <i>SUSY Amplitudes in the high-energy limit</i>	
Oscar Catà	5	Int. Workshop on Effective Field Theories, Valencia, Spain, Feb 2009, <i>Chiral corrections to vector meson decay constants</i>	
Sergio Giudici	5	6 <sup>th</sup> International Workshop on Chiral Dynamics, Berna, Switzerland, Jul 2009, <i><math>\pi\pi</math> scattering from <math>K</math> decays</i>	
Antonio Vairo	5	Charm 2009, Leimen, Germany, May 2009, <i>Hidden Charm: Theoretical Overview</i>	
Mario Antonelli	5	FPCP 2009, Lake Placid, USA, May 2009, <i><math>V_{us}</math> and <math>V_{ud}</math> from <math>K</math> and <math>\pi</math> decays</i>	
Henryk Czyż	6	FLAVIANET TOPICAL WORKSHOP: Low energy constraints on extensions of the Standard Model, 23-27 July 2009 Kazimierz (Poland). <i>Radiative return: progress and prospects</i>	
		XXXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions, Ustroń, Poland September 11-16, 2009. <i>Strong and electromagnetic <math>J/\psi</math> and <math>\psi(2S)</math> decays into pion and kaon pairs and the implementation in PHOKHARA</i>	
Sergiy Ivashyn	6	International Workshop on Effective Field Theories: from the Pion to the Upsilon, 2-6 February 2009, Valencia, Spain. <i>On modeling the scalar meson dynamics with RChT</i>	ESR
		FLAVIANET TOPICAL WORKSHOP: Low energy constraints on extensions of the Standard Model, 23-27 July 2009 Kazimierz (Poland). <i>Testing models for final state photon emission in <math>\pi^+\pi^-</math> production at <math>e^+e^-</math> colliders</i>	ESR
		XXXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions, Ustroń, Poland September 11-16, 2009. <i>Radiative return: a progress on FSR tests</i>	ESR

Karol Kołodziej	6	XXXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions, Ustroń, Poland September 11-16, 2009. <i>e+e- → t anti-t H: signal vs backgrounds</i>
Maria Krawczyk	6	FLAVIANET TOPICAL WORKSHOP: Low energy constraints on extensions of the Standard Model, 23-27 July 2009 Kazimierz (Poland). <i>Loop effects in 2HDM</i> XXXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions, Ustroń, Poland September 11-16, 2009. <i>Evolution of the Universe to the present Inert phase</i>
Mikołaj Misiak	6	Ringberg Workshop on New Physics, Flavors and Jets, Ringberg Castle, Rottach-Egern ( Germany) 27.04-1.05 2009. <i>Evolution of the Universe to the present Inert phase</i> XXXIII International Conference of Theoretical Physics MATTER TO THE DEEPEST: Recent Developments in Physics of Fundamental Interactions, Ustroń, Poland September 11-16, 2009. <i>Radiative B Decays - current status</i>
Sławomir Wycech	6	Workshop: Critical stability 13-17 October 2008, Ettore Majorana Centre for Scientific Culture (Italy) <i>Variational calculations of K-few-nucleon states</i> INTERNATIONAL BOGOLYUBOV CONFERENCE: PROBLEMS OF THEORETICAL AND MATHEMATICAL PHYSICS August 21-27, 2009, Moscow-Dubna, Russia <i>Nuclear states of anti- K mesons</i>
Johan Bijnens	7	Bound States and Resonances in Effective Field Theories, ECT*,Trento, Italy, 28/9-4/10/2008. <i>Chiral Mesons at Two Loops: Recent Progress</i> Bound States and Resonances in Effective Field Theories, ECT*,Trento, Italy, 28/9-4/10/2008. <i>Highlights of the Meson Session</i> EFT09: International workshop on effective field theories, Valencia, Spain, 2-6/2/2009. <i>Status of Strong ChPT</i> European Nuclear Physics Conference 2009 (EUNPC09), Bochum, Germany, 16-20/3/2009. <i>Chiral Perturbation Theory and Mesons</i> Sixth International Workshop on Chiral Dynamics, Berne 6-10 July, 2009. <i>Chiral Perturbation Theory in the Meson Sector</i>

Ilaria Jemos	7	EFT09: International workshop on effective field theories, Valencia, Spain, 2-6/2/2009. <i>Determination of Low Energy Constants and testing Chiral Perturbation Theory at Next to Next to Leading Order</i>	ESR
		Sixth International Workshop on Chiral Dynamics, Berne 6-10 July, 2009. <i>Relations at Order <math>p^6</math> in Chiral Perturbation Theory</i>	ESR
Mikko Sainio	7	Workshop "Polarization Observables and Partial Wave Analysis", March 1-4, 2009, Bad Honnef, Germany. <i>Hoehler and Cutkosky parametrization/solution</i> 5th International Pion-Nucleon PWA Workshop and Interpretation of Baryon Resonances, 1-5 June 2009, ECT*, Trento, Italy. <i>Analytic Properties of Karlsruhe-Helsinki Type PWA</i> Sixth International Workshop on Chiral Dynamics, Berne 6-10 July, 2009. <i>Analyticity constrained pion-nucleon analysis</i>	
Jan Eeg	7	Progress and Challenges in Flavour Physics, Primosten Croatia 29 Sept - 3 Oct, 2009. <i>Lambshift-like Dipole Contributions for <math>K \rightarrow 2\pi</math> decays</i>	
T.N. Pham	8	Oberwolz workshop, Oberwolz, Austria. September 2008. <i><math>B \rightarrow K\eta, K\eta'</math> decays</i> Eighth Particle Physics Phenomenology Workshop, Tainan, Taiwan. May 2009. <i><math>B \rightarrow K\eta, K\eta'</math> decays on QCD factorisation</i>	
B. Blossier	8	SuperB VIII workshop, Orsay, France. February 2009. <i>Exclusive <math>B \rightarrow D</math> decays</i> Int. Europhysics Conf. on High-Energy Physics 2009 European Physics Society, Cracow, Poland. July 2009. <i><math>g_{B^*B\pi}</math> coupling in the static heavy quark limit</i>	
L. Oliver		School and Workshops on the Standard Model and Beyond - Standard Cosmology, Corfu, Greece. September 2009. <i>Heavy Quark limit of QCD, Isgur-Wise functions and the Lorentz group</i>	
B. Haas	8	SuperB VIII workshop, Orsay, France. February 2009. <i>Leptonic B and D decays</i> Moriond QCD and High Energy Interactions, La Thuile, Italy. March 2008. <i>Charmed meson decays at Lattice QCD</i>	
D. Becirevic	8	SuperB VIII workshop, Orsay, France. February 2009. <i>Soft photon issues of leptonic B decays</i>	

E. de Rafael	8	International Workshop on Effective Field Theories: from the Pion to the Upsilon (EFT 09), Valencia, Spain. February 2009. <i>Status of the muon anomalous magnetic moment</i>	
L. Lellouch	8	Euroflavour 08, Durham, UK. September 2008. <i>The light hadron spectrum in QCD</i> 15th International Symposium on Particles Strings and Cosmology (PAS-COS 2009), Hamburg, Germany. July 2009. <i>News from the lattice</i> Scientific Challenges for Understanding the Quantum Universe and the Role of Computing at Extreme Scale, Stanford, CA, USA. December 2008. <i>Kaon physics in the era of exascale computing</i>	
K. Kampf	8	International Workshop on Effective Field Theories: from the Pion to the Upsilon (EFT 09), Valencia, Spain. February 2009. <i>Chiral expansion for <math>\pi^0</math> decays</i>	
J. Trnka	8	International Workshop on Effective Field Theories: from the Pion to the Upsilon (EFT 09), Valencia, Spain. February 2009. <i>Note on renormalization of the spin-1 resonance propagator at one loop order</i>	
A. Ramos	8	XXVII International Symposium on Lattice Field Theory (Lattice 2009), Beijing. July 2009. <i><math>F_K/F_\pi</math> in <math>N_f = 2 + 1</math> QCD and a determination of <math> V_{us} </math></i>	ER
E. Kou	8	FPCP 2009, Lake Placid, USA. May 2009. <i>Charmless <math>B_c</math> decays</i>	
B. Moussallam	8	Strong Frontier 2009, Bangalore, India. January 2009. <i>Aspects of the <math>m_s</math> chiral expansion and <math>\pi K</math> sum rule</i>	
N. Offen	8	International Workshop on Effective Field Theories: from the Pion to the Upsilon (EFT 09), Valencia, Spain. February 2009. <i>Renormalization of B-meson distribution amplitudes</i>	ESR
S. Descotes-Genon	8	Int. Europhysics Conf. on High-Energy Physics 2009 European Physics Society, Cracow, Poland. July 2009. <i>Renormalisation of B-meson distribution amplitudes and Non-leptonic charmless <math>B_c</math> decays</i>	

		CIPANP 2009: Tenth Conference on the Intersections of Particle and Nuclear Physics, San Diego, USA. <i>CKMfitter : putting flavour physics altogether</i>	
Simone Bifani	9	XVII International Conference on Supersymmetry and the Unification of Fundamental Interactions (SUSY09) - Boston (United States), 5th-10th June 2009, <i>Standard Model tests at the NA62 CERN experiment</i>	ESR
	9	New Opportunities in the Physics Landscape at CERN - Geneva (Switzerland), 10th - 13th May 2009	ESR
Gilberto Colangelo	9	Euroflavour08, Annual Workshop of the European Flavour Physics Network FLAVIANet, IPPP, Durham, UK, September 21-28, 2008, <i>Pion observables in lattice QCD and activities of the FLAG</i>	
	9	International Conference on Particles And Nuclei (PANIC08), 9-14 November, Eilat, Israel <i>QCD at low energy: mesonic sector</i>	
	9	International Workshop on Frontier Problems in Strong Interactions Physics, Bangalore India, January 12-18, 2009, <i><math>\pi\pi</math> scattering from low to high energy</i>	
	9	4th International Symposium on Symmetries in Subatomic Physics, Taipei, Taiwan, June 2-5, 2009, <i>Recent progress in low energy hadronic physics</i>	
	9	Kaon International Conference (KAON'09), Tsukuba, Japan, June 9-12 2009, <i>The FLAG working group activities and Precise SM tests</i>	
Jürg Gasser	9	International Workshop on Frontier Problems in Strong Interactions Physics, Bangalore India, January 12-18, 2009, <i>Hadron physics at threshold</i>	
Leonardo Giusti	9	XXVII International Symposium on Lattice Field Theory (Lattice 2009) - July 25-31 2009, Beijing, China. <i>Symmetries and exponential error reduction in YM theories on the lattice: theoretical setup</i> QCD Green's Functions, Confinement and Phenomenology: Workshop organized at ECT* Trento, Italy (Invited talk) <i>Chiral symmetry breaking and the Banks-Casher relation</i>	
Tobias Hurth	9	Open Research Meeting, KEK, Japan, 10-12 October 2008, <i>Interplay of High-<math>p_T</math> and Flavour Physics</i>	
	9	SuperB plenary meeting, LAL, Orsay, France, 15-18 February 2009, <i>On the physics case of a Super Flavour Factory in the TDR phase</i>	

	9	SuperB physics meeting, Warwick, England, 14-17 April 2009, <i>Superb Opportunities in Inclusive and Exclusive <math>b \rightarrow s\gamma</math> Modes and Summary of the working group II</i>	
	9	International Europhysics Conference HEP 2009, Cracow, Poland, 15-22 July 2009, <i>New Physics Sensitivity of <math>\bar{B} \rightarrow \bar{K}^*\ell^+\ell^-</math> and Flavour-violating Squark and Gluino Decays</i>	
	9	9th Hellenic Workshop on Elementary Particle Physics, Corfu, Greece, 30 August-6 September 2009, <i>Role of Flavour Physics in the LHC Era and New Physics Reach of <math>\bar{B} \rightarrow \bar{K}^*\ell^+\ell^-</math></i>	
Martin Lüscher	9	École de Physique, Session XCIII: Modern perspectives in lattice QCD, Les Houches, France. August 2009. <i>Computational strategies in lattice QCD</i>	
Emilie Passemar	9	5 <sup>th</sup> International Workshop on the CKM Unitarity Triangle, University of La Sapienza, Roma, Italy, September 9-13, 2008. <i>Dispersive approaches for <math>K_{l3}</math> form factors</i>	ESR
	9	Euroflavour08, Annual Workshop of the European Flavour Physics Network FLAVIANet, IPPP, Durham, UK, September 21-28, 2008. <i>Robustness of the dispersive representation of the <math>K_{\ell 3}</math> form factors and analysis of <math>KTeV</math> data</i>	ESR
	9	French Particle Physics Meeting, Ecole Polytechnique, Palaiseau, France, March 23-25, 2009. <i>Dispersive representation of the <math>K_{\ell 3}</math> form factors and applications</i>	ESR
	9	Kaon International Conference (KAON'09), Tsukuba, Japan, June 9-12 2009. <i>Precision SM calculations and theoretical interests beyond the SM in <math>K_{\ell 2}</math> and <math>K_{\ell 3}</math> decays</i>	ESR
Volker Pilipp	9	“DPG Frühjahrstagung” in Munich, Germany. March 2009. <i><math>b \rightarrow s\ell^+\ell^-</math> in the high <math>q^2</math> region at two-loops</i>	
	9	“Ringberg Workshop on New Physics, Flavors and Jets, Ringberg 2009” at Ringberg castle in Rottach-Egern, Germany. April 2009. <i><math>b \rightarrow s\ell^+\ell^-</math> in the high <math>q^2</math> region at two-loops</i>	
	9	“Lepton Photon 2009” in Hamburg, Germany. August 2009. <i>Poster on: <math>b \rightarrow s\ell^+\ell^-</math> in the high <math>q^2</math> region at two-loops</i>	
Urs Wenger	9	International Workshop on Frontier Problems in Strong Interactions Physics, Bangalore India, January 12-18, 2009, <i>The phase diagram of QCD at finite isospin density</i>	

	9	XXVII International Symposium on Lattice Field Theory (Lattice 2009) - July 25-31 2009, Beijing, China. <i>Simulating Wilson fermions without critical slowing down</i>	
Jackson Wu	9	Europhysics Conference on High Energy Physics, 16-22 July 2009, Krakow, Poland, <i>Non-Supersymmetric New Physics from Møller Scattering</i>	
Gerhard Ecker	10	International Workshop on Effective Field Theories: from the pion to the upsilon, Valencia, Spain, February 2009 22nd Workshop on Weak Interactions and Neutrinos WIN'09, Perugia, Italy, September 2009, <i>Chiral perturbation theory</i>	
Svjetlana Fajfer	10	FLAVIANet Workshop: Low energy constraints on extensions of the standard model, Kazimierz, Poland, July 2009, <i>Search for new physics in charm processes</i> Workshop: Progress and Challenges in Flavour Physics, Primosten, Croatia, September 2009, <i>Signature of new physics in <math>t \rightarrow c\ell^+\ell^-</math> decays</i>	
Nejc Kosnik	10	5th Vienna Central European Seminar on Particle Physics and Quantum Field Theory: Highlights in Computational Quantum Field Theory, Vienna, Austria, November 2008 FLAVIANet Workshop: Low energy constraints on extensions of the standard model, Kazimierz, Poland, July 2009, <i>Soft photon emission in semileptonic <math>B \rightarrow D</math> decays</i> Workshop: Progress and Challenges in Flavour Physics, Primosten, Croatia, September 2009, <i>Soft photons in <math>B \rightarrow D\ell\nu</math></i>	
Helmut Neufeld	10	International Workshop on Effective Field Theories: from the pion to the upsilon, Valencia, Spain, February 2009, <i>Electromagnetic effects in <math>K_{\ell 3}</math> decays</i> Workshop on Chiral Dynamics 2009, Bern, Switzerland, July 2009, <i>Some aspects of isospin breaking in kaon decays</i>	
Sasa Prelovsek	10	Conference: Lattice 2009, Beijing, China, July 2009, <i>Spectroscopy of light tetraquark states</i> Lepton-Photon Conference 2009, Hamburg, China, August 2009, <i>Searching for tetraquarks on the lattice</i>	
Martin Zdrahal	10	International Workshop on Effective Field Theories: from the pion to the upsilon, Valencia, Spain, February 2009, <i>Dispersive construction of two-loop <math>P \rightarrow 3\pi</math> (<math>P = K, \pi</math>) amplitudes</i>	ESR



		47. Internationale Universitätswochen für Theoretische Physik, Schladming, Austria, February 2009	ESR
		Workshop on Chiral Dynamics 2009, Bern, Switzerland, July 2009	ESR
Jure Zupan	10	Super B Physics Workshop, Warwick, UK, April 2009, <i>General minimal flavour violation</i> , and <i>Why measure precisely (and how)?</i>	
Karl Jansen	11	ILDG Workshop, video conference, december 2008. <i>Status report of German Lattice Grid activities</i> Extreme Computing workshop: Nuclear Physics Workshop, Washington, USA, January 2009. <i>Finite temperature physics from twisted mass fermions</i> ILDG workshop, Machines, algorithms and ILDG, Tsukuba, Japan, March 2009. <i>Using the ILDG with ETMC</i> QCD bound states: methods and properties, Argonne National Lab, Argonne, USA, June 2009. <i>Recent results from maximally twisted mass fermions</i>	
Gernot Münster	11	INTERNATIONAL BOGOLYUBOV CONFERENCE, PROBLEMS OF THEORETICAL AND MATHEMATICAL PHYSICS, Moscow and Dubna, Russia, August 2009. <i>Lattice QCD results at light quark masses</i> XXVII International Symposium on Lattice Field Theory (Lattice 2009), 25 - 31 Jul 2009, Beijing, China, <i>Numerical simulations of supersymmetric Yang-Mills theory</i> ICREA Workshop on Quantum Gauge Theories and Ultracold Atoms, Sep 2009, Sant Benet, Spain, <i>QCD on the lattice</i>	
Rainer Sommer	11	Extreme Computing workshop: Particle Physics Workshop, Stanford, USA, December 2008. <i>Heavy quarks with Eflow computers</i> Extreme Computing workshop: Particle Physics Workshop, Stanford, USA, December 2008. <i>Quark mass reweighting</i> Les rencontres de Moriond, Electroweak session, La Thuile, Italy, March 2009. <i>New perspectives for heavy flavour physics from the lattice</i>	
Michele Della Morte	11	MAMI and beyond, March/April 2009, Mainz. The XXVII International Symposium on Lattice Field Theory, Peking, China, July 2009. <i>Symmetries and exponential error reduction in YM theories on the lattice: simulation results</i>	

Ulli Wolff	11	Irish Quantum Field Theory meeting 2009, Trinity College, Dublin, May 2009. <i>Sampling strong coupling graphs instead of field configurations</i>	
Andreas Jüttner	11	Johannes-Gutenberg-Universität at CeBIT, Hannover, Germany, March 2009. <i>Representation of Mainz WILSON cluster at CeBIT 2009</i> FLAG (FLAVIA Net Lattice Averaging Group meeting), Bern, Switzerland, April 2009. <i>Discussion of FLAG lattice averaging efforts</i> Chiral Dynamics Workshop 2009, Bern, Switzerland, June 2009. <i>Talk: Pion form factor from UKQCD and RBC</i> Lattice 2009 International Conference, Beijing, China, July 2009. <i>Talk: New ideas for <math>g - 2</math> on the lattice</i>	
Michael Donnellan	11	11th Meeting of the SFB/TR 9, RWTH Aachen, Aachen, October 2008	ESR
		Lattice Practices 2008, DESY Zeuthen, Zeuthen, October 2008	ESR
		12th Meeting of the SFB/TR 9, DESY Zeuthen, Zeuthen, March 2009	ESR
		Introduction to Jugene and Juropa Forschungszentrum Jülich, Jülich, August 2009	ESR
		4th VI-HPS Tuning Workshop, Universität Bremen, Bremen, September 2009	ESR
Francesco Virota	11	Lattice Practices 2008, DESY Zeuthen, Zeuthen, October 2008.	ESR
		12th Meeting of the SFB/TR 9, DESY Zeuthen, Zeuthen, March 2009.	ESR
		Modern perspectives in lattice QCD: Quantum field theory and high performance computing, École de physique des Houches, Les Houches, France, August 2009.	ESR
Ulf-G. Meißner	11	invited lectures, XXI Heidelberg Physics Graduate Days of the Graduate School of Fundamental Physics, University of Heidelberg, Germany (October 2008). <i>An introduction to chiral perturbation theory</i>	
Hermann Krebs	11	LATTICE 2008, Williamsburg, USA (July 2008), H. Krebs, B. Borasoy, E. Epelbaum, D. Lee and U.-G. Meißner, PoS(LATTICE 2008)023, (October 2008). <i>Nuclear effective field theory on the lattice</i>	
Ulf-G. Meißner	11	invited talk, CANU & FFE Workshop 2008, Bad Honnef, Germany (December 2008). <i>Isospin violation: from COSY to FAIR</i>	

Akaki Rusetsky	11	<p>invited talk, International Workshop on Effective Field Theories (EFT09), Valencia, Spain (February 2009). <i>EFT for nuclear physics</i></p> <p>invited talk, International Workshop “MAMi and beyond”, Schloß Waldthausen, Germany (March/April 2009). <i>Hadron Physics at the 1 GeV scale and its impact</i></p> <p>invited lectures, 1<sup>st</sup> Lecture-Week of the SFB/TR-16 “Subnuclear structure of matter”, Bonn, Germany (August 2009). <i>Theory of nuclear forces</i></p> <p>invited talk, Workshop on Hadron Structure and Dynamics, Bad Honnef, Germany (August 2009). <i>Resonances in a finite volume</i></p> <p>invited talk, PANDA workshop, Forschungszentrum Jülich, Germany (September 2009). <i>Baryon-baryon interactions from effective field theory</i></p> <p>invited lectures, Guangxi Normal University, Guilin, China (September 2009). <i>Theory of nuclear forces</i></p> <p>plenary talk, Vth International Conference on Quarks and Nuclear Physics, (QNP 09), Beijing, China (September 2009). <i>Isospin violation, light quark masses and all that</i></p> <p>invited talk, Colloquium in memory of Jan Stern, Instiut Henri Poincaré, Paris, France (October 2009). <i>Excited hadrons in a box</i></p> <p>invited talk, First Bethe Center Workshop, Bad Honnef, Germany (October 2009). <i>Hadrons in a box</i></p> <p>plenary talk, Sixth International workshop on Chiral Dynamics, Bern, Switzerland (July 2009). <i>Isospin symmetry breaking</i></p> <p>Sixth International workshop on Chiral Dynamics, Bern, Switzerland (July 2009). <i>Hadronic atoms</i></p> <p>invited talk, International Workshop “MAMi and beyond”, Schloß Waldthausen, Germany (March/April 2009). <i>Resonance properties from finite volume energy spectrum</i></p> <p>invited talk, International Workshop “Bound States and Resonances in Effective Field Theories,” Trento, Italy (Sept/Oct 2008). <i>Theory of Hadronic Atoms</i></p> <p>International Workshop “Bound States and Resonances in Effective Field Theories,” Trento, Italy (Sept/Oct 2008). <i>Finite-volume effect in the spectrum of the Delta-resonance</i></p> <p>invited talk, EXA08, Vienna, Austria (Sept. 2008). <i>Antikaon-nucleon scattering lengths</i></p>
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Bastian Kubis	11	<p>Lectures at the Hadron Physics Summer School, 11-15 August 2008, Bad Honnef, Germany, <i>From QCD to Hadron Physics</i></p> <p>Invited talk at the WASA collaboration meeting, 9 June 2009, Jülich, Germany, <i>The cusp effect in <math>\eta' \rightarrow \eta\pi\pi</math> decays</i></p> <p>Invited talk at the Symposium on the occasion of Walter Glöckle's 70th birthday "Frontiers in Nuclear Physics", 18-20 June 2009, Bad Honnef, Germany, <i>Cusps in <math>K \rightarrow 3\pi</math> decays</i></p> <p>Invited talk at the 4<sup>th</sup> International Workshop 'From Parity Violation to Hadronic Structure and more' (PaVi09), 22-26 June 2009, Bar Harbor, Maine, USA, <i>Charge Symmetry Violation</i></p> <p>Invited talk at the 26<sup>th</sup> Students' Workshop on Electromagnetic Interactions, 30 August-4 September 2009, Bosen (Saar), Germany, <i>Meson chiral perturbation theory</i></p> <p>Invited talk at the 19<sup>th</sup> Int. Conference on Few-Body Problems in Physics, 31 August-5 September 2009, Bonn, Germany, <i>Cusp effects in meson decays</i></p>
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### 3.3 General Networking

During the reporting period the FLAVIANet nodes have pursued an active scientific exchange. Here we list the visits focusing on research; visits devoted to training are listed in the Training Report.

Name	from Node no.	to Node no.	dates
Germán Rodrigo	1	3 (IPPP, Durham)	21 Sep - 13 Oct 2008
Germán Rodrigo	1	5 (LNF, Frascati)	5 - 8 Apr 2009
Germán Rodrigo	1	4 (TU, Munich)	9 - 11 Jul 2009
Antonio Pich	1	9 (CERN)	21 - 22 Oct 2008
Antonio Pich	1	4 (TTP Karlsruhe)	10 - 13 Sep 2009
Joaquim Prades	2	7 (Lund)	15 Oct - 16 Nov 2008
Aoife Bharucha	3	4 (TUM)	1 Feb - 31 Mar 2009
Vicent Mateu	4	1 (Valencia)	13-17 Oct 2008
Vicent Mateu	4	9 (Bern)	22 - 26 Sep 2008
Vicent Mateu	4	1 (Valencia)	2 - 6 Feb 2009
Alexander Khodjamirian	4	8 (Orsay)	14 -18 Feb 2009
Ulrich Nierste	4	11 (Berlin)	4 - 5 May 2009
Susanne Westhoff	4	11 (Mainz)	28 - 29 May 2009
Pablo Roig Garces	5	4 (Munich)	17 Jan - 5 Apr 2009
Pablo Roig Garces	5	4 (Munich)	10 Apr - 10 May 2009
Pablo Roig Garces	5	4 (Munich)	20 May - 30 Sep 2009

Jernej Fesl Kamenik	5	8 (Orsay)	2 - 8 Nov 2008
Jernej Fesl Kamenik	5	4 (Karlsruhe)	14 - 19 Dec 2008
Jernej Fesl Kamenik	5	4 (Karlsruhe)	14 - 20 Apr 2009
Jernej Fesl Kamenik	5	10 (Ljubljana)	16 May - 7 June 2009
Nora Brambilla	5	4 (Munich)	29 Sep - 3 Oct 2008
Antonio Vairo	5	4 (Munich)	29 Sep - 3 Oct 2008
Matthew Moulson	5	9 (CERN)	1 - 8 Oct 2008
Federico Mescia	5	8 (Orsay)	2 - 8 Nov 2008
Olga Shekhovtsova	5	1 (Valencia)	1 - 7 Feb 2009
Oscar Catà	5	4 (Munich)	23 - 27 Feb 2009
Silvano Simula	5	9 (Bern)	20 - 22 Apr 2009
Vittorio Lubicz	5	9 (Bern)	20 - 22 Apr 2009
Olga Shekhovtsova	5	4 (Munich)	28 Apr - 8 May 2009
Silvano Simula	5	10 (Wien)	4 - 9 May 2009
Henryk Czyż	6	4(Karlsruhe)	20.11-19.12 2008
Henryk Czyż	6	4(Karlsruhe)	15.01-15.02 2009
Henryk Czyż	6	5(INFN, Bologna)	17.09-06.10 2009
Michał Gunia	6	4(Karlsruhe)	15.01-15.02 2009
Sergiy Ivashyn	6	4(Karlsruhe)	11.01-10.02 2009
Mikołaj Misiak	6	4(Karlsruhe)	9.06-14.07 2009
Johan Bijmans	7	1 (Valencia)	12 - 14 Oct 2008
Jan Eeg	7	10 (Ljubljana)	4 - 8 May 2009
N. Offen	8	1 (Valence)	2 - 6 Feb 2009
E. de Rafael	8	1 (Valence)	1 - 6 Feb 2009
M. Knecht	8	1 (Valence)	1 - 6 Feb 2009
K. Kampf	8	1 (Valence)	1 - 6 Feb 2009
J. Trnka	8	1 (Valence)	1 - 6 Feb 2009
E. de Rafael	8	2 (Barcelona)	8 - 10 Feb 2009
L. Lellouch	8	2 (Barcelona)	22 - 24 Feb 2009
L. Oliver	8	2 (Barcelona)	15 - 18 Apr 2009
S. Descotes-Genon	8	3 (Durham)	23 - 26 Sep 2008
N. Offen	8	3 (Durham)	21 - 26 Sep 2008
N. Offen	8	4 (Siegen)	3 - 7 Nov 2008
N. Offen	8	4 (Siegen)	25 - 30 Nov 2008
H. Sazdjian	8	4 (München)	24 - 27 Feb 2009
N. Offen	8	4 (Siegen)	4 - 8 May 2009
A. Tayduganov	8	4 (Karlsruhe)	6 - 18 Sep 2009
B. Malaescu	8	4 (Karlsruhe)	6 - 18 Sep 2009
B. Haas	8	5 (Rome)	25 Jan - 4 Feb 2009
L. Lellouch	8	5 (Rome)	7 - 8 May 2009
T.N. Pham	8	5 (Bari)	15 - 21 Jun 2009
J. Charles	8	9 (CERN)	13 - 14 Nov 2008
L. Lellouch	8	9 (Bern)	20 - 22 Apr 2009

V. Bernard	8	9 (Bern)	6 - 10 Jul 2009
S. Descotes-Genon	8	9 (CERN)	10 - 11 Dec 2008
R. Garcia-Martin	8	9 (Bern)	5 - 10 Jul 2009
H. Sazdjian	8	10 (Vienna)	18 - 22 May 2009
B. Blossier	8	11 (Zeuthen)	27 - 30 Apr 2009
Gilberto Colangelo	9	11 (Desy-Hamburg)	25-27 Jan 2009
Christoph Greub	9	11 (Desy-Hamburg)	23 Jan - 1 Feb 2009
Christoph Greub	9	4 (Karlsruhe)	12 Feb - 13 Feb 2009
Christoph Greub	9	11 (Desy-Hamburg)	8 - 9 Apr 2009
Tobias Hurth	9	2 (Barcelona)	6 - 8 Oct 2008
Tobias Hurth	9	8 (Marseille)	1 - 4 Dec 2008
Emilie Passemar	9	10 (Wien)	12 - 17 Oct 2008
Emilie Passemar	9	8 (IPN-Orsay)	2 - 7 Jan 2009
Emilie Passemar	9	8 (IPN-Orsay)	12 - 17 Apr 2009
Emilie Passemar	9	5 (INFN-Frascati)	6 - 12 Sep 2009
Volker Pilipp	9	4 (Karlsruhe)	23 - 25 Apr 2009
Martin Zdrahal	10	8 (Marseille)	14 - 19 Dec 2008
Beatrix Hiesmayr	10	5 (Frascati)	9 - 10 Apr 2009
Martin Zdrahal	10	8 (Prague)	24 - 26 May 2009
Jure Zupan	10	4 (RWTH Aachen)	28 May 2009
Nejc Kosnik	10	8 (IPN-Orsay)	14 - 21 Jun 2009
Martin Zdrahal	10	9 (PSI and Bern)	26 Jun - 10 Jul 2009
Helmut Neufeld	10	4 (TU Munich)	13 - 17 Jul 2009
H. Wittig	11	10 (Uni Bern)	20 - 22 Apr 2009
A. Jüttner	11	10 (Uni Bern)	20 - 22 Apr 2009
D. Renner	11	1 (Groningen)	23 - 25 Sep 2009
D. Renner	11	8 (Grenoble)	6 - 12 Oct 2008
D. Renner	11	8 (Grenoble)	18 - 21 Mar 2009
K. Jansen	11	8 (Orsay)	20 - 21 Jan 2009
K. Jansen	11	8 (Grenoble)	18 - 21 Mar 2009
K. Jansen	11	1 (Groningen)	23 - 25 Sep 2009
S. Dinter	11	1 (Groningen)	23 - 25 Sep 2009
G. Herdoiza	11	1 (Valencia)	1 - 7 Feb 2009
G. Herdoiza	11	8 (Grenoble)	18 - 21 Mar 2009
G. Herdoiza	11	1 (Groningen)	23 - 25 Sep 2009
F. Goertz	11	4 (Karlsruhe)	7 - 18 Sep 2009
T. Pfoh	11	4 (Karlsruhe)	7 - 18 Sep 2009

Collaborations among the different nodes have resulted in several joint publications. We present the list of our common publications in the form of a matrix in Tab. 4 in order to display the networking aspect.

### 3.4 Changes to the schedule

The duration of the 2009 Flavianet School on Flavour Physics (Sep 7–18 in Karlsruhe, Germany) has been extended to 12 days; this has allowed to schedule a broader set of lectures covering all aspects of flavour physics and effective field theories.

Note that our 2008 annual meeting *Euro-Flavour 08* took place in September 2008 and was covered in last year's periodical report. *Euro-Flavour 09* will take place November 9-11, 2009, in Bari, Italy, and will be covered in the next periodical report.

## 4 Economic spin-off

The spin-off company  $\langle\text{phi-t}\rangle$  founded by the experimental CDF/BELLE-II group in node 4 has further expanded and continues to hire physicists who completed their PhD in flavour physics. Generally, private enterprises hire PhD students trained within Flavianet because of the computing skills developed during their thesis work.

## 5 Conclusions

FLAVIANet members have written roughly 300 papers for refereed journals during the reporting period. We estimate that the FLAVIANet activity corresponds to at least  $2/3$  of the scientific output in theoretical flavour physics in Europe. Experimentalists in FLAVIANet were involved in numerous analyses of data from BaBar, BELLE, KLOE and the CERN experiments. The visibility of FLAVIANet research at international conferences is evident from the talks listed in Sect. 3.2. FLAVIANet members organised workshops and conferences at their home institutions as described in Sect. 3.2.

FLAVIANet continues to foster transnational scientific cooperations, which resulted in common publications of different nodes (see Tab. 4). FLAVIANet brings people and their expertises together and actively contributes to a structured European science landscape.

	1	2	3	4	5	6	7	8	9	10	11
1	<b>33</b>	[1–3, 6, 44–46, 55, 69, 155]	[33, 71, 76, 84]	[6, 16, 17, 19, 20, 33]	[25, 33–35, 44–46, 155]			[33, 34, 44–46, 155]	[33, 155]	[4, 33]	[33, 34, 38, 40, 155, 306]
2	[1–3, 6, 44–46, 55, 69, 155]	<b>24</b>		[6, 56]	[49–51, 56, 75, 155]			[54, 68, 75, 155, 231, 232]	[155]		[155]
3	[33, 71, 76, 84]		<b>21</b>	[33, 76, 80, 82]	[33, 76, 84, 85, 92]			[33, 84]	[33, 97]	[33]	[33, 82, 96, 97, 99]
4	[6, 16, 17, 19, 20, 33]	[6, 56]	[33, 76, 80, 82]	<b>48</b>	[33, 127, 134, 138, 165–168, 185]	[133]		[33, 114]	[33, 106, 147, 266, 267]	[33]	[33, 82]
5	[25, 33–35, 44–46, 155]	[49–51, 56, 75, 155]	[33, 76, 84, 85, 92]	[33, 127, 134, 138, 165–168, 185]	<b>22</b>		[160]	[33, 75, 155, 157, 159, 179, 245]	[33, 155, 159, 162, 169, 245]	[33, 160, 161, 183, 184, 278]	[33, 155, 169, 179, 282, 290]
6				[133]		<b>6</b>	[191, 192]	[190]			[194, 197, 198]
7					[160]	[191, 192]	<b>8</b>			[160]	
8	[33, 34, 44–46, 155]	[54, 68, 75, 155, 231, 232]	[33, 84]	[33, 114]	[33, 75, 155, 157, 159, 179, 245]	[190]		<b>33</b>	[33, 155, 210, 211, 214, 215, 229, 230, 242, 243]	[33, 210, 211]	[33, 34, 155, 179, 229, 230, 296, 306, 334]
9	[33, 155]	[155]	[33, 97]	[33, 106, 147, 266, 267]	[33, 155, 159, 162, 169, 245]			[33, 155, 210, 211, 214, 215, 229, 230, 242, 243]	<b>6</b>	[33, 210, 211]	[33, 34, 97, 155, 162, 229, 230, 251, 254, 263]
10	[4, 33]		[33]	[33]	[33, 160, 161, 183, 184, 278]		[160]	[33, 210, 211]	[33, 210, 211]	<b>5</b>	[33, 294, 319]
11	[33, 34, 38, 40, 155, 306]	[155]	[33, 82, 96, 97, 99]	[33, 82]	[33, 155, 169, 179, 282, 290]	[194, 197, 198]		[33, 34, 155, 179, 229, 230, 296, 306, 334]	[33, 34, 97, 155, 162, 229, 230, 251, 254, 263]	[33, 294, 319]	<b>49</b>

Table 4: Joint publications of several nodes within the reporting period. Rows and columns correspond to the 11 nodes, the bibliographical items refer to the list of publications in Sect. 2. The diagonal elements (boxed boldface numbers) are the number of publications which the corresponding node wrote without participation of other nodes.