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Literature Review

School of Mechanical and Chemical Engineering

Final Year Project

CHPR 4411/4412
MATE 4411/4412
MECH 4401/4402
MCTX 4421/4422
OGEG 4500/4501

Starting Out

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- Most students start with either little detailed understanding of their project topic, or a narrow understanding based on (limited) experience
- It is important that you develop your understanding of the state of the art in your field as early as possible
  - Your understanding will provide a basis for your project proposal.
  - It enables you to ask well-informed questions of your supervisor, increasing their confidence in your ability to undertake the project successfully.
  - It may help to make additional resources available – it definitely helps you to identify the resources you will need
  - The better (and broader) your understanding, the better the chances are that you will develop a sound project proposal and plan.

What is a Literature Review?

- The literature review is the first step in any successful research effort.
- The purpose of the literature review is to establish the state of the art in the area that you are working in.
  - For investigative research, this will mean reviewing the academic literature.
  - For design projects, this will mean identifying current approaches to solving the problem of interest (or similar problems)
  - For industrial projects, this will entail reviewing standards and current operating practices.

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Every statement and conclusion in a professional report must be supported by accepted literature or your results and deductions

Building a Foundation

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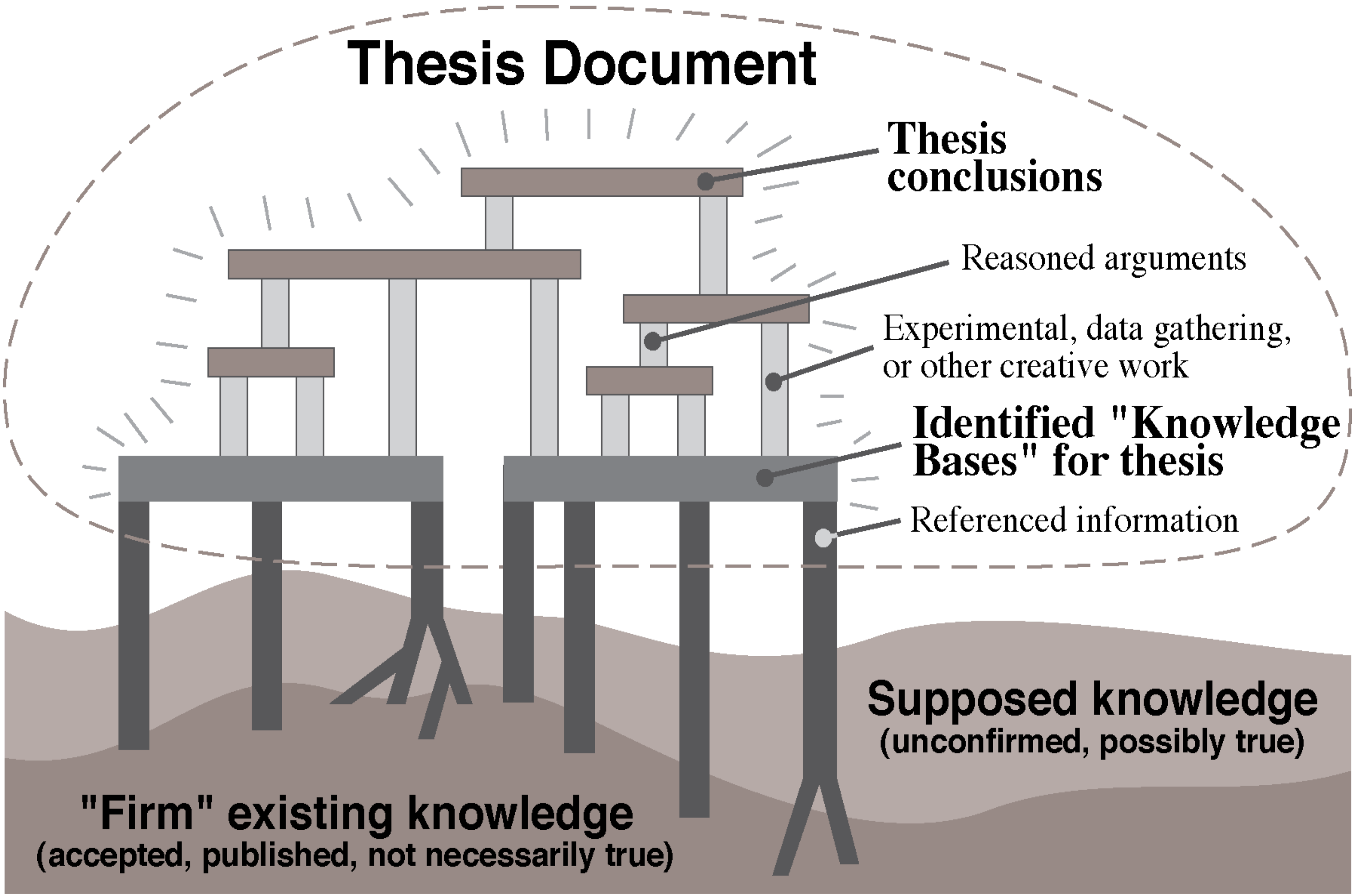

Basic Tools

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- Internet search engines have greatly simplified the process of identifying information sources.
- Google, Wikipedia and Media sites can and should be used to provide a quick overview of a field
  - Use to identify relevant publications and experts.
  - Can help with basic definitions or even formulae.
- However, it must be remembered that it is generally **UNACCEPTABLE** to reference these sources in a thesis
  - The reviewing and control of posted data ranges from inconsistent to non-existent.
  - It can be difficult to assess the expertise (or motives) of the poster.

Expert Materials

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- A research report should rely on peer reviewed and/or edited materials such as
  - Books
  - Scientific Journal Articles
  - Scientific Conference Proceedings
- The UWA library is an excellent research library
  - In addition to the materials in the stacks, there is a wide range of journals available electronically
  - If a particular paper or book is not available, the library can generally locate a copy via inter-library loan relatively quickly. This service (**GETIT**) is free to students enrolled in final year project

Expert Search Tools

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- The library website makes available a variety of web-based search engines/databases that can be used to search for scientific publications and books
  - These tools are <u>much</u> more powerful than the likes of the Google, as they are focused solely on quality scientific publications.
  - They are relatively simple and intuitive to use – you may search by keywords, words in the title, author (essentially the same as when using the library catalogue)
- These may be accessed via the “Supersearch” link on the UWA library’s main web page.
  - Use the “Find Resources” Tab to find specific indexes

Engineering Databases

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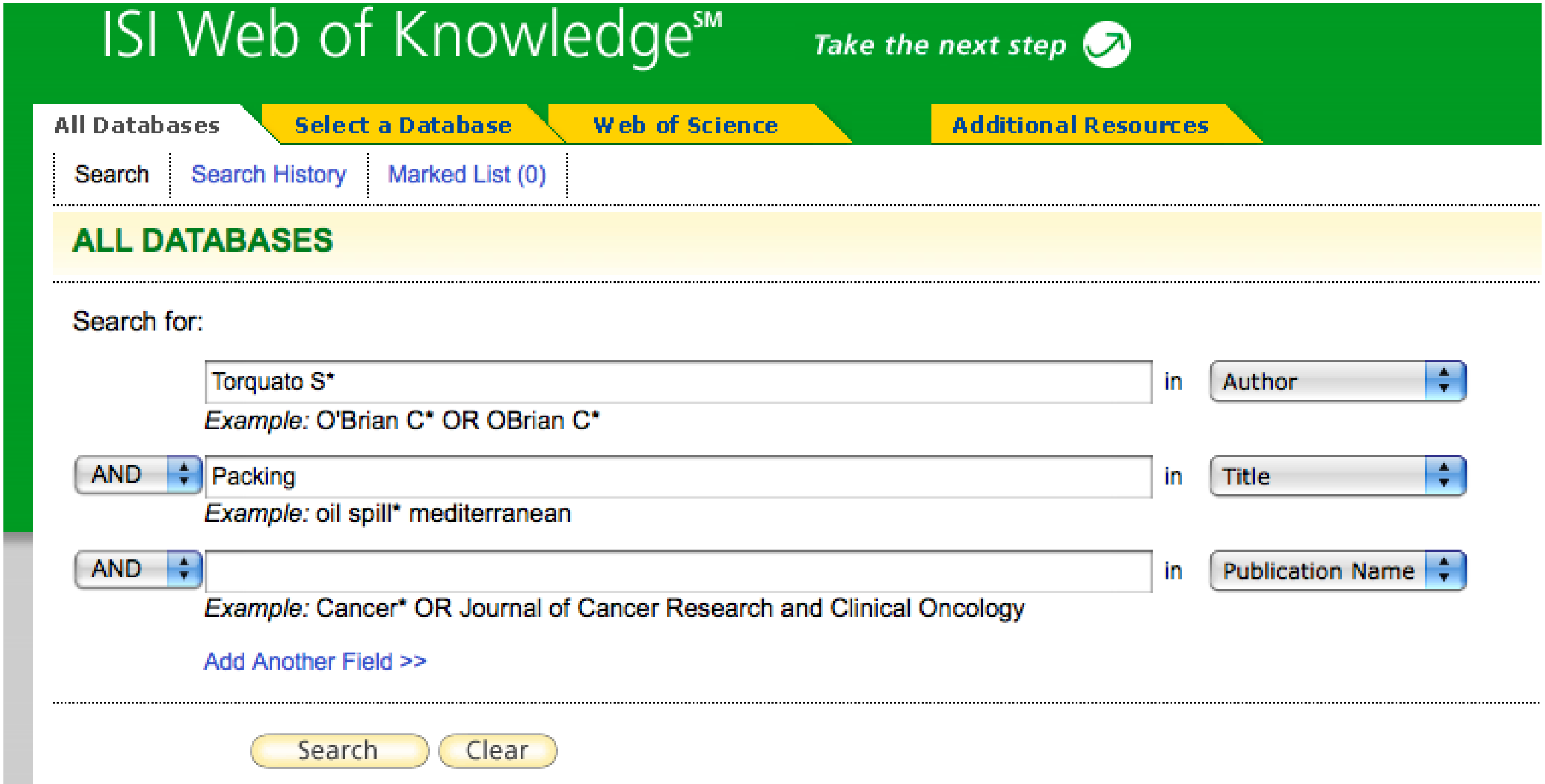
- For engineering, two of the major indexes are "Compendex" and the "Web of Knowledge".
- Compendex provides a list of papers matching your specified search terms.
  - Access via "Supersearch" link and the "Physical Sciences Option".
  - Compendex finds both journal papers and conference proceedings (Web of Knowledge focuses on journal papers)
- The "Web of Knowledge" provides a similar capability but can be more powerful because it also provides a Citation Index.
  - The number of citations tells you how influential a paper is.
  - You can follow a "citation trail" from an important paper to research the current state of knowledge in a field.
  - Access via "Supersearch" link and the "Find Resources" tab (Look under "W").

Initiating a Web of Knowledge Search



Search Result Listing

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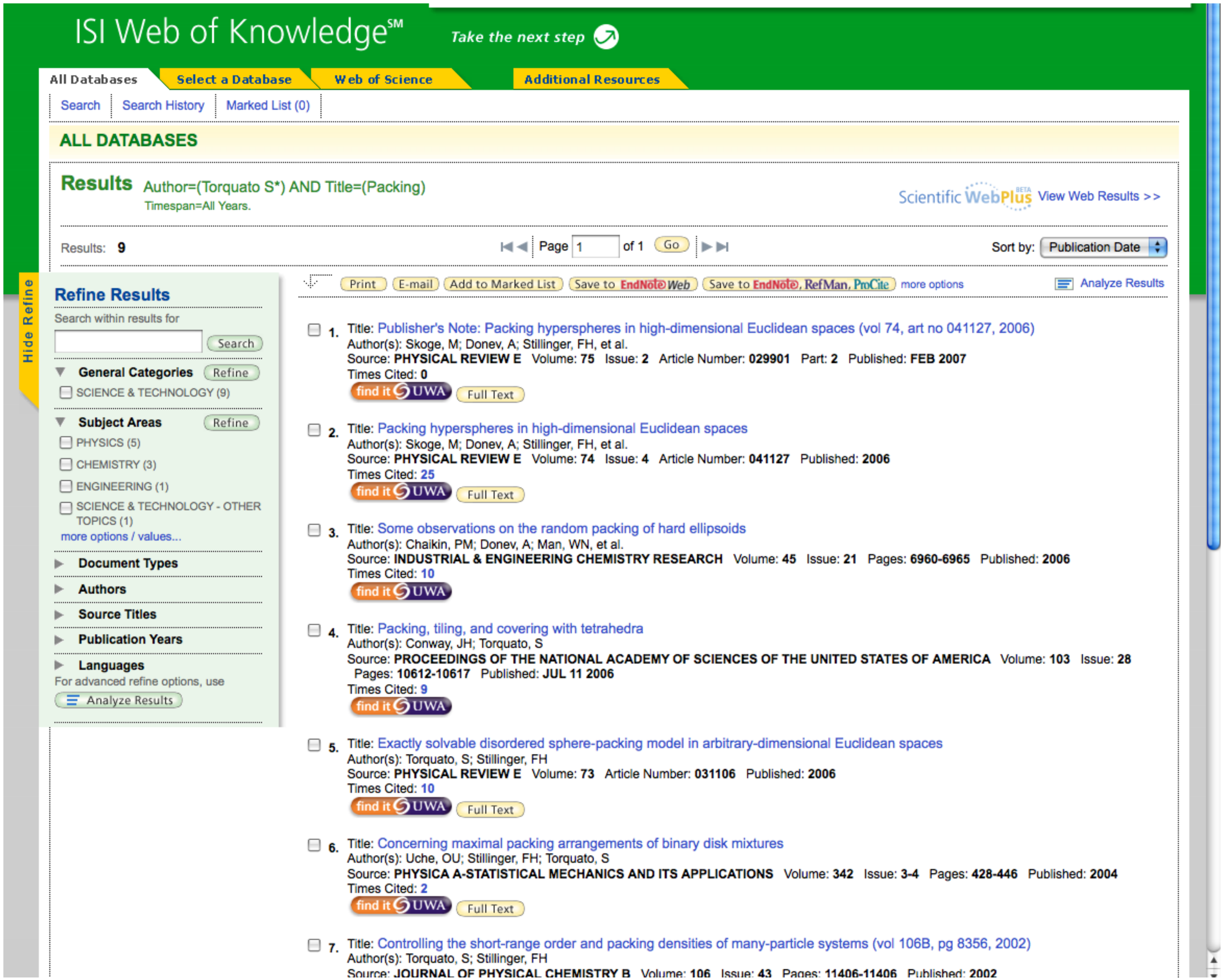

Search Result Listing

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2. Title: Packing hyperspheres in high-dimensional Euclidean spaces
Author(s): Skoge, M; Donev, A; Stillinger, FH, et al.
Source: **PHYSICAL REVIEW E** Volume: **74** Issue: **4** Article Number: **041127** Published: **2006**
Times Cited: 25
find it UWA   Full Text

Abstract Page

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Author(s): Skoge M (Skoge, Monica), Donev A (Donev, Aleksandar), Stillinger FH (Stillinger, Frank H.), Torquato S (Torquato, Salvatore)

Source: PHYSICAL REVIEW E **Volume:** 74 **Issue:** 4 **Article Number:** 041127 **Part:** Part 1 **Published:** OCT 2006

Times Cited: 25 **References:** 53 Citation Map *beta*

Abstract: We present a study of disordered jammed hard-sphere packings in four-, five-, and six-dimensional Euclidean spaces. Using a collision-driven packing generation algorithm, we obtain the first estimates for the packing fractions of the maximally random jammed (MRJ) states for space dimensions d=4, 5, and 6 to be phi(MRJ)approximate to 0.46, 0.31, and 0.20, respectively. To a good approximation, the MRJ density obeys the scaling form phi(MRJ)=c(1)/2(d)+(c(2)d)/2(d), where c(1)=-2.72 and c(2)=2.56, which appears to be consistent with the high-dimensional asymptotic limit, albeit with different coefficients. Calculations of the pair correlation function g(2)(r) and structure factor S(k) for these states show that short-range ordering appreciably decreases with increasing dimension, consistent with a recently proposed "decorrelation principle," which, among other things, states that unconstrained correlations diminish as the dimension increases and vanish entirely in the limit d ->infinity. As in three dimensions (where phi(MRJ)approximate to 0.64), the packings show no signs of crystallization, are isostatic, and have a power-law divergence in g(2)(r) at contact with power-law exponent approximate to 0.4. Across dimensions, the cumulative number of neighbors equals the kissing number of the conjectured densest packing close to where g(2)(r) has its first minimum. Additionally, we obtain estimates for the freezing and melting packing fractions for the equilibrium hard-sphere fluid-solid transition, phi(F)approximate to 0.32 and phi(M)approximate to 0.39, respectively, for d=4, and phi(F)approximate to 0.20 and phi(M)approximate to 0.25, respectively, for d=5. Although our results indicate the stable phase at high density is a crystalline solid, nucleation appears to be strongly suppressed with increasing dimension.

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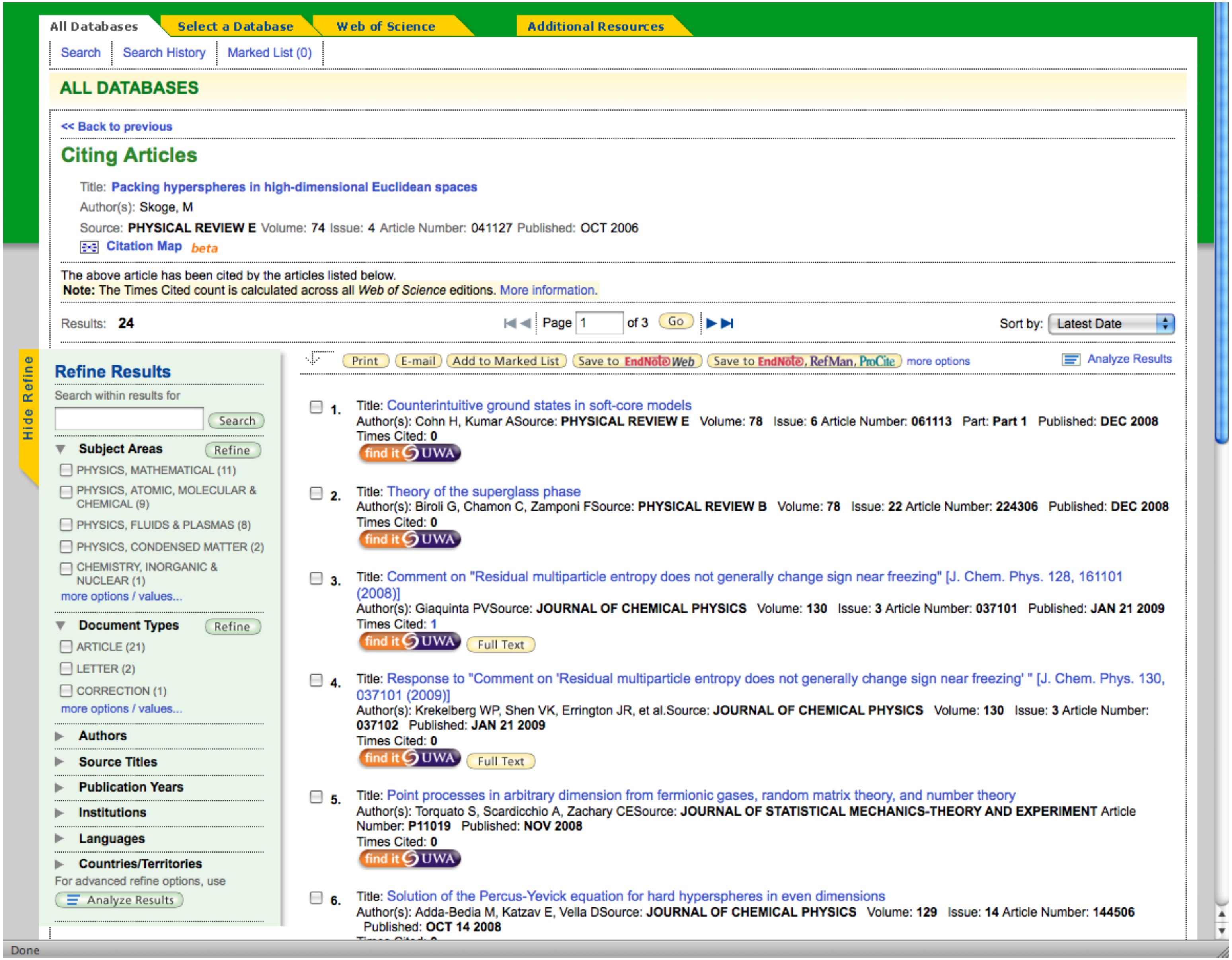

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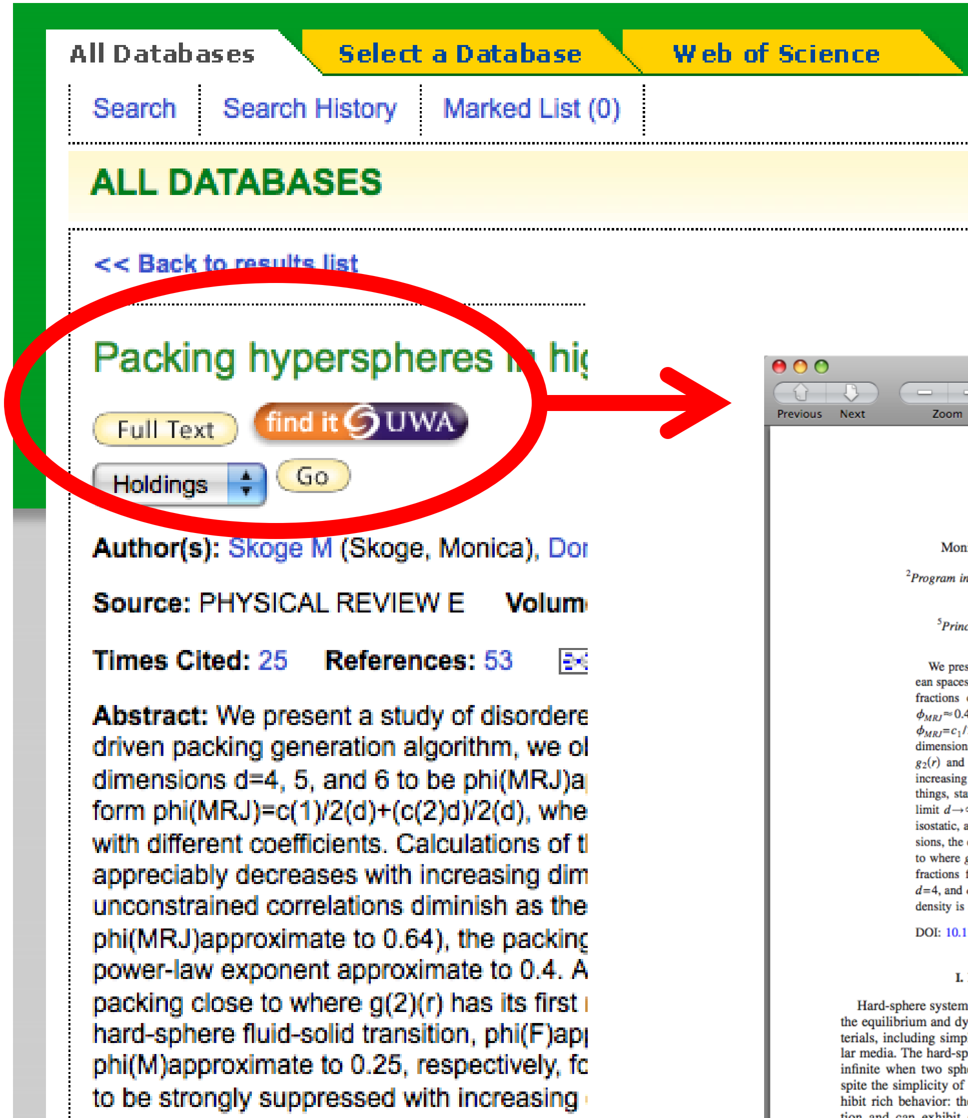

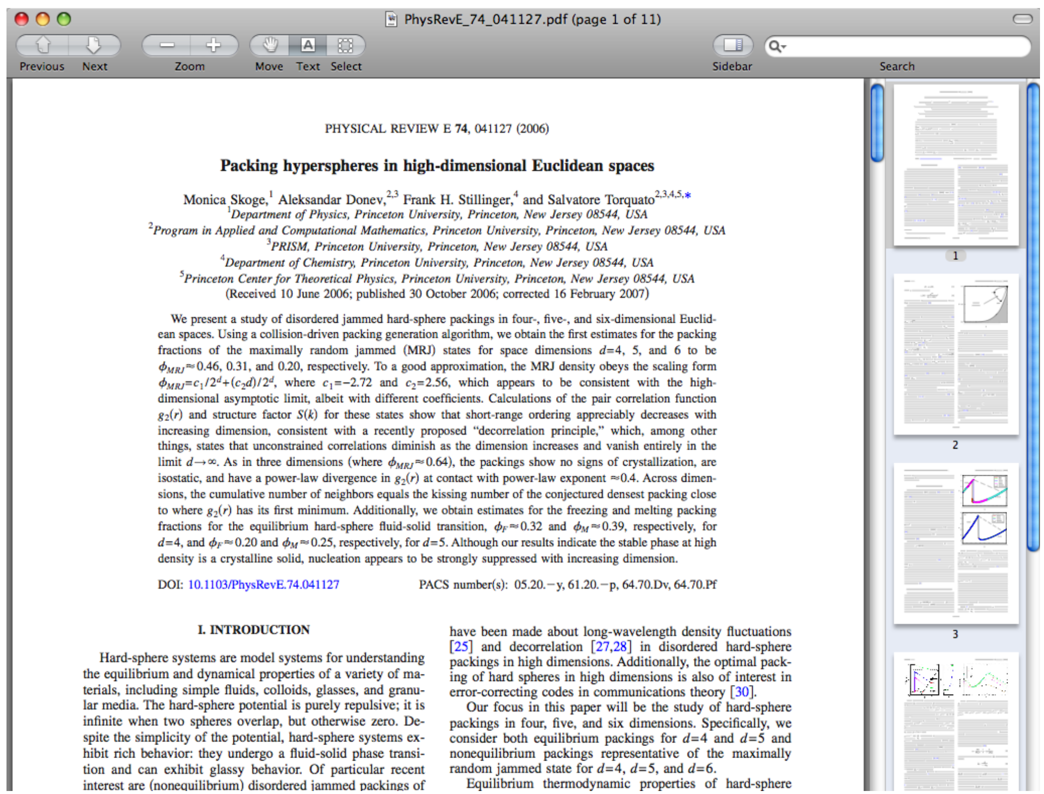

PHYSICAL REVIEW E **74**, 041127 (2006)

Packing hyperspheres in high-dimensional Euclidean spaces

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(Received 10 June 2006; published 30 October 2006; corrected 16 February 2007)

We present a study of disordered jammed hard-sphere packings in four-, five-, and six-dimensional Euclidean spaces. Using a collision-driven packing generation algorithm, we obtain the first estimates for the packing fractions of the maximally random jammed (MRJ) states for space dimensions $d=4$, 5, and 6 to be $\phi_{MRJ} \approx 0.46$, 0.31, and 0.20, respectively. To a good approximation, the MRJ density obeys the scaling form $\phi_{MRJ}=c_1/2^d+(c_2 d)/2^d$, where $c_1=-2.72$ and $c_2=2.56$, which appears to be consistent with the high-dimensional asymptotic limit, albeit with different coefficients. Calculations of the pair correlation function $g_2(r)$ and structure factor $S(k)$ for these states show that short-range ordering appreciably decreases with increasing dimension, consistent with a recently proposed "decorrelation principle," which, among other things, states that unconstrained correlations diminish as the dimension increases and vanish entirely in the limit $d \to \infty$. As in three dimensions (where $\phi_{MRJ} \approx 0.64$), the packings show no signs of crystallization, are isostatic, and have a power-law divergence in $g_2(r)$ at contact with power-law exponent ≈ 0.4. Across dimensions, the cumulative number of neighbors equals the kissing number of the conjectured densest packing close to where $g_2(r)$ has its first minimum. Additionally, we obtain estimates for the freezing and melting packing fractions for the equilibrium hard-sphere fluid-solid transition, $\phi_F \approx 0.32$ and $\phi_M \approx 0.39$, respectively, for $d=4$, and $\phi_F \approx 0.20$ and $\phi_M \approx 0.25$, respectively, for $d=5$. Although our results indicate the stable phase at high density is a crystalline solid, nucleation appears to be strongly suppressed with increasing dimension.

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I. INTRODUCTION

Hard-sphere systems are model systems for understanding the equilibrium and dynamical properties of a variety of materials, including simple fluids, colloids, glasses, and granular media. The hard-sphere potential is purely repulsive; it is infinite when two spheres overlap, but otherwise zero. Despite the simplicity of the potential, hard-sphere systems exhibit rich behavior: they undergo a fluid-solid phase transition and can exhibit glassy behavior. Of particular recent interest are (nonequilibrium) disordered jammed packings of

have been made about long-wavelength density fluctuations [25] and decorrelation [27,28] in disordered hard-sphere packings in high dimensions. Additionally, the optimal packing of hard spheres in high dimensions is also of interest in error-correcting codes in communications theory [30].

Our focus in this paper will be the study of hard-sphere packings in four, five, and six dimensions. Specifically, we consider both equilibrium packings for $d=4$ and $d=5$ and nonequilibrium packings representative of the maximally random jammed state for $d=4$, $d=5$, and $d=6$.

Equilibrium thermodynamic properties of hard-sphere

Approach

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- Remember that the word "review" is important – it is not a literature "survey"
- It is essential to read the material you find carefully and critically.
  - Does the material apply directly to your work?
  - What are the limitations of the published material?
- A good paper or book will usually be well referenced – the reference lists can help you find older, more fundamental work in a field
  - A good literature review will evolve and expand from each paper you review.
  - Fundamental papers can often make it easier to understand the topic you are researching

Approach

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- IMPORTANTLY - do not limit your consideration of literature to recent works.
  - Fundamental papers and texts can often make it easier to understand a particular technique or approach.
  - In seminal papers, the jargon of the field has usually not yet developed – so the text is often more comprehensible
  - The basis and limits of a particular approach can also often be more clearly identified in the original papers.

So don't ignore the dusty old journals! In many fields, the basis of current thinking was laid out a long time ago.