

Dynamics of droplet–film collision

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The head-on collision of a droplet onto a liquid layer of the same material, backed by a solid surface, was experimentally and computationally investigated, with emphasis on the transition from bouncing of the droplet to its absorption by the film for given droplet Weber number, We , and the film thickness scaled by the droplet radius, H_f . Experimental results show that while absorption is favoured with increasing We , there exists a range around $H_f \approx 1$ over which this tendency is moderated. This local moderation in turn corresponds to a regime, $11 \lesssim We \lesssim 14$, over which increasing H_f from a small value leads to a triple reversal behaviour of absorption, bouncing, absorption again, and bouncing again. The collision dynamics including evolution of the surface contours of the droplet and film, as well as the energy budgets, were then simulated by using a front-tracking technique. For collisions leading to absorption and partial absorption, for which part of the absorbed droplet is subsequently ejected from the film, rupture and hence merging of the interfaces were manually imposed at an instant that leads to agreement between the subsequent calculated and experimental images. The simulation satisfactorily identified the different factors influencing the observed non-monotonic response of the collision event.

1. Introduction

The collision dynamics of droplets on liquid and solid surfaces is of relevance to a variety of natural phenomena and technological applications such as spray combustion in liquid-fueled combustors, ink-jet printing, raindrop interaction with ocean and soil surfaces, insecticide spraying, meteorite impaction, spray painting and coating, etc. Earlier studies were primarily concerned with water in air (Jayaratne & Mason 1964; Stow & Hadfield 1981) because of the prevalence of water and its relevance to meteorological implications. Results showed that, depending on such parameters as the impact inertia, surface tension, and impact angle, collision can result in bouncing, absorption by the liquid layer, and splashing (Rein 1993; Stanton & Rutland 1998). The controlling dynamic parameter is the collision Weber number, defined as $We = 2\rho_l V_0^2 R/\sigma$, where R is the droplet radius, V_0 the impact velocity, and ρ_l and σ the density and surface tension of the liquid, respectively. Studies involving head-on collisions (Harlow & Shannon 1967; Rodriguez & Mesler 1985) were mostly concerned with the transition between absorption and splashing that occurs at high We . Bouncing was observed at lower values of We (Ching, Golay & Johnson 1984), although its characteristics, including the transition to merging, have not been sufficiently studied.

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Pilgrim Plymouth in Pictures ,1947 **Studies on the Dynamics of Droplet-film Collision** Tsung-Ping Hsieh,2008

Droplet Dynamics Under Extreme Ambient Conditions Kathrin Schulte,Cameron Tropea,Bernhard Weigand,2022-08-30

This open access book presents the main results of the Collaborative Research Center SFB TRR 75 which spanned the period from 2010 to 2022 Scientists from a variety of disciplines ranging from thermodynamics fluid mechanics and electrical engineering to chemistry mathematics computer science and visualization worked together toward the overarching goal of SFB TRR 75 to gain a deep physical understanding of fundamental droplet processes especially those that occur under extreme ambient conditions These are for example near critical thermodynamic conditions processes at very low temperatures under the influence of strong electric fields or in situations with extreme gradients of boundary conditions The fundamental understanding is a prerequisite for the prediction and optimisation of engineering systems with droplets and sprays as well as for the prediction of droplet related phenomena in nature The book includes results from experimental investigations as well as new analytical and numerical descriptions on different spatial and temporal scales The contents of the book have been organised according to methodological fundamentals phenomena associated with free single drops drop clusters and sprays and drop and spray phenomena involving wall interactions **Dynamics of Droplet Collision and**

Flame-front Motion Kuo-Long Pan,2004 **Dynamics of Droplet Collision and Flame Motion** ,2004 The present program aims to study the dynamics of droplet collision and flame flow interaction that are of relevance to liquid fueled turbulent combustion in propulsive devices The investigation involves experimental computational and analytical components The program recognizes the fundamental similarity between droplet collision and flame dynamics especially from the computational viewpoint in that both phenomena involve the tracking of deformable surfaces separating two media of vastly different densities During the reporting period four classes of phenomena were investigated namely 1 The dynamics of binary droplet collision especially on the criterion for the breaking of the inter droplet surfaces which enables droplet merging 2 The dynamics of droplet film collision especially on the influence of the film thickness in effecting droplet bouncing versus absorption 3 The dynamics of droplet droplet collision of dissimilar liquids showing that the initiation of droplet internal superheating and hence microexplosion can be greatly facilitated by the presence of air bubbles entrained upon coalescence of the colliding droplets 4 The dynamics and interaction of a freely propagating premixed flame with a vortex pair with particular attention on the extent of flame wrinkling and flame generated vorticity due to the generation of the baroclinic torque through the intrinsic hydrodynamic instability **Hydrodynamics** Harry Schulz,André Simoes,Raquel

Lobosco,2011-10-26 The constant evolution of the calculation capacity of the modern computers implies in a permanent effort to adjust the existing numerical codes or to create new codes following new points of view aiming to adequately simulate fluid flows and the related transport of physical properties Additionally the continuous improving of laboratory

devices and equipment which allow to record and measure fluid flows with a higher degree of details induces to elaborate specific experiments in order to shed light in unsolved aspects of the phenomena related to these flows This volume presents conclusions about different aspects of calculated and observed flows discussing the tools used in the analyses It contains eighteen chapters organized in four sections 1 Smoothed Spheres 2 Models and Codes in Fluid Dynamics 3 Complex Hydraulic Engineering Applications 4 Hydrodynamics and Heat Mass Transfer The chapters present results directed to the optimization of the methods and tools of Hydrodynamics Multiphase Flow Dynamics 5 Nikolay Ivanov Kolev, 2011-10-18 The present Volume 5 of the successful book package Multiphase Flow Dynamics is devoted to nuclear thermal hydraulics which is a substantial part of nuclear reactor safety It provides knowledge and mathematical tools for adequate description of the process of transferring the fission heat released in materials due to nuclear reactions into its environment It step by step introduces into the heat release inside the fuel temperature fields in the fuels the simple boiling flow in a pipe described using ideas of different complexity like equilibrium non equilibrium homogeneity non homogeneity Then the simple three fluid boiling flow in a pipe is described by gradually involving the mechanisms like entrainment and deposition dynamic fragmentation collisions coalescence turbulence All heat transfer mechanisms are introduced gradually discussing their uncertainty Different techniques are introduced like boundary layer treatments or integral methods Comparisons with experimental data at each step demonstrate the success of the different ideas and models After an introduction of the design of the reactor pressure vessels for pressurized and boiling water reactors the accuracy of the modern methods is demonstrated using large number of experimental data sets for steady and transient flows in heated bundles Starting with single pipe boiling going through boiling in the rod bundles the analysis of complete vessel including the reactor is finally demonstrated Then a powerful method for nonlinear stability analysis of flow boiling and condensation is introduced Models are presented and their accuracies are investigated for describing critical multiphase flow at different level of complexity Basics of designing of steam generators moisture separators and emergency condensers are presented Methods for analyzing a complex pipe network flows with components like pumps valves etc are also presented Methods for analysis of important aspects of the severe accidents like melt water interactions external cooling and cooling of layers of molten nuclear reactor material are presented Valuable sets of thermo physical and transport properties for severe accident analysis are presented for the following materials uranium dioxide zirconium dioxide stainless steel zirconium aluminum aluminum oxide silicon dioxide iron oxide molybdenum boron oxide reactor corium sodium lead bismuth and lead bismuth eutectic alloy The emphasis is on the complete and consistent thermo dynamical sets of analytical approximations appropriate for computational analysis Therefore the book presents a complete coverage of the modern Nuclear Thermal Hydrodynamics This present second edition includes various updates extensions improvements and corrections This present second edition includes various updates extensions improvements and corrections *Fluid Mechanics and Fluid Power (Vol. 3)* Suvanjan

Bhattacharyya, Saket Verma, A. R. Harikrishnan, 2023-04-17 This book presents the select proceedings of the 48th National Conference on Fluid Mechanics and Fluid Power FMFP 2021 held at BITS Pilani in December 2021 It covers the topics such as fluid mechanics measurement techniques in fluid flows computational fluid dynamics instability transition and turbulence fluid structure interaction multiphase flows micro and nanoscale transport bio fluid mechanics aerodynamics turbomachinery propulsion and power The book will be useful for researchers and professionals interested in the broad field of mechanics

Multiphase Flow Dynamics 4 Nikolay Ivanov Kolev, 2009-06-12 The nuclear thermal hydraulic is the science providing knowledge about the physical processes occurring during the transferring the fission heat released in structural materials due to nuclear reactions into its environment Along its way to the environment the thermal energy is organized to provide useful mechanical work or useful heat or both Chapter 1 contains introductory information about the heat release in the reactor core the thermal power and thermal power density in the fuel structures and moderator the influence of the thermal power density on the coolant temperature the spatial distribution of the thermal power density Finally some measures are introduced for equalizing of the spatial distribution of the thermal power density Chapter 2 gives the methods for describing of the steady and of the transient temperature fields in the fuel elements Some information is provided regarding influence of the cladding oxidation hydrogen diffusion and of the corrosion product deposition on the temperature fields Didactically the nuclear thermal hydraulic needs introductions at different level of complexity by introducing step by step the new features after the previous are clearly presented The followed two Chapters serve this purpose Chapter 3 describes mathematically the simple steady boiling flow in a pipe The steady mass momentum and energy conservation equations are solved at different level of complexity by removing one after the other simplifying assumptions First the idea of mechanical and thermodynamic equilibrium is introduced

Collision Phenomena in Liquids and Solids Alexander L. Yarin, Ilia V. Roisman, Cameron Tropea, 2017-06-15 A unique and in depth discussion uncovering the unifying features of collision phenomena in liquids and solids along with applications

Hydrodynamics and Heat Transfer of Multiple Droplet Impingement Marwan Abu Al-Roub, 1996

Science and Engineering of Droplets: Huimin Liu, 1999-12-31 This is the first book to encompass the fundamental phenomenon principles and processes of discrete droplets of both normal liquids and melts It provides the reader with the science and engineering of discrete droplets and provides researchers scientists and engineers with the latest developments in the field The book begins with a systematic review of various processes and techniques along with their applications and associations with materials systems This is followed by a description of the phenomena and principles in droplet processes Correlations calculations and numerical modeling of the droplet processes provide insight into the effects of process parameters on droplet properties for optimization of atomizer design Droplets are found in the areas of metallurgy materials automotive aerospace medicine food processing agriculture and power generation and encountered in a huge range of engineering applications

Microgravity Science and Applications Program Tasks,

1991 Revision ,1992 Previews of Heat and Mass Transfer ,1999 *Numerical Simulations of Drop Collisions* M. R. H. Nobari,1994 **Journal of Rheology** ,2008 Includes abstracts from the Journal of the Society of Rheology Japan *Eighth Conference on Space Simulation* ,1975 **NASA SP.** ,1975 *Minerals Science and Engineering* E. H. Wainwright,1976
International Aerospace Abstracts ,1998

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