

# CASE and FCC

Center for Accelerator Science and Education

Established November 19, 2008

[http://www-case.physics.sunysb.edu/wiki/index.php/Main\\_Page](http://www-case.physics.sunysb.edu/wiki/index.php/Main_Page)



## The goals of CASE are:

- To train scientists and engineers with the aim of advancing the field of accelerator science;
- To develop an unique educational program that will provide broad access to research accelerators;
- To expand interdisciplinary research and education program utilizing accelerators.

**Collaboration of SBU & BNL**

## FCC provides:

- An ultimate goal of building next generation circular  $e^+e^-$  and pp colliders;
- An opportunity for young researches to take on some of most challenging problems in accelerator science;
- The time scale of the project is well suited for students and young scientist.

# CASE topics of interest for FCC

- FFAG full energy ERL for top-up injector of polarized electrons and positrons
- Advanced cooling techniques for hadrons (to avoid detector pile-up)
- Developing open plane design for synchrotron radiation absorber in Li He environment of the pp collider
- SRF system including crab cavities
- Advanced polarized electron guns
- Beam dynamics
- ....

# SR & Li He environment

parameter	LHC	HL-LHC	FCC-hh
c.m. energy [TeV]		14	100
dipole magnet field [T]		8.33	16 (20)
circumference [km]		36.7	100 (83)
luminosity [ $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ ]	1	5	5 [ $\rightarrow$ 20?]
bunch spacing [ns]		25	25 (5)
<b>events / bunch crossing</b>	<b>27</b>	<b>135</b>	<b>170 (34)</b>
bunch population [ $10^{11}$ ]	1.15	2.2	1 (0.2)
norm. transverse emitt. [mm]	3.75	2.5	2.2 (0.44)
IP beta-function [m]	0.55	0.15	1.1
IP beam size [mm]	16.7	7.1	6.8 (3)
synchrotron rad. [W/m/aperture]	0.17	0.33	28 (44)
critical energy [keV]		0.044	4.3 (5.5)
<b>total syn.rad. power [MW]</b>	<b>0.0072</b>	<b>0.0146</b>	<b>4.8 (5.8)</b>
<b>longitudinal damping time [h]</b>		<b>12.9</b>	<b>0.54 (0.32)</b>

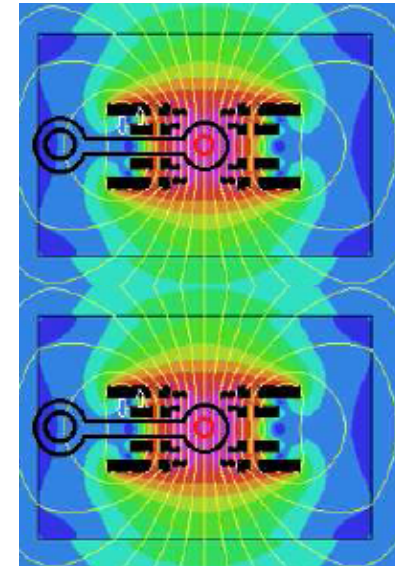
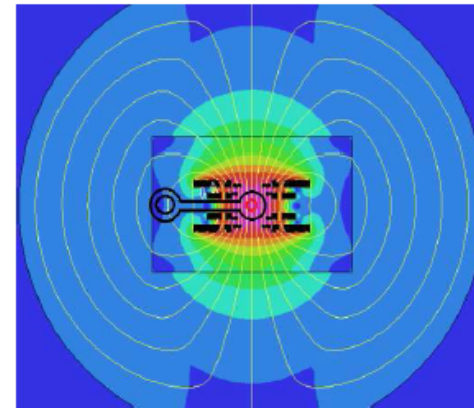
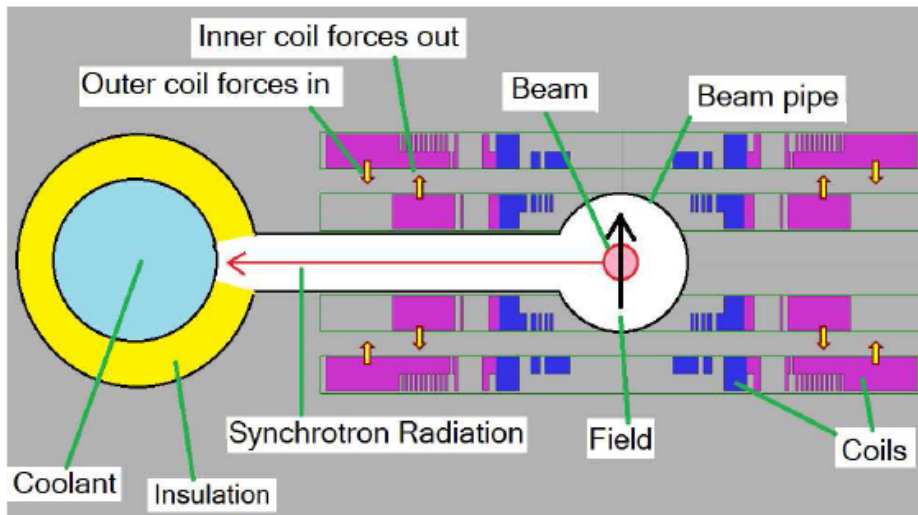
Too low for Be window

x Carno x 2  
~ 300MW AC

# Developing alternative pp FCC SR absorber scheme

## Open Mid-plane Dipoles

Magnet Division R. Gupta's design[13] for 13.5 T

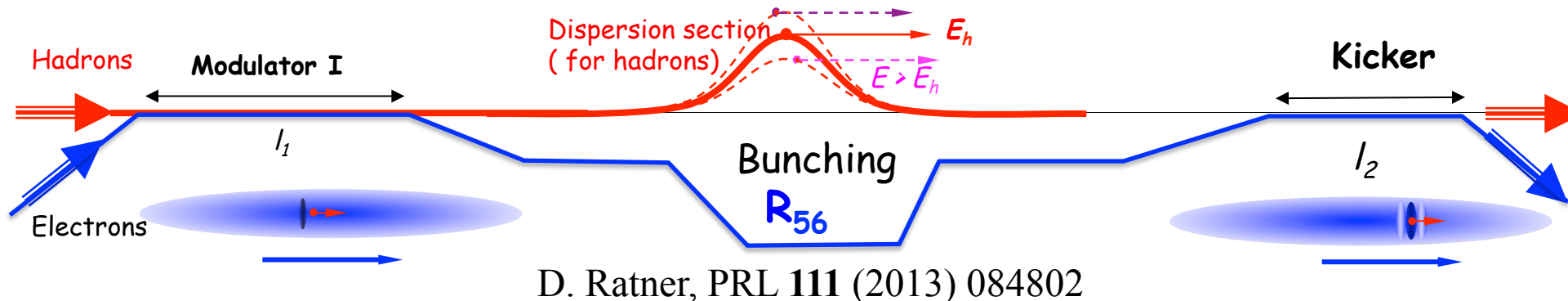


- Coils shown give very good field uniformity
- The sketched idea of the dump allows cooling at 77 K and space for good thermal insulation to 1.8 K yoke
- The open plane design will be easier at lower dipole fields.

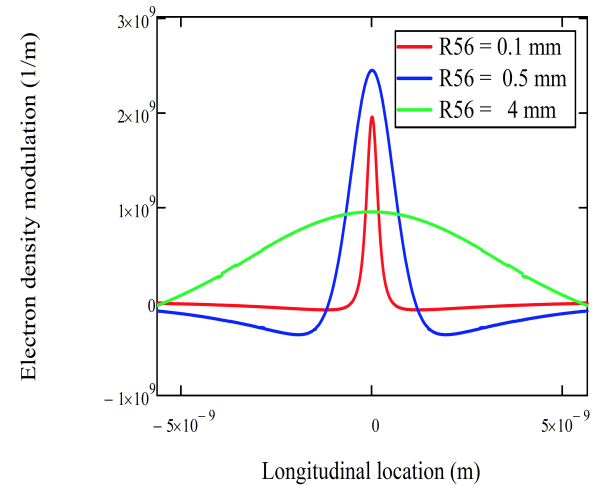
Courtesy of R. Palmer (BNL)

# Coherent Electron Cooling

Micro-bunching amplifier has potential of bandwidth  $\sim 10^{17}$  Hz



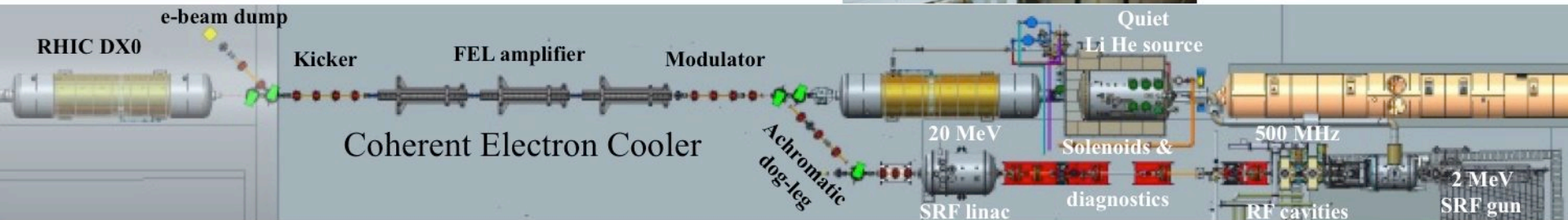
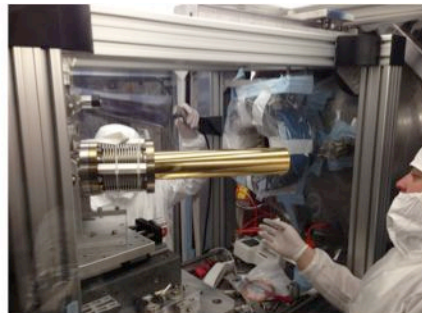
- Small  $\beta^*$  leads to
  - Smaller DA
  - Increase angular spread  $(\epsilon/\beta^*)^{1/2}$  in IR (Final Quads aperture)
- Reducing emittance,  $\epsilon$  (while increasing collision rep-rate)
  - Increases DA/ $\epsilon$  ratio for a given  $\beta^*$
  - Reduces angular spread  $(\epsilon/\beta^*)^{1/2}$  in IR



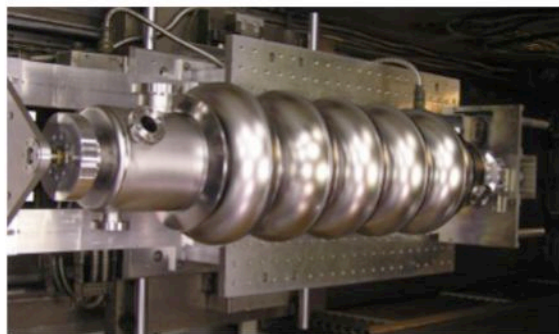
Gang Wang, 2013



# CeC test at of RHIC



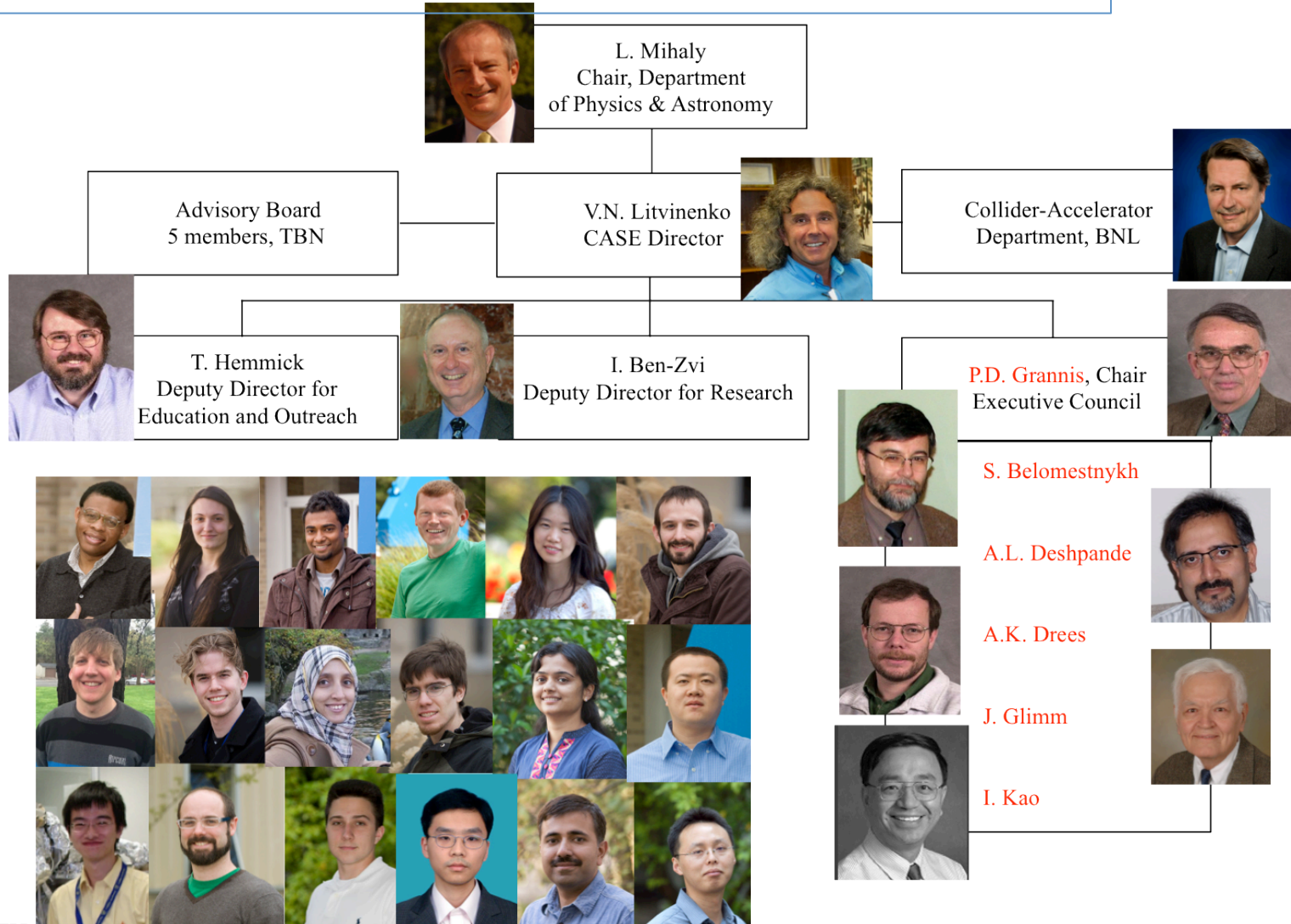
Under construction: Commissioning/test should start in 2015



# CASE and FCC

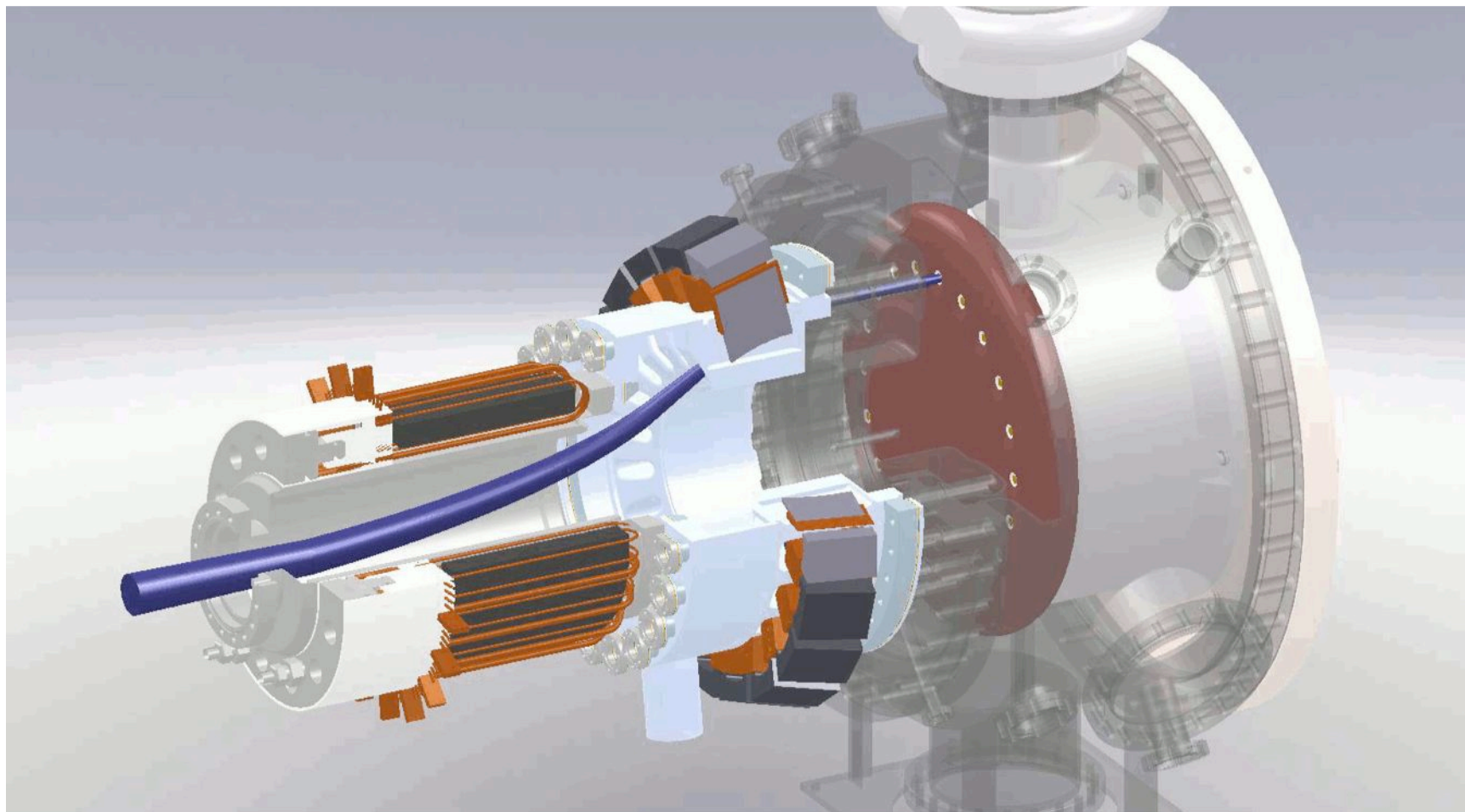
Center for Accelerator Science and Education

## A lot of excellent opportunities





# Back-up





## Current commitment:

- One joint Senior Faculty appointment, Professor of Physics
- One Assistant Research Professor (hire is in progress)
- One BNL Professor of Physics
- 8 Adjunct Professor in Physics & Astronomy
- Requested further augmentation of CASE from cluster hire initiative:
- Five faculty hires for CASE in 2012-13 in Physics and Engineering (Applied Math, EE, Computer Sci., Material Sci.) under new SBU hiring program. Three more targeted hires in 2014-17.