# Information Theory and Practice

## Duino Castle (Italy)
## October 19th-21th, 2007

*Organized by:*
***G Luhn, K. Kornwachs, H. Grassmann***
***Sponsored by:***
***Isomorph srl, Qimonda AG***

***Web: http://www.isomorph.it/science/duino2007***

# Index

# 1. Purpose of the workshop

We organize this 3-day-workshop with the aim of open discussion, active blackboard drawings, practical demonstrations/tests and common conclusions on the subject of “information”. The conference tries to unify and compare all different approaches and mindsets in an interdisciplinary fashion, including some related topics like “activity”, “order” and “chaos”. We would also like to consider the impact of the topic “information” (which seems to be still more a topic than a concept) on technical developments and also on society as a whole – and vice versa.

a) Goals of the workshop:

- Discuss status and boundaries of actual information concepts:
    - Walkthrough and elaborate your own example
    - Discuss openly and in detail power and problems of present/presented approaches
- Discuss new proposals for “information concept”:
    - We would like to encourage everybody to present or to collaborate to new proposals
    - We have prepared a paper with an example of such a proposal, which is meant to be an input for the discussion
- Draw up first examples for new solutions
    - Any new proposal you might bring in …

b) Topic memory:

- The status of the debate at present, can be summarized by the following statement: the “mixing of a syntactic and a semantic connotation of the term *information* has generated damaging effects to this very day.” Peter Rechenberg, Informatik Spectrum 10/2003, pp. 319
- We think that this workshop can be a stimulus and a source of motivation in order to continue on this road. The exercise might end in finding a common meaning for the word *information,* from both the scientific and the common sense side, as it has been the case with the concept of “energy”.

- Our goal is that we all together move (even minor) steps forward on this road.

- Information and Systems theory
  - Systems theoretic approach (limits due to “describing methodology/Kopenhagen interpretation of the world”)
  - Complementary
  - Pragmatic information
  - Knowledge systems
  - Biological systems
  - …

- Physics, Maths and information
  - Mathematical theory of Information
  - Synergetics
  - Embodiment and information
  - Algorithmic and non-algorithmic information
  - Linear physics: Non-probabilistic information theory
  - Locality, non-locality
  - “mirror-neurons”
  - …

- Information and Psychology
  - Which concepts of Information are used in Psychology/Biology
  - Main problems and limits of such concepts
  - Where does Information comes from (see debate on “free will”)
  - Information – Knowledge – Language - Emotions
  - Possible next steps in Cognitive Psychology with regard to new concepts of Information
  - …

- Philosophical discussion
  - Words and history,  about information
  - Semantics and Information
  - Information and society
  - What can we still believe, information and believing
  - …

## 2. Program

### *1. Thursday October 18th 2007: Park Hotel Duino*

18:00 Welcome at Park Hotel Duino
Kornwachs / Grassmann / Luhn

18:30 Evening talk: Klaus Kornwachs

*Into new Horizons. Short feedback from where we start*

**19:15 Dinner buffet offered at Park Hotel Duino**

### *2. Friday October 19th 2007: Duino Castle*

*Chairman: G. Mussardo*

9:15-10:05 Valentin Braitenberg

*Structure-Symmetry-Life-Frames: Aspects of new Horizons in Information*

Discussion

10:05-10:55 Gregory J. Chaitin

*The Halting Probability Omega: Irreducible Complexity in Pure Mathematics*

Discussion

**10:55 – 11:25 Coffe break offered at the bar of the Castle**

11:25-12:15 Detlef Dürr

*What is physics about? Bohmian mechanics---a case study*

Discussion

**12:15 – 14:00 Lunch (free)**

*Chairman: G. J. Chaitin*

14:00-14:50 Hans Grassmann
*Towards a Physics Theory of Information*
Discussion

14:50-15:30 Alessandro Prest + Denis Kirmiziguel
*Linear Calculation/First industrial applications and experimental results*

15:30-16:20 Jan Kåhre
*An Axiomatic Information Theory*
Discussion

**16:20-16:50 Pause**

16:50-17:40 Harald Atmannspacher
*Complexity and Information*
Discussion

**19:00 Dinner offered in the castle**

19:00-19:40 Evening talk: Giuseppe Mussardo
*Ludwig Boltzmann. The genius of disorder*

## *3. Saturday October 20th 2007:*

*Chairman: Jan Kåhre*

9:15-10:05 Koichiro Matsuno
*Biological Information from Practicing the Incompleteness Theorem Positively*
Discussion

10:05-10:55 Bernd-Olaf Küppers
*Information-theoretical Aspects of Evolution*
Discussion

**10:55-11:25 Coffe break offered at the bar of the Castle**

11:25-12:15 Ulrike Starke / Rüdiger von der Weth
*Emotion and cognition. Anticipation and Decision making in every day life.*
Discussion

**12:15 – 14:10 Lunch (free)**

*Chairman: Koichiro Matsuno*

14:10-15:00 Klaus Kornwachs
*From Pragmatic Information to Pragmatic Knowledge*
Discussion

15:00-15:50 Wolfgang Hofkirchner
*Unified Theory of Information*
Discussion

15:50-16:40 Michael Schleinitz
*Information and Religion. Resistance and Information in ex GDR*
Discussion

**From 18:30: Dinner offered at the restaurant "La Dama Bianca".**

Evening talk: Walter Schmitz
*Rilke in Duino*

## *4. Sunday October 21th 2007:*

*Chairman: Wolfgang Hofkirchner*

9:15-10:05 Walter Schmitz

*Metaphor in the humanities: on knowledge production*

Discussion

10:05-10:20 Nadine Hennig:

*The future of information*

Discussion

10:20-11:10 Gerhard Luhn

*Message – Form – Chance. Approach to a Triadic Information Concept*

Discussion

**11:10-12:30 Brunch offered at the bar of the Castle**

12:30 All

*Joint conclusion from the chairmen and Proposal for Next Steps*

**14:00 See you next time !**

# 3. Abstracts

## V. von Braitemberg: Structure-Symmetry-Life-Frames. Aspects of new Horizons in Information

The definition of Information in a modern sense has respectable origins in the down to earth field of communication engineering. It is also distantly related to some distinguished concepts current in physics (thermodynamics). Where it is defective, is where it touches on the question of meaning, which remains meaningless unless it is put in a wider philosophical context. I shall propose for discussion a few thoughts that may not be very original but may nevertheless induce the discussants to take sides one way or the other. Information and structure: No doubt biological structure (e.g. the anatomy of the brain) is information, but we find it difficult to interpret this information in the usual way as a carrier of meaning, or even to provide a quantitative measure of the information embedded in structure. Is structural information measured in terms of the redundancy it provides?

Information and symmetry: Whatever code is considered, its information carrying capacity is maximal when the message is devoid of any kind of symmetry be it periodicity, mirror symmetry, rotational symmetry etc. Can we consider information as the contrary of symmetry, neg-symmetry so to say? Information and life: Are we allowed to speak of information, when at the end of the chain of transmission there is no living being ready to absorb the information? Is the shape of a comet the result of information provided by the solar wind? Or does it become information only in the mind of the astronomer?
Frames of information: Normally information has two aspects, one macroscopical and one microscopical: the letter the postman brings and the message it contains, the sentence and its grammatical structure, the egg and the genom. Can we define information without considering the frame within which it happens?

## G. Chaitin: The Halting Probability Omega: Irreducible Complexity in Pure Mathematics

Some Gödel centenary reflections on whether incompleteness is really serious, and whether mathematics should be done somewhat differently, based on using algorithmic complexity measured in bits of information.

## D. Dürr: What is physics about? Bohmian mechanics - a case study.

Any fundamental physical theory must spell out what it is about. I will emphasize that what it is about cannot be information. I shall emphasize that this applies to all known physical theories. I introduce Bohmian Mechanics and explain how randomness and the quantum formalism emerges.

## H. Grassmann: Towards a Physics Theory of Information

Classical information theory (Shannon) shows limitations, when it meets the physics world, for instance in pattern recognition. Applying the Shannon theory to the humanities is also difficult – semantics is explicitly not considered by Shannons theory.
In order to connect information theory to the physical world we must clarify the mathematical properties of the objects of interest: For instance one can observe, that messages are vectors in a mathematical sense, so that the processes of information processing can be expressed as vector transformations, *T*, of an input vector, *a*, to an output vector, *b*, *b=T(a)*. In the physics world these vectors always will have finite length. It now becomes possible to compare and to measure messages (two messages *a* and *b* are identical if *b=T(a)* and *a=T-1(b)*), and one finds that information cannot be produced by information processing systems (this is not a new insight, but it is useful to trace it back to mathematics).
Questions, which up to now were merely philosophical or religious ones, become accessible to physics, like “how much information is contained in the universe?” (this question has been studied in the past, but based on Shannons theorem) or “where does the information in the universe come from?” or “what is the scientific meaning of the expression *understanding something* ?”. And new technical applications become possible, too: based on the physics of information we have developed successfully a new technique of computing, the so-called “linear computing”.
Among the many open questions to be studied is one important concern: would a physics of information just increase the complexity of the ongoing discussion? Or would it rather help to unify our many understandings ot information – creating a “single generic concept of information” (Hofkirchner)?

Some first and preliminary evidence might suggest, that this is indeed the case: for instance, the isomorphy of U, V and T fits well the Braitenberg dictum of “Das Bild der Welt im Kopf” as well as Rizzolatti’s description of the mirror neurons; Chaitin’s mathematical “elegant program” might be the equivalent to the physical “irreducible information of the Universe”. The physics of information quite naturally leads to Luhn’s triadic model of information. In general, our scenario is based on quantum theory (“the number of the microstates of the Universe is finite”), and so a natural connection exists to studies on quantum theory and information, as for example performed by Koichiro or Penrose.

## W. Hofkirchner: Unified Theory of Information

It was about 10 years ago when I helped organise the second conference on the Foundations of Information Science and published proceedings with the title “The Quest for a Unifying Theory of Information”. While a considerable number of scientists still today disbelieve in the feasibility of a single generic concept of information, there are several attempts to hypothesise or theorise information in a unifying manner carried out by a strong minority of scientists. E.g., a question put forward by Hans von Baeyer to the audience at the recent International Conference on Foundations of Information Science held in Paris in 2005 showed a fiftyfifty vote for either option. However, the camp of the “unifiers” itself is heterogenous. The approach I am espoused with tries to find its basis in the so-called science of complexity, that is, in a linkage to concepts of self organisation. Here, too, there are a number of options to do that. Just to name but a few, this is an incomplete list of authors:

- Morin
- Haken
- Ebeling
- Kornwachs
- Fuchs-Kittowski
- Stonier
- Brier
- Kauffman et al.
- Moreno et al.

The most recent ideas which came to my attention are the latter two. Stuart Kauffman, Robert Logan, and four other authors write in their manuscript from May 2006 “Propagating Organization: An Enquiry” that information is the constraint (known as downward causation) whose function is to propagate the organisation of a system. Alvaro Moreno and Kepa Ruiz-Mirazo describe “Information as a Decoupling Mechanism in the Origins of Life” (which is the subtitle of their article “The Maintenance and Open-ended Growth of Complexity in Nature”, in: Capra, F., Juarrero, A., Sotolongo, P., van Uden, J. (eds.), Reframing Complexity, ISCE Publishing, Mansfield 2007). I would like to discuss ideas like these in the light of my own idea of how to couple information processes to different types of real-world systems as a contribution to a taxonomy of complexity information concepts.

## J. Kåre: An axiomatic Information Theory

Modern science tends to branch out into isolated fields. For example, *communication theory* and *pattern recognition* are separate disciplines, even if both are about extracting information from a signal. A principle called the Law of Diminishing Information (LDI) is proposed as a general

information property. To be able to say anything objective about information, the information concept must be limited to its original meaning as "information about something", where the generic measure inf(B@A) stands for "the expected value of the information B gives about A". This notation emphasizes that inf(B@A) isn't necessarily symmetric; for many measures inf(B@A)≠inf(A@B). In contrast, the Shannon measure is symmetric; I(B;A) = I(A;B) = H(A) + H(B) – H(A,B).

LDI is defined by an axiom: Information decreases along a simple Markov chain A→B→C, i.e. inf(C@A)≤ inf(B@A) if $P(a_i b_j c_k) = P(a_i|b_j)P(c_k|b_j)P(b_j)$, where A is a set of outcomes $a_i$ etc. LDI is about statistical properties, while a single outcome a*i* in isolation can be assigned an arbitrary value. The rationale for LDI is twofold: **1.** Chinese Whispers or Telephone (experience). **2.** The Carnap ideal receiver (objectivity).

Examples of measures satisfying LDI: **1.** Shannon I(A;B) for which LDI is known as "Data Processing Inequality". **2.** Utility (von Neumann). **3.** Shannon reliability q (a special case of utility) **4.** Bar-Hillel cont-measure. **5.** Expected complexity (Kraft inequality). **6.** Expected information gain (Haken). **7.** Deviation from setpoint in control engineering (Wiener). **—** Measures not necessarily satisfying LDI: **8.** Surprise (Popper). **9.** Correlation. **10.** Rényi entropy.

If the LDI axiom is accepted, other results follow trivially, such as: **1.** inf(B@A) = 0 (or minimum) if $P(a_i b_j) = P(a_i)P(b_j)$. **2.** inf(B@A) ≤ inf(B@B) ≡ inf(B) where the information content inf(B) = inf(B@A) if $P(a_i|b_j) = \delta_{ij.}$ **3.** inf(BxC@A) ≥ inf(B@A) where BxC is a combined signal. **4.** Information about the same object cannot be additive, i.e. inf(BxC@A) ≠ inf(B@A) + inf(C@A). **5.** Don't compare apples and oranges, or information about different objects, e.g. inf(B@A) to inf(B@C). **6.** Byron's law: *A lie is a truth in masquerade*.

Shannon I(A;B) is convex, inf(B@A|C) ≤ inf(B@A) which makes it awkward for semantic measures, where generally the opposite, i.e. colligation ('putting two and two together') is required. Colligation is defined by inf(B@A|C) > inf(B@A), meaning that background knowledge C increases the value of information. Neither convexity nor colligation is in conflict with LDI. It can be proved that inf(B@A) must be a function of the connection $P(b_j|a_i)$ in the general case. Hence, it's pointless to discuss universal information measures based merely on inf(A) or inf(B), i.e. on $P(a_i)$ or $P(b_j)$. For example, in biological evolution, information about earlier states satisfies LDI as genetic information continuously vanishes (by mutations and culling), but the increase of complexity is not in

conflict with LDI. In many cases, inf(B@A) is a function of $P(a_i)$ as well, but pure functions of $P(b_j|a_i)$ that satisfy LDI are e.g. **1.** Capacity, i.e. selecting $P(a_i)$ to maximize inf(B@A). **2.** The absolute value of the determinant $||P(b_j|a_i)||$.

The information content inf(B) can be a measure of inf(B@A) only if there are restrictions on $P(b_j|a_i)$. Two examples of restrictions: **1.** An errorless channel A→B where $P(a_i|b_j)$ = 0 or 1, i.e. the reliability = 1 for deducing a*i*

from if $b_j$. Then the number of bits in A deduced by B satisfies LDI. In Shannon theory, the reliability approaches 1 statistically making I(A;B) a measure of deduced bits. There is, however, inconsequence in Shannon theory how reliability is defined (Jaynes). **2.** Diffusive systems $A \rightarrow B$ defined by $\Sigma_j P(b_j|a_i) = 1$ make some particular inf(B) = inf(B@A) satisfying LDI based on a monotonic property of Kullback-Leibler distance. In a thermodynamic time chain, negentropy –H(B) decreases with time, thus satisfying LDI. In quantum mechanics, Fisher information decreases by time in a diffusive process called decoherence, making it possible to derive Heisenberg uncertainty and Schrödinger's equation from the diminishing of Fisher information.

## K. Kornwachs: From Pragmatic Information to Pragmatic Knowledge: The good informer and the good doer

For a long time, the usual definition of knowledge in philosophy was the true, justified opinion (Platon Theaitetos). Craig (1993) has tried to overcome the problems with this definition, figured out by Gettier (1963), by introducing the good informer. Knowledge is defined as the ability to deliver a problem solving information on request with a sufficient reliability.

We like to expand this model into two directions: 1) With the help of the basic concepts of the theory of pragmatic information (Kornwachs 2000) we conceptualise information as a process which produces knowledge together with a cognitive system if it has been understood. This can be described by complementarily related pairs of concepts like structure and behaviour and their changes, induced by information. 2) In order to develop the knowledge concept, it is conceived pragmatically: Knowledge is then defined as a state a person has, when it has understood pragmatic information in so far as he/she is able to install a function that has the power to solve a defined problem on request. Expanding Hawley (2003) the quality of the solution (i. e. technical fiction) may be sufficient for me in actual *hic et nunc*. The person as the owner of this knowledge could be named as a good doer or enabler.

Thus a direct line between information and knowledge can be drawn without the not yet solved problems in cognitive science concerning human understanding of information. A new formal model of this relation is given.

**References:**

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**Hawley, K.**: Success and Knowledge How. In: American Philosophical Quaterly 40 (2003), pp. 19-31

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**Kornwachs, K.:** Strukturen technischen Wissens (2007) Forthcoming

**Platon:** Theaitetos. In: Werke. Hrsg. von G. Eigler. Wiss. Buchgesellschaft, Darmstadt 1990, S. 1-217

## G. Luhn: Forming Power - Message – Chance. Approach to a Triadic Information Concept

Physicists have introduced a couple of demons in order to describe new phenomena. The thought experiment of Maxwell's demon is known since 1867. Such demon would obtain information about atoms, which are freely moving within a tube, which is made of 2 chambers.* Let us replace the door by a simple funnel. The motivation to replace the door by something else comes out of the idea that the experimental setup should serve to eliminate any environmental influence on the behavior of the atoms. The form of the chambers was thought to be of no influence to the atoms. The funnel is introduced now to represent any environmental influence to this experiment. The situation we are facing is fundamentally changing: based on the influence of the funnel, we can derive a calculated value, which parts of the flight of the atom are taking place in the one chamber, and which parts are taking place in the other chamber. That means: by applying the form of experimental setup we are introducing the information in question. This approach is from its structure identical to Bohm's physical approach (Bohm is introducing the experimental setup as a kind of irreducible information; of course he still uses the terminus of 'information' within Shannons concept). And additionally, a specific force is coming out of this scenario, the funnel is forming power: *Information is form, is forming power.*

Within this scenario the funnel is carrying a specific message, as also each atom mving in the system does. Where do such messages are coming from? If the universe started to evolve out of a homogenous energy field, the very first separation of structure resembles more to an arbitrary (indeterministic) de-formation than to a well defined in-formation. For this reason Hans Grassmann is proposing his concept of irreducible information. We are living in an irreversible world, as Boltzmann is telling us. This is the reason, why new forms may appear by chance, and so we do have the elements of our proposed information concept assembled.

The goal of this paper is, to outline some ideas in the direction of an physical and philosophical information concept.

Information is a triadic concept: Information is
+ Forming Power through
+ an adequate processing of certain messages
+ by certain systems in the context (application) of physical regularities / laws

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* Those 2 chambers are connected by a (weightless) door. The demon can separate now the slowly moving atoms from the faster moving atoms by opening/closing this door accordingly. In conclusion the second law of thermodynamics would be broken. Within this classical scenario "information" is mostly explained by introducing a memory functionality. The demon needs to interact with the atoms, in order to be in-formed about their specific appearance in front of the door. He is receiving a specific signal, which needs to be stored. 'Information' needs to be stored, and energy is dissipating subsequently: the second law of thermodynamics seems to be saved.

## K. Matsuno: Biological Information from Practicing the Incompleteness Theorem Positively

A theoretical basis of reasoning the origin and development of biological information can be founded on the second incompleteness theorem discovered by Kurt Gödel in 1931. The incompleteness theorem stating that there should be a statement or a theorem that could be right but not proved right within the given axiomatic system carries a positive implication as focusing upon the role of inductive judgment on the part of mathematicians going beyond the stipulation of the system. Likewise, atoms and molecules in the empirical world exercise their capacity of induction on their own. When two hydrogen atoms form a hydrogen molecule empirically, no computation for obtaining a hydrogen molecule can halt insofar as one sticks to the axiomatic formalism preserving the hydrogen atom as a nonnegotiable element. What underlies the transition from hydrogen atoms to a hydrogen molecule is transformation of a quantum. In view of the fact that each quantum is characterized by a set of infinities or infinite varieties it can allow within itself, transformation of a quantum assumes the act of transition from one class of infinities to another one. In fact, the class of infinities unique to a hydrogen atom is different from another one belonging to a hydrogen molecule. The origin of biological information can be associated with the occurrence of transformation of a quantum closed to material flow to another type of quantum open to material flow, in which each quantum is taken to be a robust material unit admitting within itself a class of infinities. A concrete implementation of a quantum open to material flow is in the genesis of a robust heat engine operating in the presence of temperature gradients. Empirically, the evolutionary likelihood of expecting such temperature gradients must have been near hydrothermal vents on the sea floor in the primitive ocean. Theoretically, on the other hand, the origin and development of biological information could be built upon the

transformation of the robust class of infinities that no axiomatic system can internalize into itself. Naturalization of the incompleteness theorem underlies the physical origin and development of biological information.

## G. Mussardo: Ludwig Boltzmann. The genius of disorder

The 19th-century physicist Ludwig Boltzmann stirred up controversy by proposing that scientists could make intelligent guesses about the behavior of atoms, which, though they moved randomly, could be described by certain probabilistic generalizations. His suggestion, to explain thermodynamics by using statistical methods, went against the longstanding trend of assuming absolute fixed laws. These were profound and disturbing changes. The seminar discusses this enganging story of science and personal struggle of Ludwig Boltzmann, set against the intellectual climate of nineteenth-century Vienna, and shows how science has come to accept the reality of the invisible world.

## F.J. Radermacher: Superorganisms and Consciousness: Insights into the Evolution of some Powerful Systems

The paper deals with recent insights into a better **a better understanding of cognition and consciousness**. They aim simultaneously at a better understanding of biological **superorganisms** (swarms, states of insects) as well as **human-technical superorganisms** (enterprises, universities, states, humankind). We ask how concepts such as cognition and consciousness, but also **qualia**, relate to topics such as intelligence, will, the ability to learn, curiosity, emotions, creativity, the ability of speech etc. and, in part, how these concepts may generalize to superorganisms.

In doing so, very different methodical approaches for **organizing intelligent behaviour** of systems such as neural networks, rule-based systems and the use of mathematical and other theories and mechanisms for the generation of behaviour are considered. Thereby, especially the **bottleneck character** of speech for communication
among humans about such complex issues as body-related concepts and/or qualia or the mathematical theories used for their explanation, are taken into consideration.

One of the major aspects concerns the significant role of **consciousness as a sequentially organized process** for, among others, monitoring and planning purposes for an information processing system which is otherwise organized in a massively parallel way. The specific role of consciousness thereby seems to be especially the integration of many information sources which come in simultaneously and the (co-)administration and **priorization of certain scarce resources**, especially those which are available only in one instance. Examples of such crucial resources are the own attention

mechanism, short-term memory, the ability to process abstract information or the actual movement of a system in time and space.

It seems interesting that this view about cognition and consciousness allows to be transferred to a considerable extent to human organizations, like companies or to humankind as a whole (as **superorganisms**). Also, the different types of knowledge processing considered, such as neural networks, symbolic reasoning and mathematical models, carry nicely over, allowing additional insights and interesting analysis. Here, it seems that hierarchies as element of the organizational structure of enterprises - which in turn constitute massively parallel organised systems - can be adequately conceptualized, defined and justified through the responsibility for certain scarce resources (investments, staff, brand positioning, etc.).

## R. von der Weth: Emotion and cognition. Anticipation and Decision making in every day life

Several empirical studies have been conducted in which complex problem solving activities of different types of professionals have been analysed in detail. Often important decisions were made early in the planning process without careful analysis of the task and possible ideas and solutions. In many cases this type of planning behavior is effective and successful, in some cases occurs failure. The experts themselves explain successful performance with terms like „intuition“ or „feeling“. Moreover complex patterns of team cooperation exist, which also have not been learned in a conscious process: Experienced teams have shared mental models and a shared situational awareness. Processes like coordination, cooperation and exclusion work often without conscious regulation.

Basing on theories about the interaction of emotion and cognition (Dörner, Bischof, Scherer) and the concept of situated cognition we are working on a model describing how intuition and feeling work and develop in the course of everyday activities. On the background of this model and our research questions the explanatory power of the concepts “intuition” and “free will” will be discussed**.**

# 4. Contacts

## a. Organizers

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## c. Important addresses

1. The Park Hotel Duino, which is hosting the participants:

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2. The Duino Castle, which is hosting the conference:

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# 5. Useful information

## a. Arrival in Duino


### By Plane:

Trieste (Ronchi dei Legionari) is the nearest airport which we encourage you to use. There are connecting flights from Milan, Rome, Munich, Belgrade and London. From the Trieste airport you must take the local (blue) bus (line 51) going to Trieste.
The bus leaves from the bus park, located to the right of the main entrance. You must get off in the center of Duino. It is enough to tell the driver your destination: Duino-Park Hotel. Every bus going to Trieste stops in Duino. The trip takes about 20 minutes. Tickets may be bought at the ATP (Azienda Provinciale Trasporti) desk inside the airport, or from machines outside the airport. The cost is € 1.45. The earliest bus is at 06:00 a.m. and the latest is at 23:35. If you prefer you can take a taxi (mobile tel: 347 6466965 – English spoken)
Venice (Marco Polo) is the second nearest airport and has connections from nearly every European capital. If flying into Venice, you must take a train to Monfalcone, the nearest train station to the college, and the trip takes approximately two hours. From the airport there are buses to Mestre train station (Mestre is the mainland Venice train station). Bus tickets are sold inside the airport and NOT on the bus. The ticket office is to the left of the Arrivals area. The ticket costs € 3.00, the earliest bus leaves at 08:00 and the latest at 24:00. More precise information regarding the schedule and price, may be obtained at the ticket office where there are English speaking salespersons. You may consult the train schedule in advance: www.trenitalia.it . The earliest train is 05:31 a.m. and the latest is 23:02 p.m. The ticket costs between € 6-14 depending on the class (1st or 2nd) and type of train - local or long distance with fewer intermediate stops.
Make sure you take the train that goes via Portogruaro to Trieste and NOT via Udine (much longer route).

### By Train:

The nearest train station is Monfalcone, about 8 km from Duino and 25 km West of Trieste. If you have notified us of your arrival time we will try to meet you at Monfalcone station. From Monfalcone you can reach Duino by bus, but you need two different buses: a city bus to the Piazza Duomo (ticket € 0.91) and then a blue APT bus - Line 51 (ticket € 1.10) to Duino. Both these tickets are sold at the train station newsstand. There are taxis

available outside the train station if you prefer. The taxi takes about 15 minutes and costs approximately € 20. If you arrive from the East, your bus or train will arrive in Trieste without going through Monfalcone. You must take a bus from Trieste to Duino. The blue APT bus, Line 51 departs from the central bus station next to the Trieste train station. Ticket € 2.25 The trip takes about 30 minutes.

### By Car:

Take the A4 toll highway Milan-Trieste. Go all the way to the end, “Lisert” Exit. After paying the toll, proceed straight ahead on the highway in the direction of Trieste. Approximately 7/8 km further on is the exit of Duino (immediately after the Holiday Inn). Coming off the exit, turn right and 200 mt further on turn left to the centre of Duino.

## b. Duino

Duino (Devin in Slovenian, Tybein in German) in the coastal part of the Municipality of Duino-Aurisina, lying in the region of Friuli-Venezia Giulia in the province of Trieste in north-east Italy.
The total population is recorded as 8,753, the population density (per square kilometre) as 193.8. It is noted as the place of death of the physicist Ludwig Boltzmann, and for the *Duino Elegies* of Rainer Maria Rilke. The two castles are the main attraction: the older, dating back to the eleventh century, is in ruins, while the newer is inhabited to this day and can be visited by tourists. Below the ruins of the ancient castle, there lies a white rock projecting into the sea, the *Dama Bianca (White Lady)*, which resembles a veiled woman. Like other ancient castles, Duino too had its own legend. In our case it is the legend about the White Lady. At one time a knight lived at Duino fort. He was a very nasty man, who disdained his consort, because she was very graceful and virtuous. His dislike for her turned into hatred, and one evening he attracted her to a rock above the sea, so that he could descend her into the depth. Horrified the chatelaine looked toward the sky, and tried to cry out, but something hindered her to express her horror and she remained petrified in her great pain. Since then, towards midnight, the White Lady gets up from the cliffs and begins to wander about in the castle's rooms, until she finds the cradle, in which once upon a time her son slept. There, she remains in silence until daybreak. Then, she returns to the rock, where the pain transforms her anew into the stone. When the fishermen are active in the Gulf of Trieste, it

serves them as an orientation sign, when an unexpected tempest surprises them at sea.
The new castle of Duino is approximately dated to about the year 1400, when the family Wallsee commanded the construction of a strong fortress. Over time, the Wallsee family disappeared and the castle, after having been used as a prison, became the residence of the Luogar and Hofer. At the end of the 19th century it became the property of the Prince Alexander of Thurn and Taxis. It remains with the family to this day with his grandson Prince Carlo Alessandro della Torre e Tasso, Duke of Castel Duino the current owner.
Since 1982, the town has been home to the United World College of the Adriatic, a no-fee international school attended by students from 80 different countries.

## c. Restaurants and bars in Duino

In the center of Duino

1. Mickey Mouse
Fraz. Duino, 28 - 34013 Duino Aurisina
Tel.: +39 040 208351
Sandwiches and salads.

2. Bowling Duino
Fraz. Duino, 4/1 - 34013 Duino Aurisina
Tel.: +39 040 208238
Pizza, grilled meat.

3. Albergo Ristorante Dama Bianca
Fraz. Duino, 61/C - 34013 Duino Aurisina
Tel.: +39 040 208137
Elegant but simple, on the sea. Excellent fish

Nearby Duino

4. Al Pescaturismo Villaggio del Pescatore
Zona Cava
Tel.: +39 339 6390473
On the sea. Simple. Good fish

5. Ristorante il Gabbiano
Fraz. Villaggio del Pescatore, 103
34013 DuinoAurisina
Tel.: +39 040 208145
On the sea. Simple. Excellent fish

## d. Seightseeing in Duino

**The Rilke promenade**

The visitors of the Trieste Riviera in the coast between Duino and Sistiana, are offered the opportunity to stroll along a path which is unique in all the Mediterranean coast: the «Rilke Promenade».
It is named after the poet Rainer Maria Rilke, from Prague, who stayed in the Duino Castle from 1911 to 1912, guest of the Princes della Torre e Tasso: according to tradition, it was along this path that Rilke found inspiration for his *Duino Elegies*.
Thanks to the generous concession of His Most Serene Highness Prince della Torre e Tasso, the «Rilke Promenade», after having been unusable for several years, has been restored by the Province of Trieste and the Municipality of Duino Aurisina and given back to citizens.


Continuing on the way to Monfalcone - about 25 km from Trieste - the visitor crosses the small village of S. Giovanni di Duino. It is worth stopping to see

**The Church of San Giovanni in Tuba (XV century)**

It was built on the remains of a pre-existing paleochristian building, and the mouths of the mysterious river Timavo coming back to the open air after flowing for many miles under the Carsic plateau along a path that so far defied all investigations. It is quite possible that the church and the pre-existing building stand on the ruins of a Roman temple devoted to Speranza Augusta. Its style is typically gothic. Next to the church a monastery was built too to house the monks preaching to Slavic peoples.
The beautiful church of San Giovanni is much more recent, designed by the architect Angelo Mazzoni. The church is adorned with frescos by the Slovene painter of Trieste, Avgust âernigoj.
Excavations performed in this area produced an excellent documentation about Carsic pre-history and findings belonging to the Castellieri civilization of the iron age. These findings, valuable per se, assume even greater

importance because of their proximity to the mouths of the Timavo, a sacred place since very ancient ages
The Timavo, beginning near the village of Cave Auremiane (Vremski Britof, Slovenia), behaves actually as quite a normal river until, coming to S. Canziano (Slovenia), it suddendly sinks into an impressive chasm opening on a complex system of caves (Grotte di S. Canziano) where it disappears in the rock. Here it follows its long and vastly unknown underground path (35 km) until a share of its water reappears in S. Giovanni di Duino.

**The Roman open-cast mine**
is a rich marble source delivering excellent quality stone since the Roman ages. That marble was intensively used to build the Roman town of Aquileia and other important monuments.

**The temple of Mitra**
Is a remarkable archaeological site. Is the hypogeal temple devoted to the cult of the god Mitra, discovered near the resurgent springs of the Timavo. The Temple is the only example of sacred place located in a natural cave that has been found in Italy, and it dates back to Roman times.
If you want to visit the temple, please ask our help (is not easy to be found)

## 6. Our sponsors: Isomorph and Qimonda

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