

# 21st-century directions in de Broglie-Bohm theory and beyond



International Quantum Foundations Workshop  
Saturday 28th August - Saturday 4th September 2010  
The Apuan Alps Centre for Physics @ TTI, Vallico Sotto, Tuscany

[www.vallico.net/tti/tti.html](http://www.vallico.net/tti/tti.html)

This is the official programme document for the 2010 international workshop *21st-century directions in de Broglie-Bohm theory and beyond* - the first workshop of a series in the field of quantum foundations to be held at the Apuan Alps Centre for Physics. The general purpose of workshops at this venue is to gather together a limited number of expert physicists to discuss subjects where the need for new insights is felt with particular intensity, as is most certainly the case with the de Broglie-Bohm formulation of quantum mechanics. Largely neglected for most of its eighty-five year history, it has been the subject of increasing interest in the last few decades. If the theory is to remain relevant and vigorous, it is essential to decide where it is to go next within the wider context of the foundations of quantum mechanics, and to understand how it may contribute to the sum of human knowledge. With this workshop we hope to begin to answer these questions.

The usual format of workshops at this venue is intended to encourage a relaxed and intellectually-stimulating atmosphere rather different to the 8am to 7pm grind of your regular conference. Formal talks are restricted to the mornings, and participants are given the freedom and space to think and to contemplate and discuss the issues at hand in front of the many available blackboards. For the young and vigorous, afternoon mountain walks, caving, and other healthy outdoor pursuits are organized, whilst the unfit and elderly might enjoy artistic tours, reading and conversation in the garden, and gentle country strolls, with all participants reuniting in the evening for excellent Tuscan dinners in local restaurants. It is hoped that by taking part in these activities, whilst breathing clean mountain air and having access to good food and wine, participants will be able to return home mentally and physically refreshed as well as having learned something new about science.

# 1 LIST OF REGISTERED PARTICIPANTS

Herman Batelaan	University of Nebraska, U.S.A.
Dionigi Benincasa	Imperial College, London, U.K.
Gregorio Benincasa	Imperial College, London, U.K.
Andrew Bennett	Oregon State University, Corvallis, U.S.A.
Howard Burton	Founding Director, Perimeter Institute (now independent)
John Bush	Department of Mathematics, MIT, U.S.A
Jeremy Butterfield	University of Cambridge, U.K.
Murray Daw	Clemson University, U.S.A.
Maaneli Derakhshani	Clemson University, U.S.A.
Chris Dewdney	University of Portsmouth, U.K.
Christos Efthimiopoulos	Academy of Athens, Greece
Lucien Hardy	Perimeter Institute, Canada
Richard Havery	University of Portsmouth, U.K.
Basil Hiley	Birkbeck College, London, U.K.
Kris Krogh	University of California, U.S.A.
Alberto Montina	Perimeter Institute, Canada
Wayne Myrvold	University of Western Ontario, Canada
Gillie Naaman-Marom	Tel Aviv University, Israel
Hrvoje Nikolic	Rudjer Boskovic Institute, Zagreb, Croatia
Travis Norsen	Marlboro College, U.S.A.
Xavier Oriols	Universitat Autònoma de Barcelona, Spain
F. David Peat	Pari Centre, Italy
Pedro Naranjo Pérez	University of Seville, Spain
Patrick Peter	Institut d'Astrophysique de Paris, France
Nelson Pinto-Neto	CBPF, Rio de Janeiro, Brazil
Enrico Prati	CNR, Italy
Paavo Pylkkänen	University of Skövde, Sweden
Anton Ramsak	University of Ljubljana, Slovenia
Peter Riggs (V)	ANU, Canberra, Australia
Joshua Rosaler	University of Oxford, U.K.
Shantena Sabbadini	Pari Centre, Italy
Ilja Schmelzer	Berlin, Germany
Rafael Sorkin	Perimeter Institute, Canada
Ward Struyve	Katholieke Universiteit Leuven, Belgium
Mike Towler	Cambridge University, U.K.
Jos Uffink	University of Utrecht, Holland
Lev Vaidman	Tel Aviv University, Israel
Wouter Valentín	Leiden University, Holland
Antony Valentini	Imperial College, London, U.K.
James Yearsley	Imperial College, London, U.K.

## **Family:**

Michael Naaman-Marom  
Elaine Bennett, Mari Hirano, Glenys Dewdney  
Irena Burton, Louis Burton, Emma Burton  
Elina Pylkkänen, Kasper Pylkkänen, Ester Pylkkänen  
Vanessa Hardy, Vivienne Hardy  
Branka Ramsak

## **Staff:**

Samantha Keil, Saska Towler, Samuel Denny, Daniel Thorpe, Pui Ip, [Joshua Rosaler]

## **Withdrawn:**

Guido Bacciagaluppi, Jeffrey Bub, Maurice de Gosson, Jonathan Halliwell, Tim Maudlin, Roger Penrose  
Carlo Rovelli, Simon Saunders, Maximilian Schlosshauer, Lee Smolin, Rob Spekkens, Georg Wikman

## 2 FLIGHTS AND TRANSPORT

This section gives details on how to get to the Institute for people flying into Galileo Galilei Airport, Pisa. It is also possible to fly to Florence which is only slightly further away - though flights to this airport are more limited. In principle one could also fly to other airports such as Perugia, Bologna, Parma, Milano, Verona, Genova or Roma but you should count on a train ride of up to four or five hours to get to the Institute (we can arrange this for you). A list of airlines flying to Pisa from destinations within Europe is given on the TTI web page (see 'Flying to Italy' in the left-hand column). Americans should note that Delta Airlines now operate a direct service to Pisa from New York. Further details about transport, including how to drive to the Institute, are also given on the TTI web site.

Participants should aim to arrive at Pisa airport on Saturday 28th August. If this is not possible (say, if flights from your country are irregular) then we recommend having a brief holiday in Florence or similar before coming to TTI. Both early and late departures are possible if necessary, though we do stress that, because of the nature of the workshop, participants should try to attend the whole of the meeting rather than just a few days; in particular it can be difficult to arrange transport to and from Vallico Sotto at irregular times because of the nature of the terrain.

*How to get to TTI from Pisa airport:*

Go to Pisa Centrale train station - either by taxi (c. 8 EUR, "*stazione centrale*", phonetic: "*statsioanay chentrarlay*") in five minutes from the airport (preferable) or by a short train ride from Pisa Aeroporto station (which you get to by walking out of one end of the airport concourse - turn left as you walk into the main hall). From Pisa Centrale you then need to get a train to Barga-Gallicano. This is an isolated station north of the city of Lucca somewhere along a branch line going up the valley of the river Serchio into the mountains (see the map on the TTI web site). Depending on the train time, you may need to change at Lucca to get the train north - the train will usually be flagged as going to "Aulla", "Minucciano", "Piazza al Serchio" or "Fivizzano".

The train in question is a little unimportant train, and only tickets for big important trains tend to be available on the internet. It is easy to buy tickets on the station platform ("*Uno a Barga-Gallicano. Solo andata.*"). On all Italian train journeys you are supposed to validate your ticket by getting it stamped in the yellow machines on the platform or you may have to pay a fine. Note that Italian trains are very (even absurdly) cheap by international standards, particularly British ones. The ticket should cost around 4 to 6 Euros.

At Barga-Gallicano station you should find a TTI representative who will meet each train as required and take new arrivals to the Institute. If no-one is there you can wait in the station café - do call if you have to wait more than five or ten minutes. Clearly we need to know in advance the time of the train on which you intend to arrive. The timetable is linked from the TTI web site, but all relevant train times are in fact given in the table below. Note that the last train from Pisa is at 20:50 (19:50 on Sundays) so it would be a good idea to arrive earlier in the day if possible (particularly if you want to enjoy the welcome buffet dinner).

Please note - if you miss your scheduled train PLEASE TELEPHONE US - it is a one-hour round trip from the monastery to the station and back, and it is very frustrating for us to arrive at the station to find no-one there.

In emergencies it is possible to get a taxi to Vallico Sotto from the station but in general this needs to be pre-booked - see the instructions on the web site (Barga Taxi : bargataxi@libero.it Tel. 331 3378051). If you are a non-Italian speaker who hasn't pre-booked and you need to talk to the guy (Massimo) on the phone you will find he doesn't speak English so just say (phonetic) "*Taxi a Vallico Sotto da la stasjonay di Barga-Gallicano?*" or similar down a phone at him - the trip should cost 35 Euro. Note that "I don't speak Italian" is "*Non parlo italiano.*"

Please note that with disabled or elderly people who have difficulty carrying luggage it may be possible

to arrange a car pickup straight from Pisa airport - please ask. Unfortunately this is a two-and-a-half hour round trip and can be done only a limited number of times since our vehicles are generally required to pick up people from Barga-Gallicano station. It may even be best to arrive a day early if you require this service.

In case of problems contact Mike Towler on his mobile phone - 3479172621. Additional assistance may be available from Samantha Keil on 00 44 7979 554034 (though be aware that Samantha is only vaguely aware of what is going on, or where anything is - best to ask her to find Mike). TTI has two direct phone lines (0583 761608 and 0583 1805441) but these should be used as a last resort.

### 3 TRAIN TIMETABLES

See [www.ferroviedellostato.it/homepage\\_en.html](http://www.ferroviedellostato.it/homepage_en.html).

#### Sunday 22nd. Pisa Centrale to Barga-Gallicano

dep. Pisa	arr. Lucca	dep. Lucca	arr. Barga-Gallicano
05:30			06:54
07:50			09:13
08:50	09:17	10:02	10:52
09:50	10:17	11:45	12:34
13:43			14:50
14:50	15:17	16:20	17:02
17:50			18:57
18:50	19:17	19:36	20:21
19:50			21:30

#### Monday 23rd - Friday 27th August. Pisa Centrale to Barga-Gallicano

dep. Pisa	arr. Lucca	dep. Lucca	arr. Barga-Gallicano
05:30			06:54
06:20	06:45	06:53	07:37
07:50			09:13
10:20	10:47	11:30	12:13
13:43			14:50
15:20			16:28
16:50			18:21
17:50			18:57
18:50			20:20
19:50			21:30
20:50	21:17	21:40	22:20

#### Saturday 28th August, Pisa Centrale to Barga-Gallicano.

dep. Pisa	arr. Lucca	dep. Lucca	arr. Barga-Gallicano
05:30			06:54
06:20	06:45	06:53	07:37
07:50			09:13
10:20	10:47	11:30	12:13
12:50	13:15	13:26	14:12
13:43			14:50
15:20			16:28
16:20	16:44	16:58	17:40
17:50			18:57

18:50			20:20
19:50			21:30
20:50	21:17	21:40	22:20

**Saturday 4th September, Barga-Gallicano to Pisa Centrale**

dep. Barga-G.	arr. Lucca	dep. Lucca	arr. Pisa
06:02	06:45	06:53	07:16
06:43			08:12
07:24			08:42
08:00			09:12
08:41	09:25	09:42	10:12
12:00	12:50	13:12	13:42
14:02			15:42
15:14	16:00	16:12	16:42
17:28			18:45
18:46	19:34	19:42	20:12
20:10			22:12

## 4 SPECIFIC TRAVEL PLANS

SUNDAY 22nd

-----

Antony Valentini

Arr Pisa 14:30 Sun 22 Aug. Airport pickup c. 17:50

Dep Pisa 14:55 Sun 05 Sep.

Nelson Pinto-Neto

Arr Pisa 17:25 Sun 22 Aug. Airport pickup c. 17:50

Dep Pisa 18:00 Thu 02 Sep.

WEDNESDAY 25th

-----

Joshua Rosaler

Arr Pisa 09:45 Wed 25 Aug. Train 13:43 to Barga-Gallicano@14:50

Holiday in Italy afterwards.

Daniel Thorpe

Arr Pisa 12:00 Wed 25 Aug. Train 13:43 to Barga-Gallicano@14:50

Dep Pisa 06:55 Sun 05 Sep.

Samuel Denny

Arr Pisa 15:35 Wed 25 Aug. Train 16:50 to Barga-Gallicano@18:21

Dep Pisa 22:10 Sun 05 Sep.

Pui Ip

Arr Pisa 16:10 Wed 25 Aug. Train 16:50 to Barga-Gallicano@18:21, or

Train 17:50 to Barga-Gallicano@18:57 (PHONE MDT IF ON THIS TRAIN)

Dep Pisa 11:50 Sat 04 Sep.

THURSDAY 26th

-----

Ilja Schmelzer

Arr Pisa 20:00 Wed 25 Aug. Hotel. Random train to Fornaci di Barga. Walk to  
TTI from FdB station.

Dep Pisa 17:00 Sat 04 Sep.

Kris Krogh

Arr Thu 26 August. Train to Fornaci di Barga@21:25. Taxi to Vallico Sotto (BOOKED).

Dep 08:00 Sat 04 Aug

FRIDAY 27th

-----

Wouter Valentin

Arr Pisa 12:10 Fri 27 Aug. Train 13:43 to Barga-Gallicano@14:50.

Dep Pisa 08:35 Sat 04 Sep.

Wayne Myrvold

Vacation in Cinque Terre. Arr Fri 27 Aug Barga-Gallicano@15:13 (from north).

Dep Pisa 13:05 Sat 04 Sep

Lev Vaidman, Gillie Naaman-Marom, Michael Naaman-Marom

Arr Rome 08:00 Fri 27 Aug. Rental car to TTI. Will attend restaurant.

Dep Rome evening Fri 3rd Sep.

Shantena Sabbadini

Arr Fri 27 Aug in private car, late afternoon. Will attend restaurant.

Dep Tue 31 Aug in private car.

TOO LATE FOR RESTAURANT:

Paavo Pylkkanen, Elina Pylkkanen, Ester Pylkkanen, Kasper Pylkkanen

Arr Florence 19:10. Fri 27 Aug in rental car - expected c. 21:45?

Dep Tue 31 Aug in rental car for noon flight from Florence (1.5 hours from VS)

John Bush

Arr Pisa 17:25 Fri 27 Aug. Train 19:50 to Barga-Gallicano@21:30.

Dep Pisa 13:30 Tue 31 Aug.

Lucien Hardy, Vanessa Hardy, Vivienne Hardy

Arr Pisa 18:50 Fri 27 Aug. Train 19:50 to Barga-Gallicano@21:30. (MDT pick up)

Dep Thu 02 Sep.

SATURDAY 28th

-----

Murray Daw

Arr Pisa 11:40 Wed 25 Aug. Train 10:20 Sat 28 Aug to Barga-Gallicano@12:13

Dep Pisa 13:15 Sat 04 Sep.

Patrick Peter

Arr Pisa 08:40 Sat 28 Aug. Train 10:20 to Barga-Gallicano@12:13

Dep Pisa 09:10 Sat 04 Sep.

Ward Struyve

Arr Pisa 08:10 Sat 28 Aug. Train 10:20 to Barga-Gallicano@12:13

Dep Pisa 08:35 Sat 04 Sep.

Alberto Montana

Arr Pisa Fri 27 Aug. Visit Florence. Train Sat 28 Aug to Barga-Gallicano@12:13

Dep Sat 04 Sep.

Maaneli Derakhshani

Arr Pisa 12:25 Sat 28 Aug. Train 13:43 to Barga-Gallicano@14:50

Dep Pisa 23:05 Sat 04 Sep.

Richard Havery

Arr Pisa 12:25 Sat 28 Aug. Train 13:43 to Barga-Gallicano@14:50 (Maaneli help)

Dep Pisa 19:40 Sat 04 Sep. (Lift to the airport?)

Hrvoje Nikolic

Arr Sat 28 Aug by train from Zagreb. Arr Barga-Gallicano@14:50

Dep Sat 04 Sep by train from Barga-Gallicano@12:00

Travis Norsen

Arr Pisa 12:20 Sat 28 Aug. Train 13:43 to Barga-Gallicano@14:50

Dep Pisa 13:05 Sat 04 Sep

Pedro Naranjo Perez

Arr Pisa 11:55 Sat 28 Aug. Train 13:43 to Barga-Gallicano@14:50

Dep Pisa 12:40 Sat 04 Sep.

Xavier Oriols

Arr Pisa 13:55 Sat 28 Aug. Train 15:20 to Barga-Gallicano@16:28

Dep Pisa 14:35 Sat 04 Sep.

Herman Batelaan

Arr Roma 12:10 Sat 28 Aug. Train 14:10 from Roma to Pisa Centrale@16:57

Train 17:50 from Pisa to Barga-Gallicano@18:57

Dep Fri 03 Sep afternoon for Roma flight 12:10 04 Sep

James Yearsley

Arr Pisa 18:50 Sat 28 Aug. Train 19:50 to Barga-Gallicano@21:30

Dep Sunday 05 Sep (extra night). Train 12:30 from Pisa to Venice.

Dionigi Benincasa, Gregorio Benincasa, Rafael Sorkin

Arr Sat 28 Aug in rental car from Roma (afternoon?)

Dep Sat 04 Sep in rental car

Andrew Bennett, Elaine Bennett

Arr Sat 28 Aug in rental car.

Dep Sat 04 Sep in rental car.

Howard Burton, Irena Burton, Louis Burton, Emma Burton

Arr Sat 28 Aug in rental car.

Dep Wed 01 Sep evening in rental car.

Chris Dewdney, Glenys Dewdney

Arr Sat 28 Aug in rental car.

Dep Sat 04 Sep in rental car.

Branka Ramsak, Anton Ramsak

Arr Sat 28 Aug by private car.  
Dep Fri 03 Aug (morning)

Jos Uffink  
Travel from Milano by bicycle. Arr Sat 28 Aug  
Dep Sat 04 Sep

MONDAY 30th  
-----

Enrico Prati  
Arr Mon 30 Aug early morning by private car  
Dep N/A (will return each night to Pisa)

Jeremy Butterfield, Mari Hirano  
Arr Mon 30 August c. 17.00 in rental car.  
Dep Pisa 16:05 Fri 03 Sep. Travel to airport in rental car.

Basil Hiley  
Arr Pisa 14:30 Mon 30 Aug. Travel with Jeremy Butterfield in rental car.  
Dep Pisa 14:55 Fri 03 Sep

Christos Efthimiopoulos  
Arr Pisa Mon 30 Aug. Train 17:50 to Barga-Gallicano@18:57  
(TAXI BOOKED FROM BG STATION TO LAGHETTO RESTAURANT..)  
Dep Pisa 19:15 Fri 03 Sep

CURRENTLY UNKNOWN  
-----

F. David Peat

NEVER ARRIVING  
-----

Peter Riggs (will participate virtually from Australia)

## **5 ACCOMMODATION**

All accommodation is either in the monastery itself (TTI) or in adjacent/nearby houses in Vallico Sotto. People wishing to live in more luxurious 'hotel' accommodation (some local hotel rooms are listed below) should contact Mike Towler to arrange booking.

NOT REQUIRED  
Enrico Prati (will stay in Pisa)

TTI, ATTIC - one single mattress  
Mike Towler

TTI, NURSERY - one single bed  
Rafael Sorkin

TTI, PLAYROOM - two single beds, one double bed  
Hrvoje Nikolic, Daniel Thorpe, Kris Krogh



TTI, PINK ROOM - 1 double bed, one child mattress  
Samantha Keil, Saska Towler

TTI, LILAC ROOM - two single beds  
Nelson Pinto-Neto, Patrick Peter

TTI, TINY ROOM - one single bed  
Antony Valentini

TTI, RED ROOM - one double bed  
Chris Dewdney, Glenys Dewdney

TTI GARDEN ROOM - two single bunk beds  
Travis Norsen, Ward Struyve

DOCTOR'S HOUSE, UPPER BIG ROOM - 1 double bed, 1 cot, child rucsac, Mayan wrap  
Lucien Hardy, Vanessa Hardy, Vivienne Hardy

DOCTOR'S HOUSE, UPPER TWIN ROOM - two single beds [+ temporary mattresses]  
Paavo Pylkkanen, Elina Pylkkanen [+ Kasper Pylkkanen, Ester Pylkkanen Mon 30]  
(4 nights from Fri 27th, dep morning Tue 31)

Maaneli Derakhshani, Joshua Rosaler (4 nights from Tue 31)

DOCTOR'S HOUSE, UPPER SMALL ROOM - one three-quarter bed, one child's bed  
Kasper Pylkkanen, Ester Pylkkanen  
(3 nights from Fri 27th, move to parents' room on Mon 30)

Basil Hiley  
(4 nights from Mon 30)

DOCTOR'S HOUSE, LOWER APARTMENT - one double bed, two single bunk beds,  
one comfortable sofa  
Gregorio Benincasa, Christos Efthimipoulos, Dionigi Benincasa

CASA FRANCA - ROOM 1 - one double bed  
Jeremy Butterfield, Mari Hirano

CASA FRANCA - ROOM 2 - one double bed  
Richard Havery

CASA FRANCA - ROOM 3 - one double bed  
Murray Daw

CASA FRANCA - ATTIC ROOM - one single bed  
Jos Uffink

CASA LUCIANA - ROOM 1, one double bed, one single bed  
Gillie Naaman-Marom, Michael Naaman-Marom

CASA LUCIANA - ROOM 2, one double bed  
Wayne Myrvold

CASA LUCIANA - ROOM 3, one pull-out sofa bed (not private)  
Maaneli Derakhshani (3 nights from Sat 28, move Tue 31 to DOCTOR'S HOUSE, UPPER TWIN ROOM)

CASA ANNA MARIA - ROOM 1 - one double bed, one single bed  
Pui Ip  
Joshua Rosaler (6 nights from Wed 25, move Tue 31 to DOCTOR'S HOUSE, UPPER TWIN ROOM)

CASA ANNA MARIA - ROOM 2 - one double bed  
Wouter Valentin

CASA ANNA MARIA - ROOM 3 - one double bed  
James Yearsley

BEDOUIIN TENT - two single beds ([www.vallico.net/tti/tti\\_tent.html](http://www.vallico.net/tti/tti_tent.html))  
Samuel Denny, Ilja Schmelzer

CASA GIANPIERO - ROOM 1 - one double bed  
Alberto Montana

CASA GIANPIERO - ROOM 2 - two single beds  
Herman Batelaan  
Xavier Oriols

Nearby 'hotel rooms' (within 15 minutes drive)

-----  
DA SANDRA - [dasandra.jimdo.com](http://dasandra.jimdo.com) - 20 min. walk/5 min. drive from Vallico Sotto  
=====

1 double room with bathroom at 50 EUR/night  
Booked from Sat 28 Aug for 7 nights leaving Sat 04 Sep for:  
Andrew Bennett, Elaine Bennett

1 double room with bathroom at 50 EUR/night  
Booked from Sat 28 Aug for 6 nights leaving Fri 03 Sep for:  
Anton Ramsak, Branka Ramsak

1 triple apartment (1 double, 1 single in separate rooms) with bathroom/kitchen at 60 EUR/night  
Booked from Fri 27 Aug for 7 nights leaving Fri 03 Sep for:  
Lev Vaidman  
Pedro Naranjo Perez

1 triple apartment (three singles in 1 room), bathroom/kitchen at 60 EUR/night  
Booked from Fri 27 Aug for 7 nights leaving Tue 31 Aug for:  
Shantena Sabbadini  
John Bush  
David Peat if required..

1 quadruple apartment (1 double bed, 2 singles, bathroom, kitchen) 70 EUR/night  
Booked from Sat 28 Aug for 4 nights leaving Sat 04 Sep:

ALL DA SANDRA ROOMS MUST BE PAID FOR PRIVATELY

CASALE DEI RUSCELLI - [www.casaledeiruscelli.com/en/](http://www.casaledeiruscelli.com/en/) (10-15 minutes drive)  
=====

1 quadruple apartment, 110 EUR/night  
Booked from Sat 28 Aug for 4 nights leaving Wed 1 Sep, for:  
Howard Burton, Irena Burton, Louis Burton, Emma Burton

MUST BE PAID FOR PRIVATELY

Real hotel rooms (30 minutes drive)

-----  
VILLA MOORINGS - 3 star luxury hotel in Barga  
<http://www.villamoorings.it>

HOTEL MEDIAVALLE - Adequate hotel in Galliciano  
[http://www.accademiadelturismo.com/strutture/alberghi\\_gr04.htm](http://www.accademiadelturismo.com/strutture/alberghi_gr04.htm)

## 6 CONFERENCE VEHICLES

OFFICIAL VEHICLES (COLLECTIVELY ABLE TO TRANSPORT EVERYONE SIMULTANEOUSLY)

17 seater minibus (driver: Mike Towler)  
6 seater Fiat Multipla (driver: Herman Batelaan)

OTHER VEHICLES PRESENT FOR WHOLE WEEK:

5 seater car (driver: Andrew Bennett)  
5 seater car (driver: Dionigi Benincasa)

OTHER VEHICLES PRESENT FOR PART OF THE WEEK:

5 seater car	(driver: Jeremy Butterfield)	Mon 30-Thu 02
5 seater car	(driver: Howard Burton)	Sat 28-Wed 01
5 seater car	(driver: Paavo Pylkkanen)	Fri 27-Tue 31
5 seater car	(driver: Anton Ramsak)	Sat 28-Fri 03
5 seater car	(driver: Shantena Sabbadini)	Fri 27-Tue 31
5 seater car	(driver: Vaidman/Naaman-Marom)	Fri 27-Thu 02

OTHER VEHICLES MAY BE PRESENT BUT NOT RELIED UPON

5 seater car	(driver: David Peat)	??
5 seater car	(driver: Enrico Prati)	??

SPARE DRIVERS FOR EMERGENCIES (please bring driving licenses)

Murray Daw  
Patrick Peter

56 people in total

VEHICLE AVAILABILITY TABLE

-----

DAY	NO. SEATS	NO. PEOPLE TO TRANSPORT
Sun 22	23	5
Mon 23	23	5
Tue 24	23	5
Wed 25	23	9
Thu 26	23	11
Fri 27	38	24
Sat 28	58+	51
Sun 29	58+	52 (assume Peat arrives/departs)
Mon 30	63	55
Tue 31	53	51
Wed 01	48	47

Thu 02	48	43
Fri 03	33	32
Sat 04	33	31

Prati assumed each day Mon to Fri, though in fact only 2 dinners/excursions.  
 Prati may have 0, 1 or 2 guests (not counted in the table).  
 Prati's and Peat's cars not counted in vehicles.

## 7 THINGS TO BRING WITH YOU

- The overheads for your talk if you intend to give one - see later section for supported formats.
- Your laptop, if you wish (though this is not strictly necessary if you wish to simply read email or browse as we have large numbers of them - see note in Technical Equipment section).
- Summer hiking gear such as boots, socks, little rucsacs, sunhats etc.
- Italian plug converters if you want to plug anything in (we have some spare ones). Our sockets mostly have two round pins (with an optional third one between them). There are two types of thin prongs on European adaptors. You want the thinner of the two. Just to confuse things, there are also lots of totally incompatible English plug sockets into which English equipment can be plugged directly.
- Some Euros for spending in restaurants and shops. Please note that there is no cash machine in Vallico Sotto, and although we might pass them from time to time on our afternoon trips, large numbers of people getting money out can cause considerable delays. There is a cash machine in Pisa airport to your right as you emerge into the arrivals hall. In 2008 a cash machine was installed in the village of Fabbriche di Vallico a few kilometres away which, after a shaky start, has now become reasonably reliable at dispensing money on request.
- People who intend to visit caves or canyons should bring some clothes and old shoes that you don't mind getting wet and a head torch (though we have supplies of torches if necessary).
- Climbing equipment (harness, helmet plus via ferrata gear if you have them) if you intend to take part in activities where this will be needed. We have limited supplies which are not enough to go round.
- Light sleeping bag and a torch (if you intend to sleep in the Bedouin tent).
- Hay fever tablets, if your body doesn't like living in the countryside.
- A musical instrument, if you can play a portable one. See Section 15.
- Sunscreen
- A towel
- Swimming costume (if you wish to go swimming).

In the traditions of earlier workshops, you might also optionally like to bring

- A nice bottle of wine (or whatever passes for it in your country).
- An interesting thing

## 8 CONFERENCE SCHEDULE

This section contains the schedule for the conference, including a list of talks. The number of talks per day is deliberately small to allow time for thinking, discussion and deliberation. There may also be evening discussion sessions (currently unscheduled) as required. If you do not wish to give a talk, or if you wish to give a shorter/longer talk than suggested, please ask. All excursions and activities are, of course, optional - and you may elect simply to relax at the Institute in the afternoons. We have to book restaurants well in advance for such large groups so please make it known as soon as you can if you do not wish to attend particular meals.

Wednesday 25th-Thursday 26th August  
-----

STAFF TRAINING

Friday 27th August  
-----

EARLY ARRIVALS

Dinner at Il Canapale in Vallico Sopra (0583 761829) - BOOKED FOR 17.

Saturday 28th August  
-----

ARRIVALS

Assault on Pizzo d'Uccello - the 'Matterhorn of the Apuan Alps'

[www.tcm.phy.cam.ac.uk/~mdt26/tti2/photos/pizzo\\_ducello.jpg](http://www.tcm.phy.cam.ac.uk/~mdt26/tti2/photos/pizzo_ducello.jpg)

Depart Vallico Sotto car park 8am.

You will need to arrive at TTI on Fri 27th to take part in this expedition.

VOLUNTEERS: Lev Vaidman, Wayne Myrvold, Ilja Schmelzer

7pm : Welcome buffet dinner and drinks in the Institute garden.

Sunday 29th August  
-----

08.30 : Mike Towler (40 minutes)

- "Introduction to the conference part 1"

09.10 : Antony Valentini (40 minutes)

- "Introduction to the conference part 2"

10.00 : Lucien Hardy (50 minutes)

- "Why we should consider situating the de Broglie-Bohm model in the context of a much more general framework for hidden variable theories?"

11.00 : Nelson Pinto-Neto (50 minutes)

"The de Broglie-Bohm interpretation of quantum cosmology"

12:00 : Alberto Montina (25 minutes)

- "Resource cost in the classical simulation of a quantum preparation-measurement process"

12.30pm : CHURCH (if you want)

EXCURSION:

Trip to Alto Matanna. Four spectacular walks of varying difficulty.

See the Versilia coast, Elba, Corsica and sometimes even France from

the easily accessible summits of some of the most beautiful scenery in the

Apuan Alps. Bring one of the Institute's antique telescopes to watch the

more courageous of you scale the 500 foot cylindrical barrel of Monte Procinto.

Followed by drinks and dinner in 19th Century Alpine hotel.

- Balloon station walk
  - Monte Matanna walk
  - Monte Procinto climb
  - Grotta all'Onda walk (Neanderthal cave)
- DINNER : Alto Matanna hotel 0584 776005 (20 EUR per adult) - BOOKED FOR 52 (51)

Monday 30th August

-----

- 08.30 : Paavo Pylkkanen (50 minutes)
  - "The philosophical relevance of Bohm's interpretation of quantum theory"
- 09.30 : Hrvoje Nikolic (50 minutes)
  - "Making Bohmian mechanics compatible with relativity and quantum field theory"
- 10:30 : Lev Vaidman (50 minutes)
  - "Bohm versus Everett"
- 11:30 : John Bush (25 minutes)
  - "Pilot waves and the quantum behaviour of bouncing droplets"
- 12.00 : Mike Towler (25 minutes)
  - "Dynamical relaxation to quantum equilibrium: the magic of moving nodes"

SUGGESTED EXCURSIONS:

- Monte Sumbra
- Orrido di Botri/Montefegatesi
- Barga with optional swimming
- Staying in the monastery

DINNER : Il Laghetto 0583 75798 (25 EUR per adult) - BOOKED FOR 56 (55)

Tuesday 31st August

-----

- 08.30 : Basil Hiley (50 minutes)
  - "Moyal and Clifford algebras and the Bohm approach"
- 09.30 : Travis Norsen (50 minutes)
  - "Out of this world ontology"
- 10.30 : Andrew Bennett (40 minutes)
  - "Lorentz-invariant relaxation to quantum thermal equilibrium"
- 11.20 : Xavier Oriols (25 minutes)
  - "Quantum many-particle computations with Bohmian trajectories"
- 11:50 : Howard Burton (25 minutes)
  - "TBC"

SUGGESTED EXCURSIONS:

- Tana di Cascaltendine + search for the Cave of the Fairies
- Turrte di San Rocco canyon walk
- Boating on the Turrte Cava lake (+ Buca del Lago della Turrte Cava)
- Staying in the monastery

DINNER : Da Sandra 0583 761712 (20 EUR per adult) - BOOKED FOR 52 (51)

Wednesday 1st September

-----

- 08.30 : Antony Valentini (50 minutes)
  - "In search of a breakdown of quantum theory"
- 09.30 : Rafael Sorkin (50 minutes)
  - "A re-formulation of quantum theory in which events really do (or do not) happen."
- 10.30 : Herman Batelaan (50 minutes)

- "Particle diffraction from a double slit and a phase grating; can random electrodynamics provide a physical picture for the de Broglie-Bohm pilot wave?"
- 11:30 : Wayne Myrvold (25 minutes)
- "Are corpuscle trajectories idle wheels?"
- 12:00 : Joshua Rosaler (25 minutes)
- "Decoherence and the emergence of deterministic classical behaviour in de Broglie-Bohm theory"

#### SUGGESTED EXCURSIONS

- Walk Matanna to Monte Forato (rock arch) to Fornovolasco
  - Tana che urla/"Cave that screams" exploration (+ optional cave hunting)
  - Grotta del Vento tourist cave
  - Fornovolasco church and flood frescoes
  - Swimming at Gallicano
  - Staying in the monastery
- DINNER : Eremo di Calomini 0583 767041 (20 EUR per adult) - BOOKED FOR 48 (47)

#### Thursday 2nd September

-----

- 08.30 : Ward Struyve (50 minutes)
- "Pilot wave theory and quantum fields"
- 09.30 : Ilja Schmelzer (50 minutes)
- "About pilot wave field theory"
- 10.30 : Patrick Peter (50 minutes)
- "Cosmological problems and a possible non-inflationary solution in the framework of de Broglie-Bohm quantum cosmology"
- 11.30 : Anton Ramsak (25 minutes)
- "De Broglie-Bohm analysis of entangled qubit pairs"
- 12.00 : Peter Riggs (25 minutes)
- "Testing de Broglie-Bohm theory with 21st-century technology"

#### EXCURSION : A DAY IN THE VILLAGE

- Abseiling to the Buca della Fate di Vallico di Sotto
- Walk to Trassilico
- Staying in the monastery

FOOTBALL MATCH 6.30pm - Vallico Sotto vs the world/Vallico Sotto contro il mondo

DINNER 7.30pm : Provided by Federico and his assistants in the old Vallico Sotto restaurant (10 EUR per adult) - BOOKED FOR 43

#### Friday 3rd September

-----

- 08.30 : Christos Efthimiopoulos (50 minutes)
- "The role of chaos in the de Broglie-Bohm quantum theory"
- 09.30 : Enrico Prati (50 minutes)
- "From classical to quantum observables in mesoscopic electron systems"
- 10.30 : Maaneli Derakhshani (25 minutes)
- "On the phase-quantization problem in stochastic mechanics"
- 11.00 : James Yearsley (25 minutes)
- "Comparing solutions to the arrival time problem in de Broglie-Bohm theory and decoherent histories: What can we learn?"
- 11.30 : Gillie Naaman-Marom (25 minutes)
- "The validity of a naive approximating formula for Bohmian velocity"

SUGGESTED EXCURSIONS:

- Trip to Lucca

DINNER: Il Totto, Sassi, 0583 760061 (20 EUR per adult) - BOOKED FOR 32

Saturday 4th September  
-----

DEPARTURES

POSSIBLE EXCURSIONS FOR THOSE WHO ARE NOT LEAVING IMMEDIATELY.

Suggested excursion: the climb of Pania della Croce.

Extra unassigned activities which can be easily planned:

- Lucca villas
- Random cave hunting trips following new cave maps acquired this year (e.g. Campolemissi, Fabbriche di Vallico, Antro della Paura, Motrone)
- Pietrasanta
- Vinci (Leonardo's birthplace)
- Walk from Collodi to Pescia
- Local mountain trips (Monte Sumbra, Monte Croce etc..)
- Beach trips to e.g. Sestri Levante, Portofino, Cinque Terre

NO TALKS: Dionigi Benincasa, Gregorio Benincasa, Jeremy Butterfield, Murray Daw, Chris Dewdney, Richard Havery, Kris Krogh, F. David Peat, Shantena Sabbadini, Jos Uffink, Wouter Valentin, Pedro Naranjo Perez  
-----

## 9 TTI TECHNICAL EQUIPMENT

There are a large number of Sony Vaio and Acer Ferrari 4005 laptop computers in the Institute available for public use, almost all in dual-boot configurations running OpenSuse/Ubuntu Linux (preferred) and Windows XP or Vista.

All connections are made through a standard wireless network. If you wish to bring your own laptop then it therefore needs to be wireless-enabled if you wish to log into the network (for older machines we have three spare wireless network cards that you can plug into your laptop PC card slot). The Institute SSID is 'TTI' and the network is completely unencrypted due to the total absence of hackers, or indeed computers, in remote mountain villages. Since June 2009, TTI is hooked up to the local 2 Mb/s wireless broadband network.

Apart from computers and networking devices, we also have the following equipment available:

- HP Laser P3015 b/w laser printer (on a wireless print server). Print queue 'hp'.
- Canon Pixma ip4000 colour inkjet printer (attached to laptop 22). Print queue 'canon'.
- Epson Stylus R340 colour inkjet printer (attached to laptop 20).
- Hi-Ti Transphotable and Sony photo printers for instant printing of photographs (you can plug in your camera directly - no need to go through a laptop - accepts all memory card formats that I am aware of).
- Epson Perfection 4990 scanner



- A3 laminator
- Guillotine.
- Finepix F455 digital camera
- Four memory sticks (2-8 Gb)
- A supply of writeable CD-Rs, CD-RWs and DVD-Rs.
- The usual stationery and staples etc..

## 10 INTERNET USE

TTI laptops are mainly black/grey Sony Vaios with a few red Acer Ferraris (note the difference in power supplies - the ones for the Ferraris have yellow ends, the Sony machines have black ones). All but `tii_laptop1` and `tii_laptop14` are in dual boot configurations with some version of OpenSuse or Ubuntu Linux and Windows XP/Vista - after turning them on you should choose which OS you want. All will boot into Linux after some time by default unless you say otherwise. We essentially never use Windows here so the setup on the Windows partitions will be minimal if it has been done at all.

Since June 2009 the monastery's local network connects to the outside world through a 2Mb/s wireless broadband network (having previously been on dialup!). All local machines have static IP addresses 192.168.1.xx (where xx is 20 plus the number of the machine - a red plastic label saying e.g. `tii_laptop14` implies 192.168.7.34) so they can all talk to each other via ssh or ftp etc. With appropriate software all the laptops can be used together as a parallel supercomputer should anyone need to do intensive calculations.

Other network details for administrators: IP 192.168.1.xx (static xx=10-99, DHCP assigned numbers from xx=102-200), Gateway 192.168.1.1, Primary DNS 62.94.0.41, Secondary DNS 212.216.112.112.. The router has a (password protected) web page at 192.168.1.2. Other equipment attached to the network - a VoIP phone (192.168.1.98), an internet radio (192.168.1.99), a wireless print server (192.168.1.101) and possibly the NEC projector on DHCP. Do not assign your own static IP number on personal hardware without consulting MDT.

Please be mindful of the needs of other users of the network. Although we have broadband, it is hardly a superfast connection, and downloading Gb of files to patch your machine or whatever is discouraged, especially if you are using Windows..

Note also that there is currently network coverage only in the main TTI building and not in any of the other houses we use for accommodation (Doctor's House, Casa Franca, Casa Luciana, Casa Anna Maria, Bedouin Tent etc.).

## 11 PRESENTATION EQUIPMENT

The church is equipped with a good quality NEC MT1075 projector (native resolution : 1024x768, maximum resolution 1600x1200) with speakers, and an auxiliary Toshiba DPD TDP-T250U projector, both with DVI and regular RGB cabling. There is a giant 16' by 12' main screen, a 7'8 x 5'9 electric auxiliary screen, an Avervision document camera, a dual projection stand, a projection laptop, a DVD player with decent speakers, and various wireless control devices. There is a giant blackboard in the church and a smaller one in the lower corridor stolen from the TCM Seminar room in the Cavendish Laboratory. There are two blackboards outside, and a portable one which can be taken on excursions if you wish to debate physics in restaurants or up mountains.

The NEC projector is wireless capable, so you can beam your talk from your laptop straight to it from anywhere in the room, as well as with old-fashioned direct connection from your own laptop (full technical specs on the TTI website). The official TTI presentation laptop directly connected to the projector is

the only one in the Institute running Windows (due to the great difficulty open-source Linux programmes have with rendering powerpoint files correctly). Talk files can be transferred to it using memory sticks or by wireless download; it has the usual software such as Acroread (for displaying PDFs) and Powerpoint Viewer (for attempting to display Microsoft ppt etc. files). If you send the talk file to MDT beforehand he will ensure that it is on the projection laptop ready for your talk. If you wish to do this yourself, you should put your talk file on the Desktop of the projection laptop - at least the day before if possible - and *test* that it is displayed correctly.

The Avervision document camera is a sort of cool overhead projector. It will display any printed document, photo, slides, X-ray film or 3D object straight through the projector, so basically you can dissect a frog, or a scorpion, live on the wall. There is a Victorian microscope with an attachment that allows it to be connected to the Avervision, so biological people can project the microworld on the big screen. Although we have a table with a white square painted on it, non-electronic talks are probably better on white pieces of paper rather than on transparencies..

## 12 TTI LIBRARIES

There are also a very large number of scientific and technical books which may be borrowed (top floor of the main building, and in the various bookshelves in the church). Please sign your name and the title of the book on the sign-up sheets attached to the various bookshelves.

To serve the interests of this conference we have an extensive collection of quantum foundations physics and philosophy books in the "Quantum Foundations Library", and printed copies of pretty much every paper on de Broglie-Bohm theory that has ever been published in the "Literature Pigeonholes". Both these libraries are located at the back of the church/lecture hall. The latter is a physical manifestation of the "Further Reading" page of MDT's online course in de Broglie-Bohm theory which may be found at the following URL:

[www.tcm.phy.cam.ac.uk/mdt26/~pilot\\_waves.html](http://www.tcm.phy.cam.ac.uk/mdt26/~pilot_waves.html)

Each section of the "Further Reading" list corresponds to one pigeonhole. The papers in each are in date order (newest at the top). Please try to keep them in roughly the same order if possible.

The main non-scientific collections are in the middle floor bookcases, including the "TTI Antiquarian Library" (be careful with these mainly very old books - ask MDT for a tour), and the Guide book, Tourism and Map shelves. The top floor bookcases also include a large section of non-scientific books however, including novels.

Tucked away in a corner of the attic is the 'Crap Book collection' containing embarrassing trashy novels and Mills and Boon Romances.

## 13 EXCURSIONS AND ACTIVITIES

The various excursions and activities are divided into categories according to the physical effort involved. As there will be around 60 people at the conference, it is envisaged that each day the group will split into three or more subgroups, with the young muscular virile people doing the strenuous excursions, and the lazy, elderly and unfit doing more relaxed activities. Although we have incorporated suggested activities into the programme above, everyone is welcome to consider the following list and also to consult the various guidebooks in the TTI library in order to suggest alternative activities.

### 13.1 Very strenuous activities

- Climb the peak of Pizzo d'Uccello. Requires early start with no other activities (e.g. day before conference). See [www.tcm.phy.cam.ac.uk/~mdt26/tti2/photos/pizzo\\_ducello.jpg](http://www.tcm.phy.cam.ac.uk/~mdt26/tti2/photos/pizzo_ducello.jpg).

Enough said. They don't call it the 'Matterhorn of the Apuan Alps' for nothing.

- The ascent of Monte Procinto. This is a huge cylindrical rock tower with a belt of trees around its middle from which rise 500-foot walls, overhanging on every side. Michelangelo had the idea of carving it into a gigantic sculpture along the lines of Mount Rushmore but never got round to it. You can see the mountain here: [www.vallico.net/procinto2.jpg](http://www.vallico.net/procinto2.jpg). Yes - the walls are more or less vertical, but there is a *via ferrata* to clip yourself onto. Instruction, assistance, and the necessary equipment can usually be supplied - but we only have about ten harnesses so feel free to bring your own if you have one!
- Reach the high peak of Pania della Croce from Piglionico (described as 'The finest peak in the whole of Italy' in *Below the Snow Line* - one of the 19th century books in the TTI Antiquarian Library). Also features in Dante's *Divine Comedy*. This defeated some of TTI finest mountaineers for several years before they finally succeeded in 2007 (note - it isn't that hard if you move quickly).
- Find the spectacular natural rock bridge of Monte Forato (under which someone once flew a bi-plane). Start from Fornovolasco (lots of up) or from Matanna/Palagnana (much easier) or even have two groups that meet in the middle and exchange car keys. New for 2010: there is a fun *via ferrata* traverse on the way to the arch from Matanna, and we can consider a new route via Foce di Valli.
- Find the Neanderthal cave (Grotte all'Onda) down the slope from the balloon station near Matanna. "This vast grotto stretches 40 x 60 meters and it originally hosted numerous internal tunnels, which are obstructed today. Its enormous cavity offers important evidence that suggests the frequency with which people entered the grotto, from pre-historical times to more recent periods. The first people to use the cave were Neanderthals; they hunted throughout the surrounding area and probably used it to hoard their tools and weapons, together with the bones of the animals they cooked. Hunters from the Superior Palaeolithic period (Homo Sapiens) lived in the more external part of the grotto where they set up a giant hearth. Later, Neolithic farmers and shepherds planted their huts in the shelter of the grotto's vast vault, carrying out their daily activities there during many seasons. This cave was also used during the Neolithic period (the Bronze Age), during which new models were developed for decorating ceramic. During this period, new raw materials, imported from distant locations, were adopted to make special equipment. From the post-Bronze Age until recent times, the grotto was not continuously frequented."
- The new Geoscopio web site (link/instructions at [www.vallico.net/tti/tti\\_mountaineering.html](http://www.vallico.net/tti/tti_mountaineering.html)) shows precise locations of all of the thousands of caves in Tuscany (even the crap ones) together with a brief technical description and a plan of the cave. Interesting little expeditions may be made that have the aim of finding the entrance to particular caves, as well as exploring them. This is of course the most fun that a boy can have. The Apuan Alps have more caves than you can possibly imagine, so this will still be a viable activity in 2050. In particular, ask Mike about the untried Campolemisi, Fabbriche di Vallico, Motrone, and Antro della Paura expeditions.
- Explore the gorgeous canyon of the Turrite di San Rocco river. This starts from the fork in the river upstream from Fabbriche di Vallico before you get to Gragliana. Take the left-hand fork. The aim is to go all the way through it to take coffee at the cafe near the Chiesa di San Rocco in Turrite. Be prepared to get wet. There are some great natural swimming pools in there. Once reaching the village where the cafe is (there is also a children's playground and a nice river) you will have to bribe a local (pool your Euros) to give your driver a lift back via Focchia to your van. Use your initiative here.
- Morning workout. Run from the Institute each morning at 6am to the spectacular summit of Monte Palodina in order to tone up your thigh muscles and pep yourself up in preparation for the morning's talks. Mad people only.
- Complete the Cinque Terre coastal walk, a four-hour excursion through some of Italy's most spectacular scenery, or a similar walk near the famous seaside haven of Portofino.
- *Orrido di Botri* canyon walk. The Orrido is a giant canyon created by the Pelago river in the Apennines (about an hour's drive from the Institute) with deep steep walls as high as 200 metres

and in some places only a few metres apart. This is a geologists' and naturalists' paradise. It can only be visited with helmets and suitable clothing you don't mind getting wet. There are some nice long walks in the country above the canyon (watch out for marmites and Royal Eagles - this is one of your best chances to contribute to the TTI Wildlife Photography expedition).

- There are of course any number of spectacular high mountain expeditions in the Apuan Alps and the Institute has a library of guidebooks which you can browse through. Let me know if you want to try anything else (that will fit in the clearly limited amount of time). There is also the TTI Antiquarian library (Mountaineering section) to inspire you.

## 13.2 Quite strenuous activities

- Go to Alto Matanna at the end of the Turrtecava valley and visit the beautiful nineteenth-century hunting lodge that was once the destination for travellers in Rosetta the Balloon on her aerostatic cableway. See the old balloon station at Foce del Pallone and the extraordinary view. On clear days you can see Elba - 100 miles to the South - and sometimes the even more distant Corsica and the French Alps. Come back over the top of Monte Matanna and descend back to the lodge. Take one of the Institute's antique telescopes with you.
- From the Matanna hotel, climb up to the cross on the adjacent ridge for a spectacular view of Monte Procinto, Stazzema and the Apuan Alps. From there you can climb Monte Matanna the other way around, or visit the donkey and his little horse friends who live on the top of Monte Nona. Or you could go on a longer walk below the Giant West Wall of Nona, threading past Monte Procinto, and round the back of Monte Nona which will take several hours. Finish up the day with a fabulous dinner in the Matanna hotel.
- Take part in the latest expedition to the ancient cave known as the *Tana di Cascaltendine* which is the subject of Pietro Magri's 1880 book *An expedition to Mount Gragno and the Cave of Cascaltendine* as translated by Mike and available on the TTI web site (click the Local History Projects link). The 2007 summer school crew were able to photograph the result of the following quote : *'Before coming down from the cavern we used a chisel to inscribe our initials and the year 1880 on both walls of the passage near the entrance.'* This was done in the "Palace of Ismeno" which was the name Magri's group gave to an extensive cave whose entrance is a 6 foot hole about forty feet up a cliff - the full story is on the News from the Towler Institute blog. It is also known that the cave continues for a kilometre beyond where we have penetrated before and this remains to be explored (note that in summer 2007, Mike and Evans went up the big wall in the final chamber with the dangling rope - a place many TTI visitors have visited before - with somewhat amusing consequences - see the blog story 'Bronze Hermaphrodites and the Fat Boy Filter'). Expedition to be followed by cold beers and refreshments in the lovely village of Cardoso, or a circuit of Monte Penna hunting for the lost Cave of the Fairies..
- Visit Selva del Buffardello adventure park ([www.selvadelbuffardello.it/index.php?lang=eng](http://www.selvadelbuffardello.it/index.php?lang=eng)). I quote from their web site: "Among the centuries-old fir trees some acrobatic forest paths, open to everybody, have been created and their aim is to show the wood from a different and adventurous point of view: hanging in the air. It is a challenge for children, youth and adults, who can test their ability with suspension bridges, swinging beams, vertical nets, ropes and obstacles, finding again their lost adventurous spirit. The Adventure Park 'Selva del Buffardello' in San Romano in Garfagnana (locality Pra di Lago) is a real novelty in the Appennino Tosco Emiliano. An old wood of two hectares and a half in the heart of Garfagnana, near the natural 'Parco dell'Orecchiella', with a wonderful view on the Alpi Apuane and on the Fortezza delle Verrucole (old castle). The park entrance is free if you don't practise in the adventure paths." We have never tried this, but it looks like great fun.
- TTI management has discovered that there is a secret underground tunnel in Vallico which starts from the Doctor's House next door to the Institute (a former barracks) and which goes up to the Rocchetta above the village (the site of an old castle on the summit of a little hill, where we now pitch the Bedouin Tent). This was used in mediaeval times for escape from the frequent warfare so common in these parts. The supposed entrance to the tunnel was bricked up (we think) in the

1930s - there are a couple of elderly men in the village who vaguely remember it. This summer we hope to unblock the entrance and explore. We also wish to find the upper entrance, so if you know anyone who has a ground-penetrating radar set we can borrow, let us know. This will probably be one of the next thrilling tales in "News from the Towler Institute".

- Explore the Vallico Sotto mule trail and the spectacular forgotten waterfall of Cascata Pendolina - one of the highest in Italy. Vallico was only connected by road to the outside world in the 1960s - before then people went up and down the *mule trail*. This has now been forgotten and is a little overgrown (though less so following TTI clearing activities) but is still very beautiful. Once we reach the bottom of the valley we will head over the river to the site of the Cascata Pendolina where we will take lunch. On the way back the bravest people will try to ascend the *Canyon of the Pili* carved by the Rio Selvano (you will get wet!). EDIT: and they will fail - I have recently discovered the only way you can feasibly do this is to *descend* from the top. Apparently this canyon is quite famous - the Apians group from Castelnuovo organize tours through it. One of these days I will have to attach myself to one of these expeditions to learn how to do it. Apparently there are 12 major waterfalls to descend - photos and rough maps are linked from the Mountaineering page of the web site.
- Explore the *Buca della Freddana* cave near the mule trail from Vallico Sopra to San Luigi. This was (re-)discovered by Mike in Easter 2007 following conflicting and confusing advice from several local old ladies who remembered its existence from 40 years ago. He has also found the upper entrance of the same cave on the summit of Monte Penna - the two are apparently connected by a 1 kilometre passage. The old ladies have advised us not to go inside because of the evil monsters and dark pits that lurk within, but then again, they always say that. Dare you explore?
- Five a side-football (a new fenced pitch was constructed in Vallico a couple of years ago) or regular football (on the local full-sized pitch).
- Rock climbing or low-level bouldering - the Institute should have some ropes and climbing equipment. I've read that there is good climbing near the Trombacco dam in the next-door Fornovalasco valley - ask MDT for more details. Don't forget to bring climbing boots and a harness that fits if you want to do this seriously (we have a rope you can borrow).
- Pietro Magri in his 1880 book mentioned above states that there are two other caves in Monte Gragno besides the Tana di Cascaltendine. Today no-one seems to know where they are. Having found the Buca della Freddana, Mike has narrowed down the lost "Cave of the Fairies" to a relatively small area. Can you find it?
- Traverse from San Luigi via Monte Palodina and the cliffs of Monte Gragno past the giant karst depression of Pian di Lago to the spectacular Rocca Estense fortress of Trassilico. Come back along the road past La Fornace.
- Explore the *Tana che urla* (the Cave that Screams!) - first explored and scientifically described by Vallisneri in 1726 - off the footpath to Foce di Petrosciano from Fornovalasco. This isn't a tourist cave - so bring some appropriate clothes and torches. The initial waterfall that defeated Vallisneri was climbed by four TTI students in Summer 2009, and we left a rope up there (since stolen!). If you can read Italian, have a look at [www.buffardello.it/attivita/pubblicazioni/di\\_alcune\\_grotte.pdf](http://www.buffardello.it/attivita/pubblicazioni/di_alcune_grotte.pdf).
- Go on a beautiful walk over the highest stone railway bridge in Europe to the church in Sambuca.
- Go wild boar hunting.
- Learn to play local sport *palla elastica* (elastic ball) with the village youths.
- Use TTI's two inflatable boats to play on the Turrtecava lake - accompanying picnic recommended. Have races. Try to find the Buca del Lago della Turrte Cava (as you sail towards the dam, it is on the left just after the exit of the second road tunnel).
- Go kayaking on the Turrtecava. Bring your own canoe.
- Explore the ancient *Vasaio di Motrone* cave in the nearby village of Motrone (see [www.apuane2007.it/italiano/vasaio/zona\\_vasaio.php](http://www.apuane2007.it/italiano/vasaio/zona_vasaio.php)).

- Explore the Buca delle Fate di Coreglia Antelminelli cave. Located and partially explored for the first time by a TTI team in summer 2010, this 2km cave has lots to explore. Mapping, photographs, and written descriptions required.

### 13.3 Relaxed activities

- Visit the Pinocchio park, the Garzoni gardens, and the Collodi butterfly house in Collodi. See [www.pinocchio.it/park.htm](http://www.pinocchio.it/park.htm). From the website: “Inaugurated in 1956, the Pinocchio Park is no ordinary theme park, but rather a precious masterpiece created by artists of great character working together. The literary itinerary, marked out by mosaics, buildings and sculptures set amidst the greenery, emerges from an inspired combination of art and nature. The path is winding, and the dense vegetation means that every stage on the route comes as an unexpected surprise, with the very plants and trees contributing to create the atmosphere and the episodes in the story of the Adventures of Pinocchio. The Park itself is the site of constantly renewed cultural activities that are always mindful of its roots: exhibitions of art and illustrations inspired by childrens’ literature and the Story of Pinocchio, puppet-making workshops, puppet and marionette shows and minstrels enliven the visit to the Park, depending on the season. ”. For the gardens: “The historic Garzoni Garden, one of the most beautiful in Italy, represents a felicitous synthesis between Renaissance geometry and the spectacular quality of the nascent Baroque. The garden is a work of art of rare equilibrium, where the greenery, the flights of steps the water plays and statues form a truly unique ensemble. It is an absolutely unforgettable experience to lose oneself amidst the wonders of this fantastic place: grottoes, theatres carved out of box hedges, statues representing mythological creatures, satyrs, female figures, greenhouses with peacocks, forests of bamboo. An ancient, and somewhat arch tradition considers the visit to be propitious for lovers, and not only on account of the leafy shade and the arbours that offer secluded spots for tender caresses, but also of the maze, a symbolic allusion to the path to follow together throughout life. As soon as we enter the garden we come upon delightful parterres, statues and two large circular pools. Proceeding we then reach two magnificent double ramps of steps featuring a complex hydraulic system that supplies the water plays. These steps lead to the three upper terraces. Beyond is the impressive water staircase, flanked by two female statues representing the eternal rivals Lucca and Florence. At the very top is the statue of Fame blowing into a shell, emerging from which a jet of water traces out a lofty arc. Leading off the main route through the garden are numerous side paths and avenues where we can discover its marvels among the fragrances of the different plants, the plays of light and shade of the vegetation, the intrigue of the mazes and the enchantment of the sculptures. The garden has recently been restored.”
- If you’re here around the last week of July/first week of August, you can visit the Opera Barga festival. Ask Mike in advance for tickets and reservations.
- Look in the latest issue of Lucca “Grapevine” magazine in English for local cultural activities and concerts etc..
- Play with the Institute’s Victorian Scientific Instrument Collection.
- Spend the afternoon bathing in the outdoor hot pool at the ancient thermal baths of Bagni di Lucca (one of the most fashionable spots in Europe in Lord Byron’s time - the Switzerland of Tuscany!). Followed by shopping, sightseeing and coffee in the town centre.
- Samantha has two other favourite open-air pools at Galliciano and Barga. These are like little beach resorts where one lazes about on deckchairs and has the occasional dip.
- Watch the night sky through the Institute’s astronomical telescope.
- Visit the ancient city of Barga ([www.barganews.com](http://www.barganews.com)) for an afternoon’s relaxed sightseeing, shopping and culture.
- Visit the beautiful city of Lucca.
- Visit Castelnuovo di Garfagnana, where you can find Andrea’s (the ‘Indiana Jones of the Garfagnana’) famous Osteria, where all day you can sample fabulous local wines, cheeses and snacks.

- Follow in the footsteps of Michaelangelo, and visit some of the Apuan Alps famous marble quarries.
- Day trip to Florence.
- Drive to the next valley along from ours over a spectacular high mountain road where the eagles live. Visit the Grotta del Vento - the Cave of the Winds ([www.grottadelvento.com](http://www.grottadelvento.com)). This is the most famous cave system in Tuscany and the visitor will enjoy a spectacular and bizarre landscape of caverns and lakes. Take a pullover as the temperature is a reliable 10 degrees the whole year round. Then head down the valley to visit the *Eremo di Calomini* - an ancient monastery built into a high steep cliff.
- Table football and drinking in Fabbriche di Vallico.
- Horse riding at La Fornace.
- Various mild short walks around the Institute.
- Digging the Institute garden and doing little DIY things like restoring the church or clearing paths (I say this merely in hope..).

### 13.4 Very relaxed activities

- TTI now has a high-definition video camera. Make a film of life at one of the world's best conferences.
- Budding archaeologists may use the TTI metal detector - bought following last year's spooky event when Evans and Mike were digging a hole in the ground for the satellite dish (I'm really not making this up): MIKE: Hey Evans, watch out for crucifixes when you're digging that hole. This used to be a monastery you know. EVANS (REACHING INTO THE HOLE) What, like this one? (HOLDS UP A THOUSAND YEAR OLD BRONZE CRUCIFIX FROM FIVE FEET DOWN).
- Spend all day in the TTI garden relaxing in one of the Institute's three hammocks, drinking wine, snoozing or reading one of the books from the TTI library.
- The Institute has a variety of board games, jigsaws, and similar entertainments together with a number of Victorian books with titles like "What To Do On Cold Winter Evenings Given That We Haven't Invented Television Yet".
- Debate physics with the help of the Institute's five blackboards (two of them outside in the sunshine).
- Listen to one of Mike's lectures inspired by the contents of the TTI Antiquarian Library such as *Richard Burton and the Source of the Nile* (Burton the Victorian explorer and polymath, not the one out of *Where Eagles Dare*..) or *Up The Orinoco with Alexander von Humboldt*.
- Spa treatments in the Bagni di Lucca 'Thermal resort'.
- Mike is translating some chapters of a book on the history of Vallico Sotto. If he's finished it by the time you visit, then walk around the village looking at the buildings and places it describes.

### 13.5 General

- The Institute has a wildlife photography notice board. Prizes for the best entries, particularly if you can take a picture of one of the eagles that regular soar above Vallico or of the elusive *marmite*.
- The Towler Institute Exploration Society also has a photographic competition running - see the web site for details.

- Revitalize the economy of Vallico Sotto. It's barely 60 years since 800 people lived here. Now less than 100 do so. Just because modern lazy teenagers want to be fashion models smoking drugs in Milan rather than having a nice healthy outdoor life, the population of rural Italy has been denuded. Let's bring back the time when all the mountain terraces were in production, packs of nice mules helped carry things, teams of volunteers kept paths and bridges open, and everyone knew how to bake chestnut cakes. All serious suggestions gratefully received.

## 14 FOOD

In general both breakfast/cappuccinos and lunch will be provided in the little bar at the bottom of Vallico Sotto run by the lovely Monica.

In the Institute some basic food staples will be provided which participants should feel free to consume but in general you may also buy your own food from local shops. The village shop in Vallico Sotto is currently closed, but there are two food shops in Fabbriche di Vallico - five minutes drive downhill, and a giant Leclerc supermarket in Gallicano (twenty-five minutes drive). There is a tiny shop in the upper village of Vallico Sopra - it always looks closed but they will generally open it if you knock on the door.

To find the Vallico Sotto bar for lunch, go down the tunnel underneath the Doctor's house (the big house opposite the TTI church front door). Then take any path downwards until you get to the Vallico main square - the bar is just underneath that.. You are strongly encouraged to take your lunch here, as normally it doesn't serve food and Monica is doing us a big favour by buying food and preparing it - so we need to make it worth her while. Note you can also get beers and coffees and so on here..

Note that people in local shops - or indeed anywhere round here - tend not to speak English, so learning some basic Italian food words before you come will help : *pane* = bread, *formaggio* = cheese, *prosciutto* = ham, *pomodori*=tomatoes, *birra* = beer, *vino* = wine, *caffè* = coffee, *latte* = milk, *grazie!* = thank you!.

You are of course welcome to make use of the Institute's cooking facilities whenever you want. There is a big downstairs kitchen in the main building with a total of 10 rings formerly run by a proper cook, and a small upstairs kitchen. The Institute even has its very own *Il Collegio Cookbook* written and published by former owner Leonie Whitton whose recipes you are encouraged to try. There are also two kitchens in the adjacent Doctor's house which will be rented for the duration of the conference, and one in each of the Casa Franca and Casa Luciana houses. The one in Casa Anna Maria is best described as 'non-functional'.

On the first evening a simple buffet dinner will be provided. Later in the week the Institute's 16th Century pizza oven may be pressed into service. The rest of the time we will make use of the excellent local restaurants - these are mostly extremely cheap by tourist standards (typically around 20 Euros for a huge feast with wine). Given the large number of people staying at the Institute, people are encouraged to break up into at least two groups, although many of them - especially Da Sandra - are large enough to handle everyone. Unless told otherwise, Mike will simply assume that you will be coming to each evening meal and will make bookings accordingly (generally a few weeks in advance). these bookings can be changed but please give Mike plenty of notice.

Finally, if you are a vegetarian, you need to be aware that the locals will consider you to be slightly mad and will feel very sorry that you are unable to enjoy their passion for delicious animal products of all kinds. Don't worry about this. Following several years of TTI activities, they are now used to us bringing bizarre foreigners to their restaurants and most are now able to supply vegetarian meals of some kind.

### A FEW LOCAL RECOMMENDED RESTAURANTS

- Mulino Biologico (3280 707037, Fabbriche di Vallico) - CURRENTLY CLOSED
- Da Sandra (0583 761289 on the road between Fabbriche di Vallico and Vallico Sotto).
- Il Canapale (0583 761829, Vallico Sopra)



- Al Laghetto (0583 75798, near the lake at the entrance to the Turrtecava valley)
- La Rondine (0583 761751 Fabbriche di Vallico, open Fri evening, plus all day Sat/Sun)
- Alto Matanna (0584 776005, Matanna)
- Ristorante Rita e Rinaldo (0583 357728, Focchia)

#### RESTAURANTS SLIGHTLY FURTHER AFIELD

- Circolo dei Forestieri, Bagni di Lucca
- Antica Trattoria dell'Eremita, Vergemoli
- Il Garfagnino, on the main road near Turrtecava.
- Quadrifoglio, on the main road near Calavorno.
- LOTS MORE - ASK

#### SPECIAL RESTAURANTS

- La Buca di Sant'Antonio, Lucca
- La Mora, Ponte a Moriano
- Butterfly, Lucca

See also the TTI Restaurant Guide page on the website.

## 15 AMATEUR EVENING CONCERTS

The Institute has a high-quality antique violin, a modern electric violin, an electric piano, an acoustic guitar, a microphone and an amplifier. Please feel free to bring your own instruments. Practice in advance is highly recommended.

## 16 CINEMA VALLICO

The requirements of modern science presentations means the Institute church is also the only cinema in the whole of the Apuan Alps - a fact that local people very much enjoy (since the opening presentation of *Cinema Paradiso* in August 2005). During the conference you are welcome to use the projectors and it is expected that movies will be shown on some evenings. The Institute has an extensive DVD library which you are welcome to browse. Feel free also to bring your own movies that you think we might enjoy.

## 17 NEWS FROM THE TOWLER INSTITUTE

MDT has taken to writing stories about events at the Institute and publishing them on his blog at the local Barga News website. See [www.barganews.com](http://www.barganews.com) and the "News from the Towler Institute" blog (or go to the TTI web site [www.vallico.net/tti/tti.html](http://www.vallico.net/tti/tti.html) and click on the relevant link in the left-hand column). So far these are mainly about cave explorations and similar adventures. However, Mike doesn't have a monopoly on this. If you wish to contribute your literary efforts then please send your stories about your adventures in Italy to him, and they will be published on the blog.

## 18 FOOTBALL MATCH: VALLICO SOTTO CONTRO IL MONDO

The thrusting young lads of Vallico Sotto have challenged the Rest of the World - i.e. you - to a game of 5-a-side football on the village pitch. This tradition - which we began a few years ago - attracts a large crowd and we usually get absolutely caned (even when I have had Brazilians available). Can a small mountain village with less than a hundred inhabitants continue to defy the other 6 billion of us? If you think you can stop them, please volunteer.

Volunteers for the TTI team are below:

Herman Batelaan  
Maaneli Derakhshani  
Pui Ip  
Travis Norsen  
Xavier Oriols  
Pedro Naranjo Perez  
Ilja Schmelzer  
Mike Towler (in emergencies)

## 19 SUMMER SCHOOL

Note that in Summer 2011, AV and MDT are thinking of organizing a “Foundations of Quantum Mechanics” summer school at the Institute. The details of this have yet to be worked out, but if you are interested in helping with this event, then please discuss with the organizers during the meeting.

## 20 HEALTH AND SAFETY

We should all recognise that climbing and mountaineering are activities with a danger of personal injury or death. Participants in these activities during their stay at TTI are asked to be aware of and accept these risks and be responsible for their own actions.

Vallico Sotto is a mediaeval village built a thousand years ago on a steep slope with many steps, and the facilities for the disabled are thus completely disastrous to non-existent. However don't let this put you off; if we have to carry your wheelchair up the hill with you in it, then so be it.

TTI is a smoking venue and visitors may smoke as much as they like (ashtrays will be provided).

## 21 APPENDIX 1 : Talk abstracts

Speakers are encouraged to provide abstracts for their talks. The ones we have received are gathered here.

Herman Batelaan

-----

"Particle diffraction from a double slit and a phase grating; Can Random Electrodynamics provide a physical picture for the de Broglie-Bohm pilot wave?"

Abstract: We have demonstrated diffraction from a phase grating (The Kapitza-Dirac effect [1]). For this effect, the momentum kick suffered by the electron can be thought of as due to stimulated Compton scattering. We have also demonstrated electron diffraction from a nano-fabricated double slit [2]. Perhaps surprisingly, by which fundamental process the electron suffers a momentum kick for the double slit case is an open question. It appears not acceptable (to me) that two very similar phenomena (the KD-effect and double

slit diffraction) would not have a similar physical description. To attain such a similar description, we will explore the possibility that the slit imposes a boundary condition on the electromagnetic vacuum field, which in turn affects the electron motion. We have started to use Randon Electrodynamics for this investigation. The result appears to be connected to Stochastic Mechanics and the de Broglie-Bohm theory as these approaches all yield well-defined trajectories.

[1] Observation of the Kapitza-Dirac effect. D. L. Freimund, K. Aflatooni, and H. Batelaan, Nature 413, 142-143 (2001)

[2][http://www.perimeterinstitute.ca/en/Perimeter\\_Explorations/General/Perimeter\\_Explorations/](http://www.perimeterinstitute.ca/en/Perimeter_Explorations/General/Perimeter_Explorations/)

Maaneli Derakhshani

-----

"On the phase-quantization problem in stochastic mechanics"

Abstract: Stochastic mechanics refers to a set of theories which attempt to derive Schroedinger wave mechanics from a stochastic particle dynamics with time-symmetric constraints. Wallstrom ('89) argued that all known stochastic mechanical theories are unsuccessful in this aim, because, in order to achieve equivalence with quantum mechanics, they all require imposing, as a completely ad-hoc constraint, the Bohr-Sommerfeld-Wilson (BSW) quantization condition on the (postulated) current velocity of the particles. Since Wallstrom, various attempts have been made to justify the BSW condition, but all such attempts are problematic in one way or another. This difficulty in justifying the BSW condition is referred to here as 'the phase-quantization problem'. In this talk, I will review stochastic mechanics (using the formulation by Nelson) and the phase-quantization problem, as well as the various (problematic) attempts in the literature to solve the latter. Time permitting, I will then propose a new approach to solving the phase-quantization problem, involving the use of a classical Zitterbewegung particle model (from which the BSW condition can be dynamically justified), and its consistent incorporation into Nelson's stochastic dynamics.

Christos Efthymiopoulos

-----

"The role of chaos in the de Broglie - Bohm quantum theory"

Abstract: Chaotic motions in the de Broglie - Bohm quantum theory arise by the dynamical effects of quantum vortices. The main scaling laws quantifying chaos in two degrees of freedom systems are found by local perturbation theory and verified in numerical experiments. A vortex causes the formation of a particular quantum flow structure called the 'nodal point - X-point complex'. When a large degree of chaos is present, a system with non-typical initial conditions quickly relaxes to a state of quantum equilibrium. In weakly nonlinear oscillators the time of approach to equilibrium is given by a quantum analog of the classical Nekhoroshev time. A particular application of the dBB theory of motion near vortices arises in problems of charged particle diffraction through crystals. An array of vortices is formed in a 'separator' zone between the

domains of prevalence of ingoing and outgoing quantum flow. When the Bohmian trajectories approach a vortex they are scattered abruptly. The total time of flight from source to a detector placed at some angle  $\theta$  can be explicitly calculated in dBB theory. It turns out that for two different angles  $\theta_1$  and  $\theta_2$ , the respective times of flight differ by a quantity  $\Delta T_{1,2} = D/v_0$ , where  $D$  is the beam transverse quantum coherence length and  $v_0$  is the mean particle velocity. Such scaling diversifies the Bohmian theory from other theories of time observables (cf. talk by J. Yearsley), and it is in principle testable by experiment.

Lucien Hardy

-----  
"Why we should consider situating the de Broglie-Bohm model in the context of a much more general framework for hidden variable theories?"

Abstract: The de Broglie Bohm model takes the Schroedinger equation as given and adds particle positions to it in such a way that consistency with the Born rule can be achieved. The hidden variables are (i) the particle positions and (ii) the wavefunction. Having the wavefunction as part of the hidden variables is a bit of a problem for proponents of this model because it leaves open the attack that de Broglie Bohm is just the Many Worlds interpretation in denial. Some people have proposed that the wavefunction should be regarded as law-like but this is distasteful to most because a wavefunction is such a complicated entity. I propose situating the de Broglie-Bohm interpretation in the context of a more general framework for hidden variable theories in which the idea of state evolution is not take as the most fundamental way of doing physics. Rather, we consider the hidden variables which pertain to arbitrary regions of space-time and consider how to combine them when two regions are taken together. This approach offers the hope of resolving the issue of whether the wave function is state-like or law-like in favour of the solution that it would be, in part, both. Further, the question will be raised of whether we can hope to find simple postulates or axioms for the de Broglie Bohm model in the context of such a more general framework which do not take the Schroedinger equation as a given.

Gillie Naaman-Marom

-----  
"The validity of a naive approximating formula for Bohmian velocity"

Abstract: A simple formula for calculating Bohmian velocity for overlapping wave packets. It is exact for particles with a spin, but it also provides good approximation for particles without spin. The approximation improves when the trajectory is observed in a delayed-outcome measurement.

Hrvoje Nikolic

-----  
"Making Bohmian mechanics compatible with relativity and quantum field theory"

Abstract: Nonlocal Bohmian mechanics can be formulated in a relativistic-covariant way by first reformulating ordinary quantum mechanics such that time is treated on an equal footing with space. This means that space

probability density is generalized to spacetime probability density, and that single-time wave functions are generalized to many-time wave functions. The corresponding Bohmian spacetime particle trajectories are parameterized by an external scalar parameter that does not involve a preferred reference frame. The states of quantum field theory are represented by wave functions that depend on an infinite number of spacetime positions, leading to an infinite number of particle trajectories. The appearance of creation and destruction of a finite number of particles results from quantum theory of measurements describing entanglement with particle detectors.

Slides: [www.vallico.net/tti/slides/nikolic\\_2010.pdf](http://www.vallico.net/tti/slides/nikolic_2010.pdf)

Travis Norsen

-----

"Out of this world ontology"

Abstract: I will review Bell's notion of "beables" (local and non-local), and then survey the common reactions to the fact that the de Broglie - Bohm theory appears to involve a non-local beable (the wave function). After reviewing also the several virtues of theories which (like dBB) also involve \*local\* beables, I will argue that these virtues could be realized more consistently and more fully in a theory which posited \*only\* local beables. That is, I will propagandize on behalf of the prematurely- abandoned research program which aims at constructing an empirically adequate Theory of Exclusively Local Beables (TELB), and in particular will argue that dBB represents a particularly promising jumping-off point for this research program.

Xavier Oriols

-----

"Quantum many-particle computations with Bohmian trajectories"

Abstract: From a computational point of view, the direct solution of a system of  $N$  interacting particles is inaccessible for more than very few degrees of freedom. This is at the heart of most of the unsolved problems in quantum transport. I have demonstrated [1] that a system of  $N$  interacting particles can be decomposed into  $N$  single-particle (pseudo) time-dependent Schroedinger equations coupled by Bohmian trajectories. The proposal has similarities with the original work of Kohn and Sham [2] on the Density Functional Theory (DFT). The formidable simplification on the many-particle computations comes at the price that some terms of the potential energy of the corresponding single-particle Schroedinger equations are unknown (the exchange correlation functional in the DFT and a complex potential energy in [1]).

In particular, the previous algorithm [1,3] has been used to develop a powerful quantum (Monte Carlo) simulator for electron transport where randomness appears because of the uncertainties in the energies (of the wave-packets) and initial positions (of the Bohmian trajectories) associated to electrons. Within standard computing facilities, the present proposal is able to deal with  $N < 100$  electrons with Coulomb and exchange interactions in (time-dependent, open systems and far from equilibrium) nanoelectronic devices. Numerical computations of the electron-electron correlation effects on the DC, AC and current noise in resonant tunneling devices will be presented [3-6]. The 'continuous' measurement of the (time-dependent) electric current with Bohmian mechanics [3,6] and the application of the mentioned quantum many-particle

algorithm to other state-of-the-art research fields [1,3] will also be discussed.

#### REFERENCES

[1] X. Oriols, "Quantum trajectory approach to time dependent transport in mesoscopic systems with electron-electron interactions", Phys. Rev. Let. 98(6), 066803, (2007).

[2] W.Kohn and L.Sham, "Self-Consistent Equations Including Exchange and Correlation Effects" Phys. Rev. 140, A1133 (1965).

[3] X.Oriols and J.Mompart, "Applied Bohmian Mechanics: From Nanoscale Systems to Cosmology", Editorial Pan Stanford (in press).

[4] G. Albareda, H. Lopez, X. Cartoixa, J. Sune and X. Oriols, "Time-dependent boundary conditions with lead-sample Coulomb correlations: Application to classical and quantum nanoscale electron device simulators", Phys. Rev. B, in press, (2010).

[5] G. Albareda, J. Sune, and X. Oriols, "Many-particle hamiltonian for open systems with full coulomb interaction: Application to classical and quantum time-dependent simulations of nanoscale electron devices", Phys. Rev. B. 79 (7), 075315-075331, (2009).

[6] A.Alarcon and X.Oriols, "Computation of quantum electron transport with local current conservation using quantum trajectories", Journal of Statistical Mechanics: Theory and Experiment. P01051, (2009).

Enrico Prati

-----

"From classical to quantum observables in mesoscopic electron systems"

Abstract: Semiconductor quantum dots made possible to localize and measure the observables of single electrons. I first review the experimental results from the perspective of the description of experimental process required to extract observables of one or few localized electrons. The generalized temperature of a single electron is defined. The implication of experimental procedure based on macroscopic equipments to define quantum observables on the Gelfand theorems and the algebraic approach to classical and quantum mechanics is discussed. Fundamental limitations of the dBB theory based on the previous discussion are highlighted.

Joshua Rosaler

-----

"Decoherence and the emergence of deterministic classical behaviour in de Broglie-Bohm theory"

Abstract: Assuming that the pilot wave picture of quantum mechanics is true, how can we explain the fact that some macroscopic objects follow deterministic classical trajectories? Attempts to answer this question have tended with few exceptions to regard vanishing of the so-called quantum potential as the central criterion for emergence of macroscopic classical trajectories in pilot wave theory, in some cases ignoring altogether the effects of decoherence. I

point out a number of severe difficulties with this approach and present what I believe to be a far more transparent account of deterministic macroscopic classical motion in pilot wave theory. My approach is first to establish the behavior of the wave function, and only then to consider the evolution of the Bohmian trajectory. In my analysis, I underscore the need for the wave function to undergo a special kind of decoherence in order for pilot wave theory to explain the deterministic classical evolutions of certain macroscopic systems.

Ilja Schmelzer  
-----

"About pilot-wave field theory"

Abstract: In the first part, I argue against the thesis proposed by Wallace that beables have to be decoherence-preferred. In particular, I discuss the question if macroscopic pointer states overlap for Bohmian field theories as well as more general Bohmian theories.

In the second part I present a new proposal for a Bohmian field theory for fermions. It gives a pair of Dirac fermions together with some massive scalar bosonic field.

This proposal is closely connected with a condensed matter interpretation for the standard model of particle physics and gravity which will be shortly introduced.

Rafael Sorkin  
-----

"A re-formulation of quantum theory in which events really do (or do not) happen."

Abstract: I will rephrase the question, What is a quantal reality?, as What is a quantal history? (the word history having here the same meaning as in the phrase sum-over-histories). The answer I will propose seeks to resolve the contradiction between the classical conception of reality as a single history and the principle that events of measure zero cannot occur (the Kochen-Specker paradox being a classic expression of this contradiction). Instead of being identifiable with a single history, reality will be described by an "anohomomorphic coevent", a sort of polynomial in such histories. The so called measurement problem is then solved if macroscopic events possess a certain separability property related to, but distinct from, "consistency" as used by "consistent historians". The new conception of reality modifies the rules of logical inference in a certain sense, but it involves neither multiple worlds nor external observers. It is therefore suitable for quantum gravity in general and for causal sets in particular.

Ward Struyve  
-----

"Pilot-wave theory and quantum fields"

Abstract: I present some possible pilot-wave theories for quantum fields. I will also discuss the issue of fundamental Lorentz invariance.

Lev Vaidman

-----

"Bohm vs. Everett"

Abstract: The versions of Bohm and Everett interpretations of quantum mechanics, which I find most attractive, will be presented. Strengths and weaknesses will be briefly discussed. In particular, the two approaches will be compared in their description of the past of a quantum particle.

James Yearsley

-----

"Comparing solutions to the arrival time problem in de Broglie-Bohm theory and decoherent histories: What can we learn?"

Abstract: The study of quantum non-equilibrium notwithstanding, it is well known that probabilities for the outcomes of measurements as computed by de Broglie-Bohm theory (dBB) agree with those obtained via standard quantum theory. There are situations, however, where standard quantum theory does not supply us with a unique probability distribution, and it is natural to ask whether alternative interpretations of quantum theory can do any better.

One such situation is the arrival time problem in quantum mechanics: what is the probability that an incoming wave packet crosses the origin during a given time interval? This question is straightforward in classical mechanics, but is ambiguous in standard quantum mechanics.

By contrast, the same calculation in dBB is trivial. Since the theory is formulated in terms of trajectories, the arrival time probability is just the flux. However the issue is not without subtlety. For example, it is not obvious that there exists any measurement that would yield the flux as the outcome. It is therefore useful to compare the computation of arrival time probabilities in dBB with other interpretations of quantum theory.

I will present a summary of recent progress in understanding this problem from the perspective of the decoherent histories approach to quantum theory. This approach is naturally suited to the problem because, like dBB, it makes use of the concept of a trajectory. I will show how one can derive a probability distribution on histories corresponding to arriving in a given time interval, and that these histories are decoherent for simple initial states. The associated probabilities are then time integrals of the flux at the origin, and thus agree with the expected classical result, and also with the result from dBB.

I will argue that the decoherent histories analysis both supports the conclusion of dBB that the correct arrival time probabilities are related to the flux, but also helps us to understand whether these probabilities can in principle be measured. This is because decoherence of histories is equivalent to the statement that there



exists some measurement that one could perform that would reproduce these probabilities.