



BNL-105620-2014-TECH

BNL/SNS Technical Note No. 051;BNL-105620-2014-IR

# SNS Accumulator Ring Extraction Fast Kicker Modulator Initial Simulation

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September 1998

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USDOE Office of Science (SC)

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# **SNS Accumulator Ring Extraction Fast Kicker Modulator Initial Simulation**

BNL/SNS TECHNICAL NOTE

NO. 051

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September 25, 1998

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# **SNS Accumulator Ring Extraction Fast Kicker Modulator Initial Simulation**

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**September 25, 1998**

## **1. Introduction**

The fast kicker is used for extracting the beam, from the accumulator ring, in a single turn taking place in less than one beam revolution period of approximately 800nS, very soon after the injection stacking process is completed. The accumulated beam will have a gap of 250 nS to enable the magnetic field in the fast kicker to rise its extraction level within this gap. The fast kicker system consists of eight or more sections of ferrite core magnets. A pulse-forming network (PFN) is discharged into a single - turn ferrite core magnet by a fast ceramic thyatron, which is trigger by a ring radio frequency (rf) synchronized time trigger.

## **2. Kicker requirements**

The requirements for the SNS extraction kicker are given in the SNS Design Report. section 5.11 (WBS 1.5.9). The main parameters are:

Vert deflection angle	16.8 mrad
Gap (H × V)	11.5cm × (12.9 ~ 15.4cm)
Length of F <sub>e</sub> section	37cm ~ 44 cm

## **3. Kicker magnet initial electric parameters**

For an eight (8) section kicker magnet, the following parameters are obtained.

Kicker magnet inductance	1.1	μH
Peak current	2.8	kA
Pulse repetition rate	60	Hz
Rise time	200	nS
Pulse flattop	600	nS

Fall time	N.A.
Magnet sections	8
Re- charging time 12 ~ 14	mS

#### 4. Kicker modulator simulation

The simulation of the fast kicker modulator consists of a pulse-forming network (PFN), a switch (SW), kicker inductor ( $L_k$ ) and a resistor (R). The PFN is a equal capacitance pulse forming network which consists of twenty LC sections. The impedance of the PFN is  $6\Omega$ . The simulation parameters are following:

PFN section	20
Load inductance: $L_K$	1.10 $\mu$ H
Load resistance R	6 $\Omega$
PFN capacitance $C_0$	4.15 nF
PFN inductance $L_0$	0.15 $\mu$ H
PFN impedance $Z_0$	6 $\Omega$
Charging voltage	34 kV
Peak current	2.8 kA
Rise time	<200 nS
Pulse flattop:	700 nS

This simulation waveform of the kicker magnet current is shown in Fig 1. The vertical scale is current /100 and the horizontal scale is simulation time in  $\mu$ sec. The peak current shown is 2845 Amperes.

