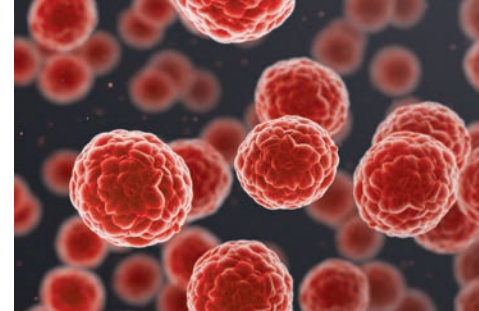


Cancer therapeutics

Despite significant advances in the field of anti-cancer therapy, cancer remains one of the main causes of mortality worldwide. The absence of targeted therapeutic options for most cancer types, along with the persistent challenge of drug resistance, underscore the urgent need for collaborative efforts.

Researchers at the I2BC are actively investigating cellular processes associated with cancer, with a specific focus on processing genetic information and on the architecture of cellular structures. Through these studies, the I2BC is well poised to address the critical public health issues posed by cancer, offering novel perspectives for cancer diagnosis, prevention and treatment.



Exploring novel avenues for cancer therapy

Through an integrative approach, the I2BC characterizes various cellular processes, yielding valuable insights into factors influencing gene function and cell development:

- **Epigenetics**
 - Uncovering the role of epi-mutations (e.g. DNA methylation, histone modifications) in disrupting CTCF binding, 3D genome organization, and (onco-) gene activity^{1,2}
 - Investigating the protein machineries responsible for modulating epigenetic information, with a specific emphasis on histones and their chaperones³
- **DNA damage repair**
 - Elucidating mechanisms governing DNA damage repair to maintain genome integrity, including the interplay between transcription and DNA repair processes^{4,5}
- **RNA expression and alterations**
 - Developing advanced bioinformatics tools for mining RNA-seq data, aiming to identify RNAs that generate potential shared neoantigens in lung tumors⁶
- **Cell proliferation**
 - Pioneering the engineering of bacterial effectors to hinder cancer cell invasiveness and proliferation⁷

Exploring innovative anti-tumor agents

Employing modeling, biomimetic chemistry and structural biology, the I2BC is actively developing protein-protein interaction inhibitors designed to disrupt complexes and potentially serve as groundbreaking anti-tumor agents:

- **Peptides and foldamers**
 - Generating peptides and foldamers to disrupt histone-chaperone complexes, potentially offering therapeutic benefits for triple negative breast cancer³
- **DNA damage repair inhibitors**
 - Investigating processes of DNA damage repair to disrupt implicated complexes, thereby enhancing the effectiveness of radiotherapy⁸

Using synthetic biology for anti-tumor agent

Drawing on expertise in bacterial metabolism and synthetic biology, the I2BC is charting innovative paths to produce anti-tumor agents

- **Production of natural products**
 - Developing strategies to produce natural products with anti-tumor properties and their analogs through *in vivo* approaches, including the design and construction of genetically modified microorganisms (*E. coli*, *Streptomyces*)^{9,10}
- **Production of peptides/proteins**
 - Optimizing PURE (composed of purified elements) cell-free systems for producing peptides and proteins with anti-tumor properties, including the use of flexizymes to introduce artificial amino acids into these molecules¹¹

Fields of expertise

- DNA repair
- Gene expression
- Epigenetics
- Cell proliferation
- Molecular interactions
- Anti-tumor activities
- Synthetic biology

Technical skills

- Multi-omics: RNA-seq, ChIP-seq, Slam-seq, Methyl-seq, (capture) Hi-C, CPD-seq, Ribo Seq
- Production, purification and characterization of proteins, protein complexes, protein-DNA complexes, protein-RNA complexes
- Structural predictions (AlphaFold), characterization (NMR, crystallography, cryoEM, biophysical methods) and modelling of multimolecular complexes
- Molecule screening and drug binding analysis
- Calculation, storage, use of bioinformatics software (development of workflows, data processing), access to general biological data collections and specialized databases (proteomic and genomic data mining, bacterial and archeal genome mining), online tools and services

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