APPENDIX 2

Technical Specifications of the Boomerang Storage Ring

The Australian Synchrotron is based on the Boomerang Storage Ring[1,2] which has a double bend achromat structure (Figure 1) with fourteen cells or superperiods. Each cell comprises two dipoles (D), six quadrupoles (Q) and seven sextupoles (S) separated by appropriate drift spaces. The dipoles have modest gradient fields to provide set horizontal defocussing. There are also small defocussing quadrupoles within the achromat. Each cell includes seven sextupoles that have been carefully position to maximise the dynamic aperture. The main parameters are listed in Table 1 for two operational modes of the lattice. The storage ring will be fed by a full energy booster synchrotron that in turn will be fed by a 100 MeV linac. The contract for the building has been let to Thiess and tenders for the entire injection system are being evaluated.

Table 1 Basic properties of the lattice

	$\eta = 0$	$\eta = 0.24$ m
Energy	3.0 GeV	3.0 GeV
Circumference	216 m	216 m
Harmonic Number	360	360
Number of Available Straights	12	12
Revolution Time	720.5 nsec	720.5 nsec
Revolution Frequency	1.3879 MHz	1.3879 MHz
Current	200 mA	200 mA
Betatron Tune – H	13.30	13.30
Betatron Tune – V	5.20	5.20
Momentum Compaction	1.969×10^{-3}	2.091×10^{-3}
Natural Chromaticity – H	-30.77	-28.33
Natural Chromaticity – V	-23.87	-24.47
Synchrotron Integral – 1	0.425	0.451
Synchrotron Integral – 2	0.817	0.817
Synchrotron Integral – 3	0.106	0.106
Synchrotron Integral – 4	-0.289	-0.306
Synchrotron Integral – 5	0.00132	0.000593
Damping Partition – H	1.354	1.375
Damping Partition – V	1.000	1.000
Damping Partition – E	1.646	1.625
Radiation Loss	932.2 keV	932.2 keV
Natural Energy Spread	1.021×10^{-3}	1.028×10^{-3}
Natural Emittance	15.81 nm rad	6.98 nm rad
Radiation Damping – H	3.428 msec	3.373 msec
Radiation Damping – V	4.641 msec	4.637 msec
Radiation Damping – E	2.819 msec	2.853 msec
Rms Hor. Beam Size – Straights	389 microns	340 microns
Rms Vert. Beam Size – Straight	19.7 microns	13 microns
Rms Hor Divergence	40.8 µrads	20.5 µrads
Rms Vert Divergence	8.0 µrads	5.3 µrads

1 J. W. Boldeman, The Australian Synchrotron Light Source, 8th European Particle Accelerator Conference, EPAC 2002, Paris, June 2002, page 650.

2 J. W. Boldeman and D. Einfeld, The Physics Design of the Australian Synchrotron Storage Ring – Boomerang, NIM, (2003) in press.

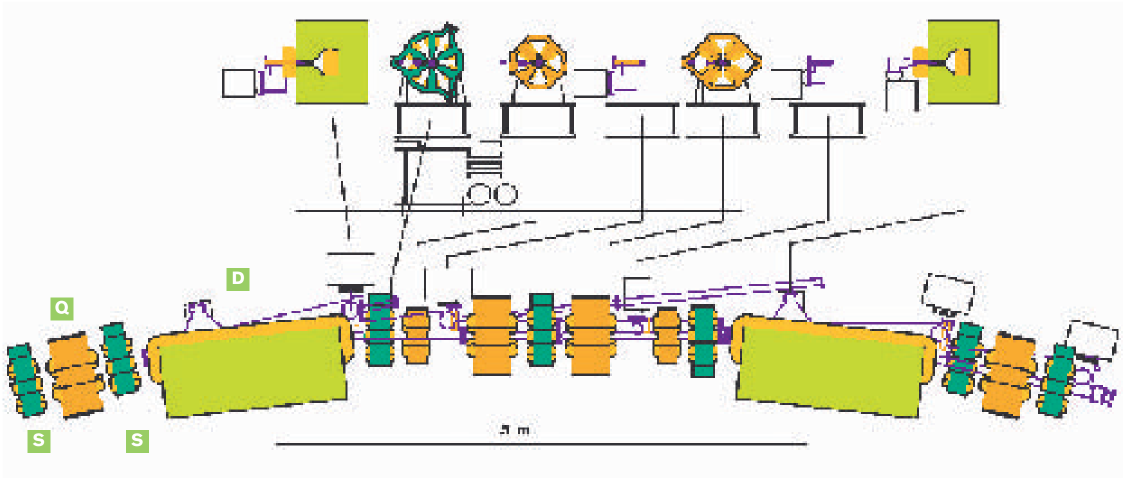

Figure 1. One superperiod of the Boomerang lattice, D – light background dipoles, Q – dark background quadrupoles and S – semi-dark background sextupoles.

Following wide scale consultation both nationally and internationally, the design objectives for the Australian Synchrotron were as follows:

- an energy of 3 GeV to provide high performance in the x-ray energy range, 100 eV to approximately 65 keV
- that it should be competitive with other third generation compact facilities under construction
- that it should have adequate beam line and experimental stations to satisfy 95% of the research requirements of an expected Australian community of 1,200 different researchers
- provide internationally competitive performance for essentially all Australian industry requirements.

It is believed that these objectives have been achieved. A key measure of the performance of this lattice is provided by either the brightness curves for undulators or flux curves for wigglers. The brightness for a 22 mm in-vacuum undulator is presented in figure 2.

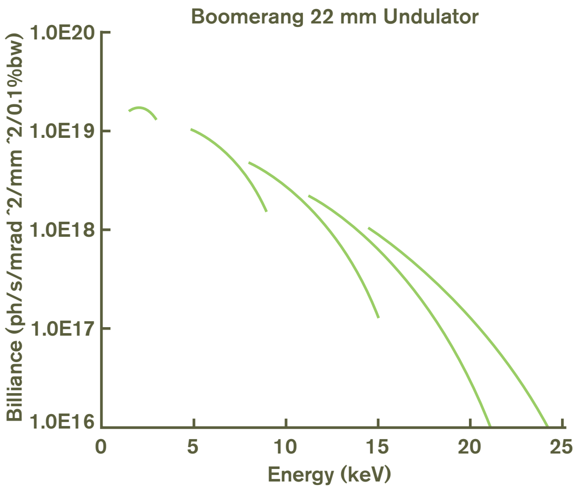

Figure 2. Brightness curves for a 22 mm period undulator in the Boomerang Storage Ring. Distributed dispersion $\eta = 0.24$ m.