ENVISION is a four year funded project with a budget of 6 million Euros. Launched in 02/2010 and prolonged to 07/2014. 16 leading European research centers and industrial partners are coordinated by CERN.

Project structure: 5 research work packages
- Time-of-flight in-beam PET (WP2)
- In-beam single particle tomography (WP3)
- Particle therapy in-vivo dosimetry and moving targets (WP4)
- In-vivo dosimetry, treatment planning and clinical relevance (WP5)
- Monte Carlo simulation of in-vivo dosimetry (WP6)

Time-of-flight in-beam PET

Compare technologies for achieving sub-nanosecond TOF resolution
- Dual-head demonstrator
  - Crystal-based TOF-PET
  - RPC-based TOF-PET

Simulate a full ibSPAT system
- Develop and optimize fast image reconstruction algorithms
  - Achieved TOF resolutions close to 200 ps
- Improvements in image quality
  - Compton scatter rejection & artifacts reduction

In-beam single particle tomography

Develop and optimize detector systems & reconstruction algorithms for ibSPAT
- Develop clinically real-time monitoring methods
- Feasibility of prompt γ-ray imaging demonstrated
- Passive system for prompt γ-ray imaging tested
  - Promising results for clinical application
- Several dedicated Compton camera prototypes developed
  - Active collimation system in progress
- Scintillating fibre hodoscope for beam position measurement successfully tested
- Monte Carlo simulations and experiments at HIT demonstrated that prompt γ imaging delivers a reliable particle range information

Particle therapy in-vivo dosimetry and moving targets

Assess feasibility and clinical potential of 4D in-vivo dosimetric imaging analysis systems of motion-compensated scanned ion beams
- Experimental investigations at CSI (3D MLEM vs 4D MLEM)
  - Changes in high activity region due to beam delivery type
  - Automated range comparison
  - Detection of overranges & underranges
- Integration of ultrasound tracking system
  - In PET/CT
  - In beam delivery

In-vivo dosimetry, treatment planning and clinical relevance

Development of an automated PT-PET evaluation tool
- Development and test of purpose built phantoms ion beam dosimetry
- Software development for PET verification (2 approaches)
  - Range comparison algorithm
  - Pearson correlation coefficient based evaluation
- Moving phantom designed and constructed
- Control software written to allow movement on predefined path

Monte Carlo simulation of in-vivo dosimetry

MC model development for production of β⁻ and prompt γ emission
- Simulation tools for actual patient cases
  - Toolkits: GEANT4, FLUKA, GATE, MCNPX
- Steps for full simulation of clinical cases:
  - Importing DICOM
  - Generating complex detector geometry
  - Production of sinograms for PET scanners
- OpenPET and dual-head dedicated PET systems have been simulated
  - Spatial resolution and reconstruction ability correspond to real clinical proton irradiation

The ENVISION project is cofunded by the European Commission under FP7 Grant Agreement No. 241851.