

# Connecting Nuclei to the Cosmos

## Experimental Nuclear Astrophysics

Conveners: Melina Avila, Dan Bardayan, Kelly Chipps, Catherine Deibel, Chuck Horowitz, Richard Longland, Alan McIntosh, Hendrik Schatz, Frank Strieder



# Charge – what we are supposed to do

Main points to address for each Working Group include:

- Scientific Challenges
- Progress since 2015 LRP
- Scientific Opportunities
- Resources Needed

Where relevant, please also consider addressing benefits, impacts, and opportunities of:

- International coordination and collaborations afforded by current and planned major facilities and experiments in the United States (U.S.) and other countries
- Interagency coordination and collaboration in crosscutting areas
- Synergies with neighboring research disciplines and further opportunities for mutually beneficial interactions with outside disciplines

Final product is the white paper from this group – we should focus on what goes in there.

# 2022 Horizons White Paper Serves as Input for this Working Group

arXiv:2205.07996v1 [nucl-ex] 16 May 2022

## Horizons: Nuclear Astrophysics in the 2020s and Beyond

H Schatz<sup>1,2,3</sup>, A D Becerril Reyes<sup>2,3</sup>, A Best<sup>4,5</sup>, E F Brown<sup>1,2,6,3</sup>, K Chatziioannou<sup>7,8</sup>, K A Chipps<sup>9,10</sup>, C M Deibel<sup>11</sup>, R Ezzeddine<sup>12,3</sup>, D K Galloway<sup>13,14,15</sup>, C J Hansen<sup>16,17,18</sup>, F Herwig<sup>19,3</sup>, A P Ji<sup>20,21</sup>, M Lugaro<sup>22,23,13</sup>, Z Meisel<sup>24,3</sup>, D Norman<sup>25</sup>, J S Read<sup>26</sup>, L F Roberts<sup>27</sup>, A Spyrou<sup>1,2,3</sup>, I Tews<sup>28</sup>, F X Timmes<sup>29,3</sup>, C Travaglio<sup>30</sup>, N Vassh<sup>31</sup>, C Abia<sup>32</sup>, P Adsley<sup>33</sup>, S Agarwal<sup>34,3</sup>, M Aliotta<sup>35</sup>, W Aoki<sup>36,37</sup>, A Arcones<sup>38,39</sup>, A Aryan<sup>40</sup>, A Bandyopadhyay<sup>40</sup>, A Banu<sup>41</sup>, D W Bardayan<sup>42,3</sup>, J Barnes<sup>43</sup>, A Bauswein<sup>39</sup>, T C Beers<sup>42,3</sup>, J Bishop<sup>44</sup>, T Boztepe<sup>45</sup>, B Côté<sup>19,22,3</sup>, M E Caplan<sup>46</sup>, A E Champagne<sup>47,48</sup>, J A Clark<sup>49,3</sup>, M Couder<sup>42,3</sup>, A Couture<sup>50</sup>, S E de Mink<sup>51,52</sup>, S Debnath<sup>53</sup>, R J deBoer<sup>54</sup>, J den Hartogh<sup>22</sup>, P Denissenkov<sup>19,3</sup>, V Dexheimer<sup>55</sup>, I Dillmann<sup>56,19,3</sup>, J E Escher<sup>57</sup>, M A Famiano<sup>34,3,58</sup>, R Farmer<sup>51</sup>, R Fisher<sup>59</sup>, C Fröhlich<sup>60,3</sup>, A Frebel<sup>61</sup>, C Fryer<sup>62</sup>, G Fuller<sup>63</sup>, A K Ganguly<sup>64</sup>, S Ghosh<sup>60</sup>, B K Gibson<sup>65</sup>, T Gorda<sup>66,67</sup>, K N Gourgouliatos<sup>68</sup>, V Graber<sup>69,70</sup>, M Gupta<sup>71</sup>, W Haxton<sup>72,73</sup>, A Heger<sup>13,14,74,3</sup>, W R Hix<sup>9,10</sup>, W C G Ho<sup>75</sup>, E M Holmbeck<sup>76,3</sup>, A A Hood<sup>44</sup>, S Huth<sup>66,77</sup>, G Imbriani<sup>4</sup>, R G Izzard<sup>78</sup>, R Jain<sup>1,2,3</sup>, H Jayatissa<sup>79</sup>, Z Johnston<sup>1,3</sup>, T Kajino<sup>36,37,80</sup>, A Kankainen<sup>81</sup>, G G Kiss<sup>82</sup>, A Kwiatkowski<sup>56,19</sup>, M La Cognata<sup>83</sup>, A M Laird<sup>84</sup>, L Lamia<sup>85,83,86</sup>, P Landry<sup>87</sup>, E Laplace<sup>88,52</sup>, K D Launey<sup>11</sup>, D Leahy<sup>89</sup>, G Leckenby<sup>31,90</sup>, A Lennarz<sup>31,91</sup>, B Longfellow<sup>57</sup>, A E Lovell<sup>28</sup>, W G Lynch<sup>1,2</sup>, S M Lyons<sup>92,3</sup>, K Maeda<sup>93</sup>, E Masha<sup>94</sup>, C Matei<sup>95</sup>, J Merc<sup>96,97</sup>, B Messer<sup>98,10</sup>, F Montes<sup>2,3</sup>, A Mukherjee<sup>99,100</sup>, M Mumpower<sup>28,62,3</sup>, D Neto<sup>101</sup>, B Nevins<sup>1,2,3</sup>, W G Newton<sup>102</sup>, L Q Nguyen<sup>54</sup>, K Nishikawa<sup>103</sup>, N Nishimura<sup>104,105</sup>, F M Nunes<sup>2,1</sup>, E O'Connor<sup>106</sup>, B W O'Shea<sup>6,1,2,3</sup>, W-J Ong<sup>57,3</sup>, S D Pain<sup>9,10</sup>, M A Pajkos<sup>1,6,3</sup>, M Pignatari<sup>22,107,108</sup>, R G Pizzone<sup>83</sup>, V M Placco<sup>25</sup>, T Plewa<sup>109</sup>, B Pritychenko<sup>110</sup>, A Psaltis<sup>38,108</sup>, D Puentes<sup>1,2</sup>, Y-Z Qian<sup>111</sup>, D Radice<sup>112,113,114</sup>, D Rapagnani<sup>4,5</sup>, B M Rebeiro<sup>115,116</sup>, R Reifarh<sup>16</sup>, A L Richard<sup>57,2</sup>, N Rijal<sup>2</sup>, I U Roederer<sup>117,3</sup>, J S Rojo<sup>118</sup>, J S K<sup>119</sup>, Y Saito<sup>90,56</sup>, A Schwenk<sup>66,77,120</sup>, M L Sergi<sup>85,83</sup>, R S Sidhu<sup>39,120,35</sup>, A Simon<sup>54</sup>, T Sivarani<sup>121</sup>, Á Skúladóttir<sup>122,123</sup>, M S Smith<sup>9</sup>, A Spiridon<sup>124</sup>, T M Sprouse<sup>28,62</sup>, S Starrfield<sup>29</sup>, A W Steiner<sup>125,9</sup>, F Strieder<sup>126</sup>, I

Sultana<sup>127,3</sup>, R Surman<sup>54,3</sup>, T Szücs<sup>82</sup>, A Tawfik<sup>128</sup>, F Thielemann<sup>129,39</sup>, L Trache<sup>124</sup>, R Trappitsch<sup>130,108</sup>, M B Tsang<sup>2</sup>, A Tumino<sup>131,83</sup>, S Upadhyayula<sup>31</sup>, J O Valle Martínez<sup>132</sup>, M Van der Swaelmen<sup>123</sup>, C Viscasillas Vázquez<sup>133</sup>, A Watts<sup>52</sup>, B Wehmeyer<sup>22,134</sup>, M Wiescher<sup>42,35,3</sup>, C Wrede<sup>1,2</sup>, J Yoon<sup>135,3</sup>, R G T Zegers<sup>1,2,3</sup>, M A Zermene<sup>136</sup>, M Zingale<sup>137</sup>

- 579 participants JINA Horizon Meeting December 2020
- White paper writing: 165 co-authors from 20 countries
- Sections
  - Dynamic Nuclear Burning in Stars
  - Origin of the Heavy Elements
  - Understanding the Transient Sky
  - Neutron Stars and Dense Matter
  - Diversity in Nuclear Astrophysics
  - Career Development: Perspective of Early Career Researchers
  - The Role of Centers
- arXiv:2205.07996
- Good starting point, but
  - Not focused on US needs
  - Not everyone was there or provided input
  - Some things have changed
  - This is just one input - NEED MORE!

# We Need Your Input [1]

Input form will stay open until Nov xxx –  
submit text or slides during meeting or after



## Contributions to the Astro Working Group session at the 2022 LRP Town Hall

Please use this form to add your contribution to the Astro WG at the Long Range Plan  
Town Hall meeting.

Google doc to view and comment  
We will update this live

## Google drive to share input received

| Name               | Owner |
|--------------------|-------|
| OtherInput         | me    |
| Presentations      | me    |
| AstroExpSummary 10 | me    |

Schedule document will serve as hub for links to other resources (linked from town meeting website)

# We Need Your Input [2]

## Connecting Nuclei to the Cosmos (Experimental Nuclear Astrophysics)

### Schedule

Provide white paper input through form (written comments or slides): <https://forms.gle/tNRfJ3u5JMT3j4wR7>

| start  | end   | talk | discussion |  |                  |                         |  |
|--|-------|------|------------|--|------------------|-------------------------|--|
| <b>Tuesday Nov 15, WG Session 3, 13:30 - 15:00</b> |       |      |            | <b>Chairs: Hendrik Schatz and Catherine Deibel</b> |                  |                         |  |
| 13:30  | 13:40 | 0:10 |            | Convener   |                  | Introduction            |  |
| 13:40  | 14:00 | 0:15 | 0:05       | Michael Wiescher                                   | Notre Dame       | Dynamic Nuclear Burning |  |
| 14:00  | 14:20 | 0:15 | 0:05       | Wei Jia Ong  | LLNL             | Transient Sky           |  |
| 14:20  | 14:40 | 0:20 |            | Rapid Fire Talks I: (2 min talk time each)         |                  |                         |  |
|  |       |      |            | 1  | Richard Longland | NC State                | An overview of current and future nuclear astrophysics research at TUNL      |
|  |       |      |            | 2  | Carl Brune       | Ohio U                  | Nuclear astrophysics with stable beams and neutron beams at Ohio University. |
|  |       |      |            | 3  | Moshe Gai        | UConn                   | New capabilities with improved AT-TPCs                                       |
|  |       |      |            | 4  | Steve Pain       | ORNL                    | Capabilities and needs for direct-reaction program                           |
|  |       |      |            | 5  | Philip Adsley    | Texas A&M               | Slide on scattering with ISLA.   |
|  |       |      |            | 6  | George Fuller    | UCSD                    | BSM physics/dark matter  |
|  |       |      |            | 7  | Jack Bishop      | Texas A&M               | Future indirect approaches at Texas A&M                                      |
| 14:40  | 15:00 |      | 0:20       |  |                  | Discussion              |  |

Short talks:  
2 min strict



#### Discussion:

- Comments and discussion of presentations
- Comments and discussion of anything else pertaining to the charge
- Discussion and work on google doc