



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

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Comments on the DOE-SC Program in  
High Energy Density Laboratory Plasma Science  
&  
Inertial Fusion Energy Science

Sean Finnegan & Ann Satsangi  
Fusion Energy Sciences  
*Program Management Team* for HEDLP



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Fusion Energy Sciences is pursuing a strategic vision to provide the

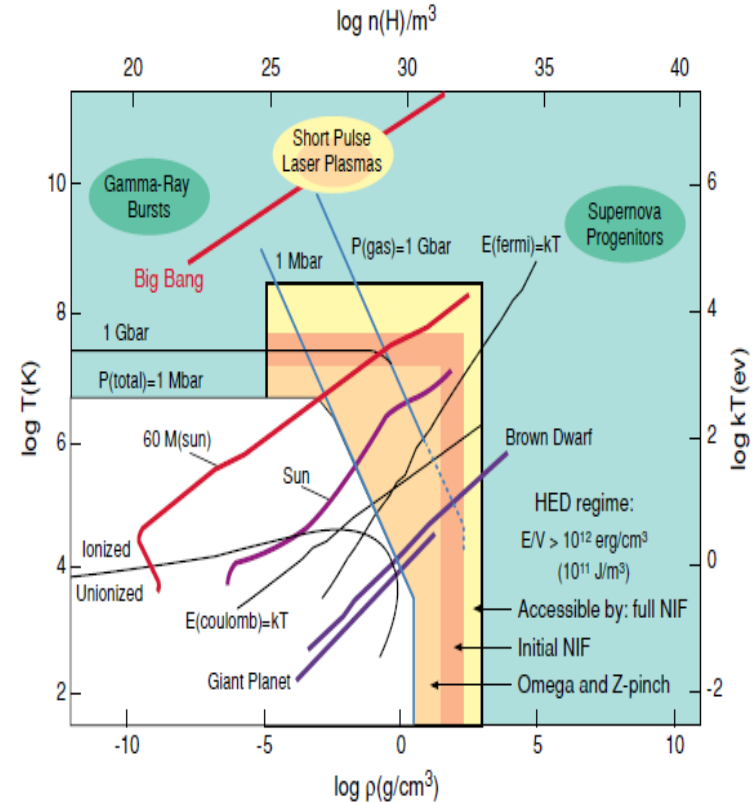
- **Stability,**
- **Flexibility,** and
- **Growth**

necessary to develop and strengthen an autonomous research community in High Energy Density Laboratory Plasma (HEDLP) science including Inertial Fusion Energy (IFE) science.

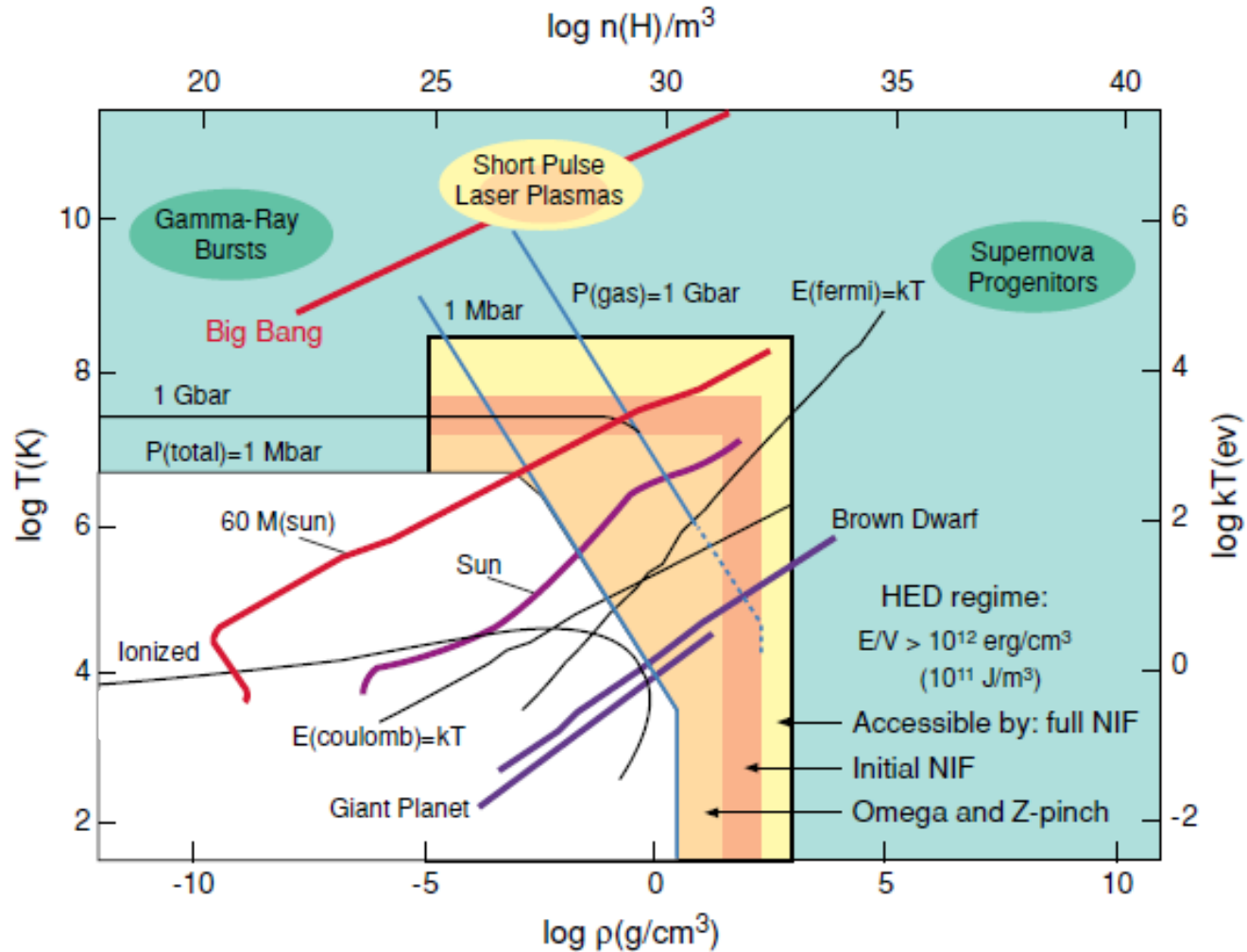


“High-energy-density laboratory plasma (HEDLP) physics is the study of ionized matter at extremely high density and temperature, specifically when matter is heated and compressed to a point that the **stored energy in the matter reaches approximately 100 billion Joules per cubic meter** (e.g., the energy density of a hydrogen molecule). This corresponds to a pressure of approximately 1 million atmospheres or **1 Mbar**”.\*

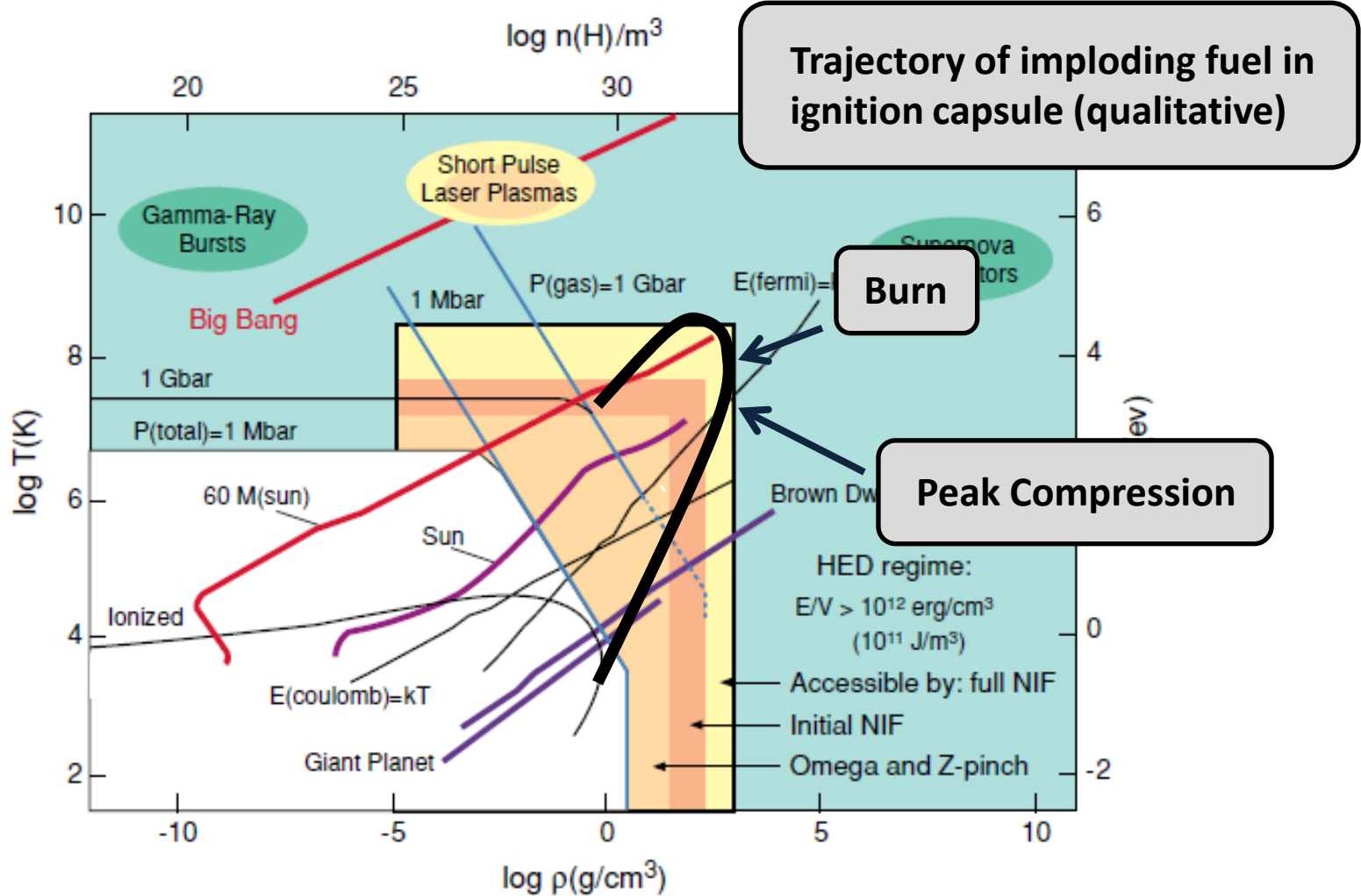
\*Systems in which free electrons play a significant role in the dynamics and for which the underlying assumptions and methods of traditional ideal-plasma theory and standard condensed matter theory do not apply (e.g., Warm Dense Matter at temperatures of a few eV) can have pressures as low as 0.1 Mbar and are also considered HED plasmas.



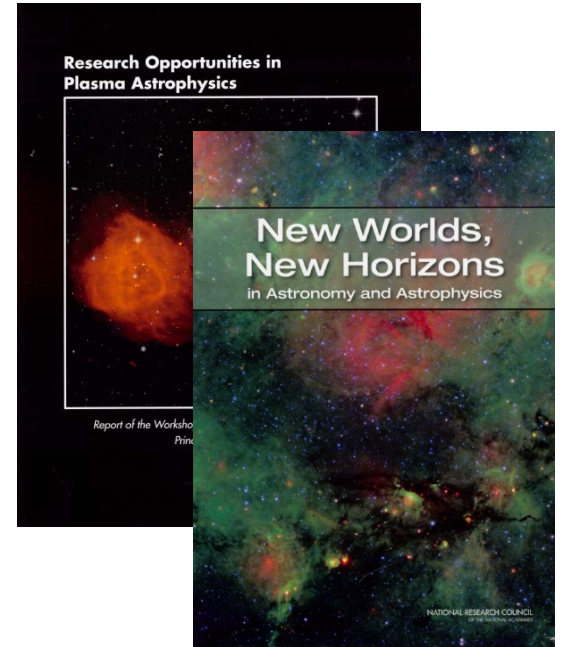
1Mbar is also used by *The Journal of High Energy Density Physics* published by Elsevier as well as *The High Energy Density Summer School* organized by the Fusion Science Center at the University of Rochester.



\* Figure 1.1, *Frontiers in High Energy Density Physics: The X-Games of Contemporary Science*



\* Figure 1.1, Frontiers in High Energy Density Physics: The X-Games of Contemporary Science



exemplify cross-cutting  
nature of HEDLP science.



## Expanding Opportunity in the HEDLP/IFES Program

*“The expanding scope of plasma research is creating an abundance of new scientific opportunities and challenges. These opportunities promise to further expand the role of plasma science in enhancing economic security and prosperity, energy and environmental security, national security, and scientific knowledge.”*

*- Physics 2010: Plasma Science, advancing knowledge in the national interest , 2007*

*“The Federal government would be well served by the establishment of strategic planning, management and merit-based, science-driven stewardship for High Energy Density Laboratory Plasmas (HEDLP).”*

*- Report of the Interagency Task Force on High Energy Density Physics, 2007*

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*“Priority should be given to discovery-driven research efforts of high intellectual value that are expected to advance the field, explore its practical and scientific potentials, stimulate the interest of graduate students, and attract scientists from other disciplines.”*

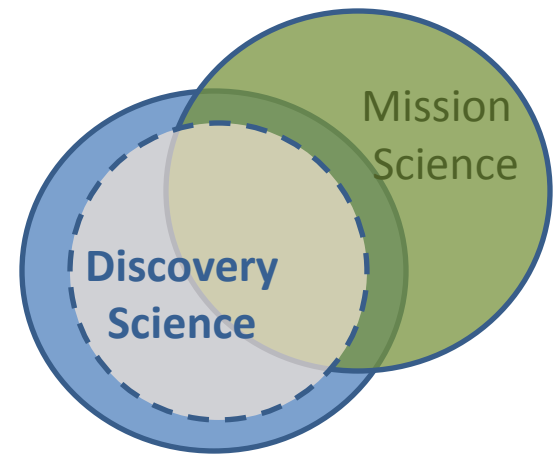
*- FESAC HEDLP report 2009*





## Discovery Science...

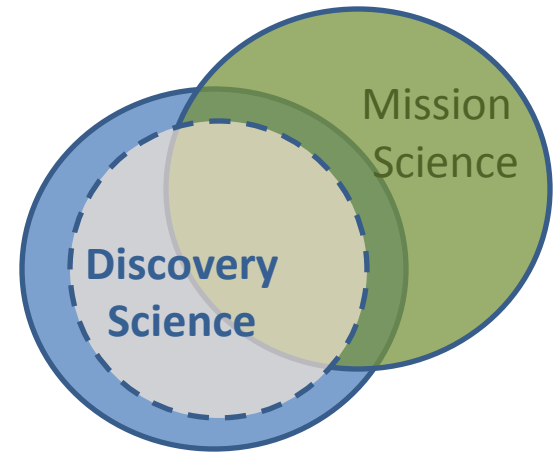
- Freedom to develop as a autonomous scientific field
- Flexibility to address cross-cutting science
- Agility to capitalize on emerging opportunities and capabilities
- Strength to develop future technologies





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HEDLP as a field with its own discovery-driven scientific base of support contributes to IFE scientific needs through

- Student recruitment,
- Expanded university involvement and recognition.



PRL 107, 035006 (2011)

PHYSICAL REVIEW LETTERS

week ending 15 JULY 2011



### Fusion Yield Enhancement in Magnetized Laser-Driven Implosions

P. Y. Chang,<sup>1,2,3</sup> G. Fiksel,<sup>1,2</sup> M. Hohenberger,<sup>1,2,4</sup> J. P. Knauer,<sup>2</sup> R. Betti,<sup>1,2,3,4</sup> F. J. Marshall,<sup>2</sup> D. D. Meyerhofer,<sup>1,2,3,4</sup> F. H. Séguin,<sup>1,5</sup> and R. D. Petrasso<sup>1,5</sup>

<sup>1</sup>Fusion Science Center, University of Rochester, Rochester, New York 14623, USA

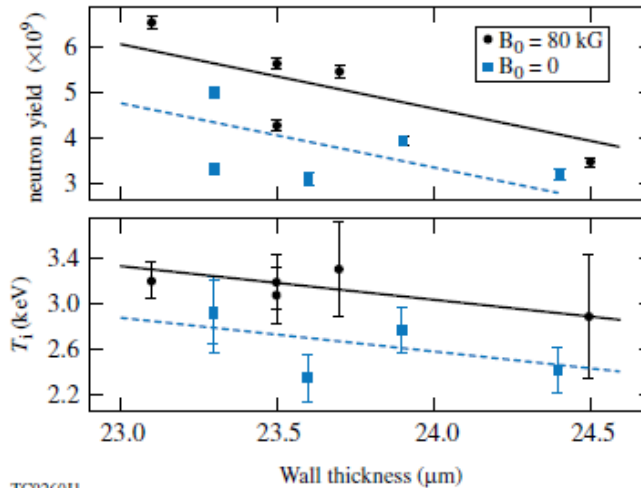
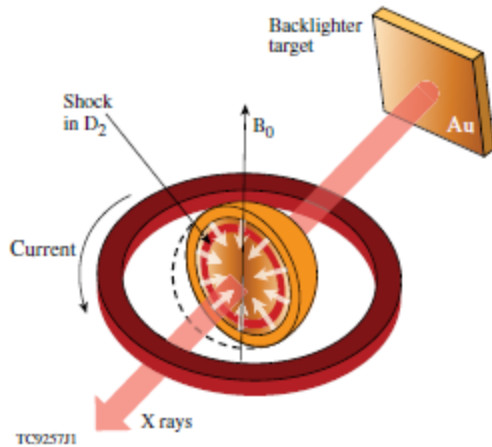
<sup>2</sup>Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623, USA

<sup>3</sup>Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627, USA

<sup>4</sup>Department of Mechanical Engineering, University of Rochester, Rochester, New York 14627, USA

<sup>5</sup>Plasma Science and Fusion Center, MIT, Cambridge, Massachusetts 02139, USA

(Received 11 April 2011; published 15 July 2011)



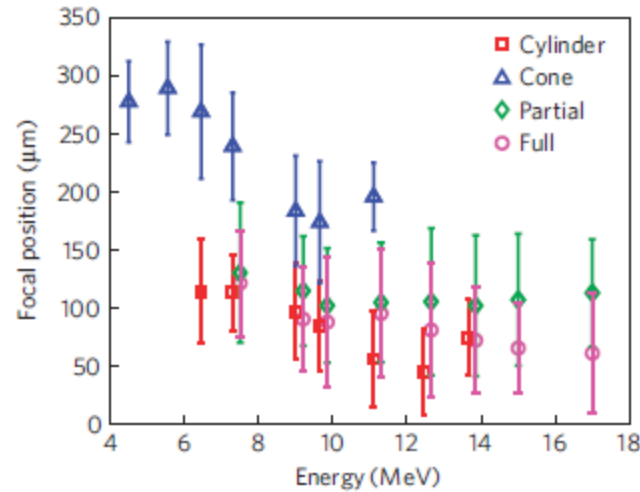
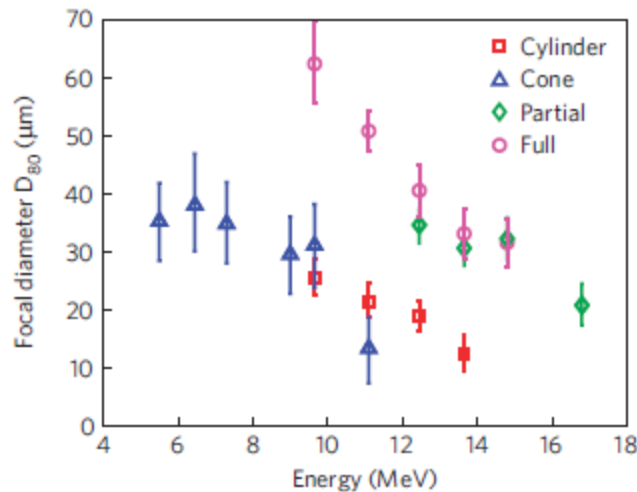
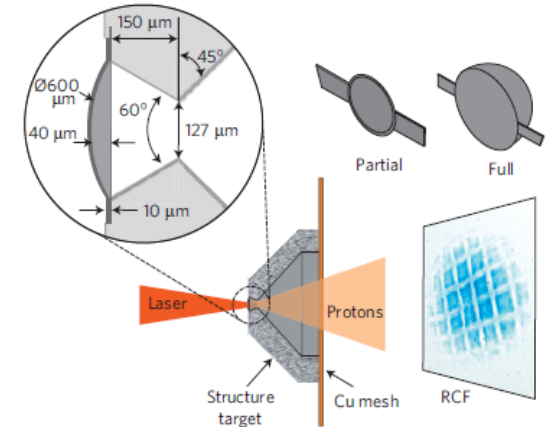
↑ 30 %

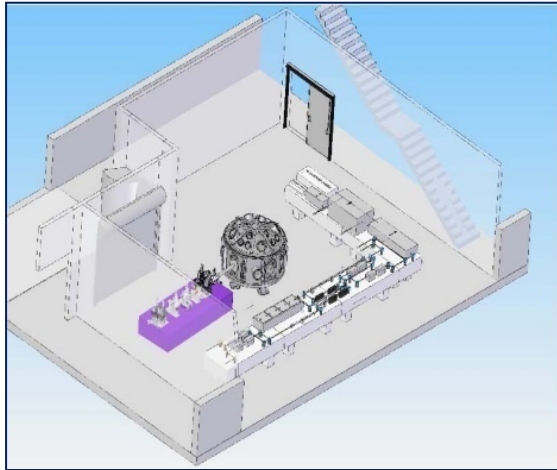
↑ 15 %



# Focusing of short-pulse high-intensity laser-accelerated proton beams

Teresa Bartal<sup>1,2</sup>, Mark E. Foord<sup>2</sup>, Claudio Bellei<sup>2</sup>, Michael H. Key<sup>2</sup>, Kirk A. Flippo<sup>3</sup>, Sandrine A. Gaillard<sup>4</sup>, Dustin T. Offermann<sup>3</sup>, Pravesh K. Patel<sup>2</sup>, Leonard C. Jarrott<sup>1</sup>, Drew P. Higginson<sup>1,2</sup>, Markus Roth<sup>5</sup>, Anke Otten<sup>5</sup>, Dominik Kraus<sup>5</sup>, Richard B. Stephens<sup>6</sup>, Harry S. McLean<sup>2</sup>, Emilio M. Giraldez<sup>6</sup>, Mingsheng S. Wei<sup>6</sup>, Donald C. Gautier<sup>3</sup> and Farhat N. Beg<sup>1\*</sup>





## Materials at Extreme Conditions Instrument (MECI) at SLAC Linear Coherent Light Source (LCLS)

Lasers (High energy, high peak power)	+ X-Ray Beam	=	Unprecedented opportunities for research in WDM and HED matter
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Projected Completion Date: January, 2013

First Users in FY2012 (interleave with 2<sup>nd</sup> laser installation)

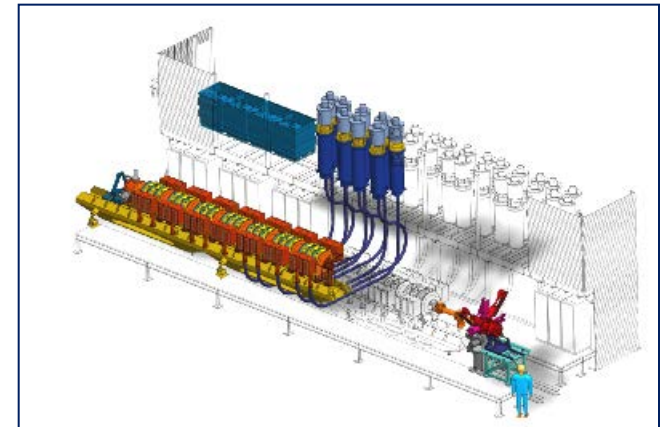
## Neutral Drift Compression Experiment (NDCX-II)

Heavy Ion Fusion and Warm Dense Matter Science

Intense, Short-pulse Ion Beams	➔	Fast, Uniform Heating of Targets
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Projected Completion Date: March, 2012

First Users in FY 2012

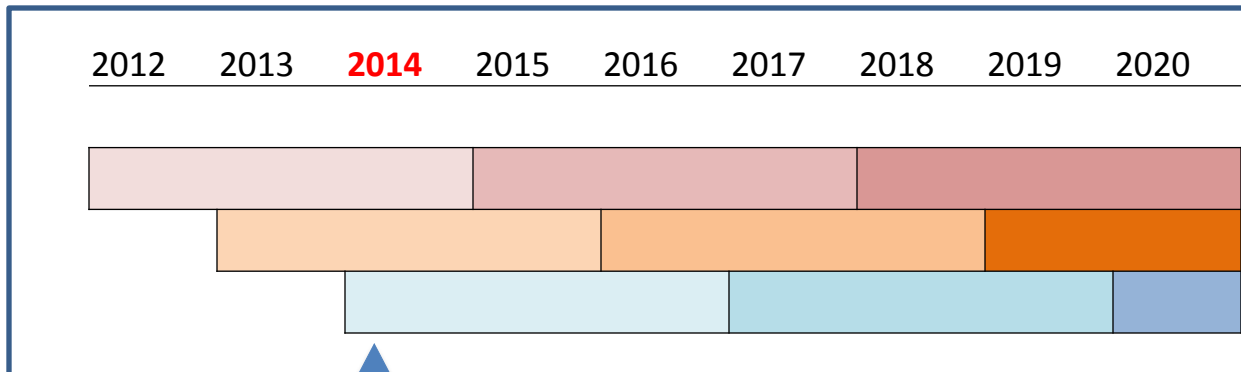




**Stability** – provide confidence for investments in HEDLP: people, departments, reapplication opportunities

**Flexibility** – ability to respond to scientific and technological changes

**Growth** - provide opportunity for emerging faculty and students each year



\* annual solicitation by 2014 will provide a strong and vibrant scientific base for a potential IFE program



## Promotion of Success:

- You can:
- maintain an open dialog, please contact us
  - keep us informed of breaking news, publications, significant interactions
- We will:
- highlight technical successes to SC management
  - notify of opportunities (i.e., SC-Graduate and Postdoctoral fellowships, funding opportunities at other agencies) via HEDSA, DPP, FES web page, social media



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## Supporting and Strengthening YOUR community:

Quality reviewing of proposals is essential to: GPS Partnership (NSF/DOE), ASCR, Early Career, SBIR, HEDLP Joint Program

You can: - participate ( reviews, panels, volunteer)

We will: - ensure scientific quality and provide a level playing field through rigorous, peer evaluation

- ***support the best science!***

A strong science portfolio provides the best justification and defense of our program in a toughening budgetary environment.





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## **The HEDLP & IFE Sciences Management Team**

Please feel free to contact us:

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(301) 903-9707

[Ann.Satsangi@science.doe.gov](mailto:Ann.Satsangi@science.doe.gov)



PRL 107, 115002 (2011)

PHYSICAL REVIEW LETTERS

week ending  
9 SEPTEMBER 2011

## Monoenergetic Ion Beam Generation by Driving Ion Solitary Waves with Circularly Polarized Laser Light

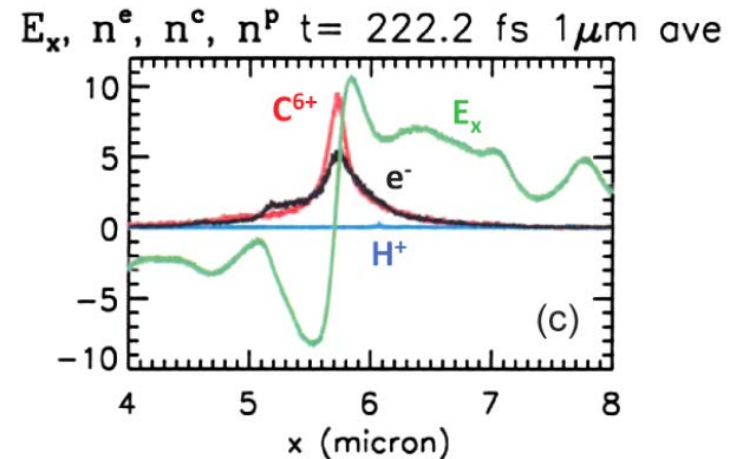
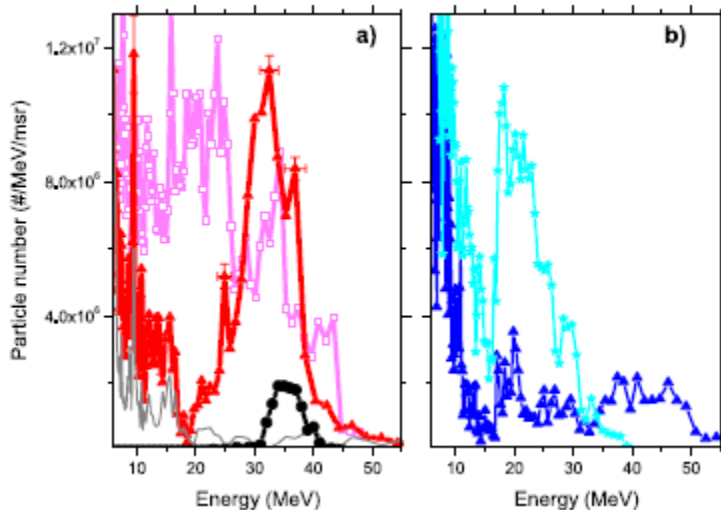
D. Jung,<sup>1,2,3,\*</sup> L. Yin,<sup>1</sup> B. J. Albright,<sup>1</sup> D. C. Gautier,<sup>1</sup> R. Hörlein,<sup>2,3</sup> D. Kiefer,<sup>2,3</sup> A. Henig,<sup>2,3</sup> R. Johnson,<sup>1</sup> S. Letzring,<sup>1</sup> S. Palaniyappan,<sup>1</sup> R. Shah,<sup>1</sup> T. Shimada,<sup>1</sup> X. Q. Yan,<sup>3</sup> K. J. Bowers,<sup>1</sup> T. Tajima,<sup>2</sup> J. C. Fernández,<sup>1</sup> D. Habs,<sup>2,3</sup> and B. M. Hegelich<sup>1,2</sup>

<sup>1</sup>Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA

<sup>2</sup>Department für Physik, Ludwig-Maximilians-Universität München, D-85748 Garching, Germany

<sup>3</sup>Max-Planck-Institut für Quantenoptik, D-85748 Garching, Germany

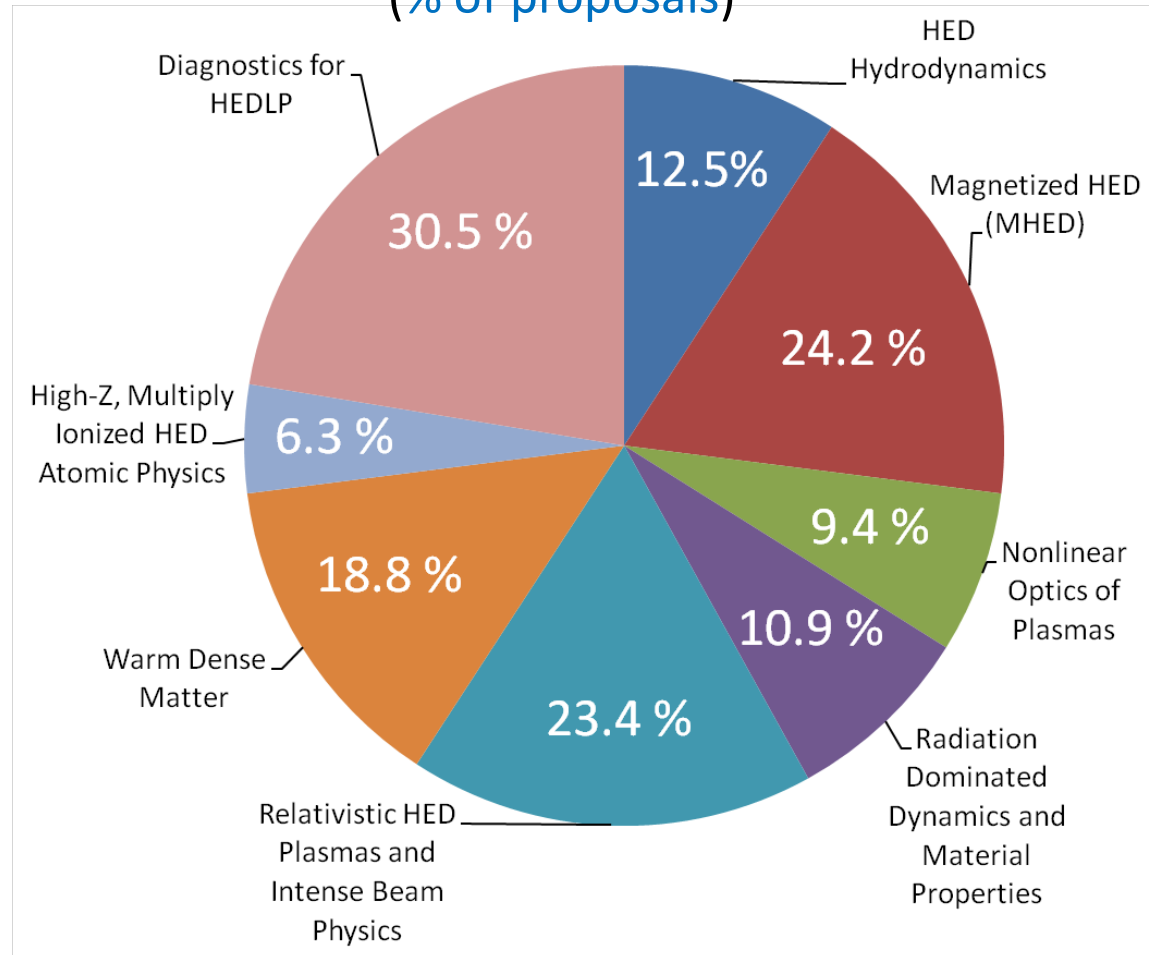
(Received 21 March 2011; published 8 September 2011)



Typical areas of interest defined in HEDLP ReNeW 2010



cancelled FY11 solicitation applicants  
(% of proposals)





## Timeline:

*Published:* 8 September 2011

*Deadline:* 3 November 2011

*Anticipated Award Date:* 1 June 2012

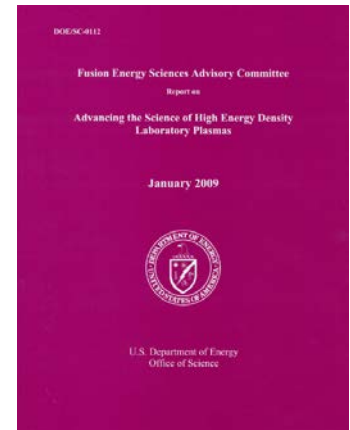
## Topic Interest

Joint SC/NNSA interest in discovery-driven science spanning topics identified in FESAC and ReNeW HEDLP reports, emphasizing new facilities (MECI, NDCX-II, NIF) and,

HEDLP Science – including IFE science, shifting away from IFE technology development.

**Peer Review ...** vital to maintaining scientific credibility!

Panel review – *Please* participate, volunteer

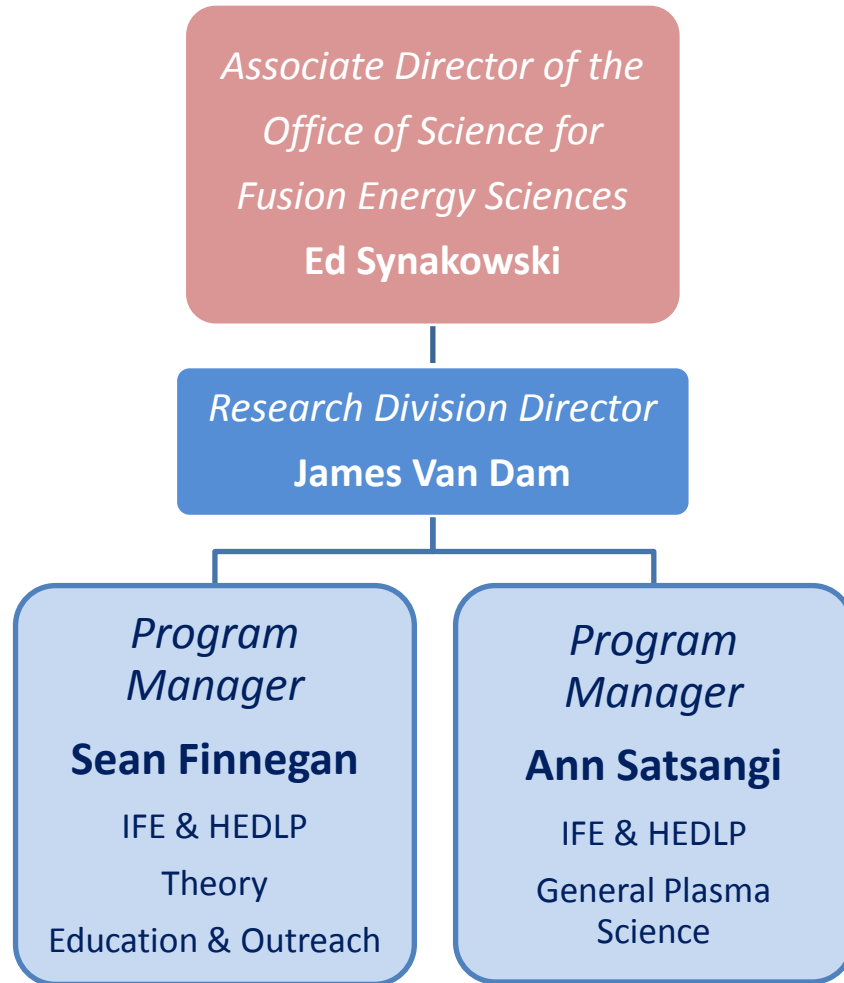




## Community/Concept Development

We are pursuing a community/concept development initiative intended to:

- Build connections between researchers with cross-cutting HEDLP interests.
- Increase opportunity for university researchers to access world class user facilities (e.g., Z, NIF, OMEGA, MECI, NDCX-II).
- Broaden impact on greater scientific community.
- Incentivize non-HEDLP researchers to get involved.
- Prepare awardees to submit competitive, collaborative proposals at the end of concept development funding cycle.



Welcome our new  
Research Division Director

### The IFE & HEDLP Management Team

Please feel free to contact us:

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(301) 903-9707  
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(301) 903-4920  
[Sean.Finnegan@science.doe.gov](mailto:Sean.Finnegan@science.doe.gov)