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SDC
SOLENOIDAL DETECTOR NOTES

Luminosity Evolution at the SSC

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Abstract

A "realistic" model for the time evolution of the SSC luminosity is given. The SDC instrumentation and physics strategy should be informed by this profile.

Introduction

For many reasons, the evolution of SSC luminosity in time is important to SDC. Although we cannot predict this function with great precision, it will certainly *not* be a step-function up to the design value of 10^{33}. Also, even though the start-time for collisions in the SSC may be quite uncertain, the evolution of luminosity after that time is probably predictable. Taking these statements seriously, and also noting that SSCL has not yet produced an official expectation for the luminosity growth, the present document introduces an informed model for the interim use of the Collaboration.

The relevant time scale for this exercise is years. The key variable for physics is the integrated luminosity over time. From the point of view of trigger requirements, radiation damage and data analysis plans, both the integrated and the instantaneous luminosity are relevant. We provide a model of the instantaneous luminosity (averaged over a day or so) and integrate this function to arrive at the integral values.

Model and Results

We take as our model the turn-on behavior as anticipated by SSCL accelerator scientists at the present time[1]. This model predicts:

SSC Luminosity Growth

Time (years)	*Luminosity ($cm^{-2}sec^{-1}$)*	*Luminosity (SSC years/year)*
0	0	0
0.5	1.0×10^{31}	0.01
1.0	1.0×10^{32}	0.1
1.5	5.0×10^{32}	0.5
2.0	1.0×10^{33}	1.0
2.5	1.2×10^{33}	1.2
3.0	1.5×10^{33}	1.5
3.5	1.7×10^{33}	1.7
4.0	2.0×10^{33}	2.0
5.0	2.8×10^{33}	2.8
6.0	3.2×10^{33}	3.2
7.0	4.0×10^{33}	4.0
8.0	5.0×10^{33}	5.0
9.0	6.0×10^{33}	6.0
10.0	8.0×10^{33}	8.0
11.0	9.0×10^{33}	9.0
12.0	10.0×10^{33}	10.0

* the value taken here is assumed to be the average over a 'fill', taken as a 24-hour period.

This model for luminosity growth is shown in graphical form in Fig. 1. From this plot we can deduce several useful conclusions:

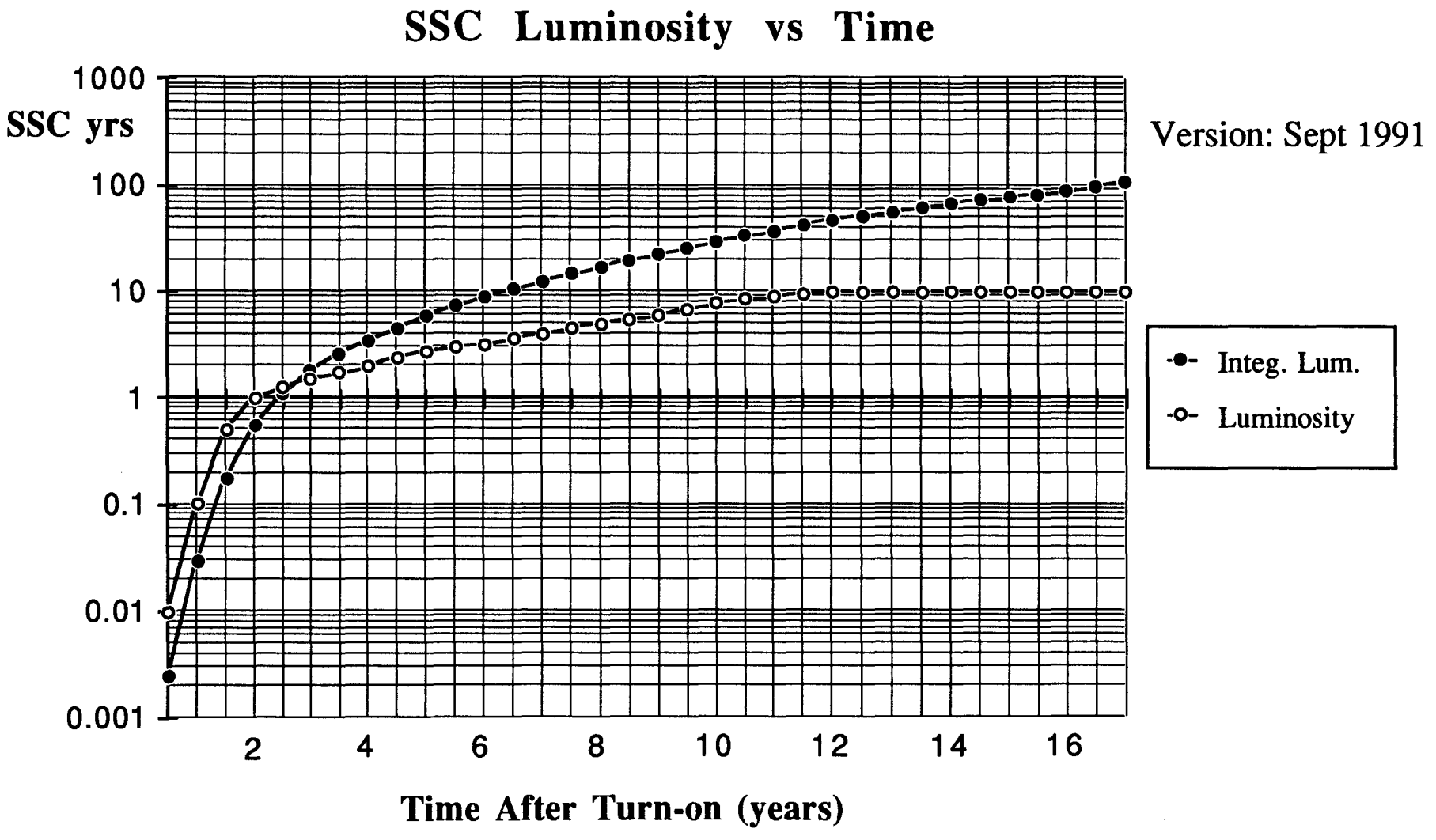
- the first 'SSC year' of integrated luminosity occurs only after 2.4 calendar years
- the fifth 'SSC year' will be achieved in less than five years of collider operation
- 100 'SSC years' will be reached after about 17 years of operation.

These conclusions assume that the luminosity of the machine will 'top out' at about 10^{34} cm^{-2} sec^{-1} *and* that the SSC Laboratory will pursue an aggressive strategy of increasing luminosity as fast as accelerator operating capabilities permit.

If, on the other hand, conditions conspire to limit luminosity at a lower value, the limits shown here could prove optimistic and the achievement of '100 years of SSC luminosity' never realized. Obviously, we should anticipate and plan for the more optimistic curve but be ready to present good physics even if a lower delivery is achieved.

References

[1] SSC, Accelerator Physics Division (private communication), July 1991.


SSC Luminosity vs Time
SSC yrs
1000
100
10
1
0.1
0.01
0.001
2
4
6
8
10
12
14
16
Time After Turn-on (years)
Version: Sept 1991
Integ. Lum.
Luminosity