

## 15.357 – Economics of Ideas, Innovation, & Entrepreneurship

Tuesdays 6:00-9:00pm  
E62-450

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This course begins with an introduction to the economics of ideas and uses the economics of ideas to evaluate the origins of invention and discovery, innovation, entrepreneurship, and the diffusion of new technology. The focus throughout is on the microeconomic and institutional foundations for phenomena that have been studied mostly at an aggregate level. The course focuses on (a) the micro-foundations of the knowledge production function (including the role of creativity and the impact of Science), (b) the impact of institutions and strategic interaction on the commercialization of new technology, and (c) the diffusion and welfare impact of ideas and technology. The course emphasizes how the unusual characteristics of ideas can result in social inefficiency, and how the microeconomic and institutional environment influences the gap between private and social welfare. The course includes a mixture (and explicit comparisons of) both theoretical and empirical research.

### Requirements:

- two group homework assignments (due October 6<sup>th</sup> and November 24<sup>th</sup>);
- two individual “referee” reports (out of a possible seven pertaining to working papers which we have highlighted in red on the syllabus);
- a succinct individual paper proposal, three to five pages, on a topic germane to the class, due on the last day of class (December 1<sup>st</sup>);

**Administration:**

- readings, the current version of the syllabus, assignments, and class slides are available through Stellar;
- please contact Tetyana Pecherska, [tetyana@mit.edu](mailto:tetyana@mit.edu), for access to Stellar or other questions about course logistics;
- there are no “official” office hours; please feel free to make appointments with Scott or Pierre individually or together.

**Schedule at a Glance**

Class 1	Ideas, Innovation, and Economic Growth	September 15	Scott
Class 2	The Nature of Ideas and Innovation	September 22	Scott
Class 3	The Supply of Innovators	September 29	Pierre
Class 4	Incentives for Innovators: Contracting and Control Rights	October 6	Pierre
Class 5	Incentives for Innovators: Market-level Rewards	October 13	Pierre
Class 6	GUEST LECTURE: The Life Cycle of Inventors	October 20	Raj Chetty
Class 7	Open Science as an Economic Institution	October 27	Scott
Class 8	Strategic Interaction in Cumulative Innovation Environments	November 2*	Scott
Class 9	Entrepreneurial Strategy	November 10	Scott
Class 10	GUEST LECTURE: Markets for Technology	November 17	Alfonso G.
Class 11	The Measurement of Innovation	November 24	Pierre
Class 12	The Measurement of Entrepreneurial Ecosystems	December 1	Scott

\*Note the odd (and exceptional) timing for this session: Monday, 6-9pm instead of Tuesday at the same time.

- (\*) Jones, Charles I. 2001. Chapter 4 and 5, pp. 78-86 and 96-122 in *Introduction to Economic Growth*. New York: W. Norton & Company.
- (\*) Varian, Hal R. 2004. "Review of Mokyr's 'Gifts of Athena'." *Journal of Economic Literature* **42**(3): 805-810.
- (\*) Nelson, Richard R. 1962. "The Link Between Science and Invention: The Case of the Transistor." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, pp. 549-583. Princeton, NJ: Princeton University Press.
- Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* **98**(5): S71-S102.
- Aghion, Philippe, and Peter Howitt. 1992. "A Model of Growth through Creative Destruction." *Econometrica* **60**(2): 323-351.
- Rosenberg, Nathan. 1979. "Technological Interdependence in the American Economy." *Technology and Culture* **20**(1): 25-50.
- Mokyr, Joel. 2005. "The Intellectual Origins of Modern Economic Growth." *Journal of Economic History* **65**(2): 285-351.
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- (\*) Arrow, Kenneth. 1962. "Economic Welfare and the Allocation of Resources for Invention." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, pp. 609-625. Princeton, NJ: Princeton University Press. **READ pp. 609-618 ONLY.**
- (\*) Jones, Charles I. 1999. "Growth: With or Without Scale Effects?" *American Economic Review* **89**(2): 139-144.
- (\*) Jones, Benjamin F. 2009. "The Burden of Knowledge and the 'Death of the Renaissance Man': Is Innovation Getting Harder?" *Review of Economic Studies* **76**(1): 283-317.
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- (\*) Jones, Benjamin F. 2010. "Age and Great Invention." *Review of Economics and Statistics* **92**(1): 1-14.
- (\*) Bresnahan, Timothy F., and Manuel Trajtenberg. 1995. "General Purpose Technologies: Engines of Growth?" *Journal of Econometrics* **65**(1): 83-108.
- Agrawal, Ajay K., Avi Goldfarb, and Florenta Teodoridis. 2014. "Does Knowledge Accumulation Increase the Returns to Collaboration?" *American Economic Journal: Applied Economics*, Forthcoming.
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- Athey, Susan, and Armin Schmutzler. 1995. "Product and Process Flexibility in an Innovative Environment." *RAND Journal of Economics* **26**(4): 557-574.
- Irwin, Douglas A., and Peter J. Klenow. 1996. "High-Tech R&D Subsidies: Estimating the Effects of Sematech." *Journal of International Economics* **40**(3-4): 323-344.
- Rosenberg, Nathan, and Manuel Trajtenberg. 2004. "A General-Purpose Technology at Work: The Corliss Steam Engine in the Late-Nineteenth-Century United States." *Journal of Economic History* **64**(1): 61-99.

- David, Paul. 1990. "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox." *American Economic Review* **80**(2): 355-361.
- Foray, Dominique. 2004. *Economics of Knowledge*. Cambridge, MA: MIT Press.
- Henderson, Rebecca, and Kim Clark. 1990. "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." *Administrative Science Quarterly* **35**(1): 9-30.
- Jovanovic, Boyan, and Peter L. Rousseau. 2005. "General Purpose Technologies." In Philippe Aghion, and Steven N. Durlauf (Eds.), *Handbook of Economic Growth*, pp. 1181-1224. Amsterdam: North-Holland.
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- Kortum, Samuel. 1997. "Research, Patenting, and Technological Change." *Econometrica* **65**(6): 1389-1419.
- Weitzman, Martin L. 1998. "Recombinant Growth." *Quarterly Journal of Economics* **113**(2): 331-360.

Class 3

The Supply of Innovators

September 39

**Who Is (or Who becomes) an Innovator?**

- Shu, Pian. 2012. "The Long-Term Impact of Business Cycles on Innovation: Evidence from the Massachusetts Institute of Technology." Working Paper, Massachusetts Institute of Technology.
- (\* Shu, Pian. 2013. "Are the 'Best and Brightest' Going into Finance? Career Choice and Skill Development of MIT Graduates." Working Paper, Harvard University.
- Stephan, Paula E. 2012. *How Economics Shapes Science*. Cambridge, MA: Harvard University Press. Chapter 7 ("The Market for Scientists and Engineers").
- Gieryn, Thomas F. 1983. "Boundary-work and the Demarcation of Science from Non-science: Strains and Interests in Professional Ideologies of Scientists." *American Sociological Review* **48**(6): 781-795.

**Immigration**

- Hunt, Jennifer, and Marjolaine Gauthier-Loiselle. 2010. "How Much Does Immigration Boost Innovation?" *American Economic Journal: Macroeconomics* **2**(2): 31-56.
- (\* Borjas, George J., and Kirk B. Doran. 2012. "The Collapse of the Soviet Union and the Productivity of American Mathematicians." *Quarterly Journal of Economics*, **127**(3): 1143-1203.
- (\* Moser, Petra, Alessandra Voena, and Fabian Waldinger. 2014. "German-Jewish Emigrés and US Invention." *American Economic Review* **104**(10): 3222-3255.
- Kerr, William R., and William F. Lincoln. 2010. "The Supply Side of Innovation: H-1B Visa Reforms and U.S. Ethnic Invention." *Journal of Labor Economics* **28**(3): 473-508.
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- Ganguli, Ina. 2015. "Who Leaves and Who Stays? Evidence on Immigrant Selection from the Collapse of Soviet Science." In Aldo Geuna (Ed.), *Global Mobility of Research Scientists: The Economics of Who Goes Where and Why*, pp. 133-154. Amsterdam: Elsevier.

Gaulé, Patrick, and Mario Piacentini. 2013. "Chinese Graduate Students and U.S. Scientific Productivity." *Review of Economics and Statistics* **95**(2): 698-701.

Kahn, Shulamit and Megan J. MacGarvie. 2015. "How Important is U.S. Location for Research in Science?" *Review of Economics and Statistics*, Forthcoming.

### **Superstars, Concavity and the Concatenation of Talent**

Cole, Jonathan R., and Stephen Cole. 1972. "The Ortega Hypothesis." *Science* **178**(4059): 368-375.

(\*) Azoulay, Pierre, Joshua Graff Zivin, and Jialan Wang. 2010. "Superstar Extinction." *Quarterly Journal of Economics* **125**(2): 549-589.

Waldinger, Fabian. 2012. "Peer Effects in Science: Evidence from the Dismissal of Scientists in Nazi Germany." *Review of Economic Studies* **79**(2): 838-861.

Zucker, Lynne G., Michael R. Darby, and Marilyn B. Brewer. 1998. "Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises." *American Economic Review* **88**(1): 290-306.

### **Discrimination and Stratification**

Ding, Waverly W., Fiona Murray, and Toby E. Stuart. 2013. "From Bench to Board: Gender Differences in University Scientists' Participation in Corporate Scientific Advisory Boards." *Academy of Management Journal* **56**(5): 1443-1464.

Arcidiacono, Peter, Esteban Aucejo, and V. Joseph Hotz. 2015. "University Differences in the Graduation of Minorities in STEM Fields: Evidence from California." *American Economic Review* **105**(12): xxx-xxx.

Blau, Francine D., Janet M. Currie, Rachel T.A. Croson, and Donna K. Ginther. 2010. "Can Mentoring Help Female Assistant Professors? Interim Results from a Randomized Trial." *American Economic Review: Papers & Proceedings* **100**(2): 348-352.

(\*) Breda, Thomas, and Son Thierry Ly. 2015. "Professors in Core Science Fields Are Not Always Biased against Women: Evidence from France." *American Economic Journal: Applied Economics* **7**(4): 53-75.

Brooks, Alison Wood, Laura Huang, Sarah Wood Kearney, and Fiona E. Murray. 2014. "Investors Prefer Entrepreneurial Ventures Pitched by Attractive Men." *Proceedings of the National Academy of Sciences* **111**(12): 4427-4431.

Ginther, Donna K., Walter T. Schaffer, Joshua Schnell, Beth Masimore, Faye Liu, Laurel L. Haak, and Raynard Kington. 2011. "Race, Ethnicity, and NIH Research Awards." *Science* **333**(6045): 1015-1019.

Zinovyeva, Natalia, and Manuel Bagues. 2015. "The Role of Connections in Academic Promotions." *American Economic Journal: Applied Economics* **7**(2): 264-292.

### **Manpower Analysis' Sad Track Record**

Goolsbee, Austan. 1998. "Does R&D Policy Primarily Benefit Scientists and Engineers?" *American Economic Review* **88**(2): 298-302.

Romer, Paul M. 2000. "Should the Government Subsidize Supply or Demand in the Market for Scientists and Engineers?" *Innovation Policy and the Economy* **1**: 221-252.

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Freeman, Richard B. 1975. "Supply and Salary Adjustments to the Changing Science Manpower Market: Physics, 1948-1973." *American Economic Review* **65**(1): 27-39.

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Teitelbaum, Michael S. 2014. *Falling Behind? Boom, Bust and the Global Race for Scientific Talent*. Princeton, NJ: Princeton University Press.

Ehrenberg, Ronald G. 1992. "The Flow of New Doctorates." *Journal of Economic Literature* **30**(2): 830-875.  
Committee on Science, Engineering, and Public Policy (COSEPUP). 2006. *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, D.C.: National Academies Press.

Class 4 Incentives for Innovators: Contracts and Control Rights

October 6

- (\*) Manso, Gustavo. 2011. "Motivating Innovation." *Journal of Finance* **66**(5): 1823-1860.
- (\*) Azoulay, Pierre, Joshua Graff Zivin, and Gustavo Manso. 2011. "Incentives and Creativity: Evidence from the Academic Life Sciences." *RAND Journal of Economics* **42**(3): 527-554.
- (\*) Aghion, Philippe, and Jean Tirole. 1994. "The Management of Innovation." *Quarterly Journal of Economics* **109**(4): 1185-1209.
- (\*) Lerner, Joshua, and Ulrike Malmendier. 2010. "Contractibility and the Design of Research Agreements." *American Economic Review* **100**(1): 214-246.
- Tian, Xuan, and Tracy Yue Wang. 2014. "Tolerance for Failure and Corporate Innovation." *Review of Financial Studies* **27**(1): 211-255.
- Hellmann, Thomas, and Veikko Thielez. 2011. "Incentives and Innovation: A Multi-tasking Approach." *American Economic Journal: Microeconomics* **3**(1): 78-128.
- Holmstrom, Bengt. 1989. "Agency Costs and Innovation." *Journal of Economic Behavior and Organization* **12**(3): 305-327.
- Lazear, Edward P. 1997. "Incentives in Basic Research." *Journal of Labor Economics* **15**(1): S167-S197.
- Lerner, Joshua, and Julie Wulf. 2007. "Innovation and Incentives: Evidence from Corporate R&D." *Review of Economics and Statistics* **89**(4): 634-644.
- Boudreau, Kevin J., and Karim R. Lakhani. 2012. "The Confederacy of Heterogeneous Software Organizations and Heterogeneous Developers: Field Experimental Evidence on Sorting and Worker Effort." Chapter 10 in *The Rate & Direction of Inventive Activity Revisited* (edited by Joshua Lerner and Scott Stern), pp. 483-502, 2012.
- Ederer, Florian. 2013. "Incentives for Parallel Innovation." Working Paper, Yale School of Management. Available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2309664](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2309664).
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- Carmichael, H. Lorne. 1988. "Incentives in Academics: Why Is There Tenure?" *Journal of Political Economy* **96**(3): 453-472.
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**PROBLEM SET #1 DUE!**

Class 5 Incentives for Innovators: Intellectual Property, Prizes, and Secrecy

October 13

- (\*) Gallini, Nancy, and Suzanne Scotchmer. 2002. "Intellectual Property: What is the Best Incentive System." *Innovation Policy and the Economy* 2: 51-77.
- (\*) Wright, Brian. 1983. "The Economics of Invention Incentives: Patents, Prizes, and Research Contracts." *American Economic Review* 73(4): 691-707.
- Williams, Heidi L. 2013. "Intellectual Property Rights and Innovation: Evidence from the Human Genome." *Journal of Political Economy* 121(1): 1-27.
- (\*) Moser, Petra. 2013. "Patents and Innovation: Evidence from Economic History." *Journal of Economic Perspectives* 27(1): 23-44.
- Weyl, E. Glen, and Jean Tirole. 2013. "Market Power Screens Willingness-to-Pay." *Quarterly Journal of Economics* 127(4): 1971-2003.
- Shavell, Steven, and Tanguy van Ypersele. 2001. "Rewards versus Intellectual Property Rights." *Journal of Law and Economics* 44(2): 525-547.
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- Boldrin, Michele, and David Levine. 2002. "The Case Against Intellectual Property." *American Economic Association Papers & Proceedings* 92(2): 209-212.

### **Prizes and Prize Design**

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- Moser, Petra, and Tom Nicholas. 2013. "Prizes, Publicity, And Patents: Non-Monetary Awards As A Mechanism To Encourage Innovation." *Journal of Industrial Economics* 61(3): 763-788.
- Murray, Fiona, Scott Stern, Georgina Campbell, and Alan MacCormack. 2012. "Grand Innovation Prizes: A Theoretical, Normative, and Empirical Evaluation." *Research Policy* 41(10): 1779-1792.
- Kremer, Michael, and Heidi Williams. 2010. "Incentivizing Innovation: Adding to the Toolkit." *Innovation Policy and the Economy* 1: 1-17.
- Williams, Heidi. 2012. "Innovation Inducement Prizes: Connecting Research to Policy." *Journal of Policy Analysis and Management* 31(3): 752-776.
- Kay, Luciano. 2011. "The Effect of Inducement Prizes on Innovation: Evidence from the Ansari XPrize and the Northrop Grumman Lunar Lander Challenge." *R&D Management* 41(4): 360-377.

### **Economics of the Patent System**

- Nordhaus, William D. 1967. "The Optimal Life of a Patent." Cowles Foundation Discussion Paper #241.
- (\*) Lemley, Mark A., and Carl Shapiro. 2005. "Probabilistic Patents." *Journal of Economic Perspectives* 19(2): 75-98.
- (\*) Scotchmer, Suzanne. 1991. "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law." *Journal of Economic Perspectives* 5(1): 29-41.
- (\*) Sampat, Bhaven, and Heidi L. Williams. 2015. "How Do Patents Affect Follow-on Innovation? Evidence from the Human Genome." NBER Working Paper #21666.
- Galasso, Alberto, and Mark Schankerman. 2015. "Patents and Cumulative Innovation: Causal Evidence from the Courts." *Quarterly Journal of Economics* 130(1): 317-369.

- Hall, Bronwyn H. 2005. "Exploring the Patent Explosion." *Journal of Technology Transfer* **30**(1-2): 35-48.
- Hall, Bronwyn H., and Dietmar Harhoff. 2012. "Recent Research on the Economics of Patents." NBER Working Paper #17773.
- Merges, Robert P., and Richard R. Nelson. 1990. "On the Complex Economics of Patent Scope." *Columbia Law Review* **90**(4): 839-916.
- Moser, Petra, Joerg Ohmstedt, and Paul W. Rhode. 2015. "Patent Citations and the Size of the Inventive Step — Evidence From Hybrid Corn." NBER Working Paper #21443.
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- Bessen, James. 2002. "Patents and the Diffusion of Technical Information." *Economics Letters* **86**(1): 121-128.
- Graham, Stuart, and Deepak Hegde. 2015. "Disclosing Patents' Secrets." *Science* **347**(6219): 236-237.
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### **Patenting and Firm Behavior**

- (\*) Budish, Eric, Benjamin N. Roin, and Heidi Williams. 2015. "Do Firms Underinvest in Long-Term Research? Evidence from Cancer Clinical Trials." *American Economic Review* **105**(7): 2044-2085.
- (\*) Hall, Bronwyn H., and Rosemarie H. Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the US Semiconductor Industry, 1979-95." *RAND Journal of Economics* **32**(1): 101-128.
- Kortum, Samuel, and Joshua Lerner. 1998. "Stronger Protection or Technological Revolution: What is Behind the Recent Surge in Patenting?" *Carnegie-Rochester Conference Series on Public Policy* **48**: 247-304.
- Czarnitzki, Dirk, Bronwyn H. Hall, and Hanna Hottenrott. 2014. "Patents as Quality Signals? The Implications for Financing Constraints on R&D." NBER Working Paper #19947.
- Rivette, Kevin G., and David Kline. 2000. "Discovering New Value in Intellectual Property." *Harvard Business Review* **78**(1): 54-66.
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- Belenzon, Sharon. 2011. "Cumulative Innovation and Market Value: Evidence from Patent Citations." *Economic Journal* **122**(559): 265-285.
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## Patenting and Antitrust

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- Lampe, Ryan, and Petra Moser. 2010. "Do Patent Pools Encourage Innovation? Evidence from the Nineteenth-Century Sewing Machine Industry." *Journal of Economic History* **70**(4): 898-920.
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## Secrecy

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- Lemley, Mark A. 2008. "The Surprising Virtues of Treating Trade Secrets as IP Rights." *Stanford Law Review* **61**(2): 311-353.
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- Hall, Bronwyn H., Christian Helmers, Mark Rogers, and Vania Sena. 2014. "The Choice Between Formal and Informal Intellectual Property: A Review." *Journal of Economic Literature* **52**(2): 375-423.
- Arundel, Anthony. 2001. "The Relative Effectiveness of Patents and Secrecy for Appropriation." *Research Policy* **30**(4): 611-624.
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Class 6    The Life Cycle of Inventors    October 20

Class 7    Open Science as an Economic Institution    October 27

- (\*) Dasgupta, Partha, and David. Paul. 1994. "Towards a New Economics of Science." *Research Policy* **23**(5): 487-521.
- (\*) Aghion, Philippe, Mathias Dewatripont, and Jeremy C. Stein. 2008. "Academic Freedom, Private Sector Focus, and the Process of Innovation." *RAND Journal of Economics* **39**(3): 617-635.
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- (\*) Stern, Scott. 2004. "Do Scientists Pay to Be Scientists?" *Management Science* **50**(6): 835-853.
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- Bikard, Michaël. 2014. "Is Knowledge Trapped Inside the Ivory Tower? Scientific and Organizational Hurdles to Invention based on Academic Research." Working Paper, London Business School.
- Levin, Sharon G., and Paula E. Stephan. 1991. "Research Productivity over the Life Cycle: Evidence for Academic Scientists." *American Economic Review* **81**(1): 114-32.
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- Gluckman, Peter. 2012. "Which Science to Fund: Time to Review Peer Review?" Office of the Prime Minister's Science Advisory Committee. Aucland, New Zealand.
- Sauermann, Henry, and Michael Roach. 2014. "Not All Scientists Pay to Be Scientists: PhDs' Preferences for Publishing in Industrial Employment." *Research Policy* **43**(1): 32-47.
- Gans, Joshua S., Fiona E. Murray, and Scott Stern. 2013. "Contracting over the Disclosure of Scientific Knowledge: Intellectual Property and Academic Publication." NBER Working Paper #19560.
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- Gans, Joshua, and Fiona Murray. 2014. "Markets for Scientific Attribution." NBER Working Paper #20677.
- Gentil-Beccot, Anne, Salvatore Mele, and Travis C. Brooks. 2009. "Citing and Reading Behaviours in High-Energy Physics: How a Community Stopped Worrying about Journals and Learned to Love Repositories." Working Paper, CERN, arXiv:0906.5418.
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