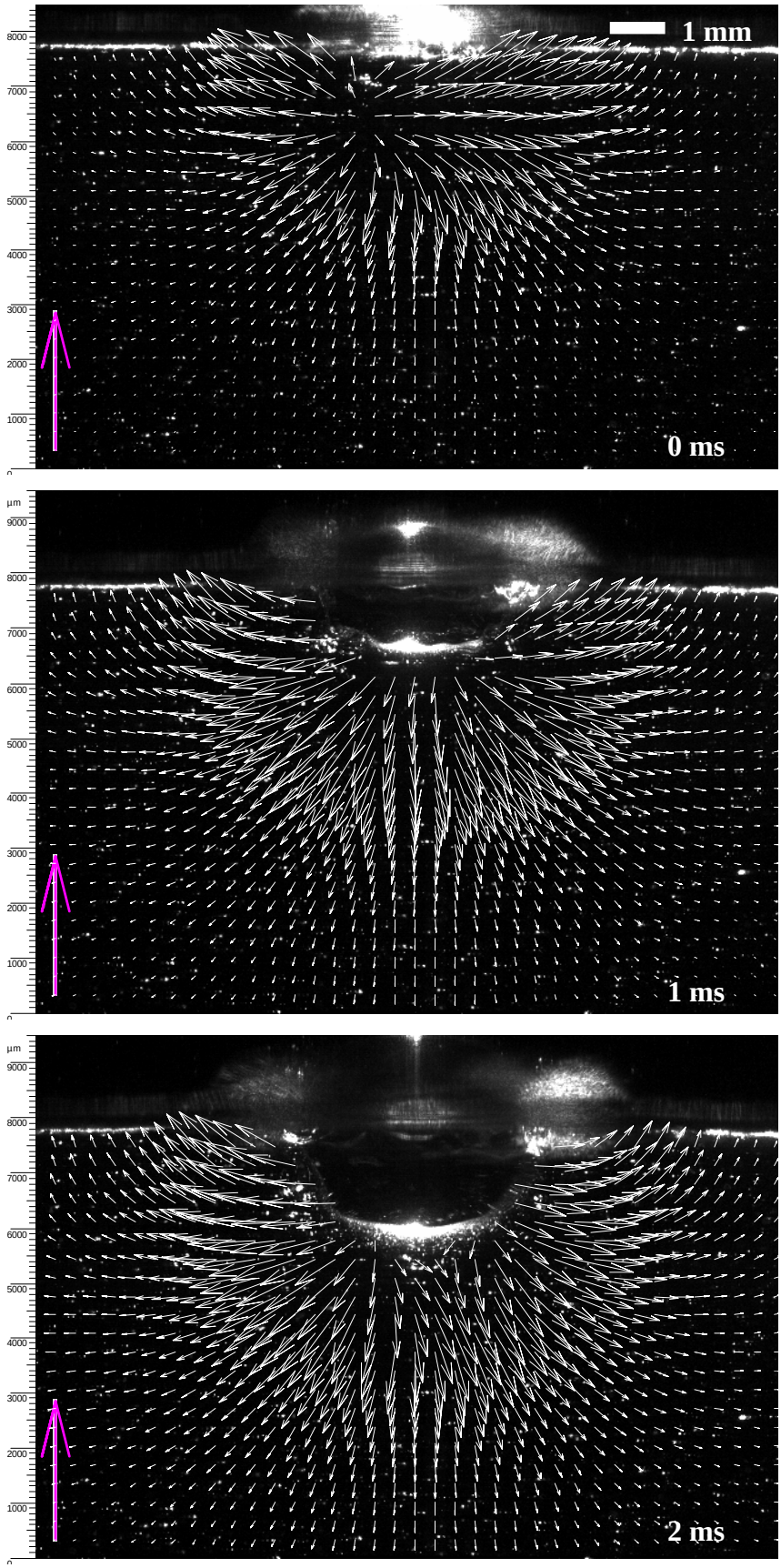
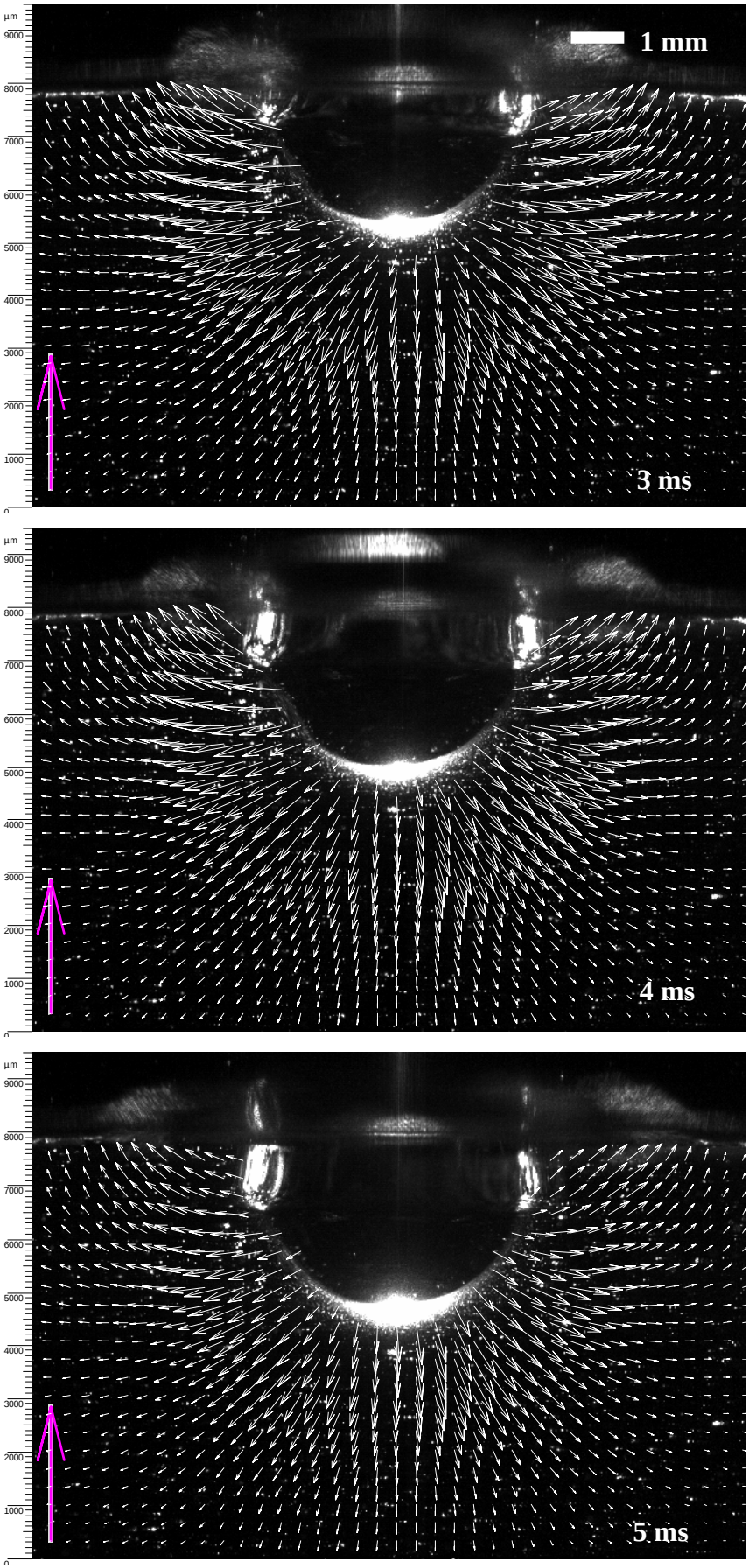
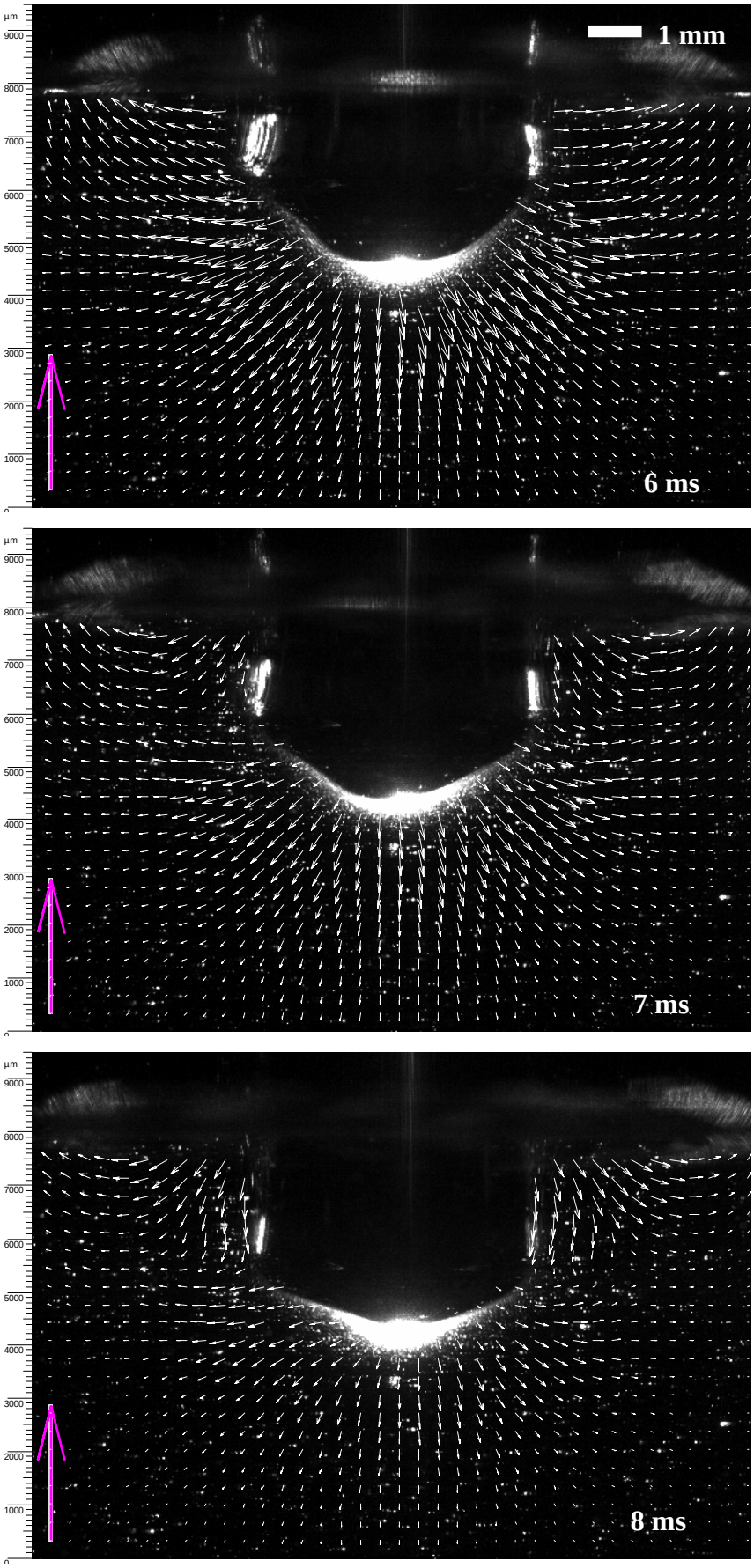
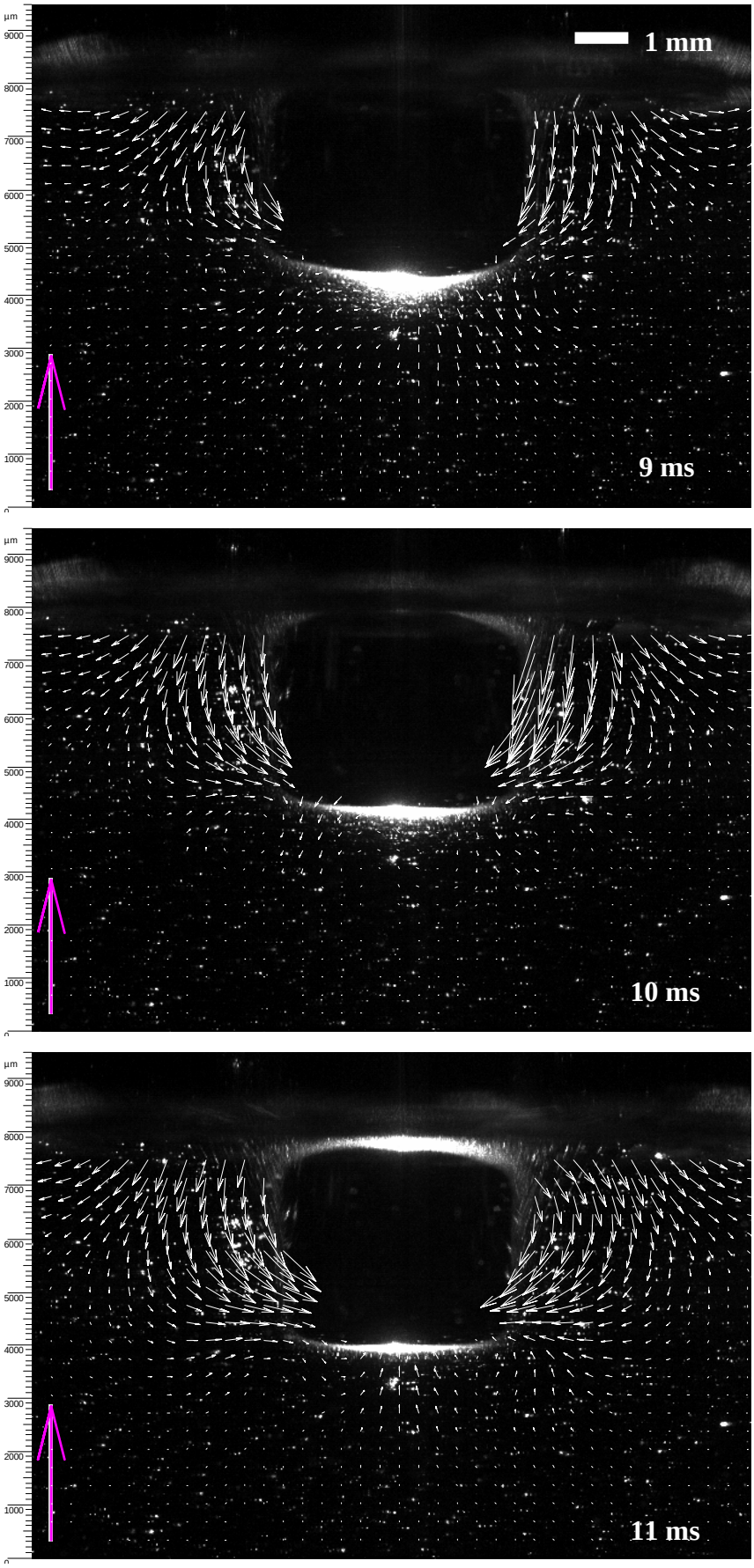
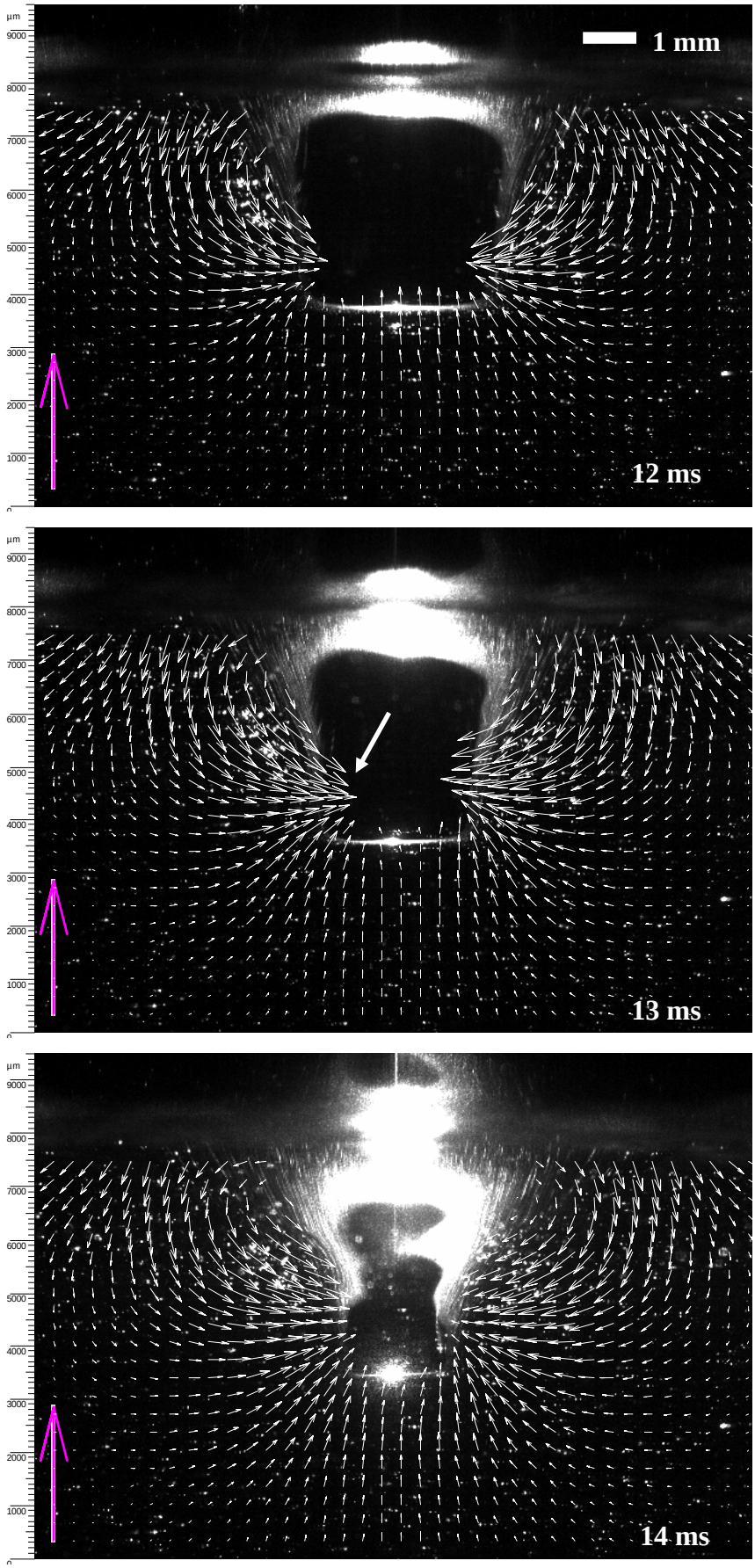
4.2.3 PIV Impact III (Fr = 297, We = 170, Re = 4509, t_c = 0.84)




µm
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1 mm
3 ms
4 ms
5 ms


1 mm
6 ms
7 ms
8 ms


µm
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1 mm
9 ms
10 ms
11 ms


µm
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1 mm
12 ms
13 ms
14 ms

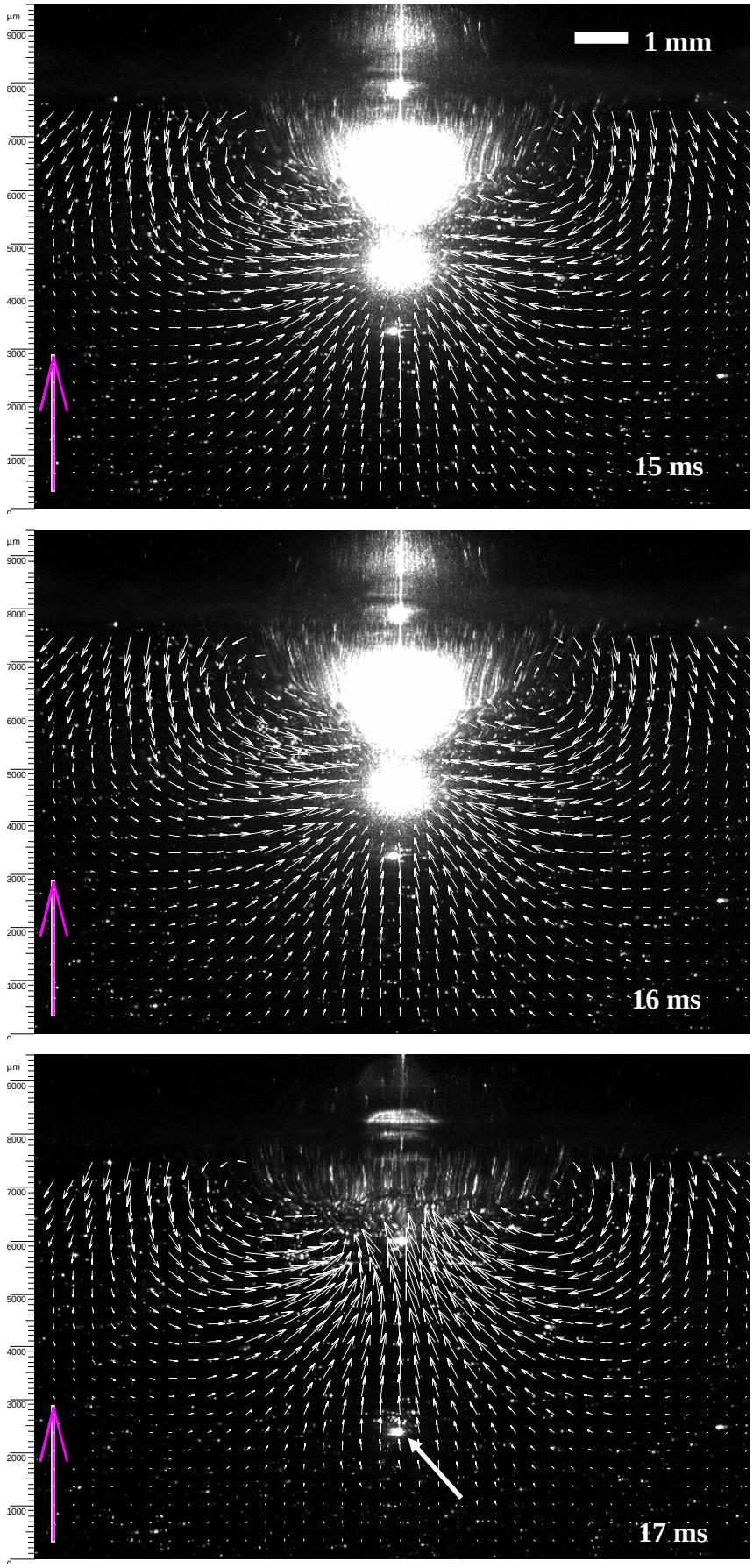


Figure 4.6 Image sequence of impact PIV-III showing velocity vectors (Reference vector 0.5 m/s) (Fr = 297, We = 170, Re = 4509, t_c = 0.84)

Impact III is an example of the PIV results from the upper end of the primary bubble entrapment regime. In this image sequence the flow field again shares many traits from the previous impacts. There is initially a strong upward velocity component near the free surface before the direction of the flow field near the surface changes directions to be pointing downward. However, in this case the vortex that is controlling the collapse drives the converging fluid toward the centreline of the cavity such that it is almost parallel to the free surface (13 ms image). This has the effect of pushing the cavity walls inward and the base of the cavity downward until a buble is pinched off. However, the bulk of the fluid movement is upwards. The entrapped bubble can be seen in the 16 ms frame as the cavity retracts. The vortex that drives the cavity collapse is more clearly shown in Figure 4.7.

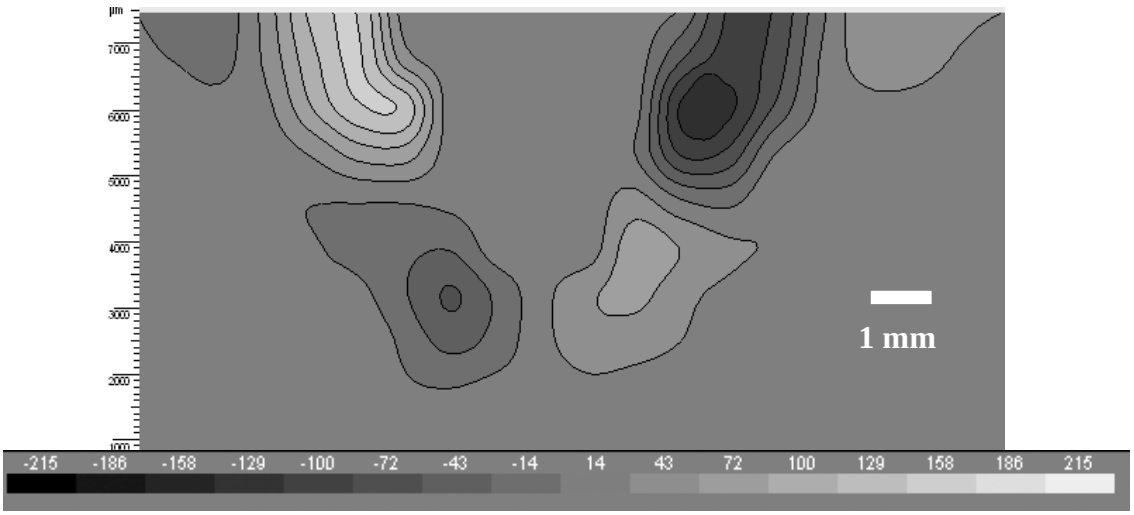
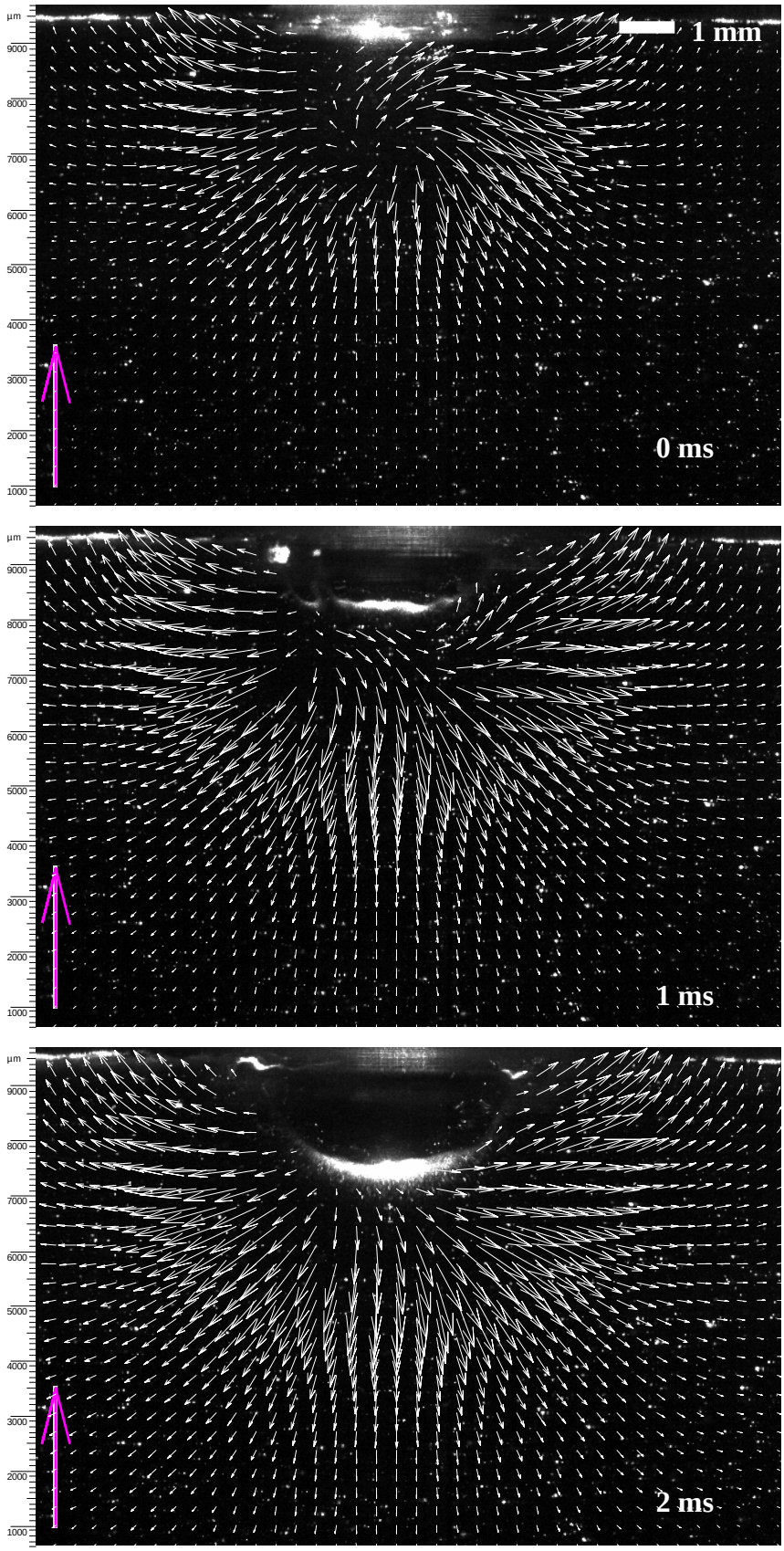
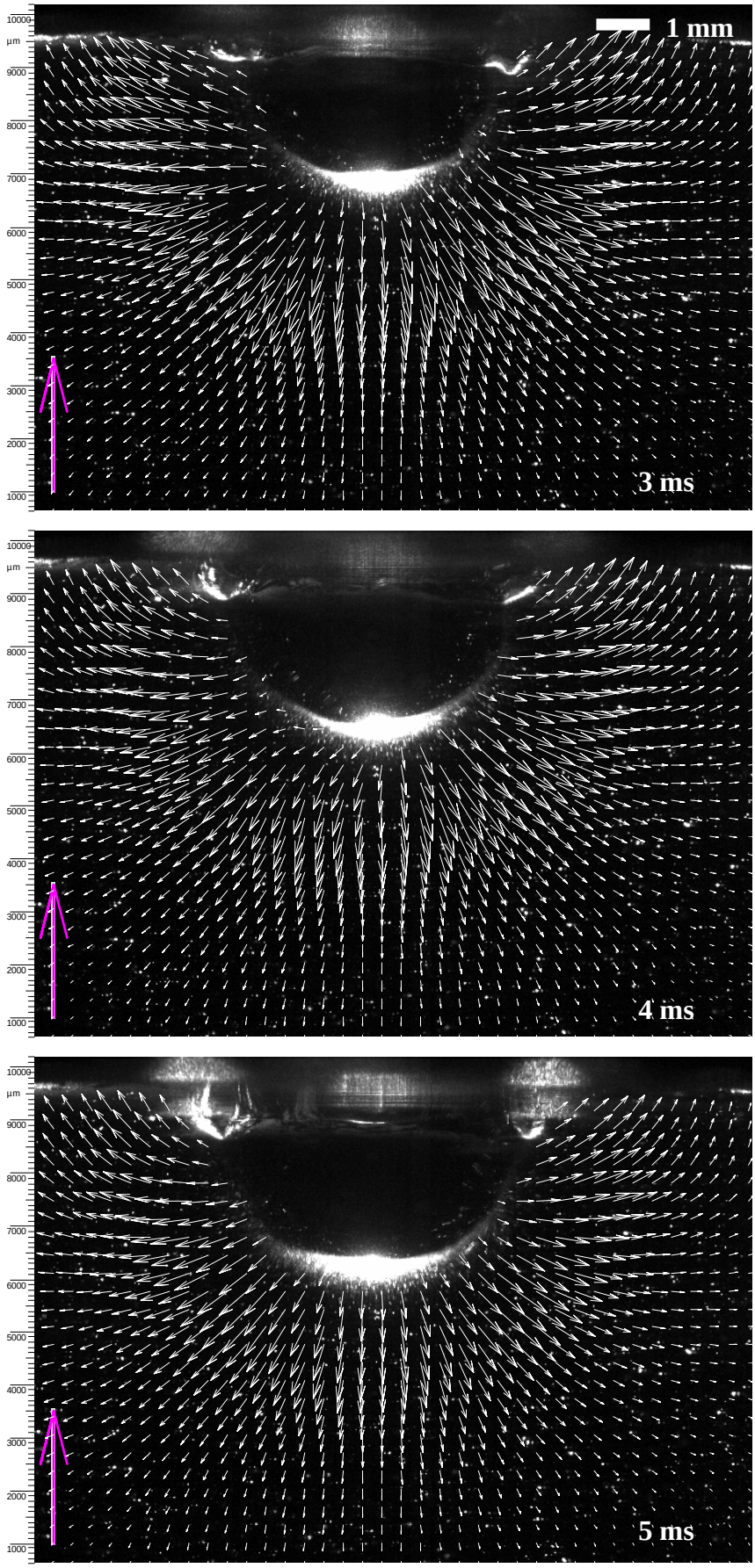
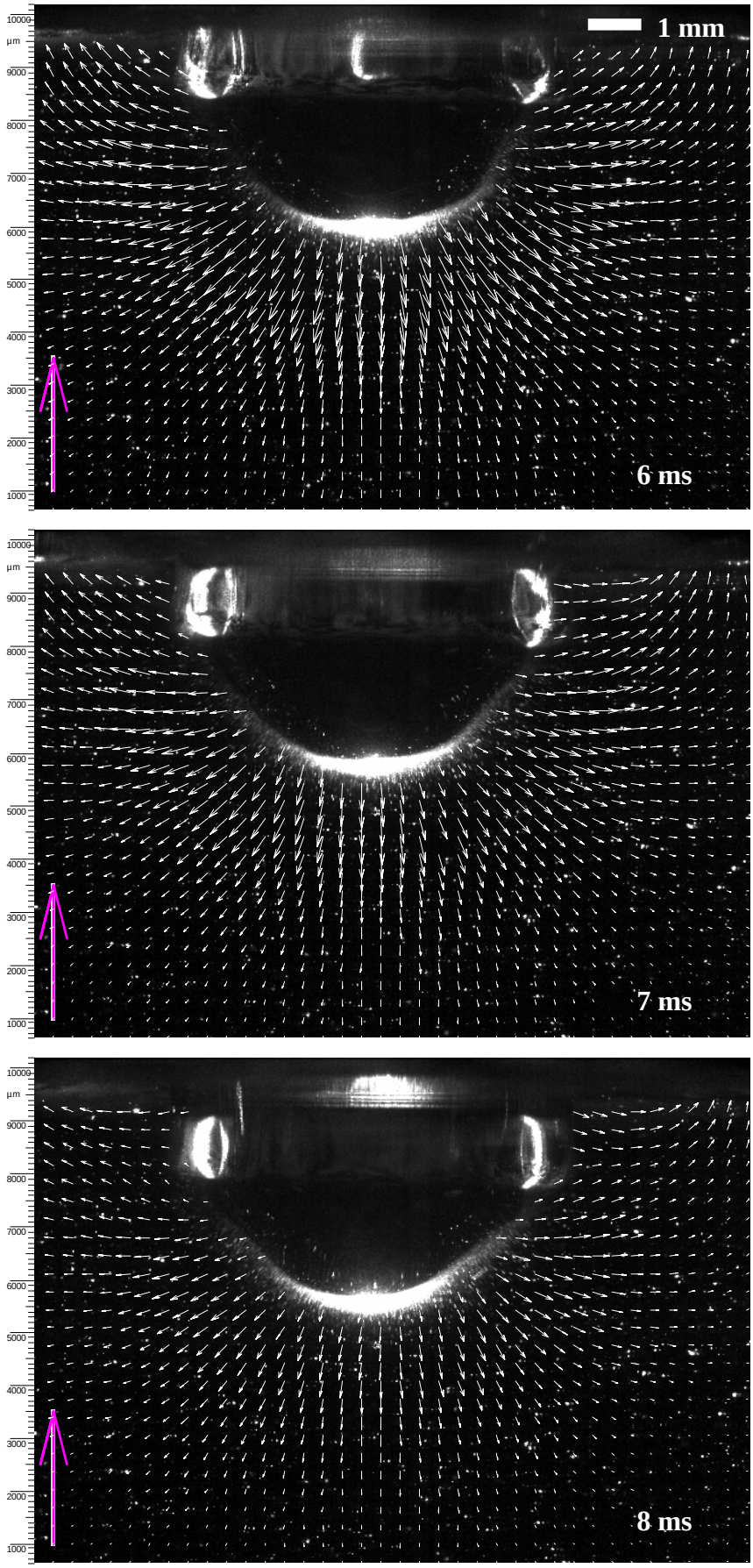


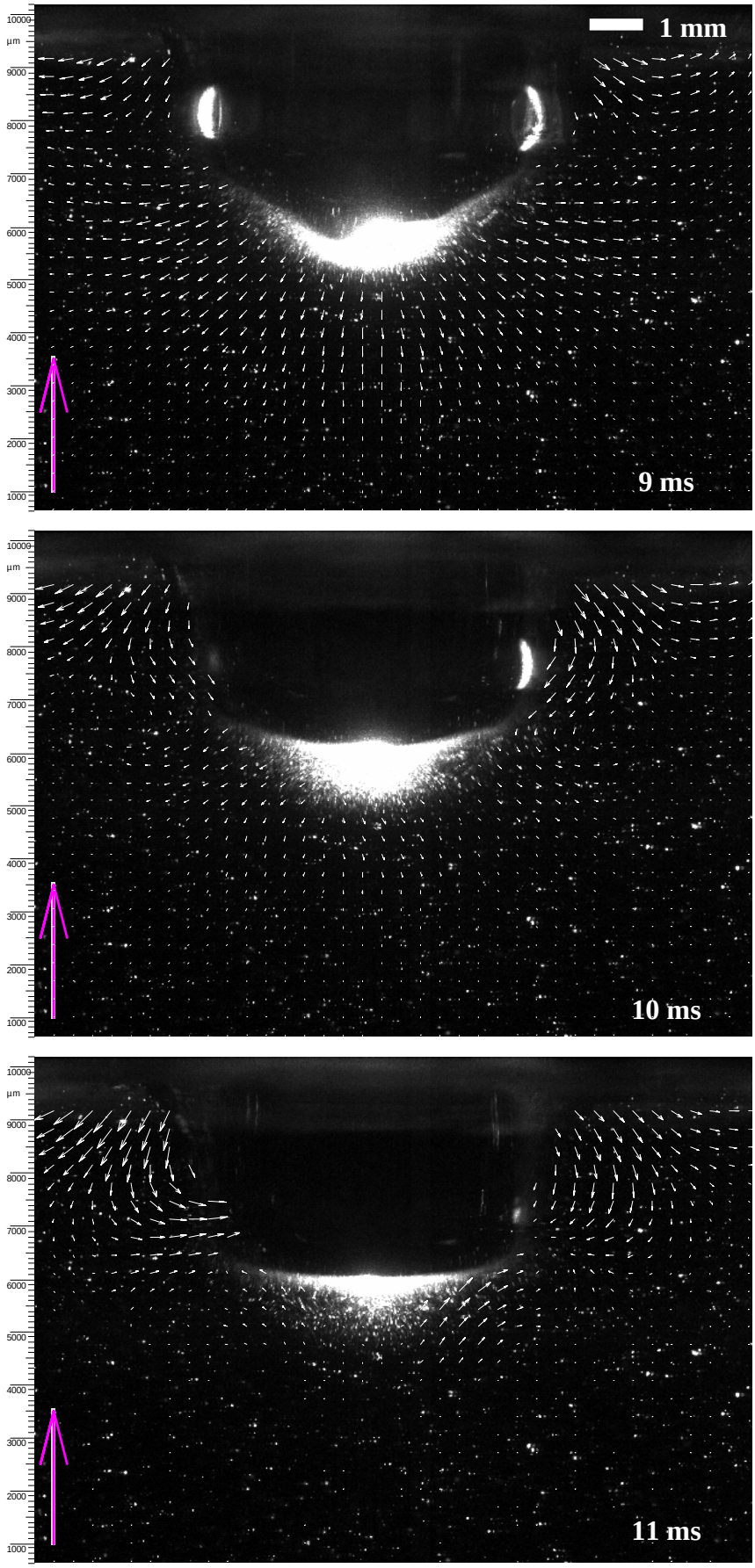
Figure 4.7 Vorticty map showing vortex formation mid way down the cavity (sec^{-1})

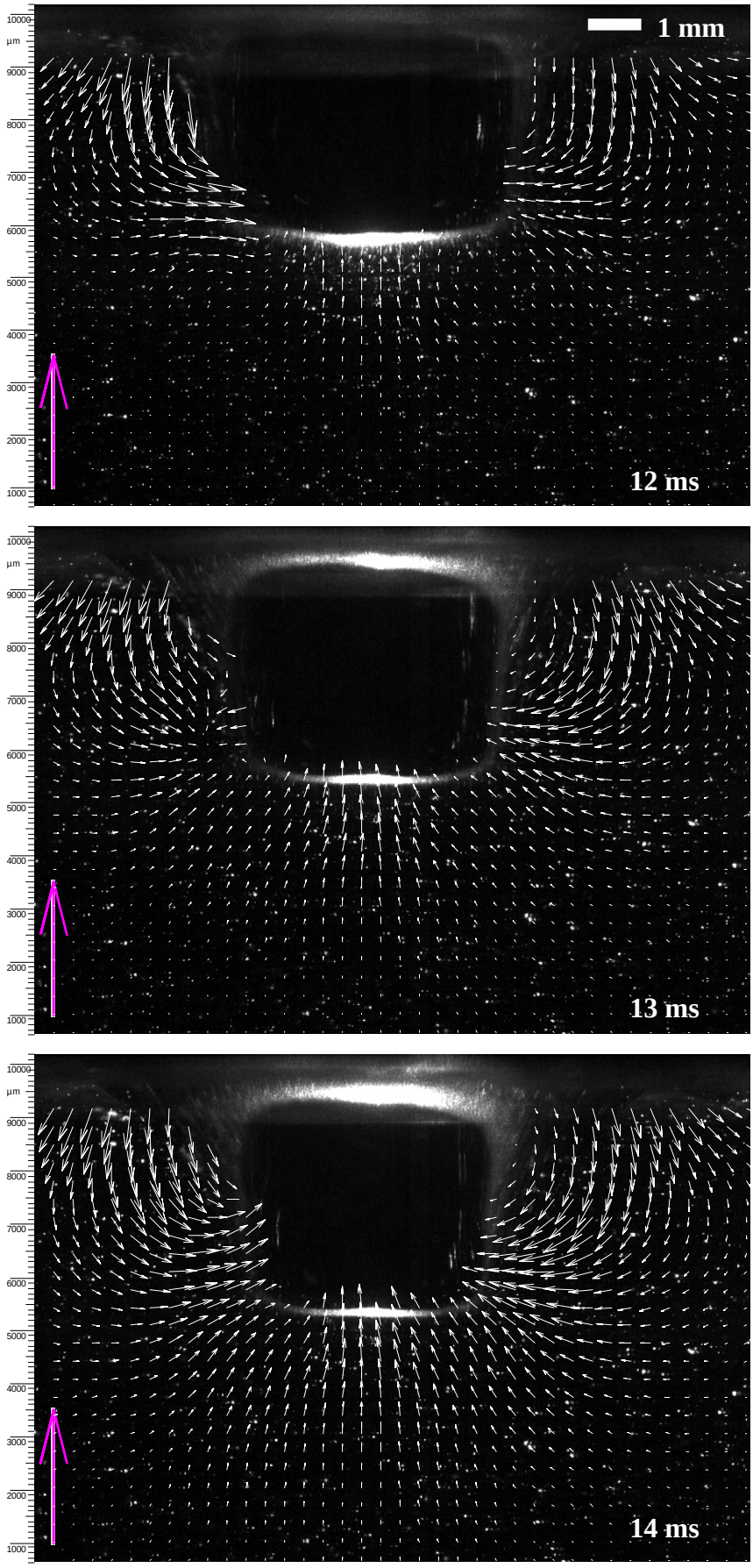
4.2.4 PIV Impact IV (Fr = 452, We = 249, Re = 5421, t_c = 0.67)

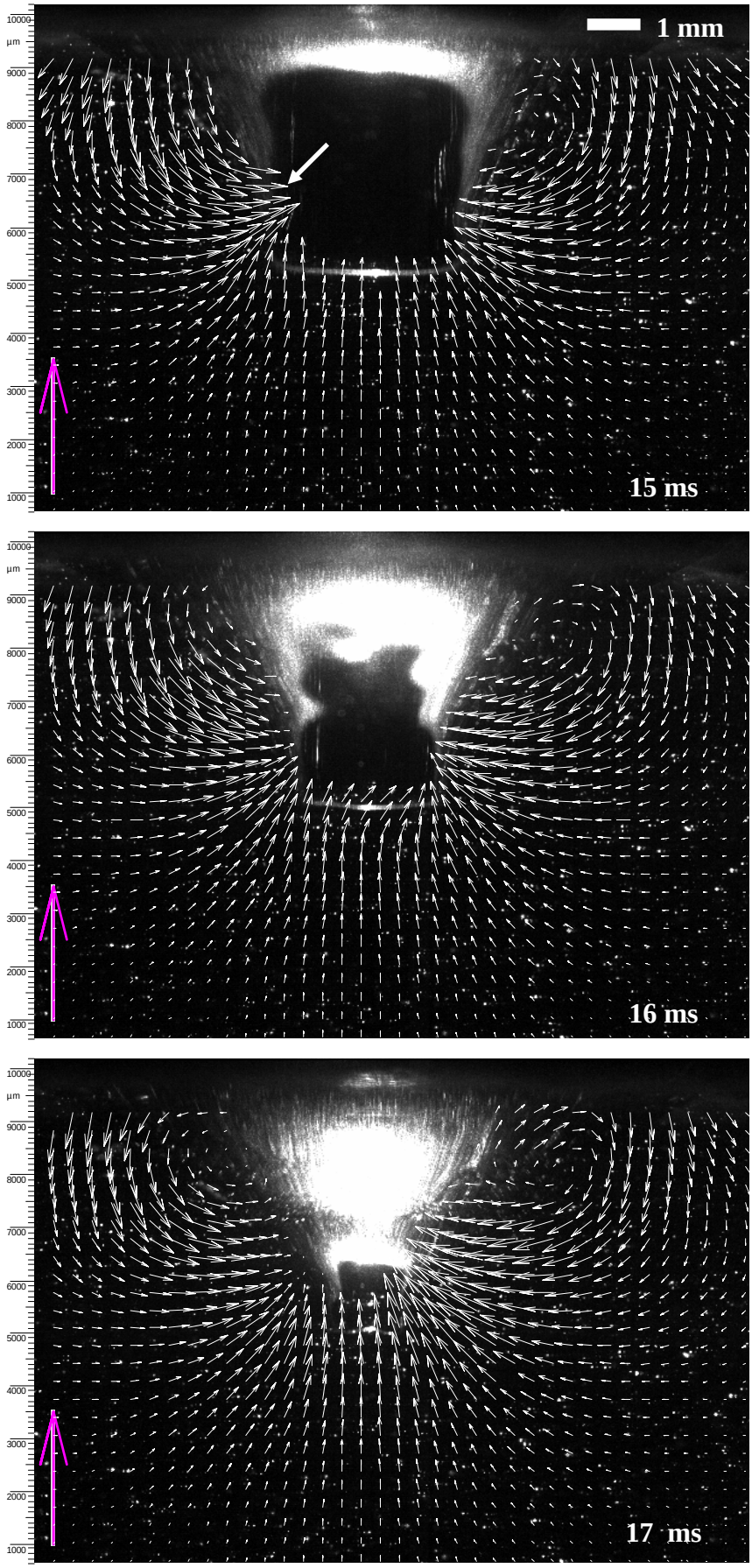



1 mm
3 ms
4 ms
5 ms
µm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000


1 mm
6 ms
7 ms
8 ms
µm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000


1 mm
9 ms
10 ms
11 ms
µm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000


1 mm
12 ms
13 ms
14 ms
µm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000


1 mm
15 ms
16 ms
17 ms
µm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000

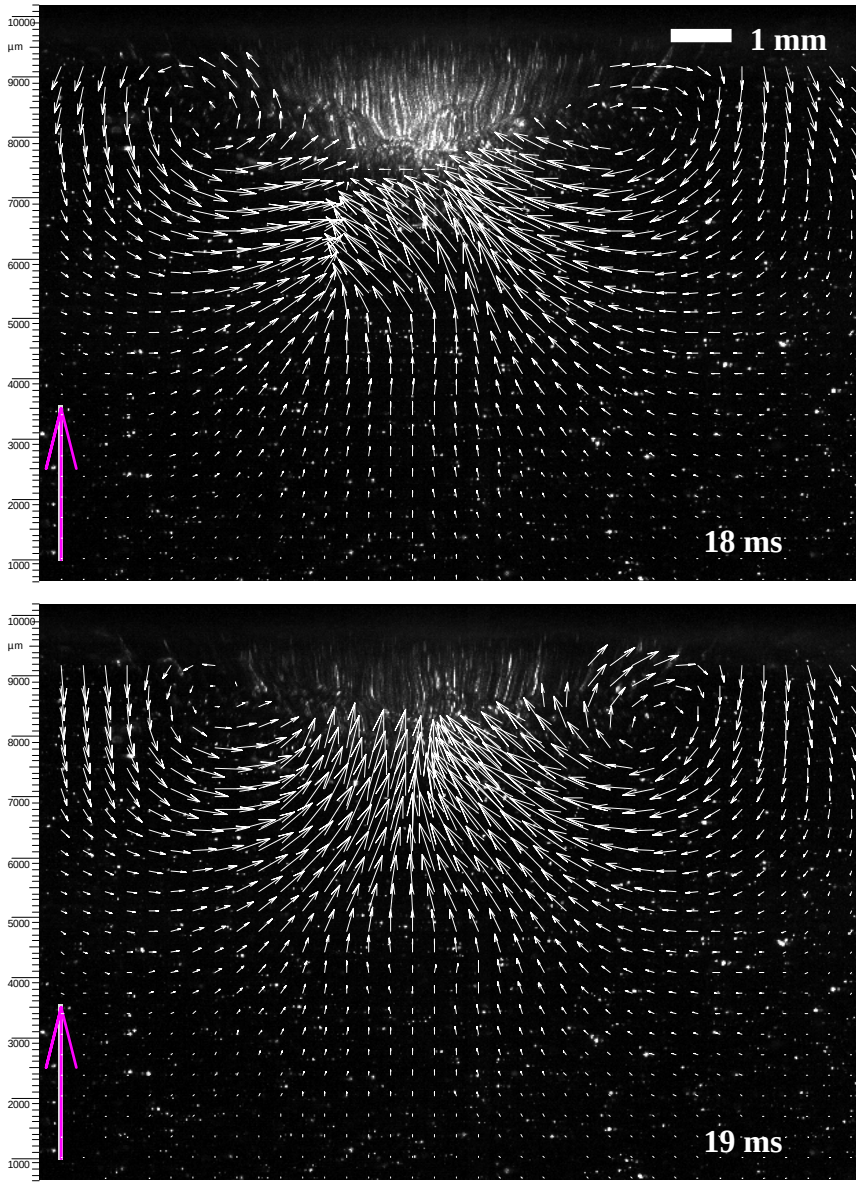


Figure 4.8 Image sequence of impact PIV-IV showing velocity vectors (Reference vector 0.5 m/s) (Fr = 452, We = 249, Re = 5421, t_c = 0.67)

The final PIV image sequence is from the post-entrapment jetting regime. In this example the vortex controlling the collapse of the cavity is again present. However, the fluid approaching the axis of symmetry has a strong upward velocity (15 ms image). This pushes the "lower corners" of the cavity toward the free surface so that no bubble becomes entrapped. Thus what appears to be the critical element in the collapse phase is how and when the vortex located mid way down the cavity forms. The effect of this vortex on the collapse will now be discussed.