SSC DETECTOR SOLENOID DESIGN NOTE #15

TITLE: Self-Inductance of 8.2-m Solenoid

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Reference: "Static & Dynamic Electricity", W. R. Smythe, page 346, problem #19, for a solenoid in air.

$$L = \frac{1}{3}\mu_0 N^2 d \left\{ \csc\alpha \left[(\tan^2\alpha - 1)E + K \right] - \tan^2\alpha \right\}$$

where : N = turns

d = solenoid diameter

c = " length

$d/c = \tan\alpha$

E, K = complete elliptic integrals of modulus $\sin\alpha$

For $d = 8.2$ m

N_{16} = number of turns (5kA design) from Berkeley report

= 5136

Length, c, (m)	N	L (H)
2	642	4.9
4	1284	14.2
8	2568	37.3
16	5136	89.1 *

* The Berkeley report gives L = 80 H.

<u>Caveat</u>: This is a NO-IRON calculation