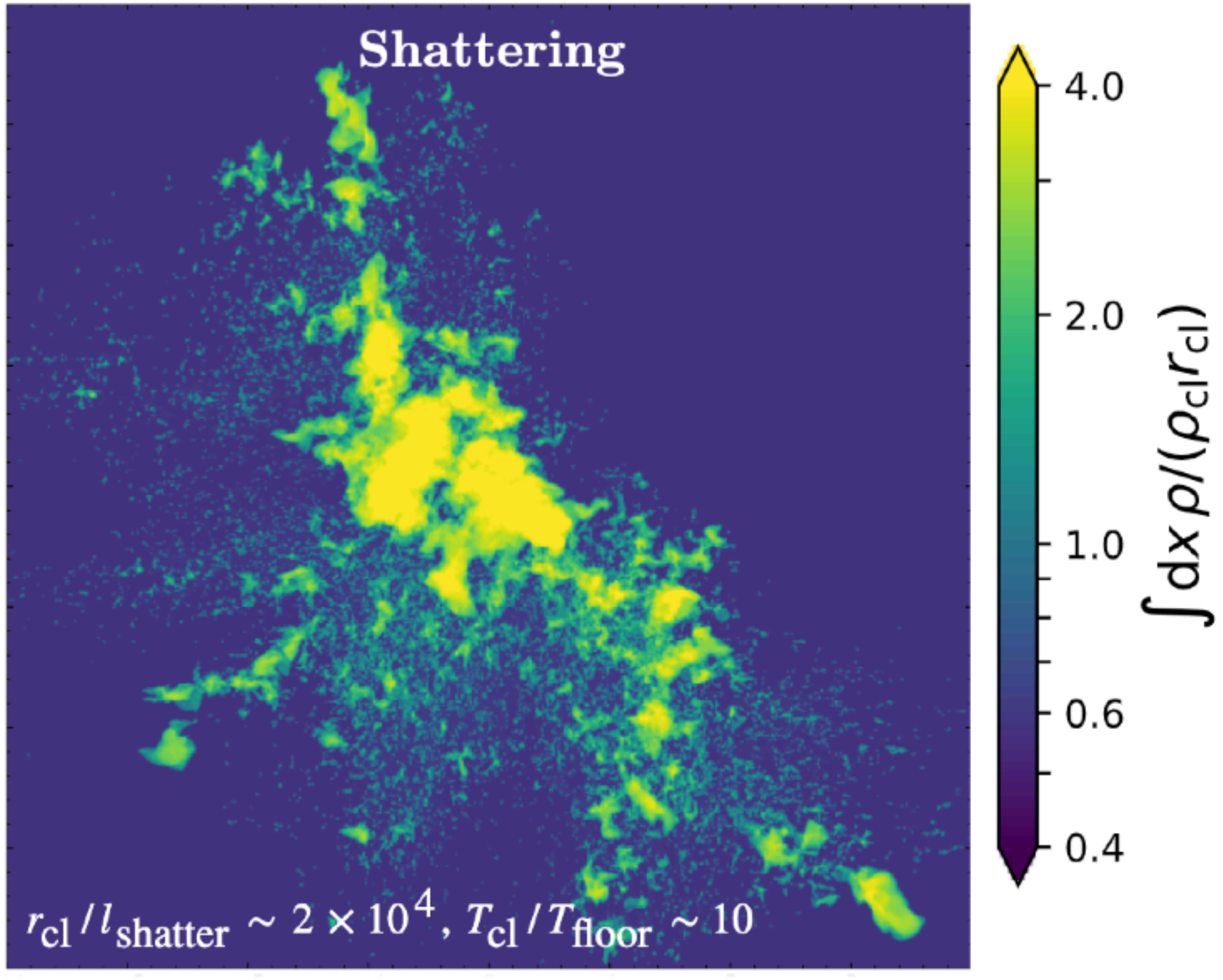
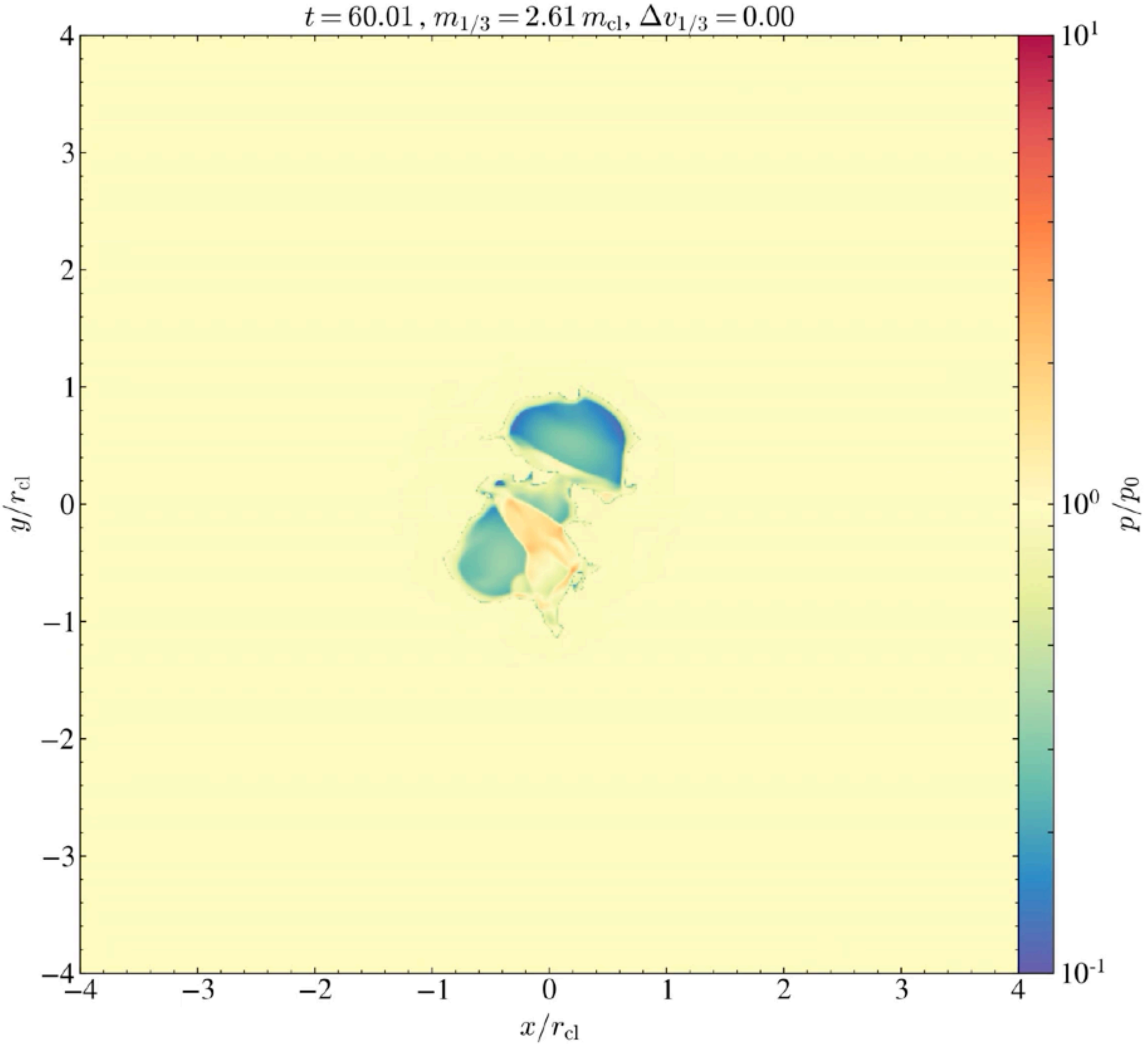
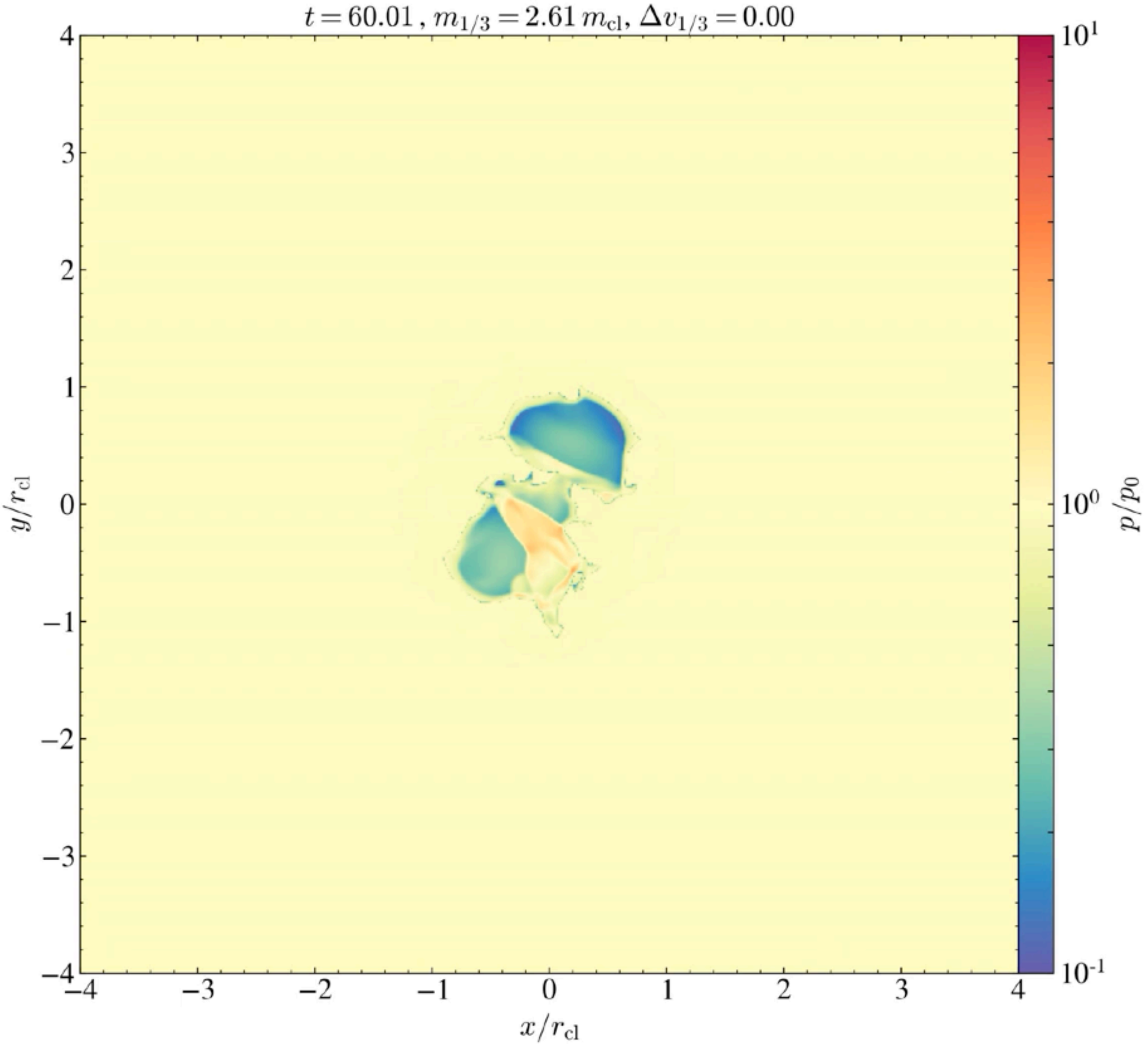
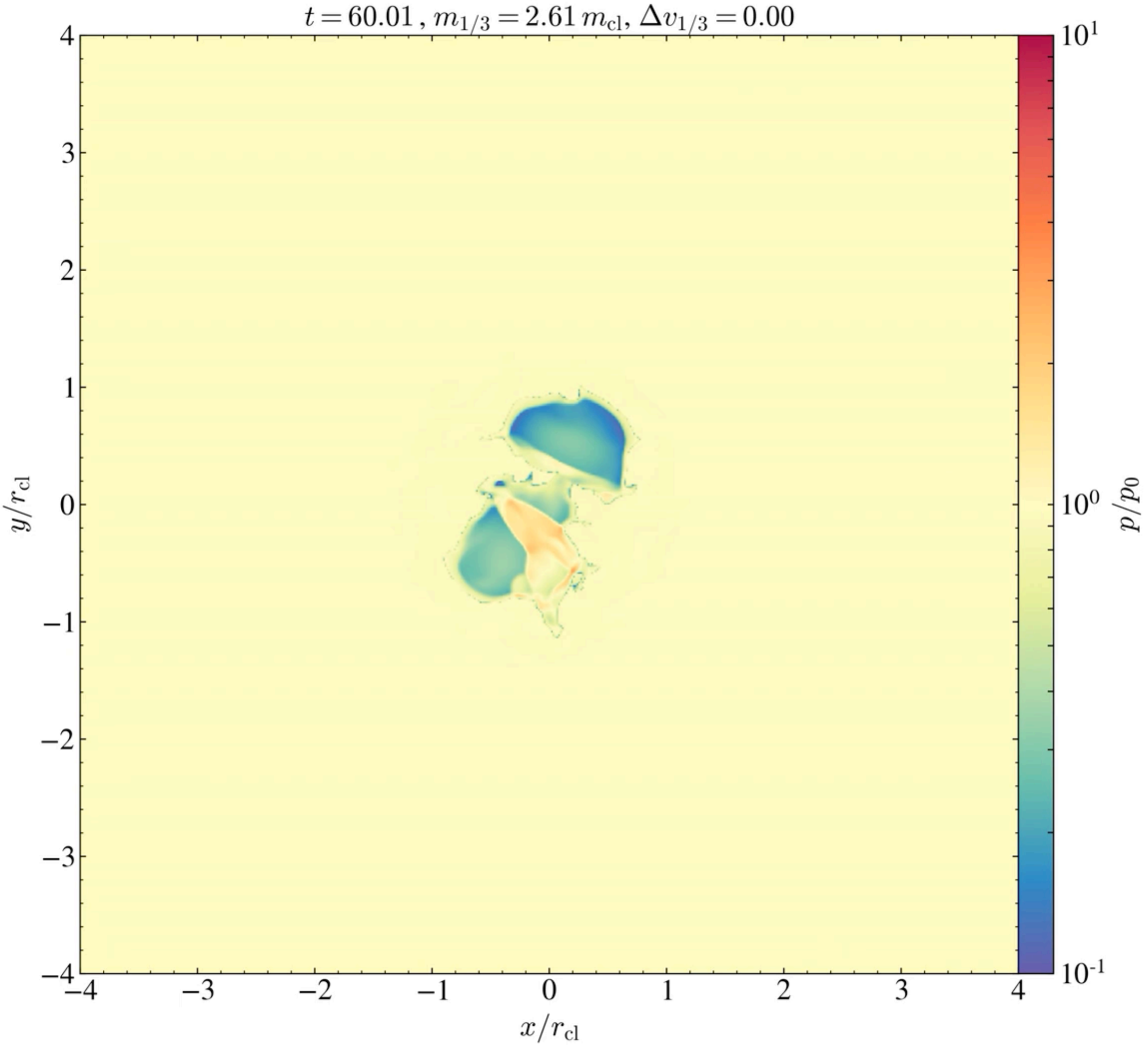
supersonic cooling


Shattering
$r_{\rm cl}\,/\,l_{\rm shatter} \sim 2\times10^4$, $T_{\rm cl}\,/\,T_{\rm floor} \sim 10$
4.0
2.0
1.0
0.6
0.4
$\int dx\,\rho/(\rho_{\rm cl} r_{\rm cl})$


$t = 60.01\,,\ m_{1/3} = 2.61\,m_{\rm cl},\ \Delta v_{1/3} = 0.00$
$y/r_{\rm cl}$
$x/r_{\rm cl}$
p/p_0
10^1
10^0
10^{-1}
4
3
2
1
0
−1
−2
−3
−4

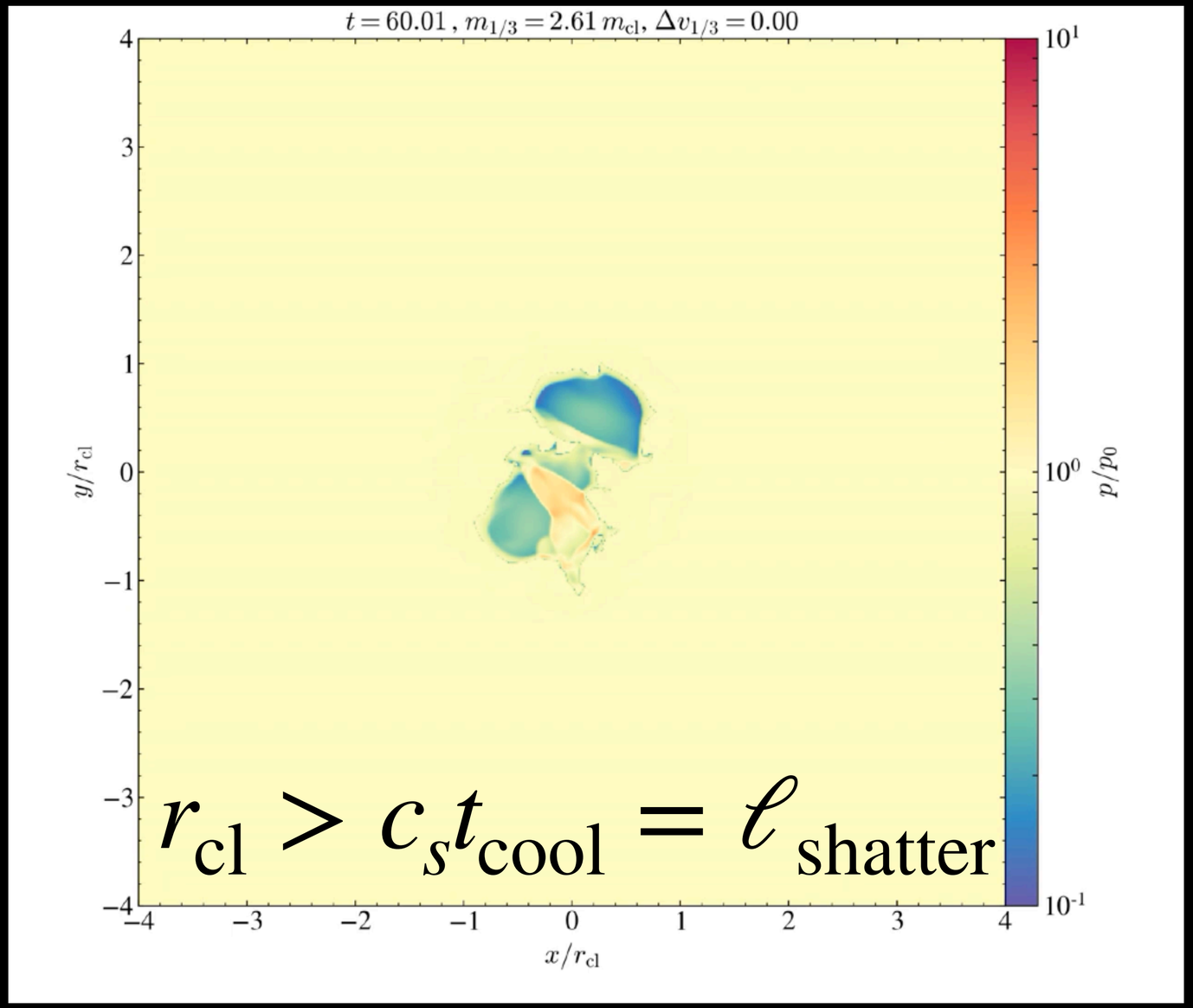
$$r_{\rm cl} > c_s t_{\rm cool} = \ell_{\rm shatter}$$

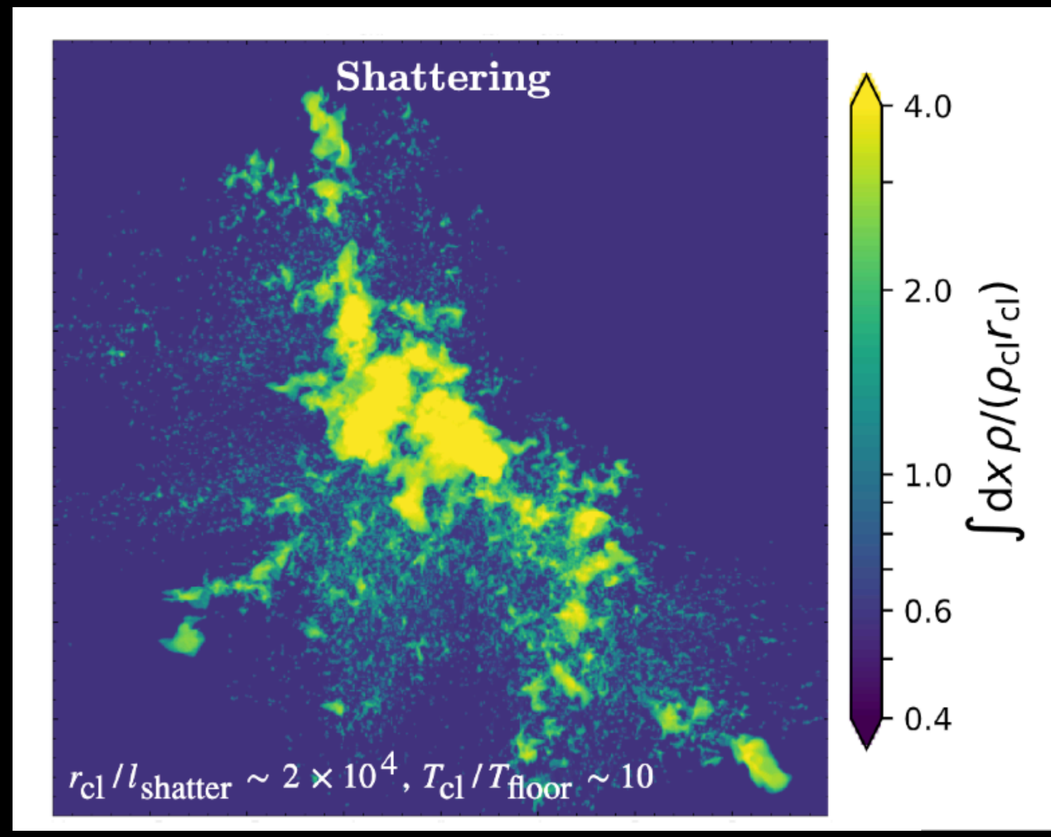

$t = 60.01\,,\ m_{1/3} = 2.61\,m_{\rm cl},\ \Delta v_{1/3} = 0.00$
$y/r_{\rm cl}$
$x/r_{\rm cl}$
p/p_0
10^1
10^0
10^{-1}
4
3
2
1
0
−1
−2
−3
−4


$t = 60.01\,,\, m_{1/3} = 2.61\,m_{\rm cl},\, \Delta v_{1/3} = 0.00$
$y/r_{\rm cl}$
$x/r_{\rm cl}$
p/p_0
10^1
10^0
10^{-1}
4
3
2
1
0
−1
−2
−3
−4
−4
−3
−2
−1
0
1
2
3
4

out of pressure equilibrium

supersonic cooling

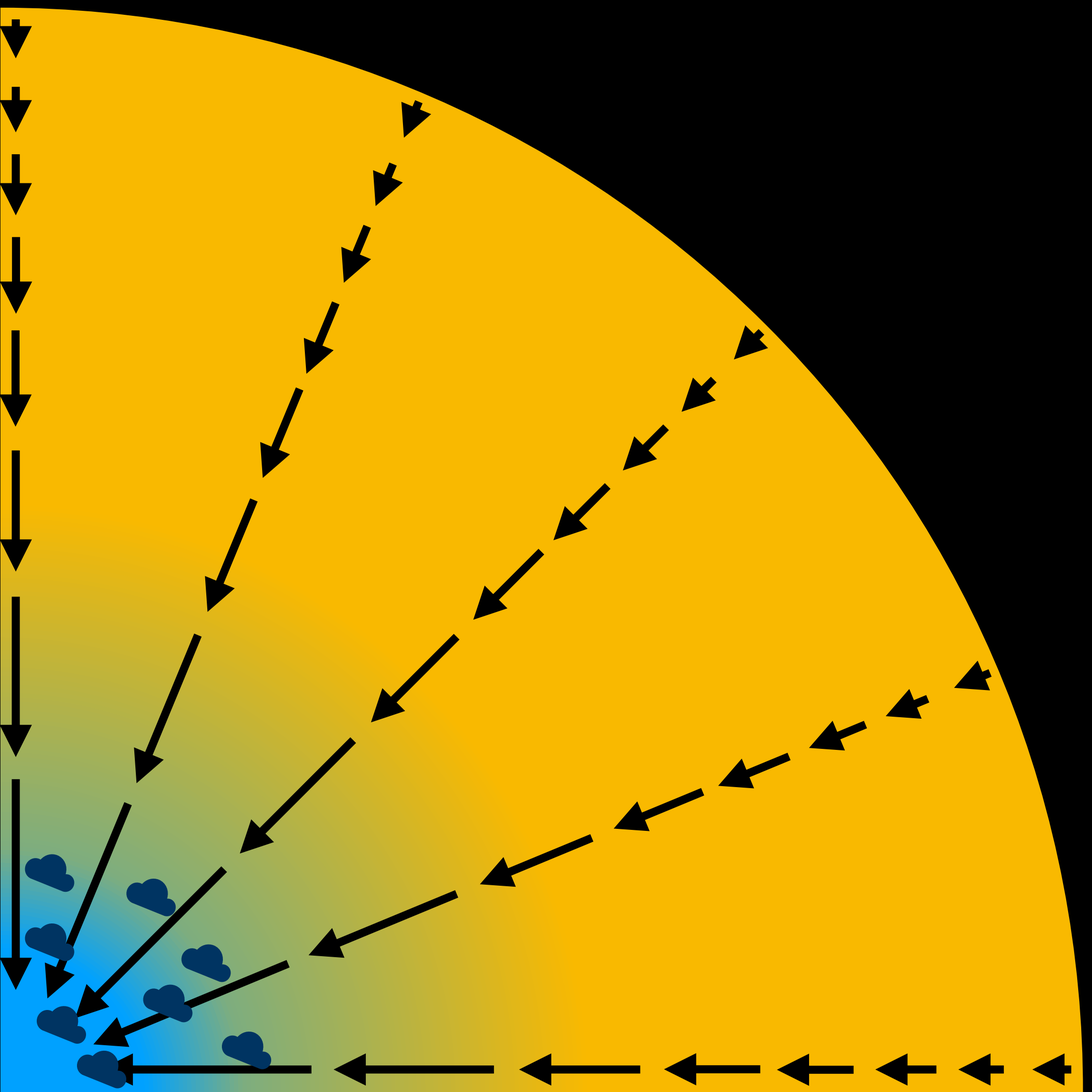




Max Gronke+ 20b

out of pressure equilibrium

supersonic cooling flow



moving too fast

+

cooling too fast

since $\frac{t_{\rm cool}}{t_{\rm flow}} = 1$

and $\mathscr{M} > 1$