Ioannis Bakas: the London Years

(Photo by courtesy of David McMullan)

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Abstract

In the early '80s, I had the pleasure and honour to befriend Giannis Bakas. We were PhD students at the Theoretical Physics group of Imperial College. Here I attempt to recreate the atmosphere of these happy London days and describe the transition of young Giannis from student to promising researcher.

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https://sites.google.com/site/xmasathens2016/home2

It is with deep sorrow that I am writing these lines in memory of my dear friend and colleague, Giannis (John) Bakas. We were postgraduate students at Imperial College and flatmates in the early eighties. In the life of a scientist, the years of transition from diligent student to researcher are very crucial. The hosting institute, the research team, the supervisors, the whole atmosphere, and even the light-hearted moments of respite, mark him or her for life. It is a true process of imprinting. Your research subject may change drastically several times after your graduation, but your style of conducting research remains, more often than not, the one learnt during these formative years. I was studying and living with John during this important phase of our development, in which we became friends for a lifetime (which was, alas, far too short for him).

John arrived at the Theory Group in the academic year 1982-83. In the early eighties, the group was basking in the sun of fame. Abdus Salam (1979 Nobel laureate) was ICTP Director in Trieste, but kept visiting the College at least twice per year. Tom Kibble was head of the Theory Group and other staff members included Ian Halliday, Chris Isham, Hugh Jones, David Olive, and Ray Rivers, with Mike Duff and Kelly Stelle the youngest newcomers. I recall postdocs of the calibre of Ian Jack, Peter Orland, Chris Pope and Graham Shore. The M.Sc. and PhD students were a healthy mixture of British and overseas young physicists, as befits a London-based high reputation international group. With the passage of time I forget many; I remember most distinctly those that stayed in Physics: Pijush Bhattacharjee (now at Saha Institute, India) Frank Gomes (San Paolo, Brazil), Mark Hindmarsh (Sussex), Desmond Johnson (Herriot Watt), Tony Kakas (Cyprus), Martin Lavelle (Plymouth), David McMullan (Plymouth), Susan Mokhtari (California State, Stanislaus), Kostas Panagiotakopoulos (Salonica), Regina Ricotta (San Paolo, Brazil), and Neil Turok (Perimeter Institute). Many others took different paths in life, such as Annie Andrikopoulou (now retired from the EU Commission in Brussels), Andrew Crumey (a successful writer), Nigel Gent (partner of PGR Capital), and Humberto La Roche (Cisco Systems). I have sadly lost track of many others, such as David Browning, Ian Fox, Mike Lewis, and Kin Yin, retaining fond memories of our time together.

In this rather big group research spanned several fields, with the main interests being perturbative QCD and sum rules, the triviality of scalar field theory with a quartic interaction, group-theoretic aspects of field theory, supersymmetry, supergravity, cosmology and unification. In the pre-string days one interesting line, hotly pursued by Chris Isham and his students, was that of quantum gravity (string theory "arrived" in London through a Mike Green seminar at King's, around 1984-85).

John knew from the very start that he wanted to learn quantum gravity and work with Chris Isham. His wish could not be fulfilled automatically. At the time British students were admitted to the PhD programme right from the first postgraduate year, having won scholarships. Overseas students, coming from very different countries and universities, had backgrounds that were not easy to evaluate. They

were only assured a place in the PhD programme at the end of the first year, which led to the Diploma of Imperial College (DIC.; a College version of the MSc). The DIC was obtained by submitting a short thesis, having successfully passed three exams of the student's choice, out of the many offered on the various courses attended. Depending on the exams selected by each overseas candidate, his/her performance in them, and the availability of a given staff member, a topic for a PhD thesis was agreed upon. Only then was one really admitted to the PhD course with that specific supervisor. Under these rules, some students had to leave at the end of the DIC year and look for places in other intitutions.

All three exams that John opted for were very demanding. This was risky, as top marks were not easy to obtain, and thus being offered a place in the PhD programme could be jeopardised. Preparing the quantum field theory exam was tricky, in spite of Tom Kibble's excellent lecturing. It should be stressed that at the time the only quantum field theory textbooks (besides the Bjorken and Drell classic) were the first edition of Itzykson and Zuber and a first ill-typeset edition of Ramond. John did well in all three exams by everyone's standards but his own.

He worked himself into a highly excited state, convinced that his performance had not been what Isham normally expected from his future students. He had arranged to see Isham one Monday morning, in order to discuss the possibility of starting to work with him at PhD level. The previous weekend was an agonising experience for him, but also for me: we were sharing a flat in 3 Old Oak Rd. in East Acton, and I was testimony to his stress. John spent the whole weekend pacing up and down his room, like a lion in its cage. It was a chain-smoking lion. I used to joke with him for years to come that during that weekend he had smoked a whole plantation of Marlboros. Any attempt on my part to distract him, failed miserably. The following Monday he saw Isham, who asked him a single simple question: "Why do you want to work on quantum gravity?". John's answer was long and well documented. Later he confided in me that he

Photo(s) 1: Tony Kakas (spring 1983)

relaxed immediately after the question was asked and that any stage fright disappeared the moment he started writing on the blackboard. As everyone else expected, Isham offered him a place in his group. The only one surprised was John himself.

Photo(s) 2: David McMullan during his birthday party in the Theory Group library (February 1983).

John was well integrated into the quantum gravity group. His enthusiasm was contagious. The first paper [1], [2] was written with fellow student Tony Kakas (photo 1). Another young collaborator was David McMullan (photo 2), co-author of ref. [3] (the first of several joint papers). David was the one who realised that John's name in Greek is actually Ioannis and that all the Greek-language fellow-students called him by the standard diminutive Giannis. In a sober moment (not captured in the photo on the left!), he argued that we should all be using Giannis instead of the anglicised John, and this stuck with Greeks and non-Greeks alike.

Life at home with Giannis was a pleasant and easy-going affair. After about a year in East Acton (photos 3), we moved south of the river, to 32 Chelverton Road, Putney. This marked an important addition in Giannis' room furniture: he was now the proud owner of a filing cabinet, where he could finally tidily keep all copies of the papers he studied; there were scores of them! Otherwise his room decoration, both in East Acton and Putney, was very Spartan, with posters of Hilbert and Klein setting the tone. In three years of flat sharing, we never ever had a single argument, though our lifestyles were quite different. He was a very clean and tidy flatmate, reliable and generous. He was always very careful not to disturb his neighbours. Sharing chores and household activities (cleaning, cooking, going together to the laundrette) could even be fun. In general, he was an easy person to come to terms with, cheerful, happy, and willing to do anything to help others. But he could also be stubborn on specifics. For example, it was hard to convince him to ride with me on my motorcycle. We drove to College a couple of times and then he decided that the whole affair was far too dangerous. To the present day I am convinced that I was a conservative driver and that he was simply overcautious. So every morning we started off from home to College, he by tube and I by motorbike.

(a)

(b)

(c)

(d)

Photo(s) 3: Everyday life in East Acton (August 1983): (a) calling home; (b) getting to grips with quantum field theory; (c) admiring Hilbert and Klein; (d) relaxing.

Giannis was fun to be with (photos 4,5). He often participated in parties and his Greek temperament, latent when he was hard at work, would surface in these occasions. Our spacious kitchen in Putney often hosted dinner with guests in the weekend. The menu was quite varied, consisting of excellent quality food from Tony Kakas' family delicatessen shop which, having just passed sell-by date, would normally have to be disposed of. Culinary improvisation reigned supreme, with Giannis proposing an improbable sandwich recipe of Scottish smoked salmon and Greek feta-cheese, which raised quite a few eyebrows!

(a)

(b)

Photo(s) 4: Happy days (1983-1984): (a) Giannis displays Greek dancing in a London back-garden; (b) culinary experiments in Putney; from left: Humberto La Roche, Tony Kakas, Giannis and the author.

(a)

(b)

Photo(s) 5: More happy days (1983-1984): (a) Giannis and Martin Lavelle acting silly; (b) Gannis with David and Mirjam McMullan (photos by courtesy of Martin Lavelle).

Equally memorable were the week-end outings to Tony's family fish-and-chips restaurant in Richmond (photos 6); thankfully, in these occasions the fish had definitely not passed its sell-by date!

(a)

(b)

(c)

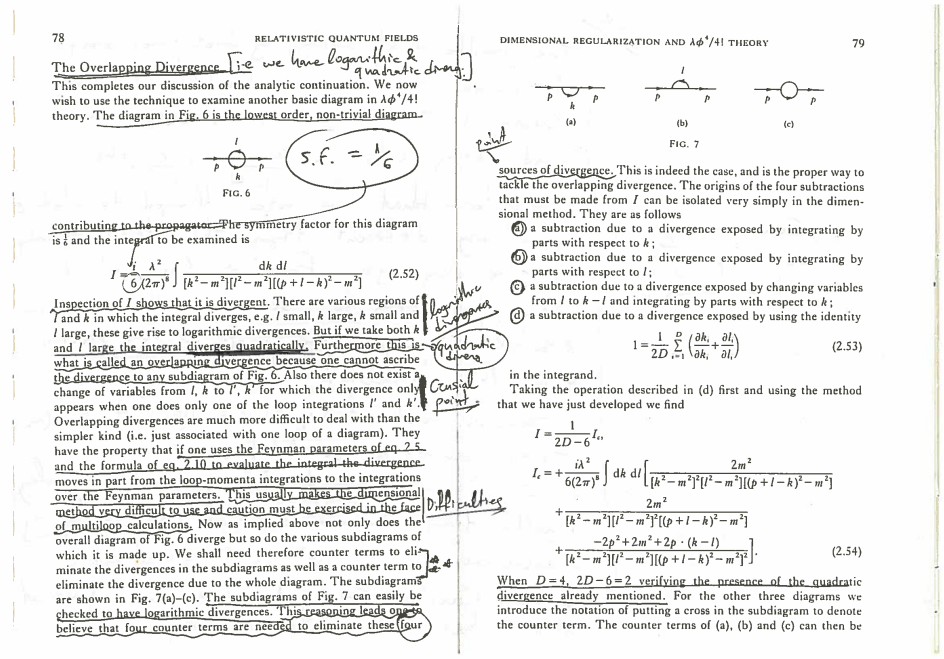
Photo(s) 6: Fish-and-chips in Richmond (February 1983): (a) Giannis with Frank Gomes and Regina Ricotta; (b) Pijush Bhattacharjee with Neil Turok; (c) Kelly Stelle, Annie Andrikopoulou and Ian Jack.

Moreover, I should mention the small Theoretical Physics library in our department, just outside Ian Halliday's room, which hosted several merry group reunions. The pictures testify the positive and relaxed spirit of our small student community (photos 7).

At work Giannis was a totally different person, always bent over a book or paper and entirely concentrated. Pages suffered in his hands: both the books and the papers he read were dotted with his comments; key phrases were underlined (sometimes triply-underlined) and important equations were framed (photos 8). At the time he was intensively studying QED and QFT, symmetries and anomalies, and most importantly gravity beyond the classical level. He very quickly built a reputation of being a very serious and reliable mathematical physicist, who was always focused on his objectives. His scientific culture grew by the hour, and his knowledge and confidence increased tremendously. In short, during his PhD years Giannis matured fully from student to an autonomous and acknowledged researcher.

Photo(s) 7: Partying in the Theory Group premises (February 1984): (top, from left) Chris Pope, Giannis, Mirjam McMullan, Nigel Gent, Annie Andrikopoulou, Susan Mokhtari, Des Johnson and Frank Gomes; (bottom, from left) Giannis, Martin Lavelle and Mark Hindmarsh.

A highlight in our young scientific lives was the delivery of our first seminar to an audience of postgraduate students (a tougher test was the first seminar in front of the whole theory group, including staff members). Giannis prepared meticulously a seminar on algebraic topology. So even at this early stage, the choice of subject-matter and style of approach were already in line with what Giannis had decided to do in his current and future research. Like everything else at the time, his seminar notes were hand-written. He prepared them with the same care one would write the final version of the manuscript of a paper, ready to be typed by the Group secretary. I can't remember whether the pages shown in photos 9 are from these seminar notes or whether they are also related to his DIC thesis. I had kept these notes as a souvenir of the time spent together, not suspecting that some thirty years later I would be gazing at them devastated by sorrow and disbelief, realising that I would never see their author again...



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The Overlapping Divergence [i.e we have logarithic & quadratic divergs.]

This completes our discussion of the analytic continuation. We now wish to use the technique to examine another basic diagram in $\lambda\phi^4/4!$ theory. The diagram in Fig. 6 is the lowest order, non-trivial diagram

FIG. 6

S.F. = 1/6

contributing to the propagator. The symmetry factor for this diagram is $\frac{1}{6}$ and the integral to be examined is

$$I = \frac{i}{6}\frac{\lambda^2}{(2\pi)^8}\int \frac{dk\, dl}{[k^2-m^2][l^2-m^2][(p+l-k)^2-m^2]} \quad (2.52)$$

Inspection of I shows that it is divergent. There are various regions of l and k in which the integral diverges, e.g. l small, k large, k small and l large, these give rise to logarithmic divergences. But if we take both k and l large the integral diverges quadratically. Furthermore this is what is called an overlapping divergence because one cannot ascribe the divergence to any subdiagram of Fig. 6. Also there does not exist a change of variables from l, k to l', k' for which the divergence only appears when one does only one of the loop integrations l' and k'. Overlapping divergences are much more difficult to deal with than the simpler kind (i.e. just associated with one loop of a diagram). They have the property that if one uses the Feynman parameters of eq. 2.5 and the formula of eq. 2.10 to evaluate the integral the divergence moves in part from the loop-momenta integrations to the integrations over the Feynman parameters. This usually makes the dimensional method very difficult to use and caution must be exercised in the face of multiloop calculations. Now as implied above not only does the overall diagram of Fig. 6 diverge but so do the various subdiagrams of which it is made up. We shall need therefore counter terms to eliminate the divergences in the subdiagrams as well as a counter term to eliminate the divergence due to the whole diagram. The subdiagrams are shown in Fig. 7(a)–(c). The subdiagrams of Fig. 7 can easily be checked to have logarithmic divergences. This reasoning leads one to believe that four counter terms are needed to eliminate these four

[logarithic divergs] [quadratic divergs] [Crucial point] [Difficulties]

DIMENSIONAL REGULARIZATION AND $\lambda\phi^4/4!$ THEORY 79

FIG. 7

[point]

sources of divergence. This is indeed the case, and is the proper way to tackle the overlapping divergence. The origins of the four subtractions that must be made from I can be isolated very simply in the dimensional method. They are as follows

(a) a subtraction due to a divergence exposed by integrating by parts with respect to k;
(b) a subtraction due to a divergence exposed by integrating by parts with respect to l;
(c) a subtraction due to a divergence exposed by changing variables from l to $k-l$ and integrating by parts with respect to k;
(d) a subtraction due to a divergence exposed by using the identity

$$1 = \frac{1}{2D}\sum_{i=1}^{D}\left(\frac{\partial k_i}{\partial k_i} + \frac{\partial l_i}{\partial l_i}\right) \quad (2.53)$$

in the integrand.

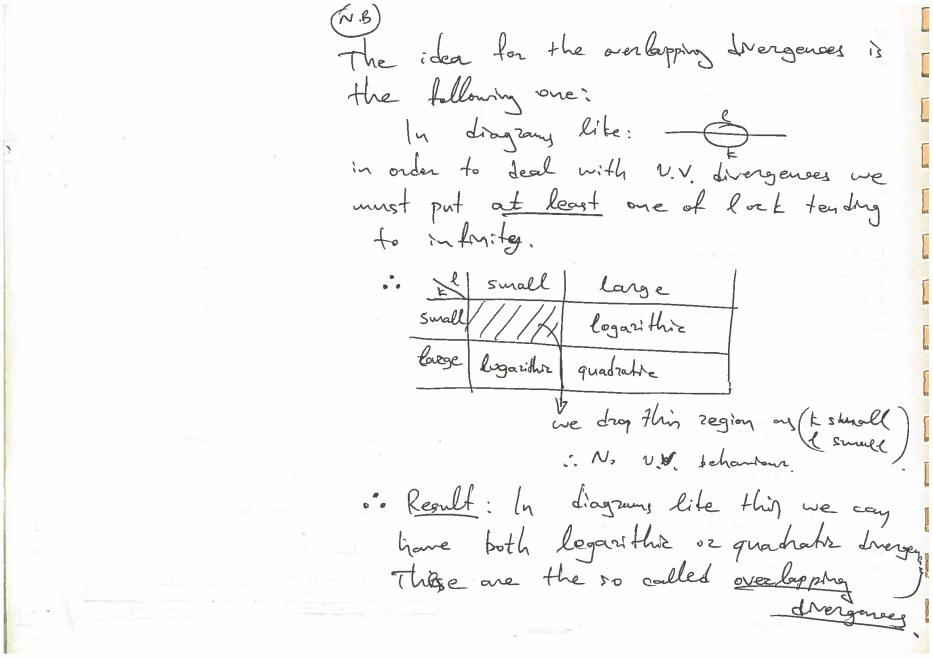
Taking the operation described in (d) first and using the method that we have just developed we find

$$I = \frac{1}{2D-6} I_c,$$

$$I_c = +\frac{i\lambda^2}{6(2\pi)^8}\int dk\, dl \left[\frac{2m^2}{[k^2-m^2]^2[l^2-m^2][(p+l-k)^2-m^2]} + \frac{2m^2}{[k^2-m^2][l^2-m^2]^2[(p+l-k)^2-m^2]} + \frac{-2p^2+2m^2+2p\cdot(k-l)}{[k^2-m^2][l^2-m^2][(p+l-k)^2-m^2]^2}\right]. \quad (2.54)$$

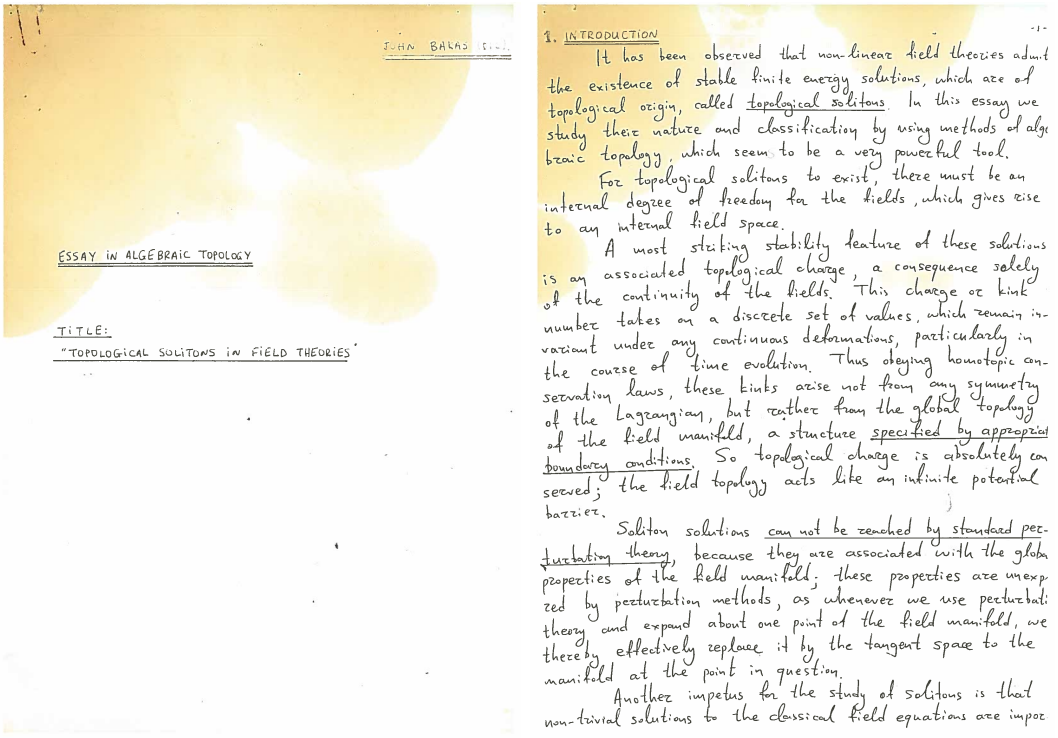
When $D=4$, $2D-6=2$ verifying the presence of the quadratic divergence already mentioned. For the other three diagrams we introduce the notation of putting a cross in the subdiagram to denote the counter term. The counter terms of (a), (b) and (c) can then be

(a)



(b)

Photo(s) 8: (a): Two pages from Nash's book "Relativistic Quantum Fields", annotated by Giannis; (b) more notes he kept while studying these pages.



(a) (b)

Photo(s) 9: The first coffee-stained pages of Giannis' notes on algebraic topology.

As the reader may well imagine, there were many illustrious guests visiting our group. Quite a few were inclined to interact with students. I recall vividly how Giannis prepared seriously for their visit, for he was very keen to make the most of these occasions. Before their arrival, he had studied their most important and most recent papers, and had prepared a list of topics that he wanted to discuss. Thus he met John Iliopoulos, Roman Jackiw, and Karel Kuchar amongst others. I recall how us other students were impressed by the fact that in the latter part of his visit, Jackiw would drop in our offices looking for Giannis. And after meeting Kuchar, Giannis was convinced that the most natural way to pursue his research interests at postdoctoral level was to join the group in Utah. Of course, he was offered the position.

Upon completing our PhD studies, we went our separate ways. Others are better suited to describe Giannis' passage from Utah, Texas [4, 5], Maryland [6–8] and CERN [9, 10], where the references indicate some of the papers he wrote during his stay in these institutes. In Austin he was reunited with our old fellow student, Humberto La Roche, with whom he shared a flat.

We never lost touch during his U.S.A. years (photo 10), but communications were infrequent. We met during his military service, during a "Tri(Pent)angular meeting" held in Heraklion, Crete. He introduced me to his girl friend, and it was immediately clear to me that their union was to be everlasting; facts were to prove me right. I was settled in Rome by then, visiting CERN quite regularly. So we had many pleasant occasions to meet, discuss and dine together in Geneva. More recently, we occasionally collaborated in a few evaluation committees of the National Technical University of Athens, where he had moved in 2012. He was asking me about work-in-progress in such a committee, even in the middle of his illness.

Photo(s) 10: Giannis in the U.S. (photo by courtesy of David MacMullan).

Of all these memories that span three decades, I mostly recall with nostalgia and affection the few but intensive formative years we have lived under the same roof in London. In our final PhD year, I shared the flat in Putney with Giannis and my then-girlfriend (now-wife). We were a family of three (photo 11) and our flat became a gathering point for several of our PhD friends and colleagues.

Photo(s) 11: "My family" in Putney.

There is one last memory that I treasure particularly: When Giannis was offered the professorship in Patras, while at CERN, we had a short but very frank discussion in Geneva, about his returning to Greece. For many Greek scientists, this amounts to crossing the Rubicon: in spite of the country's strong tradition in Theoretical Physics and the abundance of excellent colleagues, many bureaucratic impediments and lack of funding often transform routine academic work into a Herculean feat. So it was natural to ask him why he was returning, given the fact that as a CERN staff member, he had the opportunity to find senior positions in several top-class insti-

tutions in Europe and the U.S.A. Giannis immediately responded that returning to Greece was what his heart desired. In his own words: "Even if I were hypothetically given the opportunity to select any position in the world, I would opt for the very one I have been offered in Greece". I knew then that his love for Physics was second to his love for his wife Olga and his daughter Marilena. After many years of personal sacrifice, he had reaped the benefits of his hard work and he could enjoy family and research alike. It is very sad that this last phase of Giannis' life was so short. He had a lot to give to family, friends, and Science. He will be bitterly missed by all.
Acknowledgements: I wish to thank Annie Andrikopoulou, Tony Kakas and Martin Lavelle for carefully reading the manuscript and making useful suggestions.

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