

IRB BARCELONA 2010 ANNUAL REPORT

SCIENCE AT IRB BARCELONA

Research Programmes

Structural and Computational Biology

Patrick Aloy: Structural bioinformatics and network biology group



Group Members

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Highlights

- We have developed a computational approach that integrates various types of biological information to generate a list of 90 potential Aurora substrates, with a prediction accuracy of about 80%. We have demonstrated the specific phosphorylation of NUSAP (nucleolar and spindle-associated protein) by Aurora A *in vivo*.
- Our analyses of the structural features of known protein-interaction motifs reveal that they tend to have a particular stretched and elongated structure, unlike most other peptides of the same length. We have used these features to identify unnoticed peptide-mediated interactions and to provide molecular details for the binding of over 6,000 protein interactions.
- Through network and systems biology strategies, we have proposed a novel way to approach complex human diseases and new therapeutics. We have revealed a molecular relationship between type II diabetes and the metabolic changes induced by very-low carbohydrate diets.

Publications

- Brooks MA, Gewartowski K, Mitsiki E, Létouart J, Pache RA, Billier Y, Bertero M, Corr ea M, Czarnocki-Cieciura M, Dadlez M, Henriot V, Lazar N, Delbos L, Lebert D, Piwowarski J, Rochaix P, B ttcher B, Serrano L, S raphin B, van Tilbeurgh H, Aloy P, Perrakis A and Dziembowski A. Systematic bioinformatics and experimental validation of yeast complexes reduces the rate of attrition during structural investigations. *Structure*, 18 (9), 1075-82 (2010)
- Farr s J, Pujol A, Coma M, Ruiz JL, Naval J, Mas JM, Molins A, Fondevila J and Aloy P. Revealing the molecular relationship between type 2 diabetes and the metabolic changes induced by a very-low-carbohydrate low-fat ketogenic diet. *Nutr Metab*, 7, 88 (2010)
- Littler DR, Alvarez-Fern ndez M, Stein A, Hibbert RG, Heidebrecht T, Aloy P, Medema RH and Perrakis A. Structure of the FoxM1 DNA-recognition domain bound to a promoter sequence. *Nucleic Acids Res*, 38 (13), 4527-38 (2010)
- Panjkovich A and Aloy P. Predicting protein-protein interaction specificity through the integration of three-dimensional structural information and the evolutionary record of protein domains. *Mol Biosyst*, 6 (4), 741-9 (2010)
- Pujol A, Mosca R, Farr s J and Aloy P. Unveiling the role of network and systems biology in drug discovery. *Trends Pharmacol Sci*, 31 (3), 115-23 (2010)
- Sardon T, Pache RA, Stein A, Molina H, Vernos I and Aloy P. Uncovering new substrates for Aurora A kinase. *EMBO Rep*, 11 (12), 977-84 (2010)

- Stein A and Aloy P. Novel peptide-mediated interactions derived from high-resolution 3-dimensional structures. *PLOS Comput Biol*, 6 (5), e1000789 (2010)

Collaborations

- Novel strategy for network-based therapeutics. José Manuel Mas, Infociencia & Anaxomics Biotech (Barcelona, Spain)
- Novel ways of assessing protein-DNA interactions. Anastassis Perrakis, Nederlands Kanker Instituut (Amsterdam, Netherlands)
- Structural systems biology. Juan Fernández-Recio, Barcelona Supercomputing Center (BSC) (Barcelona, Spain); Baldo Oliva, Pompeu Fabra University (Barcelona, Spain); Mohan Madan Babu, LMB-MRC (Cambridge, United Kingdom); Miquel Pons, IRB Barcelona (Barcelona, Spain)

Research projects

- A bioinformatics approach to the study of contextual-specificity in protein interaction networks and potential applications to biomedicine and biotechnology. *Proyectos Investigación Fundamental Spanish (BIO2007-62426)*. Ministry of Science and Innovation (MICINN). 2007-2010. Principal investigator: Patrick Aloy
- Identification and validation of novel drug targets in Gram-negative bacteria by global search: a trans-system approach (ANTIPATHOGN), European Commission (223101). 2009-2013. Principal investigator: Patrick Aloy
- Identification of secondary targets and drug design through the structural and functional analyses of biological networks. *Proyectos Singulares Estratégicos (PSE-010000-2009-008 2009)*. Spanish Ministry of Science and Innovation (MICINN) (MICINN). 2009-2011. Principal investigator: Patrick Aloy
- Structural bioinformatics and network biology, *Grups de Recerca reconeguts per la Generalitat de Catalunya 2009-2013 (2009 SGR 1519)*. Agency for Administration of University and Research Grants (AGAUR). 2009-2013. Principal investigator: Patrick Aloy

PhD theses

- Peptide-mediated interactions in high-resolution 3-dimensional structures. Amelie Stein, University of Barcelona (2010). Thesis director: Patrick Aloy. Honors: Cum Laude

Patents

- Methods and Systems for identifying molecules or processes of biological interest by using knowledge discovery in biological data. Mas JM, Pujol A, Farrés J and Aloy P. Publication number/date: WO2011051805 (18/08/2010). Status: Pre-grant publication



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