Scientific Collaboration Community

- Complex networks approach -

- The accelerating process of world globalization embraces and pervades all aspects of the human's activity. Contemporary means and standards of conducting the scientific investigations deserve a special attention in this context as their progress at the same time constitutes both the condition and the result of this world globalization process. Indeed, the most advanced world scientific contemporary initiatives are based on multinational and often even on highly multidisciplinary collaborations (ANTONI !)

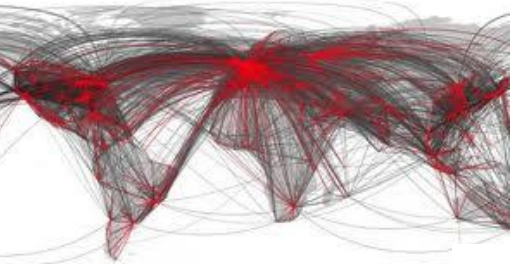
- Studying characteristics of various aspects of scientific collaboration potentially constitutes a significant contribution towards understanding the structure and dynamics of social interactions but, first of all, it is of great importance for an efficient stimulation of the future science development.

- Quantifying properties of the scientific collaboration networks in an informative and transparent way becomes highly facilitated thanks to great advances in the field of network theory.

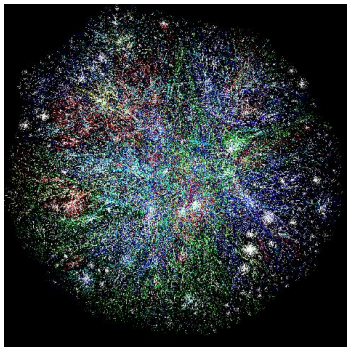
- Many real systems can be modeled as networks:
  nodes + interactions (links or edges)

- Networks permeate almost every conceivable discipline
"network science„ become a crucial component of modern scientific education.

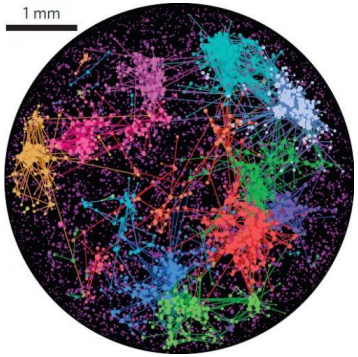
Examples of ‘real world’ networks



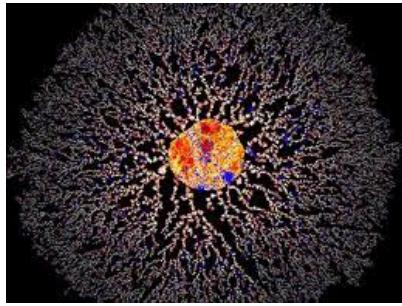
World transportation



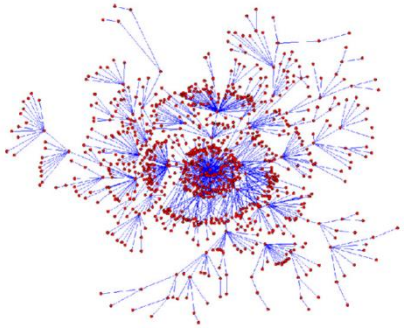
Internet



Spontaneous neuronal brain activity

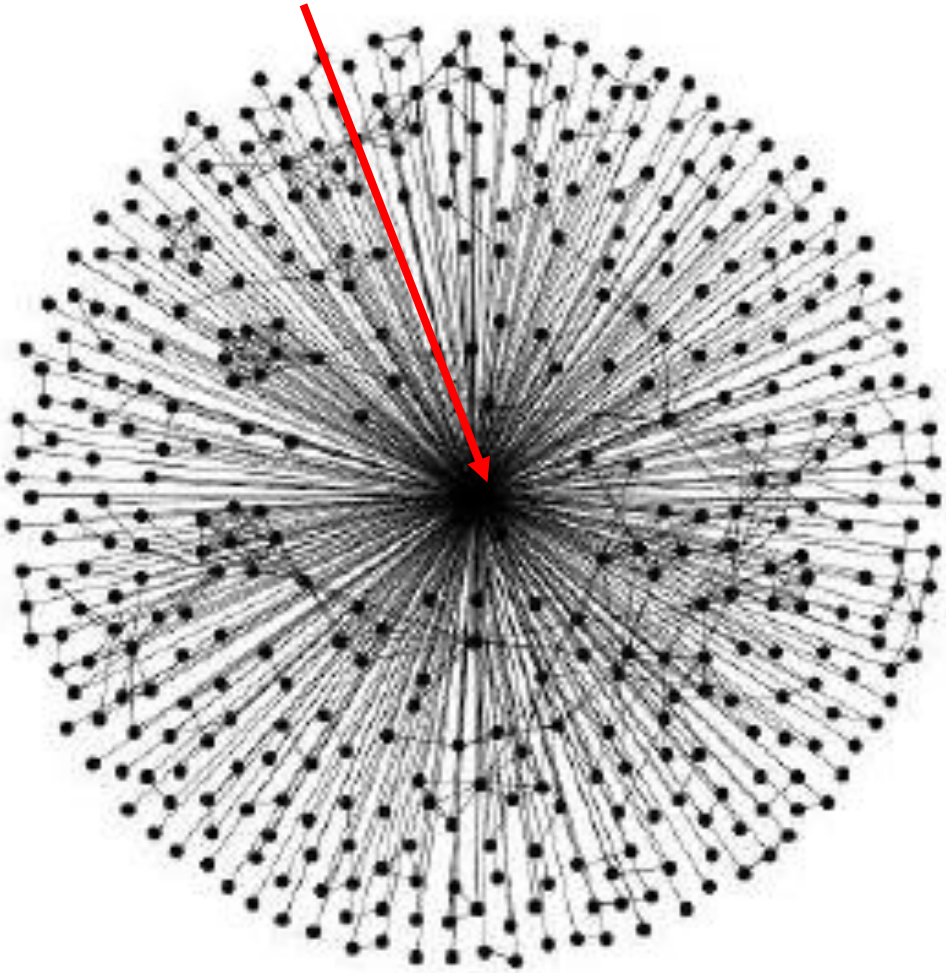


Protein homology network

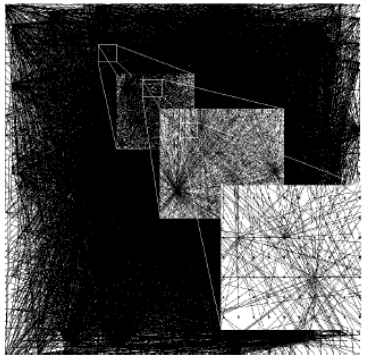


Stock market companies

Erdos #1 network



Scientific collaboration



Linguistic:
word adjacency network

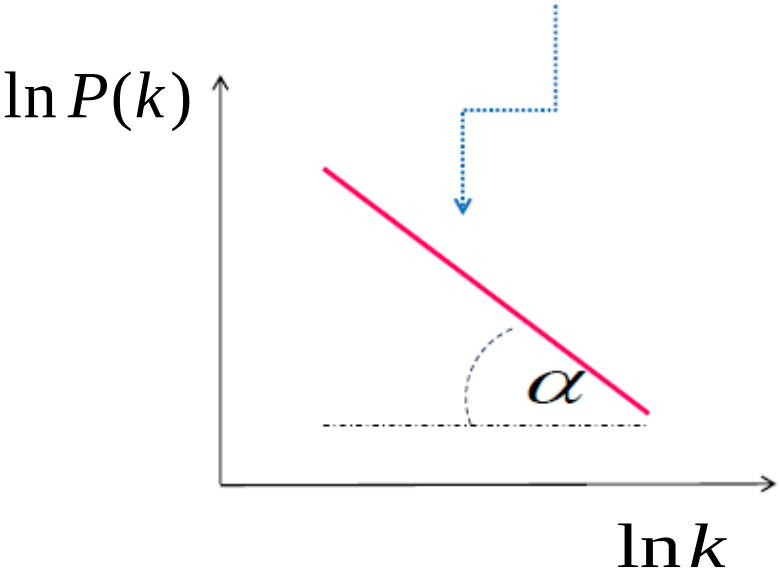
Principal network characteristics:

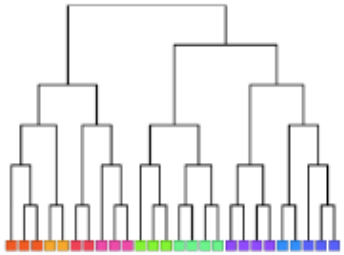
degree k distribution

$$P(k) \propto k^{-\gamma}$$

$\longleftrightarrow$ Scale-free (hierarchical)

$$\gamma = tg\alpha$$





very few nodes have many links
but
most nodes have very few links

Preferential attachment

Matthew effect: *„For whoever has will be given more"*

SESSION on the Occasion of Antoni Szczurek 60th Birthday

Antoni's

Scientific Collaboration Community

in

Weighted

Network

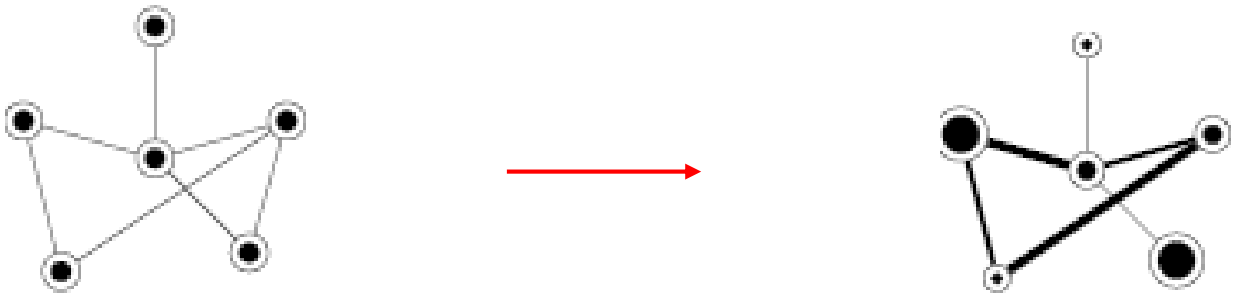
Representation

by Complex Systems Theory Department

Institute of Nuclear Physics Polish Academy of Science

Kraków, September 07, 2017

Antoni → weighted network



A more sophisticated way of introducing strengths of collaborative ties is to account for the varying number m_l of co-authors of the corresponding publication l by defining

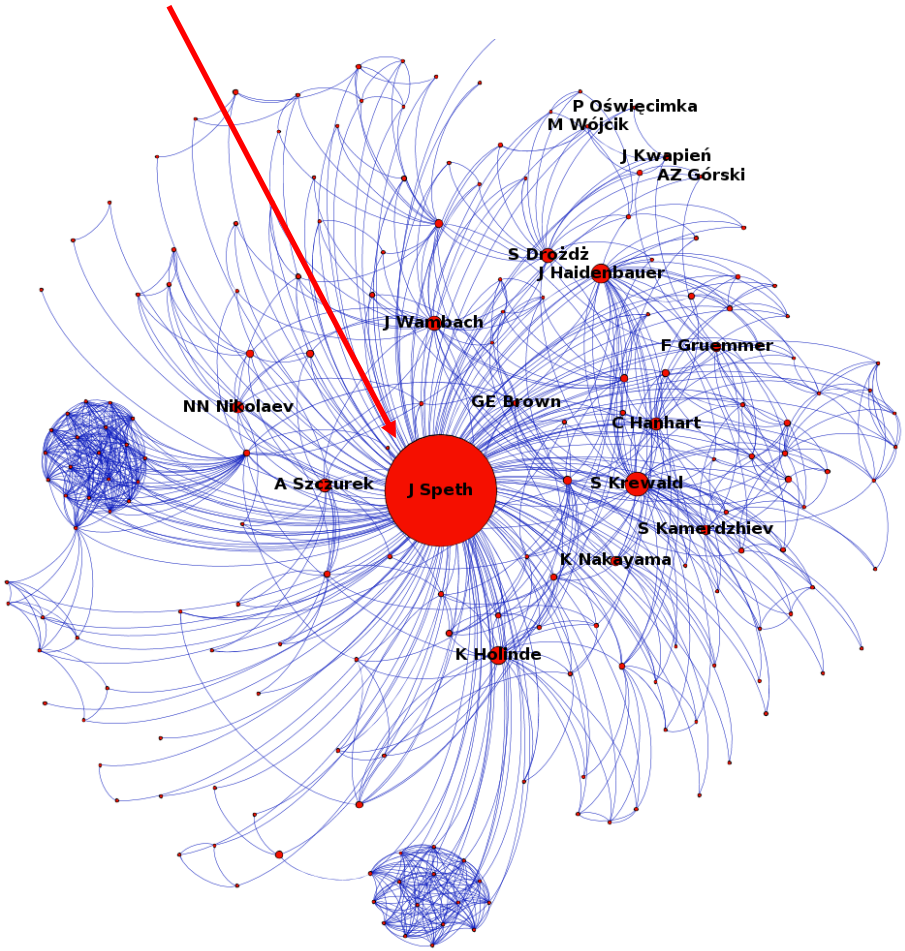
$$s_{ij} = \sum_l \frac{\delta_i^l \delta_j^l}{m_l - 1}$$

where δ_i^l is 1 if author i is a co-author of publication l and zero otherwise and l runs over all the publications involved

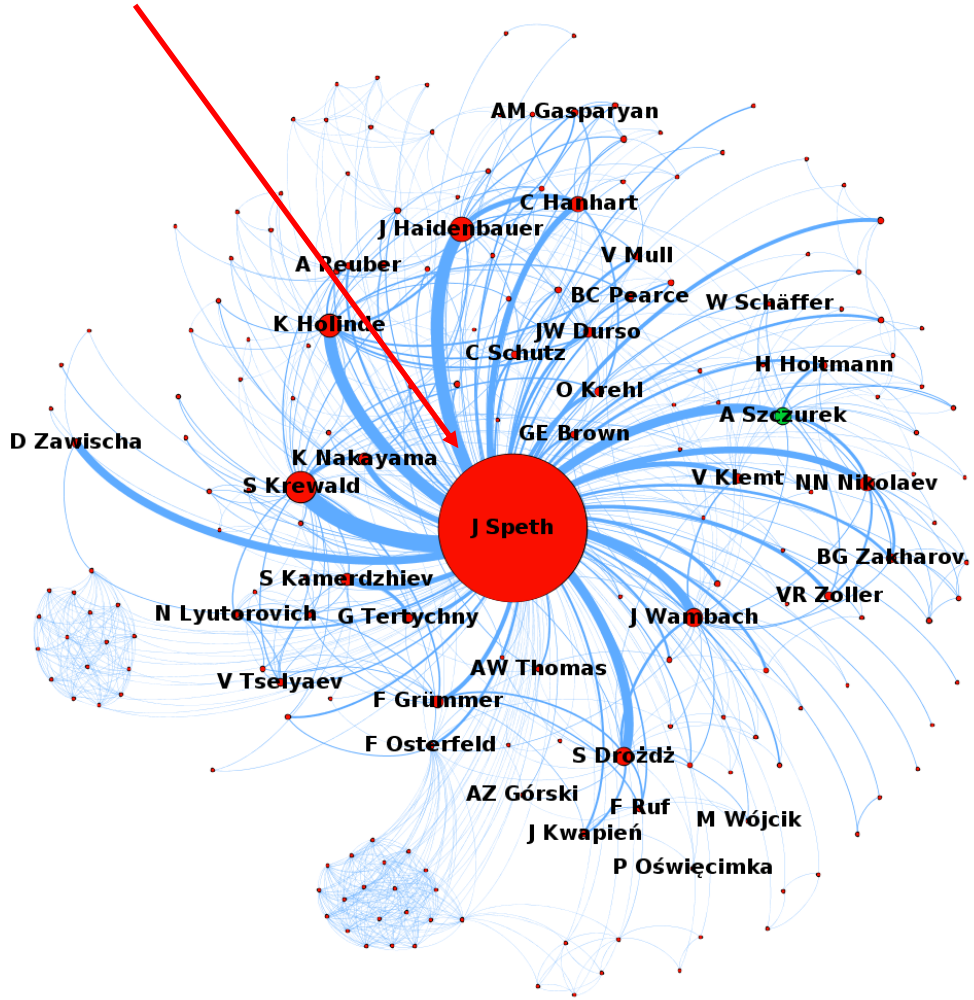
Thus $$s_i = \sum_{j(\neq i)} s_{ij}$$

expresses the collaborative strength of the author i

Speth #1 network-binary



Speth #1 network-weighted



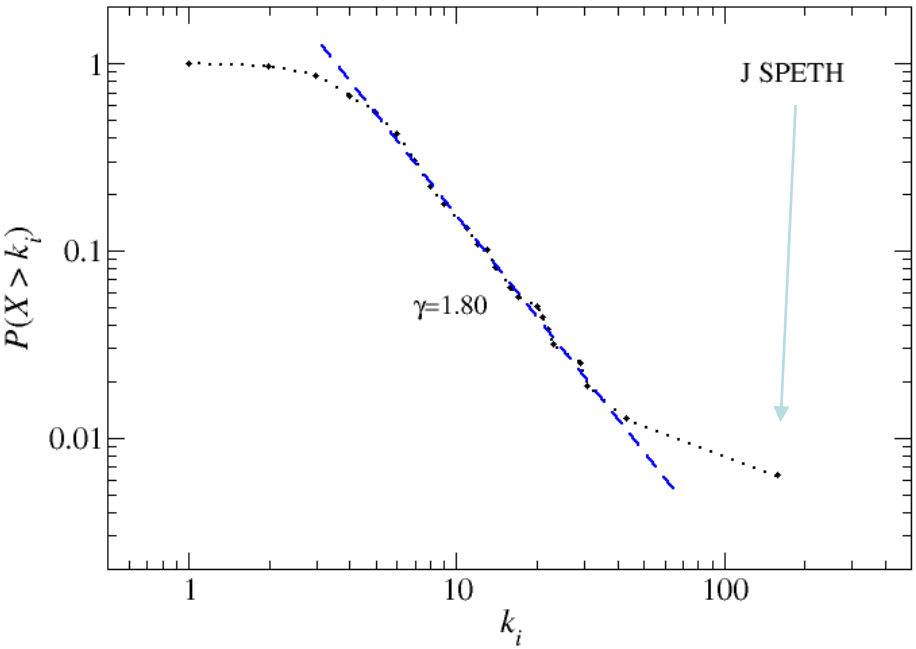
# of articles = 328

# of coauthors = 192

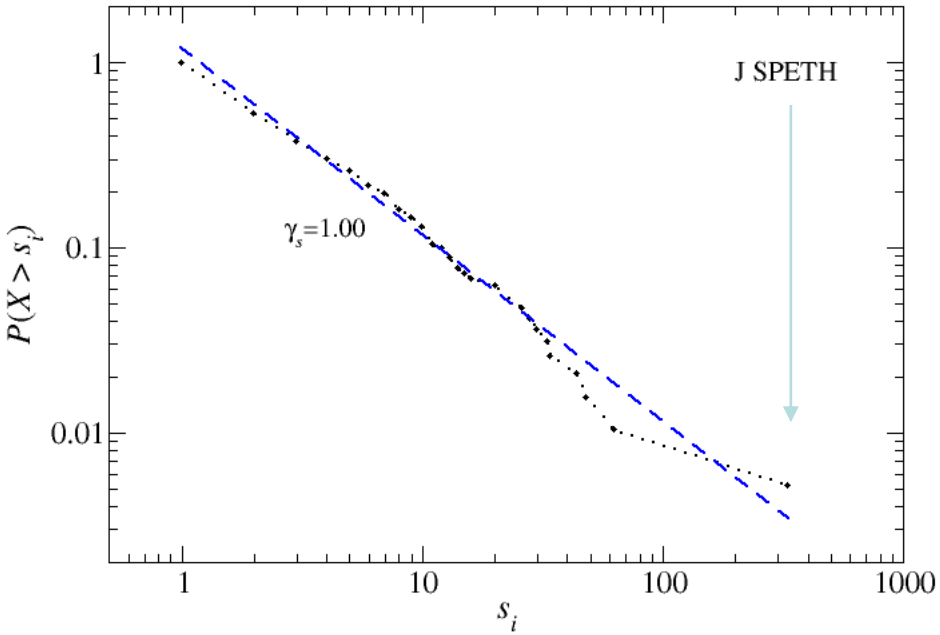
Degree distributions (cumulative)

$$P(X \geq x) \equiv \int_x^\infty P(x')dx'$$

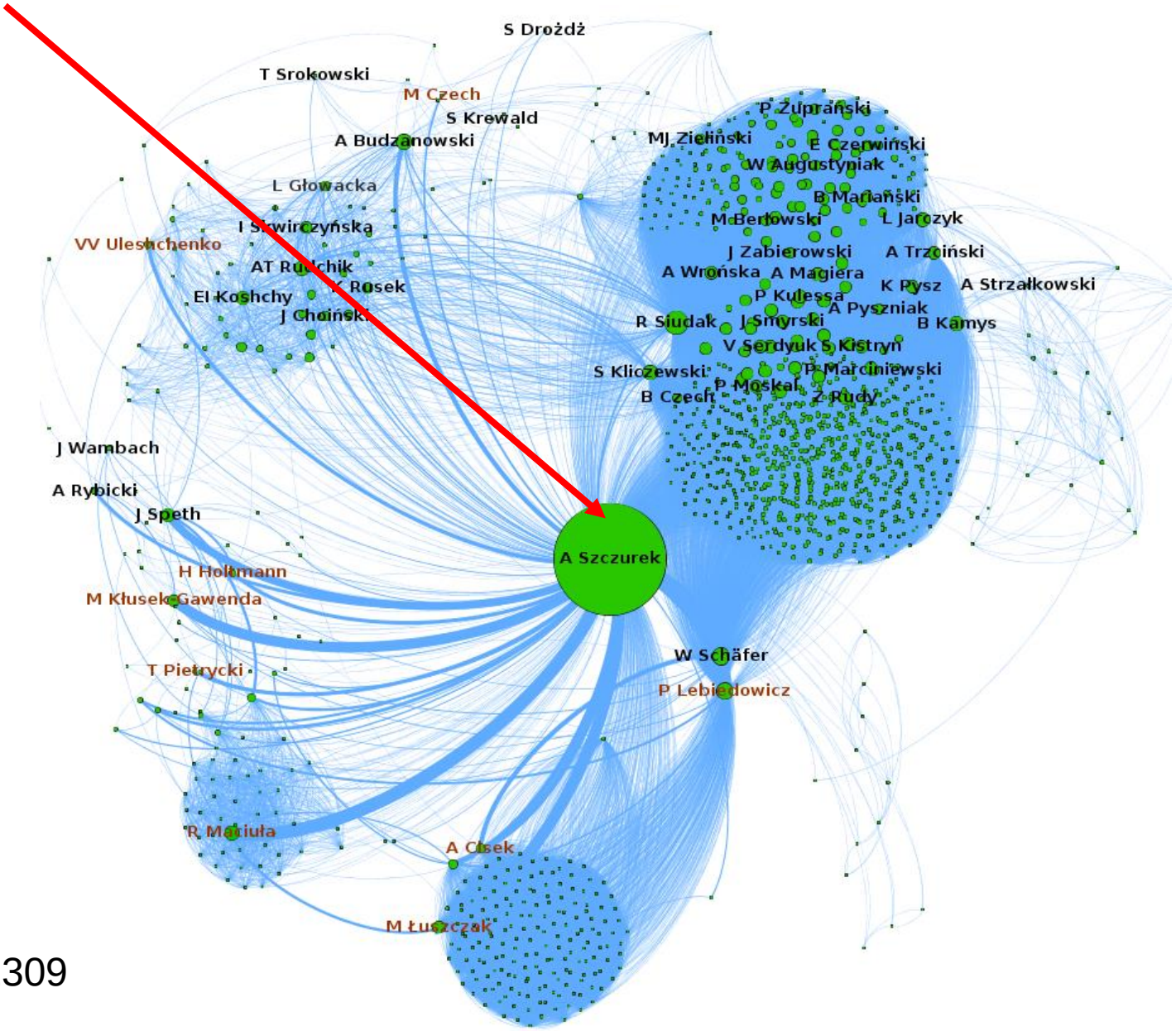
Binary (k)



Strength (s)



Szczurek #1 network-weighted



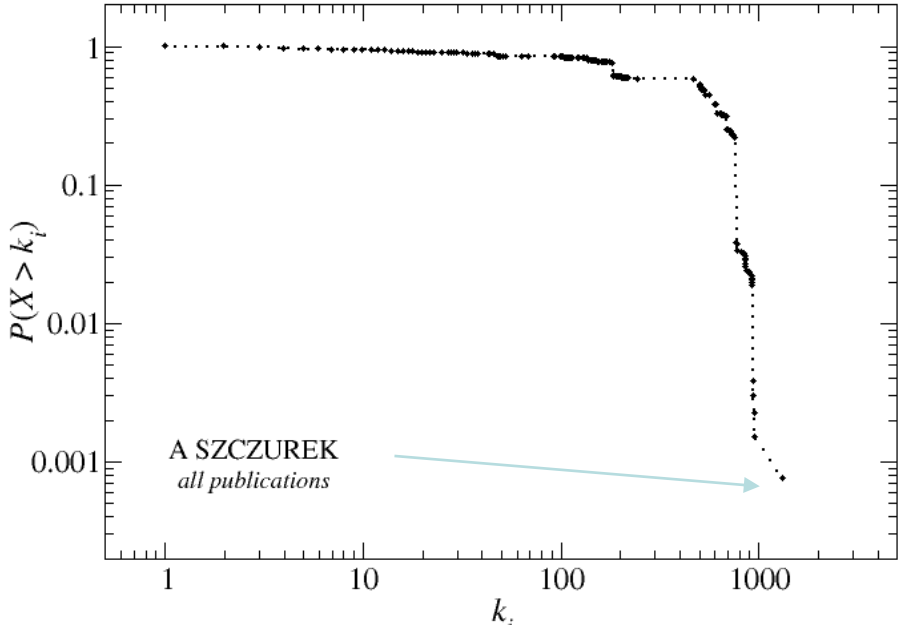
# of articles = 288

# of coauthors = 1309

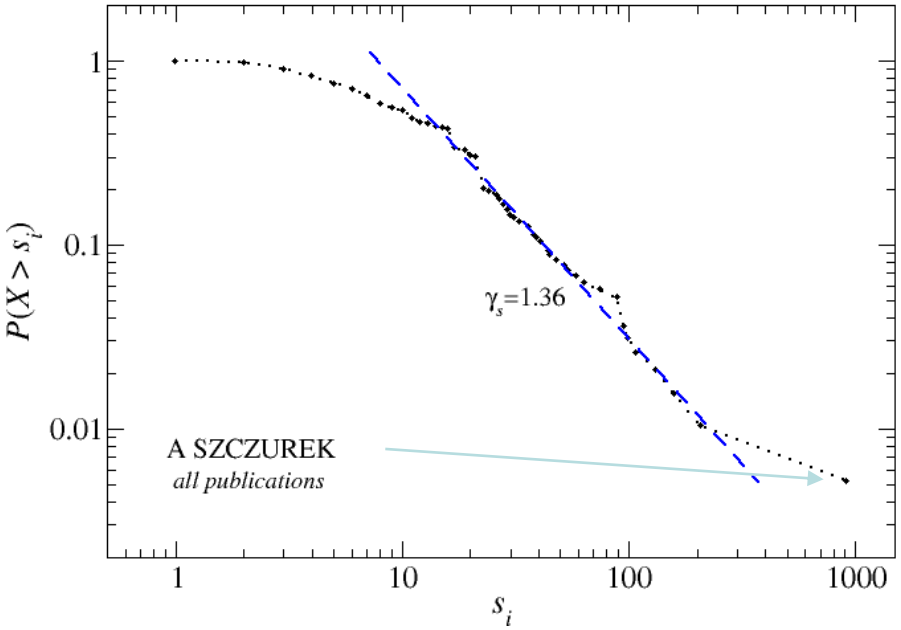
Szczurek #1 network-weighted

Degree distributions (cumulative)

Binary (k)



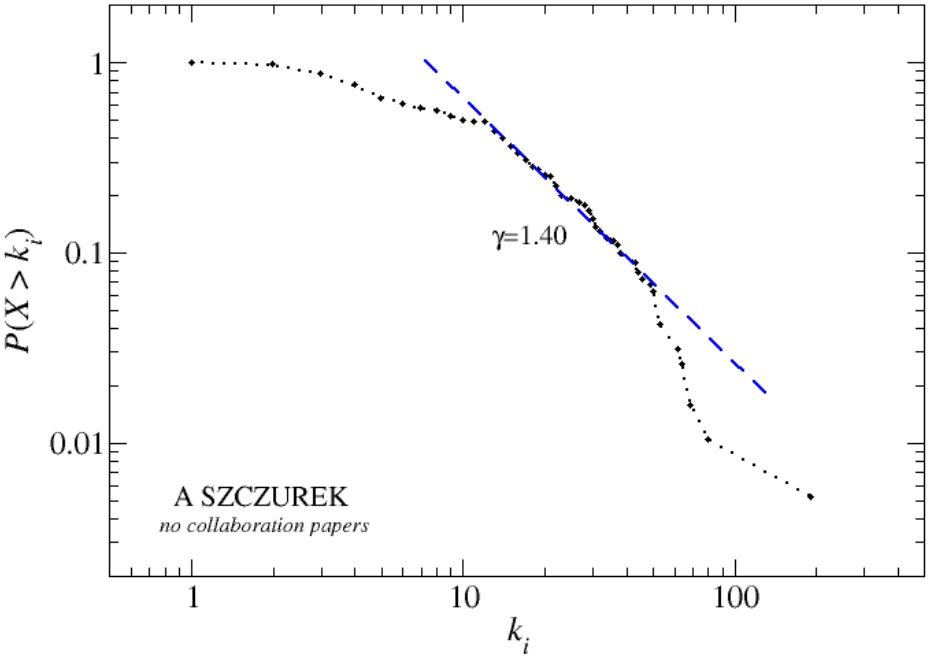
Strength (s)



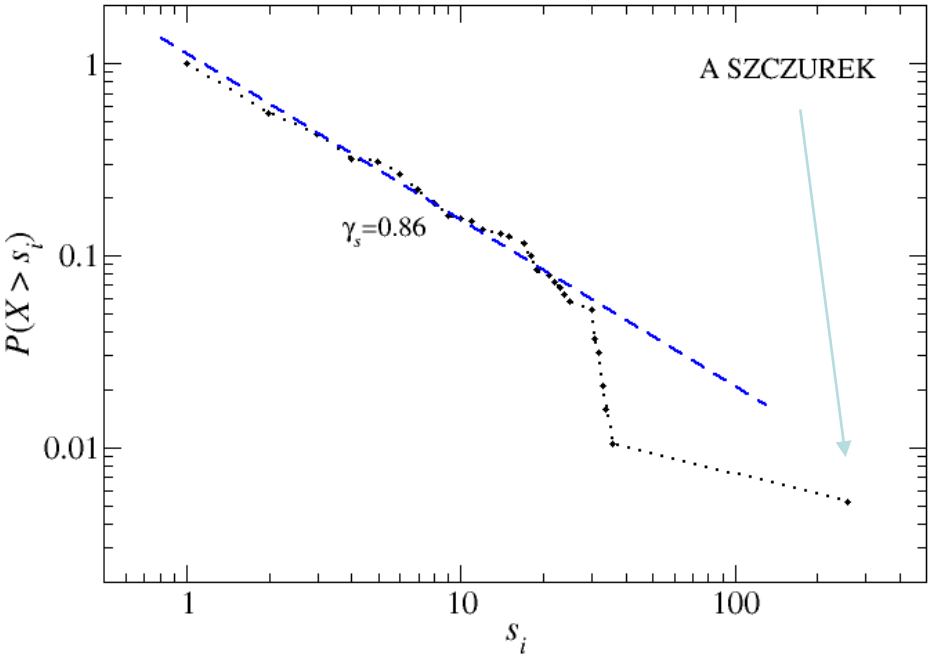
Szczurek #1 network-weighted

Degree distributions (cumulative)
(no 28 large collaboration papers)

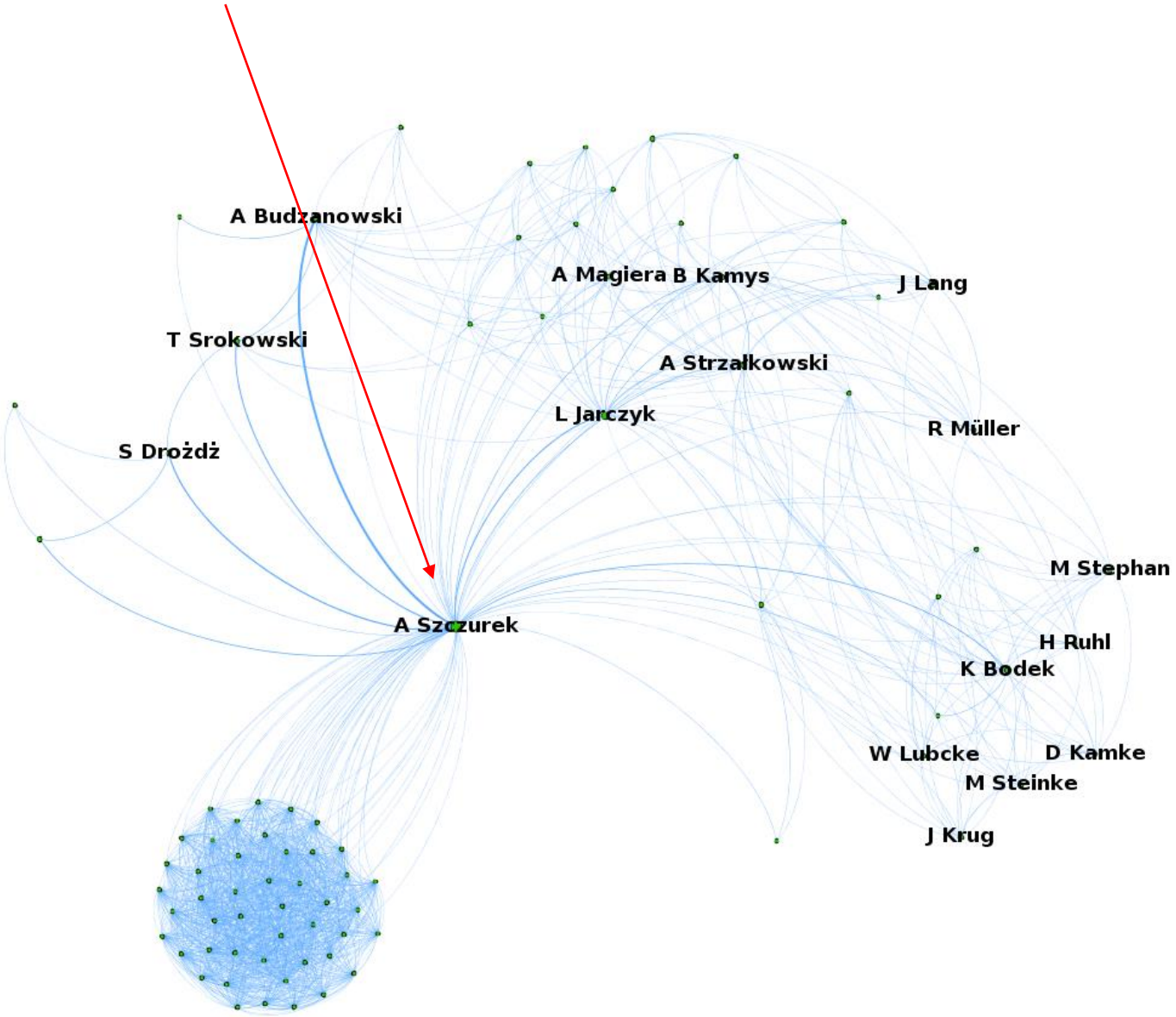
Binary (k)



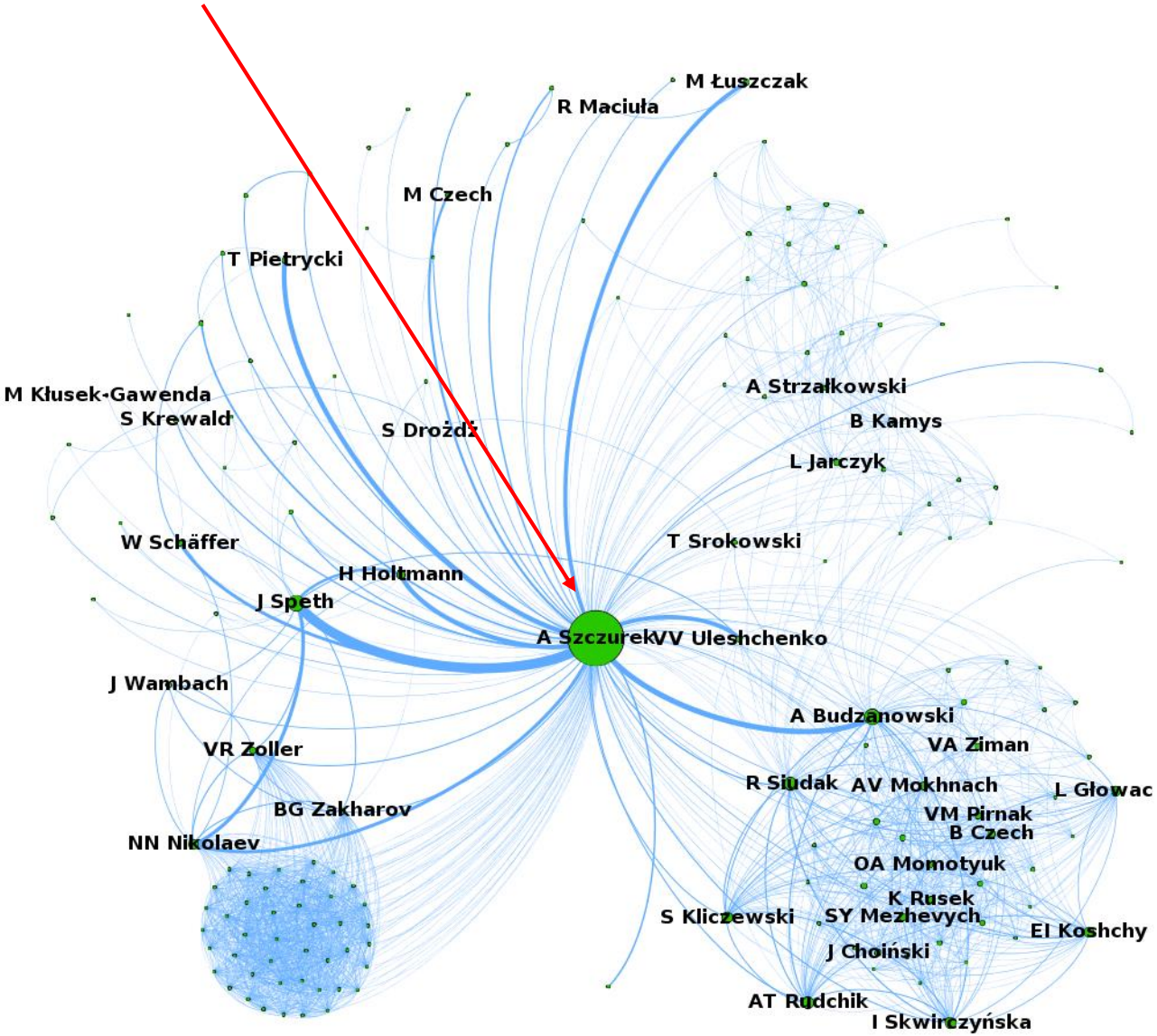
Strength (s)



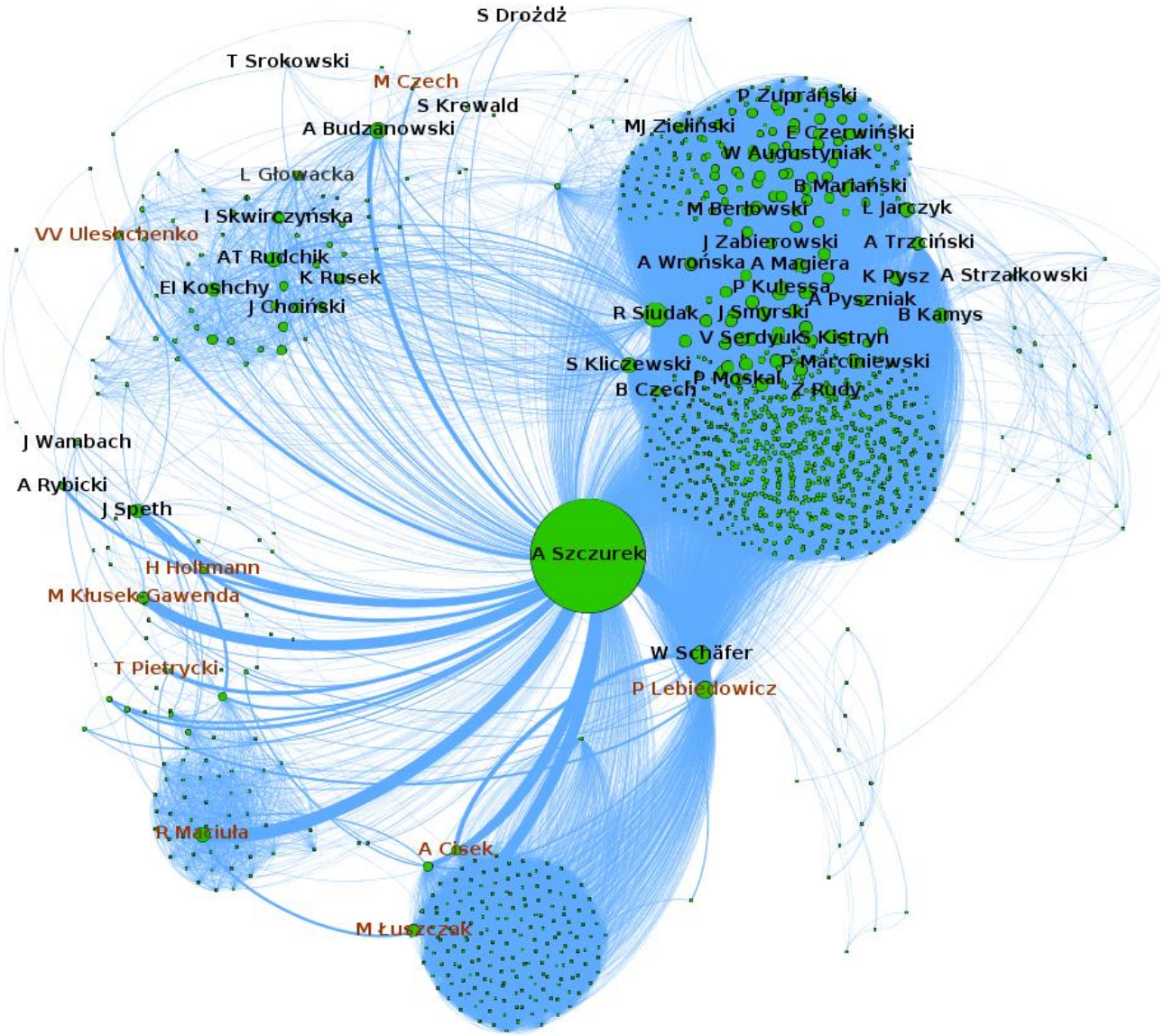
Szczurek #1 until ~ end 1992



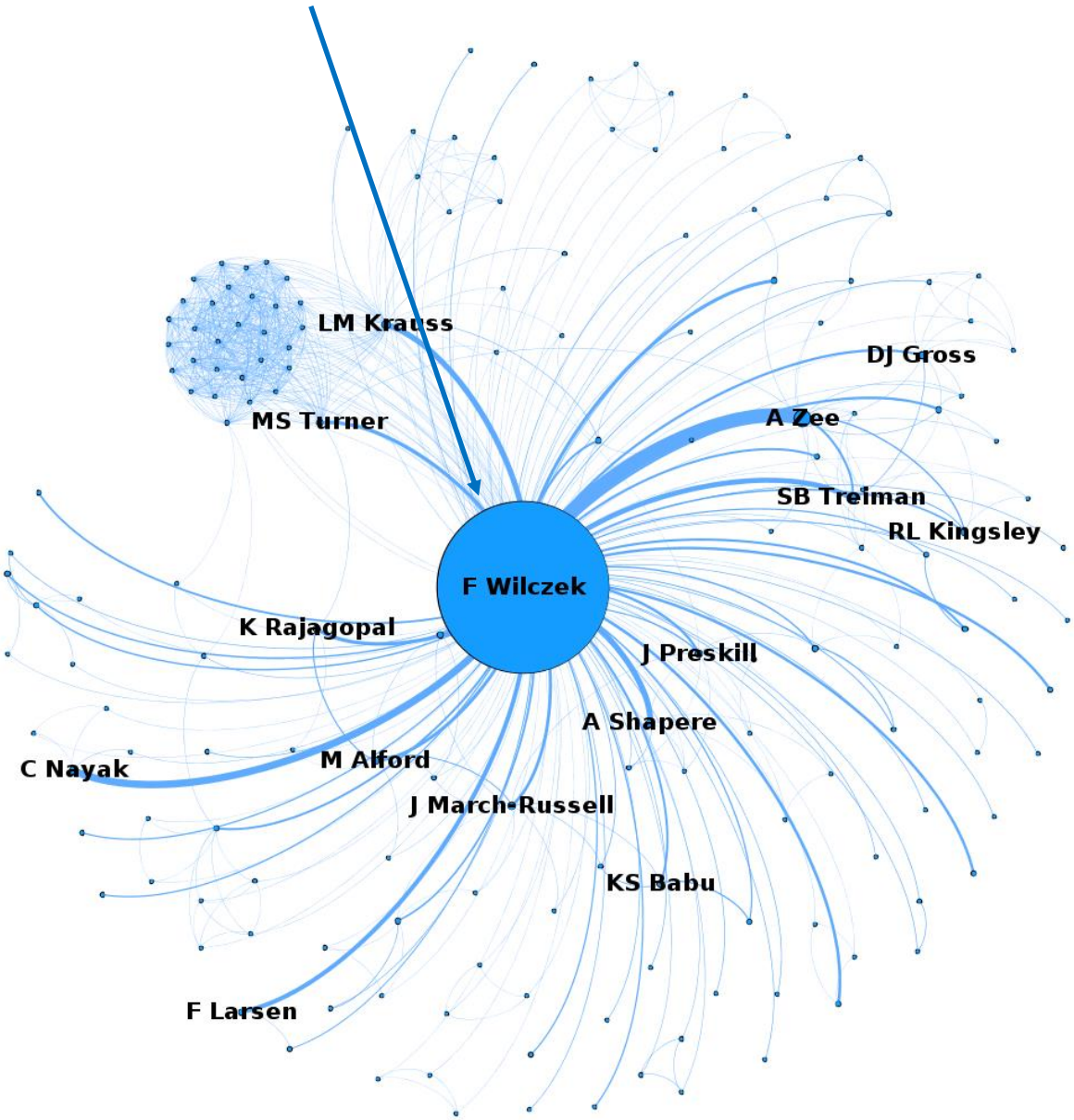
Szczurek #1 until ~ 2011

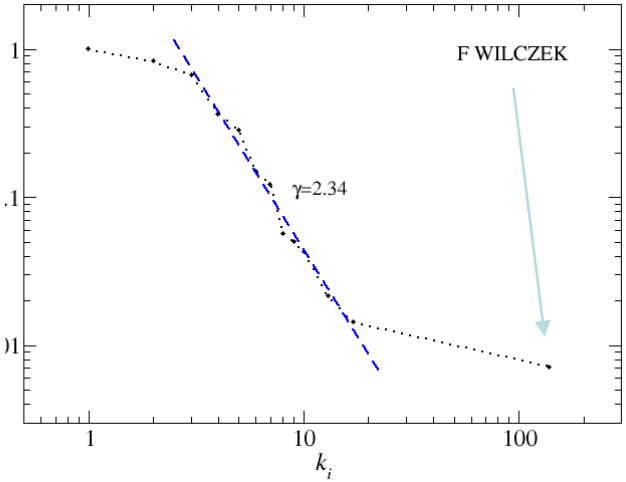


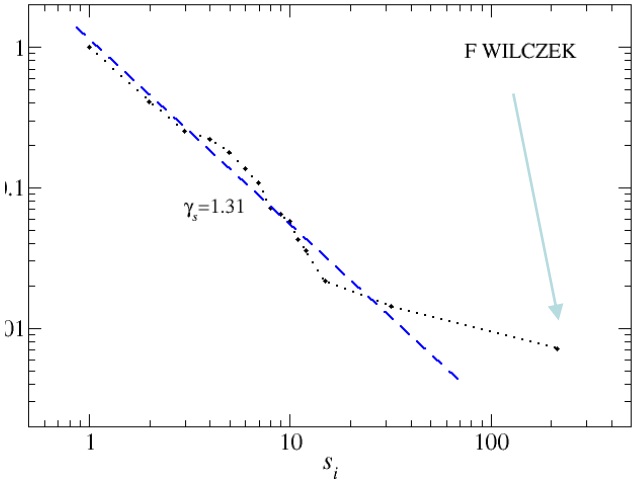
Szczurek #1 until ~ 2017



Wilczek #1


LM Krauss
MS Turner
DJ Gross
A Zee
SB Treiman
RL Kingsley
F Wilczek
K Rajagopal
J Preskill
A Shapere
C Nayak
M Alford
J March-Russell
KS Babu
F Larsen


F WILCZEK
γ=2.34
1
10
100
k_i


F WILCZEK
γ_s=1.31
1
10
100
s_i

Weighted evolving networks: coupling topology and weight dynamics.

In this model the usual *preferential attachment* is extended to the rule *"busy get busier"* (A. Barrat, M. Barthelemy, A. Vespignani, 2004, PRL 92, 228701), in which new nodes connect more likely to nodes carrying larger weights and being more central in terms of the interaction strength.
Accordingly, the local rearrangements of weights between *i* and its neighbours *j* obeys the simple rule

$$w_{ij} \to w_{ij} + \Delta w_{ij}, \qquad \text{where} \qquad \Delta w_{ij} = \delta \frac{w_{ij}}{s_i}$$

The model thus involves only one parameter δ that reflects the fraction of weight transmitted by the new link onto the others.

$\delta > 1 \longrightarrow$ a new link multiplicatively bursts the weight on neighbour

Within this model, in the large time limit, one obtains a power law scaling of the weighted degree distribution with the scaling exponent for the cumulative distribution

$$\gamma_s = 1 + \frac{1}{2\delta + 1}$$

$\gamma_s \approx 1 \longrightarrow \delta$ large

'centers of condensation' stimulate mutual interactions of their nearest neighbours

Conclusion: Scientific Collaboration Network

of Professor Antoni Szczurek is extremely involved

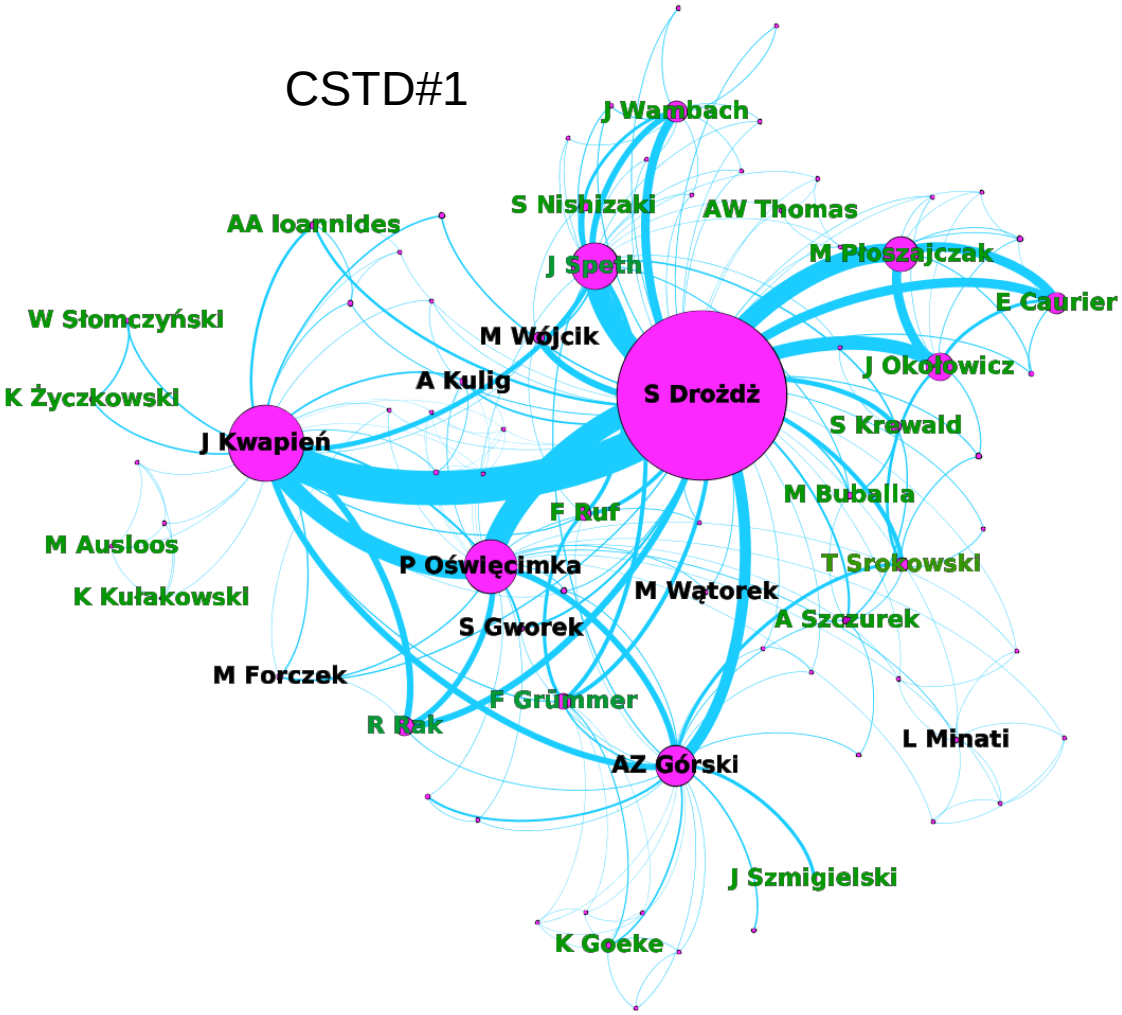
as it contains several components belonging to different classes of networks

($\gamma_s \approx 1$ (weighted scale free) is also present)

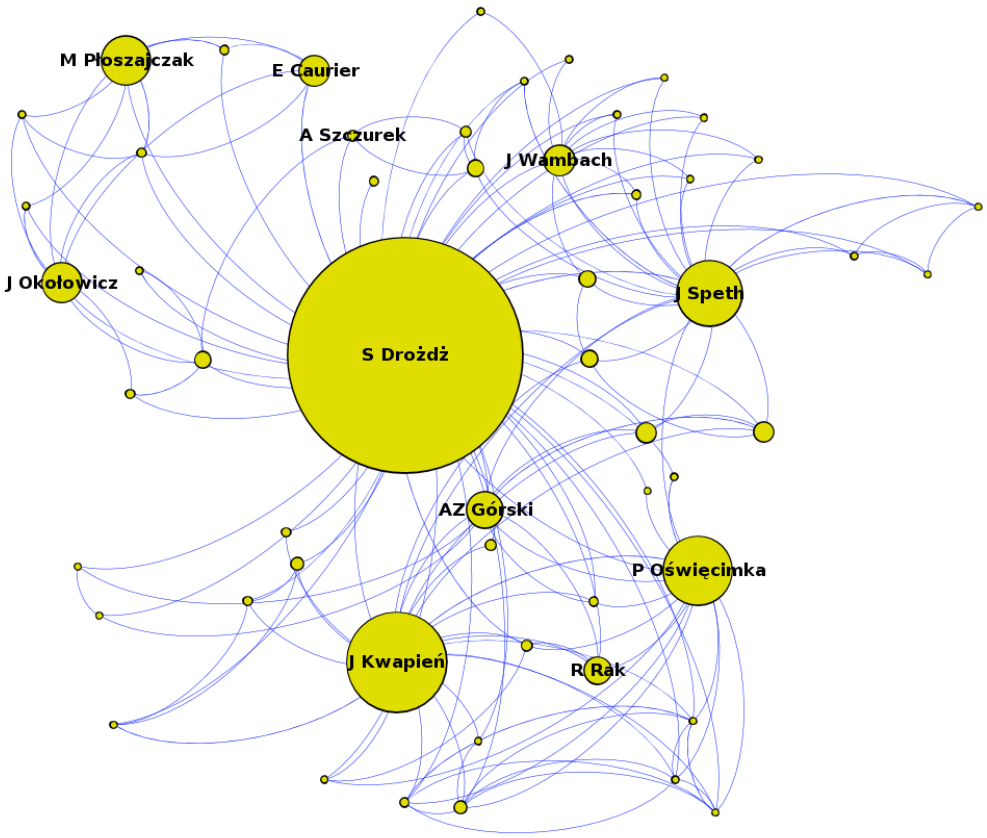
Complex Systems Theory Department of IFJ PAN

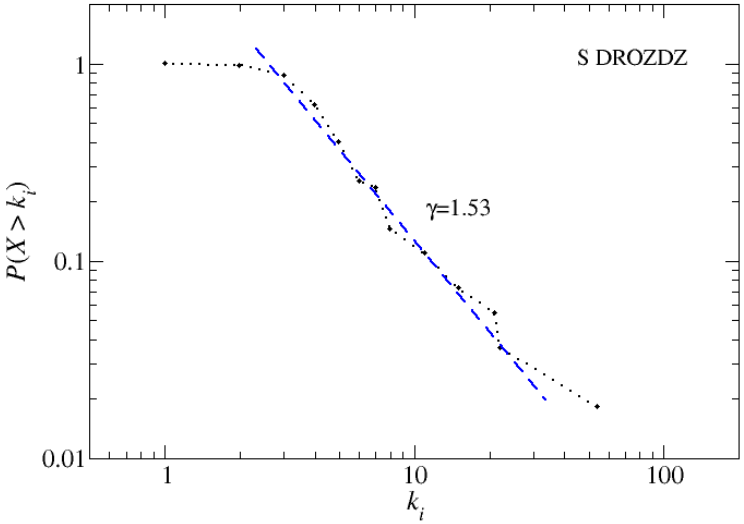
wishes Antoni that such a spectacular and productive coexistence keeps extending for many decades to come !

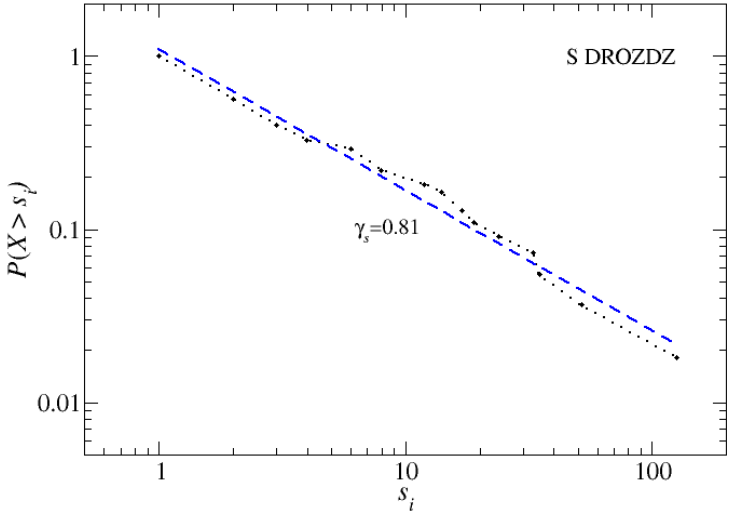
CSTD#1



Drożdż #1 ☺


M Płoszajczak
E Caurier
A Szczurek
J Wambach
J Okołowicz
J Speth
S Drożdż
AZ Górski
P Oświęcimka
J Kwapień
R Rak


S DROZDZ
γ=1.53
$P(X > k_i)$
k_i
1
0.1
0.01
1
10
100


S DROZDZ
γ_s=0.81
$P(X > s_i)$
s_i
1
0.1
0.01
1
10
100