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Liquid Crystal Ordering of Random DNA Oligomers TOMMASO BELLINI, GIULIANO ZANCHETTA, TOMMASO FRACCIA, ROBERTO CERBINO, University of Milan, Milan, ETHAN TSAI, MARK MORAN, GREGORY SMITH, DAVID WALBA, NOEL CLARK, LCMRC, University of Colorado, Boulder, DIPARTIMENTO DI CHIMICA, BIOCHIMICA E BIOTECNOLOGIE, UNIVERSITY OF MILAN, MILAN COLLABORATION, LIQUID CRYSTAL MATERIALS RESEARCH CENTER, UNIVERSITY OF COLORADO, BOULDER COLLABORATION — Concentrated solutions of DNA oligomers (6 to 20 base pairs) organize into chiral nematic (NEM) and columnar (COL) liquid crystal (LC) phases. When the oligomer duplexes are mixed with single strands, LC phase formation proceeds through macroscopic phase separation, as a consequence of the combination of various self-assembly processes including strand pairing, reversible linear aggregation, demixing and LC ordering. We extended our investigation to the case of LC ordering in oligonucleotides whose sequences are partially or entirely randomly chosen, and we observed LC phases even in entirely random 20mers, corresponding to a family of $4^{20} \approx 10^{12}$ different sequences. We have tracked the origin of this behaviour: random sequences pair into generally defected duplexes, a large fraction of them terminating with stretches of unpaired bases (overhangs); overhangs promote linear aggregation of duplexes, with a mean strength depending on the overhang length; LC formation is accompanied by a phase separation where the duplexes with longer overhangs aggregate to form COL LC domains that coexist with an isotropic fluid rich in duplexes whose structure cannot aggregate.

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