# Using NSTX data to validate theory and simulations of snowflake divertors

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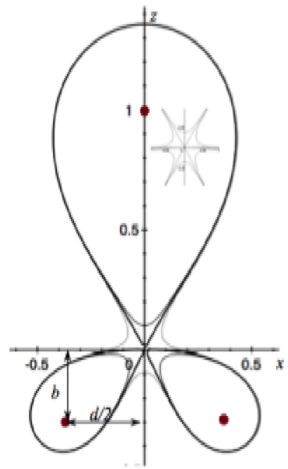
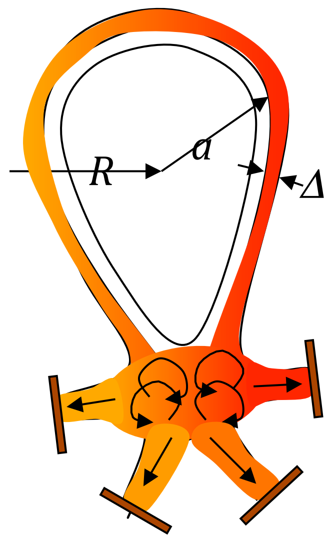
- **Snowflake divertors are predicted to provide important benefits**
  - **Divertor between-ELM peak heat-flux reduction**
    - ➢ **Flux expansion reduces heat-flux; larger volume for impurity radiation; may induce plasma detachment**
  - **Modification of ELMs; reduction of ELM peak heat-load**
    - ➢ **Magnetic shear changes stability; $\beta_p > 1$ induces heat-flux spreading; longer $L_{||}$ reduces peak heat-flux**
  - **Increase in neoclassical orbit excursion**
    - ➢ **May increase between-ELM heat-flux width; orbit losses can increase $E_r$-well depth, stabilizing microinstabilities**
- **Tools developed/in-use**
  - **Analytic models, physical insight**
  - **UEDGE 2D transport simulations in SF geometry; can include Li, C, Mo**
  - **BOUT 3D simulations of microinstabilities and ELMs**
  - **Monte-Carlo drift-orbit tracking code**



# NSTX control and data needs for snowflake validation

- **MHD equilibrium and larger flux expansion**
  - — **Robust, sensitive PF coil control algorithms**
  - — **Measure magnetic structure accurately, including shear**
- **Near divertor plates and wall heat-flux reduction**
  - — **Heat-flux measurements with <1 cm resolution on plates, including all 4 snowflake divertor strike-points; some wall data**
  - — **Divertor-plasma profiles of $n_e$,$T_e$ ($T_i$ very useful)**
  - — **Time-resolved data for attached/detached transition; resolve ELMs (~0.2 ms)**
  - — **Energetic ions from orbit loss**
- **Scrape-off layer measurements**
  - — **Plasma profiles of $n_e$,$T_e$ ($T_i$ very useful)**
  - — **Turbulence near magnetic null during ELM (key for heat-flux spreading)**
  - — **Edge $E_r$ response to geometry change**
- **Impurity radiation – Li, C, Mo**
  - — **Bolometer measurements; distinguish Li, C, Mo concentrations**
  - — **Temporal response to injected impurities – e.g., neon**