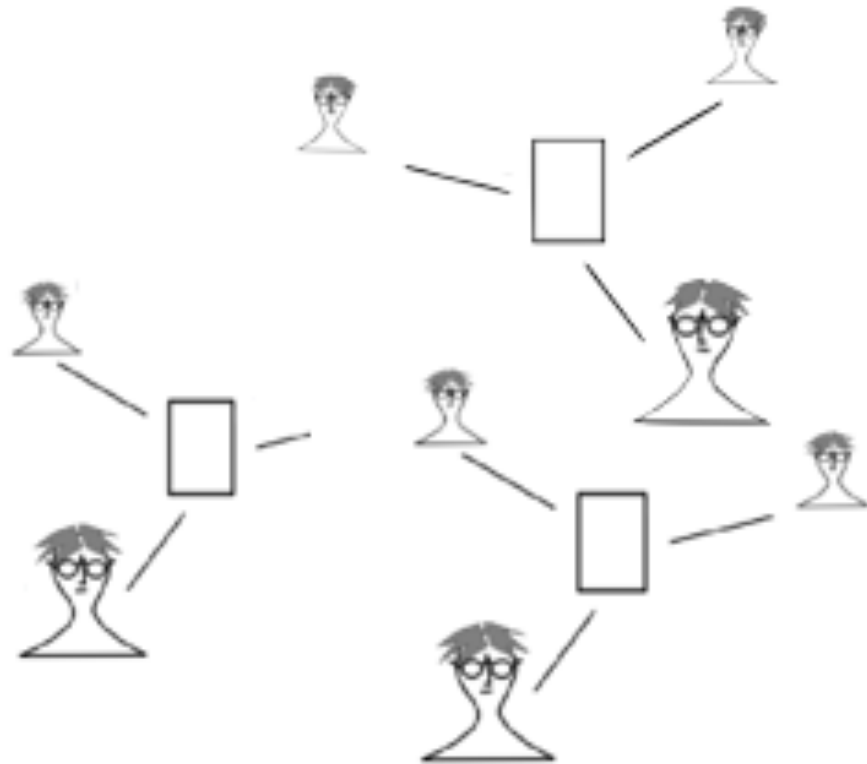# Specialisation and interdisciplinarity: Roads to scientific success
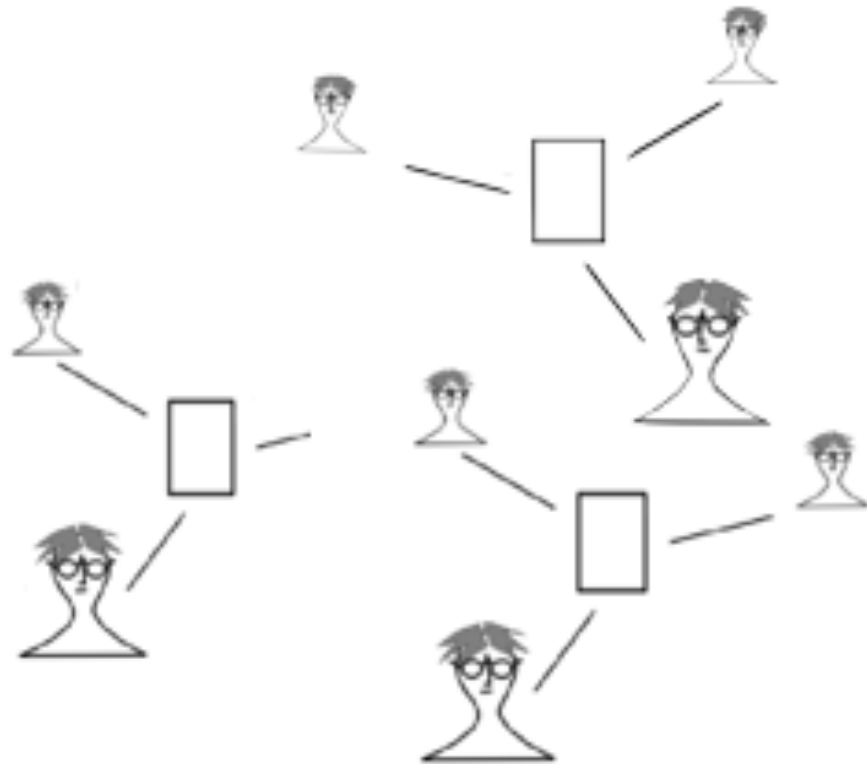
M. Bonaventura, V. Nicosia, P. Panzarasa, V. Latora
Queen Mary University of London

We study **collaboration patterns** in co-authorship networks with special **focus** on the **research** **topics** addressed in scientific papers.

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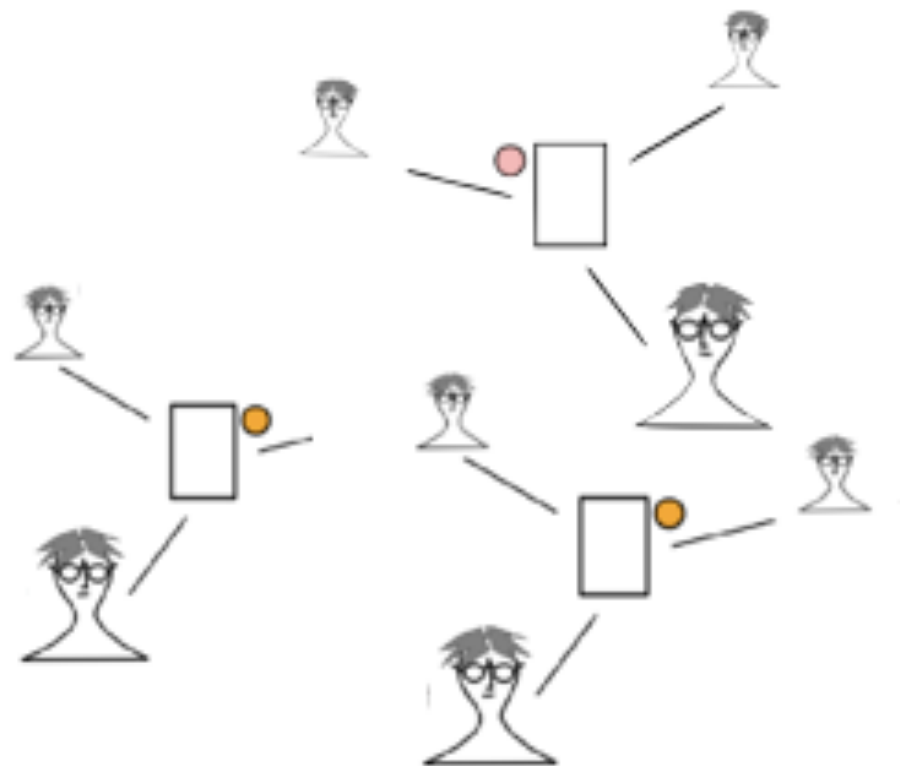
Newman, M. "The structure of scientific collaboration networks."Proceedings of the National Academy of Sciences 98.2 (2001): 404-409.

Barabâsi, A, et al. "Evolution of the social network of scientific collaborations." Physica A 311.3 (2002): 590-614.

Pan, R.K., et al. "World citation and collaboration networks: uncovering the role of geography in science." Scientific reports 2 (2012).

Pan, R.K., et al. "The evolution of interdisciplinarity in physics research." Scientific reports 2 (2012).

We study **collaboration patterns** in co-authorship networks with special **focus** on the **research** **topics** addressed in scientific papers.

- 🟠 Astrophysics
- 🟢 Biology
- 🔵 Complex Networks
- ⚪ ... ...

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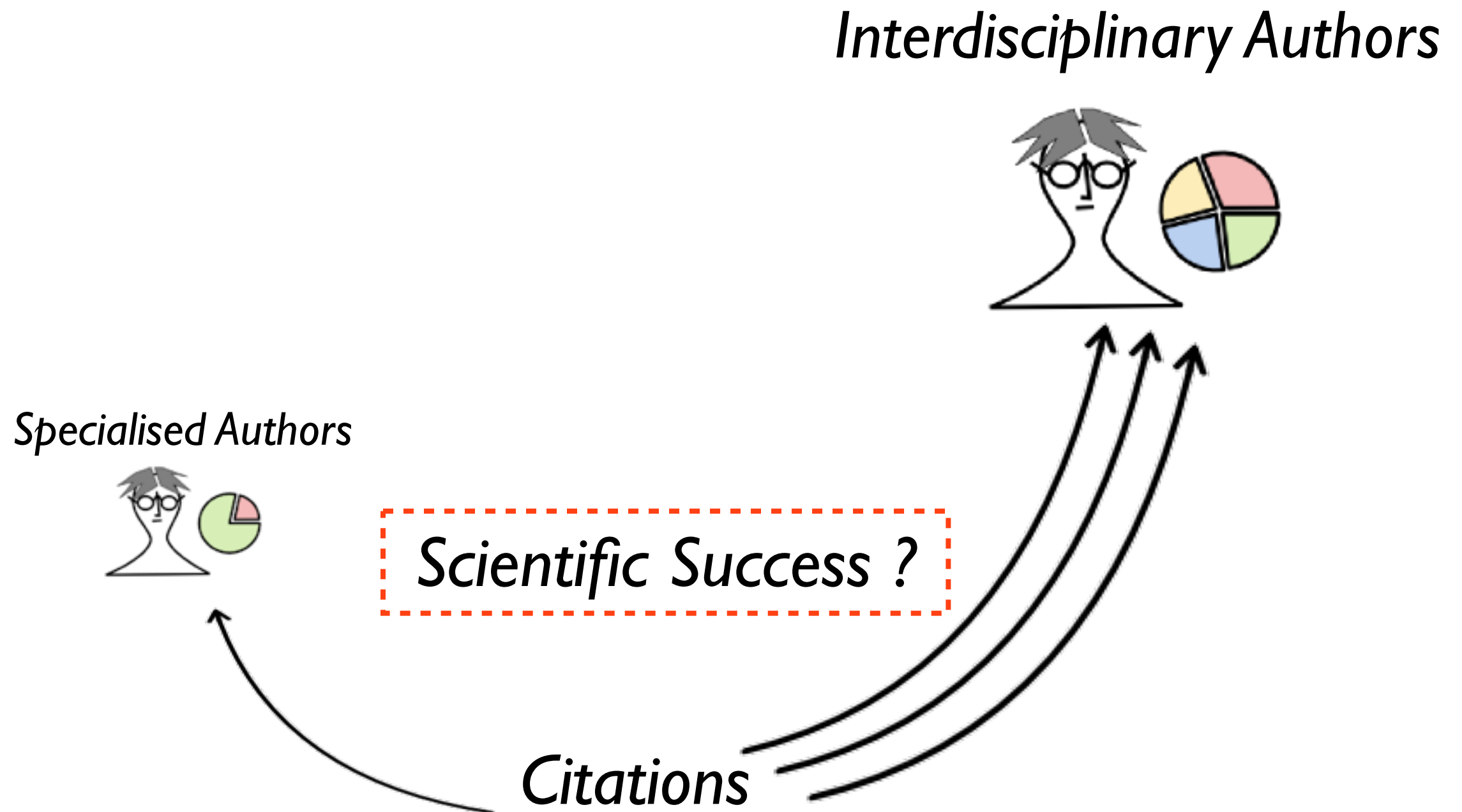
Specialised Authors

Interdisciplinary Authors

We study **collaboration patterns** in co-authorship networks with special **focus** on the **research** **topics** addressed in scientific papers.

Specialised Authors

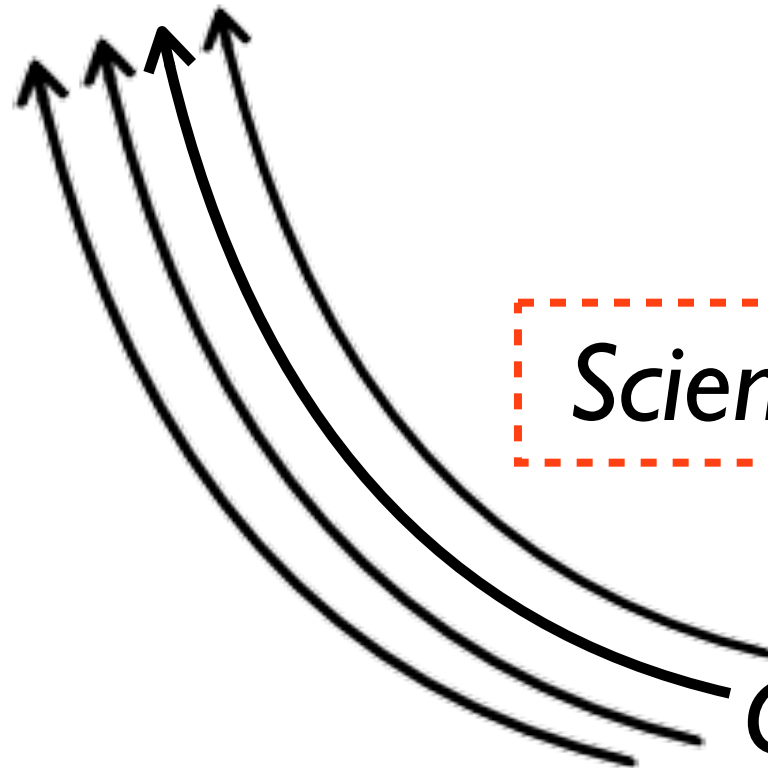*Interdisciplinary Authors*

Scientific Success ?

We study **collaboration patterns** in co-authorship networks with special **focus** on the **research topics** addressed in scientific papers.

Interdisciplinary Authors

Specialised Authors

Scientific Success ?

Citations

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Specialised Authors

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Citations

A (very) quick look at the history...

Time

Ancient Greek philosophers

Individual "authors" dealing with *philosophy, physics, politics logic, ethics, religion, mathematics...*

A (very) quick look at the history...

Time

Ancient Greek philosophers

Individual "authors" dealing with *philosophy, physics, politics logic, ethics, religion, mathematics...*

mathematics

physics

philosophy

Specialisation of disciplines in modern age

A (very) quick look at the history...

Time →

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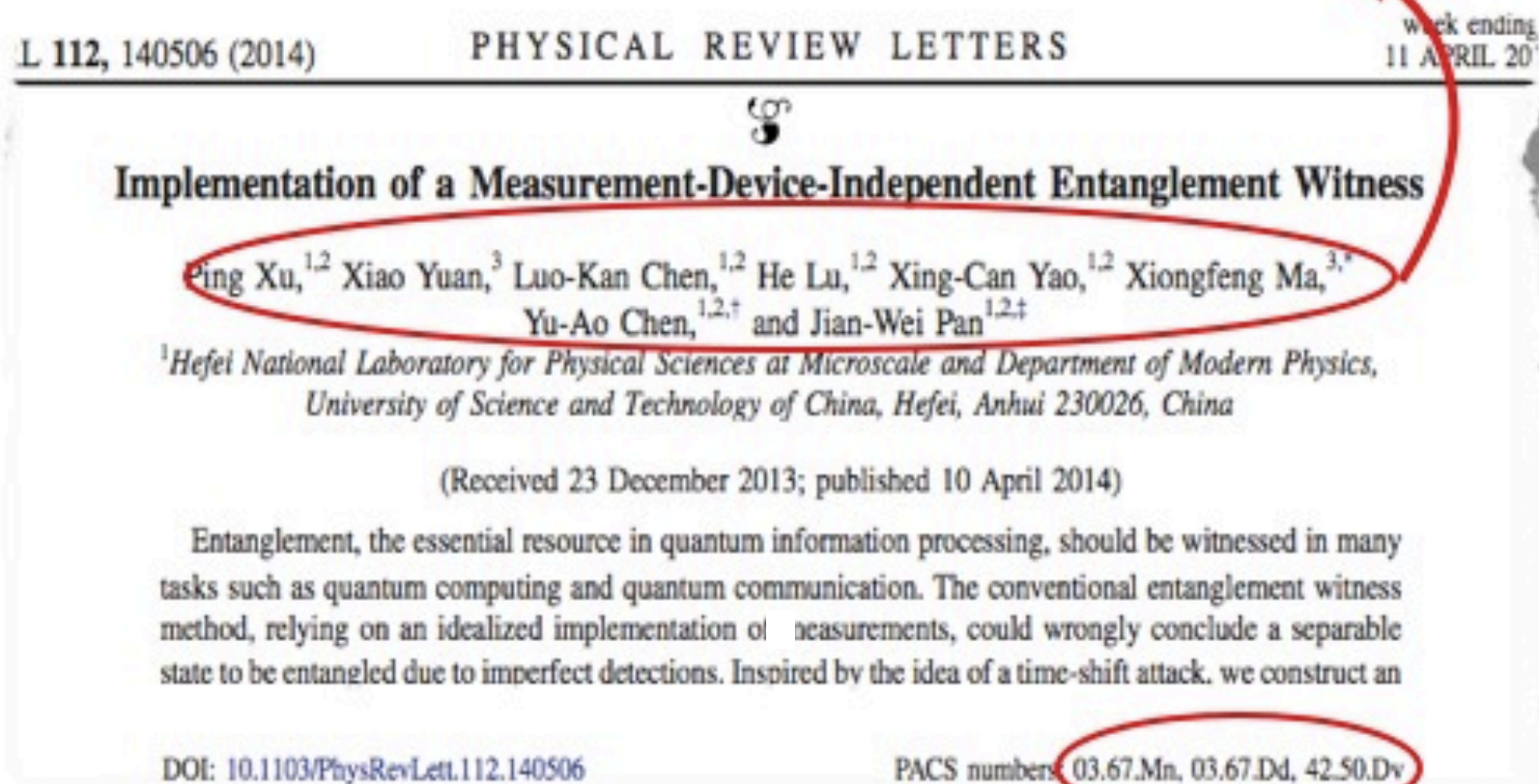
mathematics

physics

philosophy

How modern scientists deal with interdisciplinarity?

A (very) quick look at the history...

Time

Ancient Greek philosophers

Individual "authors" dealing with *philosophy, physics, politics logic, ethics, religion, mathematics...*

mathematics

physics

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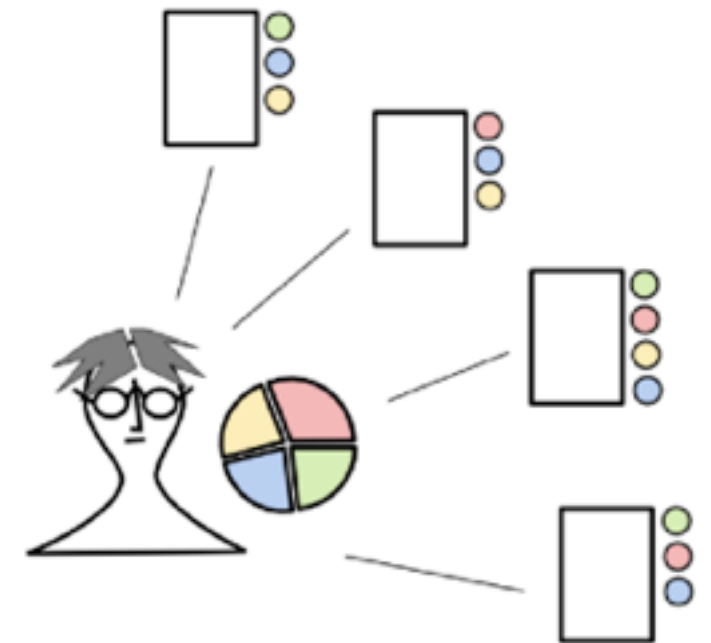Which are the most effective ways to overcome disciplinary boundaries?

The Data

American Physical Society **(APS) data set**
(1975-2009, $> 4 \cdot 10^5$ articles)

Co-authorship network

L 112, 140506 (2014)   PHYSICAL REVIEW LETTERS   week ending 11 APRIL 20...

Implementation of a Measurement-Device-Independent Entanglement Witness

Ping Xu,[1,2] Xiao Yuan,[3] Luo-Kan Chen,[1,2] He Lu,[1,2] Xing-Can Yao,[1,2] Xiongfeng Ma,[3,*] Yu-Ao Chen,[1,2,†] and Jian-Wei Pan[1,2,‡]

[1]*Hefei National Laboratory for Physical Sciences at Microscale and Department of Modern Physics, University of Science and Technology of China, Hefei, Anhui 230026, China*

(Received 23 December 2013; published 10 April 2014)

Entanglement, the essential resource in quantum information processing, should be witnessed in many tasks such as quantum computing and quantum communication. The conventional entanglement witness method, relying on an idealized implementation of measurements, could wrongly conclude a separable state to be entangled due to imperfect detections. Inspired by the idea of a time-shift attack, we construct an

DOI: 10.1103/PhysRevLett.112.140506   PACS numbers: 03.67.Mn, 03.67.Dd, 42.50.Dv

Research categories

PACS codes

Measures of interdisciplinarity

Background entropy

$$B_i = -\sum_c p_i^c \log(p_i^c)$$

Measures of interdisciplinarity

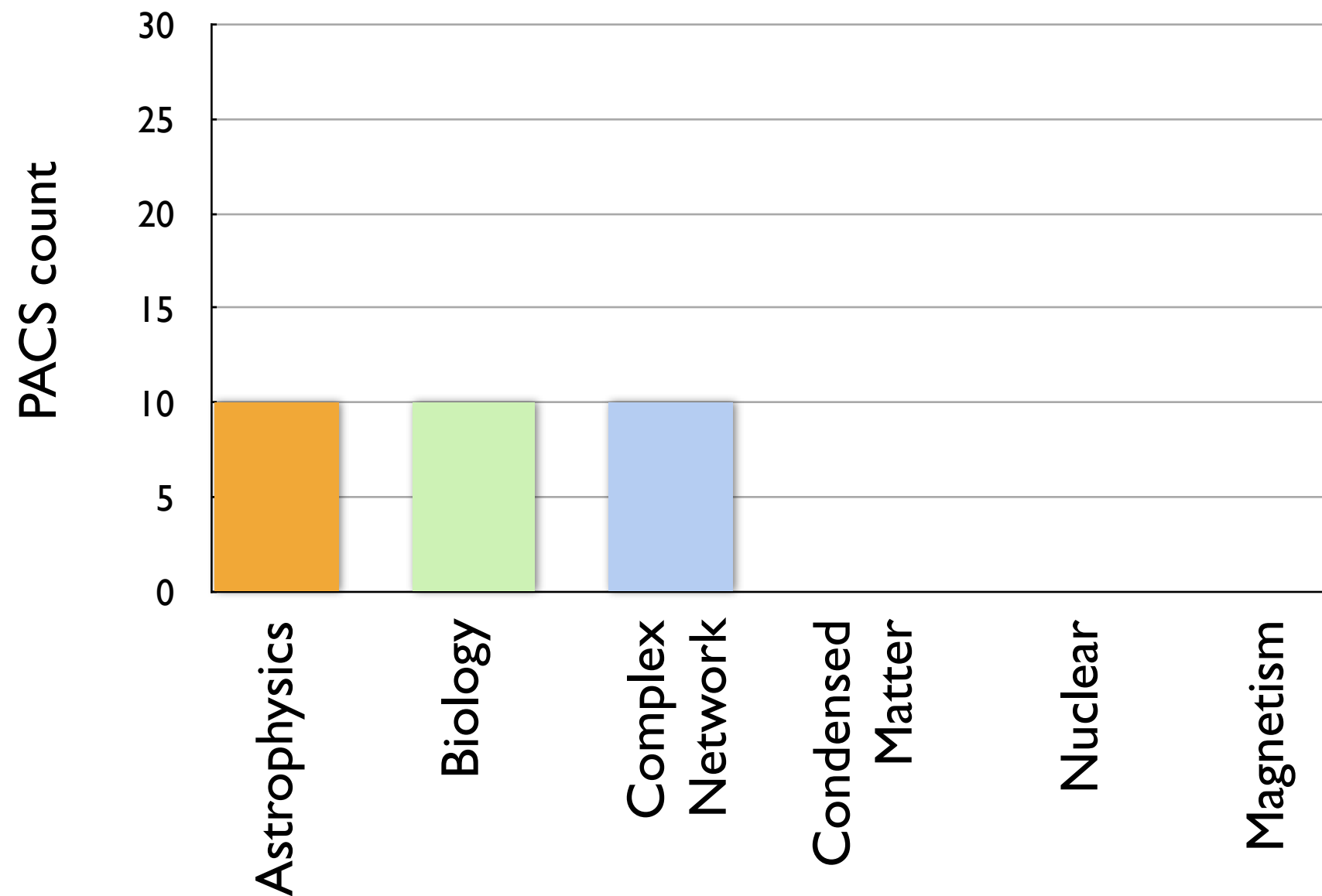Background entropy

$$B_i = -\sum_c p_i^c \log(p_i^c)$$

$B = 0.13$
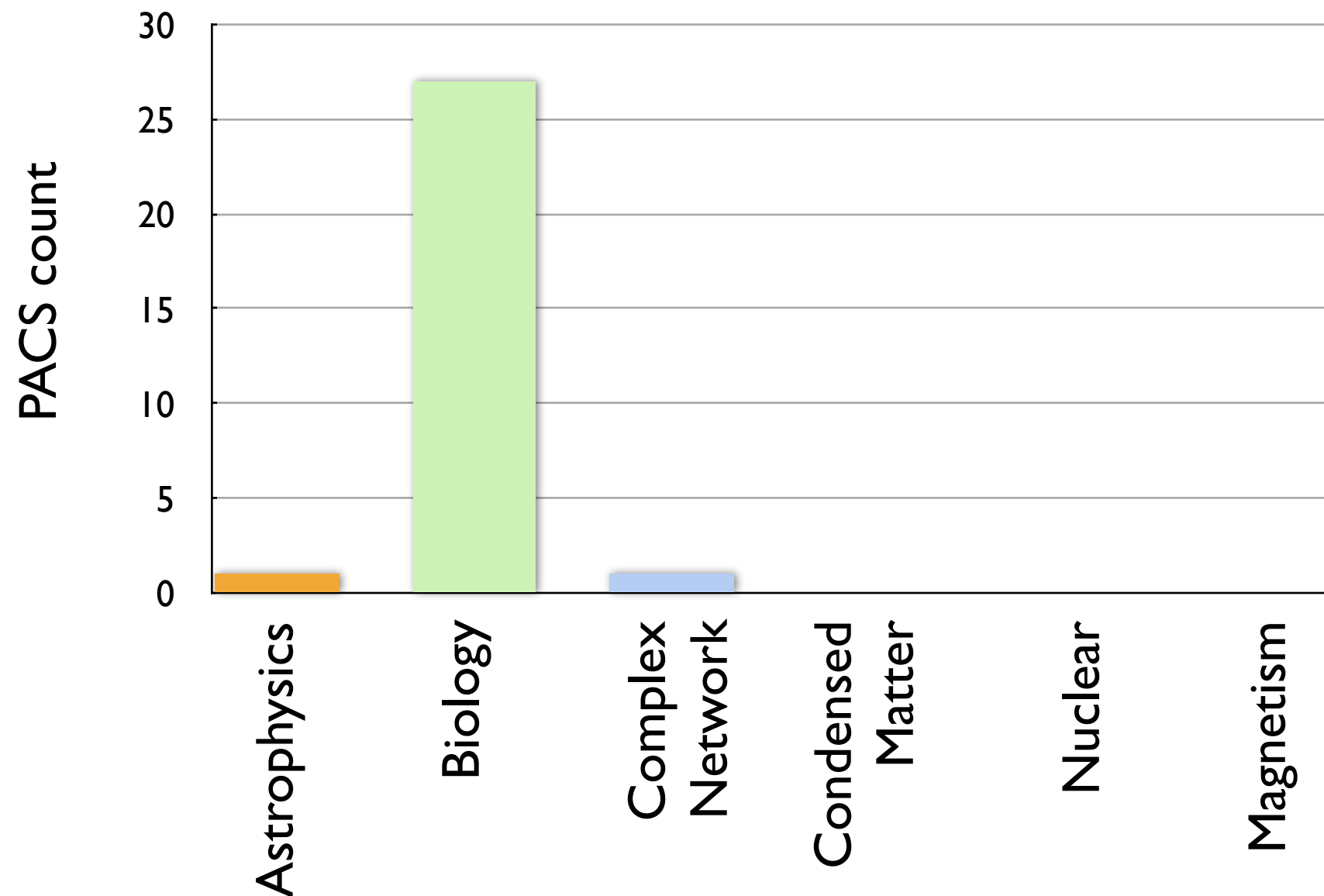
PACS count
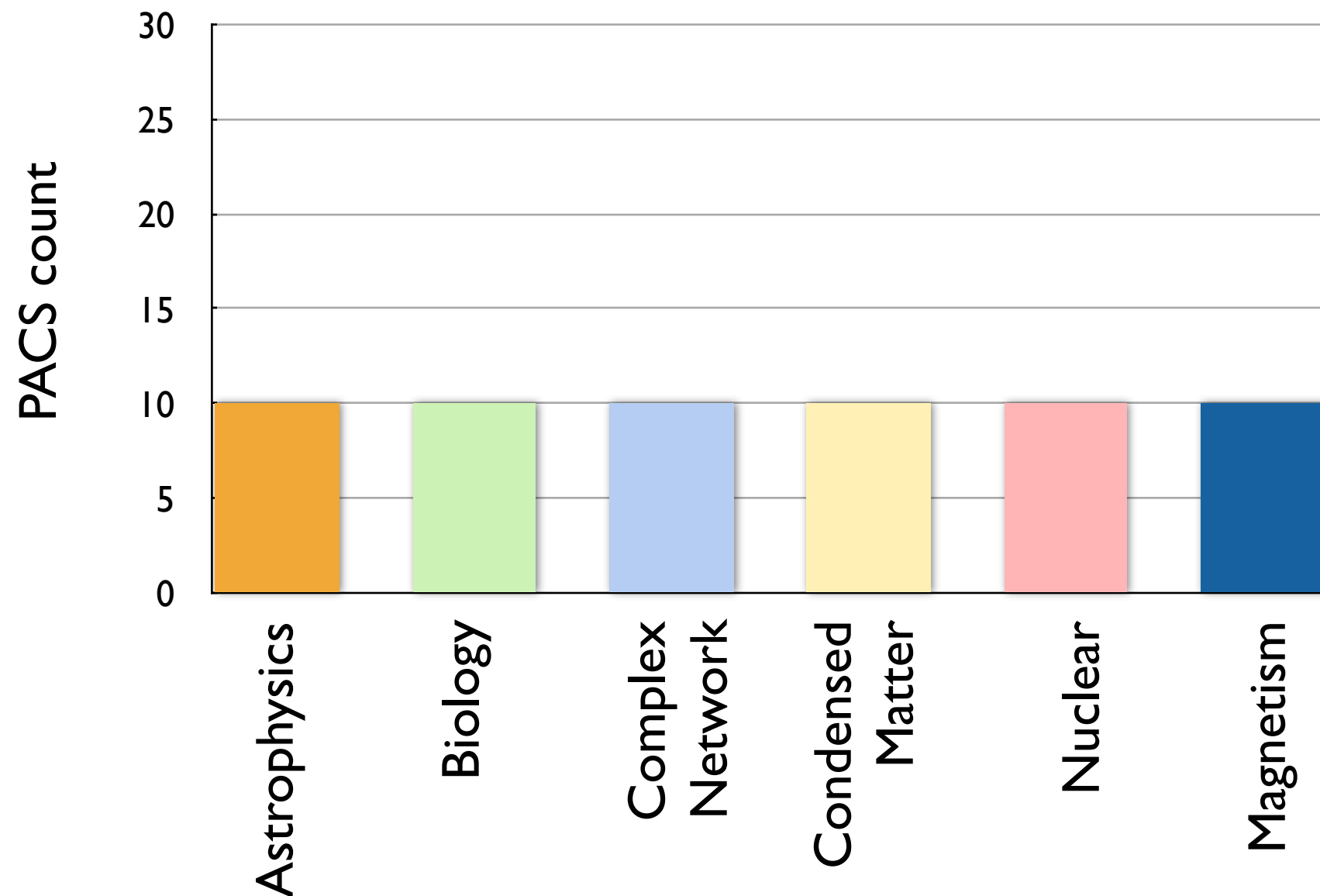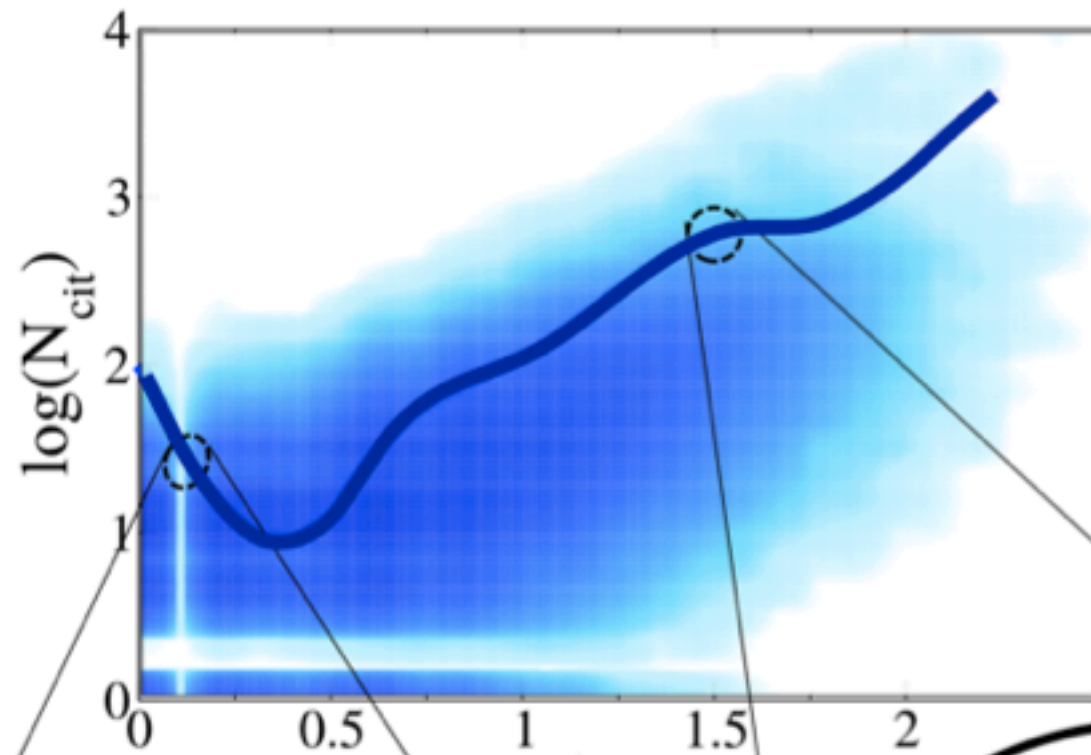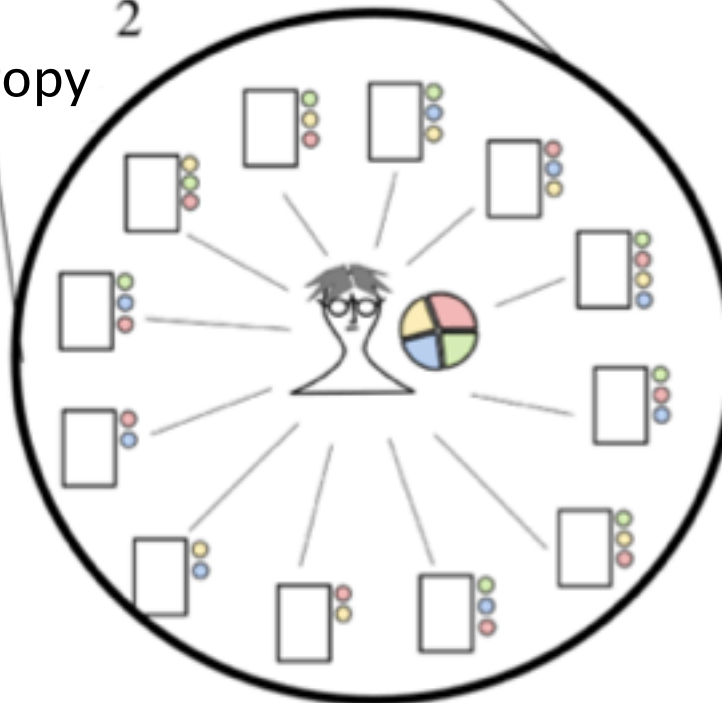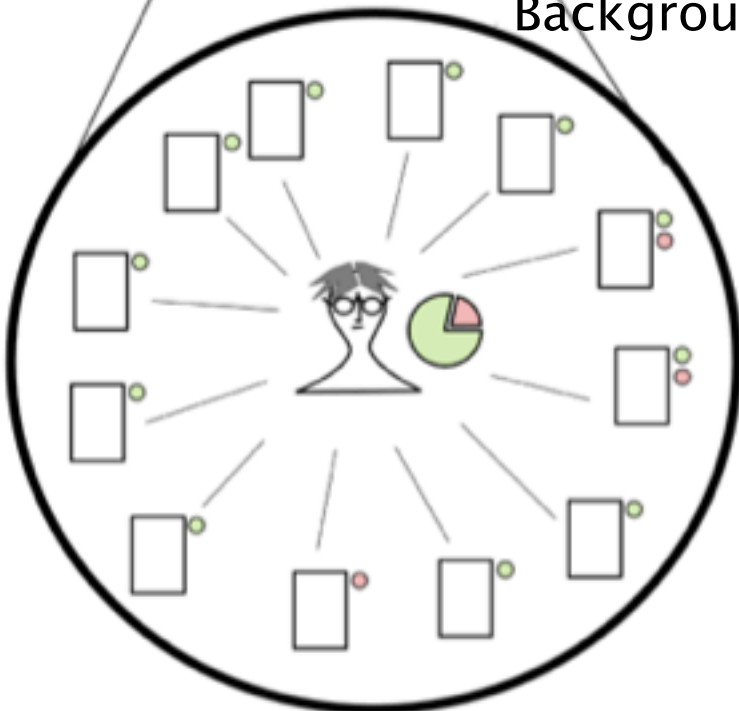
Astrophysics | Biology | Complex Network | Condensed Matter | Nuclear | Magnetism

Measures of interdisciplinarity

$$B = 0.48$$

Background entropy

$$B_i = -\sum_c p_i^c \log(p_i^c)$$

Measures of interdisciplinarity

$$B = 0.78$$

Background entropy

$$B_i = - \sum_c p_i^c \log(p_i^c)$$

Measures of interdisciplinarity

Specialised authors

Interdisciplinary authors

Background entropy

$$B_i = -\sum_c p_i^c \log(p_i^c)$$

Time evolution: comparing career stages
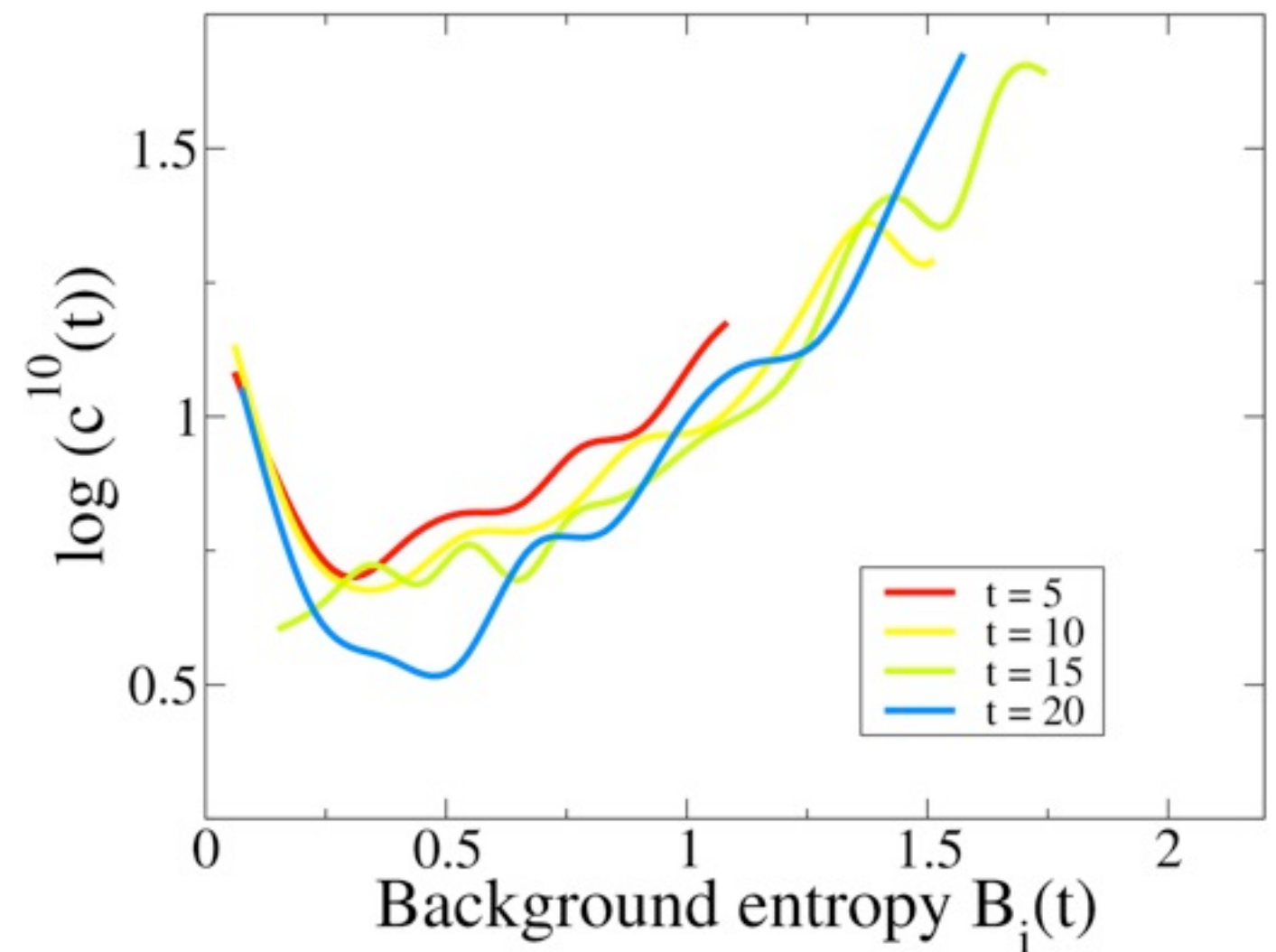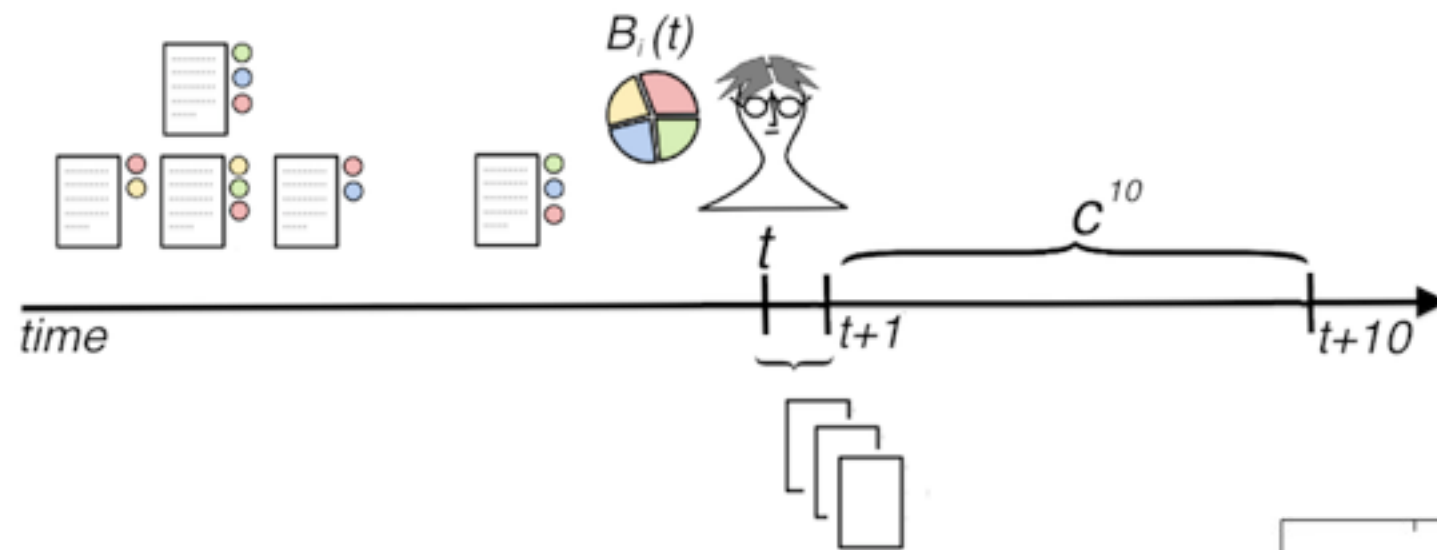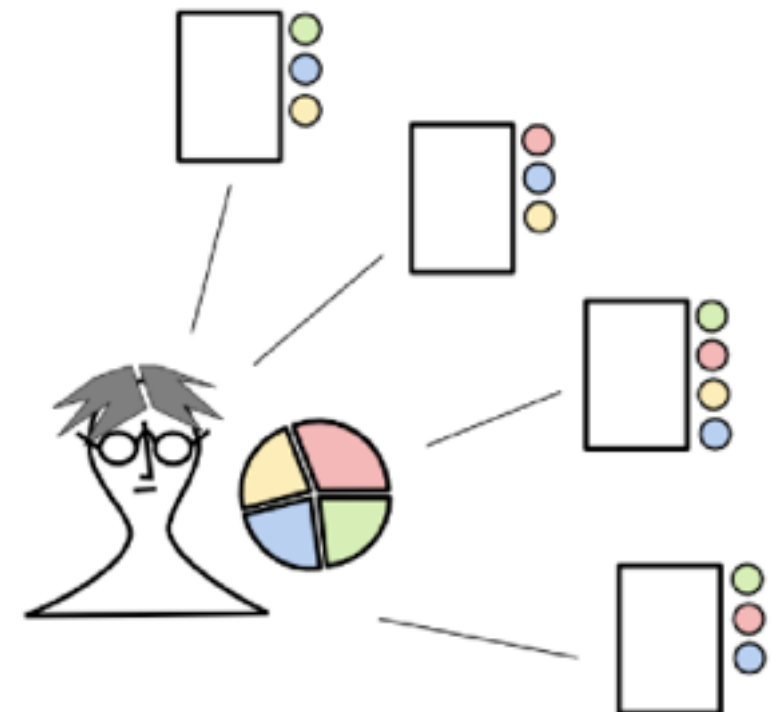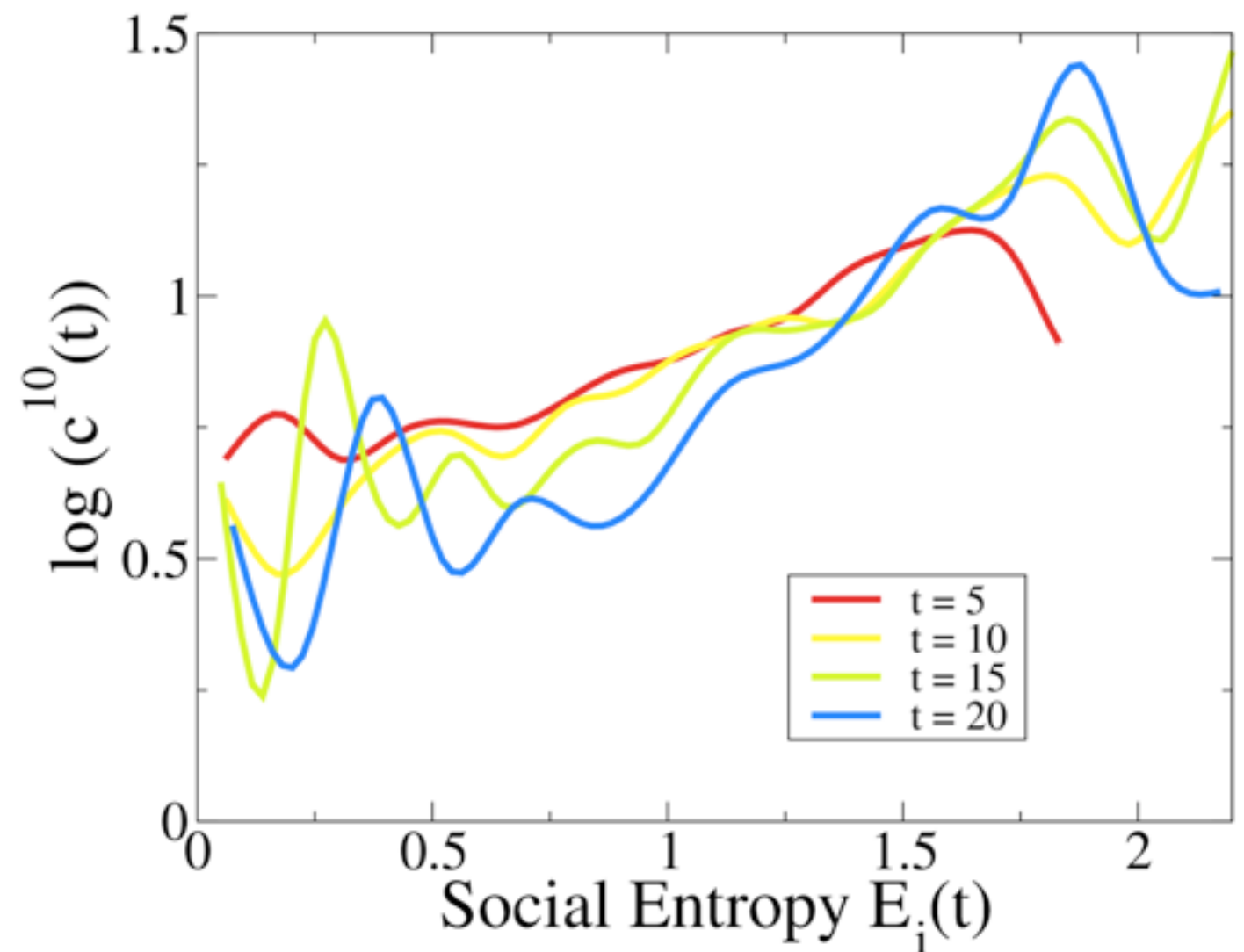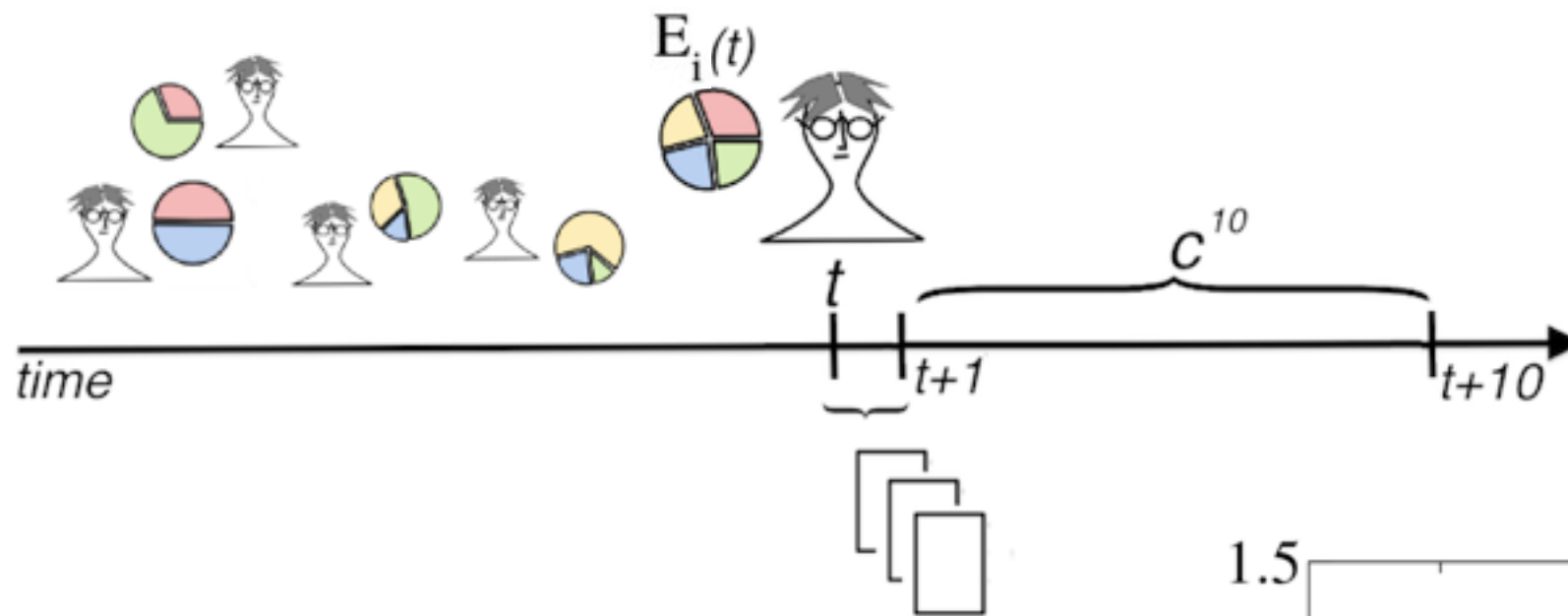
A **Social** measure of interdisciplinarity

Social Entropy

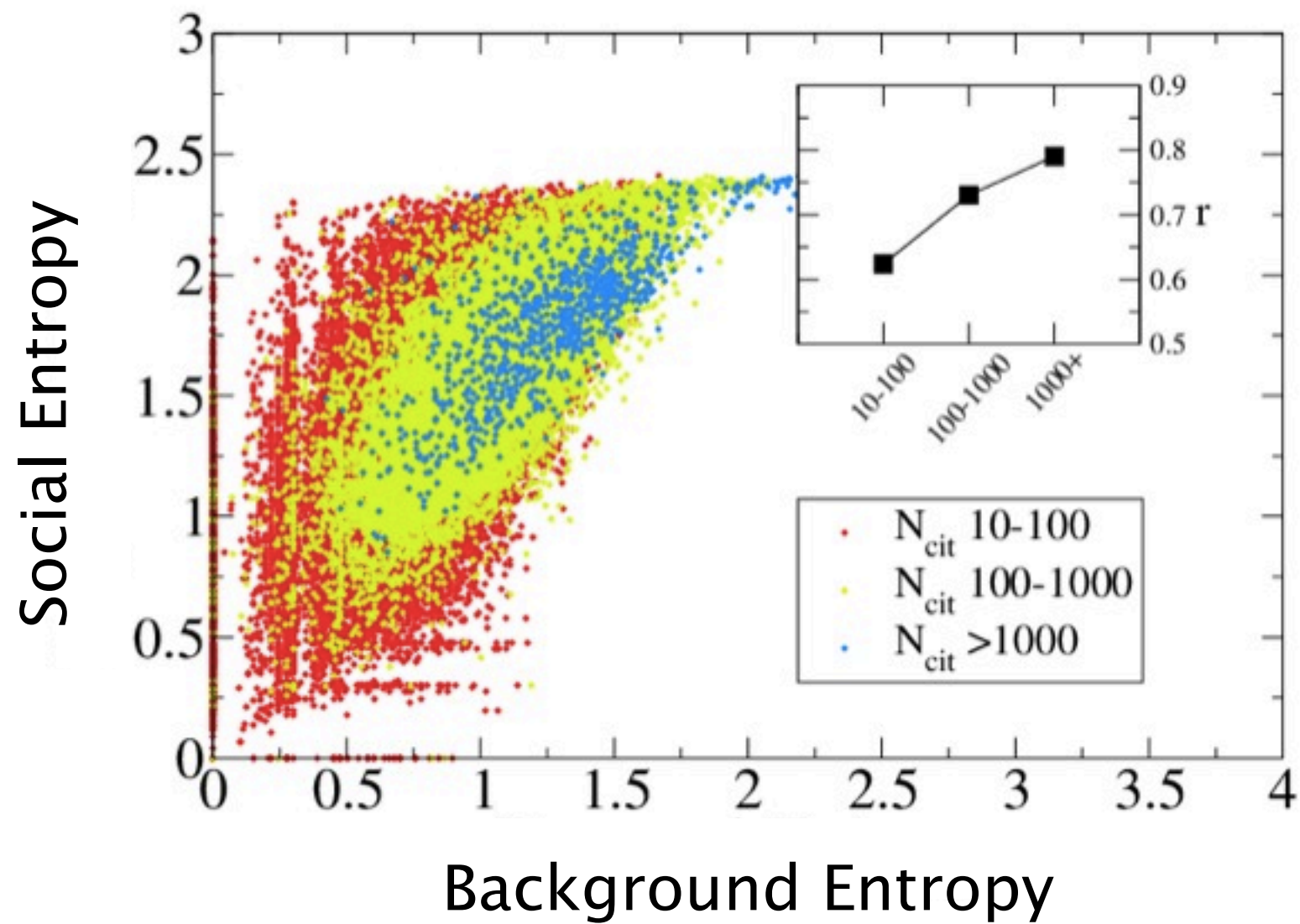$$E_i = -\sum_c q_i^c \log(q_i^c)$$

Background entropy

$$B_i = -\sum_c p_i^c \log(p_i^c)$$

Time evolution: comparing career stages

A **Social** measure of interdisciplinarity

Paths to interdisciplinarity

Master more than one discipline and handle heterogeneous collaborators is not an easy job.

Which are the sources of (new) knowledge and the strategies used by authors to access them?

Which are the most *effective* paths to interdisciplinarity?

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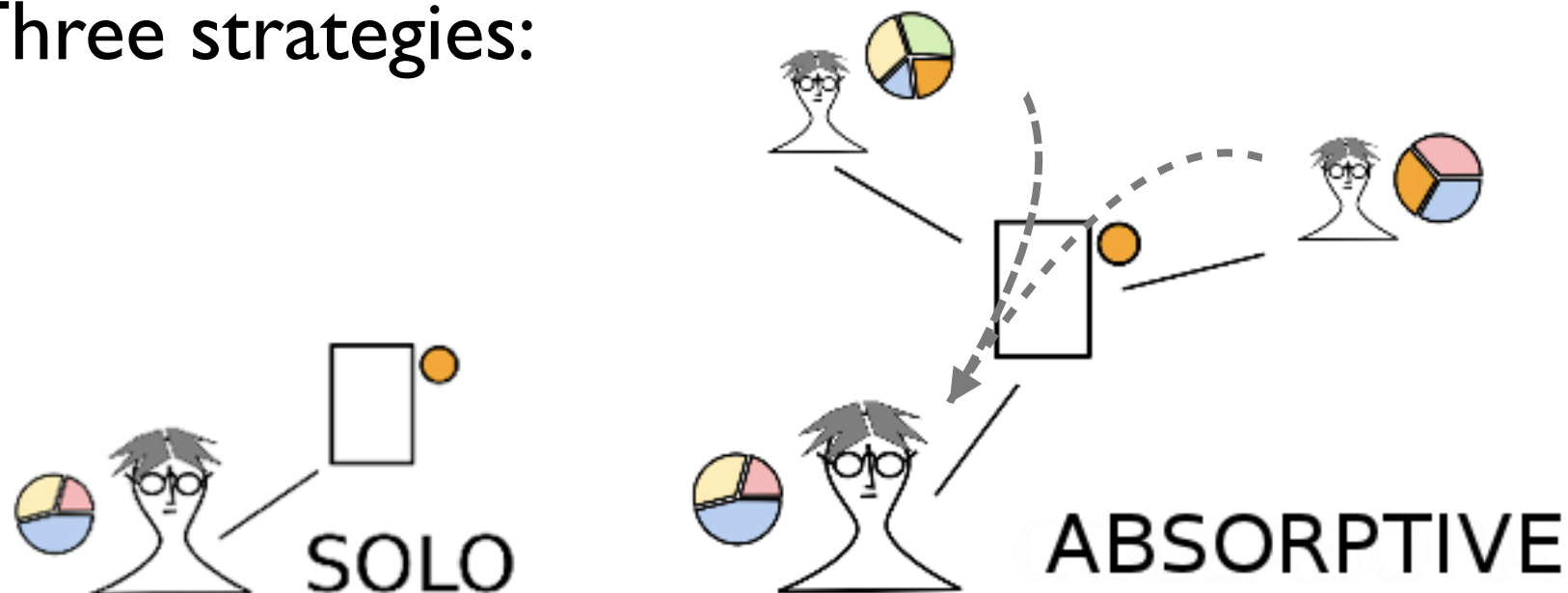
Three strategies:

Paths to interdisciplinarity

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SOLO

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ABSORPTIVE

Paths to interdisciplinarity

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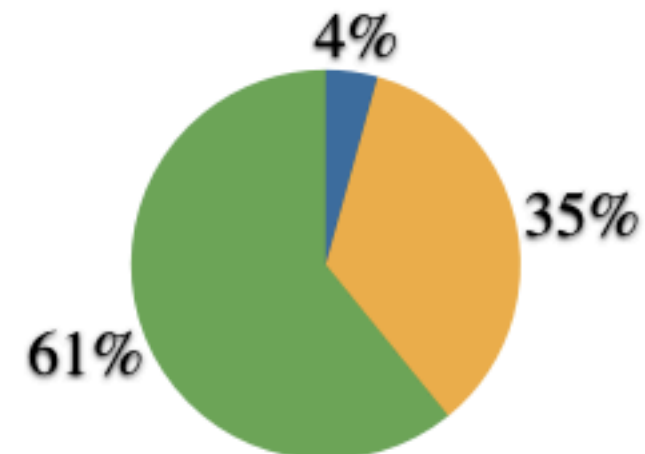Which are the most *effective* paths to interdisciplinarity?

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ABSORPTIVE
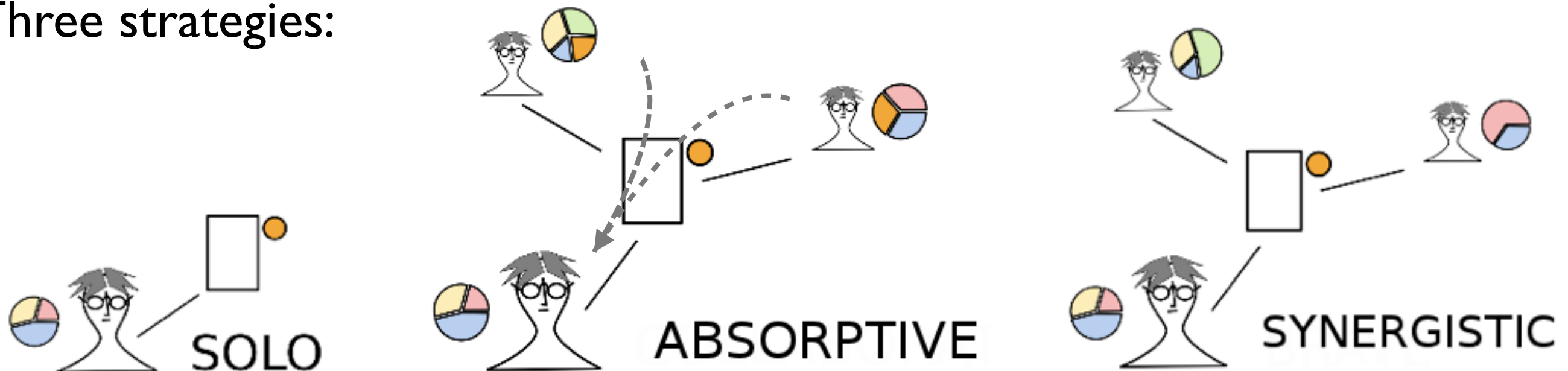
SYNERGISTIC

Paths to interdisciplinarity   -   Results

$10 < N_{cit} < 100$

$N_{cit} > 1000$

4%

4%

50%

46%

35%

61%
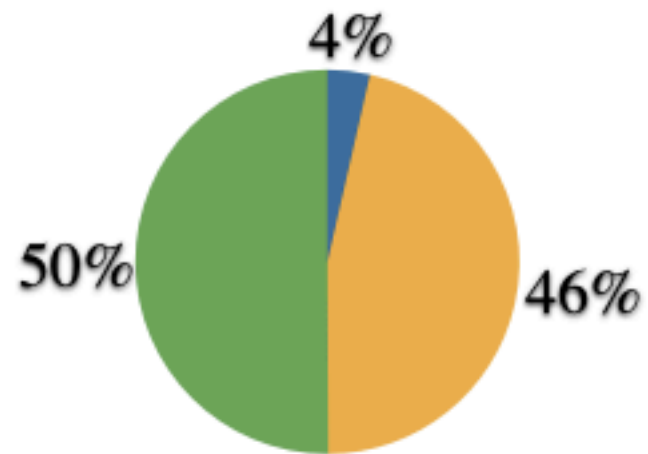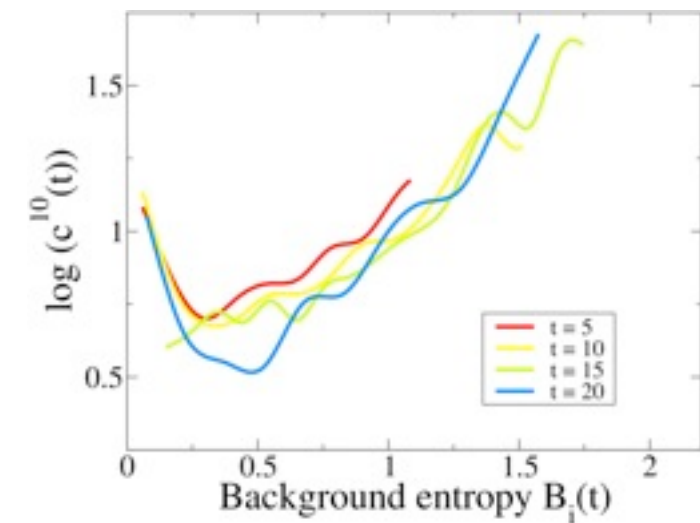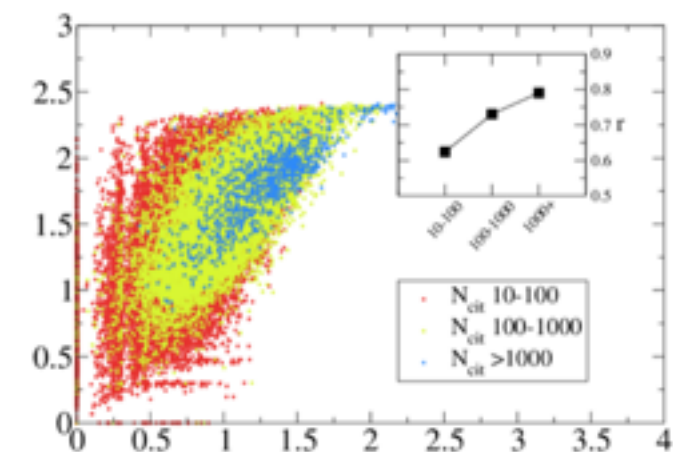
● Solo strategy
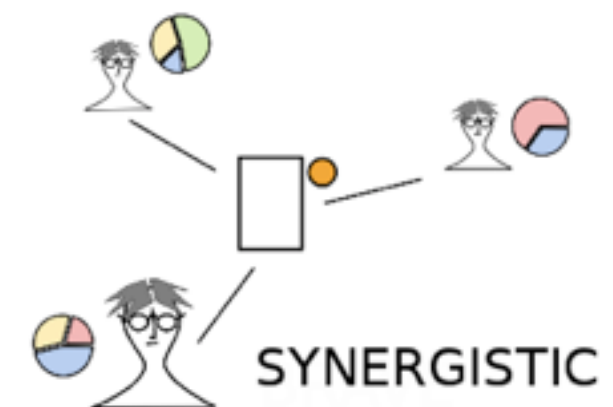● Absorptive strategy
● Synergistic strategy

Conclusions:

Mind the gap between specialisation and interdisciplinarity

Chose collaborators with care

Do not absorb knowledge from others but create it with your trusted collaborators.

SYNERGISTIC

Thank you!