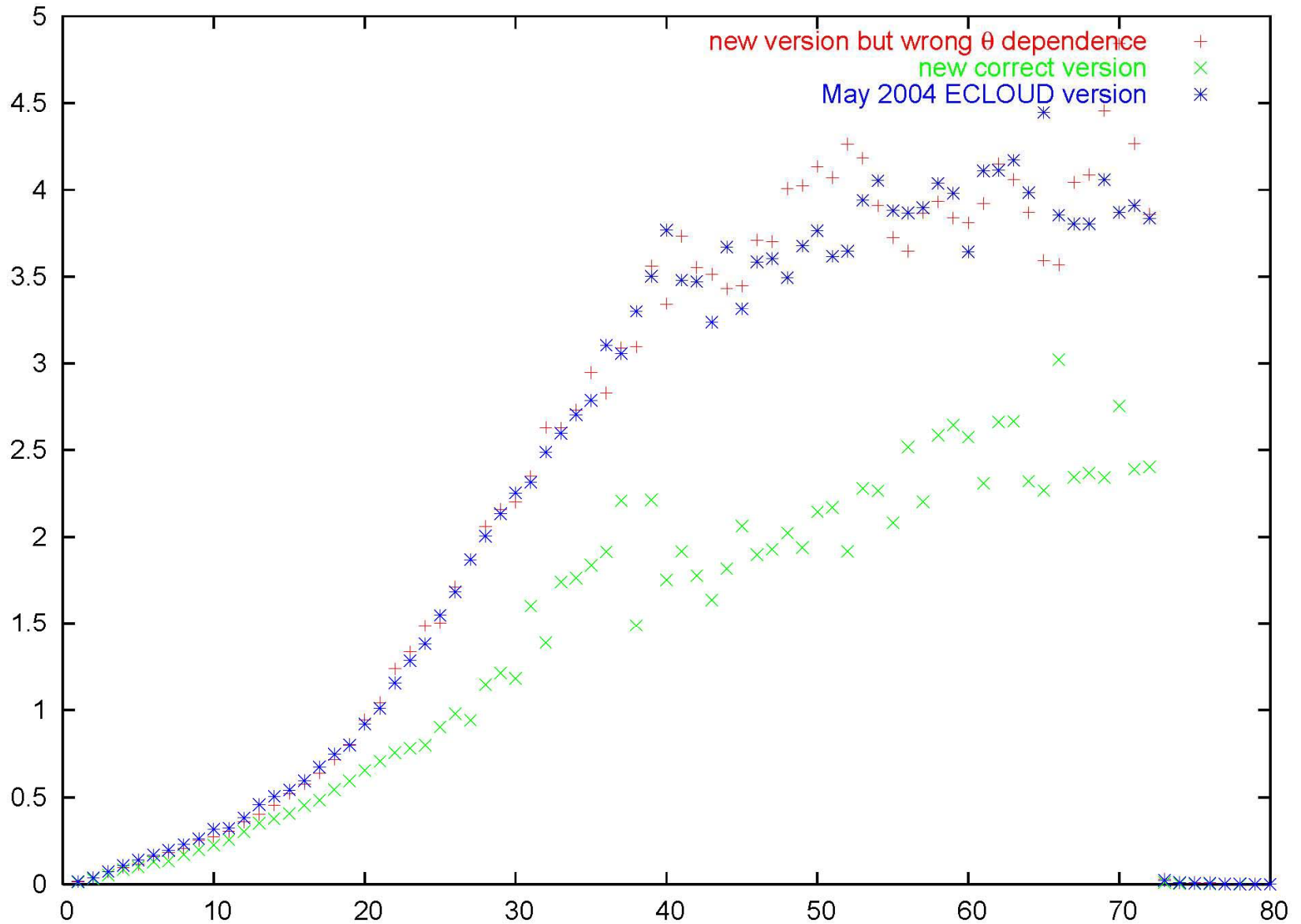


# ECLLOUD benchmarking – LHC dipole, $\delta_{\max}=1.3$ , $R=1.0$ - heat load per bunch



**heat loads & spare cooling capacities** at 4.6-20 K (for e-cloud or gas scatt.) for **nominal LHC, ultimate & two upgrade schemes**

item	symbol	nominal		ultimate	baseline upgrade	Piwinski upgrade
		injection	top energy	top energy	top energy	top energy
synchrotron radiation	$W_{sr}$	—	0.17 W/m	0.25 W/m	0.50 W/m	0.29 W/m
image currents	$W_{ic}$	0.08 W/m	0.15 W/m	0.33 W/m	1.87 W/m	0.96 W/m
static heat inleaks	$W_{st}$	0.14 W/m	0.14 W/m	0.14 W/m	0.14 W/m	0.14 W/m
net heat load	$W_1 =$	0.22 W/m	0.46 W/m	0.72 W/m	2.51 W/m	1.39 W/m
w/o e <sup>-</sup> & w/o gas scattering	$W_{sr} + W_{ic} + W_{st}$					
total cooling capacity	$P_{tot}$	2.4 W/m	2.4 W/m	2.4 W/m	2.4 W/m	2.4 W/m
residual cooling capacity for e <sup>-</sup> & gas scattering	$P_{res} = P_{tot} - W_1$	2.18 W/m	1.95 W/m	1.68 W/m	<b>-0.1 W/m</b>	1.0 W/m



baseline upgrade difficult even w/o e-cloud due to image-current heating