Topological Analysis of Scientific Coauthorship Networks

Alessio Cardillo

Università degli studi di Catania – Corso di Laurea Triennale in Fisica

3 Ottobre 2006

Outline

- Sistemi Sociali

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- Networks di collaborazioni scientifiche

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- Sistemi Sociali
- Networks di collaborazioni scientifiche
- Risultati

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- Sistemi Sociali
- Networks di collaborazioni scientifiche
- Risultati
  - Proprietà globali della rete

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  - Proprietà globali della rete
  - Proprietà di nodo (Indici di centralità)

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- Risultati
  - Proprietà globali della rete
  - Proprietà di nodo (Indici di centralità)
- Sviluppi futuri

Introduzione
Reti Sociali

Problema:

Supponiamo di voler studiare le relazioni sociali, come facciamo?

Introduzione
Reti Sociali

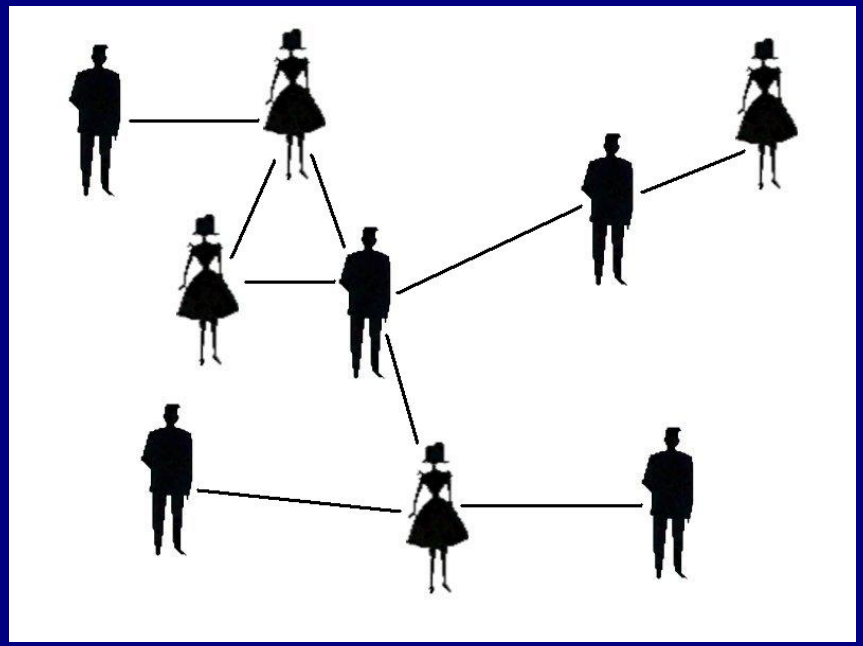
Soluzione:

Possiamo utilizzare il know-how delle reti complesse!

Introduzione

Reti Sociali $\longrightarrow$ Grafi

Un sistema sociale viene trasformato in un grafo.



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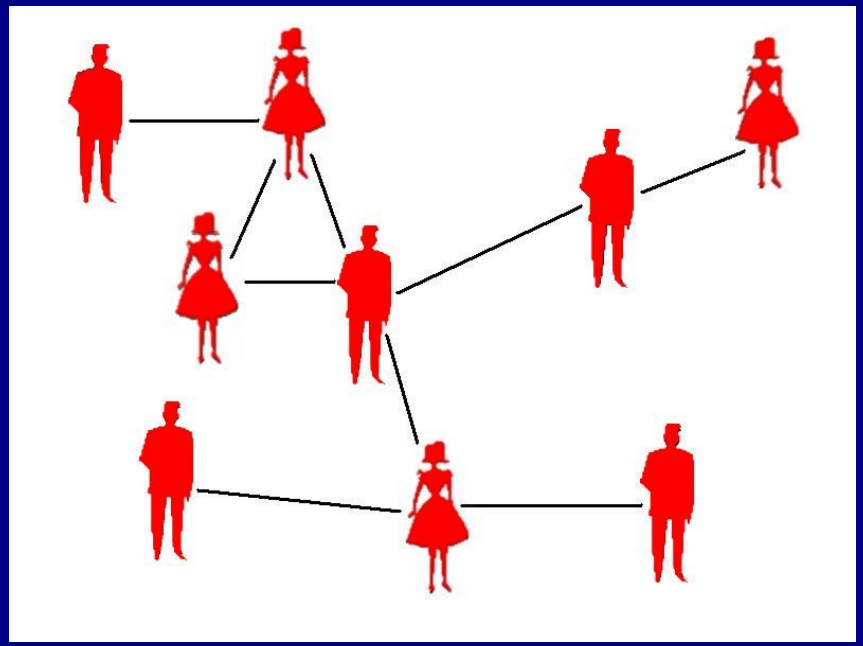
Definizione

Il grafo è composto da due insiemi:

- Quello dei nodi (individui);



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Definizione

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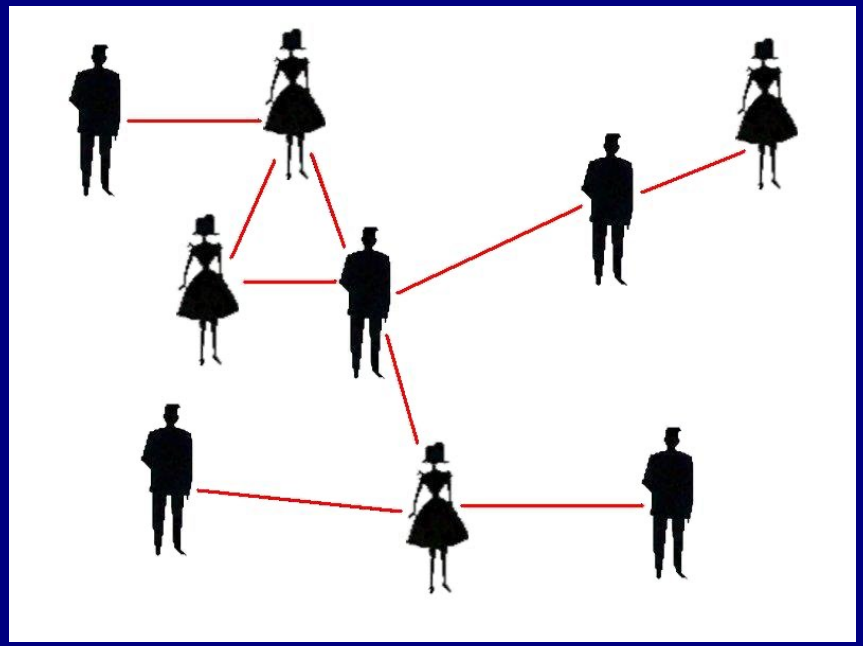
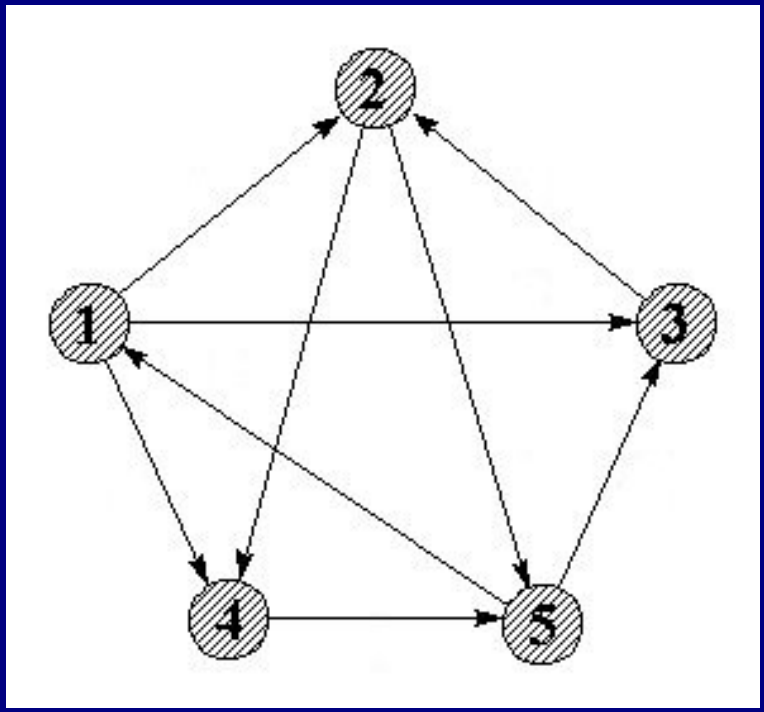
- Quello dei nodi (individui);
- Quello dei link (relazioni).



Introduzione
Caratteristiche dei grafi



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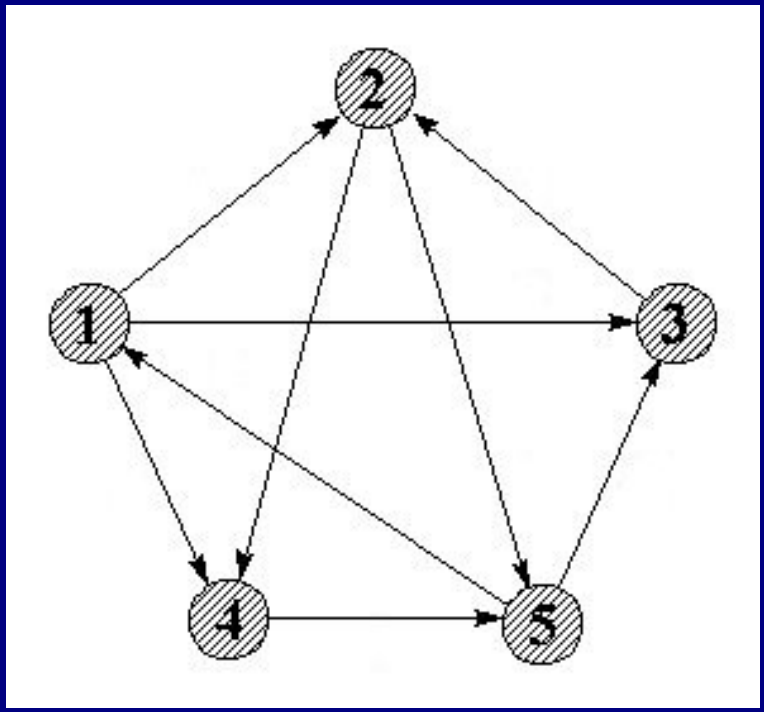
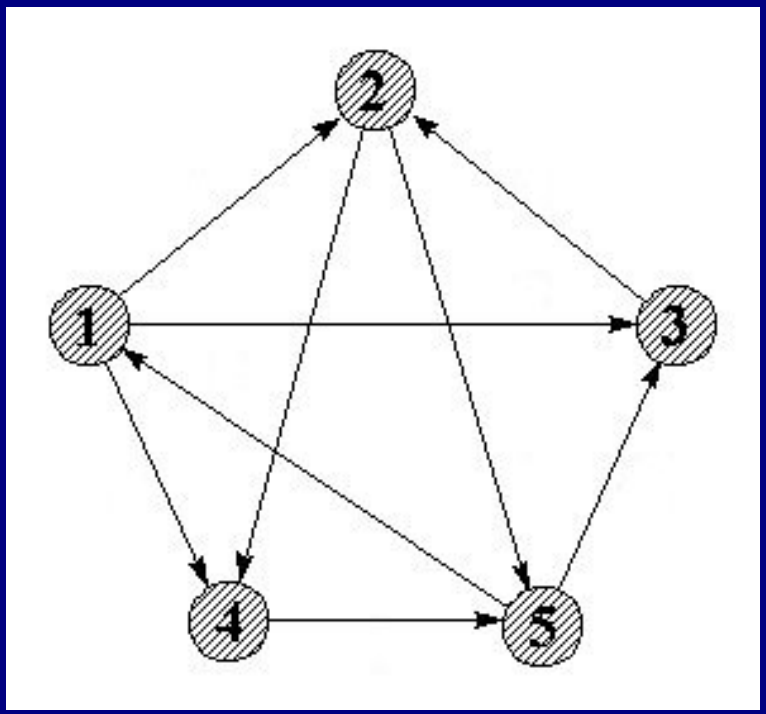


Vantaggi:

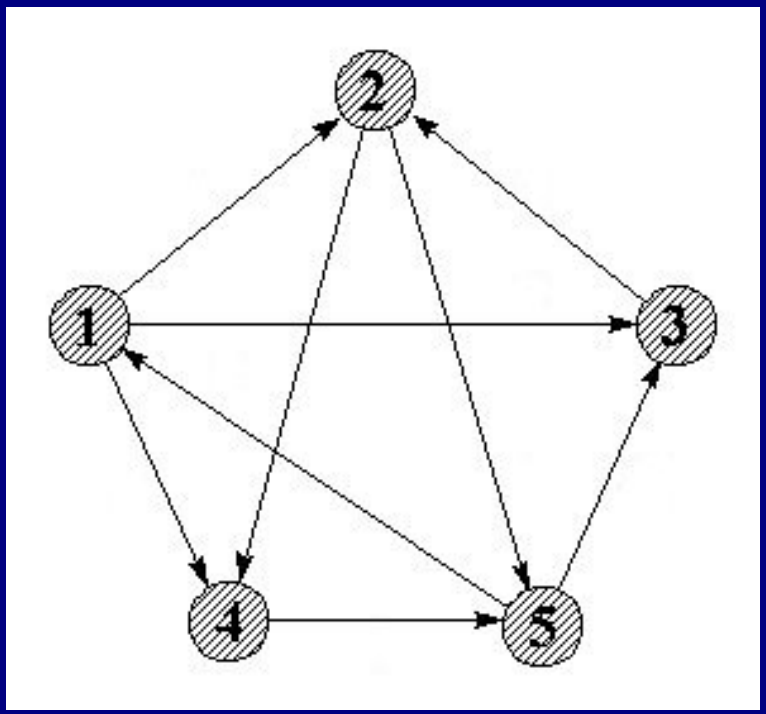
Introduzione
Caratteristiche dei grafi



Vantaggi:

- Semplicità;

Introduzione
Caratteristiche dei grafi



Vantaggi:

- Semplicità;
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Introduzione
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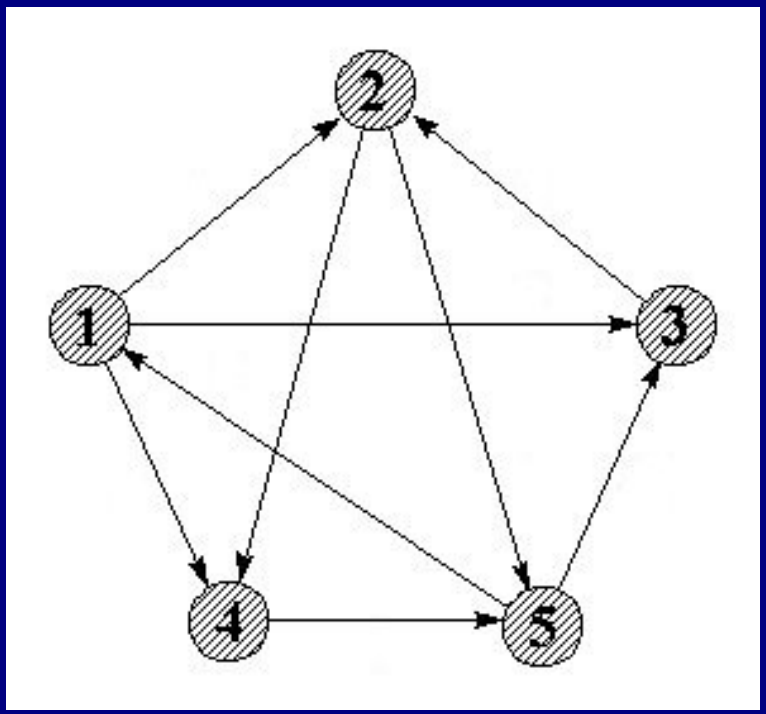

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Svantaggi:

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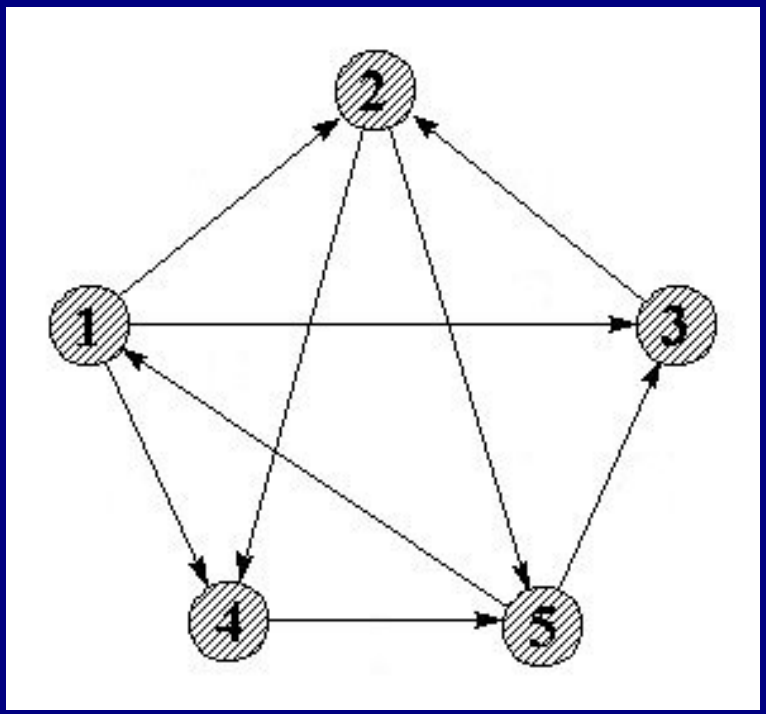
Caratteristiche dei grafi



Vantaggi:

- Semplicità;
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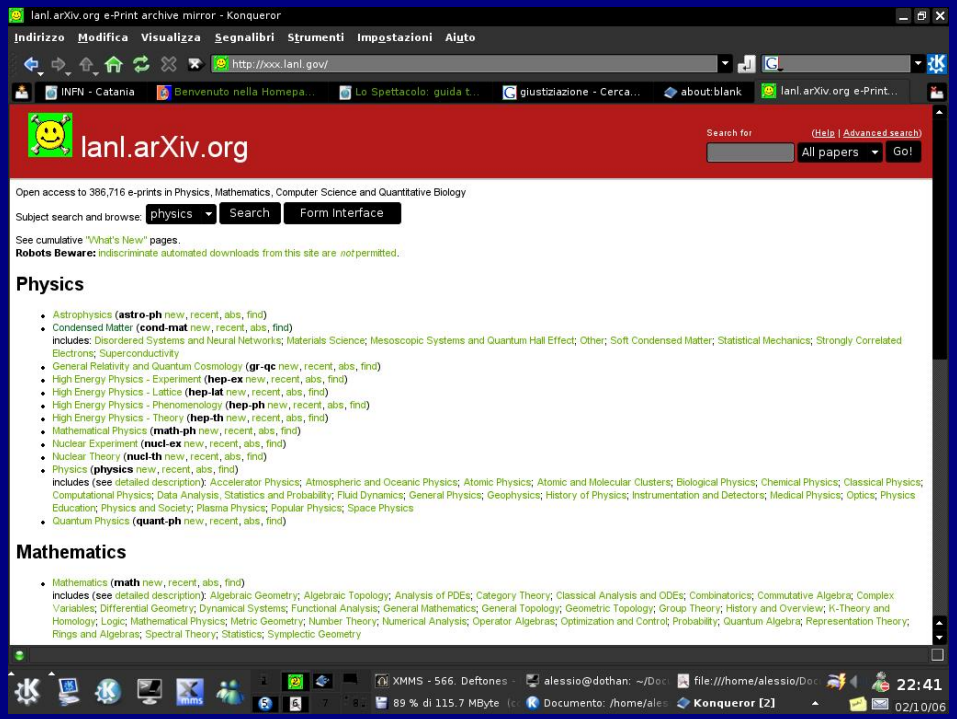
Svantaggi:

- Perdita di informazioni.

Los Alamos Archive

- Nel nostro caso sono state studiate le Reti di Collaborazione Scientifica (Scientific Coauthorship Netwoks) ottenute dagli archivi di Los Alamos (`http://xxx.lanl.gov`) nel periodo 2000 – 2005;



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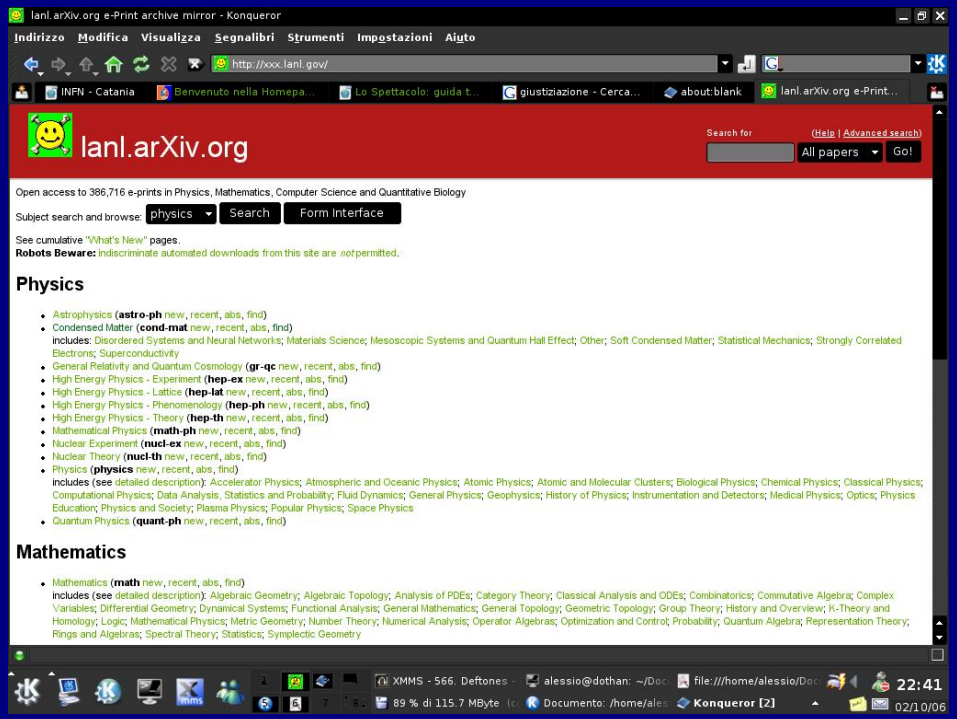
- In seguito indicheremo queste reti col nome di SCN.



Introduzione
Networks di collaborazioni scientifiche

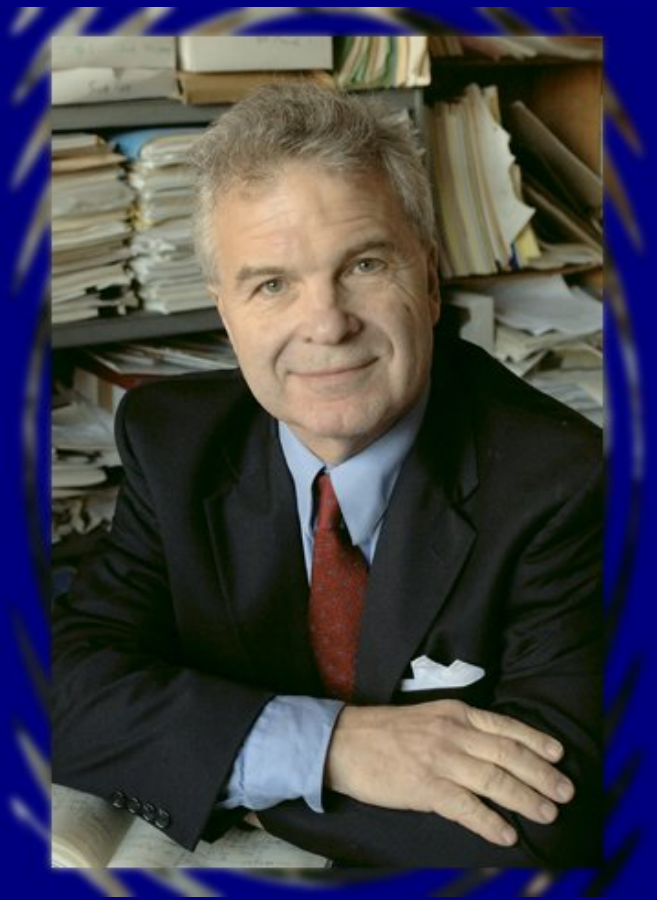
Domanda:

Come abbiamo costruito i grafi delle SCN?

Introduzione

Networks di collaborazioni scientifiche

Facciamo un esempio: costruiamo la sottorete del prof. **H. E. Stanley**



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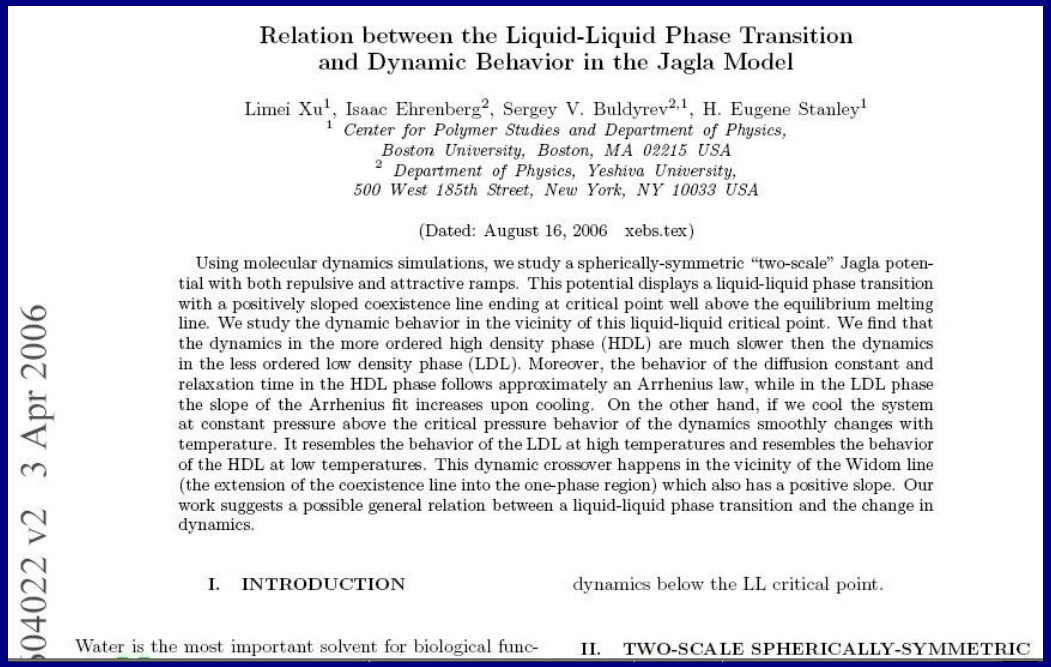

Relation between the Liquid-Liquid Phase Transition and Dynamic Behavior in the Jagla Model

Limei Xu[1], Isaac Ehrenberg[2], Sergey V. Buldyrev[2,1], H. Eugene Stanley[1]
[1] *Center for Polymer Studies and Department of Physics, Boston University, Boston, MA 02215 USA*
[2] *Department of Physics, Yeshiva University, 500 West 185th Street, New York, NY 10033 USA*

(Dated: August 16, 2006 xebs.tex)

Using molecular dynamics simulations, we study a spherically-symmetric "two-scale" Jagla potential with both repulsive and attractive ramps. This potential displays a liquid-liquid phase transition with a positively sloped coexistence line ending at critical point well above the equilibrium melting line. We study the dynamic behavior in the vicinity of this liquid-liquid critical point. We find that the dynamics in the more ordered high density phase (HDL) are much slower then the dynamics in the less ordered low density phase (LDL). Moreover, the behavior of the diffusion constant and relaxation time in the HDL phase follows approximately an Arrhenius law, while in the LDL phase the slope of the Arrhenius fit increases upon cooling. On the other hand, if we cool the system at constant pressure above the critical pressure behavior of the dynamics smoothly changes with temperature. It resembles the behavior of the LDL at high temperatures and resembles the behavior of the HDL at low temperatures. This dynamic crossover happens in the vicinity of the Widom line (the extension of the coexistence line into the one-phase region) which also has a positive slope. Our work suggests a possible general relation between a liquid-liquid phase transition and the change in dynamics.

504022 v2 3 Apr 2006

I. INTRODUCTION

Water is the most important solvent for biological func-

dynamics below the LL critical point.

II. TWO-SCALE SPHERICALLY-SYMMETRIC

Introduzione

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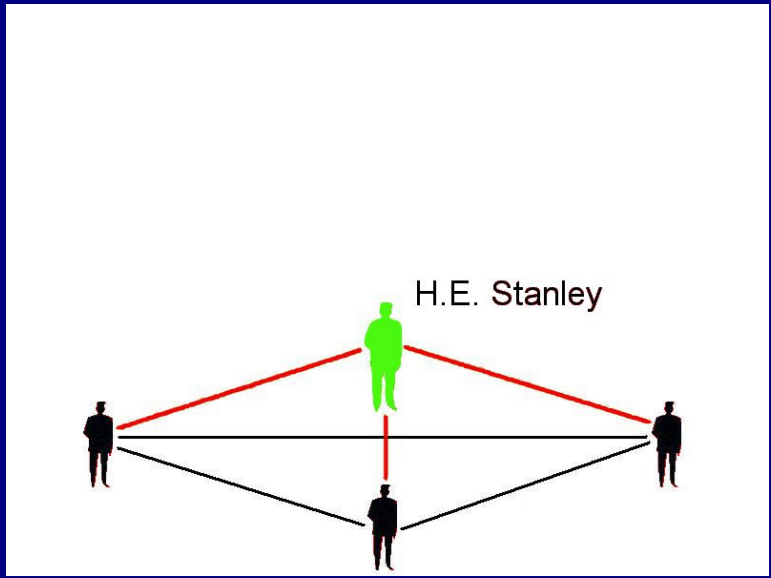

Introduzione

Networks di collaborazioni scientifiche

4023 v1 6 Apr 2006

Communication Bottlenecks in Scale-Free Networks

Sameet Sreenivasan,[1,2] Reuven Cohen,[3] Eduardo López,[4]
Zoltán Toroczkai,[2*] and H. Eugene Stanley[1]
[1] *Center for Polymer Studies and Department of Physics, Boston University, Boston, MA 02215*
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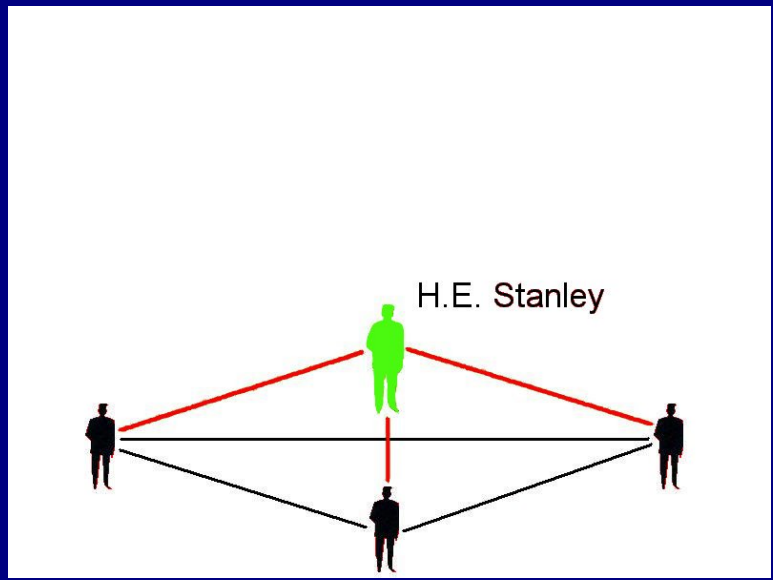
[3] *Laboratory of Networking and Information Systems and Department of Electrical and Computer Engineering, Boston University, Boston, MA 02215*
[4] *Theoretical Division, Los Alamos National Laboratory, MS B258, Los Alamos, NM 87545*
(Dated: April 7, 2006)

We consider the effects of network topology on the optimality of packet routing quantified by γ_c, the rate of packet insertion beyond which congestion and queue growth occurs. The key result of this paper is to show that for any network, there exists an absolute upper bound, expressed in terms of vertex separators, for the scaling of γ_c with network size N, irrespective of the routing algorithm used. We then derive an estimate to this upper bound for scale-free networks, and introduce a novel static routing protocol which is superior to shortest path routing under intense packet insertion rates.

PACS numbers: 89.75.Hc, 89.20.Hh, 89.75.Da

Communication has stepped into a new era with the advent of the Internet, making possible information exchange/transport across the globe virtually in an instantaneous fashion between any two people who have access to it. Broadcasting and advertising messages, homepages, blogs and practically any information posted on the WWW is within the reach of anyone accessing those pages and thus, downloading that information. This activity, exponentially increasing over the past years in-

packet). However, due to the increasing demand of information carried through the Internet, delays can occur in packet delivery, mainly caused by device (end-user and router) latency. Device latency is the amount of time τ that a device needs to process a single packet. Although the devices are getting better in their latency, this is a physical constraint and can never be completely eliminated. Since more packets may arrive at a node than it is able to process per unit time, queues can accumu-



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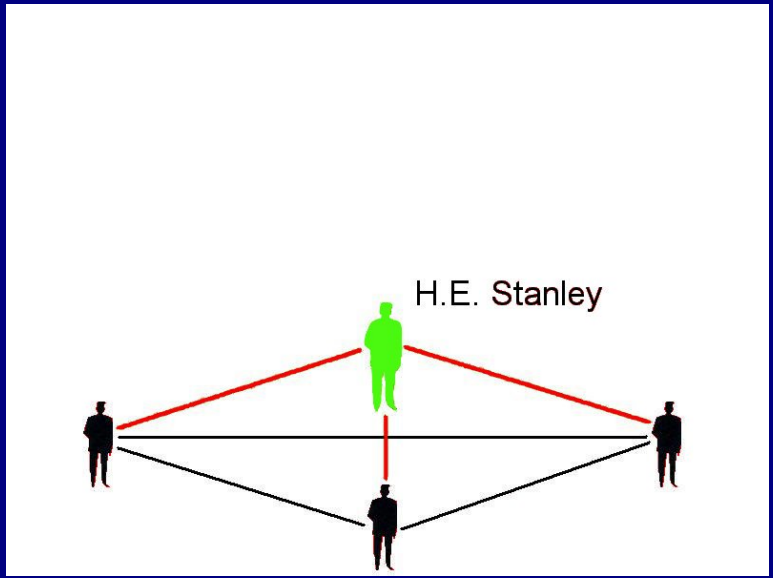

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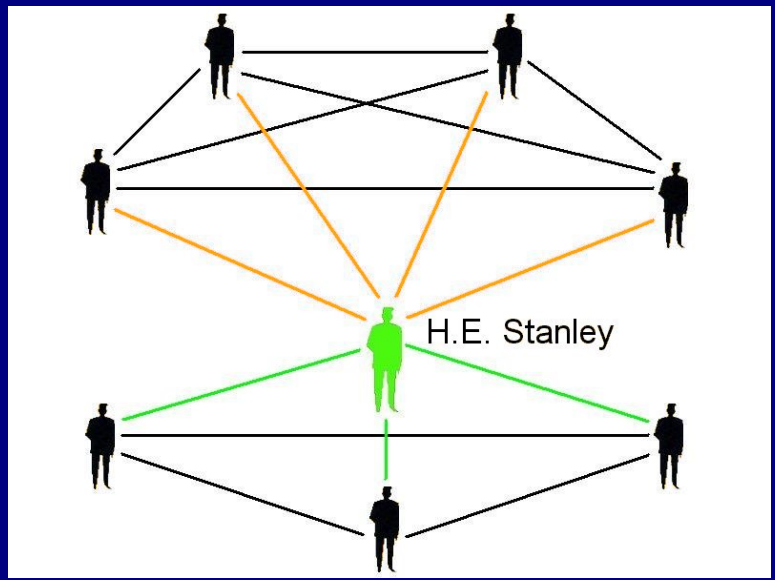
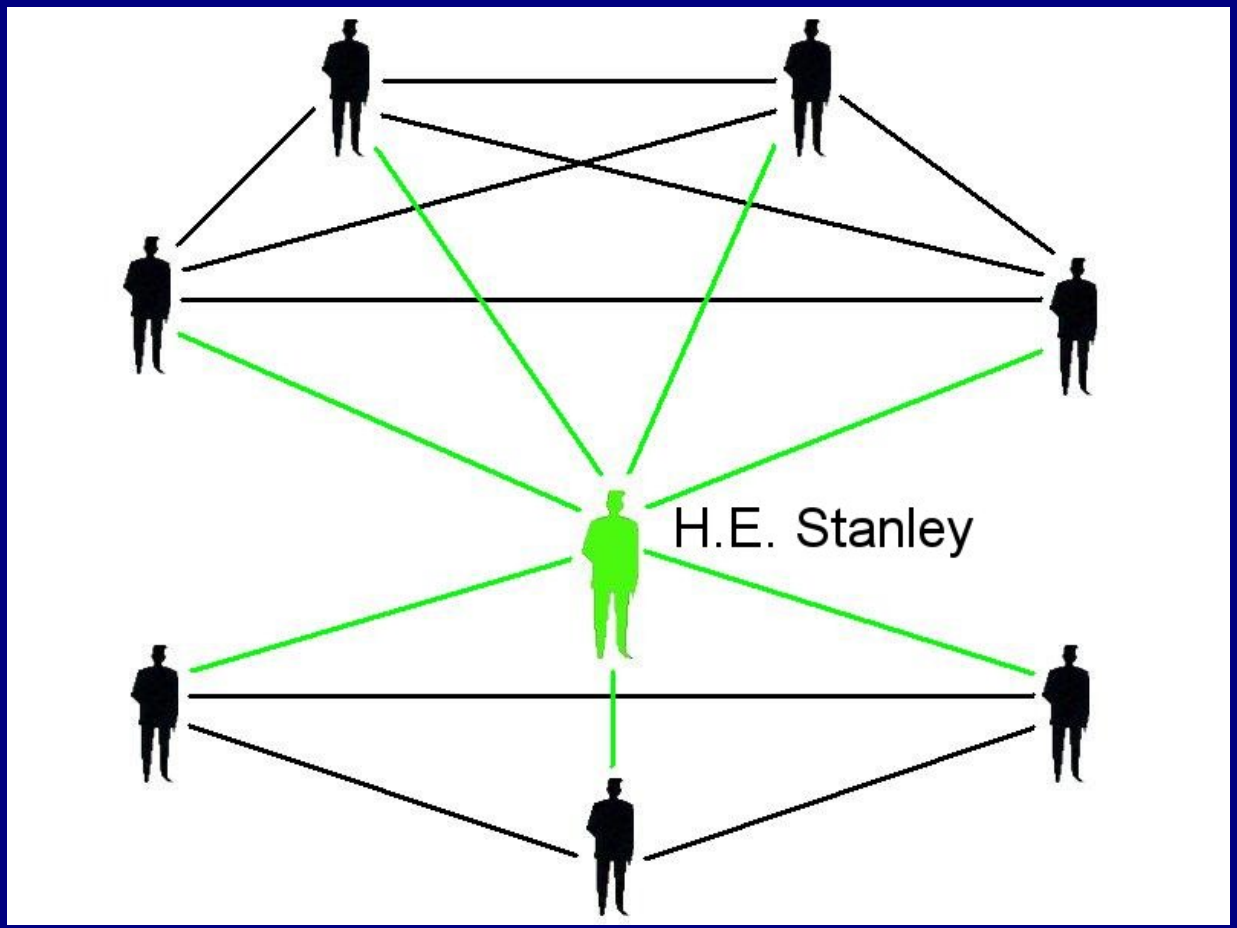


Introduzione

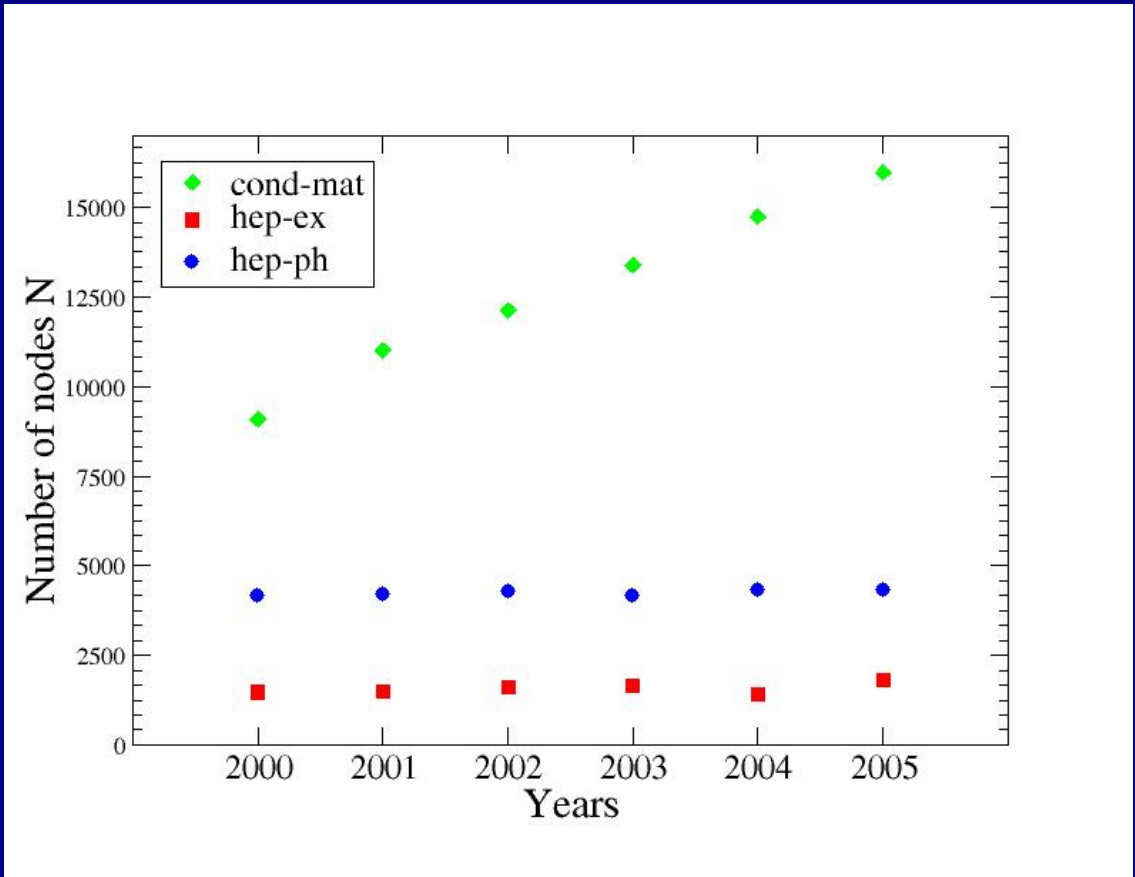
Networks di collaborazioni scientifiche

Nel complesso la sottorete del prof. Stanley sara:



Risultati
Proprietà globali

È possibile studiare l'andamento nel tempo di alcune caratteristiche globali delle reti: numero di nodi,



Risultati
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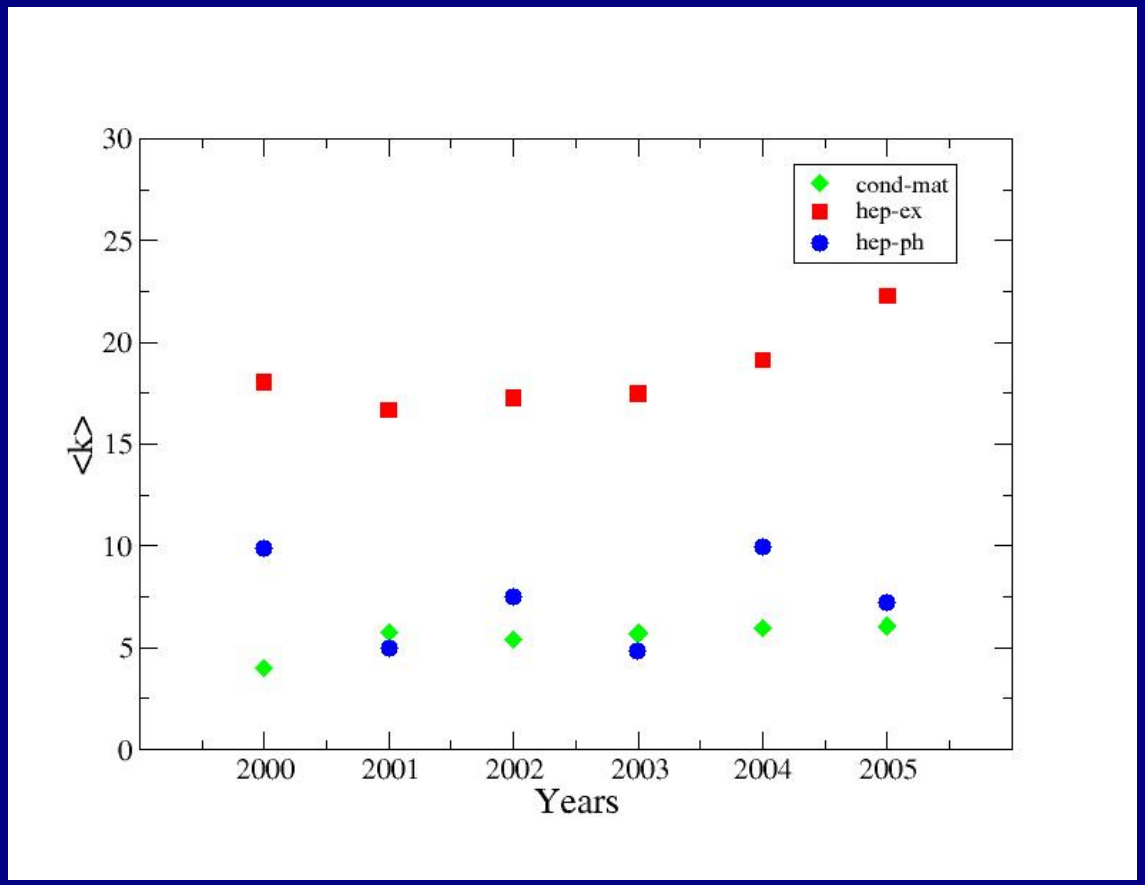
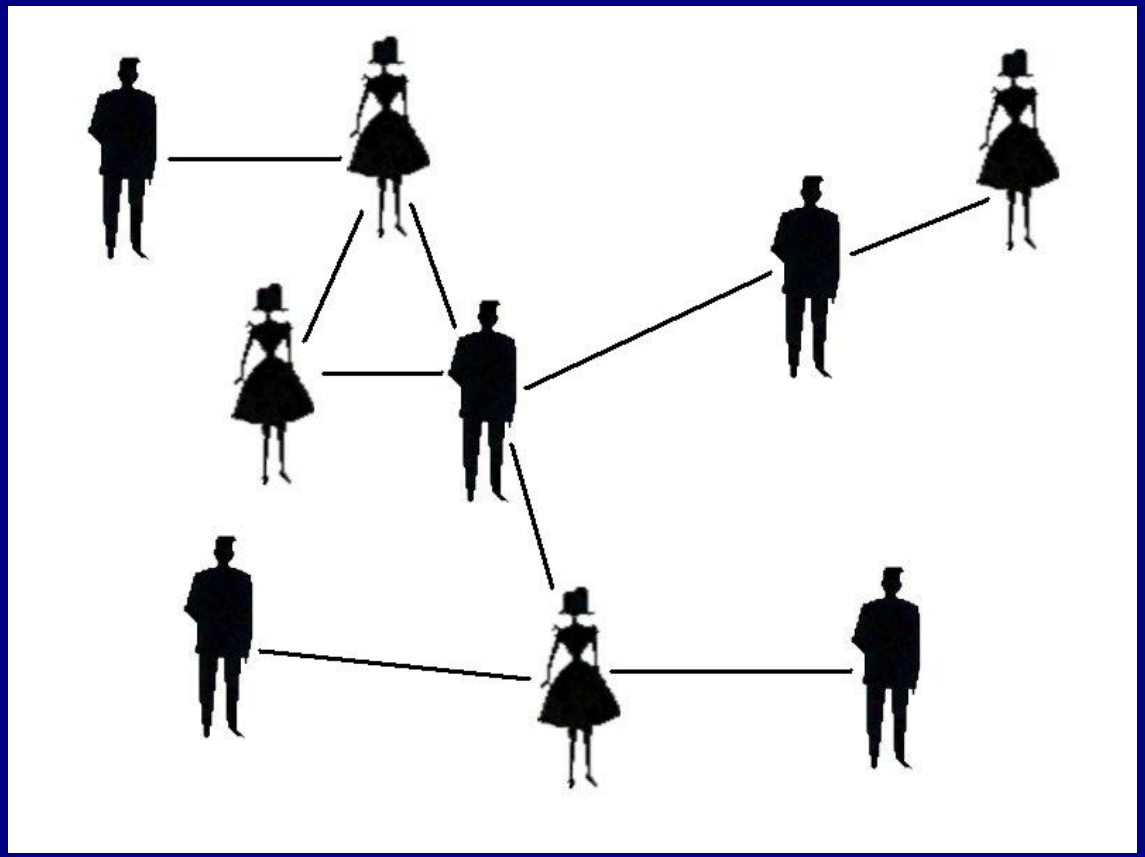


Proprietà dei nodi
Indici di Centralità

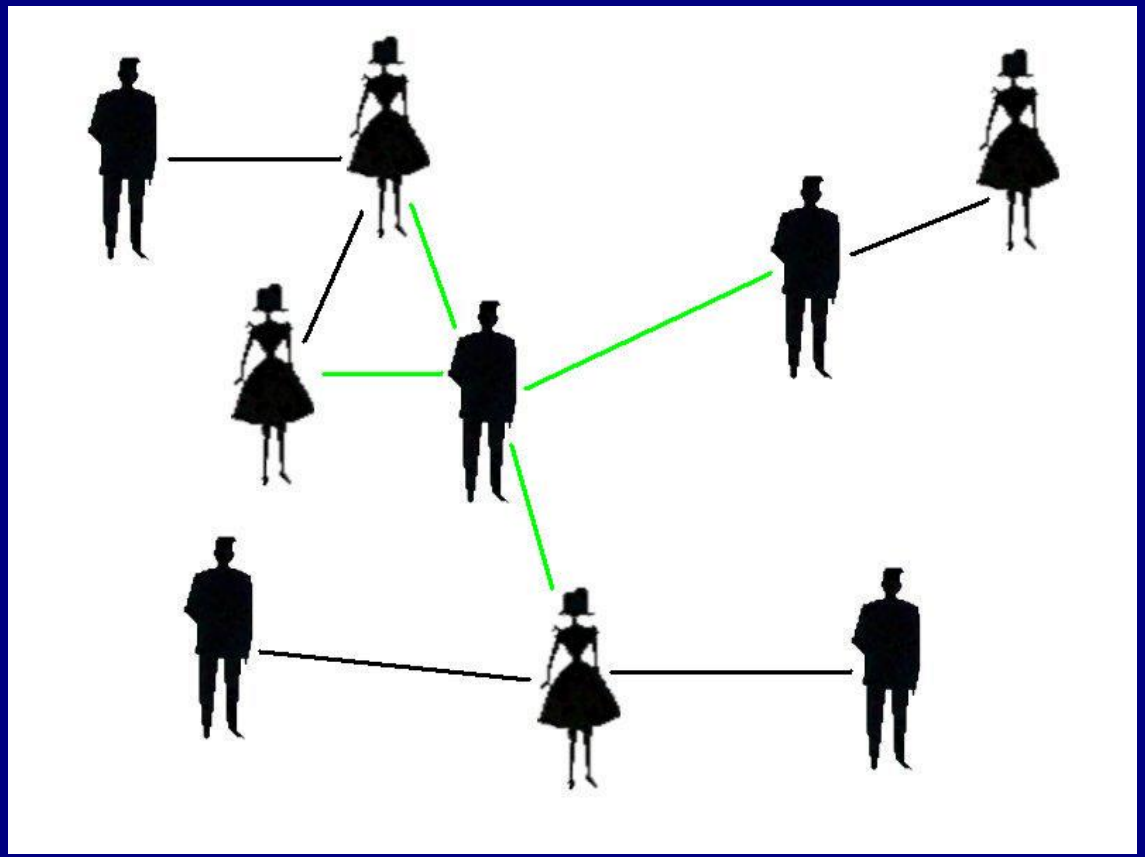
Domanda:

Cosa vuol dire essere “Centrali”?



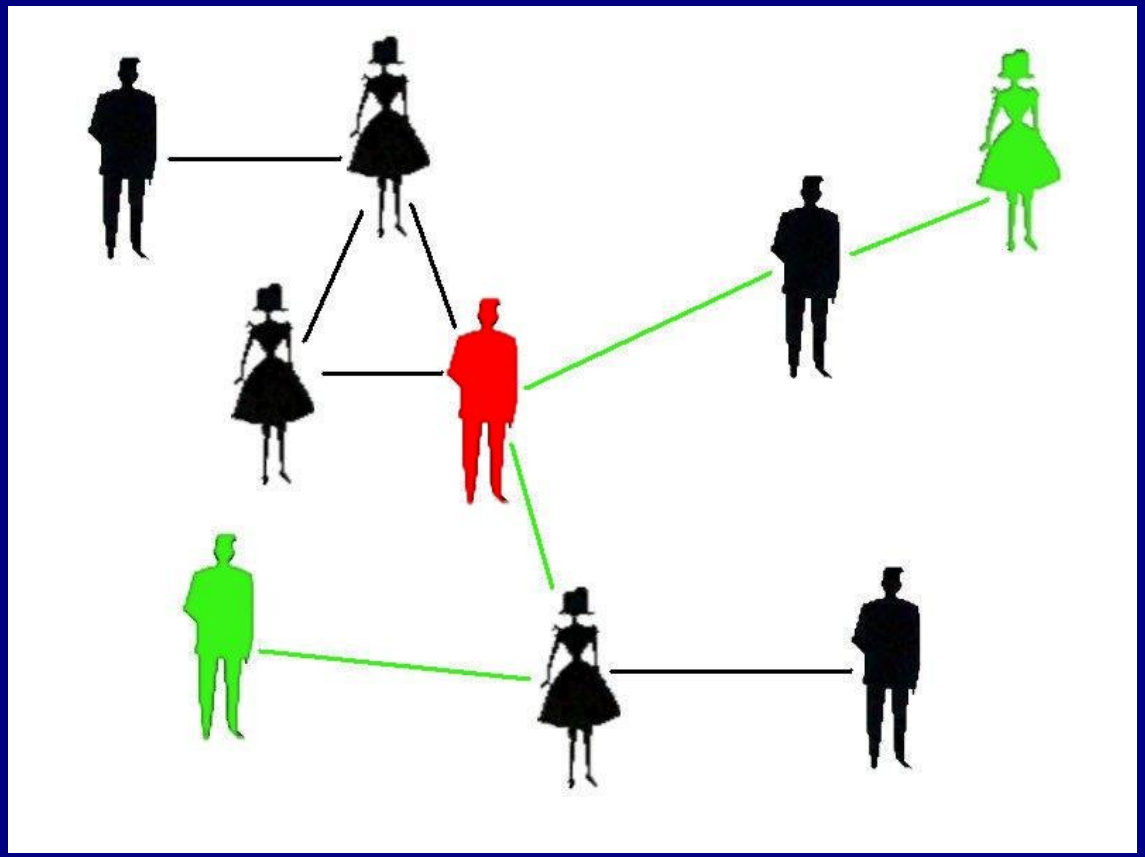
Proprietà dei nodi
Indici di Centralità

Vuol dire conoscere “tante” persone? Centralità di grado;



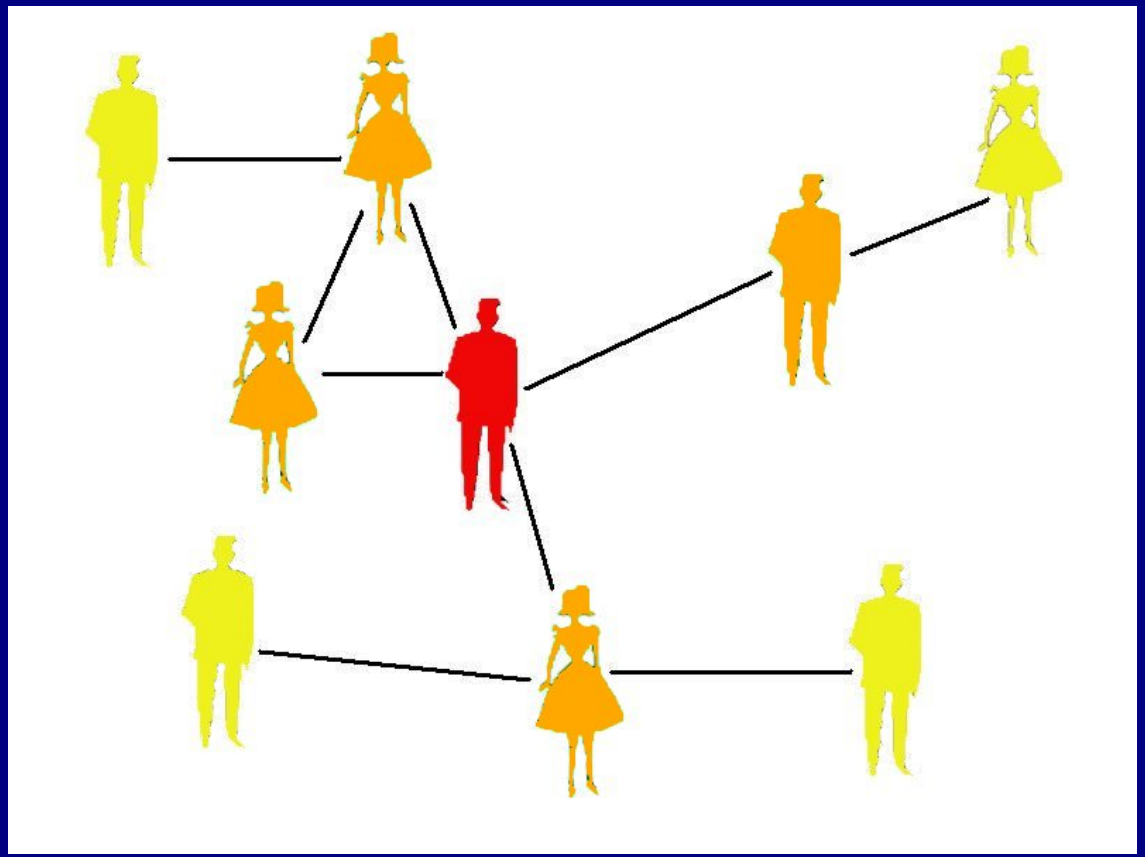
Proprietà dei nodi
Indici di Centralità

Oppure fare da “tramite” fra due individui? Centralità di betweenness;



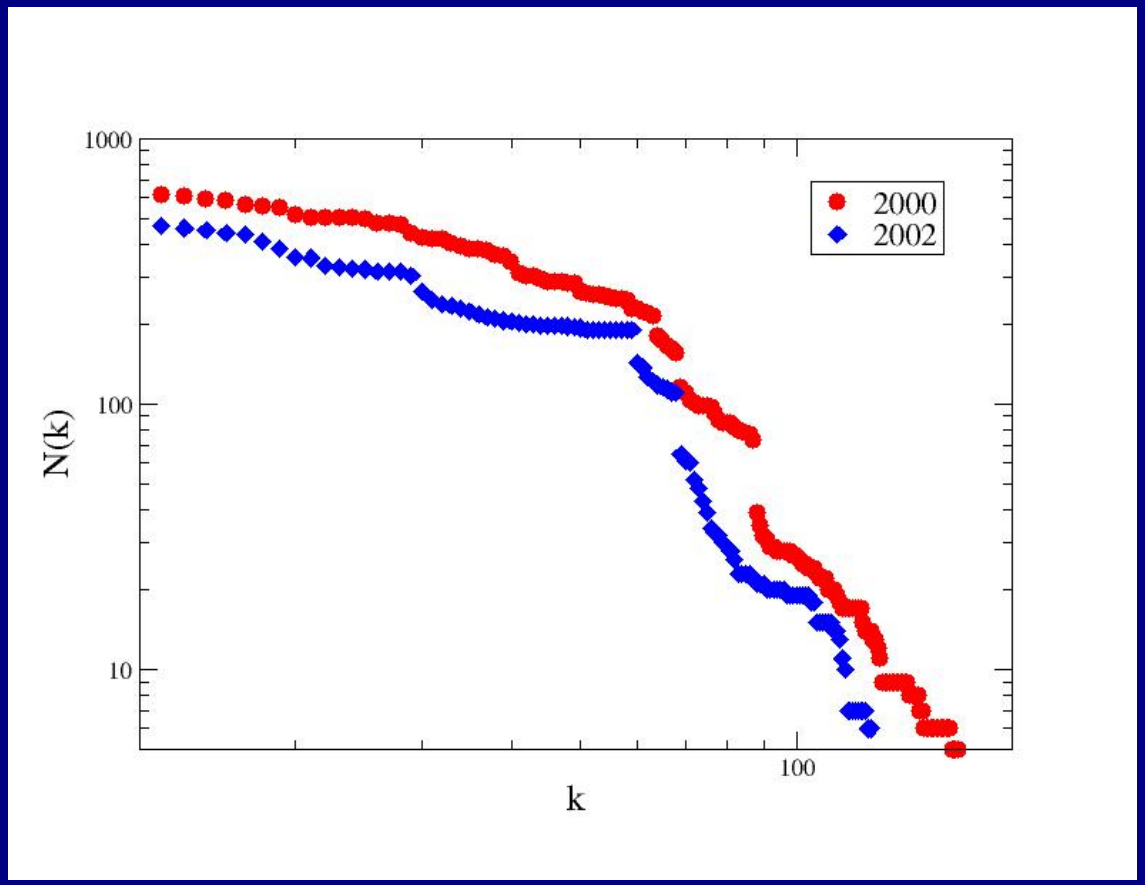
Proprietà dei nodi
Indici di Centralità

Oppure essere più “vicino” agli altri individui? Centralità di closeness;



Caratteristiche topologiche
Distribuzioni & Correlazioni

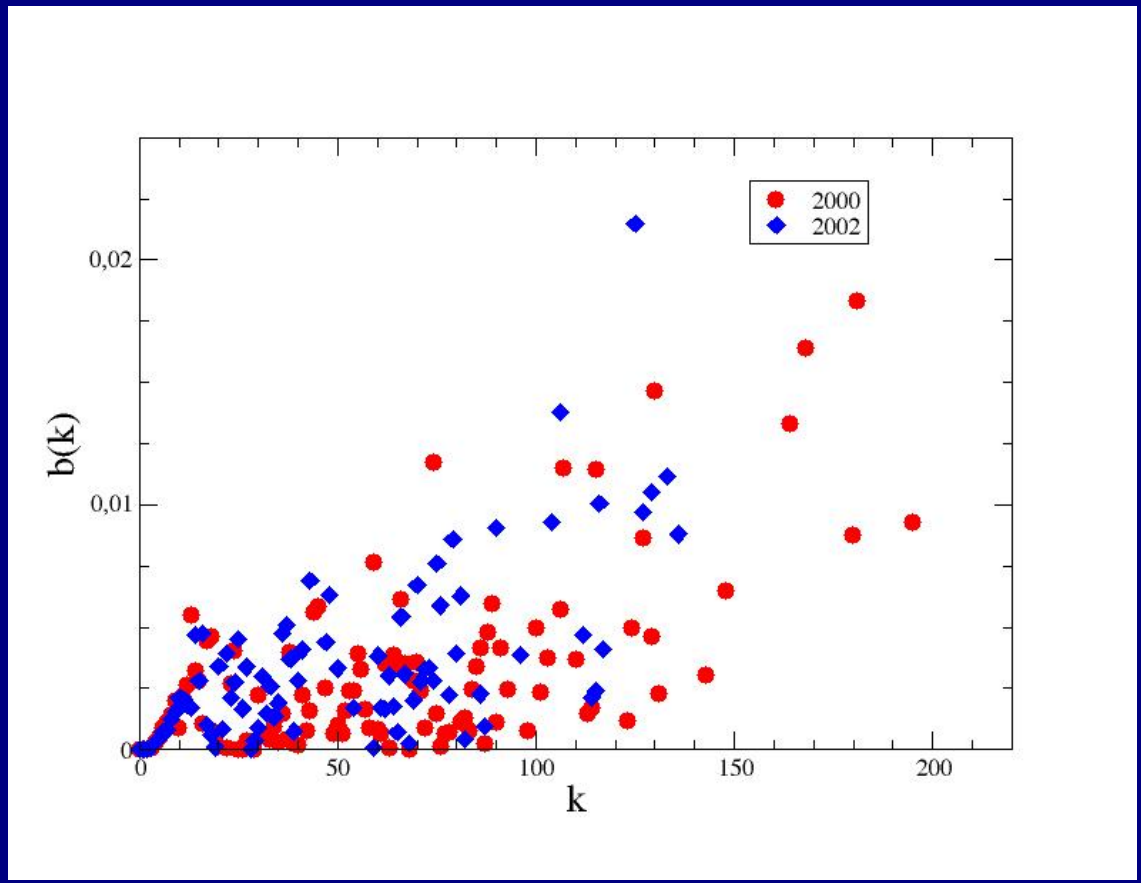
Consideriamo adesso i grafici delle distribuzioni di centralità



Caratteristiche topologiche

Distribuzioni & Correlazioni

Consideriamo adesso i grafici delle distribuzioni di centralità ed i grafici delle correlazioni tra centralità.



Top Ten nucl-th

	grado	betweenness	closeness	link betweenness
1	Meissner U.G.	Li B.A.	Oset E.	Lombardo U. Cao L.G.
2	Buervenich T.J.	Schwenk A.	Meissner U.G.	Li B.A. Danielewicz P.
3	Typel S.	Lombardo U.	Zuo W.	Levai P. Biro T.S.
4	Hausmann M.	Toki H.	Li B.A.	Ko C.M Chen L.W.
5	Madland D.G.	Oset E.	Lombardo U.	Li B.A. Yong G.C.
6	Maruhn J.A.	Meissner U.G.	Toki H.	Oset E. Kaskulov M.M.
7	Steck M.	Lynch W.G.	Meng J.	Oset E. Jido D.
8	Muenzenberg G.	Numes F.M.	Ramos A.	Steinberg P. Wheaton S
9	Franzke B.	Meng J.	Hosaka A.	Toki H. Geng L.S.
10	Beckert K.	Nogga A.	Ko C.M.	Nogga A. Bogner S.K.

Vai all'appendice

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9	Franzke B.	Meng J.	Hosaka A.	Toki H. Geng L.S.
10	Beckert K.	Nogga A.	Ko C.M.	Nogga A. Bogner S.K.

Vai all'appendice

Top Ten nucl-th

	grado	betweenness	closeness	link betweenness
1	Meissner U.G.	Li B.A.	Oset E.	Lombardo U. Cao L.G.
2	Buervenich T.J.	Schwenk A.	Meissner U.G.	Li B.A. Danielewicz P.
3	Typel S.	**Lombardo U.**	Zuo W.	Levai P. Biro T.S.
4	Hausmann M.	Toki H.	Li B.A.	Ko C.M Chen L.W.
5	Madland D.G.	Oset E.	**Lombardo U.**	Li B.A. Yong G.C.
6	Maruhn J.A.	Meissner U.G.	Toki H.	Oset E. Kaskulov M.M.
7	Steck M.	Lynch W.G.	Meng J.	Oset E. Jido D.
8	Muenzenberg G.	Numes F.M.	Ramos A.	Steinberg P. Wheaton S
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2	Buervenich T.J.	Schwenk A.	Meissner U.G.	Li B.A. Danielewicz P.
3	Typel S.	**Lombardo U.**	Zuo W.	Levai P. Biro T.S.
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5	Madland D.G.	Oset E.	**Lombardo U.**	Li B.A. Yong G.C.
6	Maruhn J.A.	Meissner U.G.	Toki H.	Oset E. Kaskulov M.M.
7	Steck M.	Lynch W.G.	Meng J.	Oset E. Jido D.
8	Muenzenberg G.	Numes F.M.	Ramos A.	Steinberg P. Wheaton S
9	Franzke B.	Meng J.	Hosaka A.	Toki H. Geng L.S.
10	Beckert K.	Nogga A.	Ko C.M.	Nogga A. Bogner S.K.

Vai all'appendice

Sviluppi futuri

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Sviluppi futuri

Ulteriori sviluppi possono riguardare le seguenti tematiche:

- Studiare il network in termini di relazioni “pesate” ;
- Verificare se le reti possiedono proprietà di “aging”;
- Effettuare lo stesso tipo di studio ma su database diversi e su comunità scientifiche diverse da quella dei fisici.

Top Ten hep-ph

	grado	betweenness	closeness	link betweenness
1	Boos E.	Ellis J.	Ellis J.	Ellis J. Battaglia M.
2	Roeck A.D.	Boos E.	Roeck A.D.	Moretti S. Odagiri K.
3	Zerwas P.M.	Roeck A.D.	Boos E.	Gambino P. DeLellis G.L.
4	Bigi I.	Dokshitzer Y.L.	Battaglia M.	Ellis J. Dorokhov A.
5	Battaglia M.	Moretti S.	Zerwas P.M.	Ellis J. Wilson G.
6	Miller D.J.	Kharzeev D.E.	Djouadi A.	Ellis J. Gehrmann T.
7	Blumlein J.	Wyler D.	Bartl A.	Matchev K.T. Roeck A.D.
8	Choi S.Y.	Kim C.S.	Miller D.J.	Battaglia M. Roeck A.D.
9	Dittmaier S.	Marchesini G.	Choi S.Y.	Ellis J. Kulagin S.A.
10	Heuer R.D.	Gambino P.	Heuer R.D.	Ellis J. Ganis G.

Top Ten hep-th

	grado	betweenness	closeness	link betweenness
1	Vafa C.	Vafa C.	Vafa C.	Vafa C. Feng B.
2	Kachru S.	Cvetic M.	He Y.H.	Simon J. Larjo K.
3	Cvetic M.	Jejjala V.	Jejjala V.	He Y.H. Gray J.
4	Tachikawa Y.	He Y.H.	Kennaway K.D.	Vandoren S. Rocek M.
5	Lust D.	Simon J.	Feng B.	Jejjala V. Balasubramanian V.
6	Mazumdar A.	Balasubramanian V.	Balasubramanian V.	Balasubramanian V. Simon J.
7	Wecht B.	Vandoren S.	Vandoren S.	Li S. Huang W.
8	Hanany A.	Ahn C.	Nelson B.D.	Vafa C. He Y.H.
9	Helayel Neto J.A.N.	Vazquez Poritz J.F.P.	Simon J.	Vafa C. Kennaway K.D.
10	Lukierski J.	Ross S.F.	Boer J.	Pope C.N. Chong Z.W.