

**Table 1: Mesh Convergence Results — Boulder BLIR3 ( $d_{eq} = 10.0$  cm, RTX 5090)**

$dp$ [m]	$N_{part}$	Part. in $d_{min}$	Displ. [m]	$\Delta\%$	Rot. [deg]	$F_{SPH}$ [N]	$F_{cont}$ [N]	Time [min]	Status
0.020	209K	2	3.495	—	95.8	166.4	2254	13.2	UNDER-RES.
0.015	496K	3	3.433	1.8%	97.2	77.0	4915	11.7	UNDER-RES.
0.010	1.7M	4	3.069	10.6%	60.3	45.3	131	23.7	MARGINAL
0.008	3.3M	5	2.408	21.5%	87.2	34.9	3229	30.3	MARGINAL
0.005	13.4M	8	1.725	28.4%	86.8	23.0	3083	117.8	TRANSITIONAL
0.004	26.1M	10	1.615	6.4%	84.8	22.8	359	260.1	ADEQUATE