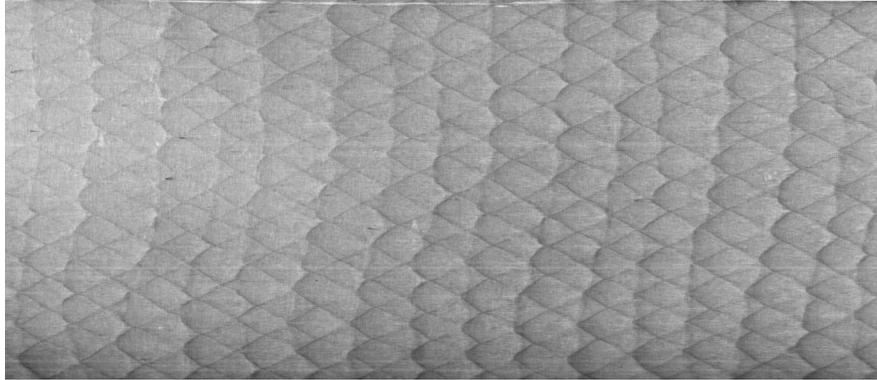
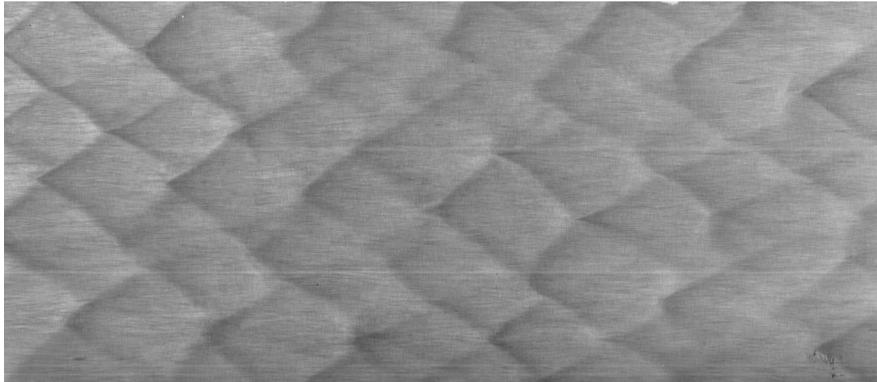
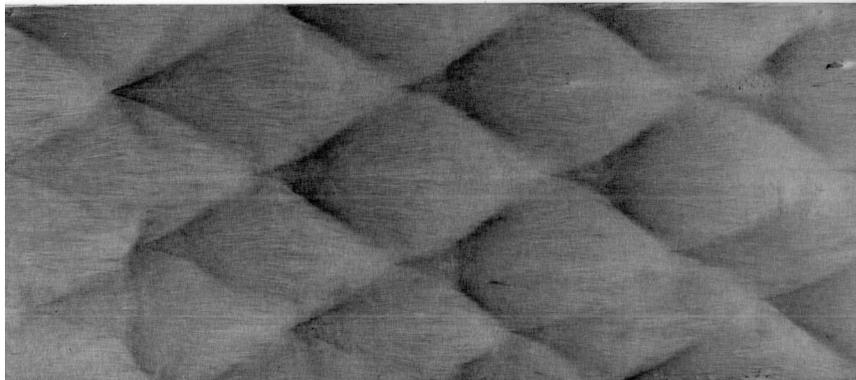


## Appendix A Images from Narrow Channel Experiments

Soot foils and images of detonation fronts from experiments carried out in the narrow channel facility. In some experiments, schlieren and PLIF images of OH fluorescence were taken for a single experiment and superimposed. The location of the PLIF image is shown as an outline on the schlieren image. Solid black squares were positioned on the window upstream of the front for registering images and for scale. Squares are 4 mm in width.

Shot 53:  $2\text{H}_2\text{-O}_2\text{-7Ar}$ Shot 39:  $2\text{H}_2\text{-O}_2\text{-12Ar}$ Shot 38:  $2\text{H}_2\text{-O}_2\text{-17Ar}$ Figure A.1: Soot foils in Ar-diluted  $\text{H}_2\text{-O}_2$  mixtures. Image height is 150 mm.

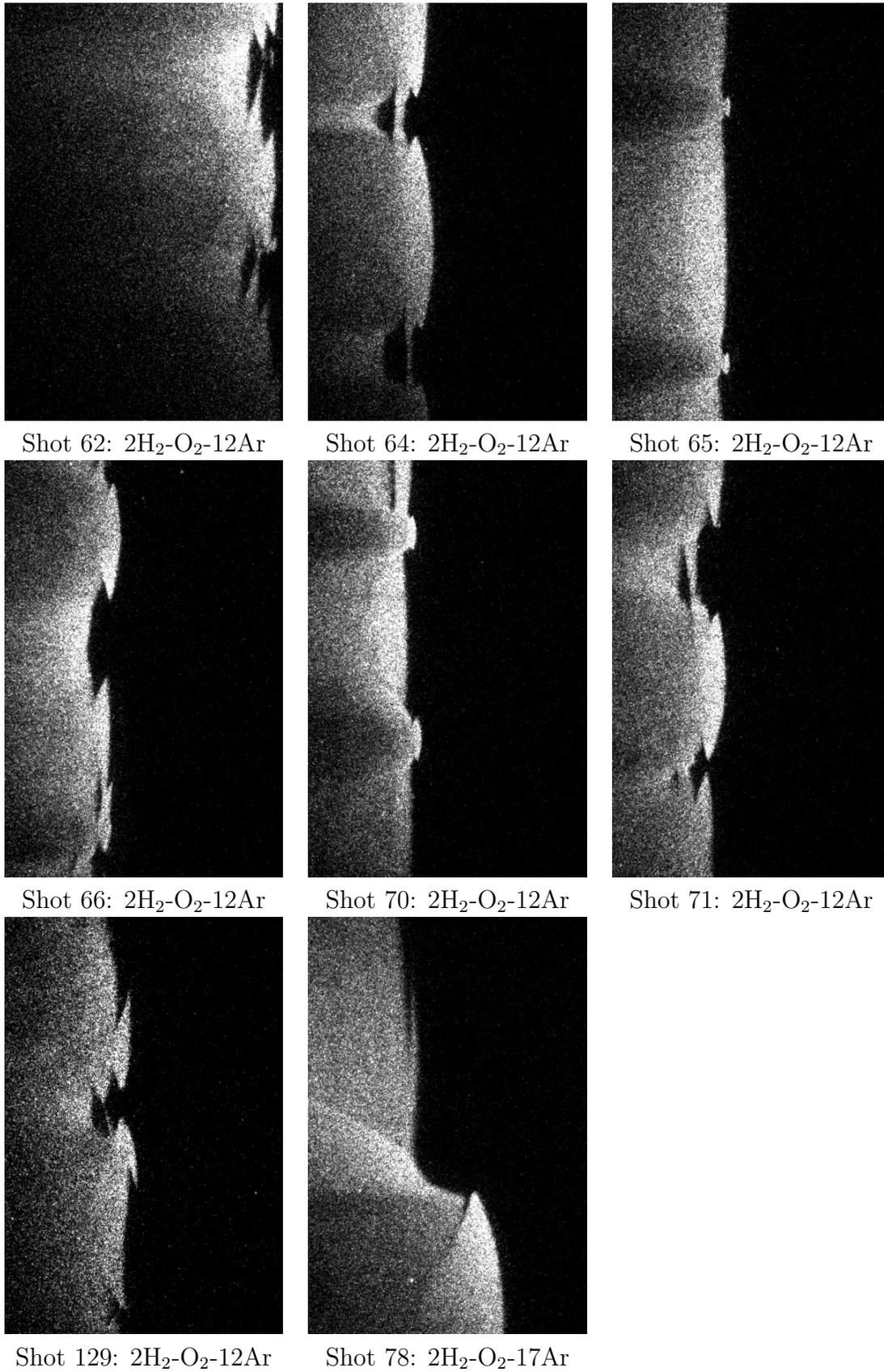
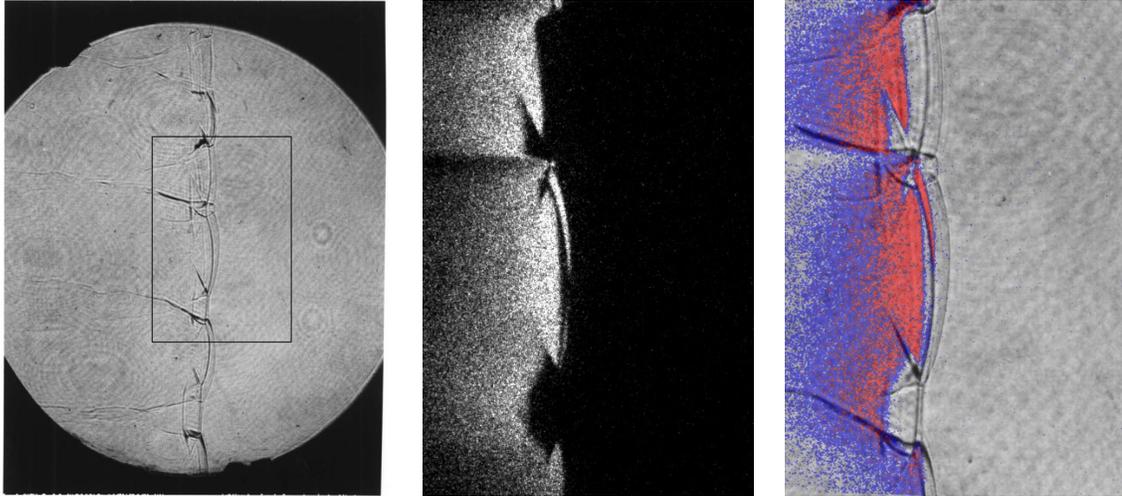
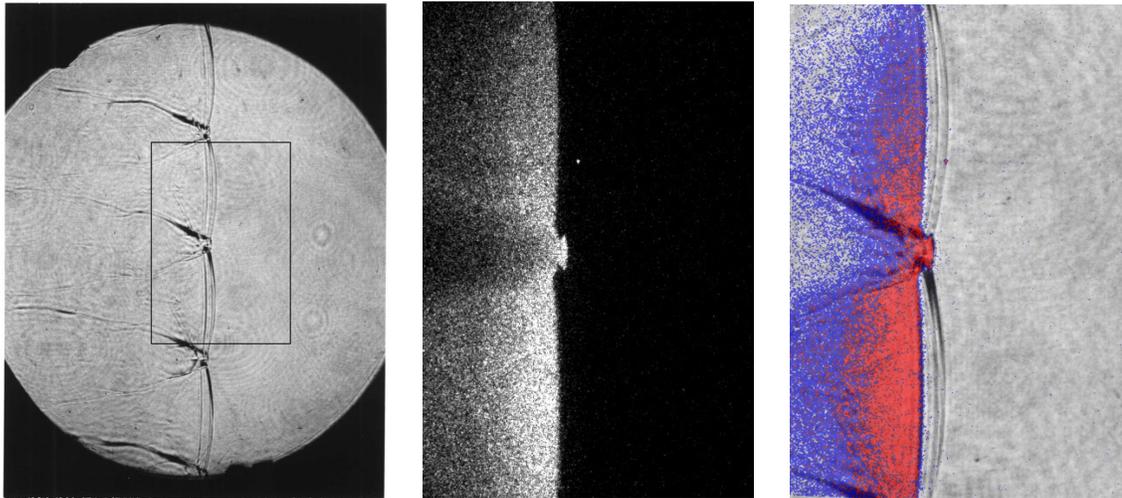
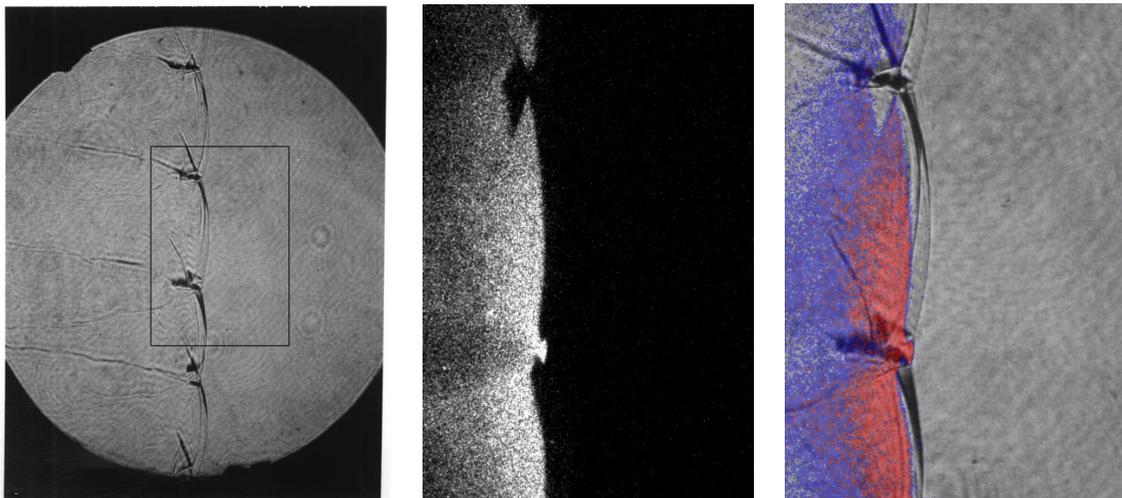
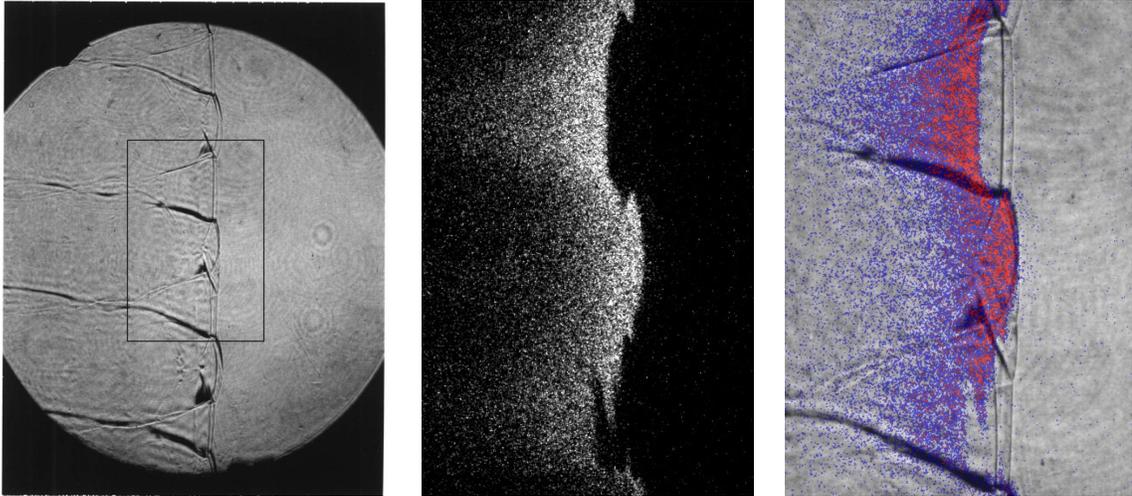
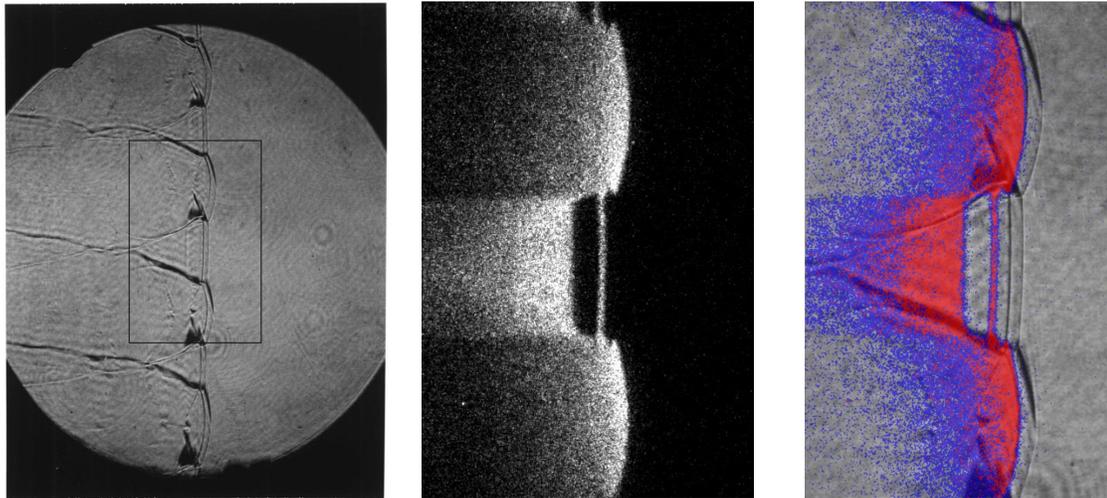
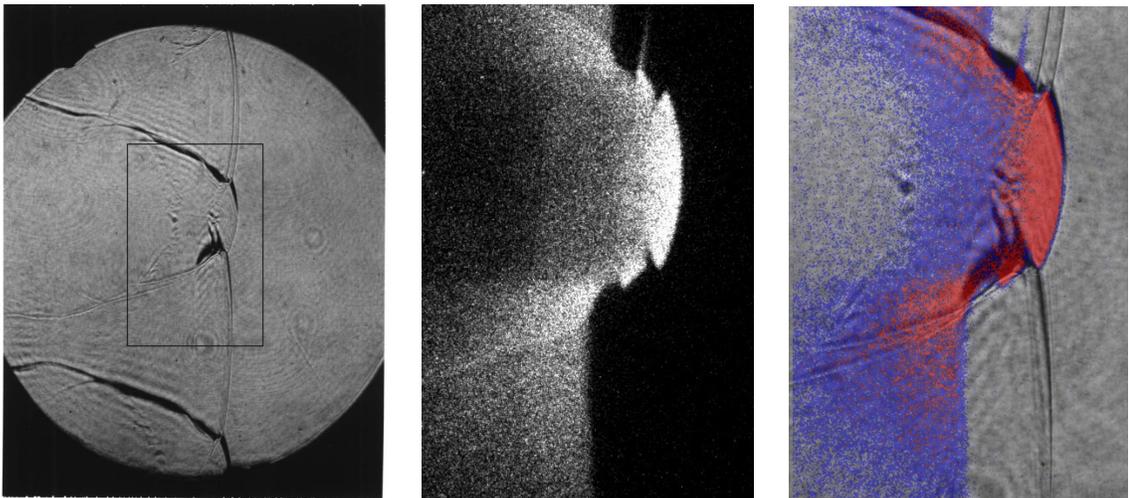
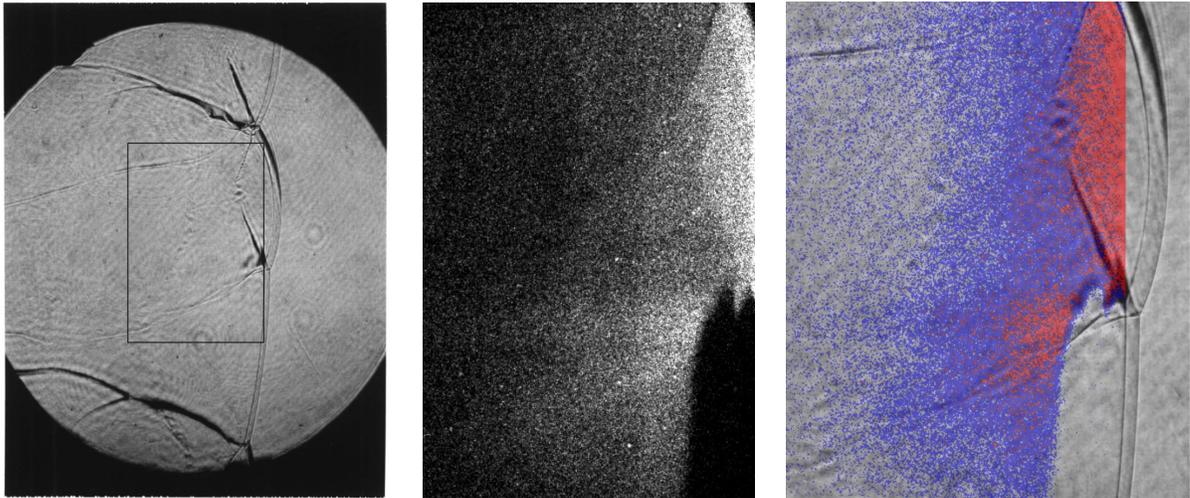
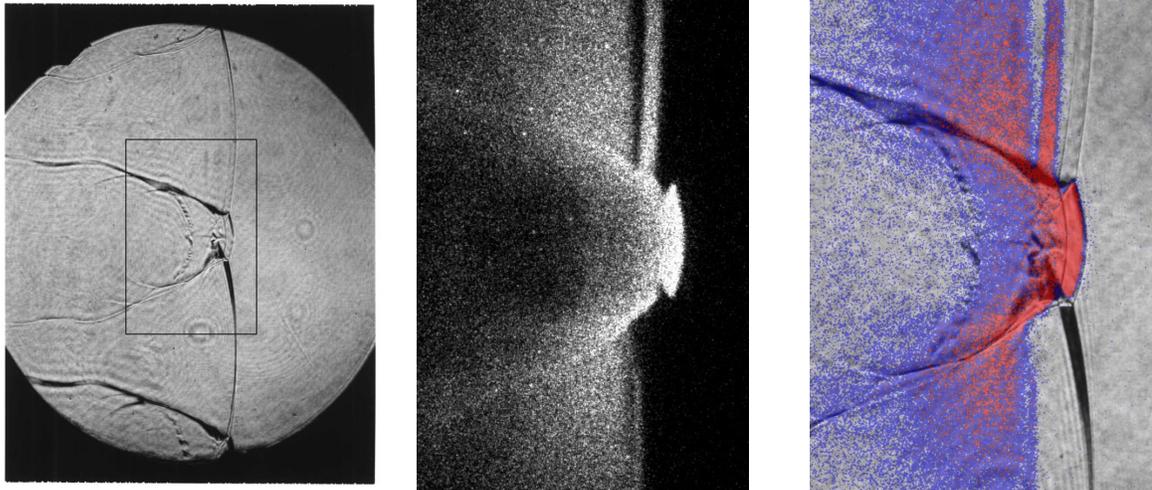
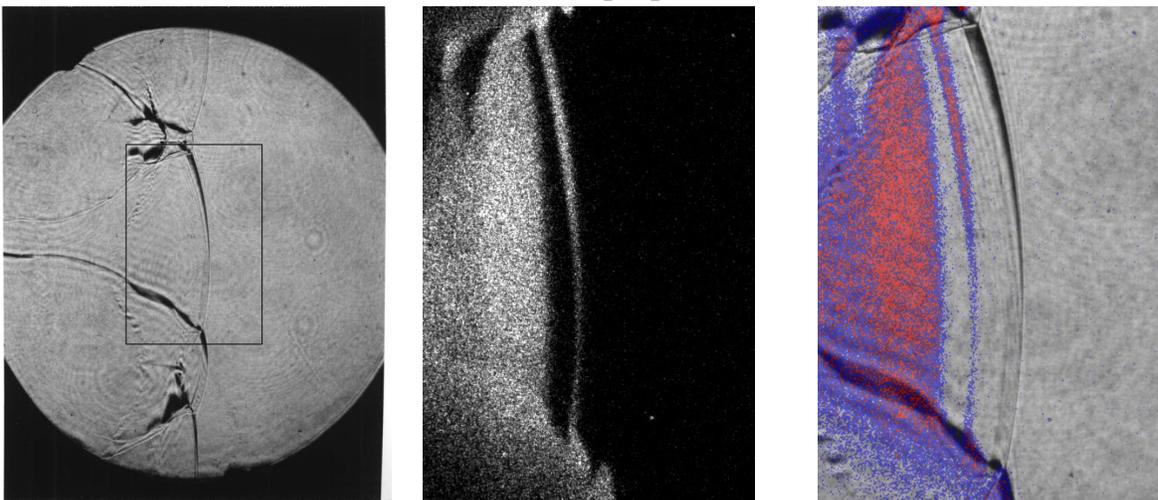
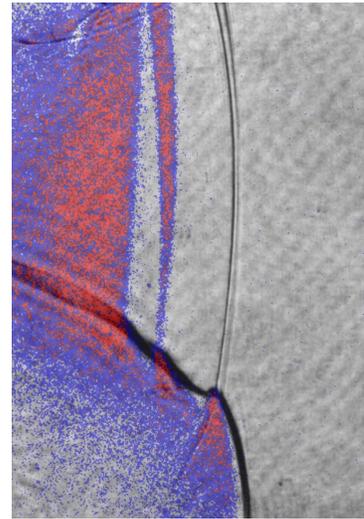
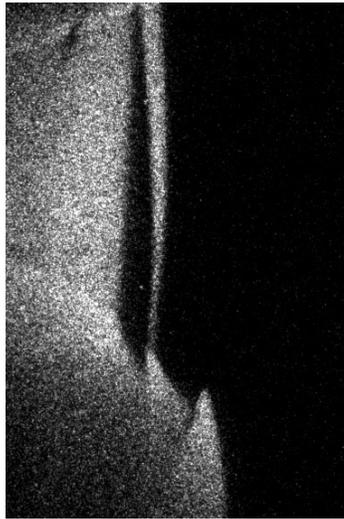
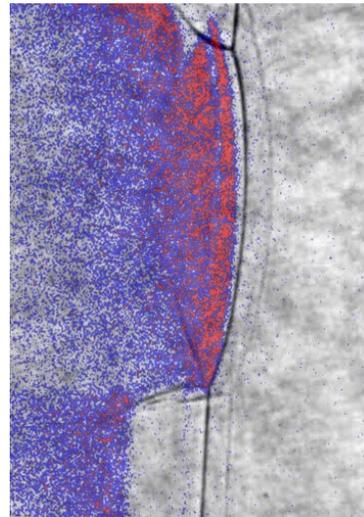
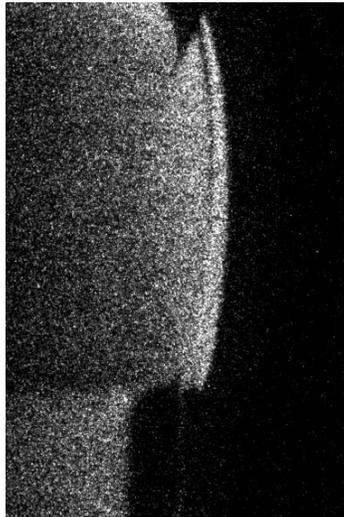
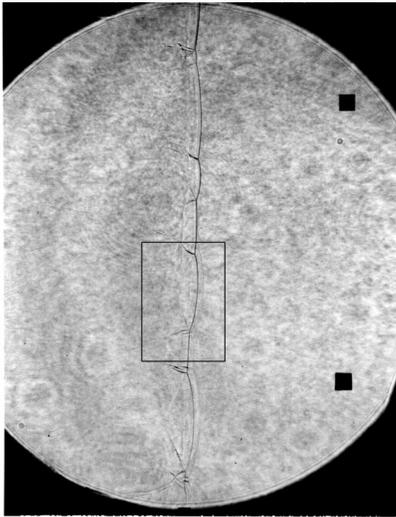


Figure A.2: OH fluorescence images of detonation in Ar-diluted  $\text{H}_2\text{-O}_2$  mixtures.

Shot 72:  $2\text{H}_2\text{-O}_2\text{-12Ar}$ Shot 73:  $2\text{H}_2\text{-O}_2\text{-12Ar}$ Shot 74:  $2\text{H}_2\text{-O}_2\text{-12Ar}$ Figure A.3: Superimposed schlieren and OH fluorescence images in Ar-diluted  $\text{H}_2\text{-O}_2$ .

Shot 76: 2H<sub>2</sub>-O<sub>2</sub>-12ArShot 77: 2H<sub>2</sub>-O<sub>2</sub>-12ArShot 79: 2H<sub>2</sub>-O<sub>2</sub>-17ArFigure A.4: Superimposed schlieren and OH fluorescence images in Ar-diluted H<sub>2</sub>-O<sub>2</sub>.

Shot 80:  $2\text{H}_2\text{-O}_2\text{-17Ar}$ Shot 81:  $2\text{H}_2\text{-O}_2\text{-17Ar}$ Shot 82:  $2\text{H}_2\text{-O}_2\text{-17Ar}$ Figure A.5: Superimposed schlieren and OH fluorescence images in Ar-diluted  $\text{H}_2\text{-O}_2$ .

Shot 83:  $2\text{H}_2\text{-O}_2\text{-17Ar}$ Shot 96:  $2\text{H}_2\text{-O}_2\text{-12Ar}$ Figure A.6: Superimposed schlieren and OH fluorescence images in Ar-diluted  $\text{H}_2\text{-O}_2$ .

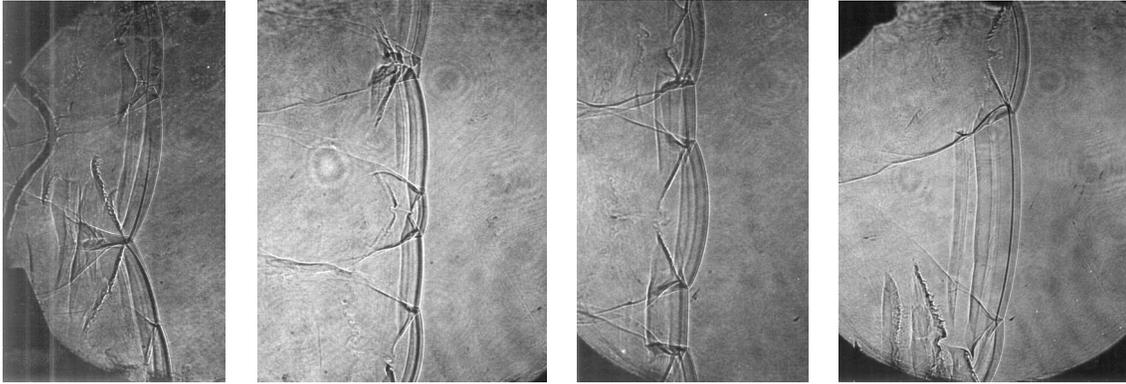
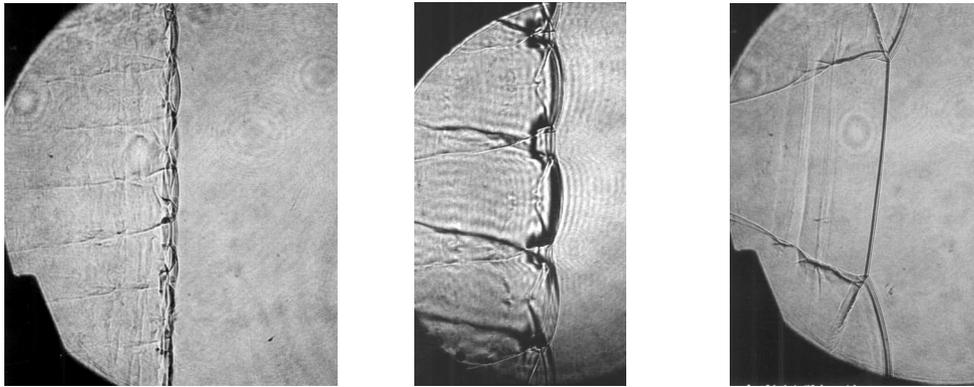


Figure A.7: Shadowgraphs of detonation in Ar-diluted 2H<sub>2</sub>-O<sub>2</sub>.



Shot 14: 2H<sub>2</sub>-O<sub>2</sub>-7Ar    Shot 56: 2H<sub>2</sub>-O<sub>2</sub>-12Ar    Shot 15: 2H<sub>2</sub>-O<sub>2</sub>-17Ar

Figure A.8: Images of detonation in Ar-diluted 2H<sub>2</sub>-O<sub>2</sub>.

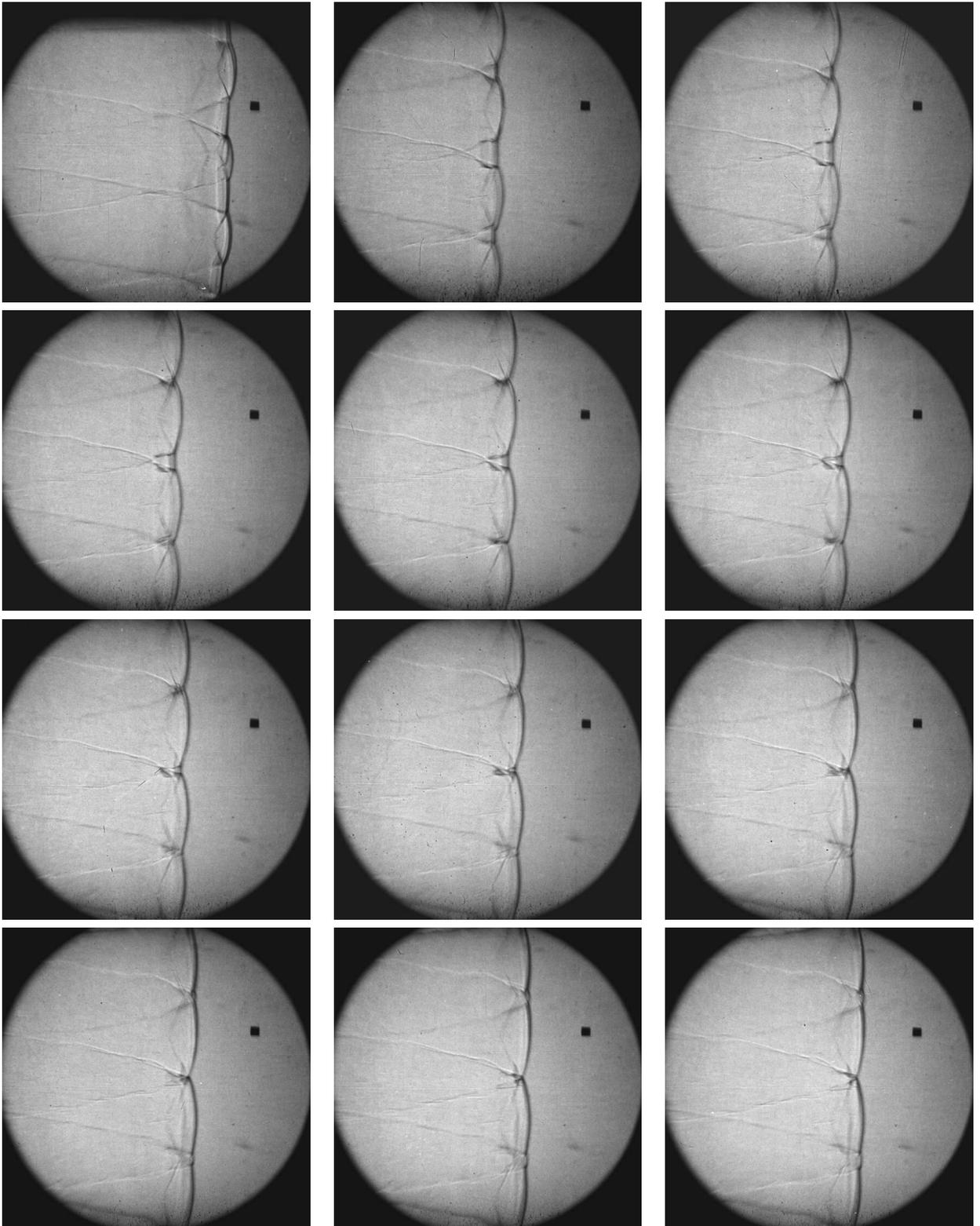


Figure A.9: Shot 229:  $2\text{H}_2\text{-O}_2\text{-12Ar}$  frames 1-12. Field of view is about 138 mm.

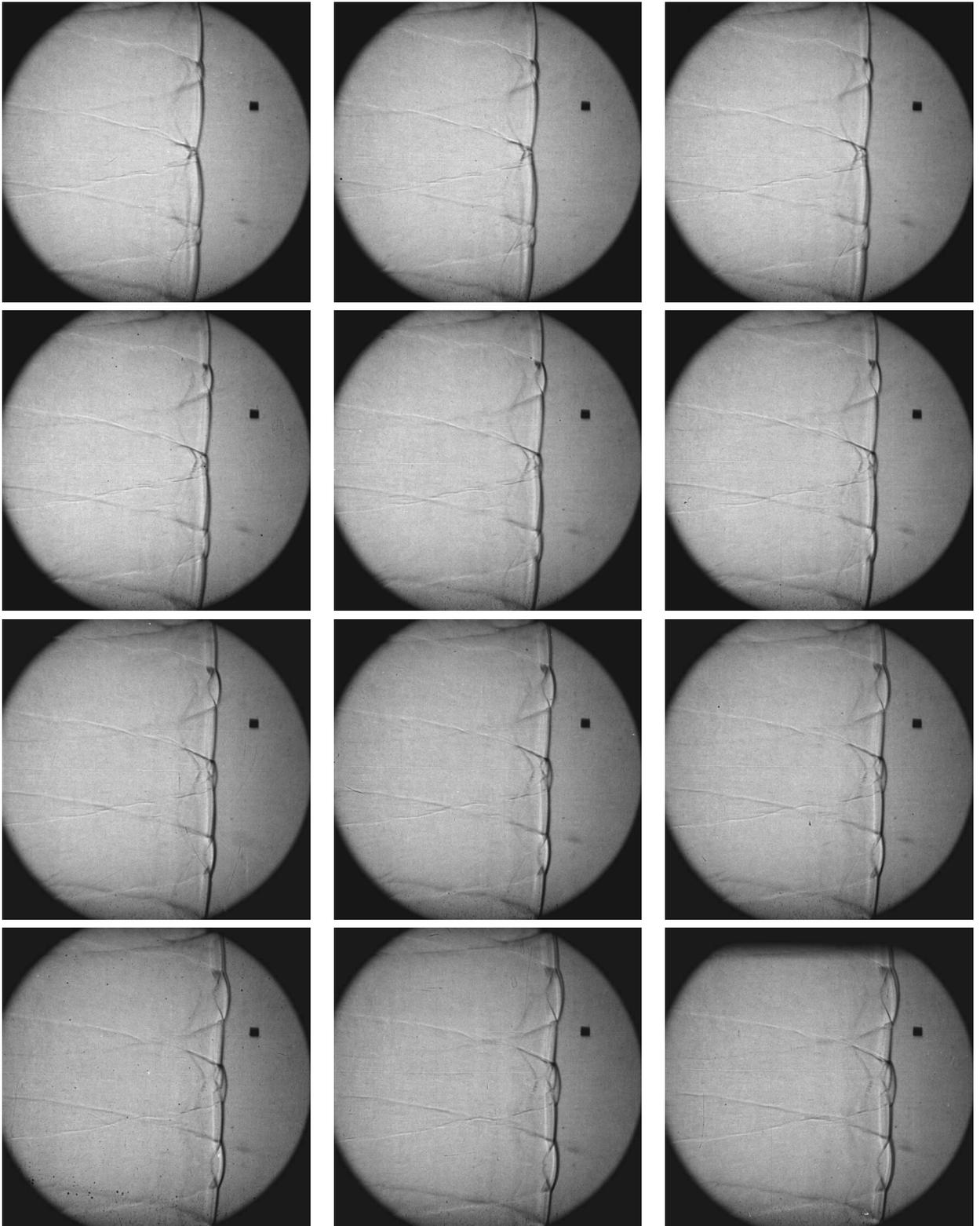
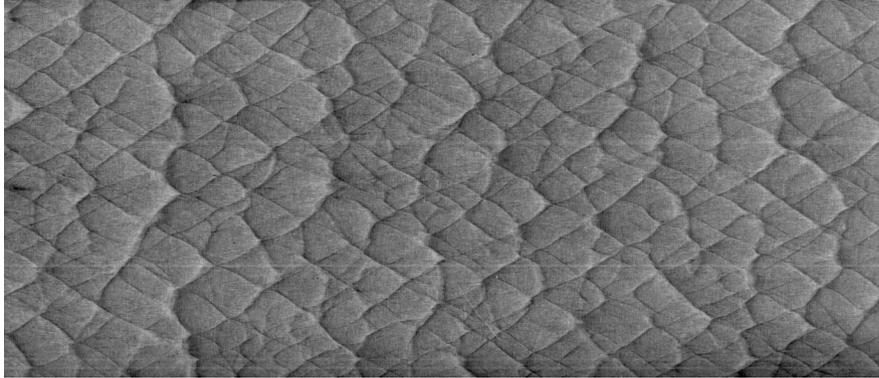
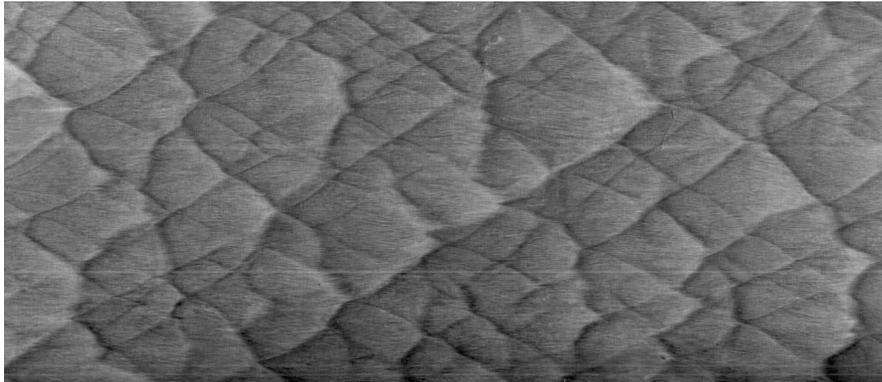
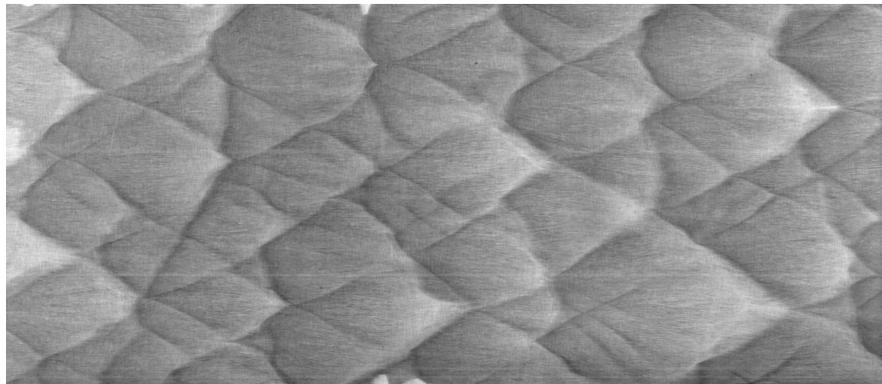


Figure A.10: Shot 229:  $2\text{H}_2\text{-O}_2\text{-12Ar}$  frames 13-24. Field of view is about 138 mm.

Shot 52:  $2\text{H}_2\text{-O}_2\text{-1.33N}_2$ Shot 51:  $2\text{H}_2\text{-O}_2\text{-3.5N}_2$ Shot 37:  $2\text{H}_2\text{-O}_2\text{-4.5N}_2$ Figure A.11: Soot foils in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$  mixtures. Image height is 150 mm.

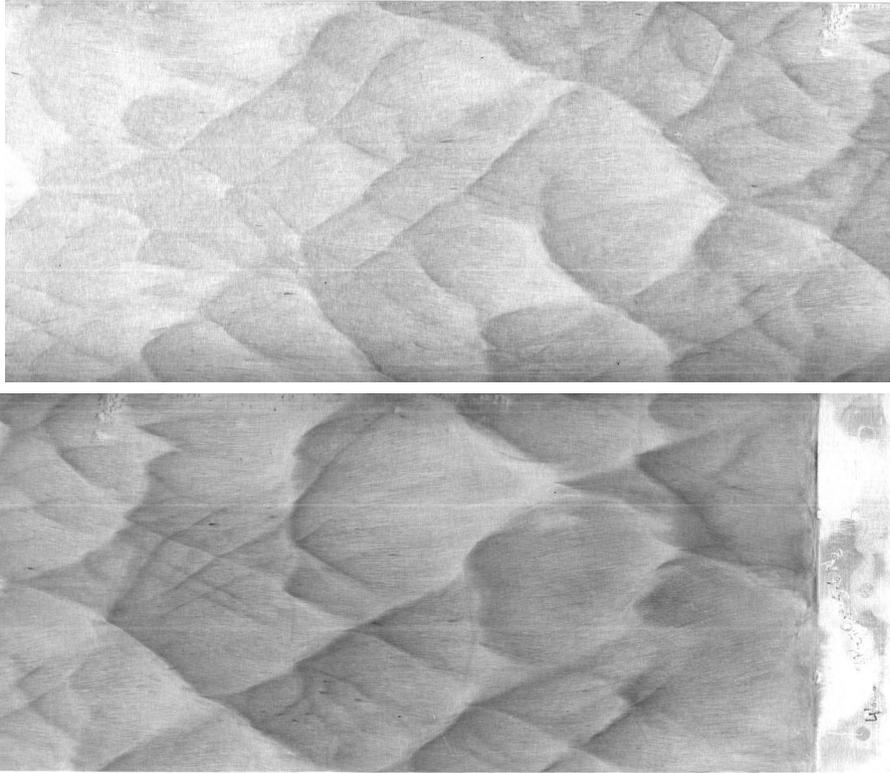
Shot 46:  $2\text{H}_2\text{-O}_2\text{-5.6N}_2$ 

Figure A.12: Soot foil in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$  mixtures. Image height is 150 mm.

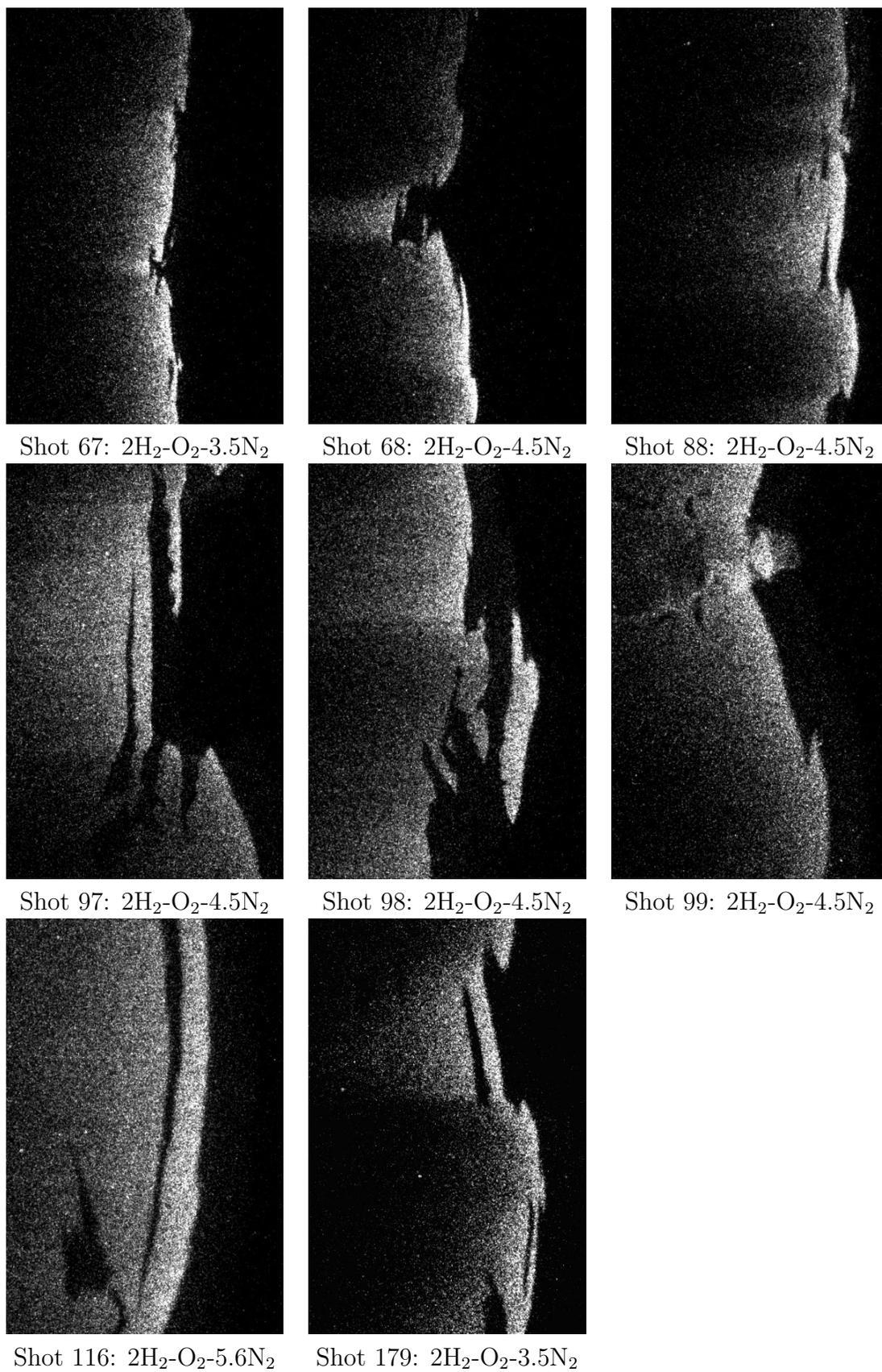


Figure A.13: OH fluorescence images of detonation in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

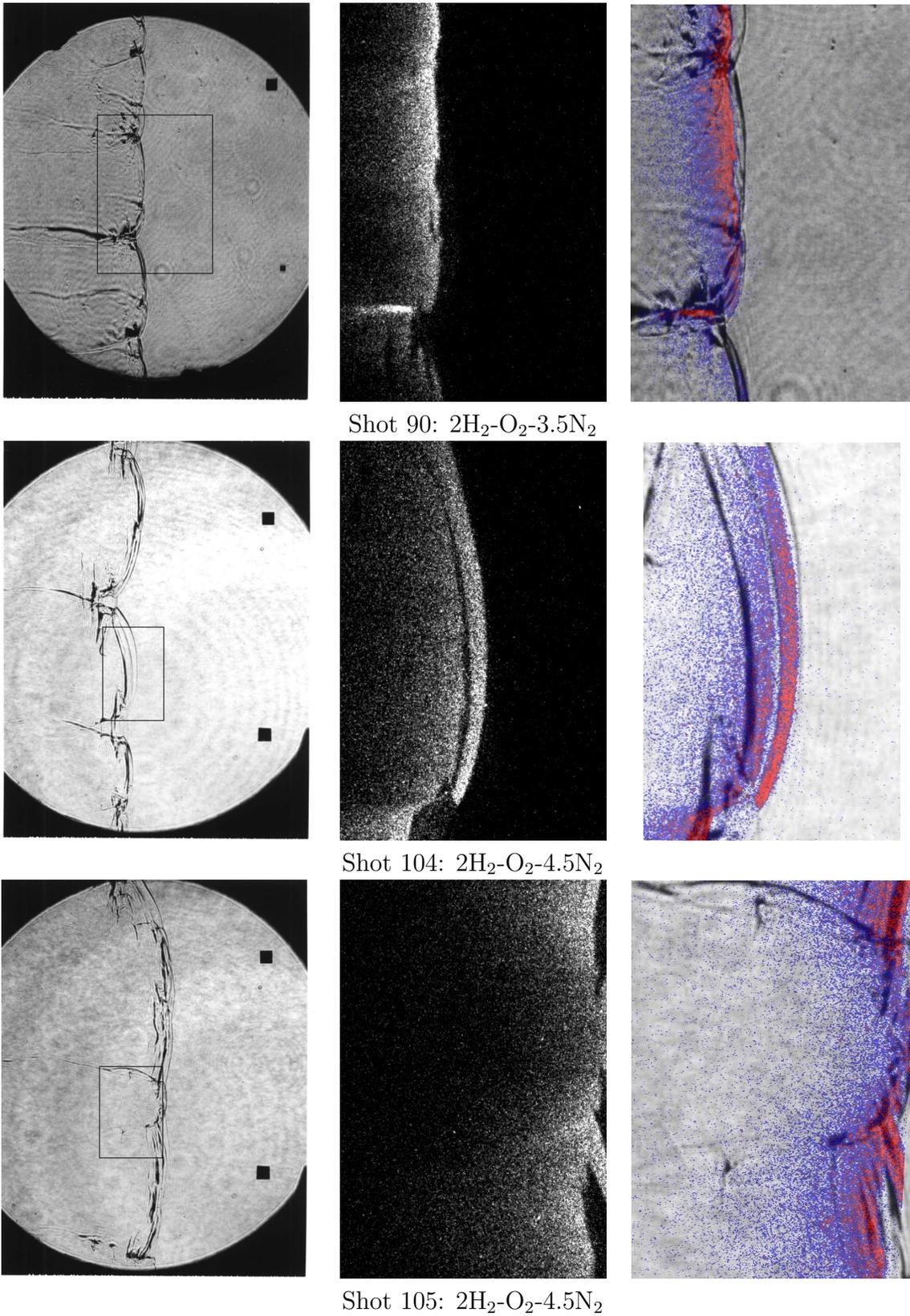
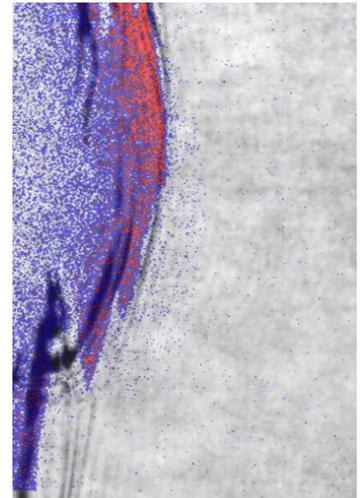
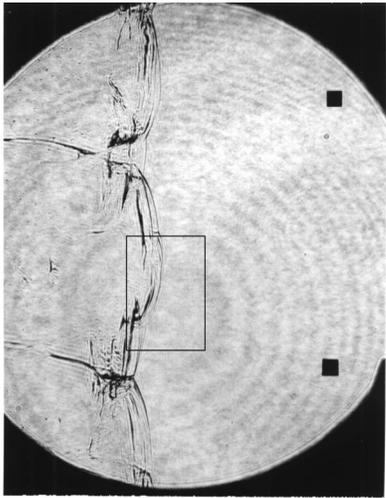
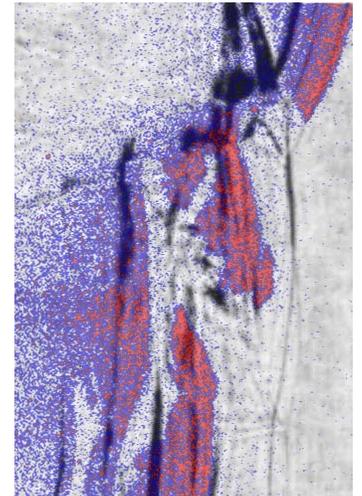
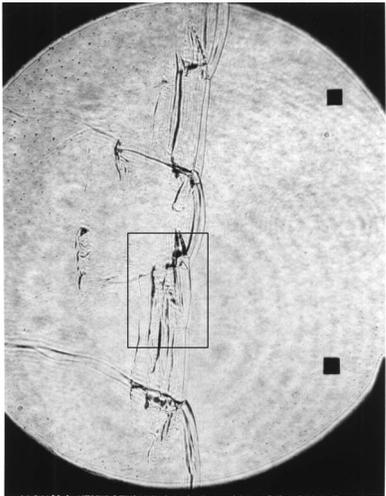
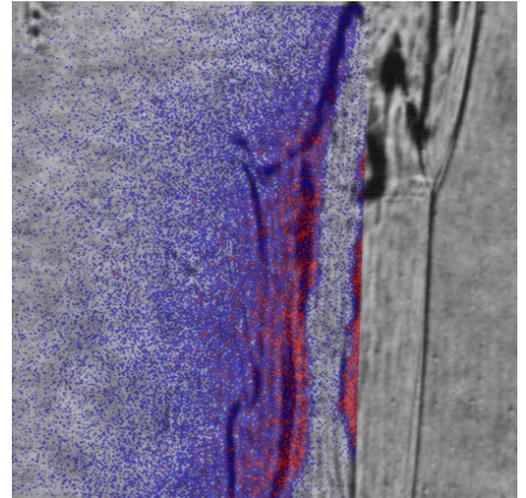
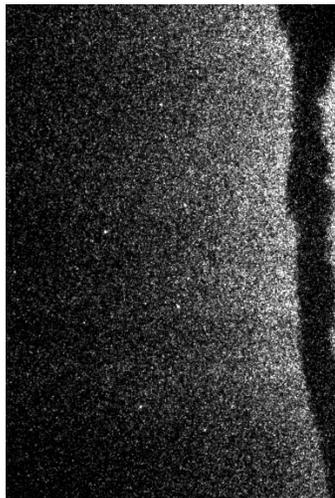
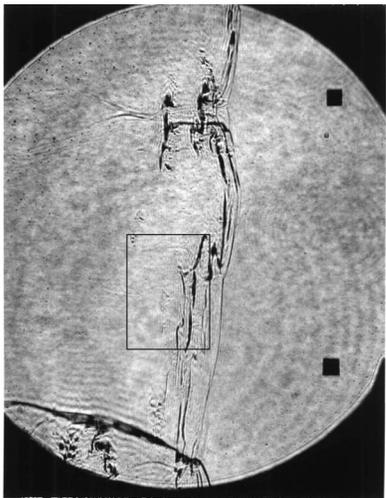


Figure A.14: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Shot 106:  $2\text{H}_2\text{-O}_2\text{-}4.5\text{N}_2$ Shot 110:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$ Shot 111:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$ Figure A.15: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

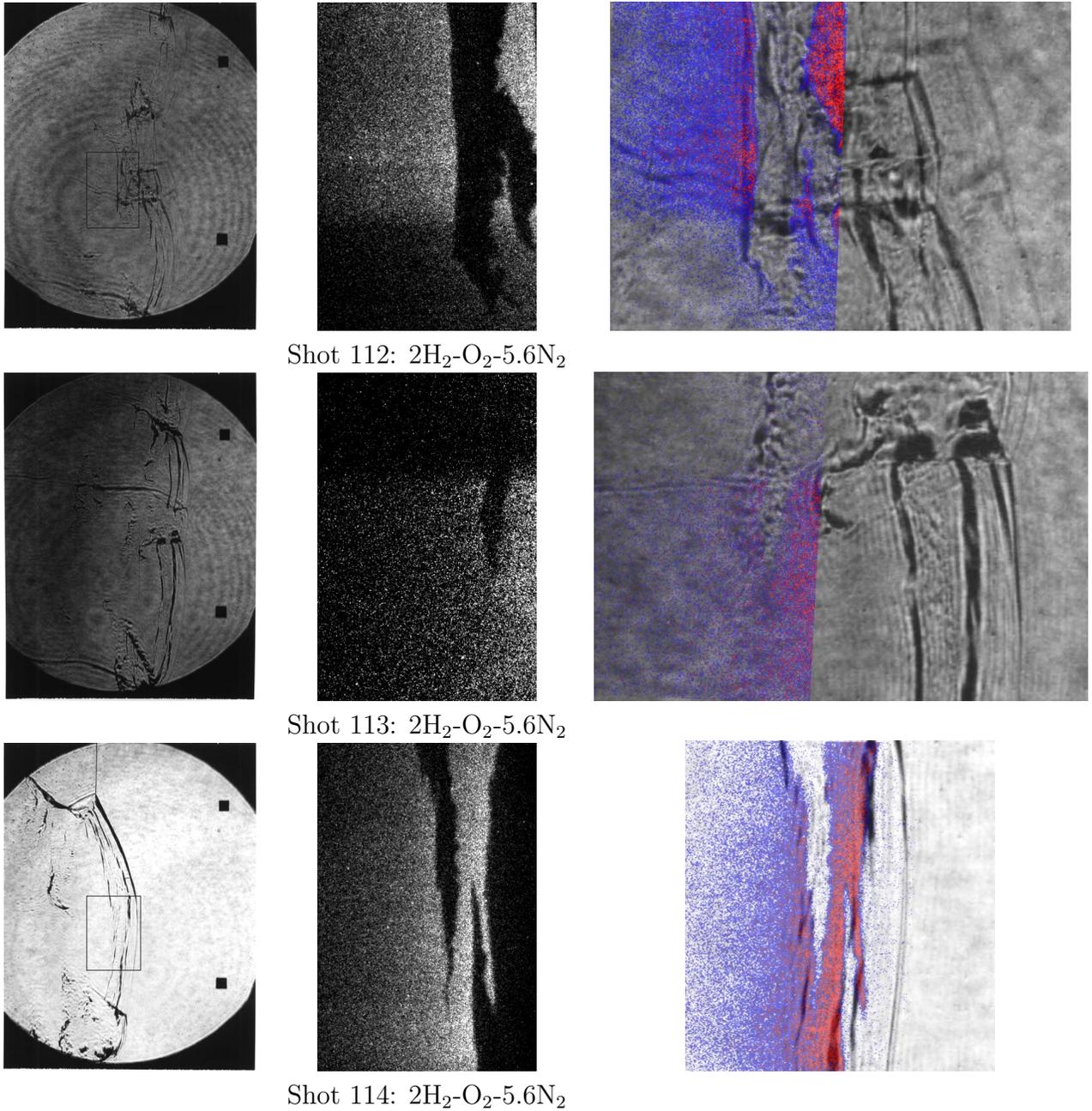


Figure A.16: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

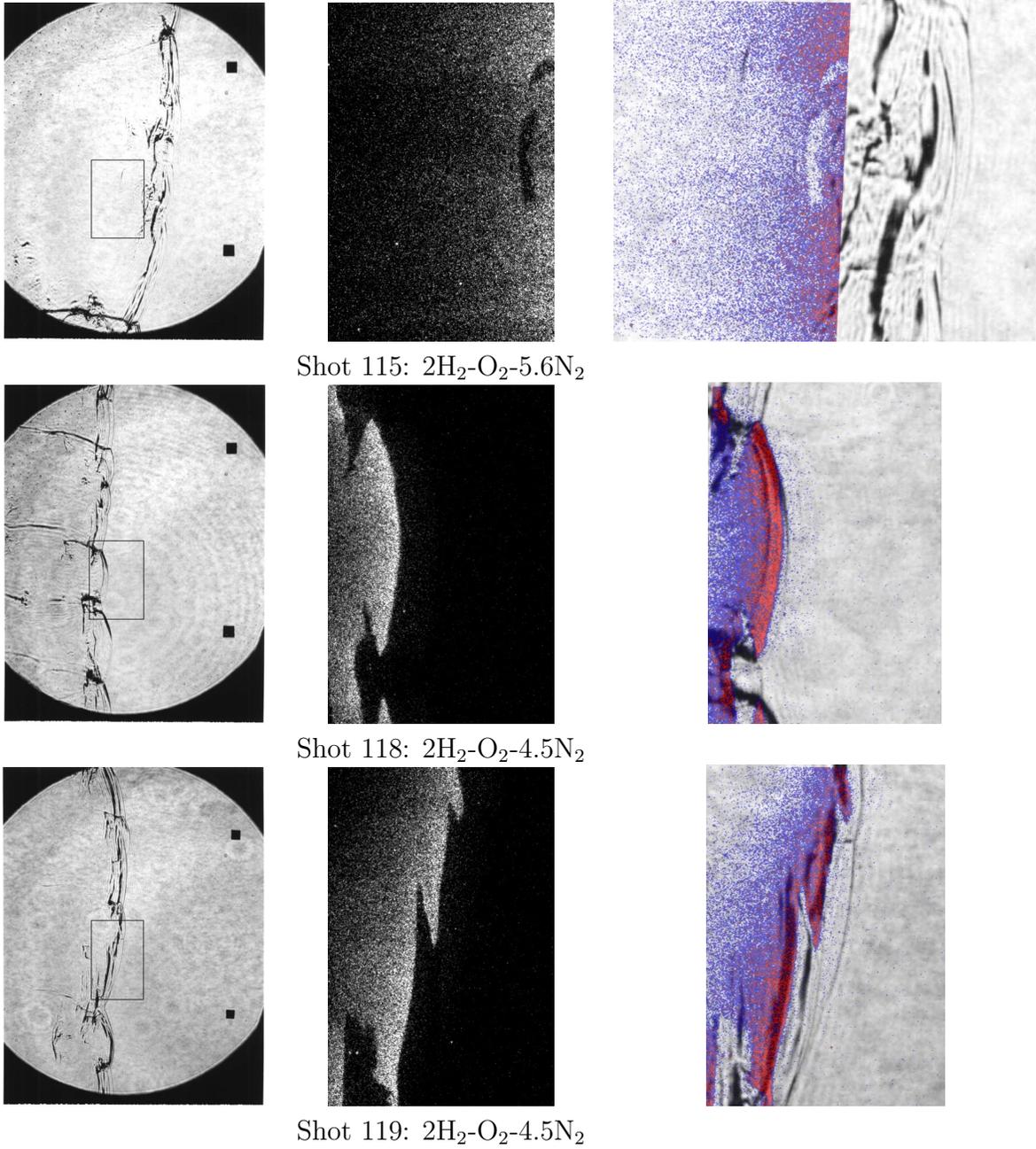
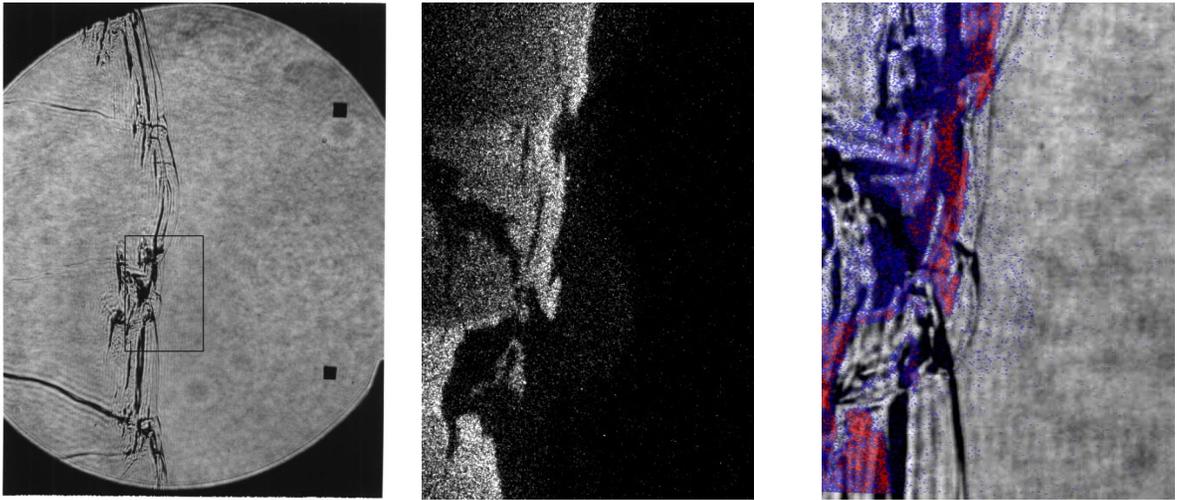
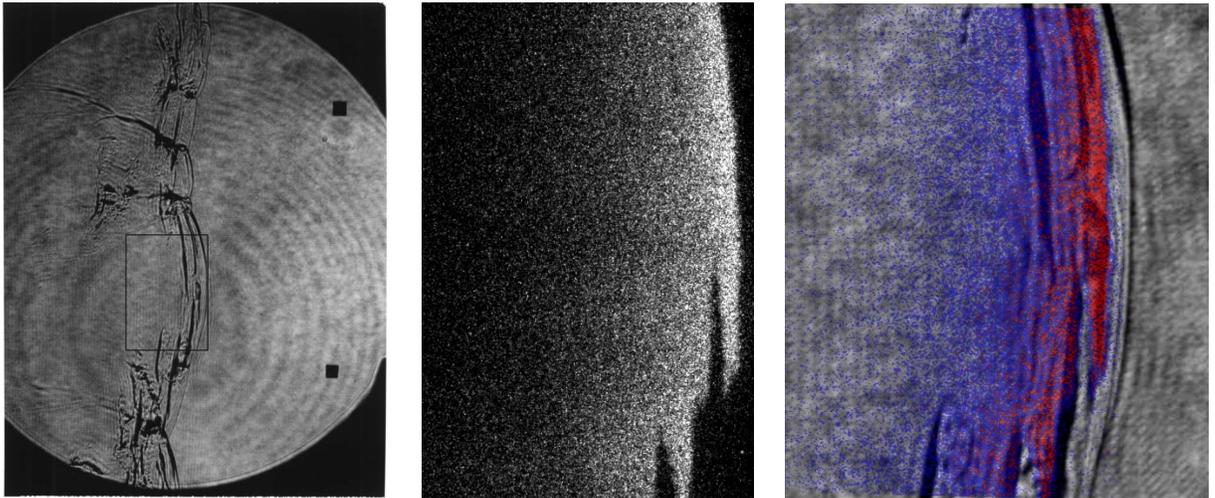
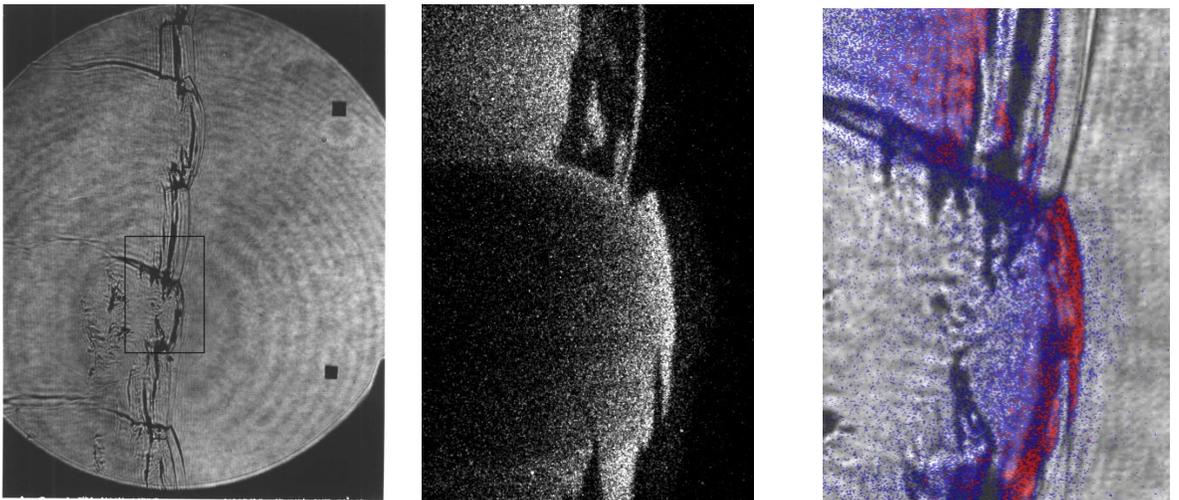


Figure A.17: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Shot 120:  $2\text{H}_2\text{-O}_2\text{-4.5N}_2$ Shot 121:  $2\text{H}_2\text{-O}_2\text{-4.5N}_2$ Shot 122:  $2\text{H}_2\text{-O}_2\text{-4.5N}_2$ Figure A.18: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

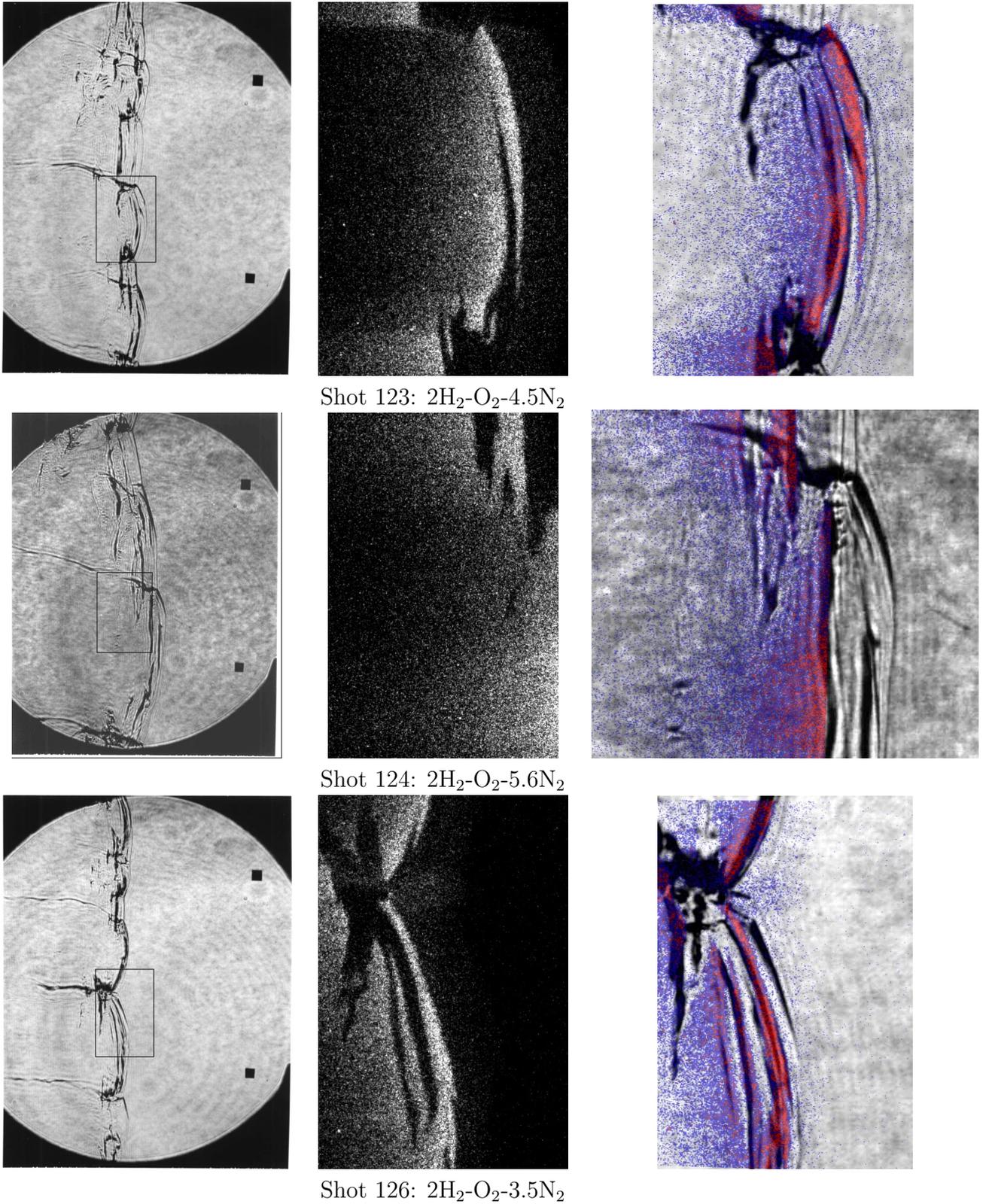


Figure A.19: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

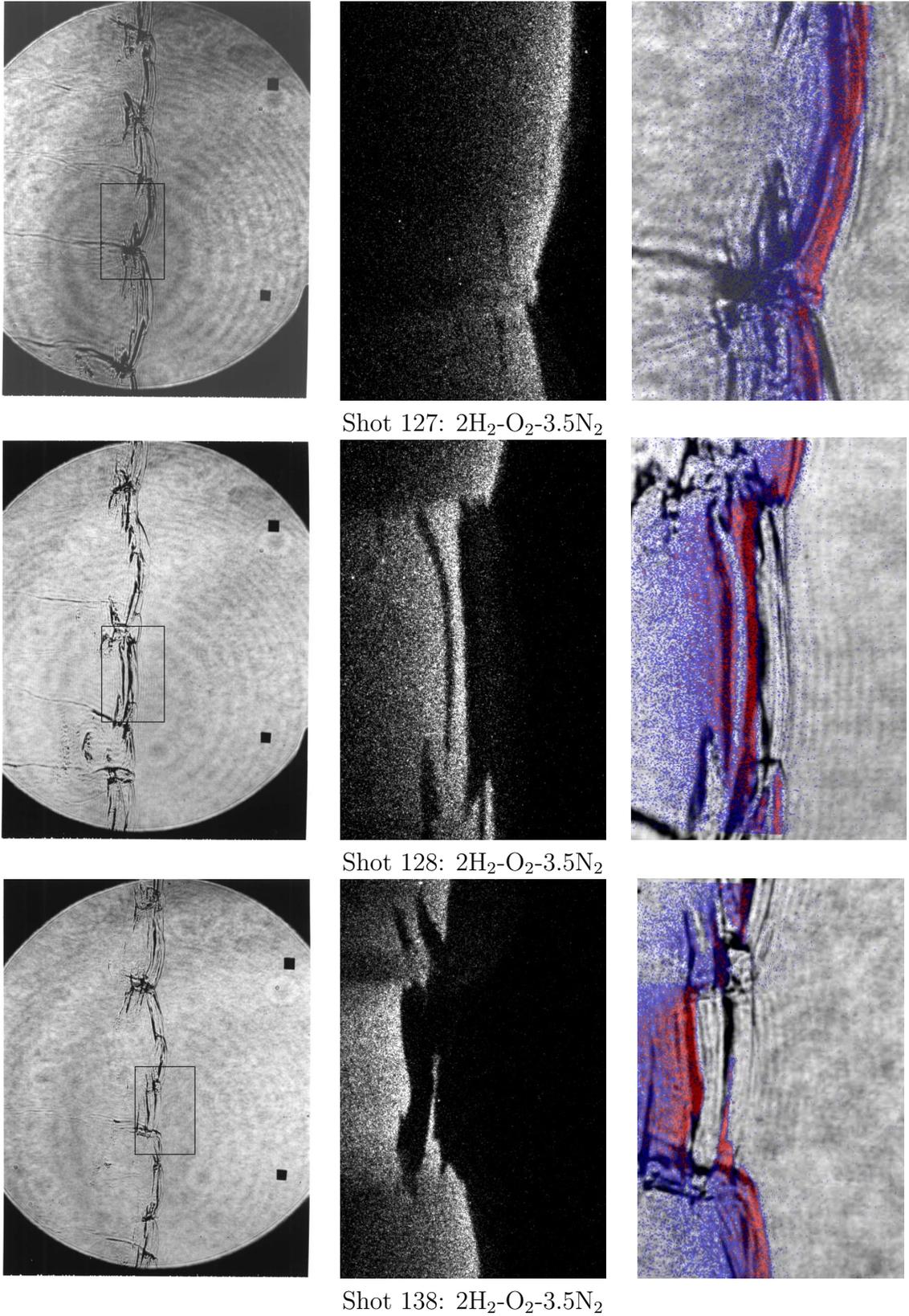
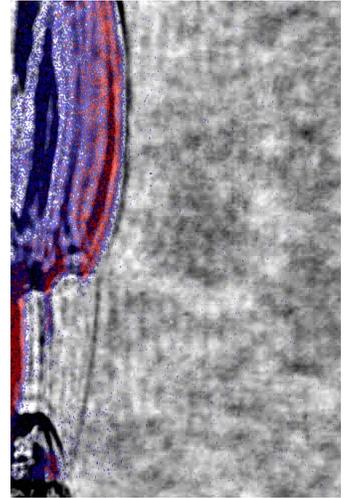
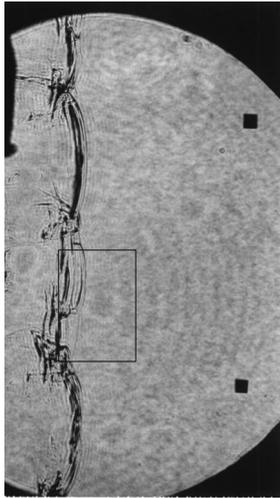
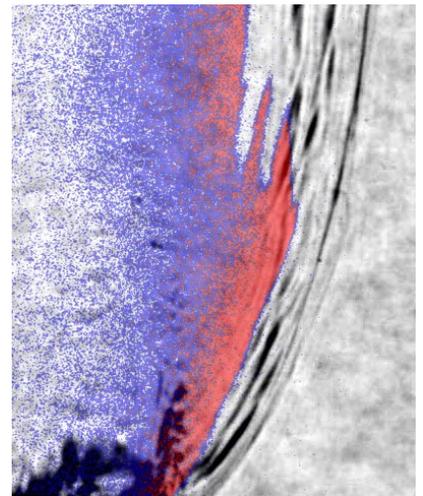
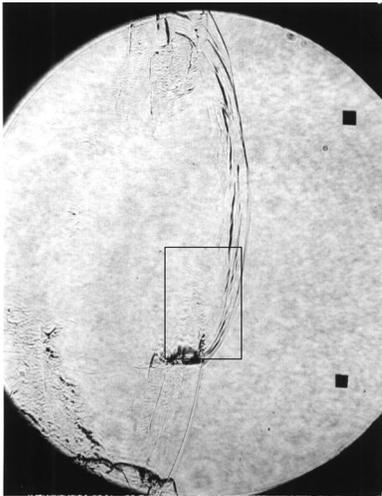
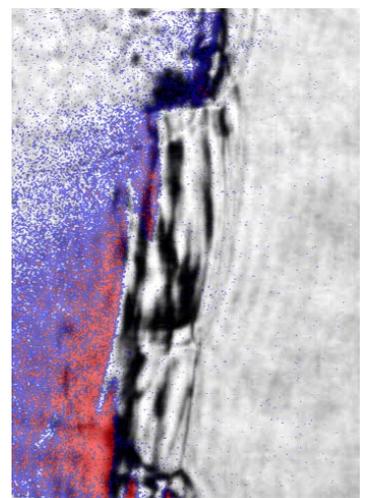
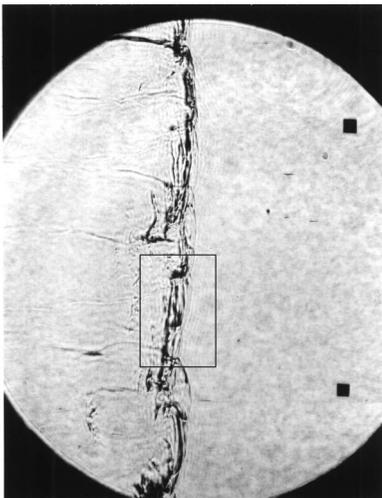
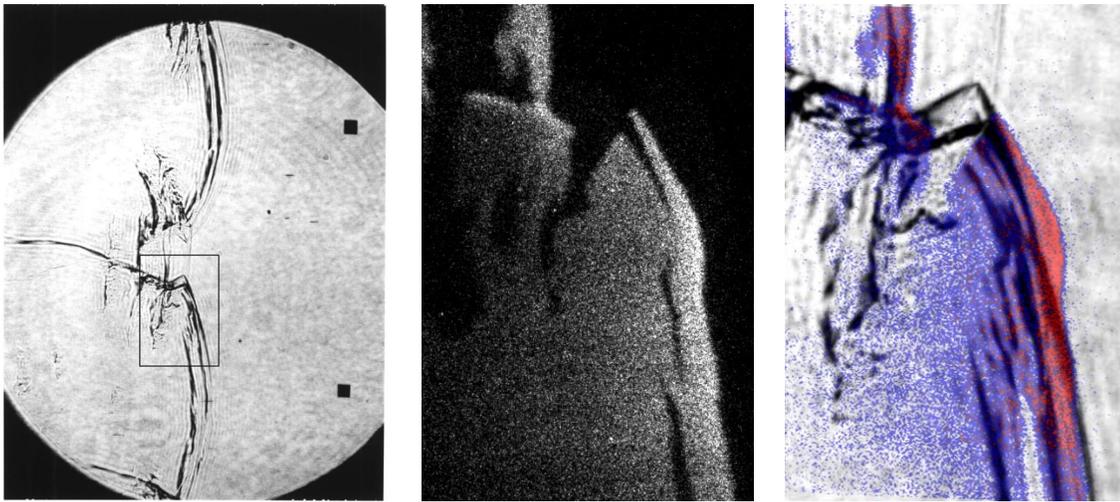
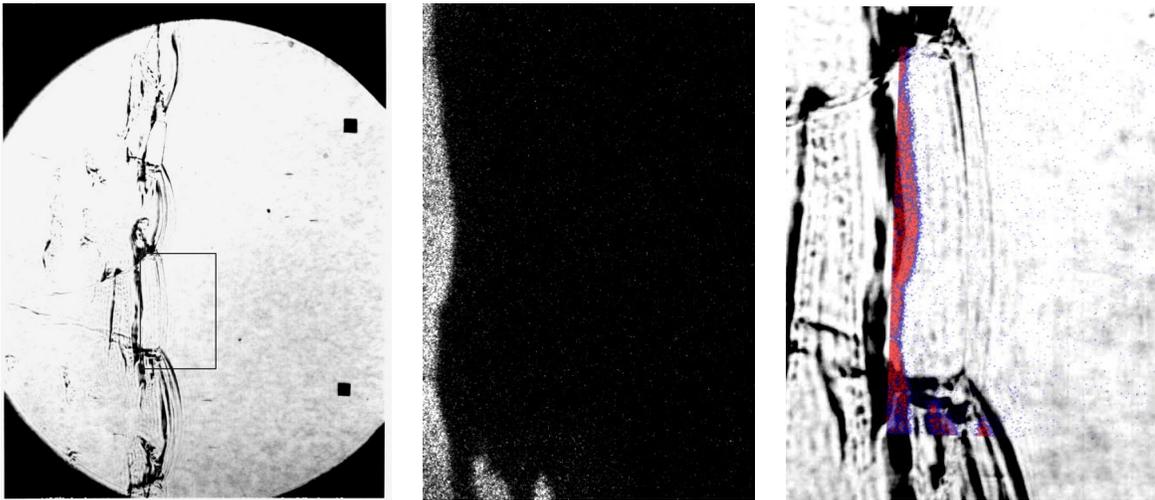
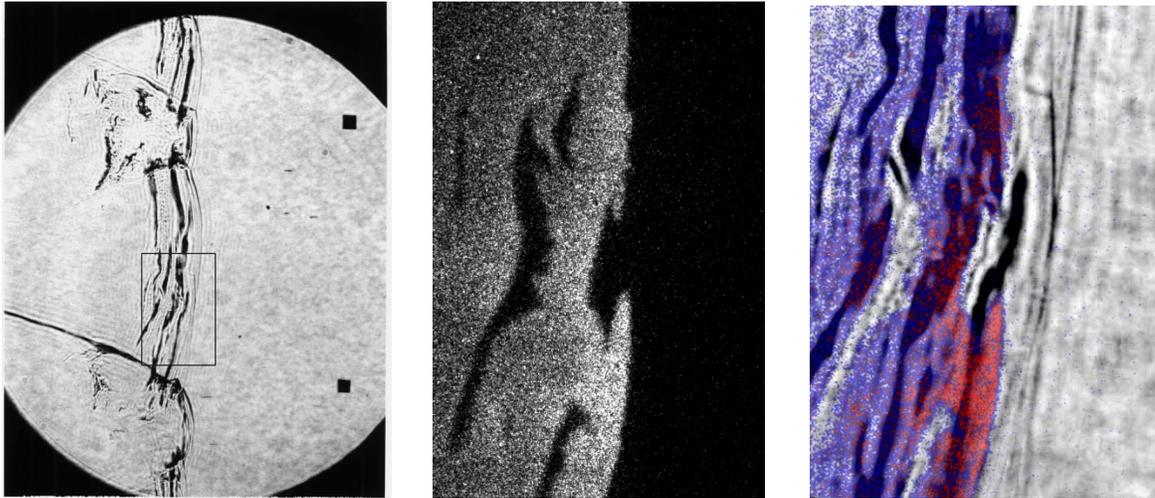
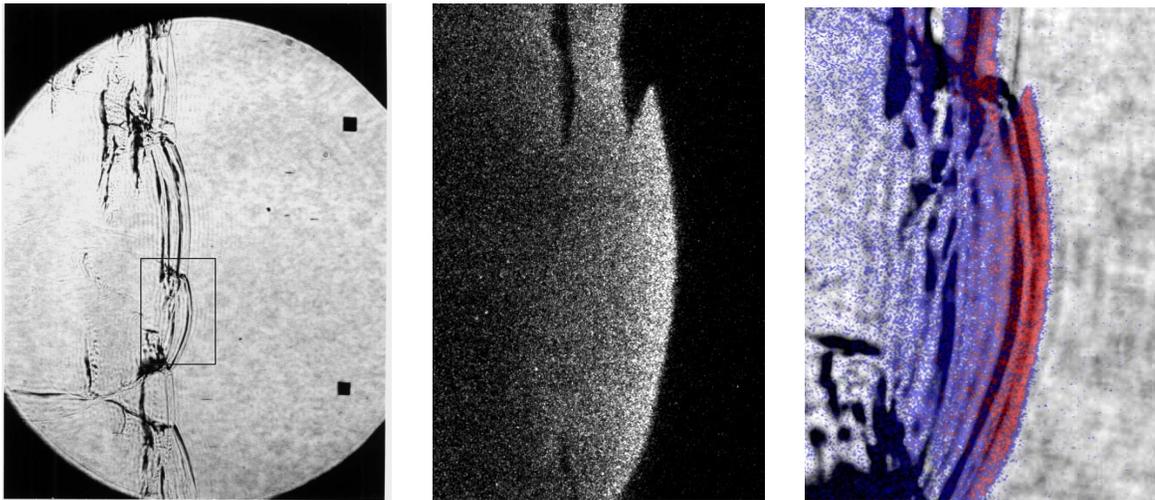
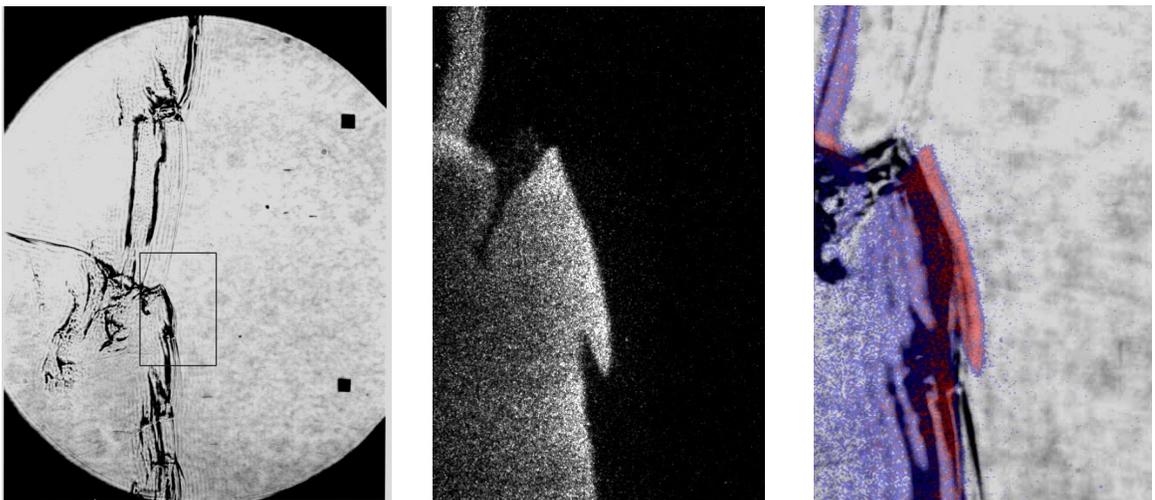


Figure A.20: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Shot 146:  $1.76\text{H}_2\text{-O}_2\text{-}3.7\text{N}_2$ Shot 151:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$ Shot 157:  $2\text{H}_2\text{-O}_2\text{-}3.5\text{N}_2$ Figure A.21: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Shot 166:  $2\text{H}_2\text{-O}_2\text{-5.6N}_2$ Figure A.22: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .Shot 167:  $2\text{H}_2\text{-O}_2\text{-5.6N}_2$ Figure A.23: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Shot 168:  $2.4\text{H}_2\text{-O}_2\text{-}5.5\text{N}_2$ Shot 169:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$ Shot 170:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$ Figure A.24: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

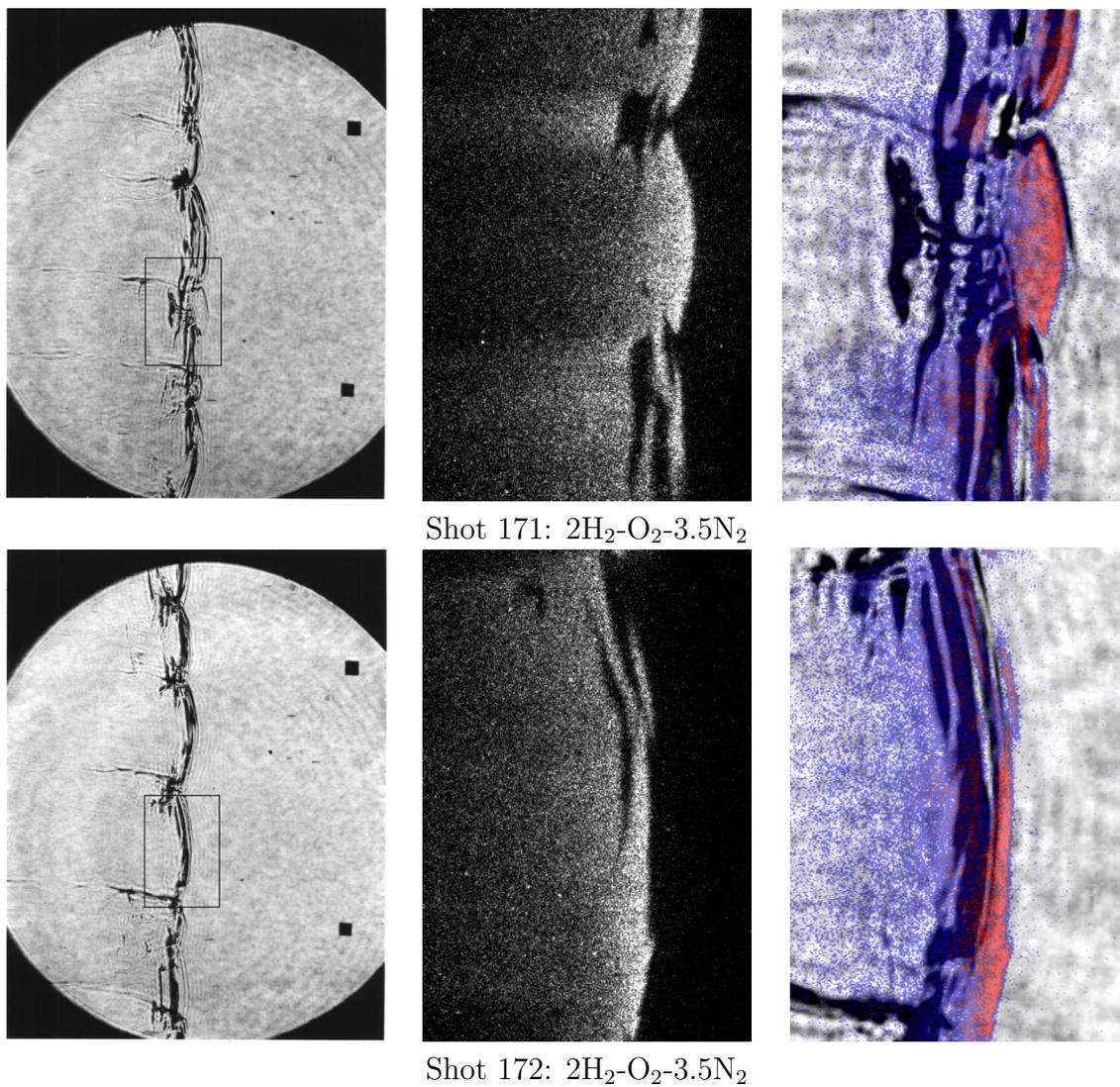
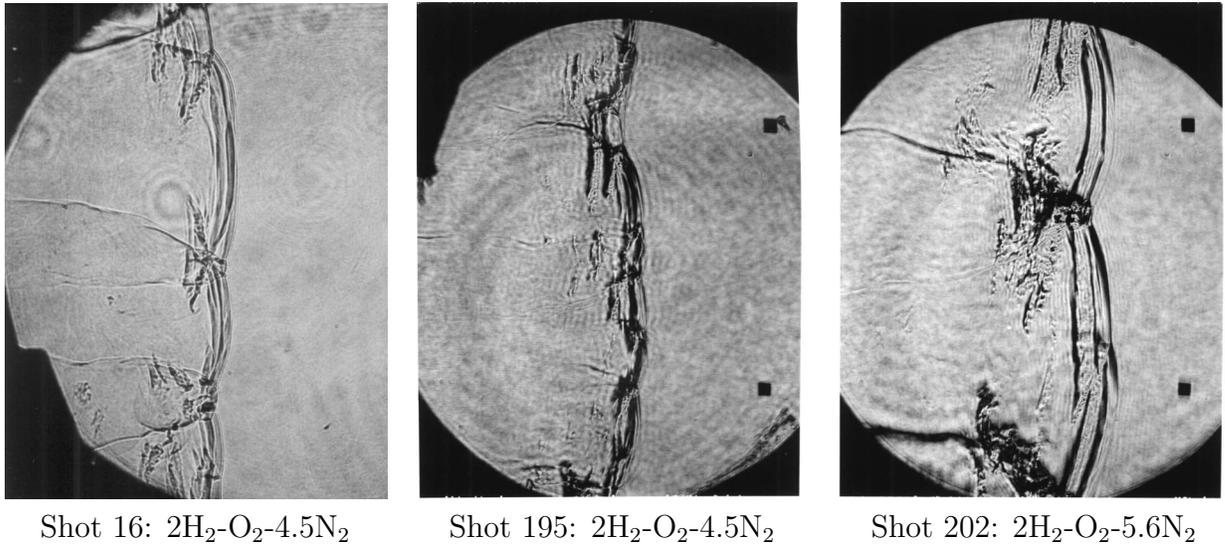
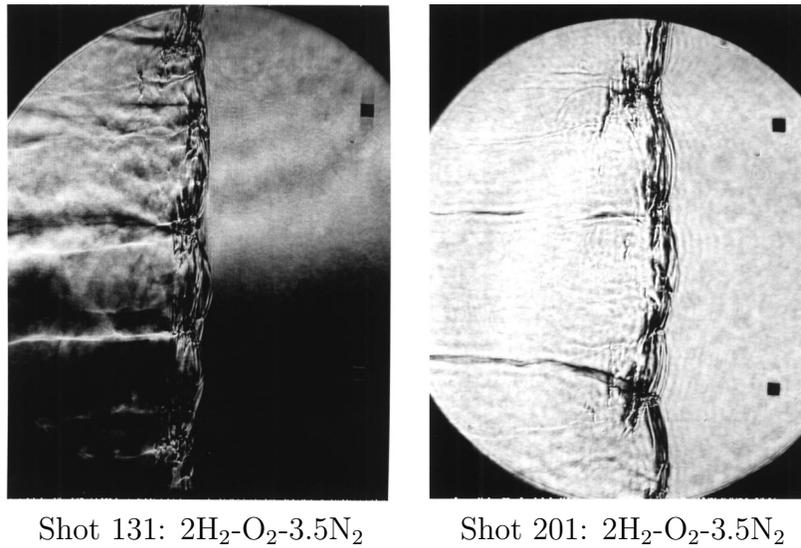


Figure A.25: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

Figure A.26: Schlieren images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .Figure A.27: Schlieren images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-O}_2$ .

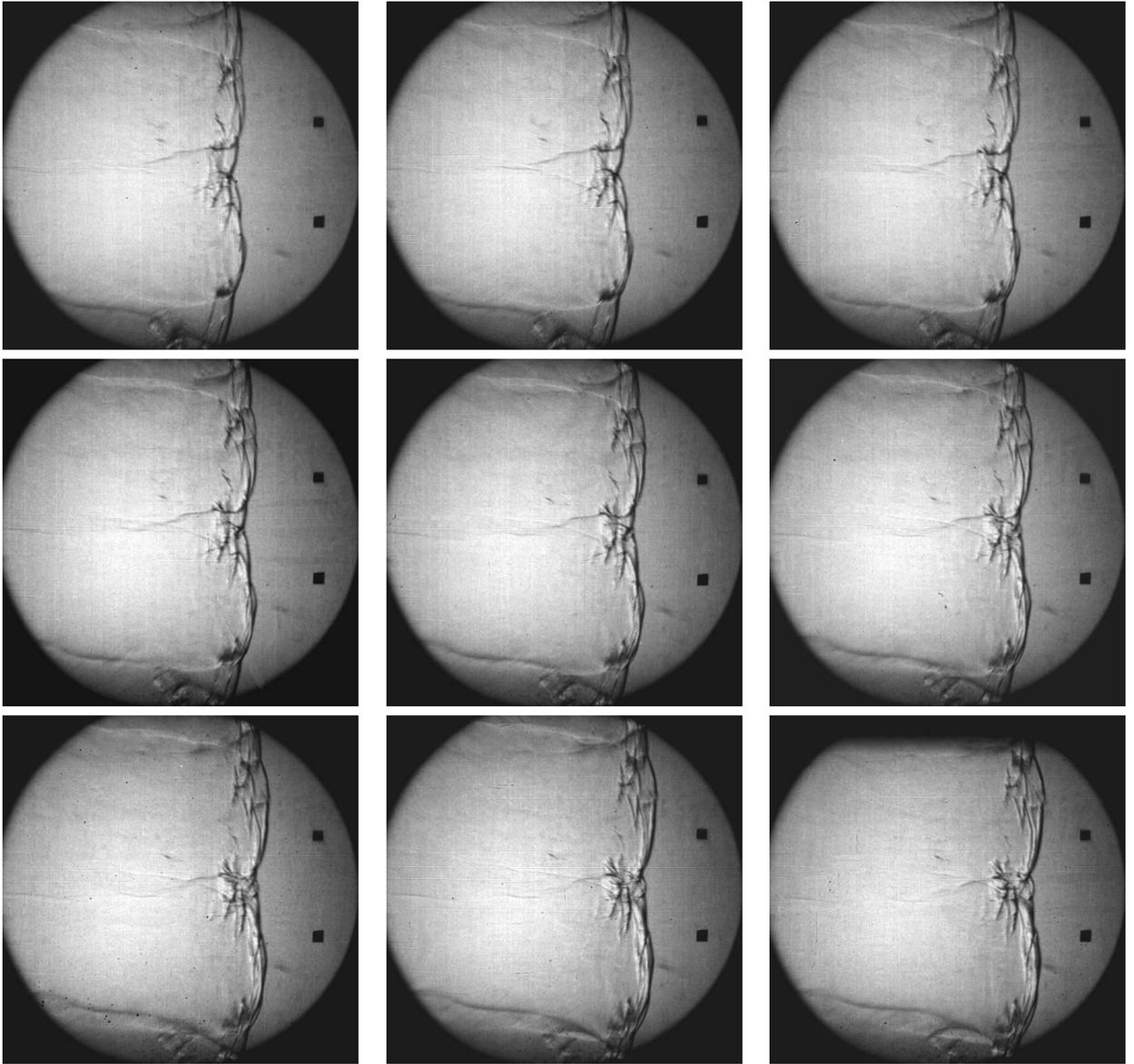
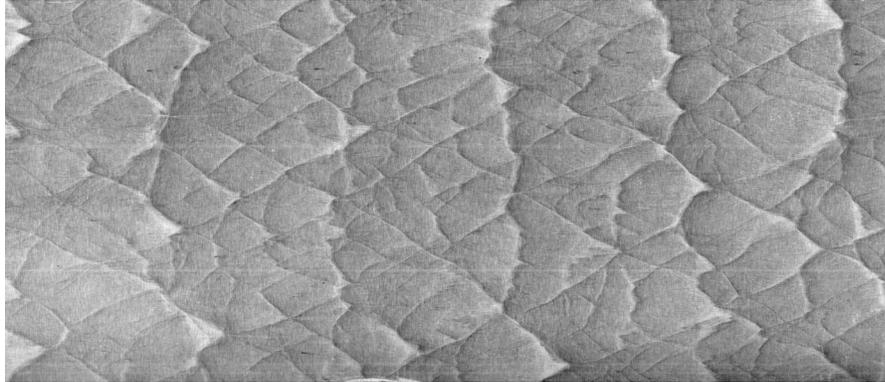
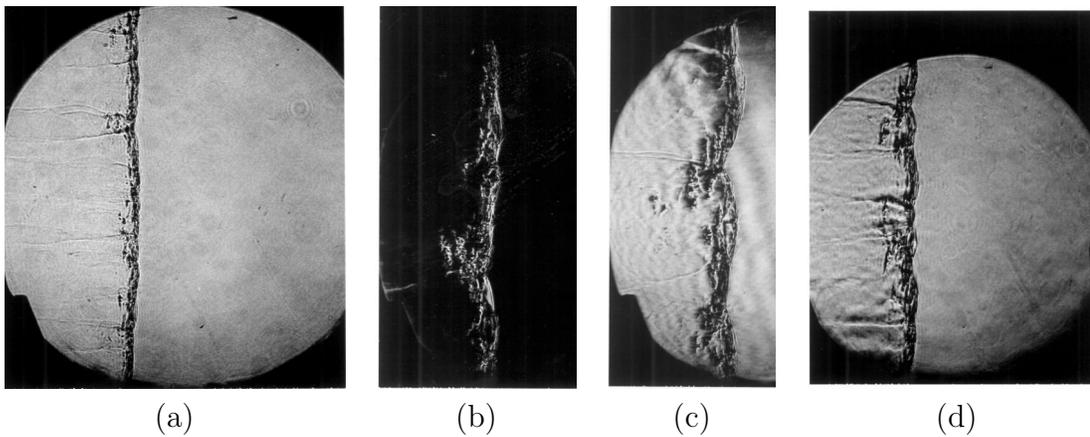


Figure A.28: Shot 267:  $2\text{H}_2\text{-O}_2\text{-}5.6\text{N}_2$  frames 16-24. Field of view is about 138 mm.

Shot 45:  $2\text{H}_2\text{-O}_2\text{-CO}_2$ Figure A.29: Soot foil in  $\text{CO}_2$ -diluted  $\text{H}_2\text{-O}_2$ .Figure A.30: Schlieren images in  $\text{CO}_2$ -diluted  $\text{H}_2\text{-O}_2$ . (a) Shot 26:  $2\text{H}_2\text{-O}_2\text{-}0.57\text{CO}_2$ . (b) Shot 27:  $2\text{H}_2\text{-O}_2\text{-CO}_2$ . (c) Shot 28:  $2\text{H}_2\text{-O}_2\text{-CO}_2$ . (d) Shot 31:  $2\text{H}_2\text{-O}_2\text{-}0.75\text{CO}_2$ .

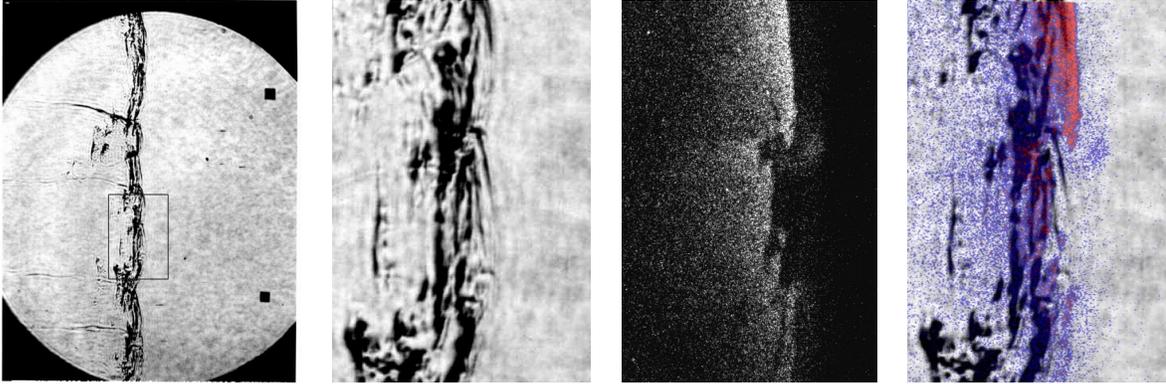


Figure A.31: Shot 164:  $2.06\text{H}_2\text{-O}_2\text{-}0.91\text{CO}_2$ ,  $P_o=21$  kPa

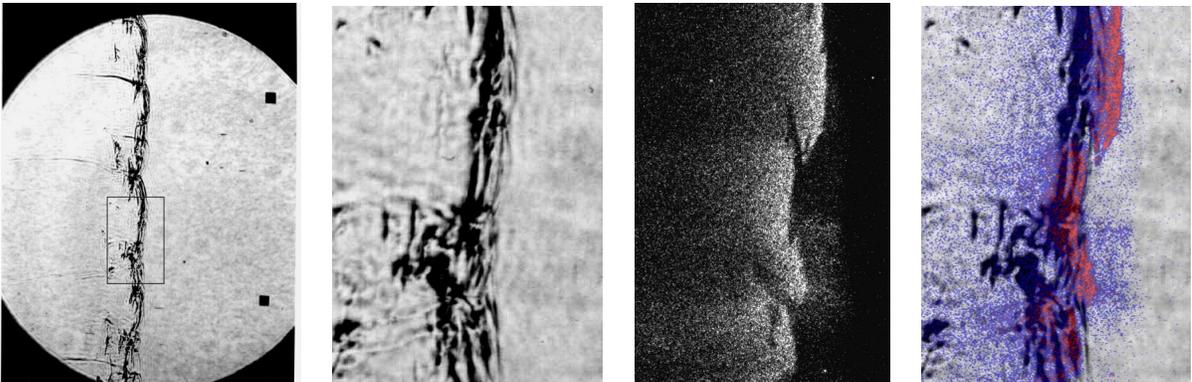
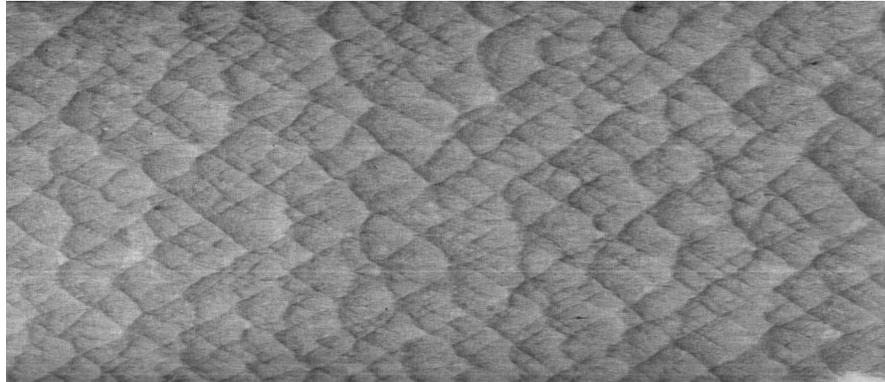
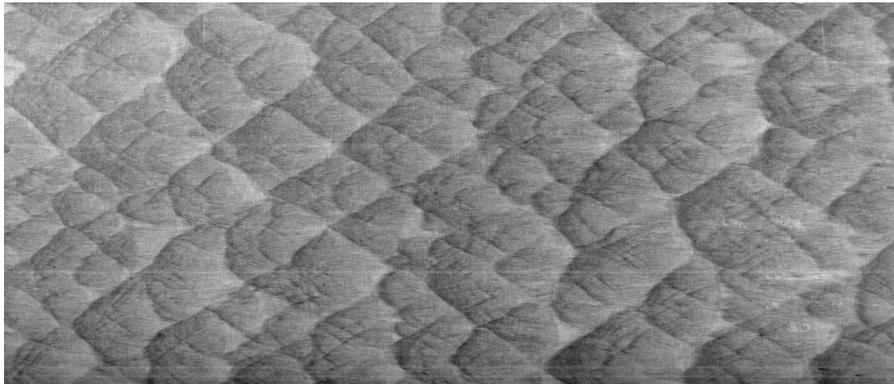


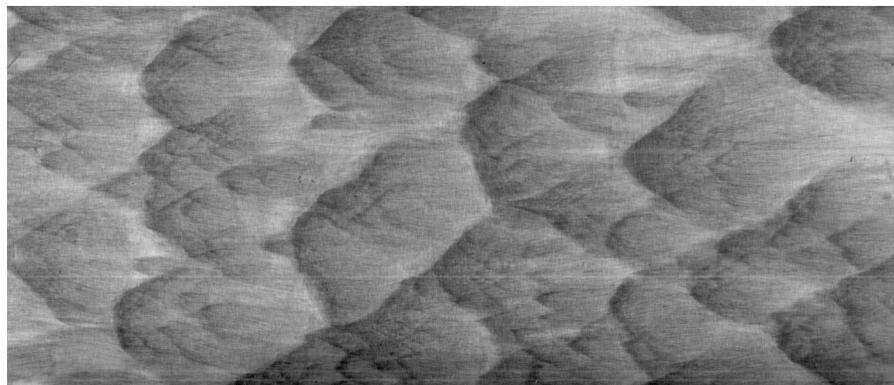
Figure A.32: Shot 165:  $2\text{H}_2\text{-O}_2\text{-CO}_2$



Shot 42:  $\text{H}_2\text{-N}_2\text{O-0.86N}_2$



Shot 43:  $\text{H}_2\text{-N}_2\text{O-1.33N}_2$



Shot 44:  $\text{H}_2\text{-N}_2\text{O-1.77N}_2$

Figure A.33: Soot foils in  $\text{H}_2\text{-N}_2\text{O-N}_2$  mixtures.

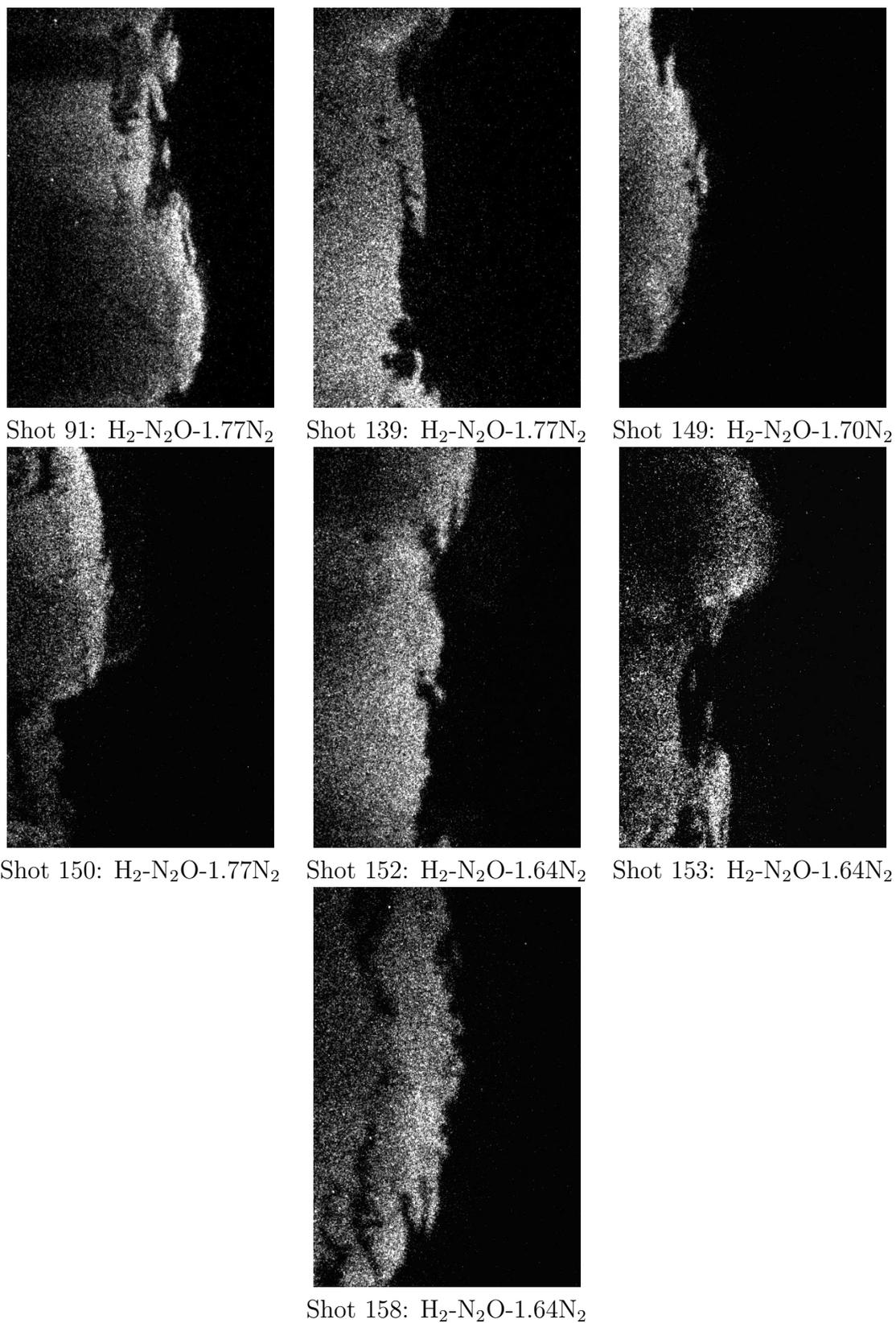
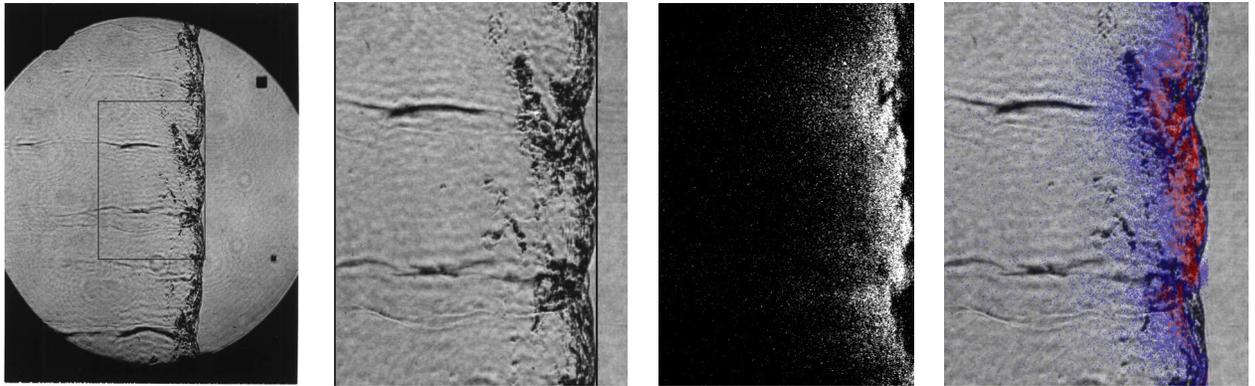
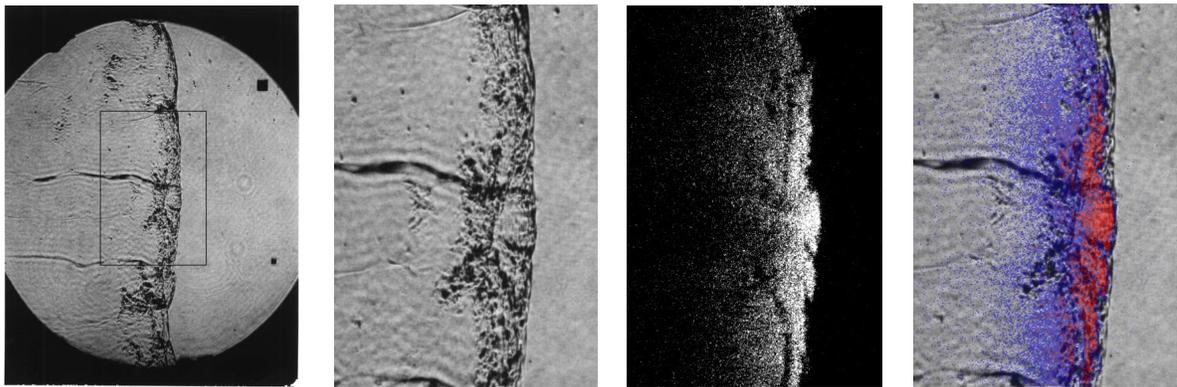
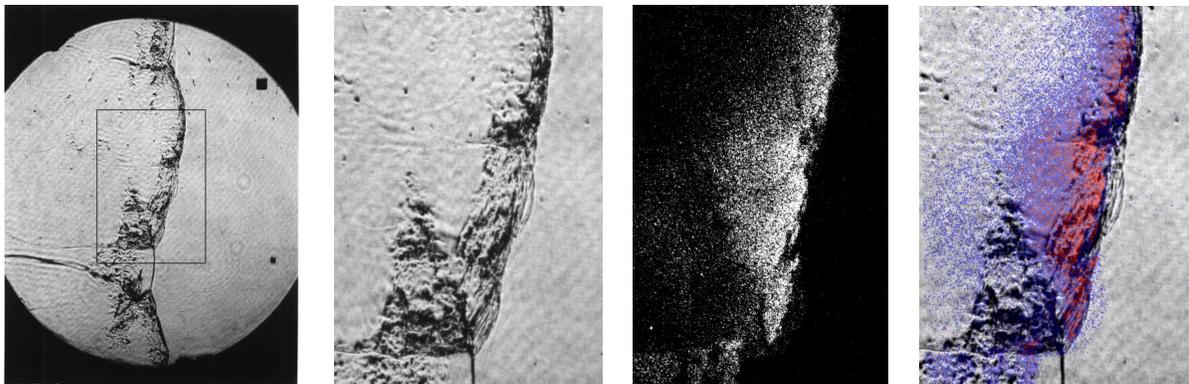
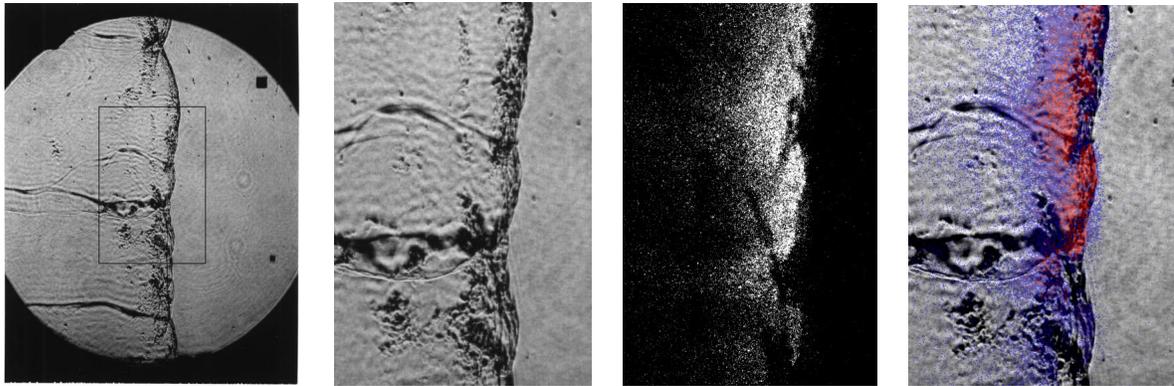
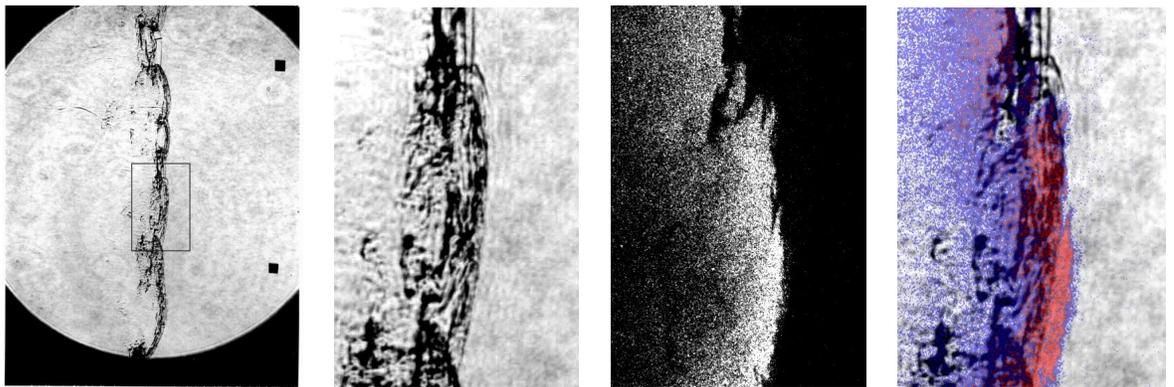
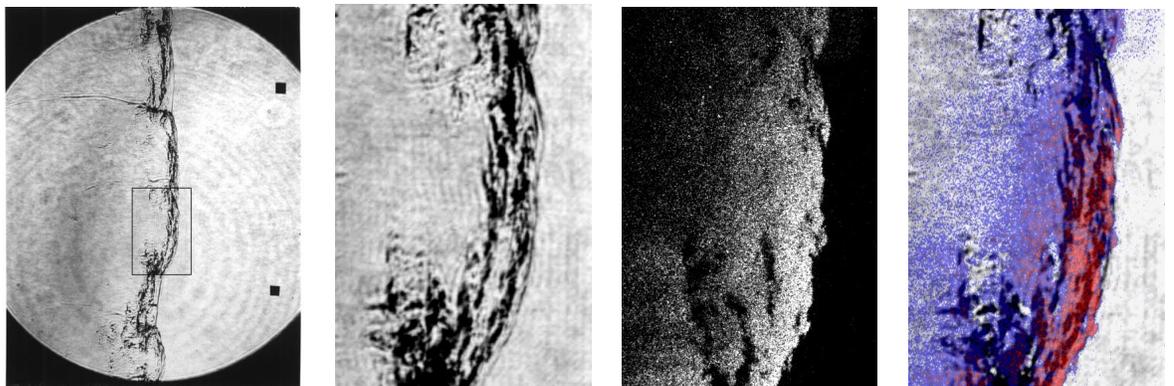
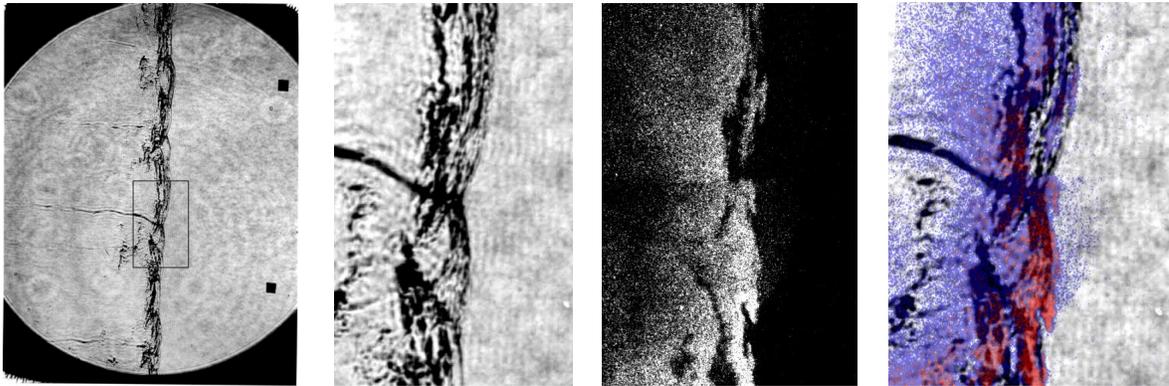
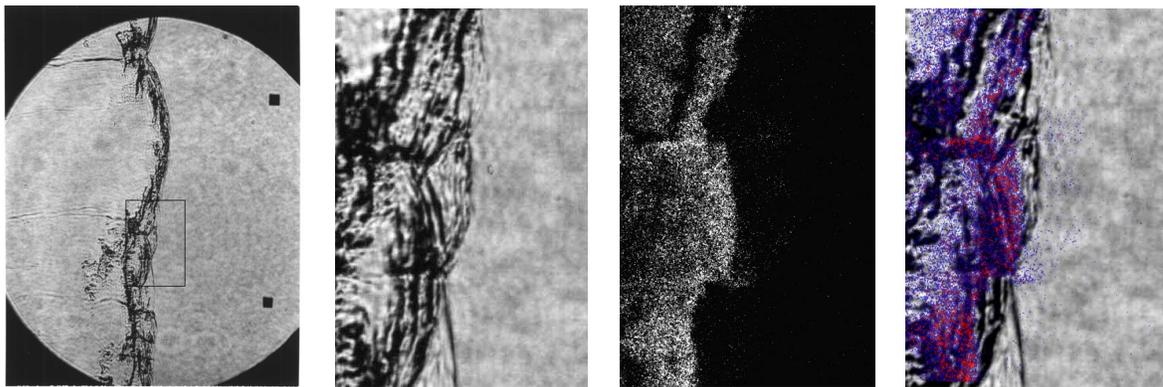
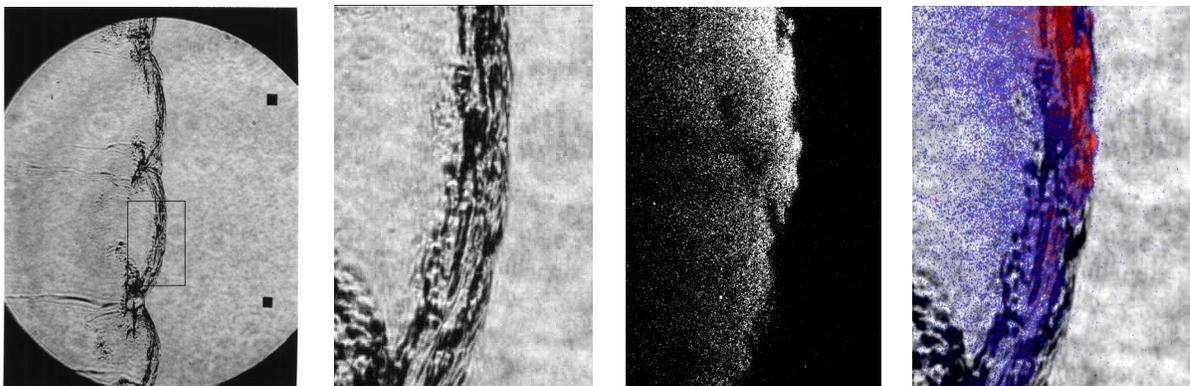
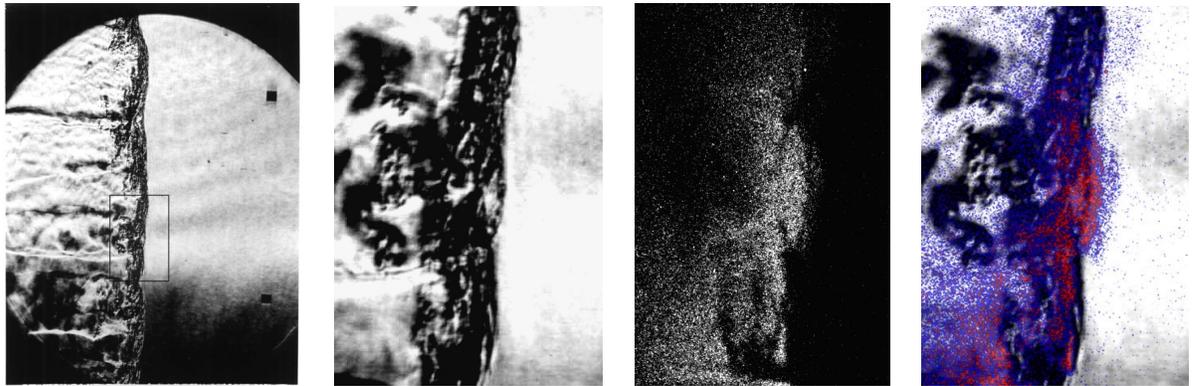
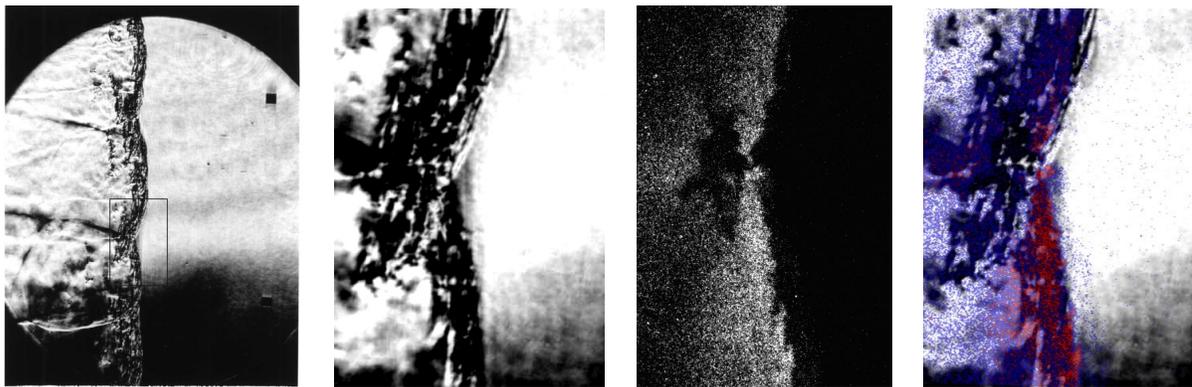
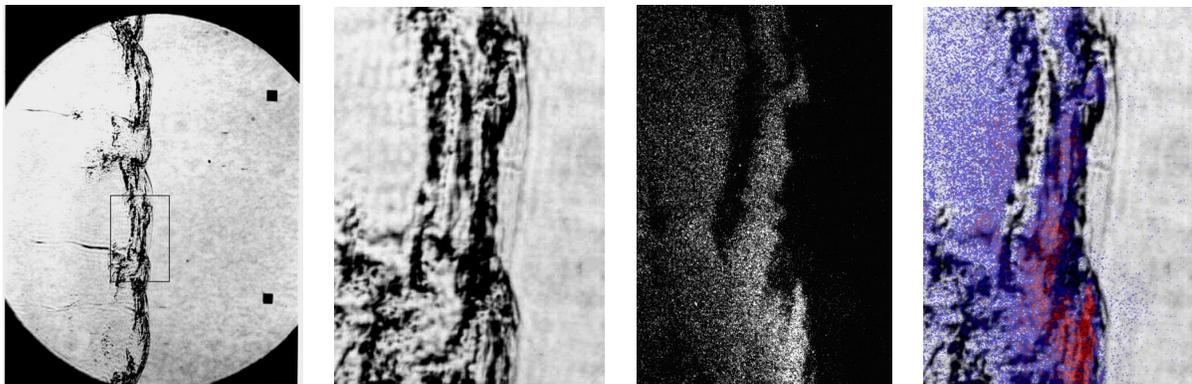


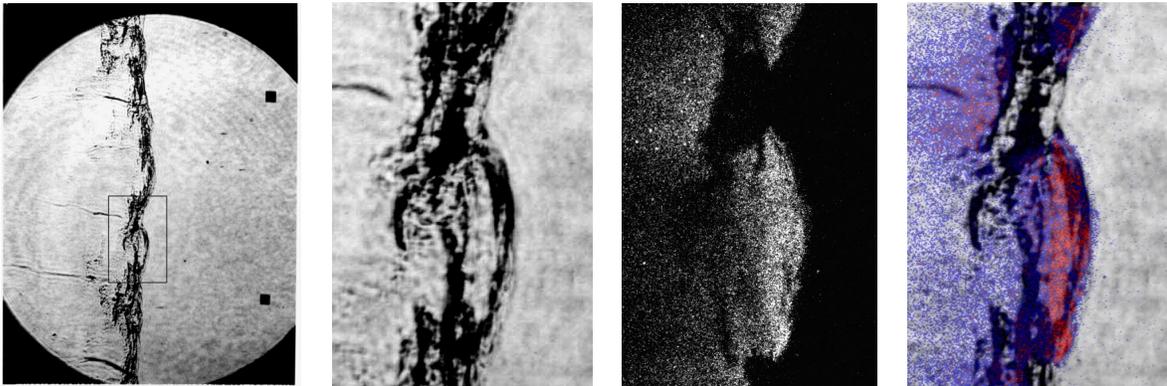
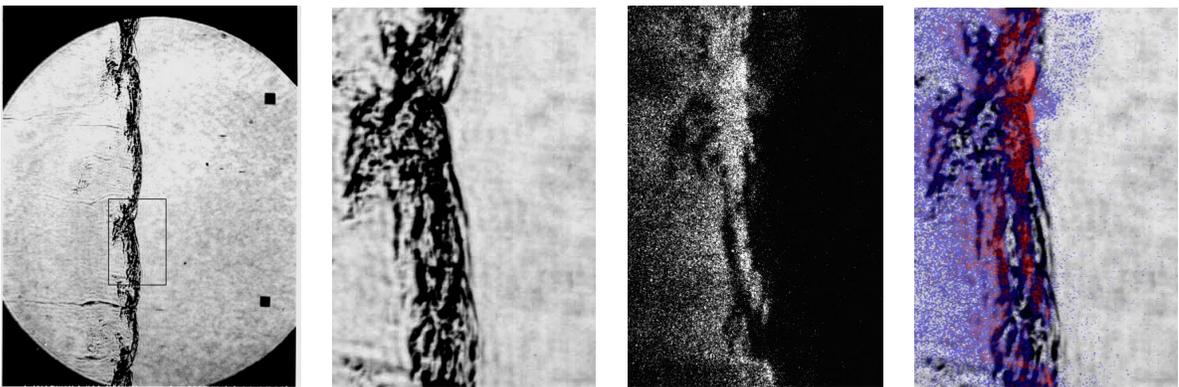
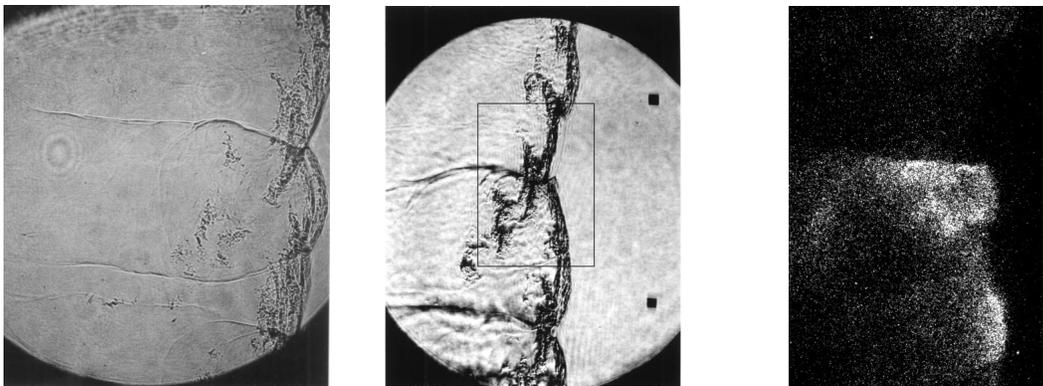
Figure A.34: OH fluorescence images in  $\text{H}_2\text{-N}_2\text{O-N}_2$  mixtures.

Shot 89:  $\text{H}_2\text{-N}_2\text{O-1.33N}_2$ Shot 92:  $\text{H}_2\text{-N}_2\text{O-1.77N}_2$ Shot 93:  $\text{H}_2\text{-N}_2\text{O-2N}_2$ Figure A.35: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-N}_2\text{O}$ .

Shot 94:  $\text{H}_2\text{-N}_2\text{O-2N}_2$ Shot 135:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Shot 136:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Figure A.36: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-N}_2\text{O}$ .

Shot 137:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Shot 147:  $\text{H}_2\text{-N}_2\text{O-1.77N}_2$ Shot 148:  $\text{H}_2\text{-N}_2\text{O-1.77N}_2$ Figure A.37: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-N}_2\text{O}$ .

Shot 159:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Shot 160:  $1.04\text{H}_2\text{-N}_2\text{O-1.60N}_2$ Shot 161:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Figure A.38: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{H}_2\text{-N}_2\text{O}$ .

Shot 162:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Shot 163:  $\text{H}_2\text{-N}_2\text{O-1.33N}_2$ Shot 17:  $\text{H}_2\text{-N}_2\text{O-2N}_2$ Shot 203:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Shot 203:  $\text{H}_2\text{-N}_2\text{O-1.64N}_2$ Figure A.39: Images of detonation in  $\text{N}_2$ -diluted  $\text{H}_2\text{-N}_2\text{O}$ .

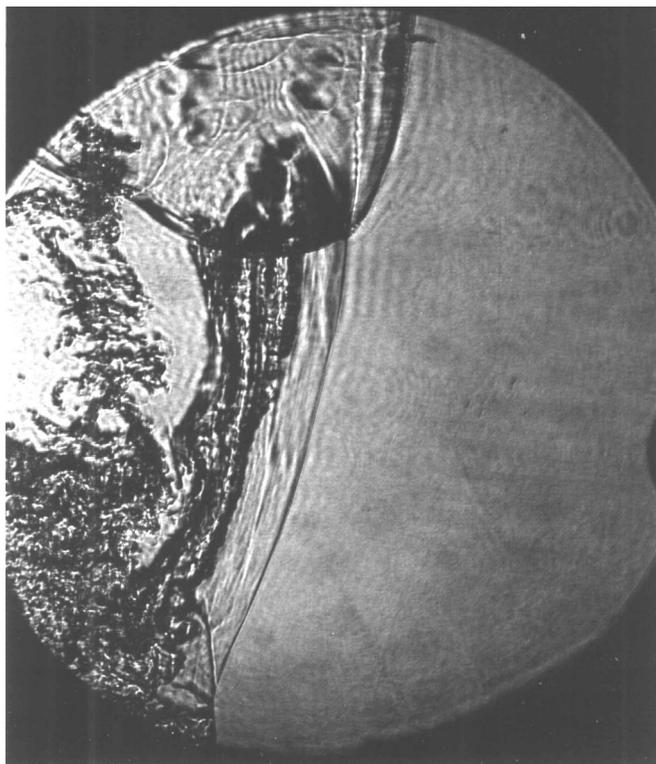
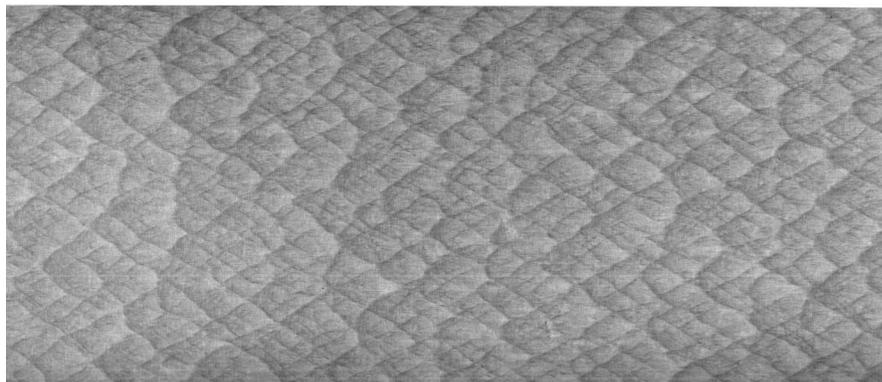
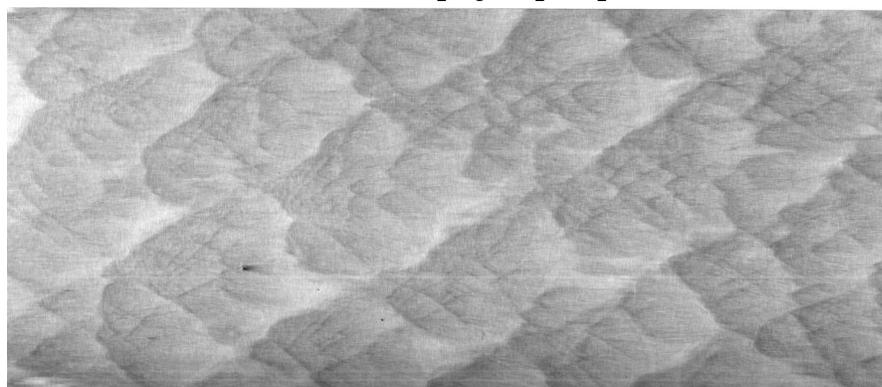
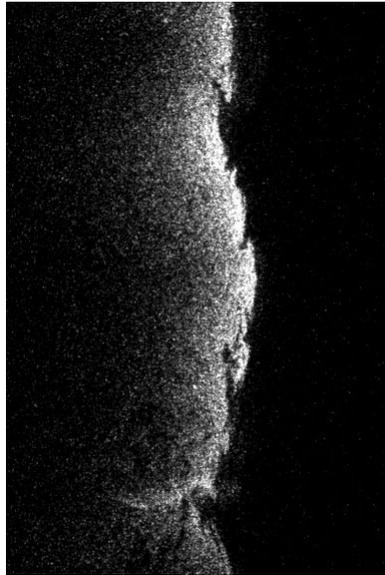
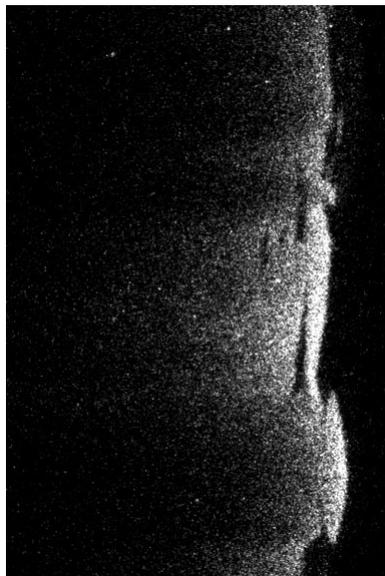
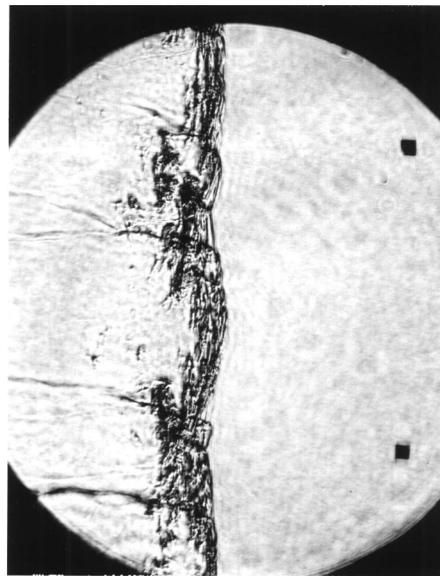
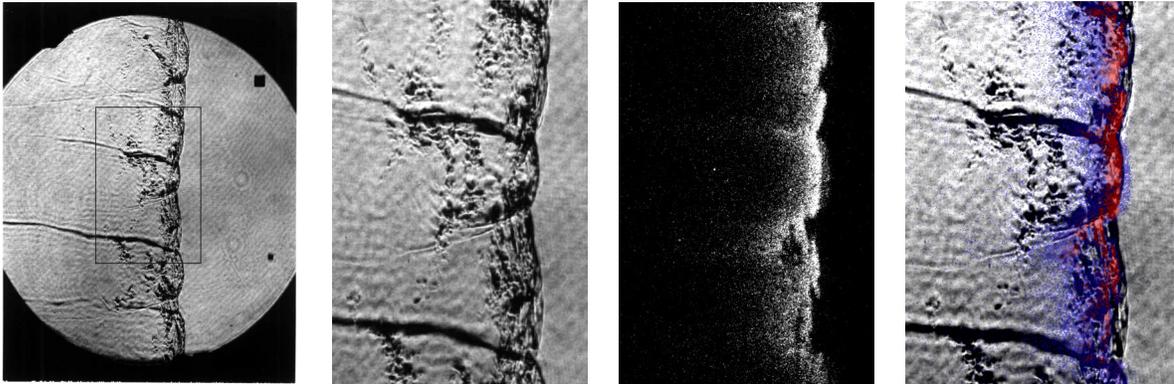
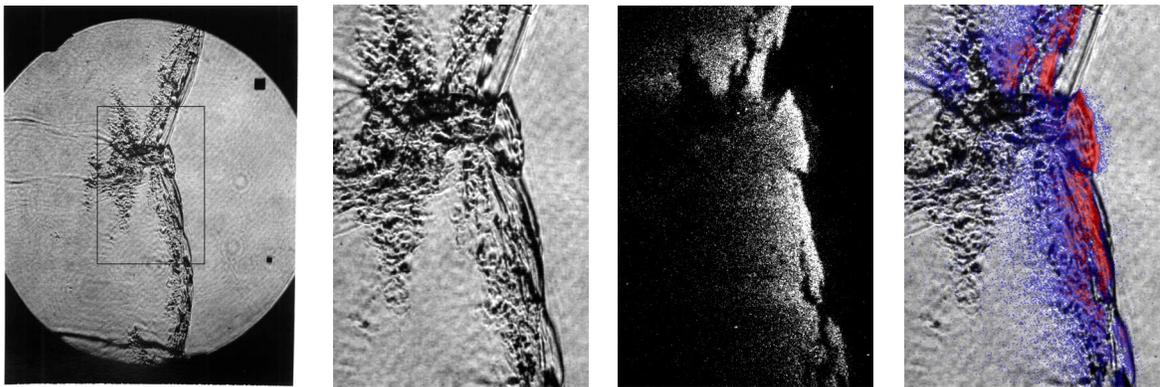
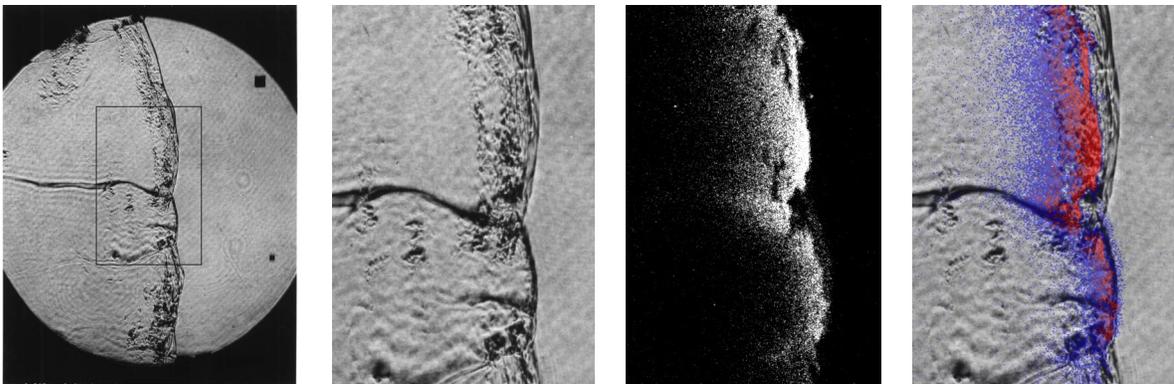
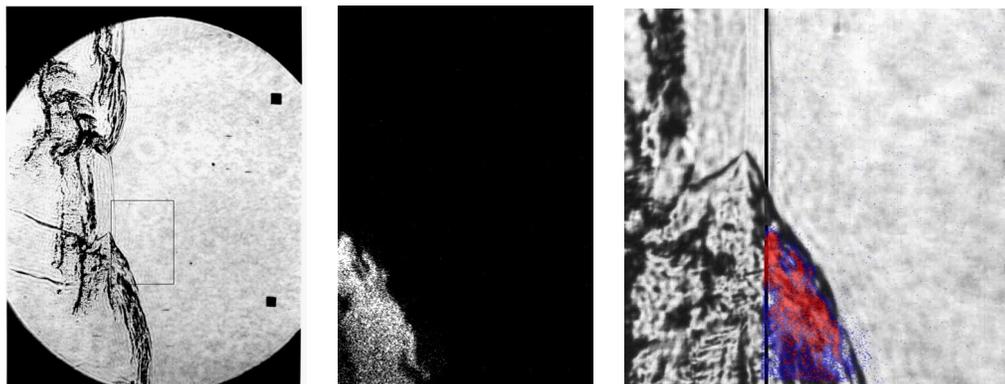
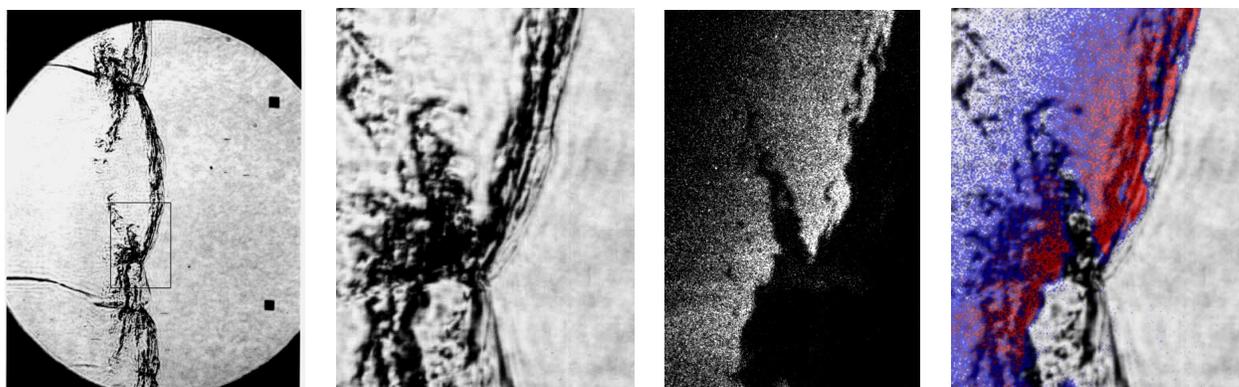


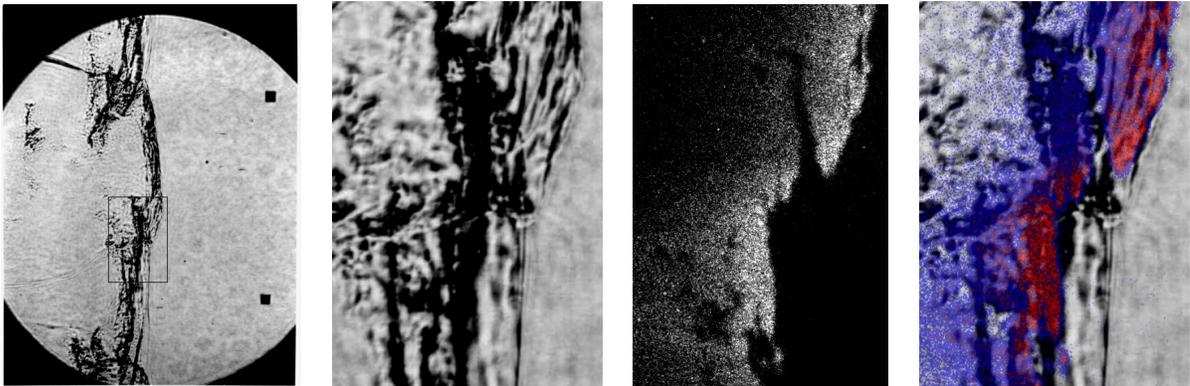
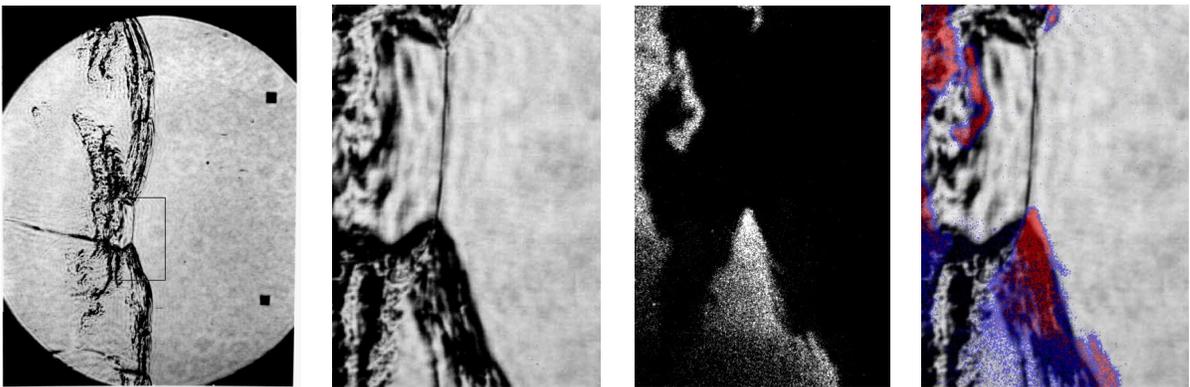
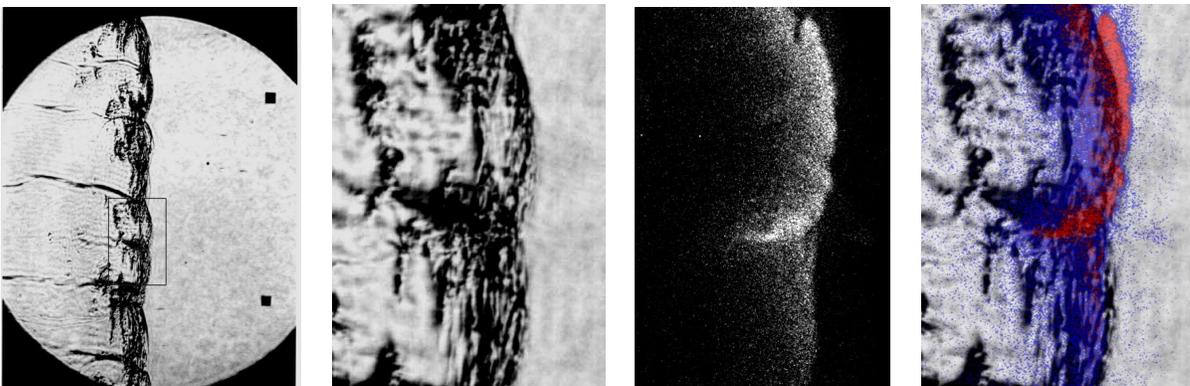
Figure A.40: Shot 33:  $\text{CH}_4\text{-2O}_2\text{-2N}_2$

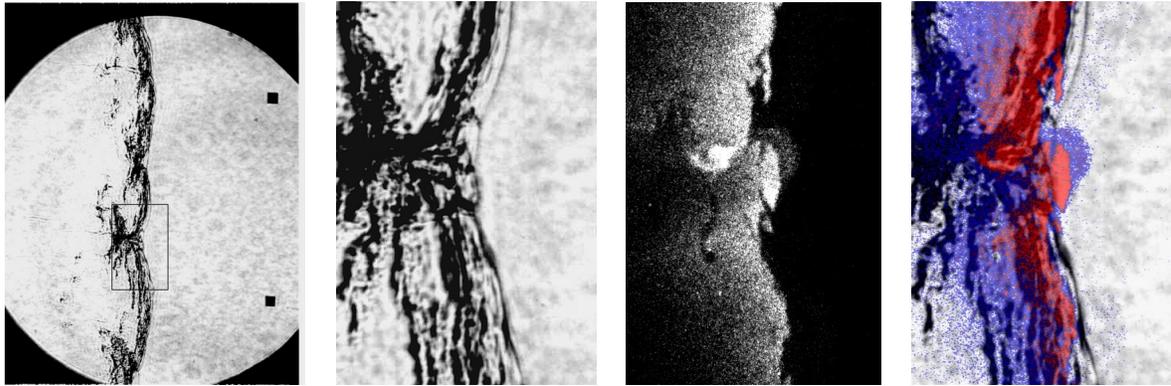
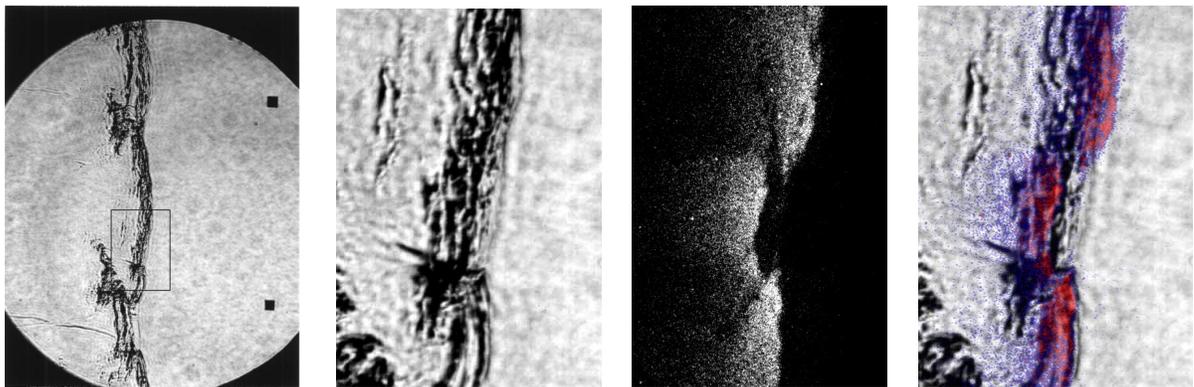
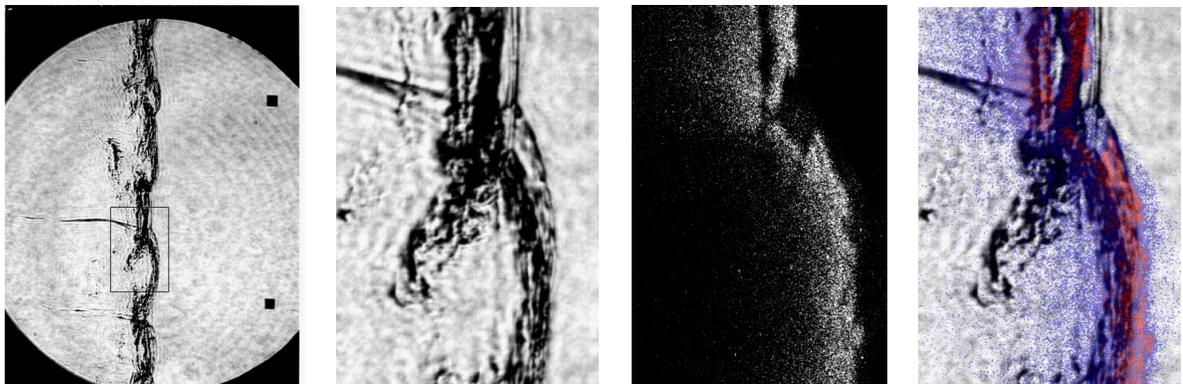
Shot 49:  $C_2H_4-3O_2-5N_2$ Shot 50:  $C_2H_4-3O_2-9N_2$ Figure A.41: Soot foils in  $N_2$ -diluted  $C_2H_4-3O_2-N_2$ . Image height is 150 mm.

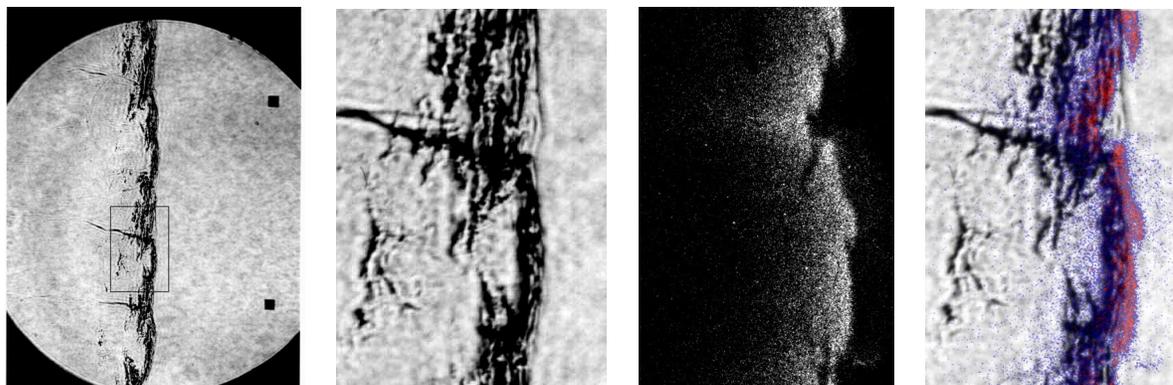
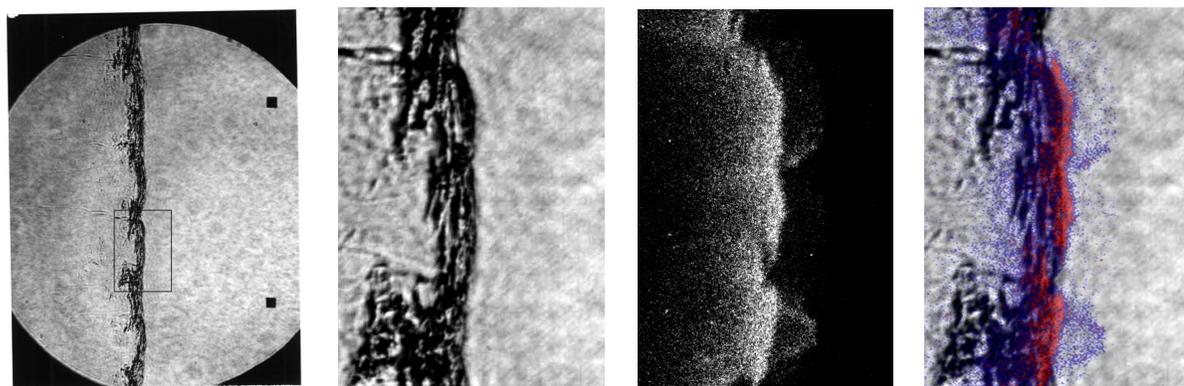
Shot 69:  $C_2H_4-3O_2-9N_2$ Shot 84:  $C_2H_4-3O_2-9N_2$ Shot 88:  $C_2H_4-3O_2-10.5N_2$ Shot 196:  $C_2H_4-3O_2-8N_2$ Figure A.42: Images of detonation in  $N_2$ -diluted  $C_2H_4-3O_2$ .

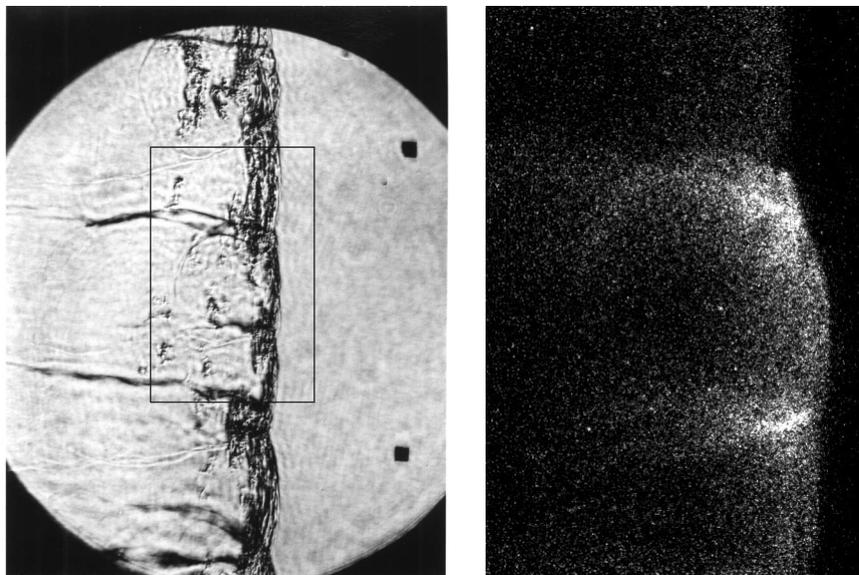
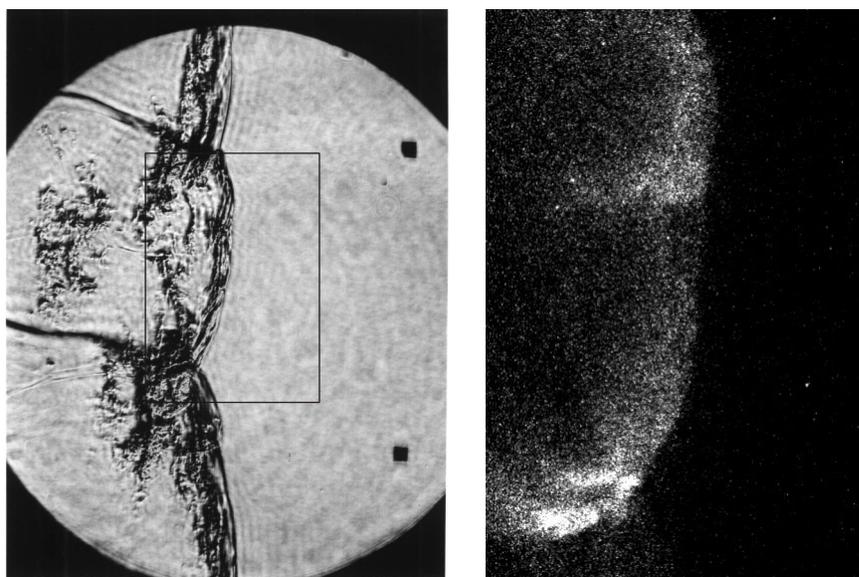
Shot 85:  $C_2H_4-3O_2-9N_2$ Shot 86:  $C_2H_4-3O_2-10.5N_2$ Shot 87:  $C_2H_4-3O_2-10.5N_2$ Figure A.43: Superimposed schlieren and OH fluorescence images in  $N_2$ -diluted  $C_2H_4-3O_2$ .

Shot 173:  $\text{C}_2\text{H}_4\text{-3O}_2\text{-10.5N}_2$ Shot 175:  $\text{C}_2\text{H}_4\text{-3O}_2\text{-10.5N}_2$ Figure A.44: Superimposed schlieren and OH fluorescence images in  $\text{N}_2$ -diluted  $\text{C}_2\text{H}_4\text{-3O}_2$ .

Shot 176:  $C_2H_4-3O_2-10.5N_2$ Shot 177:  $C_2H_4-3O_2-10.5N_2$ Shot 178:  $C_2H_4-3O_2-8N_2$ ,  $P_o = 27$  kPaFigure A.45: Superimposed schlieren and OH fluorescence images in  $N_2$ -diluted  $C_2H_4-3O_2$ .

Shot 180:  $C_2H_4-3O_2-8N_2$ Shot 181:  $C_2H_4-3O_2-8N_2$ Shot 182:  $C_2H_4-3O_2-8N_2$ Figure A.46: Superimposed schlieren and OH fluorescence images in  $N_2$ -diluted  $C_2H_4-3O_2$ .

Shot 183:  $C_2H_4-3O_2-8N_2$ Shot 184:  $C_2H_4-3O_2-6N_2$ Figure A.47: Superimposed schlieren and OH fluorescence images in  $N_2$ -diluted  $C_2H_4-3O_2$ .

Shot 199:  $\text{C}_2\text{H}_4\text{-3O}_2\text{-8N}_2$ Shot 200:  $\text{C}_2\text{H}_4\text{-3O}_2\text{-10.5N}_2$ Figure A.48: Superimposed schlieren and chemiluminescence images in  $\text{N}_2$ -diluted  $\text{C}_2\text{H}_4\text{-3O}_2$ .

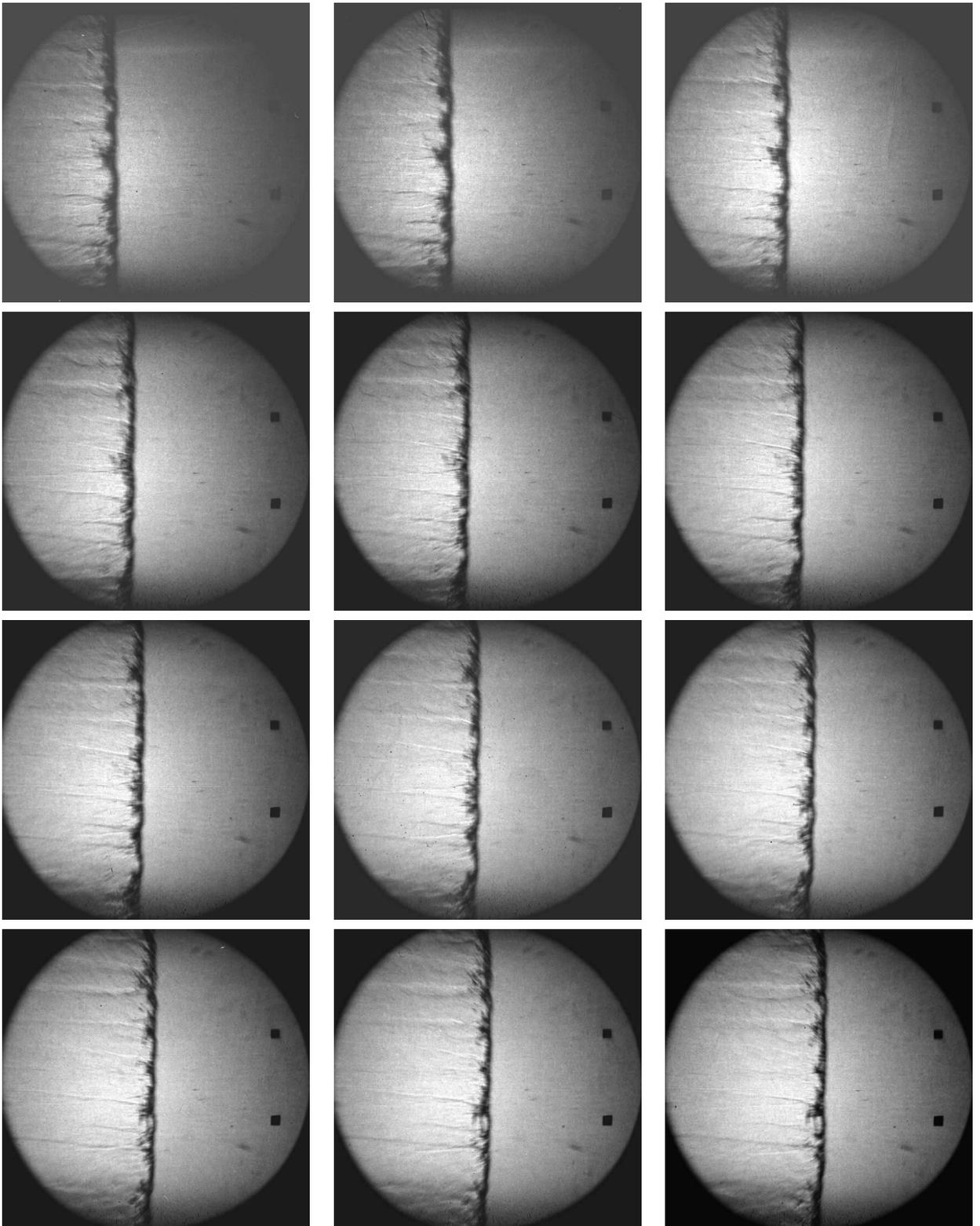


Figure A.49: Shot 268:  $C_2H_4-3O_2-6N_2$  frames 1-12. Field of view is about 138 mm.

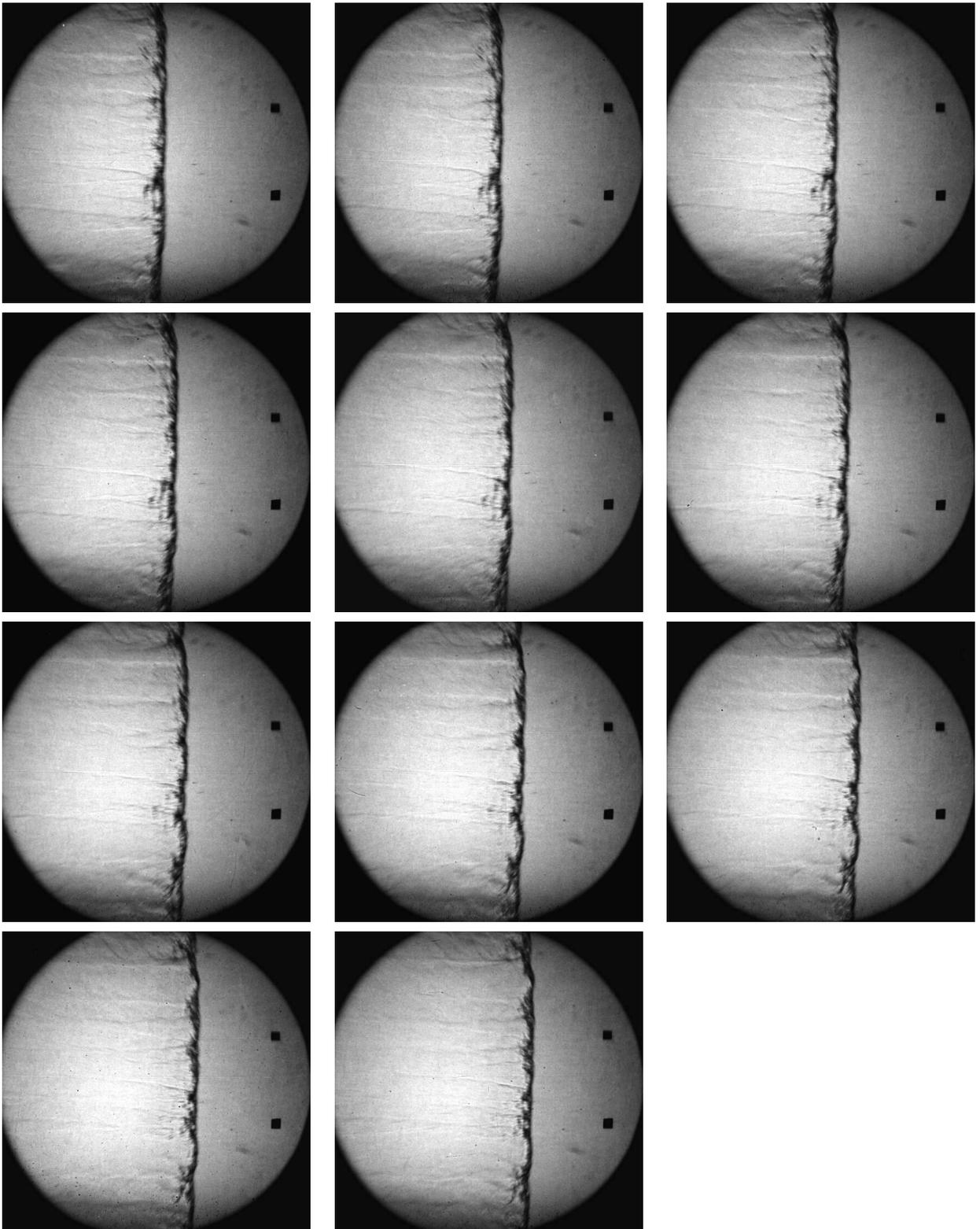


Figure A.50: Shot 268:  $C_2H_4-3O_2-6N_2$  frames 13-23. Field of view is about 138 mm.

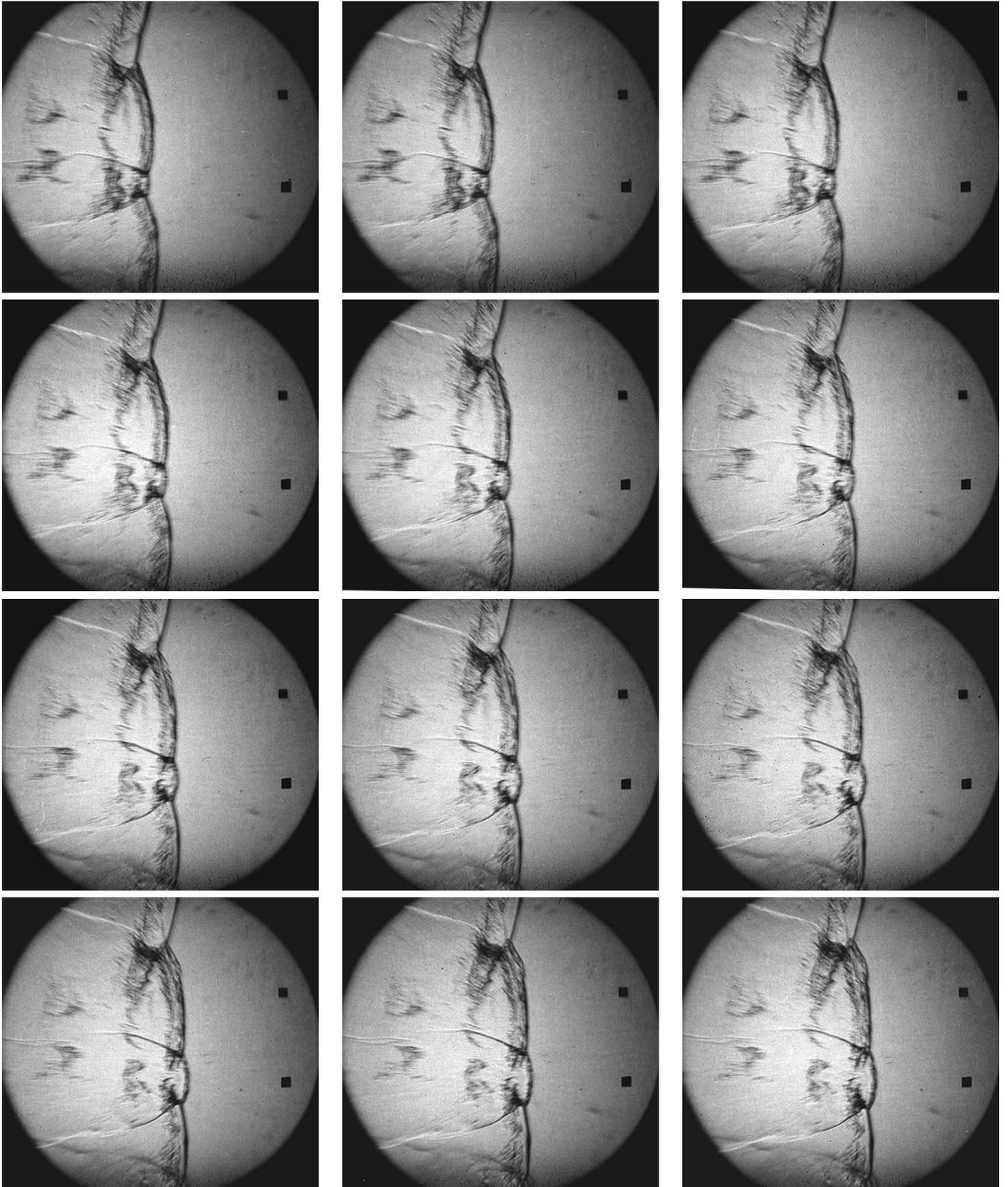


Figure A.51: Shot 251:  $C_2H_4-3O_2-10.5N_2$  frames 1-12. Field of view is about 138 mm.

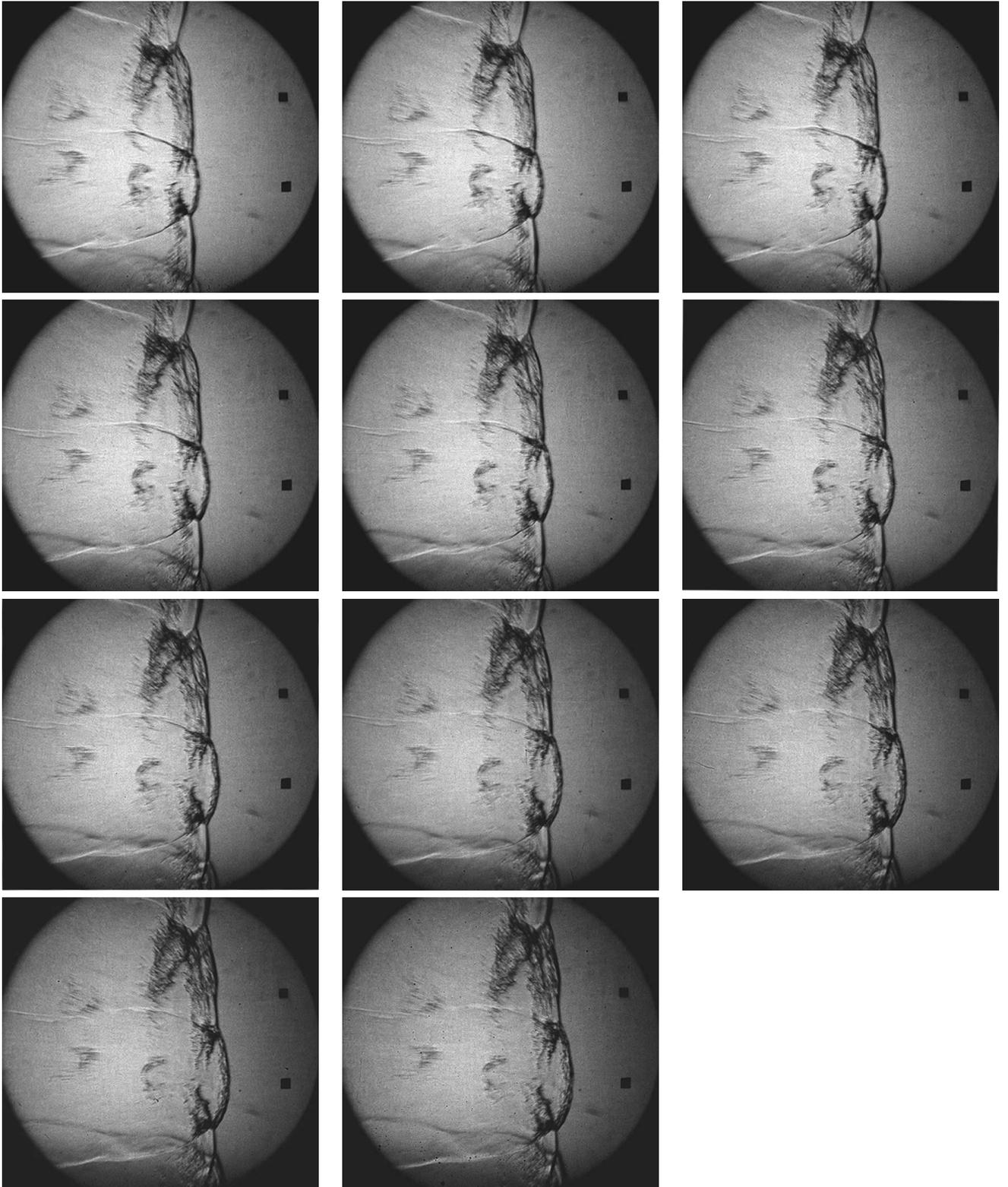
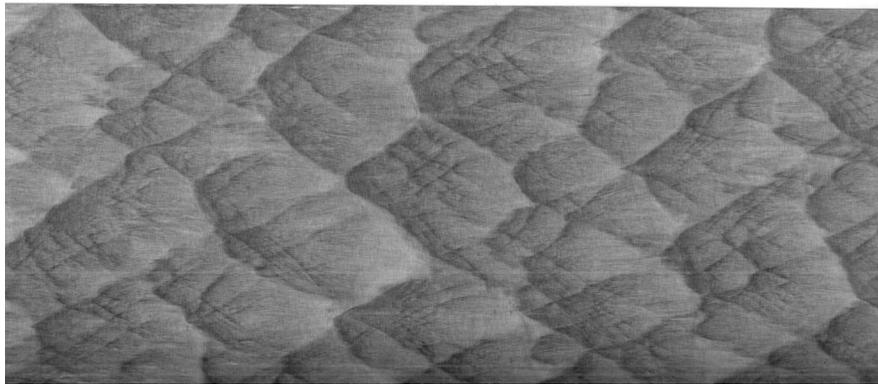
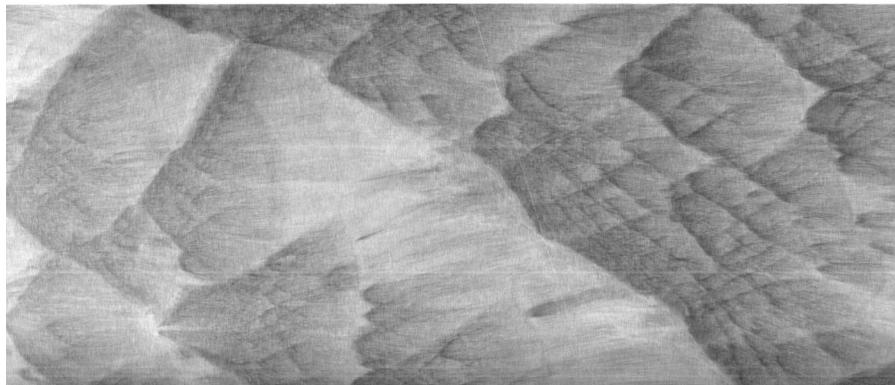
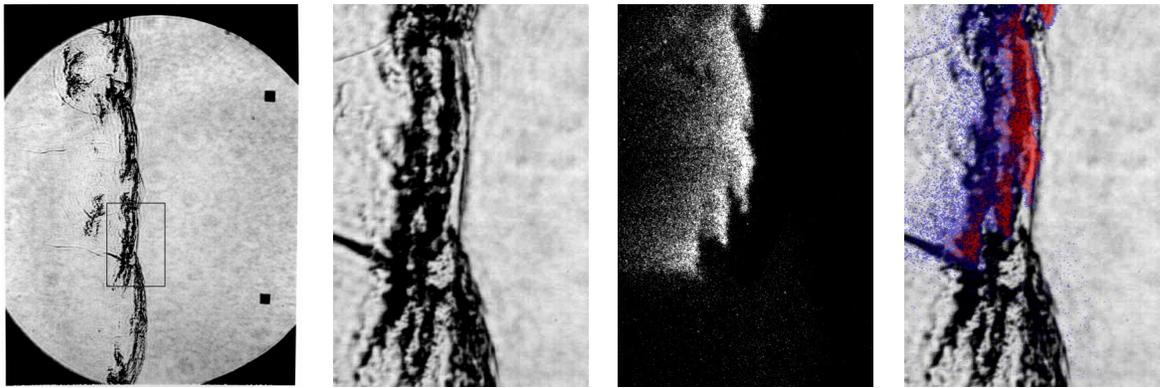
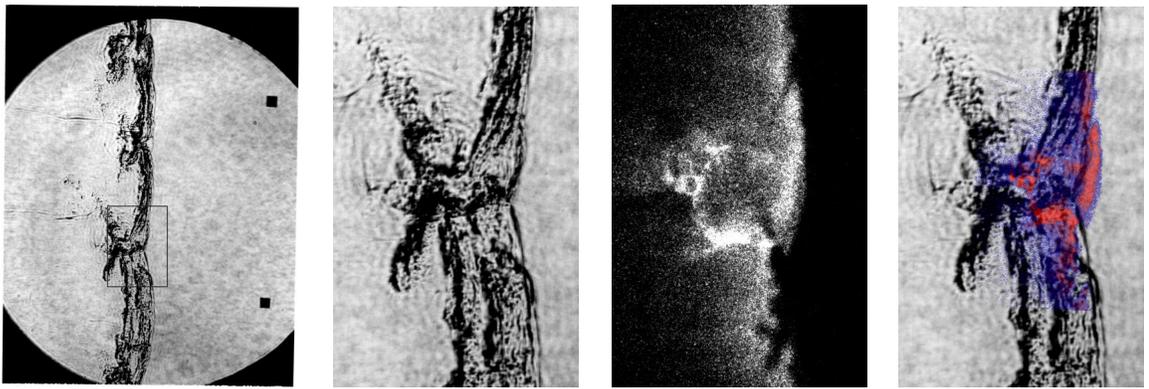
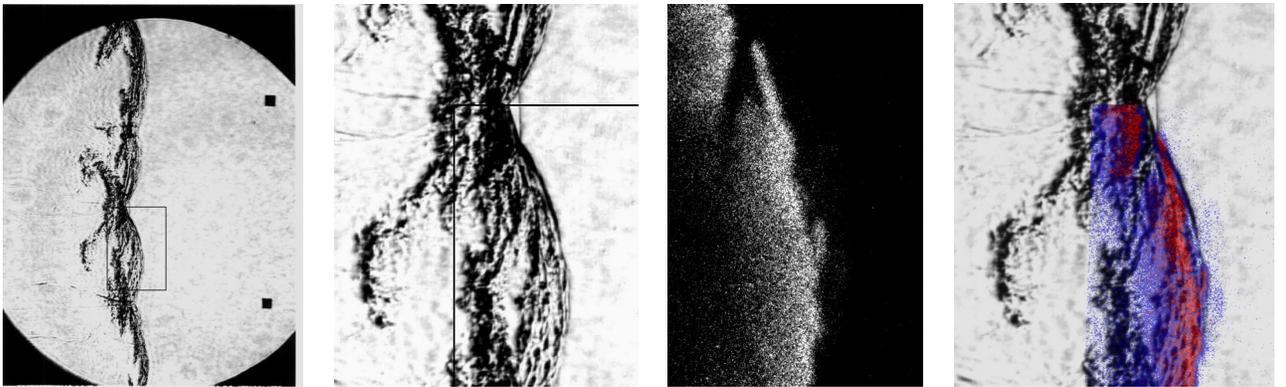


Figure A.52: Shot 251:  $C_2H_4-3O_2-10.5N_2$  frames 13-23. Field of view is about 138 mm.

Shot 47:  $C_3H_8-5O_2-9N_2$ Shot 48:  $C_3H_8-5O_2-64\%N_2$ Figure A.53: Soot foils in  $C_3H_8-O_2-N_2$  mixtures. Image height is 150 mm.

Shot 187:  $C_3H_8-5O_2-9N_2$ Shot 188:  $C_3H_8-5O_2-9N_2$ Shot 190:  $C_3H_8-5O_2-9N_2$ Figure A.54: Superimposed schlieren and OH fluorescence images in  $N_2$ -diluted  $C_3H_8-5O_2$ .

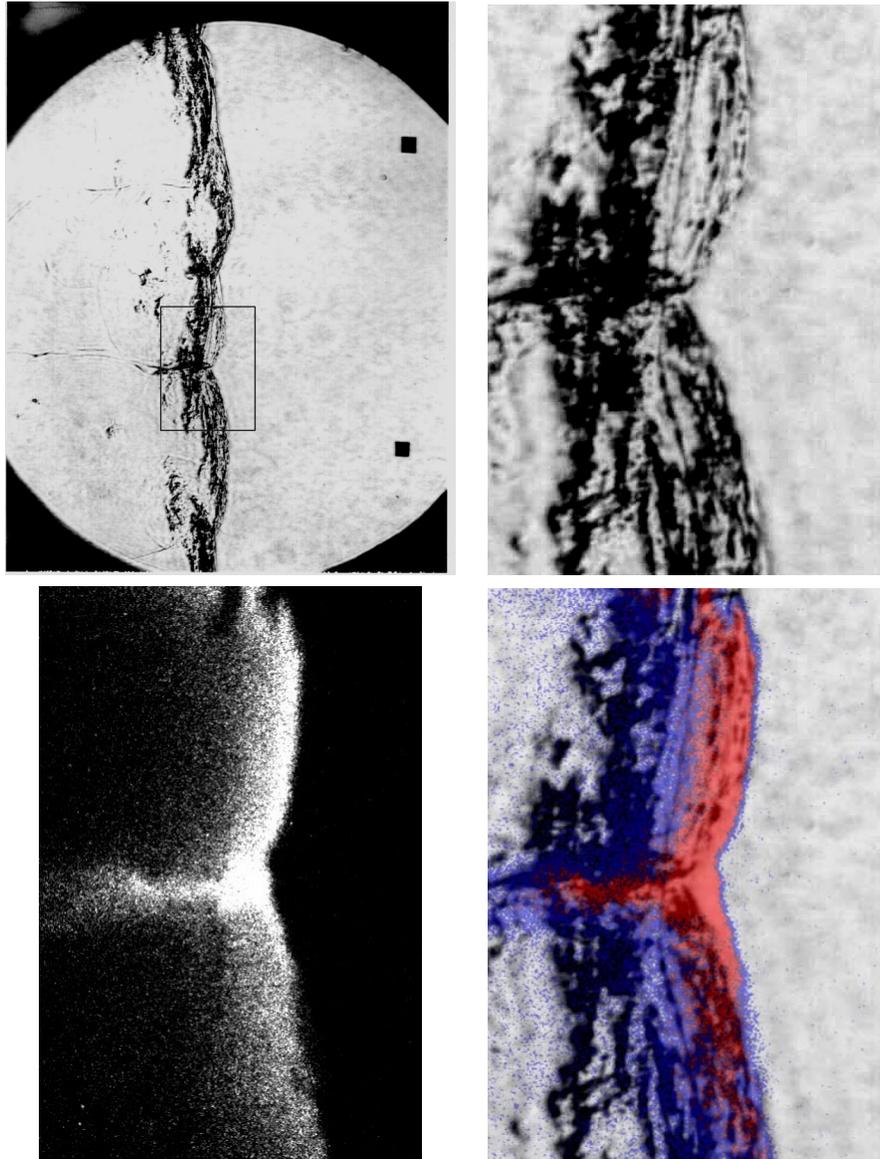
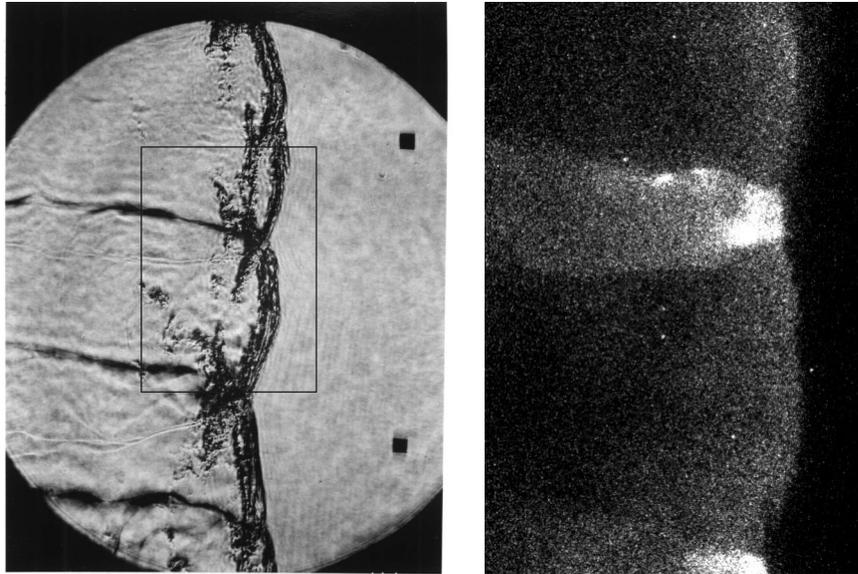
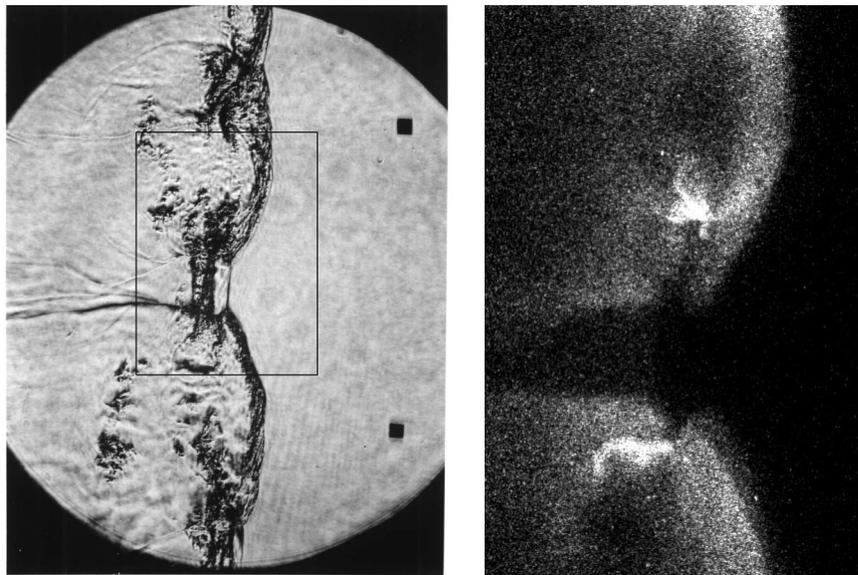
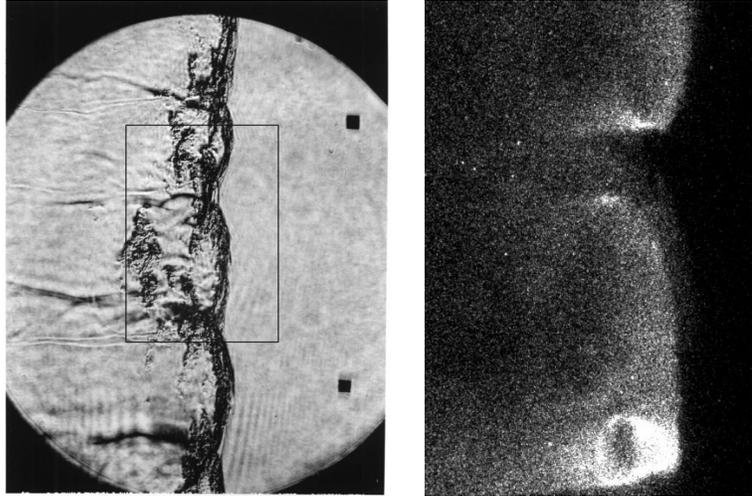
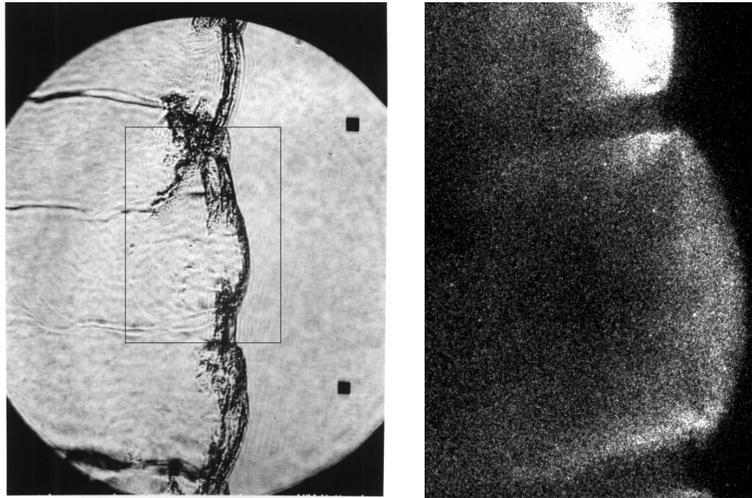
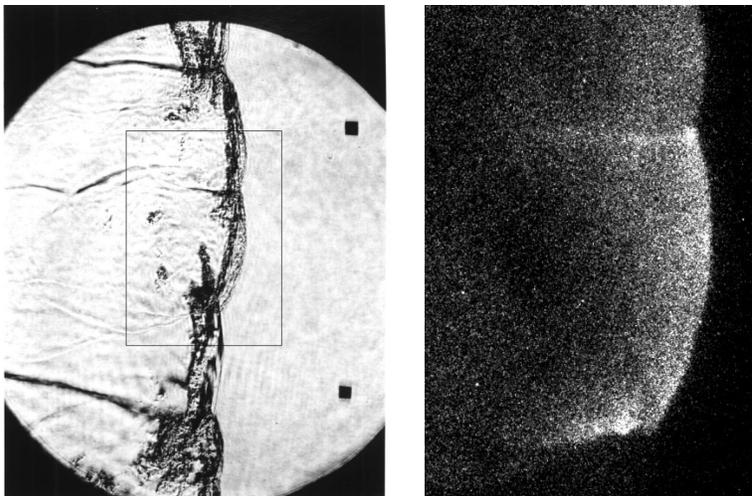


Figure A.55: Shot 192:  $C_3H_8-5O_2-9N_2$

Shot 204:  $\text{C}_3\text{H}_8\text{-5O}_2\text{-9N}_2$ Shot 205:  $\text{C}_3\text{H}_8\text{-5O}_2\text{-9N}_2$ Figure A.56: Superimposed schlieren and chemiluminescence images in  $\text{N}_2$ -diluted  $\text{C}_3\text{H}_8\text{-5O}_2$ .

Shot 206:  $C_3H_8-5O_2-9N_2$ Shot 207:  $C_3H_8-5O_2-9N_2$ Shot 209:  $C_3H_8-5O_2-9N_2$ Figure A.57: Superimposed schlieren and chemiluminescence images in  $N_2$ -diluted  $C_3H_8-5O_2$ .

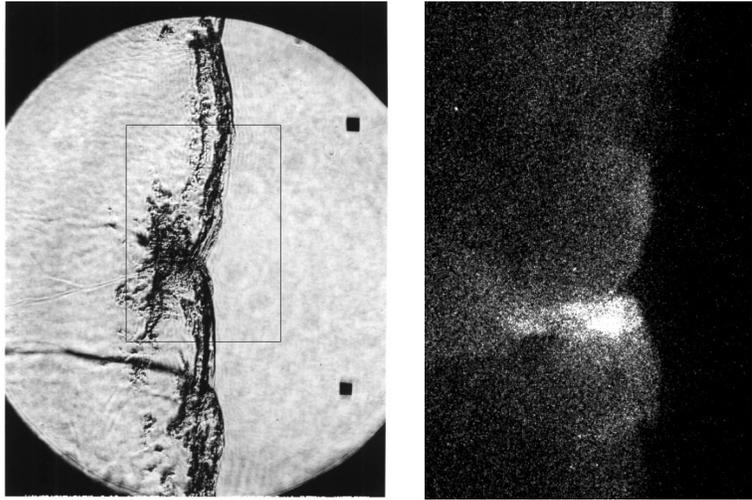


Figure A.58: Shot 210:  $C_3H_8-5O_2-9N_2$

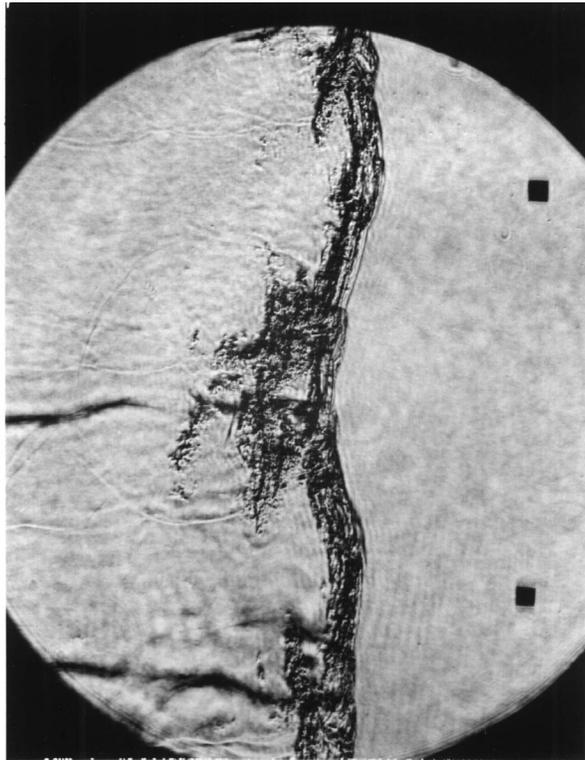


Figure A.59: Shot 208:  $C_3H_8-5O_2-9N_2$

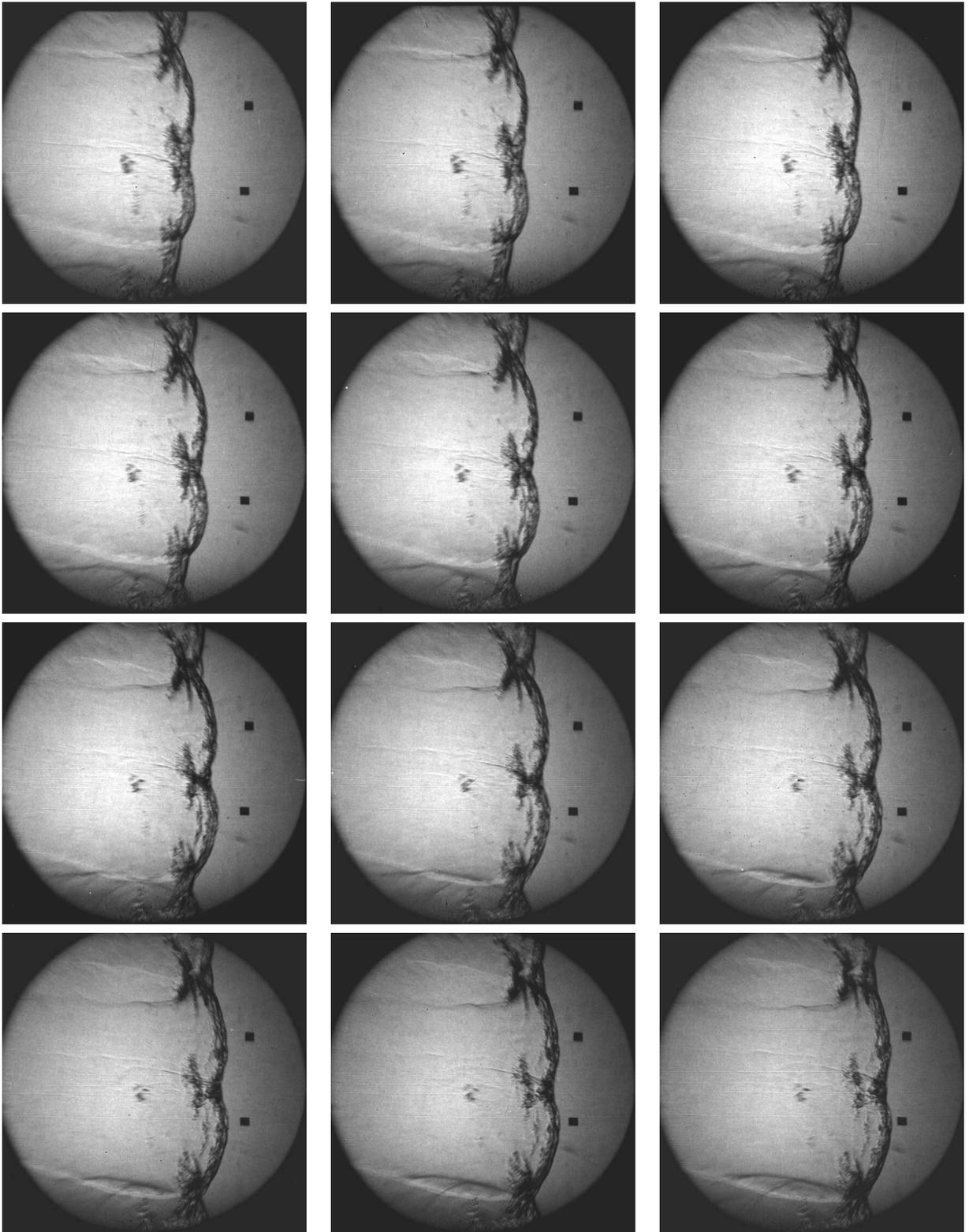


Figure A.60: Shot 230:  $C_3H_8-5O_2-9N_2$  frames 1-12. Field of view is about 138 mm.

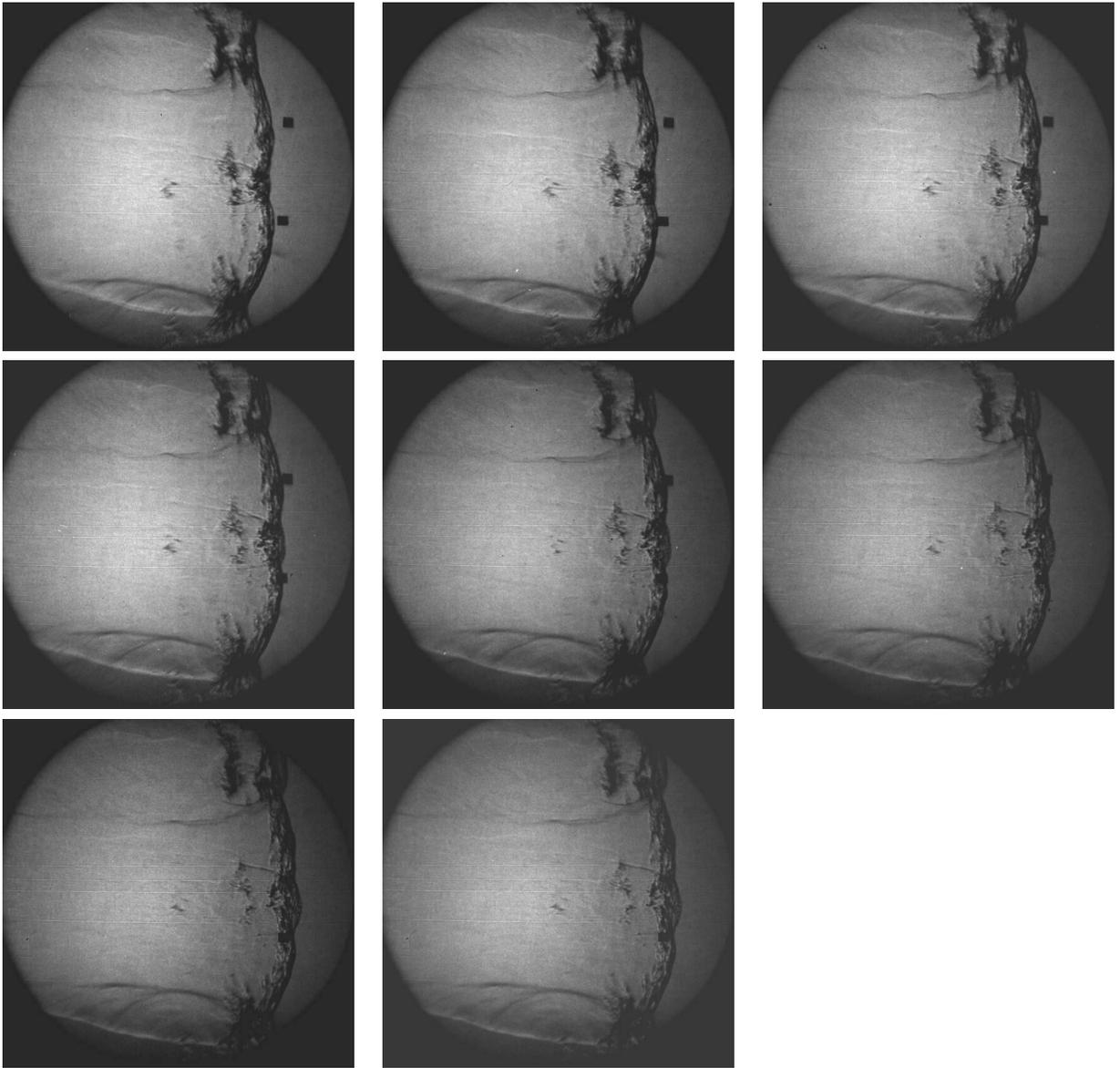


Figure A.61: Shot 230:  $C_3H_8-5O_2-9N_2$  frames 13-20. Field of view is about 138 mm.