Flight simulator

- A full simulation of the ATF/ATF2 beam.
- Allows control through the Lucretia interface via EPICS
  - Remote control will NOT be possible.
  - Local control only possible at KEK with operator's full knowledge.
- Will provide a method for algorithms to be developed in a variety of codes
  - Develop and test algorithm in simulation.
  - Bring code to ATF/ATF2 to deploy on the machine.

Multiple codes

- Primary communication with EPICS is via Lucretia.
  - How to accommodate other codes?
    - (SAD, MAD, PLACET, etc.)
- Accelerator Markup Language
  - An accelerator representation standard based on XML.
  - XML parsers for many languages already developed.
    - MAD, PLACET, ...
    - Lucretia <-> AML in progress
- Convert Lucretia lattice to AML file
  - “Master” file for Flight Simulator will be the AML file.
  - Update AML file on each control system change.

Example of AML representation

```
<element name = "QDOFF">
  <quadrupole>
    <k_u design = "-12.4518" err = "0" />
    <scaled_multipole>
      <a_u_coef n = "2" design = "0.320639" />
      <b_u_coef n = "2" design = "0.0450555" />
      <a_u_coef n = "3" design = "3.91746" />
      <b_u_coef n = "3" design = "-74.5498" />
      <a_u_coef n = "4" design = "85105.9" />
      <b_u_coef n = "4" design = "14995.1" />
      <a_u_coef n = "5" design = "2.46408e+07" />
      <b_u_coef n = "5" design = "4.26797e+07" />
      <a_u_coef n = "9" design = "0" />
      <b_u_coef n = "9" design = "-1.21905e+18" />
    </scaled_multipole>
  </quadrupole>
  <length design = "0.475" />
  <orientation origin = "CENTER">
    <x_offset design = "0" />
    <x_pitch design = "0" />
    <y_offset design = "0" />
    <y_pitch design = "0" />
    <s_offset design = "0" />
    <tilt design = "0" />
  </orientation>
  <aperture at = "ENTRANCE" shape = "CIRCLE" orientation_dependent = "TRUE" side = "BOTH">
    <xy_limit design = "0.025" />
  </aperture>
  <marker name = "MM27FF" />
  <aperture at = "EXIT" shape = "CIRCLE" orientation_dependent = "TRUE" side = "BOTH">
    <xy_limit design = "0.025" />
  </aperture>
</element>
```

Multiple codes

- Developing code at home
  - Use parser to load AML file.
  - Develop and test tuning algorithm in simulation.
- Testing on ATF/ATF2
  - Work in control room with an operator.
  - Run algorithm on machine with connection to EPICS
    - Commands passed from simulation code to Lucretia EPICS controller with plain text, “AML-like” commands.

Proof of principle test

- Test this system on ATF before shutdown
  - For example, perform a simple steering task
    - e.g. One to one steering of the extraction line
  - Run flight simulator in “simulate” and “real” modes.
- Demonstrate,
  - Security of system.
    - (No remote access, operator overrides, device limitations, etc.)
  - Ability to control and read devices.
  - Comparison of Flight Simulator readbacks with ATF readbacks.