IRENE ROSANA GIARDINA

Curriculum Vitae

Rome, 17/04/2018

Part I – General Information

Full Name	Irene Rosana Giardina
Contact details	Department of Physics
	Sapienza University of Rome, P.le Aldo Moro 2, 00185 Rome , Italy
Office	Room 504, Fermi Building
Telephone	+39 06 4991 3515
E-mail	irenerosana.giardina@uniroma1.it; irene.giardina@roma1.infn.it
Spoken Languages	Italian, English, French

Part II – Education

Type	Year	Institution	Notes (Degree, Experience,…)
PhD	1998	University of Rome La Sapienza	Advisor: G. Parisi
University graduation	1994	University of Pavia	Laurea degree 110/110 *cum laude*
Pre-graduate studies	1989-1994	Collegio Ghislieri	Fellow

Part III – Appointments

IIIA – Academic Appointments

Start	End	Institution	Position
2013	ongoing	University of Rome La Sapienza (Dept. of Physics)	Associate Professor in Theoretical Physics (Fis 02/A2)
2013	2014	Initiative for the Theoretical Sciences, The Graduate Center, CUNY, New York	Visiting Professor
2009	2013	Institute for Complex Systems - CNR, UOS Sapienza, Rome	Researcher
2003	2009	Centre for Statistical Mechanics and Complexity, INFM-CNR, Rome	Researcher

2002	2003	University of Rome La Sapienza (Dept. of Physics)	Assistant Professor with a Fellowship of the Italian Research Ministry MIUR, program "Rientro dei Cervelli"
1999	2001	Laboratoire de Physique Théorique, Centre Energie Atomique CEA-SACLAY, France	Post-doc
1998	1999	Theoretical Condensed Matter Physics Group, at the Department of Theoretical Physics, Oxford University	Post-doc

Part IV – Teaching and Tutoring experience

IVA – University teaching

Year	Institution	Lecture/Course
2017-2018	University of Rome La Sapienza (Dept. of Physics)	"Statistical Physics", laurea triennale in fisica (6 CFU)
2016-2018	University of Rome La Sapienza (Dept. of Physics)	"Theoretical Biophysics", laurea magistrale in fisica (Master degree, 6 CFU)
2016-2017	University of Rome La Sapienza (Dept. of Earth Sciences)	"General Physics", module II (6 CFU)
2014-2016	University of Rome La Sapienza (Dept. of Earth Sciences)	"General Physics", modules I and II
2010-2011	University of Rome La Sapienza (Dept. of Physics)	"Physical and Mathematical Models for Economy", laurea magistrale in fisica (Master degree, 60 hours)
2004-2009	University of Rome La Sapienza (Dept. of Physics)	Yearly PhD course in "Disordered Systems and Anomalous Diffusion"

IVB – Invited courses

Year	Institution	Lecture/Course
2017	Summer school in Theoretical Biophysics, Cargese	Collective behavior in biological groups
2014	Beg Rohu Summer school in 'Non equilibrium statistical mechanics and active matter',	Collective behavior in animal groups
2006	Les Houches Summer School "Complex Systems"	Metastable States in Glassy systems
2006	Les Houches Meeting	Econophysics

IVC– Advising

Type	Description
Bsc Advisor	V. Salvati (2016), F. Iannelli (2011), R. Tavarone (2009), R. Marino (2009)

MSc Advisor	F. Ferretti (2018), D. Piovani (2012), E. Silvestri (2010), A. Cimarelli (2010), M. Di Tanna (2007), B. Capone (2006)
PhD Advisor	E. Silvestri (2014), A. Procaccini (2008) (co-tutoring)
Member in PhD Committee	S. Toulet, (Université de Toulouse III – Biology, 2015), S. Motsch (Universitè de Toulouse III - Applied Mathematics, 2009), K. Anand (King's College London - Applied Mathematics, 2009), F. Raynaud (Université Paris Diderot-Paris 7 - Physics, 2009)
Postdoctoral mentoring	A. Jelic, E. Shen, S. Dey, S. Melillo, M. Viale, S.M. Duarte, F.Ginelli, A. Attanasi, L. Del Castello, L. Parisi, C. Creato

Part V - Society memberships, Awards and Honors

Year	Title
2017	Invited participant to the 27th Solvay Conference for Physics `The Physics of Living Matter: Space, Time and Information in Biology'
2016-2018	ERC grantee Proof of Concept – European Research council (2016)
2014-ongoing	Abilitazione Scientifica Nazionale 2012 – Prima fascia 02/A2
2013-ongoing	Abilitazione Scientifica Nazionale 2012 – Prima fascia 02/B2
2012-ongoing	Member of the Young Academy of Europe
2010-2015	ERC grantee Starting Grant (consolidator level) - European Research Council (2010)
2002-2003	MIUR "Rientro dei Cervelli" grant
1989	Alfiere del lavoro

Part VI - Funding Information [grants as PI-principal investigator or I-investigator]

Year	Role and Title	Program	Grant value
2017-ongoing	Principal Investigator of project "Collective phenomena and off-equilibrium behavior in biological networks"	Bando Sapienza Progetti di Ricerca Medi	35.750 euro
2016-2018	Principal Investigator - project "PROCEEDS"	ERC-Proof of Concept	150.000 euro
2014-ongoing	Network Member/ Member of the Managing Committee - project "Flowing Matter"	COST Action - EU Framework, cooperation grant	189.000 euro (for the whole network)
2010-2015	Principal Investigator of project "SWARM" - Empirical analysis and theoretical modelling of self-organized collective behavior in three-dimensions: from insect swarms and bird flocks to new schemes of distributed coordination	ERC-Starting Grant (consolidator level) – Panel PE2	1.124.000 euro
2010-2012	Scientist in Charge of project "PASSAROLA" for Silvio	Marie-Curie Fellowship (IEF)	166.239 euro

	Manuel Duarte		
2010-2013	Principal Investigator - project "ARTSWARM"	IIT-Seed	605.000 euro
2005-2007	Co-Investigator of the Rome node for project "STARFLAG"	STREP-EU-FP6	320.000 euro (for Rome node)

Part VII – Key Invited lectures

Year	Event
2018	APS March Meeting, Invited Session for the Delbruck prize to B. Bialek - Los Angeles
2017	27th Solvay Conference for Physics `The Physics of Living Matter: Space, Time and Information in Biology' (invited participant), Brussels
2017	Fismat 2017, Trieste
2017	Workshop "Active Living Matter", Aspen
2017	Advances in Mathematics and Theoretical Physics, Rome
2017	SISSA Physics Colloquium, invited lecture `Information propagation and collective swings in biological groups', Trieste
2017	MECO42 – 42nd Conference of the Middle-European Cooperation in Statistical Physics, Lyon
2016	Microswimmers – From Single Particle Motion to Collective Behaviour, Bonn
2016	STATPHYS2016, Invited talk, Biological Physics Section, Lyon
2016	Workshop `Statistical physics methods in biology and computer science' ENS, Paris
2016	Workshop `Collective Motion, Uppsala University
2016	Workshop 'Dynamics and information processing: from cells to tissues', Les Houches
2015	`ICMS Complexity Science Winter School, TU Eindhoven
2015	Workshop 'Active Liquids', Leiden Lorentz Center, Leiden
2015	113th Statistical Mechanics Conference, Rutgers University, Rutgers
2015	Workshop 'Flowing matter across the scales', Rome
2014	APS March Meeting, Invited talk, Focus Session 'Physics of Behavior', Denver
2014	Conference 'Active Processes in living and non living matter', Kavli Institute for Theoretical Physics at the University of California, Santa Barbara
2012	Workshop `Statistical Physics and Information Processing in Biology', Institut H. Poincare, Paris
2011	Conference "Collective Dynamics and Pattern Formation in Active Matter Systems", Max Planck Institute, Dresden
2011	Extended Workshop "Theoretical physics and the phenomena of life: Optimization and emergent behaviour", Graduate Center, CUNY, New York
2010	Workshop Statistical Physics and Biology of Collective Motion, Max Planck Institute, Dresden

2010	Workshop on Biophysics, CUNY, New York
2009	Princeton Physics Colloquium, invited lecture: "Collective animal behaviour: theoretical speculations and empirical groundings", Princeton University
2009	APS March Meeting 2009, Invited session: 'Active Soft Matter: From Granular Rods to Flocks to Living Cells'
2009	Workshop 'Self-organization and dynamics of active matter', Institut Henri Poincare, Paris
2008	22nd General Conference of the Condensed Matter Division of the European Physical Society, Rome
2008	4th European Conference on Behavioural Biology ECBB, Dijon
2007	Conference "Complexity, Metastability and Nonextensivity", Erice
2007	Workshop "Modelling and control of physical networks", Pisa
2007	Workshop "Bio inspired design of networks", Cambridge
2006	Les Houches Meeting " Statistical Physics of Glasses, Spin Glasses, Information Processing and Combinatorial Optimization", Les Houches
2005	94th Statistical Mechanics Meeting, Rutgers University, Rutgers
2005	LAWNP'05, 9th Latin American Workshop on Nonlinear Phenomena, San Carlos de Bariloche
2005	Conferenza Nazionale della Societa' Italiana di Fisica, SIF 2005, Catania
2001	Advanced Research Workshop ``Application of Physics to Economic Modelling '', Prague
1999	CECAM workshop "The Instantaneous Normal Mode Approach to Dynamics in Liquids", ENS Lyon

Part VIII – Service

VIIIA – Editorial and Reviewing activity

Period	Role
2018-	Editor in chief – Journal of Statistical Physics (starting 9/2018)
2011-2017	Mathematics Consulting Editor for Animal Behaviour
1999-ongoing	Referee for the following journals: Nature Physics, Nature Communications, Proceedings of the National Academy of Sciences USA; Physical Review (Letters, B and E); Journal of Physics A; Europhysics Letters; Physica A; Physica D; European Physical Journal B; Journal of Statistical Physics; Quantitative Finance; Journal of Economic Behavior and Organization; Proceedings of the Royal Society B; Neural Computing and Applications; Ethology; Ecology Letters; Animal Behaviour; Plos One; Plos Computational Biology; Robotics and Autonomous Systems; Swarm Intelligence
2016-2017	Project Reviewer for the Einstein Foundation

2015-2017	Project Reviewer for the Human Frontier Science Program
2012-2016	Project Reviewer for the National Science Foundation
2012	Reviewer VQR-ANVUR (National Research Evaluation 2004-2010), panel 02

VIIIB – Academic service

Period	Role
2018-	Head of the Committee General Seminars
2014-	Member of the CAD Committee to verify the students' prerequisites for the MSc curriculum

VIIIC– Conference organization and networking

Start	End	Institution	Position
2018	2018	ICTP workshop on Collective Behaviour, Trieste	Member of the Organizing Committee and Director for the Physics section
2018		IUPAP StatPhys27	Member of the International Advisory Committee
2015	2019	CNRS	Member of the European Scientific coordination network "Evolution, Regulation and Signalling" (ERS)
2014	2018	COST ACTION (EU Framework, cooperation grant)	Network member and Italian Member of the Managing Committee
2011	2011	Graduate Center, CUNY, New York	Organization (together with W. Bialek, A. Cavagna and P. Nelson) of the Extended Workshop "Theoretical physics and the phenomena of life: Optimization and emergent behaviour"

Part IX – Research Activities

Keywords	Brief Description
Physics of living	In 2005 I started working on biological systems. In the following years I

systems, Collective behavior in biological systems (2005-ongoing)	founded with Andrea Cavagna, the COBBS Lab (Collective Behaviour in Biological Systems - www.cobbs.it), the first lab to collect 3D large-scale experimental data in the field on flocking and swarming behavior, and to build theory starting directly from the data. We apply a statistical physics approach to understand how collective behavior emerges in animal groups and – more broadly – in biological systems. Our aim is to provide empirical basis and to theoretically develop a statistical physics of living matter, up to the behavioral scale. We use experiments in the field and in the lab, computer vision and imaging techniques, numerical modelling and field theory approaches to investigate collective and response behavior, scaling and universality in a variety of living systems at the micro and macro scale (cells, flocks and swarms).
Statistical Physics of disordered and complex systems (1995-2006)	My background is in theoretical statistical physics, and I have been working for several years on problems related to glassy and non-equilibrium behavior in condensed matter systems (spin glasses and structural glasses) and interdisciplinary applications, using theoretical models, numerical simulations and field theory approaches.

Part X – Summary of Scientific Achievements

XA – Citation report for the **entire scientific production** (Scopus database)

Product type	Number	Data Base	Start	End
Papers [international]	73	Scopus	1996	2018
Papers [national]				
Books [scientific]	1	Scopus	1996	2018
Books [teaching]				

Total Impact factor	318,544
Total Citations	3428
Average Citations per Product	46,32
Hirsch (H) index	29
Normalized H index*	1,34

*H index divided by the academic seniority.

XB – Citation report for the scientific production of the **last 15 years** (Scopus database)

Product type	Number	Data Base	Start	End
Papers [international]	54	Scopus	2003	2018
Papers [national]				
Books [scientific]	1	Scopus	2003	2018
Books [teaching]				

Total Impact factor	268,202
Total Citations	2611
Average Citations per Product	47,47
Hirsch (H) index	23

Part XI– Selected Publications

List of the publications selected for the evaluation.

1. The physics of flocking: Correlation as a compass from experiments to theory.
   Cavagna, A., Giardina, I., & Grigera, T. S. (2017).
   Physics Reports 728, 1-62 (2017) - IF: 17,425 - Cit: 0

2. Dynamical scaling in natural swarms
   A.Cavagna, D. Conti, C. Creato, L. Del Castello, I. Giardina, TS. Grigera, S.Melillo, L. Parisi, M. Viale
   Nature Physics 13, 214-219 (2017) - IF: 22,806 - Cit: 0
   Cover article -
   Press/media release: http://www.ansa.it/canale_scienza_tecnica/notizie/fisica_matematica/2017/10/05/il-valzer-dei-moscerini-esiste-la-fisica-ne-svela-la-coreografia-_65cf8718-e7d3-49d4-b01a-106cf8e8eaa7.html

3. Non-symmetric interactions trigger collective swings in globally ordered systems
   A.Cavagna, I. Giardina, A. Jelic, S. Melillo, L. Parisi, E. Silvestri, M. Viale
   Phys. Rev. Lett. 118, 138003 (2017) - IF: 8,462 - Cit: 1

4. Local equilibrium in bird flocks
   T. Mora, A. Walczak, L. Del Castello, F. Ginelli, S. Melillo, L. Parisi, M. Viale, A. Cavagna, I. Giardina
   Nature Physics 12, (12), 1153-1157 (2016) - IF: 22,806 – Cit: 11

5. Flocking and turning: a new model for self-organized collective motion
   A.Cavagna, L. Del Castello, I. Giardina, T. Grigera, A. Jelic, S. Melillo, T. Mora, L. Parisi, E. Silvestri, M. Viale, AM. Walczak
   Journal of Statistical Physics, 158 (3), 601-627 (2015) - IF: 1,537 – Cit: 22

6. Silent Flocks
   A. Cavagna, I. Giardina, TS. Grigera, A. Jelic, D. Levine, S. Ramaswamy, M. Viale
   Phys. Rev. Lett. 114, 218101 (2015) - IF: 7,645 – Cit: 12
   Press/media release:
   https://physics.aps.org/synopsis-for/10.1103/PhysRevLett.114.218101 (Synopsis in Physics)

7. Finite-size scaling as a way to probe near-criticality in natural swarms
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, S. Melillo, L. Parisi, O. Pohl, B. Rossaro, E. Shen, E. Silvestri, M. Viale
Phys. Rev. Lett 113, 238102 (2014) - IF: 7,512 – Cit: 38
Press/media release:
https://physics.aps.org/articles/v7/120 (Viewpoint in Physics)

8. Information transfer and behavioural inertia in starling flocks
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, TS. Grigera, A. Jelić, S. Melillo, L. Parisi, O. Pohl, E. Shen, M. Viale
Nature Physics, 10 (9), 691-696 (2014) - IF: 20,147 – Cit: 63
Cover article

9. Collective behaviour without collective order in wild swarms of midges
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, S. Melillo, L. Parisi, O. Pohl, B. Rossaro, E. Shen, E. Silvestri, M. Viale
Plos Comput. Biol., 10 e1003697 (2014) - IF: 4,620 – Cit: 44

10. Social interactions dominate speed control in poising natural flocks near criticality
W. Bialek, A. Cavagna, I. Giardina, T. Mora, O. Pohl, E. Silvestri, M. Viale, AM. Walczak
Proc. Natl. Acad. Sci. US 111 (20), 7212-7217 (2014) - IF: 9,674 – Cit: 50

11. Bird flocks as condensed matter
A. Cavagna, I. Giardina
Ann. Rev. Cond. Matt. Phys. 5, 183-207 (2014) - IF: 14,786 – Cit: 29

12. Statistical mechanics for natural flocks of birds
W. Bialek, A. Cavagna, I. Giardina, T. Mora, E. Silvestri, M. Viale, A. M. Walczak
Proc. Natl. Acad. Sci. US 109, 4786-4791 (2012) - IF: 9,737 – Cit: 196
Press/media release:
https://www.engadget.com/2013/03/18/tech-is-a-flock-of-starlings/
https://arstechnica.com/science/2012/03/animal-magnetism-using-magnetic-models-to-understand-flocks-of-birds/
https://www.wired.com/2012/03/starling-flock-dynamics/

13. Scale-free correlations in starling flocks
A. Cavagna, A. Cimarelli, I. Giardina, G. Parisi, R. Santagati, F. Stefanini, M. Viale
Proc. Natl. Acad. Sci. USA 107, 11865-11870 (2010) - IF: 9,771 – Cit: 307
Press/media release:
https://www.allaboutbirds.org/how-do-starling-flocks-create-those-mesmerizing-murmurations/
http://www.peterbeerli.com/classes/images/4/4e/AmSci2011Hayes.pdf
https://physicsworld.com/a/birds-flock-with-scale-invariance/
https://www.wired.com/2010/06/starling-physics/

14. Collective Behaviour in animal groups: theoretical models and empirical studies
I. Giardina
HSFP Journal 2, 205-219 (2008) - IF: 1,786 – Cit: 86

15. Empirical investigation of starling flocks: a benchmark study in collective animal behaviour

M. Ballerini, N. Cabibbo, R. Candelier, A. Cavagna, E. Cisbani, I. Giardina, V. Lecomte, A. Orlandi , G. Parisi, A. Procaccini, M. Viale & V. Zdravkovic V
Anim Behav 76, 201-215 (2008) - IF: 2,828 – Cit: 199

16. Interaction Ruling Animal Collective Behaviour Depends on Topological rather than Metric Distance: Evidence from a Field Study
M. Ballerini, N. Cabibbo, R. Candelier, A. Cavagna, E. Cisbani, I. Giardina, V. Lecomte, A. Orlandi , G. Parisi, A. Procaccini, M. Viale & V. Zdravkovic V
Proc. Natl. Acad. Sci. USA 105, 1232-1237 (2008) - IF: 9,380 – Cit: 773
Press/media release:
http://news.bbc.co.uk/earth/hi/earth_news/newsid_9175000/9175793.stm
https://www.telegraph.co.uk/news/science/science-news/3323488/Study-of-starling-formations-points-way-for-swarming-robots.html

Part XII– Full publication list

- Books and Book Chapters**:**

Metastable states in glassy systems
I. Giardina
in "Les Houches - Session LXXXV: Complex Systems", J.-P Bouchaud, M. Mezard and J. Dalibard eds., Elsevier, Amsterdam (2007).

Random Fields and Spin Glasses
C. De Dominicis and I. Giardina
Cambridge University Press, Cambridge (2006)

La Formulazione delle Storie della Meccanica Quantistica
I. Giardina
Bibliopolis, Napoli (1998)

- Peer reviewed research papers:

Physical constraints in biological collective behavior
A. Cavagna, I. Giardina, T. Mora, A. M.Walczak
Current Opinion in Systems Biology **9,** 49 (2018)

Propagating speed waves in flocks: a mathematical model.
Cavagna A., Conti, D., Giardina, I., & Grigera, T. S.
Preprint arXiv:1708.01431 (2017). Submitted.

The physics of flocking: Correlation as a compass from experiments to theory.
Cavagna, A., Giardina, I., & Grigera, T. S. (2017).
Physics Reports **728**, 1 (2017)

Dynamical scaling in natural swarms
A.Cavagna, D. Conti, C. Creato, L. Del Castello, I. Giardina, TS. Grigera, S.Melillo, L. Parisi, M. Viale

Nature Physics **13**, 214 (2017)

Non-symmetric interactions trigger collective swings in globally ordered systems
A.Cavagna, I. Giardina, A. Jelic, S. Melillo, L. Parisi, E. Silvestri, M. Viale
Phys. Rev. Lett. **118,** 138003 (2017)

Local equilibrium in bird flocks
T. Mora, A. Walczak, L. Del Castello, F. Ginelli, S. Melillo, L. Parisi, M. Viale, A. Cavagna, I. Giardina
Nature Physics, 12, (12), 1153-1157 (2016)

Entropic effects in a nonequilibrium system: Flocks of birds
M Castellana, W Bialek, A Cavagna, I Giardina
Phys. Rev. E **93** (5), 052416 (2016)

Spatio-temporal correlations in models of collective motion ruled by different dynamical laws
A.Cavagna, D. Conti, I. Giardina, TS. Grigera, S. Melillo, M. Viale
Physical Biology, 13 (6), 065001 (2016)

Error control in the set-up of stereo camera systems for 3d animal tracking
A Cavagna, C Creato, L Del Castello, I Giardina, S Melillo, L Parisi, ...
Eur. Phys. J. Special Topics **224** (17-18), 3211-3232 (2015)

Emergence of collective changes in travel direction of starling flocks from individual birds fluctuations
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, A. Jelic, S. Melillo, L. Parisi, O. Pohl, E. Shen, M. Viale
Interface 12 (108) (2015)

Flocking and turning: a new model for self-organized collective motion
A.Cavagna, L. Del Castello, I. Giardina, T. Grigera, A. Jelic, S. Melillo, T. Mora, L. Parisi, E. Silvestri, M. Viale, AM. Walczak
Journal of Statistical Physics, 158 (3), 601-627 (2015)

GReTA – A novel global and recursive tracking algorithm in three dimensions
A.Attanasi, A. Cavagna, L. Del Castello, I. Giardina, A. Jelic, S. Melillo, L. Parisi, F. Pellacini, E. Shen, E. Silvestri, M. Viale
Pattern Analysis and Machine Intelligence, IEEE Transactions on, issue **99**, (2015)

Short-range interaction vs long-range correlation in bird flocks
A. Cavagna, L. Del Castello, S. Dey, I. Giardina, S. Melillo, L. Parisi, M. Viale
Phys. Rev. E **92**, 012705 (2015)

Silent Flocks
A. Cavagna, I. Giardina, TS. Grigera, A. Jelic, D. Levine, S. Ramaswamy, M. Viale
Phys. Rev. Lett. **114**, 218101 (2015)

Finite-size scaling as a way to probe near-criticality in natural swarms
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, S. Melillo, L. Parisi, O. Pohl, B. Rossaro, E. Shen, E. Silvestri, M. Viale
Phys. Rev. Lett **113**, 238102 (2014)

Information transfer and behavioural inertia in starling flocks

A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, TS. Grigera, A. Jelić, S. Melillo, L. Parisi, O. Pohl, E. Shen, M. Viale
Nature Physics, **10** (9), 691-696 (2014)

Collective behaviour without collective order in wild swarms of midges
A. Attanasi, A. Cavagna, L. Del Castello, I. Giardina, S. Melillo, L. Parisi, O. Pohl, B. Rossaro, E. Shen, E. Silvestri, M. Viale
Plos Comput. Biol., **10** e1003697 (2014)

Social interactions dominate speed control in poising natural flocks near criticality
W Bialek, A Cavagna, I Giardina, T Mora, O Pohl, E Silvestri, M Viale, A.M. Walczak
Proc. Natl. Acad. Sci. US **111**, 7212-7217 (2014)

Dynamical maximum entropy approach to flocking
A. Cavagna, I. Giardina, F. Ginelli, T. Mora, D. Piovani, R. Tavarone, AM Walczak
Phys. Rev. E, **89**, 042707 (2014)

Bird flocks as condensed matter
A. Cavagna, I. Giardina
Ann. Rev. Cond. Matt. Phys. **5** (2014).

Boundary information inflow enhances correlation in flocking.
A. Cavagna, I. Giardina, F. Ginelli
Phys. Rev. Lett. **110,** 168107 (2013).

Diffusion of individual birds in starling flocks
A. Cavagna, S. M. Duarte Queiros, I. Giardina, F. Stefanini and M. Viale
Proc. Royal. Soc. B. **280**, 20122484 (2013).

Starling flock networks manage uncertainty in consensus at low cost
G F. Young, L. Scardovi, A. Cavagna, I. Giardina, N. E. Leonard
Plos Comput. Biol. **9** e1002894 (2013)

Spatially balanced topological interaction grants optimal cohesion in flocking models
M Camperi, A. Cavagna, I. Giardina, G. Parisi, E. Silvestri
Interface Focus **2**, 715 (2012)

Statistical mechanics for natural flocks of birds
W. Bialek, A. Cavagna, I. Giardina, T. Mora, E. Silvestri, M. Viale, A. M. Walczak
Proc. Natl. Acad. Sci. US **109**, 4786 (2012)

Propagating waves in starling, Sturnus vulgaris, flocks under predation
A. Procaccini, A. Orlandi, A. Cavagna, I. Giardina, F. Zoratto, D. Santucci, F. Chiarotti, C. Hemelrjik, E. Alleva, G. Parisi, C. Carere
Anim. Behav. **82**, 759 (2011)

Scale-free correlations in starling flocks
Cavagna, A. Cimarelli, I. Giardina, G. Parisi, R. Santagati, F. Stefanini, M. Viale
Proc. Natl. Acad. Sci. USA **107**, 11865 (2010).

Phase-Separation Perspective on Dynamic Heterogeneities in Glass-Forming Liquids
C. Cammarota, A. Cavagna, I. Giardina, G. Gradenigo, T. S. Grigera, G. Parisi and P. Verrocchio

Phys. Rev. Lett. **105**, 055703 (2010)

From Empirical Data to Inter-Individual Interactions: Unveiling the Rules of Collective Animal behaviour
A. Cavagna, A. Cimarelli, I. Giardina, G. Parisi, R. Santagati, F. Stefanini, R. Tavarone
Mathematical Models and Methods in Applied Sciences M3AS **20**, 1495 (2010)

Large scale behaviour in animal groups
A. Cavagna and I Giardina
Behav. Proc. **84**, 653 (2010)

Collective Behaviour in animal groups: theoretical models and empirical studies
I. Giardina
HSFP Journal **2**, 205 (2008)

New statistical tools for analyzing structure of animal groups
A. Cavagna, A. Cimarelli, I. Giardina, A. Orlandi, G. Parisi, A. Procaccini, R. Santagati and F. Stefanini
Math Biosc **214**, 32 (2008)

The STARFLAG handbook on collective animal behaviour: 2. Three-dimensional analysis
A. Cavagna, I. Giardina, A. Orlandi, G. Parisi, and A. Procaccini
Anim Behav **76**, 237 (2008)

The STARFLAG handbook on collective animal behaviour: 1. Empirical methods
A. Cavagna, I. Giardina, A. Orlandi, G. Parisi, A. Procaccini, M. Viale and V. Zdravkovic
Anim Behav **76**, 217 (2008)

Empirical investigation of starling flocks: a benchmark study in collective animal behaviour
M. Ballerini, N. Cabibbo, R. Candelier, A. Cavagna, E. Cisbani, I. Giardina, V. Lecomte, A. Orlandi , G. Parisi, A. Procaccini, M. Viale & V. Zdravkovic V
Anim Behav **76**, 201 (2008)

Interaction Ruling Animal Collective Behaviour Depends on Topological rather than Metric Distance: Evidence from a Field Study
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