# Performance and Upgrades of the Fermilab Accumulator Stacktail Stochastic Cooling

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## Theory of Stochastic Stacking

van der Meer solution:

Desire Constant Flux: $\frac{\partial \psi}{dt} = \text{constant}$

Solution: $\frac{\partial \psi}{\partial E} = \frac{\psi}{E_d}$, where $E_d$ characteristic of design $\psi = \psi_0 \exp \frac{E - E_i}{E_d}$

Exponential Density Distribution generated by Exponential Gain Distribution

with theoretical Maximum Flux: $\frac{W|\eta|E_d}{f_0 p \ln \frac{F_{max}}{F_{min}}}$

W bandwidth, $F_{max}$ and $F_{min}$ frequency range

$f_0$ beam revolution frequency, p beam momentum

$\eta$ phase slip factor

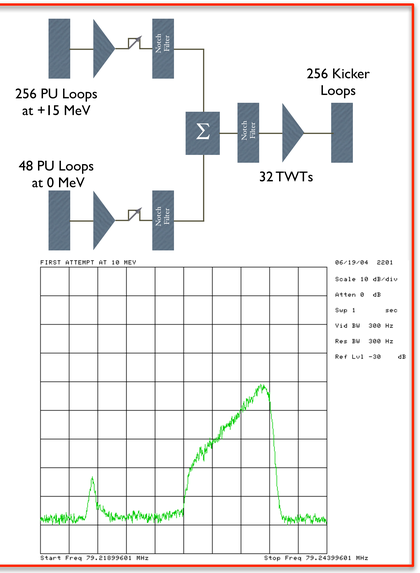
$E_d$ characteristic gain slope

Abstract:
We report on the performance and planned upgrades to the Fermilab Accumulator Stacktail Stochastic Cooling System. The current system has achieved a maximum flux of 16.5 mA/hour, limited by the input flux of antiprotons. The upgrades are designed to handle flux in excess of 40 mA/hour.

## Current System

Pickups located in region of 10 m dispersion
use pickup response relative gain & phase to build gain slope
2-4 GHz sensitivity

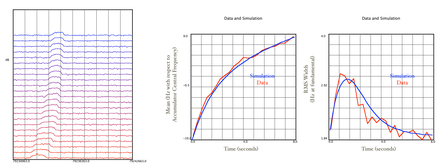
1.2 GHz bandwidth
10 MeV gain slope
Support ~29.5 mA/hr
Best Hour: 16.5 mA/hr



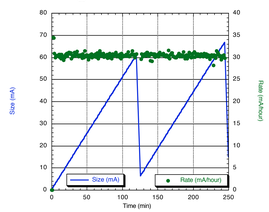

## Simulation Results:

Numerical Integration of Fokker-Planck Equation
including feedback
Model Pickups, Electronics, Kickers over bandwidth

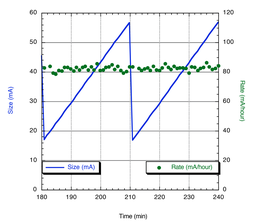
Compared to Single Pulse Evolution in Accumulator




Stage 1: Tank Move




Stage 2: Bandwidth Upgrade



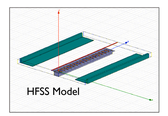

Upgrade Design: factor of 2 design margin

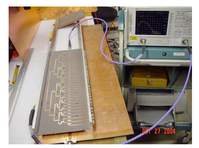
Recycler now the final repository for antiprotons

Stage 1: adjust tank positions, gains, and phases to achieve gain slope of 18 MeV maximum flux ~55 mA/hour

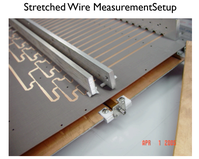
Stage 2: replace 1/2 of pickups and kickers with 4-6 GHz sensitivity maximum flux ~80 mA/hour

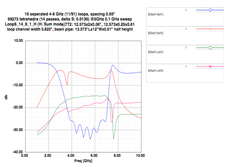
## Detailed Simulations of Pickup Response Measurements with Stretched Wires

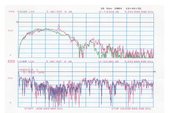


Stretched Wire MeasurementSetup







Prototype tank being prepared for beam measurements Fall 05