# Part III: Non-Newtonian Fluid Dynamics

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Phenomena

Rheometry

Constitutive Equations

Simple flow calculations

**Experiments** 

**Numerics** 

Microstructural studies

Yield problems

Stress relaxation & Normal stresses

Instabilities

Strong flows

Success and failure of Oldroyd-B and FENE

#### Phenomena

Nonlinear flow Inhibition of stretching Elastic effects Normal stress

# Rheometry

Simple shear devices Steady shear viscosity Normal stresses Oscillating shear Extensional viscosity Scalings

### Constitutive Equations

'Simple materials' Time derivatives

Linear viscoelasticity

Second-order fluid Generalised Newtonian

Oldroyd-B

K-BKZ

### Simple flow calculations

Pipe flow of a power-law fluid

Capillary rheometry

Bingham yield fluid in a Couette device

Rod-climbing of a second-order fluid

Unchanging flow field for a second-order fluid

Anisotropic converging flow

Spinning an Oldroyd-B fluid

# **Experiments**

Materials

Observations

Practical problems

### **Numerics**

Discretisation

Pressure

Elliptic and hyperbolic

Benchmarks

**Problems** 

#### Microstructural studies

Micro-Macro views

Einstein Viscosity

Rotation

Deformation

Interactions

Model of an isolated polymer

Model of an entangled polymer

### Yield problems

Yield stress

Simple applications

Squeeze film paradox

Ketchup bottle and oil lines

Open problems

#### Stress relaxation & Normal stresses

#### Instabilities

Spinline draw resonance

**Buckling instability** 

Purely elastic instability of curved streamlines

Coextrusion instability

Turbulent Drag Reduction

High-speed elastic jet

# Strong flows

Birefringent strand

Wine-glass model of contraction flow

Corner singularity

Limited-force flows

# Success and failure of Oldroyd-B and FENE