Absorber Review@FNAL 5/17/04

Design of Six-Dimensional Helical Cooling Channel (HCC)

Katsuya Yonehara

Illinois Institute of Technology

Collaborators

R. P. Johnson

Muons, Inc.

A. Bogacz, K.B. Beard, Slava Derbenev

Jefferson Lab

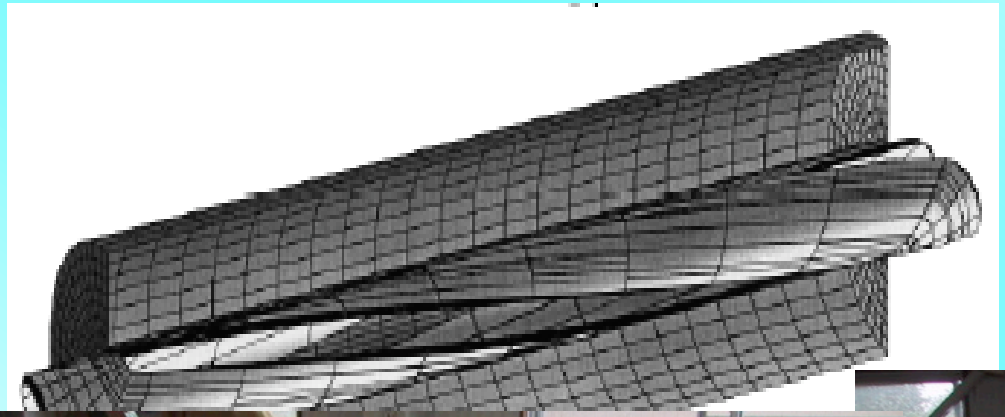
D.M. Kaplan, T.J. Roberts

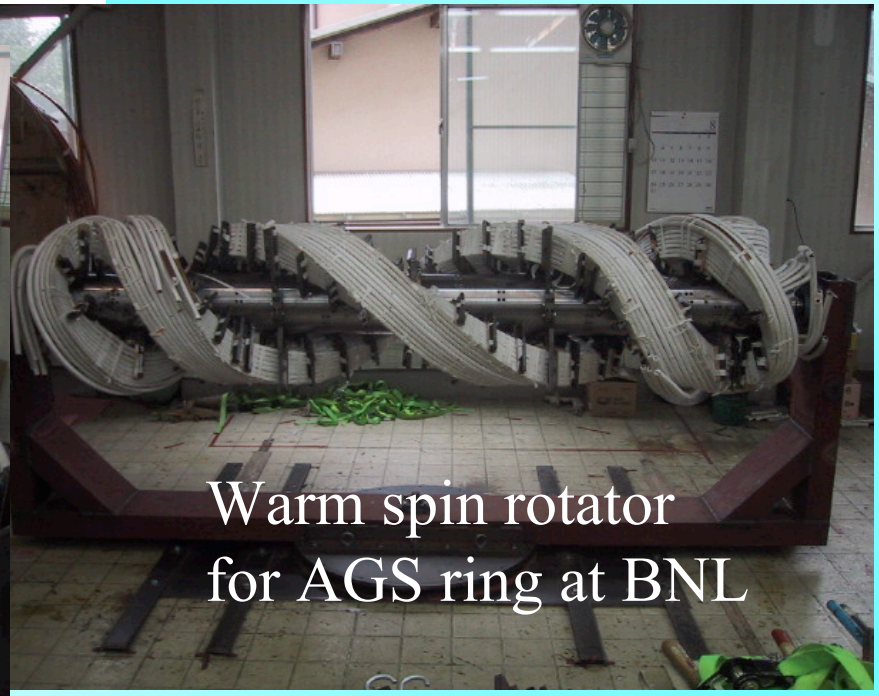
Illinois Institute of Technology

About this project

- Phase I study done
- Analytical investigation of cooling effect of HCC (MuNote0284)
- Simulate the cooling effect
  - G4BL (v0.8beta)
  - ICOOL (v271)

Helical Dipole Magnet

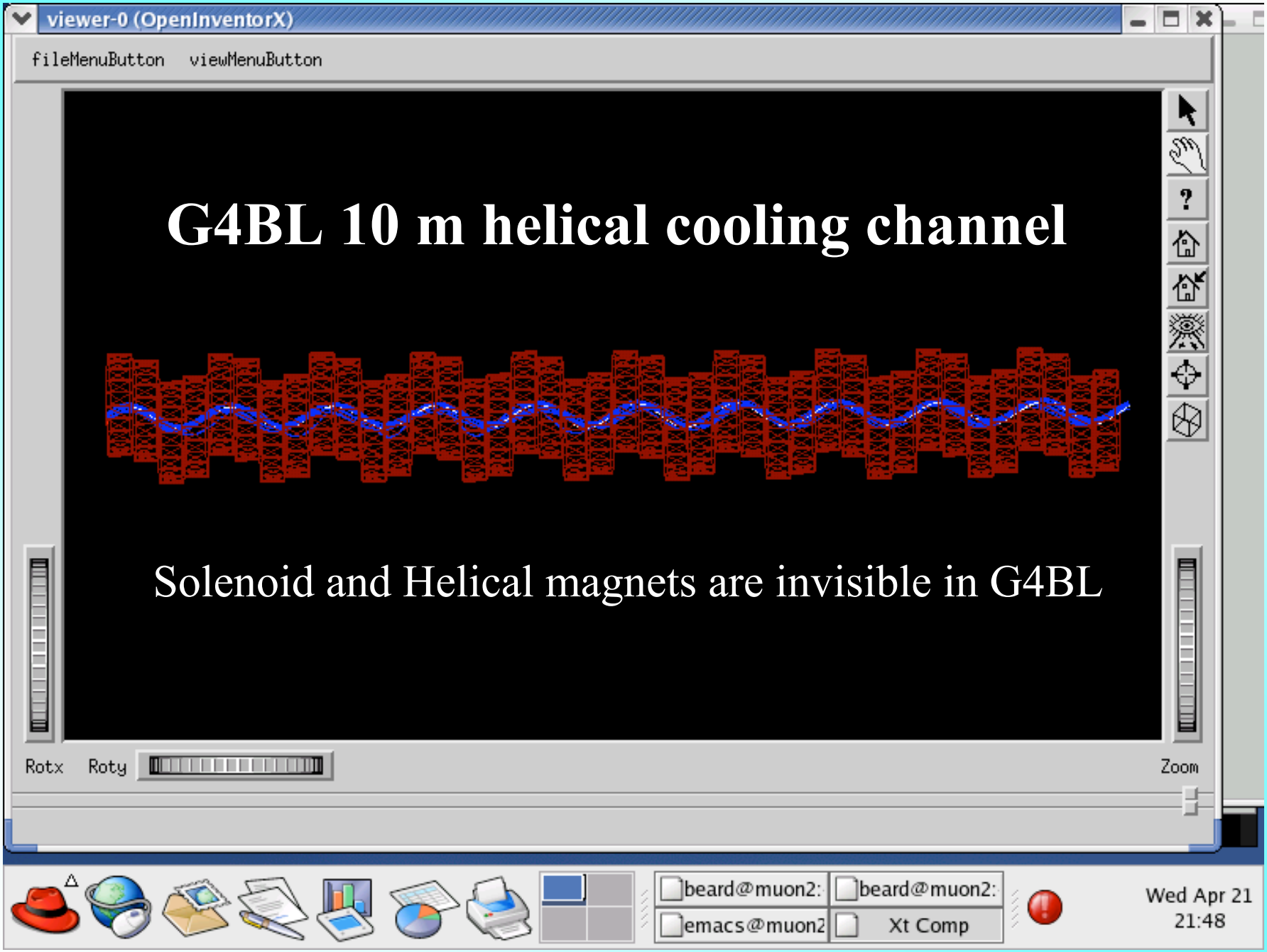




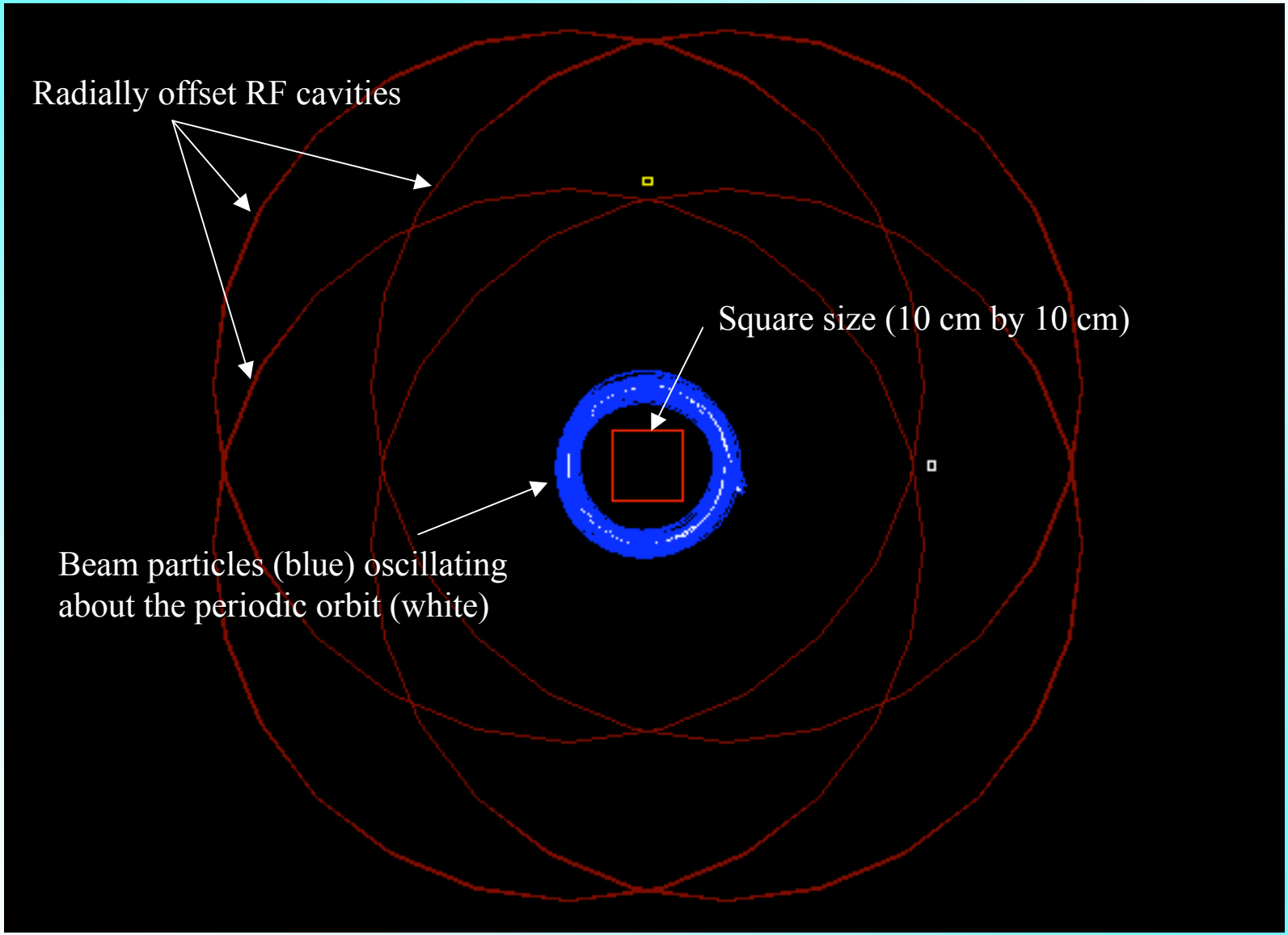
Warm spin rotator
for AGS ring at BNL

Example of analytical investigation

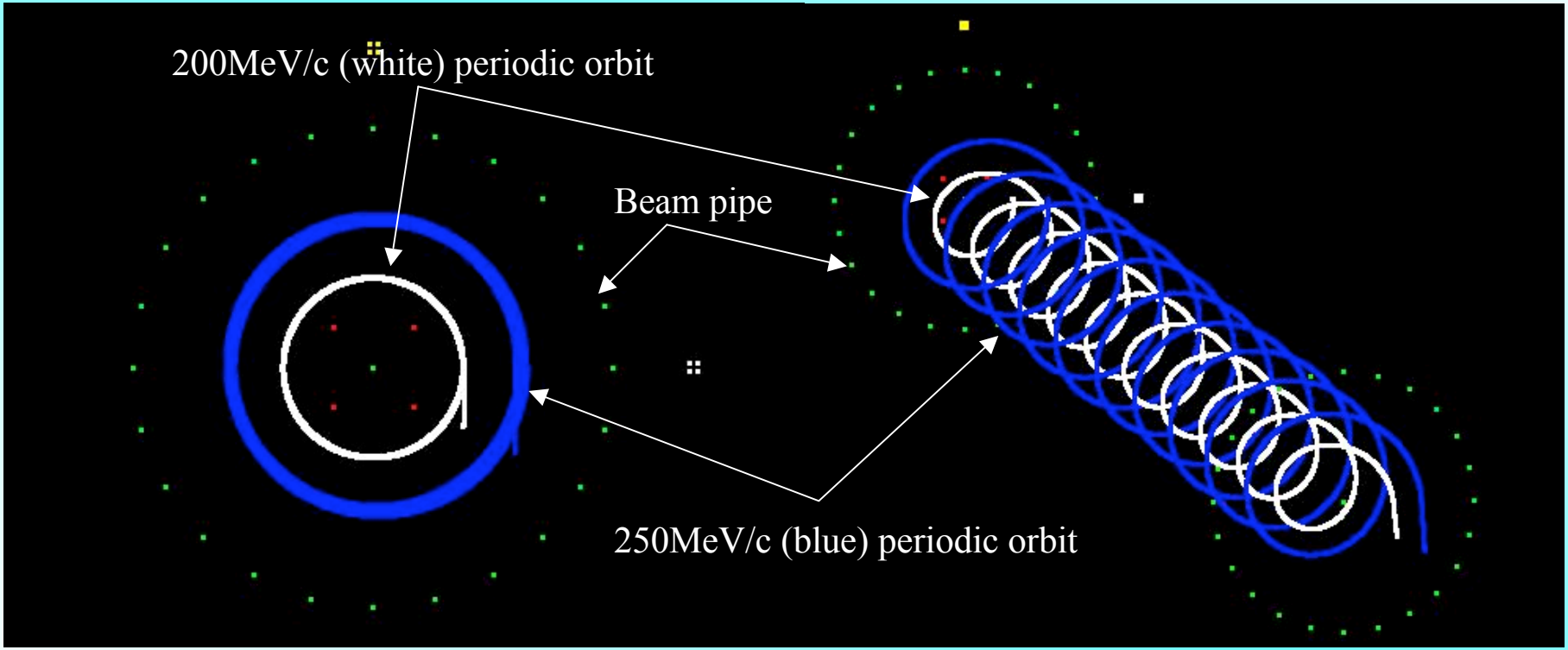
- Initial beam parameters;
  - Momentum: 100 MeV/c.
  - Relative momentum spread: ± 7.5 %
  - Beam width: ± 3 cm.
- HCC parameters;
  - Length: 56 m
  - Inner diameter: 60 cm
  - Solenoid field strength: 3.5 T
  - Helix dipole strength: 1.01 T @ reference orbit
  - RF frequency: 200 MHz
  - Estimated cooling factor: ~10^6


viewer-0 (OpenInventorX)
fileMenuButton
viewMenuButton
G4BL 10 m helical cooling channel
Solenoid and Helical magnets are invisible in G4BL
Rotx
Roty
Zoom
beard@muon2:
beard@muon2:
emacs@muon2
Xt Comp
Wed Apr 21
21:48

G4BL End view of 200MeV HCC

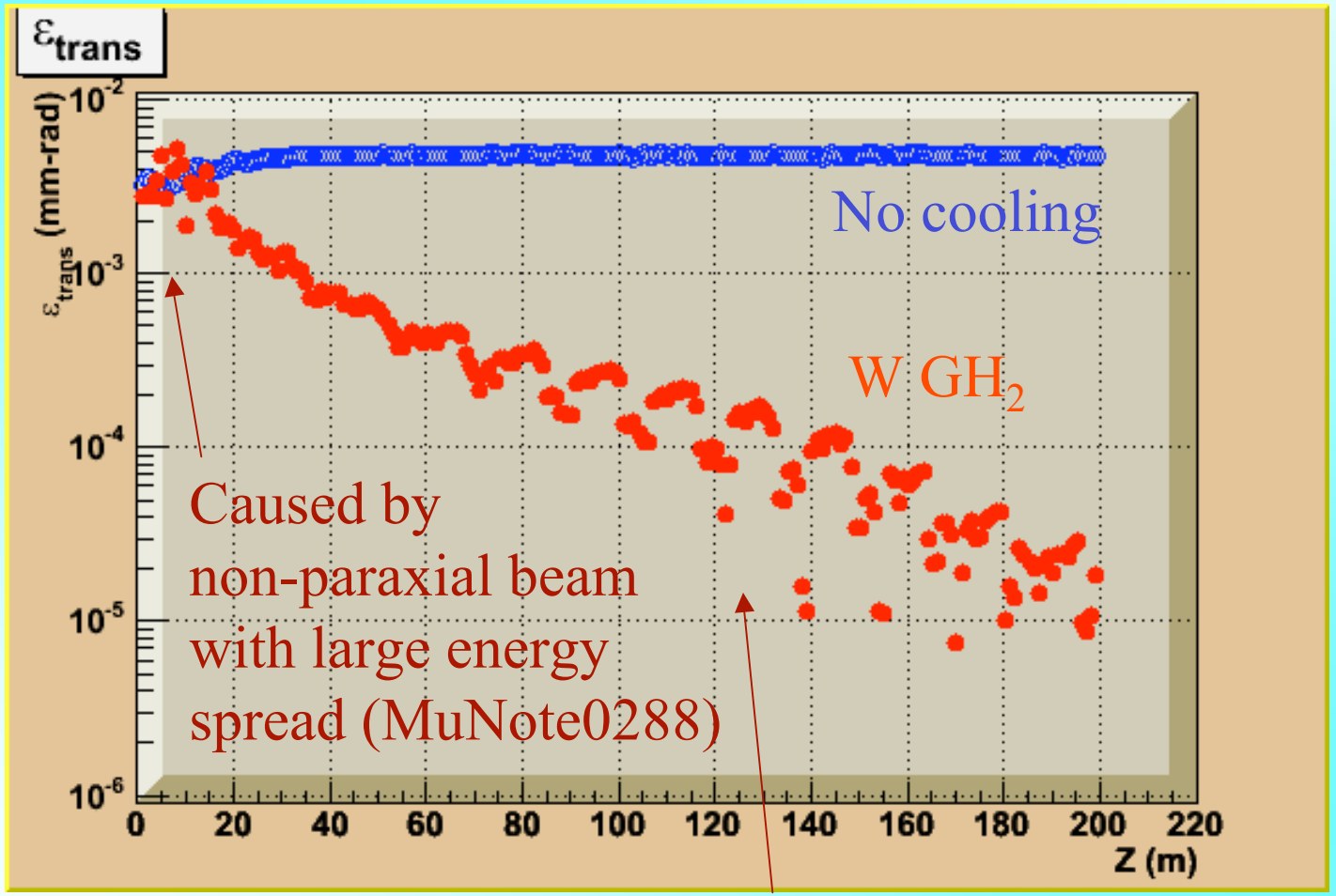


G4BL HCC Dispersion Measurement: $r_{250} = (1+0.25D)\, r_{200}$, D=2.93



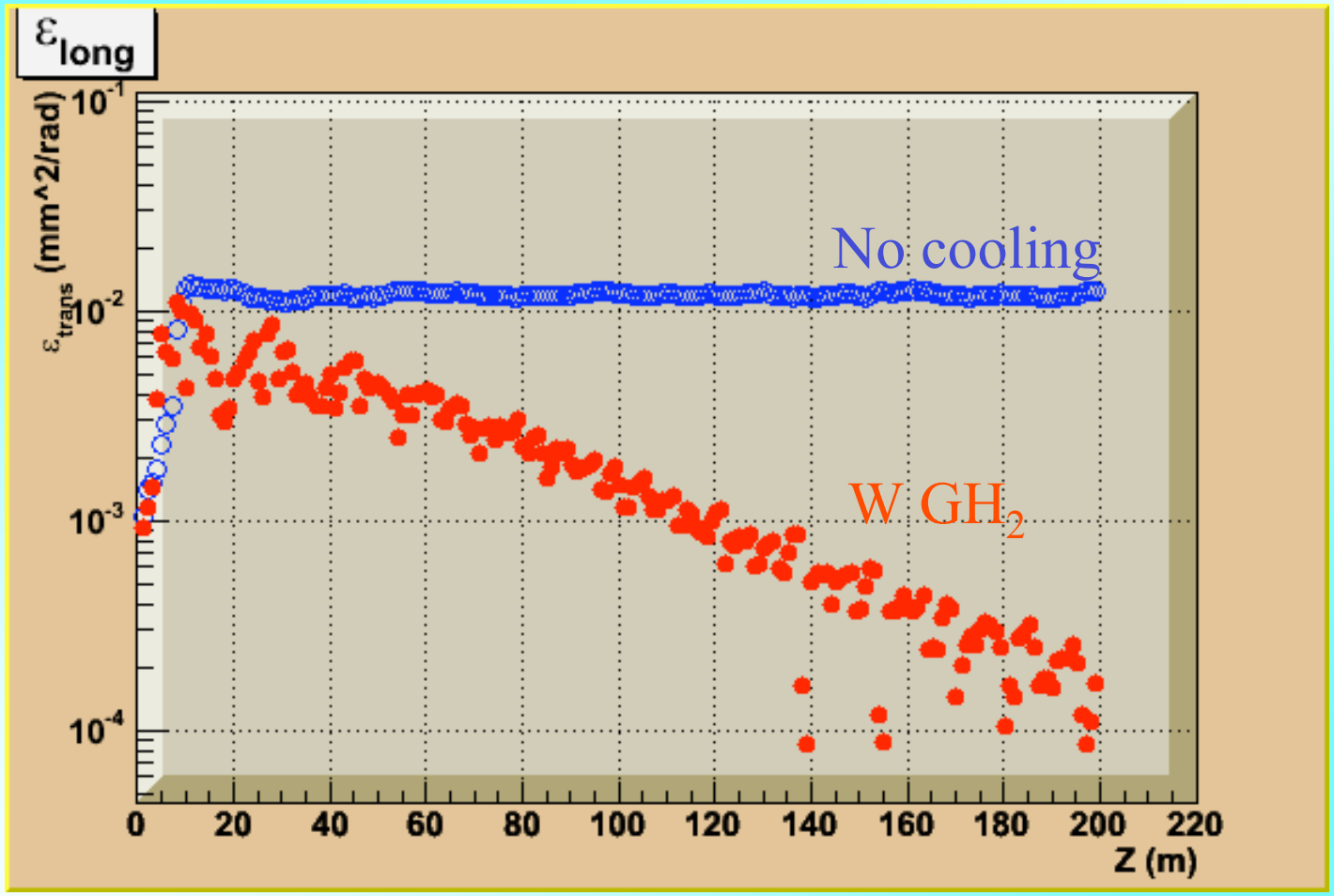
Simulation results in ICOOL

Without Stochastics



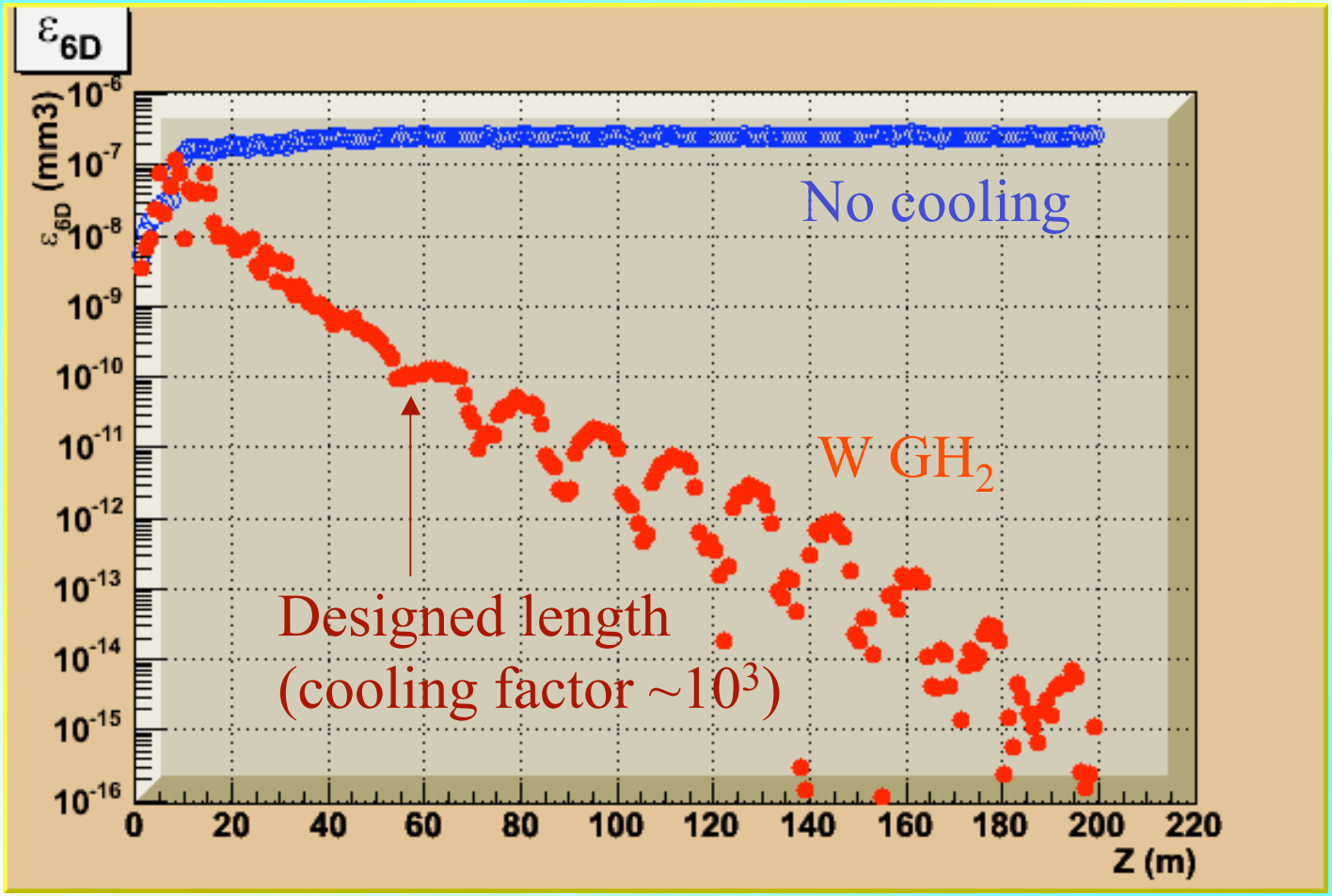
Simulation results in ICOOL

Without Stochastics



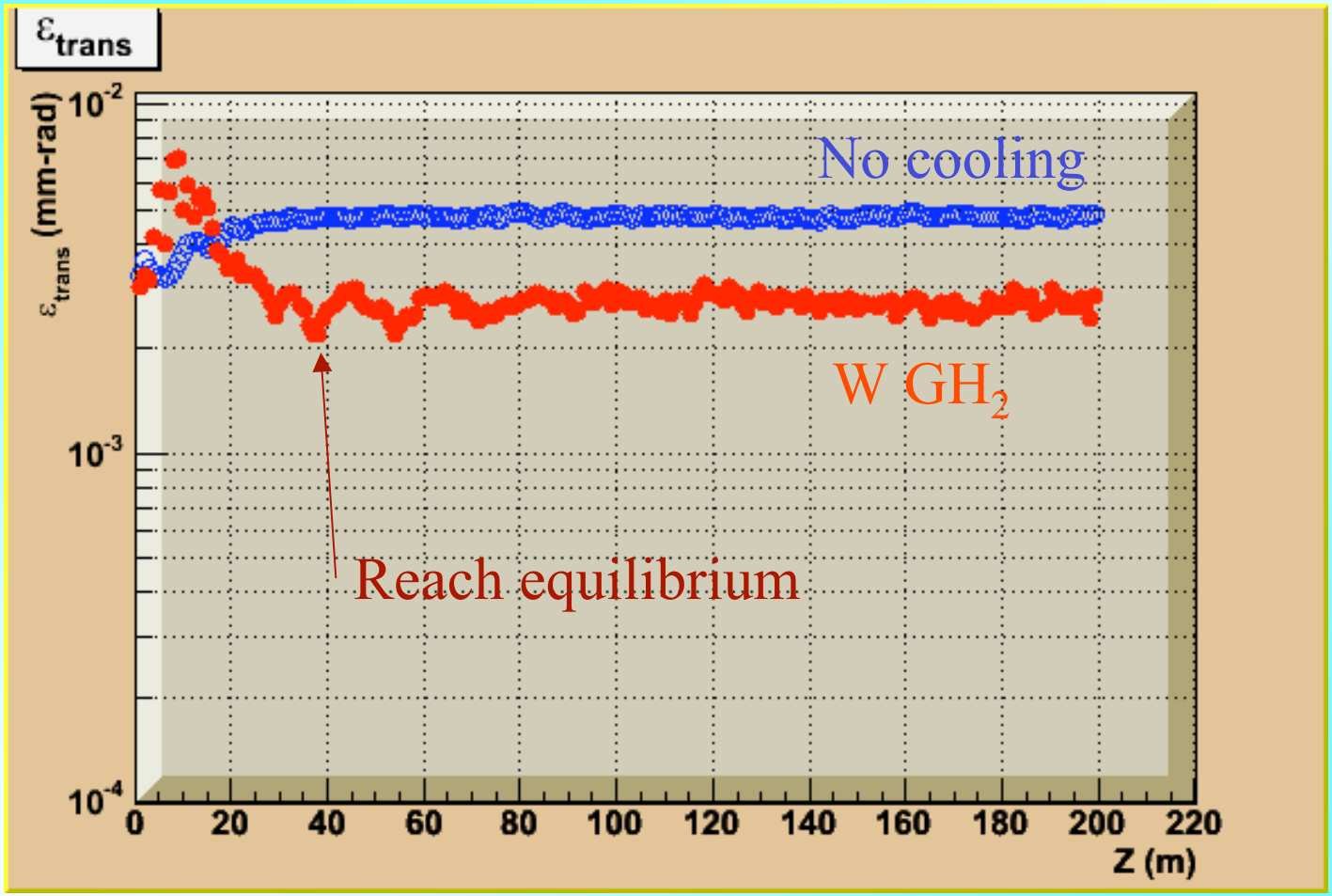
Simulation results in ICOOL

Without Stochastics



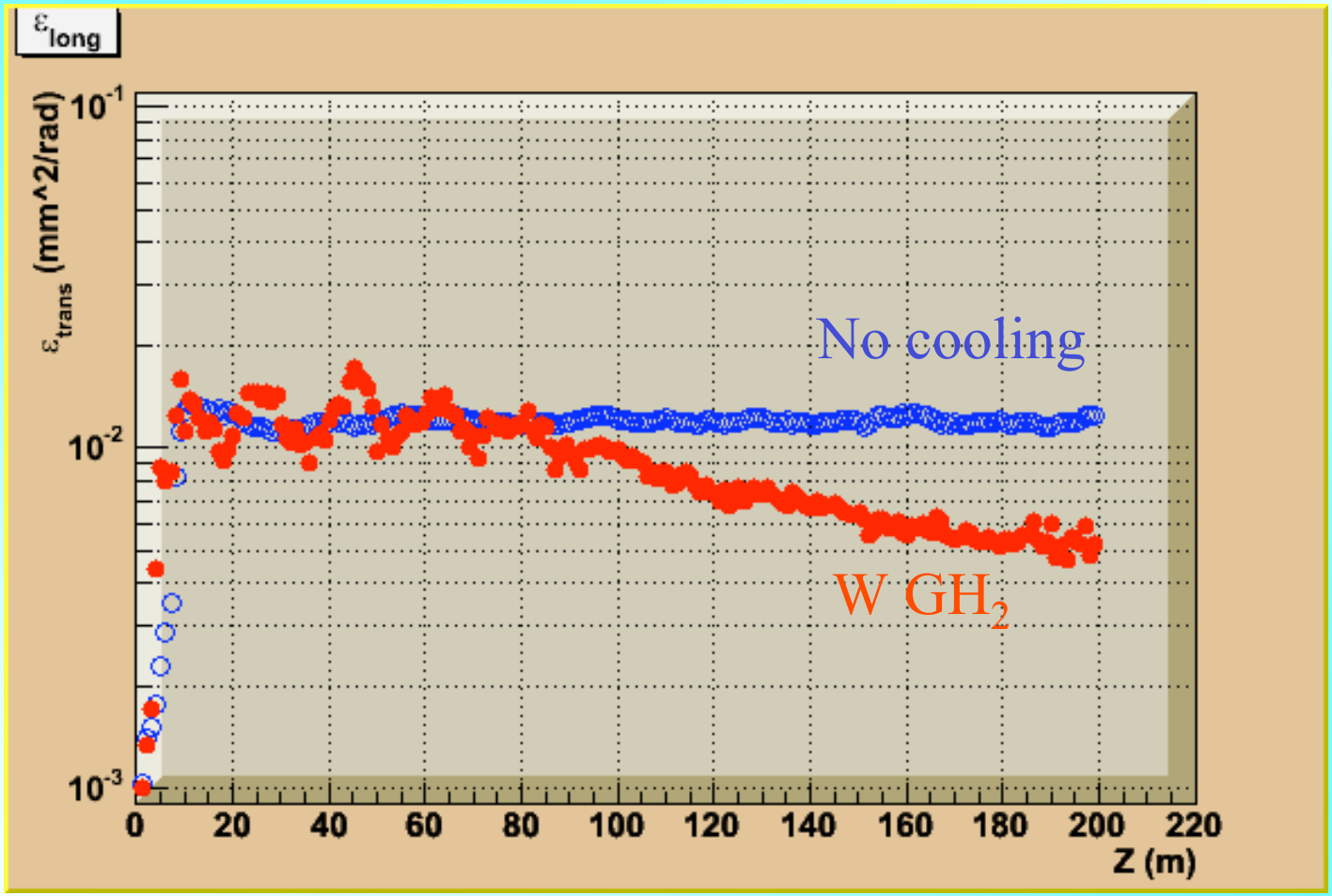
Simulation results in ICOOL

With Stochastics



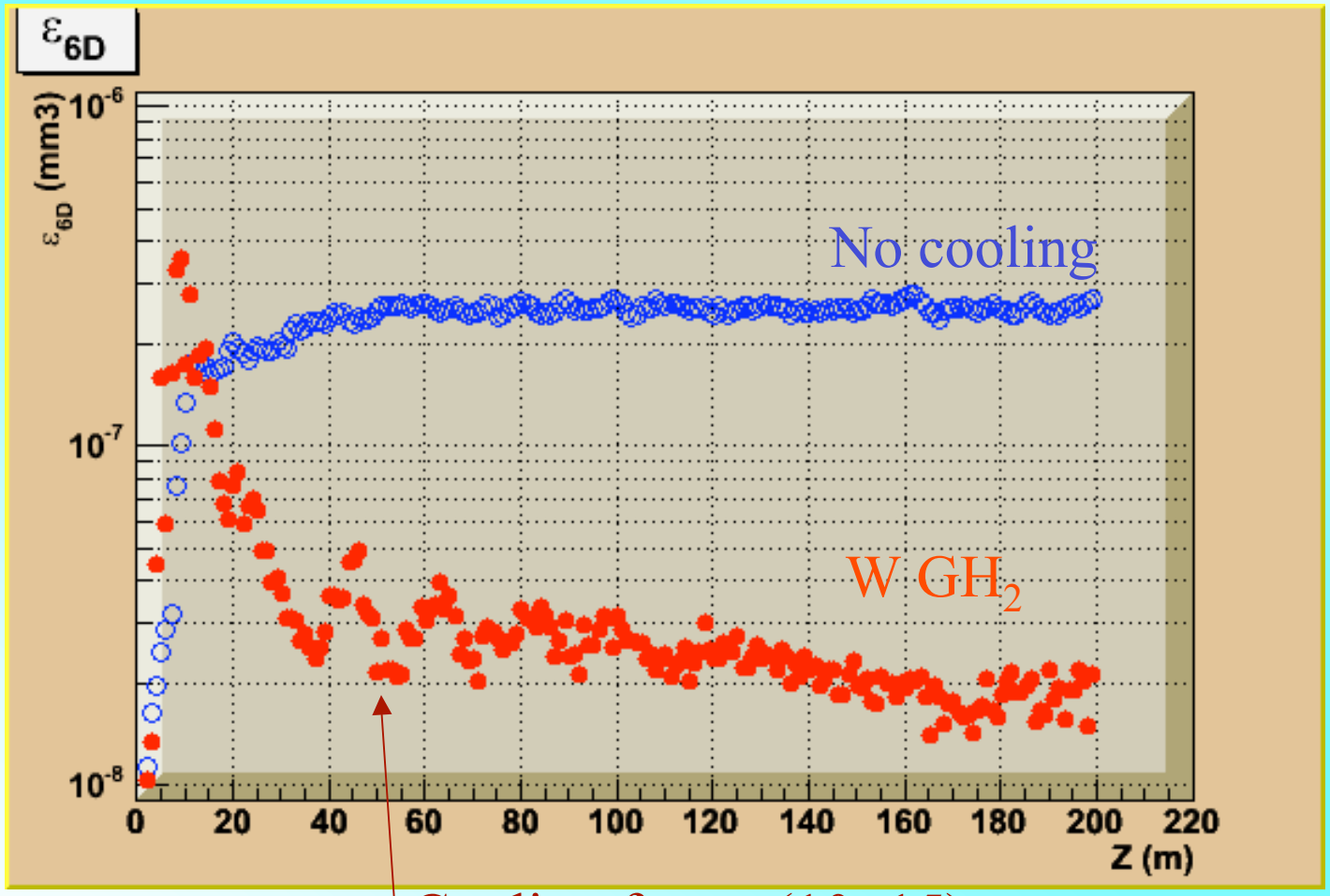
Simulation results in ICOOL

With Stochastics



Simulation results in ICOOL

With Stochastics



Summary

- Cooling effects in HCC was observed in analytical and numerical investigations.
  - Stochastics disturb the beam profile.
  - Non-paraxial beam with large energy spread makes emittance growth.
  - The RF cavity seems not to work properly.
    - The proper helix field should be found to make better transverse cooling.
    - And/Or increase beam momentum up to 200 MeV/c.
    - The proper RF cavity should be installed to make better longitudinal cooling.
- The large beam acceptance was observed in numerical investigation.
  - Beam width= ±10cm, Beam momentum spread= ±10%.
- The computer bug has to be fixed.

Go Phase II study!