R&D Plans for Ion Effects (WBS 2.2.4)

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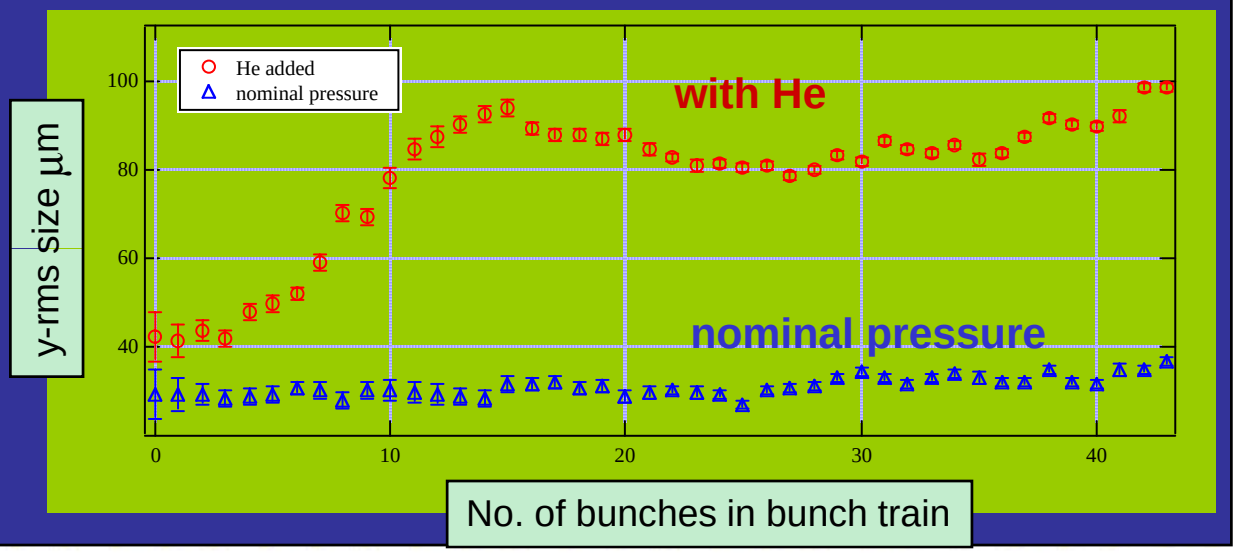
Why is it very-high priority?

- Focus is on the Fast Ion Instability (vs. conventional or 'slow' ion induced instability)
- FII has not limited the operation of any existing machine but could limit the ILC e^- DR performance because of combination of high current + small emittances
- Theory/Simulations indicate that growth rates for long bunch trains would be out of reach of existing feed-back systems. Theoretical models have yet to be thoroughly validated against experiments.

- First experimental evidence of the Fast Ion Instability at ALS (ca. 1996, J. Byrd *et al.*)



Objectives

- This work-package consists of two objectives:
  1. Characterize ion effects
  2. Specify Techniques for suppressing Ion Effects .

List of Tasks

1. Validate existing theoretical models and simulation tools for the FII by carrying out measurements in available storage rings.

2. Refine existing simulation tools beyond their current state or develop new tools to achieve acceptable agreement with the experiments.

3. Demonstrate the existence of viable machine designs capable of meeting the specifications for beam quality and stability, and show experimental feasibility of these designs using existing machines if possible.

4. Explore the effectiveness of a variety of mitigation techniques (such as clearing electrodes), if necessary.

Deliverables

- Inputs:
  - Design of lattice and vacuum systems. Specification of feedback systems.

- Deliverables:
  - Experimental validation of theoretical models and simulation tools.
  - Indication of machine design parameters (including bunch filling patterns, lattice optics, feedback and vacuum specifications) capable of delivering a beam with the required quality and stability without limitations from ion effects.
  - Guidance toward optimization of vacuum, feedback systems, and lattice design.

Current Status

- Simulation work is on going at CERN, DESY, KEK, SLAC. Experimental work is on going at ATF/KEK, CESR/Cornell and expected to start soon at ALS/LBNL. Possibly at CesrTA.
- Simulations show that multi-train filling patterns can be effectively designed to significantly increase the growth rates (to ~13 turns). It is crucial to build confidence in the validity of the models/tools being used.
- Estimated effort needed for both experiments and theory is at the level of 4.5FTE/year for 3 years