

Perspective on Magnetic Fusion Energy Directions from Early Career Fusion Scientists

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ECFS group formed to engage early/mid career researchers in magnetic fusion strategic planning

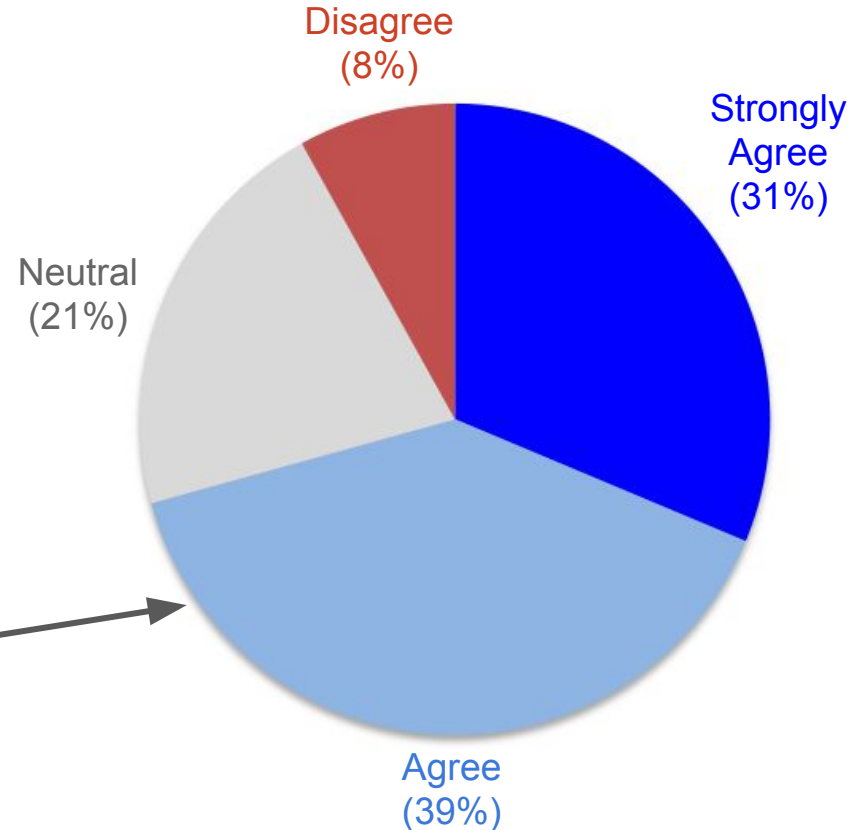
- Observed low participation by early career fusion scientists (ECFS) at 2017 US Magnetic Fusion Research Strategic Directions workshop in Madison, WI
- Group of ECFS members self-organized to spur participation by ECFS community as a whole in the strategic planning process, provide a platform for gathering ECFS input to the NAS Committee
 - ECFS are those who are currently working on magnetic fusion energy in the US, received their Ph.D. within the last ~15 years
 - I.e. Those who received their degree after 2002 Snowmass meeting
- Many in the ECFS community plan to remain in fusion research, some will likely be responsible for leading the program in the future, we believe it is vital for our community to be engaged and providing input into the strategic planning process now

Private online forum used to facilitate discussion amongst the ECFS community

- Initial organizing group formed at 2017 APS-DPP meeting
 - ~200 researchers who satisfied ECFS criteria were identified and invited to join forum
 - 163 members registered
- Primary means of data gathering and discussion organization was through a series of poll questions
 - Questions chosen by organizers
 - Accompanying forum threads promoted discussion, background information
- Six rounds of polls with a total of nearly 40 questions
 - Typically between 65-85 responses per question
 - Polls provided input to NAS Committee, follow up statement on the main two recommendations of the NAS Report on Burning Plasmas

Lack of urgency in program underlying theme of ECFS discussion

- Highlighted need for more vigorous research program to develop economical fusion energy within the next several decades
- Example poll questions: Our primary motivation for participating in MFE research is the goal of a fusion power plant [91/1], and timely progress towards fusion energy is a necessary condition for keeping us in the field [70/8]



Lack of urgency in program underlying theme of ECFS discussion

Full polling results can be found in the following whitepapers:

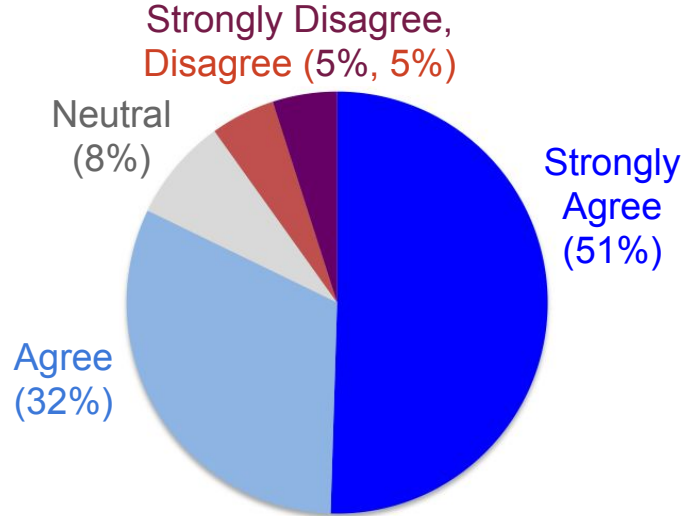
- “Perspective on Magnetic Fusion energy Directions from Early Career Fusion Scientists”, submitted to NAS Committee on Feb. 22, 2018
- “Follow-up Polling of the Early Career Fusion Scientist Community in Response to NAS Panel Feedback”, submitted to NAS Committee on April 13, 2018

Impact of ECFS recognized by NAS Committee on Burning Plasmas

- “We listened very carefully to the community, especially some of the younger scientists who are very active in the field, and what we heard from the scientists is a desire to get on with fusion energy” - Mike Mauel speaking to Science Magazine (December 2018)
- “Another example in this electronic age, is the online forum that was established by a self-organized group of ‘Early Career Fusion Scientists’ (ECFS) that took inspiration from the workshops. A poll conducted of the ECFS participants by the group’s leaders shows that group members are strongly motivated in their work by the prospect of fusion energy, and they have expressed enthusiasm for a strategic plan that would unite the community around a roadmap to achieve fusion-based electricity within their lifetimes” - NAS Final Report on Burning Plasmas

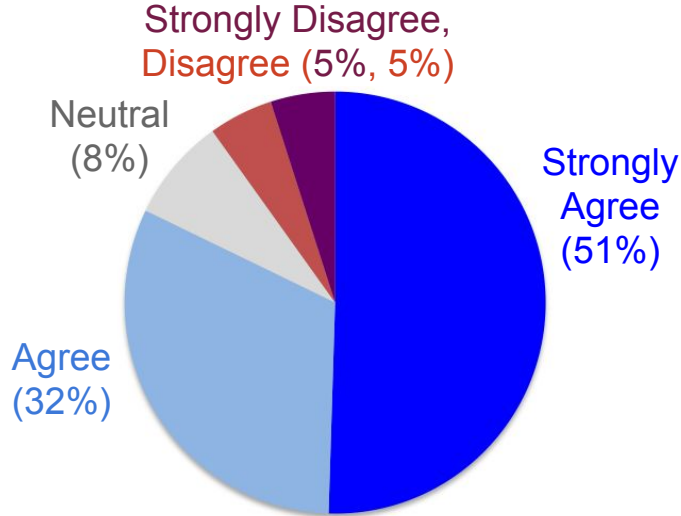
Strong agreement from ECFS reported for main recommendations of NAS Burning Plasma Report

1st: The US should remain an ITER partner as the most cost-effective way to gain experience with a burning plasma at scale of power plant [83/10]

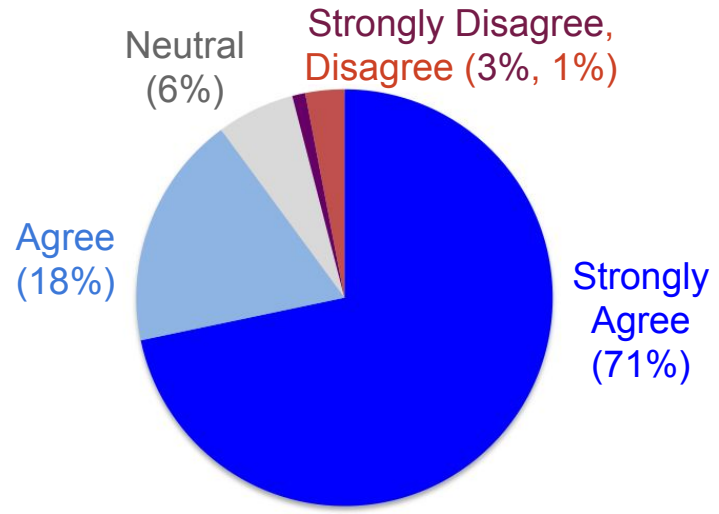


Strong agreement from ECFS reported for main recommendations of NAS Burning Plasma Report

1st: *The US should remain an ITER partner as the most cost-effective way to gain experience with a burning plasma at scale of power plant [83/10]*



2nd: *The US should start a national program of accompanying research and technology leading to construction of a compact pilot plant that produces electricity from fusion at lowest possible capital cost [89/5]*



Increase of ECFS in leadership roles and participation in recent Community Planning Process

- Perhaps more importantly than any single poll result, we believe this process has demonstrated that the ECFS community
 - Has an appetite and willingness to be actively engaged in the planning process
 - Is able to work together constructively to build a common vision for the fusion program
- With the announcement of the FES Long-Range-Strategic Planning Activity in November 2018, ECFS solicited nominations within the community for Co-Chair and Program Committee Members
 - 12 nominations for Co-Chair
 - 14 nominations for Program Committee
- Forum provided space for ECFS members to brainstorm ideas for strategic initiatives as part of the process and to form advocate groups

Many of the views at the CPP-Knoxville workshop observed in early ECFS polling results

- Near universal consensus for timeliness/urgency of fusion energy
 - The 30-year vision for the US program should be to develop the science and technology basis needed to stimulate sufficient industry involvement to bring fusion to market [81/6]
 - Clear support by CPP-Knoxville attendees for Fusion Prototypical Neutron Source (FPNS) demonstrates wide support for fusion energy mission
- Diversity and inclusion best strategy for solving challenging problems - realization of fusion energy involves many fields coming together to solve complex problems
- Polling highlights that most vocal in the room may not reflect opinion of majority and willingness to prioritize other's research ahead of own personal research to realize fusion energy
- We look forward to participating in CPP-Houston to contribute to building consensus around a plan that will benefit all in FES

Extra slides

Links to Early Career Fusion Scientists material

- [Early Career Fusion Scientists](#) forum
- “[Perspective on Magnetic Fusion Energy Directions from Early Career Fusion Scientists](#)”, submitted as input to the NAS Panel on Burning Plasmas on February 22, 2018
- “[Follow-up Polling of the Early Career Fusion Scientist Community in Response to NAS Panel Feedback](#)”, submitted as input to the NAS Panel on Burning Plasmas on April 13, 2018
- “[Statement from Early Career Fusion Scientists on the Final Report of the National Academy of Sciences Committee on a Strategic Plan for Burning Plasma Research](#)”, March 10, 2019

Lack of urgency in program underlying theme of ECFS discussion

- A new major domestic facility is a necessary component of a US strategic plan [88/4]
 - A redistribution of current funding is expected to support such a facility [73/11], and that reduced funding for current user facilities is acceptable to fund this facility [71/13]
 - ECFS community was neutral [56/13] as to whether decreased funding for their own institution was acceptable for funding a new national facility

- I am willing to change my area of of research to meet fusion energy goals [85/2]