

# Laser interferometric searches for ultralight dark matter -updates from B01 group-

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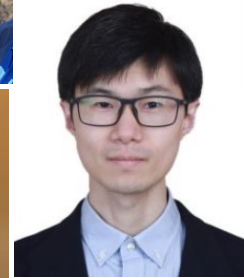
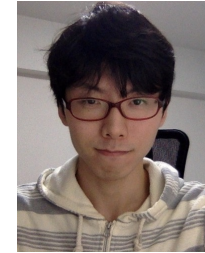
Yuka Oshima

Hinata Takidera

Haoyu Wang

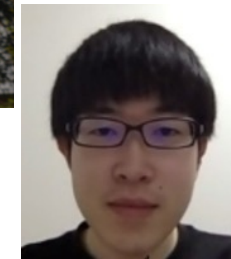
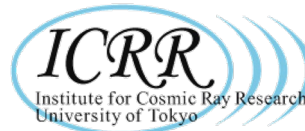


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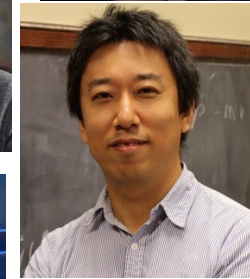
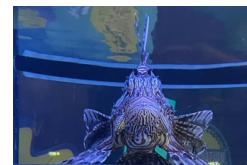


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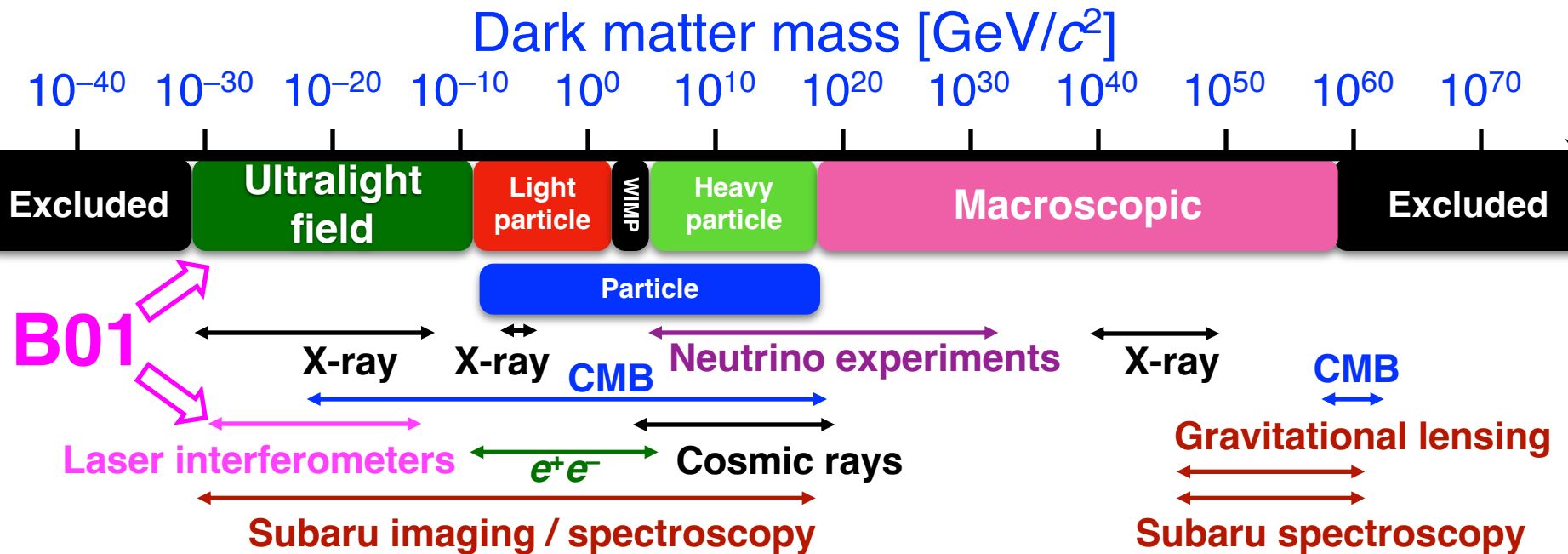


UNITRENTO



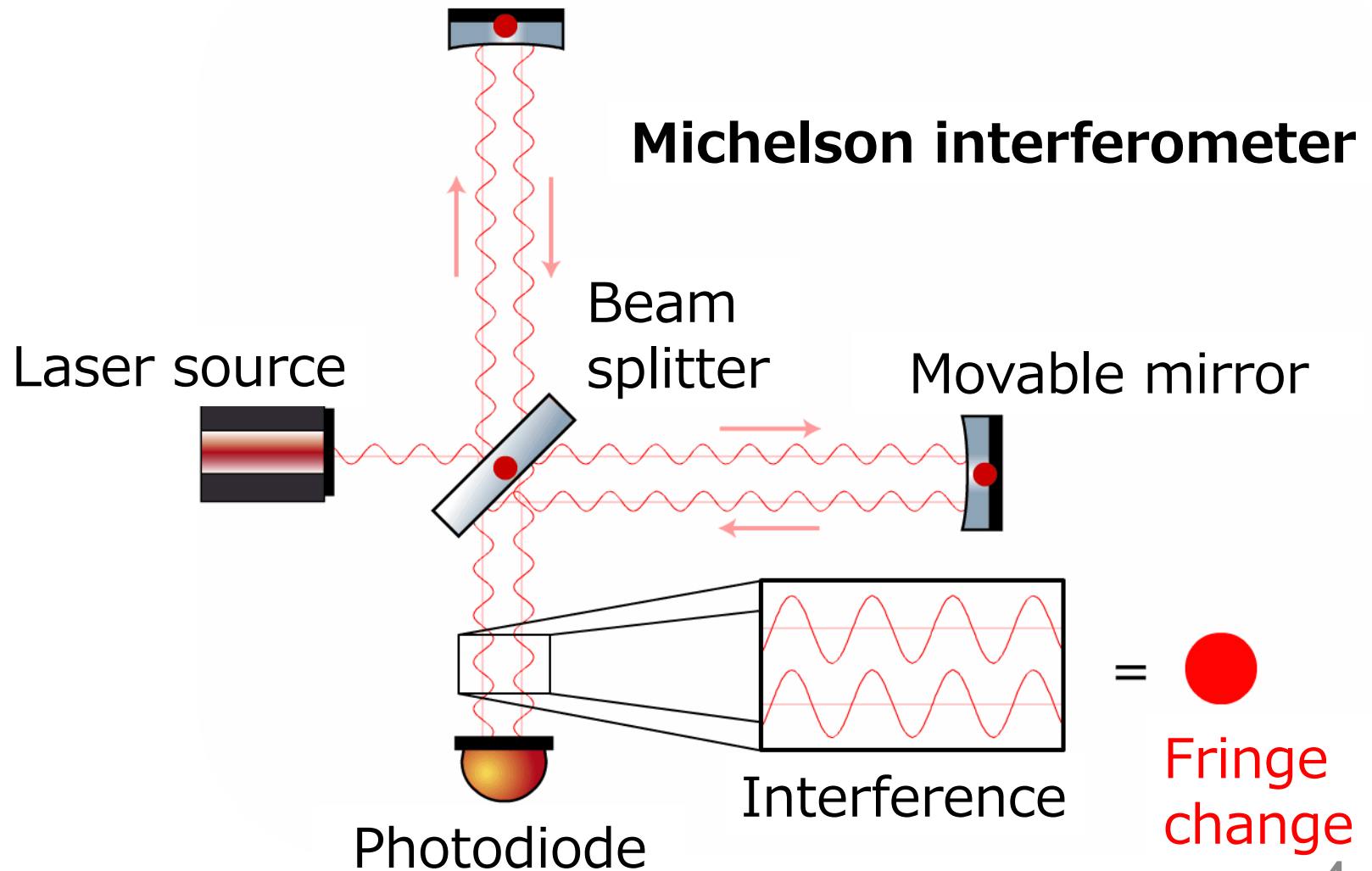
# Ultralight Dark Matter

- Ultralight DM ( $\lesssim 1$  eV) behaves as classical wave fields
- $$f = 240 \text{ Hz} \left( \frac{m_{\text{DM}}}{10^{-12} \text{ eV}} \right)$$
- Laser interferometers are sensitive to tiny length changes from such oscillations



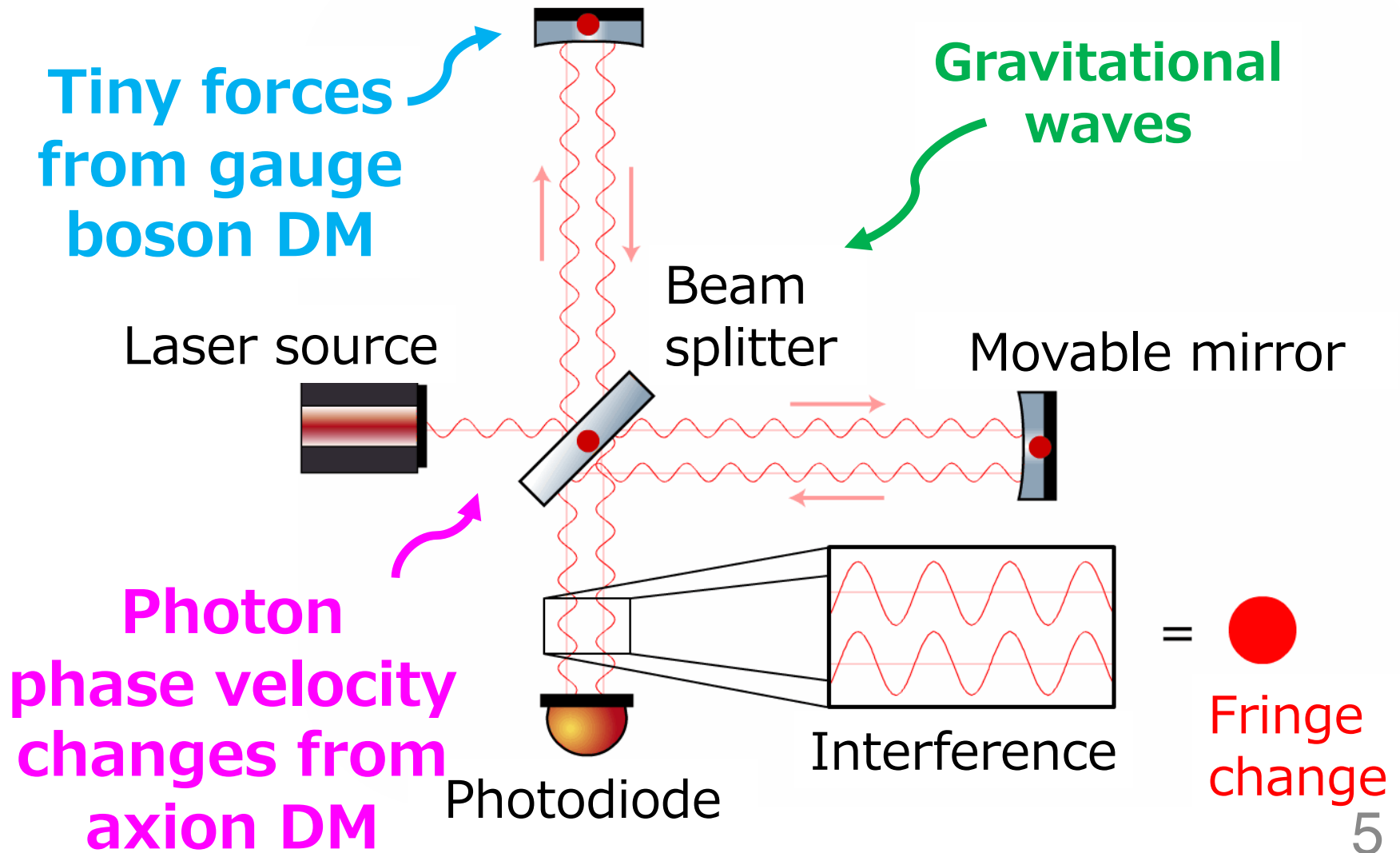
# Laser Interferometry

- measures **differential** arm length change



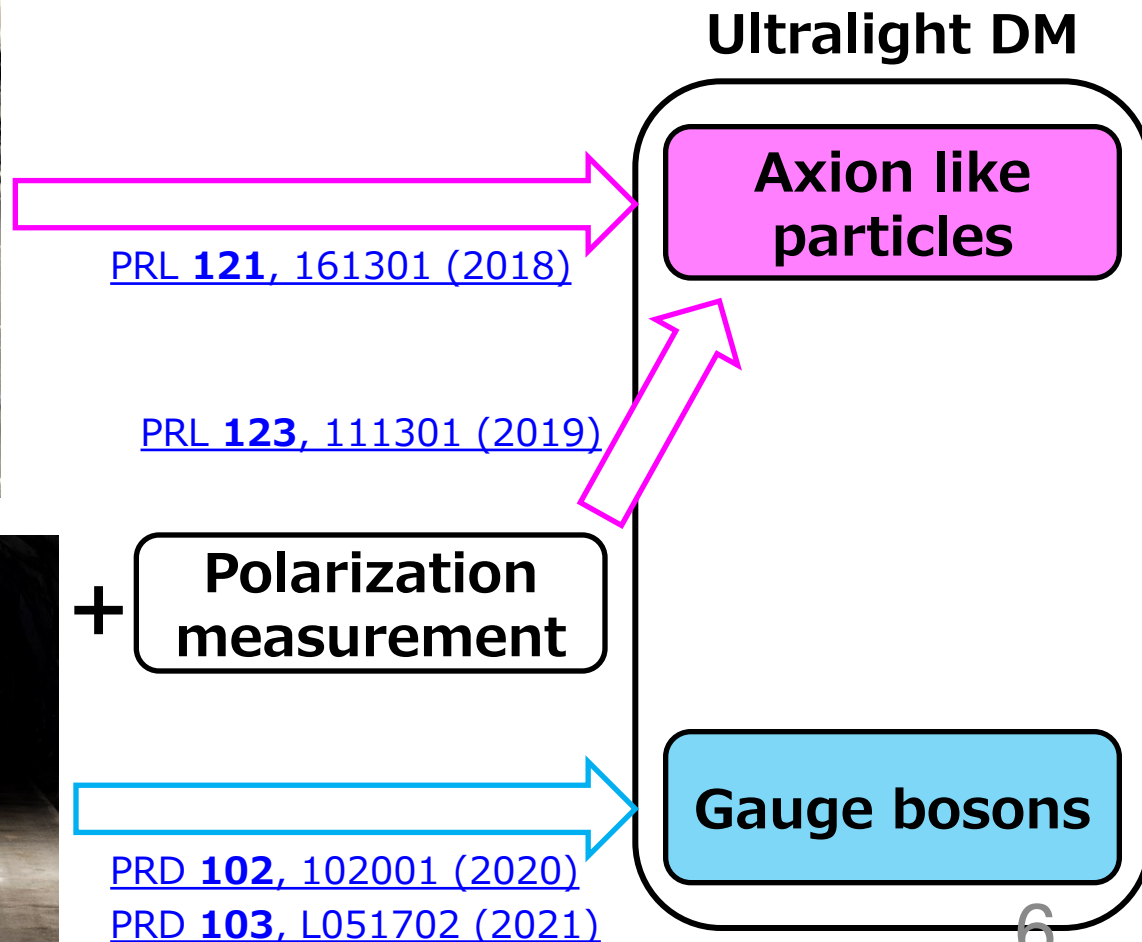
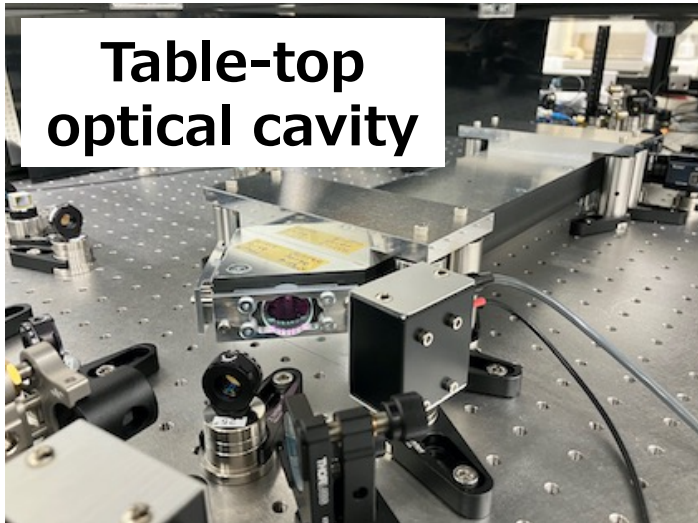
# Laser Interferometry

- measures **differential** arm length change



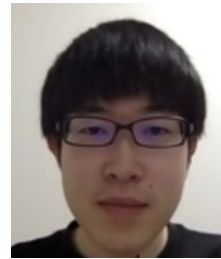
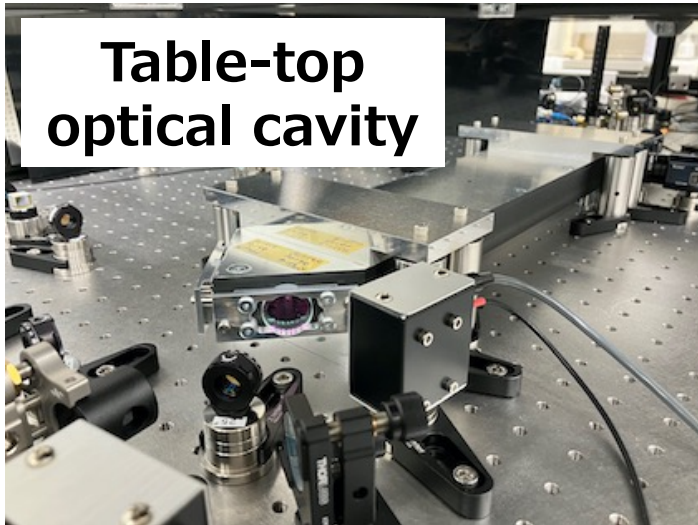
# Our Strategy

- Use both **table-top** optical cavities and **large-scale** laser interferometric gravitational wave detectors



# Improving the Sensitivity of DANCE

Talk by Hinata Takidera



Ultralight DM

Axion like particles

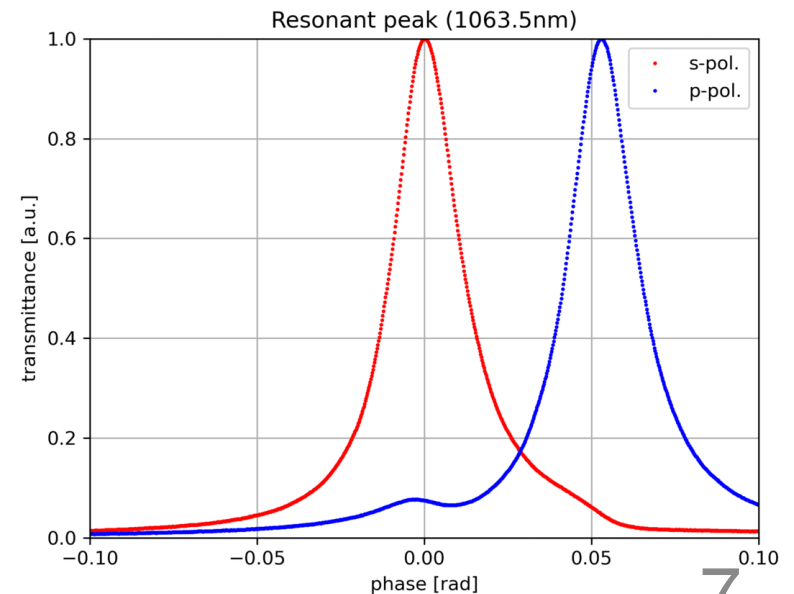
[PRL 121, 161301 \(2018\)](#)

First results published

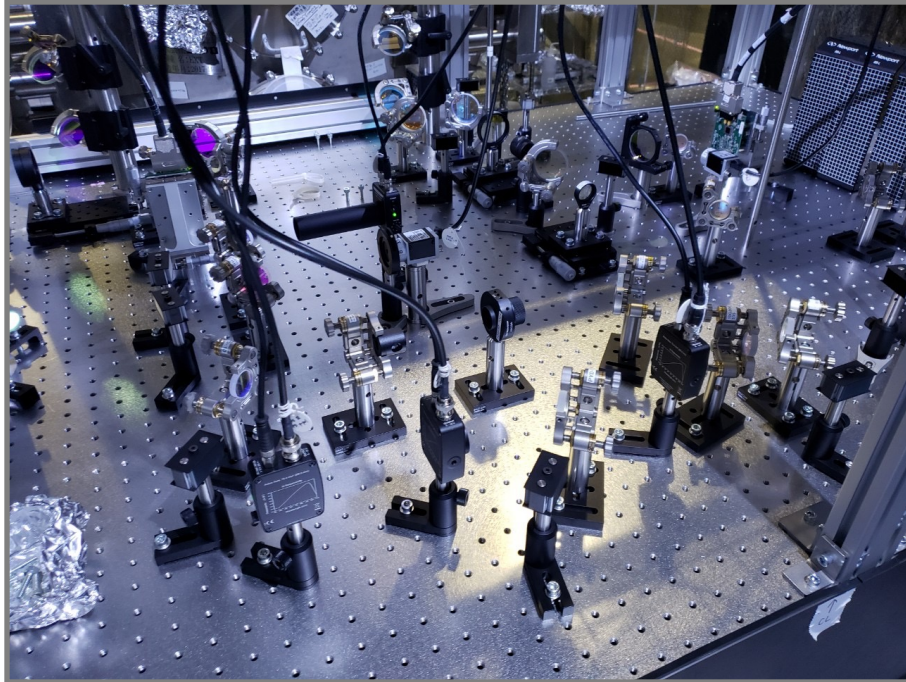
Y. Oshima+, [PRD 108, 072005 \(2023\)](#)

Collaboration with B06

New idea:  
laser wavelength tuning



# Polarizers installed for KAGRA



Ready for first data  
taking in O4 run by  
the end of 2024

(Delayed due  
to Noto  
earthquake)

Ultralight DM

Axion like  
particles

[123, 111301 \(2019\)](#)

+ Polarization  
measurement



+



# First results from KAGRA 2020 Run

Talk by Jun'ya Kume



Results released  
(finally approved by LIGO-Virgo-KAGRA;  
~1800 authors!  
A03-B01-B06-C02)

[arXiv:2403.03004](https://arxiv.org/abs/2403.03004)



KAGRA

arXiv:2403.03004v1 [astro-ph.CO] 5 Mar 2024

## Ultralight vector dark matter search using data from the KAGRA O3GK run

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Ando,<sup>36</sup> T. Andrade,<sup>37</sup> N. Andres,<sup>28</sup> M. Andrés-Carcasona,<sup>38</sup> T. Andrić,<sup>1,39</sup> J. Anglin,<sup>40</sup> S. Ansoldi,<sup>41,42</sup> J. M. Antelis,<sup>43</sup> S. Antier,<sup>44</sup> M. Aoumi,<sup>45</sup> E. Z. Appavurathar,<sup>46,47</sup> S. Appert,<sup>2</sup> S. K. Apple,<sup>48</sup> K. Arai,<sup>2</sup> A. Araya,<sup>49</sup> M. C. Araya,<sup>2</sup> J. S. Areeda,<sup>50</sup> N. Aritomi,<sup>4</sup> F. Armato,<sup>51</sup> N. Arnaud,<sup>35,52</sup> M. Arogeti,<sup>53</sup> S. M. Aronson,<sup>11</sup> K. G. Arun,<sup>54</sup> G. Ashton,<sup>55</sup> Y. Aso,<sup>22,56</sup> M. Assiduo,<sup>57,58</sup> S. Assis de Souza Mello,<sup>52</sup> S. M. Aston,<sup>59</sup> P. Astone,<sup>60</sup> F. Aubin,<sup>61</sup> K. AultO'Neal,<sup>43</sup> G. Avallone,<sup>62</sup> S. Babak,<sup>63</sup> F. Badaracco,<sup>64</sup> S. C. Badger,<sup>64</sup> S. Bae,<sup>65</sup> S. Bagnasco,<sup>25</sup> E. Bagui,<sup>66</sup> Y. Bai,<sup>2</sup> J. G. Baier,<sup>67</sup> R. Bajpai,<sup>22</sup> T. Baka,<sup>68</sup> M. Ball,<sup>69</sup> G. Ballardin,<sup>52</sup> S. W. Ballmer,<sup>70</sup> S. Banagiri,<sup>71</sup> B. Banerjee,<sup>39</sup> D. Bankar,<sup>15</sup> P. Baral,<sup>19</sup> J. C. Barayoga,<sup>2</sup> B. C. Barish,<sup>2</sup> D. Barker,<sup>4</sup> P. Barneo,<sup>37,72</sup> F. Barone,<sup>73,6</sup> B. Barr,<sup>26</sup> L. Barsotti,<sup>30</sup> M. Barsuglia,<sup>63</sup> D. Barta,<sup>74</sup> S. D. Barthelmy,<sup>75</sup> M. A. Barton,<sup>26</sup> I. Bartos,<sup>40</sup> S. Basak,<sup>21</sup> A. Basalaeu,<sup>76</sup> R. Bassiri,<sup>18</sup> A. Basti,<sup>77,20</sup> M. Bawaj,<sup>78,46</sup> P. Baxi,<sup>79</sup> J. C. Bayley,<sup>26</sup> A. C. Baylor,<sup>10</sup> M. Bazzan,<sup>80,81</sup> B. Bécsy,<sup>82</sup> V. M. Bedakihalé,<sup>83</sup> F. Beirnaert,<sup>84</sup> M. Bejger,<sup>85</sup> D. Belardinelli,<sup>86</sup> A. S. Bell,<sup>26</sup> V. Benedetto,<sup>87</sup> D. Benival,<sup>88</sup> W. Benoit,<sup>89</sup> J. D. Bentley,<sup>90</sup> M. Ben Yaala,<sup>90</sup> S. Bera,<sup>91</sup> M. Berbel,<sup>92</sup> F. Bergamin,<sup>13,14</sup> B. K. Berger,<sup>18</sup> S. Bernuzzi,<sup>93</sup> M. Beroiz,<sup>2</sup> D. Bersanetti,<sup>51</sup> A. Bertolini,<sup>32</sup> J. Betzwieser,<sup>59</sup> D. Beveridge,<sup>27</sup> N. Bevis,<sup>94</sup> R. Bhandari,<sup>95</sup> U. Bhardwaj,<sup>96,32</sup> R. Bhatt,<sup>2</sup> D. Bhattacharjee,<sup>67,97</sup> S. Bhaumik,<sup>40</sup> S. Bhownik,<sup>98</sup> A. Bianchi,<sup>32,99</sup> I. A. Bilenko,<sup>100</sup> G. Billingsley,<sup>2</sup> A. Binetti,<sup>101</sup> S. Bini,<sup>102,103</sup> O. Birnholtz,<sup>104</sup> S. Biscoveanu,<sup>71,30</sup> A. Bisht,<sup>14</sup> M. Bitossi,<sup>52,20</sup> M.-A. Bizouard,<sup>44</sup> J. K. Blackburn,<sup>2</sup> C. D. Blair,<sup>27,59</sup> D. G. Blair,<sup>27</sup> F. Bobba,<sup>62,105</sup> N. Bode,<sup>13,14</sup> G. Bogaert,<sup>44</sup> G. Boileau,<sup>106,44</sup> M. Boldrin,<sup>107,60</sup> G. N. Bolingbroke,<sup>88</sup> A. Boliand,<sup>108,34</sup> L. D. Bonavena,<sup>80</sup> R. Bondarescu,<sup>37</sup> F. Bondu,<sup>109</sup> E. Bonilla,<sup>18</sup> M. S. Bonilla,<sup>50</sup> A. Bonino,<sup>110</sup> R. Bonnard,<sup>28</sup> P. Booker,<sup>13,14</sup> A. Borchers,<sup>13,14</sup> V. Boschi,<sup>20</sup> S. Bose,<sup>15</sup> V. Bossilkov,<sup>59</sup> V. Boudart,<sup>111</sup> A. Boumerdassi,<sup>19</sup> A. Bozzi,<sup>52</sup> C. Bradaschia,<sup>20</sup> P. R. Brady,<sup>10</sup> M. Braglia,<sup>112</sup> A. Branch,<sup>59</sup> M. Branchesi,<sup>39,113</sup> M. Breschi,<sup>93</sup> T. Briant,<sup>114</sup> A. Brillet,<sup>44</sup> M. Brinkmann,<sup>13,14</sup> P. Brockill,<sup>10</sup> E. Brockmüller,<sup>13,14</sup> A. F. Brooks,<sup>2</sup> D. D. Brown,<sup>88</sup> M. L. Brozzetti,<sup>78,46</sup> S. Brumet,<sup>2</sup> G. Bruno,<sup>115</sup> R. Bruntz,<sup>116</sup> J. Bryant,<sup>110</sup> F. Buccì,<sup>58</sup> J. Buchanan,<sup>111</sup> O. Bulashenko,<sup>37,72</sup> T. Bulik,<sup>117</sup> H. J. Bulten,<sup>32</sup> A. Buonanno,<sup>118,1</sup> K. Burtnyk,<sup>4</sup> R. Buscicchio,<sup>119,120</sup> D. Buskalic,<sup>28</sup> C. Buy,<sup>121</sup> R. L. Byer,<sup>18</sup> G. S. Cabourn Davies,<sup>122</sup> G. Cabras,<sup>41,42</sup> R. Cabrera,<sup>115</sup> L. Cadonati,<sup>53</sup> G. Cagnoli,<sup>123</sup> C. Cahillane,<sup>70</sup> J. Calderón Bustillo,<sup>124</sup> J. D. Callaghan,<sup>26</sup> T. A. Callister,<sup>125</sup> E. Calloni,<sup>29,6</sup> J. B. Camp,<sup>75,51</sup> G. Caneva Santoro,<sup>38</sup> M. Cannavacciuolo,<sup>62</sup> K. C. Cannon,<sup>36</sup> H. Cao,<sup>126</sup> Z. Cao,<sup>127</sup> L. A. Capistran,<sup>128</sup> E. Capocasa,<sup>63</sup> E. Capote,<sup>70</sup> G. Carapella,<sup>62,105</sup> F. Carbognani,<sup>52</sup> M. Carlassara,<sup>13,14</sup> J. B. Carlin,<sup>129</sup> M. Carpinelli,<sup>119,130,52</sup> G. Carrillo,<sup>69</sup> J. J. Carter,<sup>13,14</sup> G. Carullo,<sup>131</sup> J. Casanueva Diaz,<sup>52</sup> C. Casentini,<sup>132,86</sup> G. Castaldi,<sup>133</sup> S. Y. Castro-Lucas,<sup>98</sup> S. Caudill,<sup>134,32,68</sup> M. Cavaglià,<sup>97</sup> R. Cavalieri,<sup>52</sup> G. Cella,<sup>20</sup> P. Cerdá-Durán,<sup>135,136</sup> E. Cesarini,<sup>86</sup> W. Chaibi,<sup>44</sup> P. Chakraborty,<sup>13,14</sup> S. Chalachadka Subrahmanya,<sup>76</sup> C. Chan,<sup>36</sup> J. C. L. Chan,<sup>125</sup> K. H. M. Chan,<sup>137</sup> M. Chan,<sup>138</sup> W. L. Chan,<sup>137</sup> K. Chandrasekhar,<sup>139</sup> R.-J. Chang,<sup>140</sup> P. Chantlal,<sup>63</sup> S. Chao,<sup>141,142</sup> C. Chapman-Bird,<sup>26</sup> E. L. Charlton,<sup>116</sup> P. Charlton,<sup>143</sup> E. Chassande-Mottin,<sup>63</sup> C. Chatterjee,<sup>27</sup> Debarati Chatterjee,<sup>15</sup> Deep Chatterjee,<sup>30</sup> M. Chaturvedi,<sup>95</sup> S. Chaty,<sup>63</sup> K. Chatzioannou,<sup>2</sup> A. Chen,<sup>144</sup> A. H.-Y. Chen,<sup>145</sup> D. Chen,<sup>146</sup> H. Chen,<sup>141</sup> H. Y. Chen,<sup>147</sup> K. H. Chen,<sup>142</sup> X. Chen,<sup>27</sup> Yi-Ru Chen,<sup>141</sup> Yanbei Chen,<sup>148</sup> Yitian Chen,<sup>149</sup> H. P. Cheng,<sup>40</sup> P. Chessa,<sup>77,20</sup> H. T. Cheung,<sup>79</sup> H. Y. Chia,<sup>40</sup> F. Chiadini,<sup>150,105</sup> C. Chiang,<sup>142</sup> G. Chiarini,<sup>81</sup> A. Chiba,<sup>151</sup> R. Chiba,<sup>152</sup> R. Chierici,<sup>153</sup> A. Chincarini,<sup>51</sup> M. L. Chiofalo,<sup>77,20</sup> A. Chiummo,<sup>6,52</sup> C. Chou,<sup>145</sup> S. Choudhary,<sup>27</sup> N. Christensen,<sup>44</sup> S. S. Y. Chua,<sup>12</sup> K. W. Chung,<sup>64</sup> G. Ciani,<sup>80,81</sup> P. Ciecielag,<sup>85</sup> M. Cieslar,<sup>85</sup> M. Cifaldi,<sup>86</sup> A. A. Ciobanu,<sup>88</sup> R. Ciolfi,<sup>154,81</sup> F. Clara,<sup>4</sup> J. A. Clark,<sup>2,53</sup> T. A. Clarke,<sup>8</sup> P. Clearwater,<sup>155</sup> S. Clesse,<sup>66</sup> F. Cleva,<sup>44</sup> E. Coccia,<sup>39,113,38</sup> E. Codazzo,<sup>39</sup> P.-F. Cohadon,<sup>114</sup> M. Colleoni,<sup>91</sup> C. G. Collette,<sup>33</sup> J. Collins,<sup>59</sup> S. Colloms,<sup>26</sup> A. Colombo,<sup>119,120,156</sup> M. Colpi,<sup>119,120</sup> C. M. Compton,<sup>4</sup> L. Conti,<sup>81</sup> S. J. Cooper,<sup>110</sup> T. R. Corbitt,<sup>11</sup> I. Cordero-Carrion,<sup>157</sup> S. Corezzi,<sup>78,40</sup> N. J. Cornish,<sup>52</sup> A. Corsi,<sup>158</sup> S. Cortese,<sup>52</sup> C. A. Costa,<sup>17</sup> R. Cottingham,<sup>59</sup> M. W. Coughlin,<sup>89</sup> A. Couineaux,<sup>60</sup> J.-P. Coulon,<sup>44</sup> S. T. Countryman,<sup>60,159</sup> J.-F. Coupechoux,<sup>153</sup> B. Cousins,<sup>9</sup> P. Couvares,<sup>2,53</sup> D. M. Coward,<sup>27</sup> M. J. Cowart,<sup>59</sup> D. C. Coyne,<sup>2</sup> R. Coyne,<sup>160</sup> K. Craig,<sup>90</sup> R. Creed,<sup>19</sup> J. D. E. Creighton,<sup>161</sup> P. Cremonese,<sup>91</sup>

Gauge bosons

[PRD 102, 102001 \(2020\)](https://arxiv.org/abs/2010.10201)

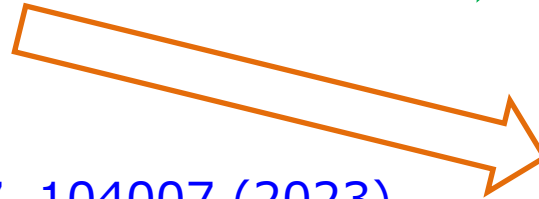
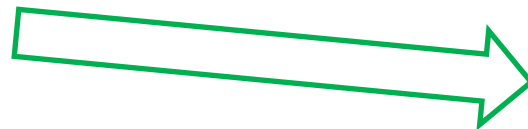
[PRD 103, L051702 \(2021\)](https://arxiv.org/abs/2010.10517)

# Scalar and Spin-2 Dark Matter

Upper limit from LIGO/Virgo O3 data  
Collaboration with D03



K. Fukusumi,  
S. Morisaki,  
T. Suyama,  
[arXiv:2303.13088](https://arxiv.org/abs/2303.13088)



Ultralight DM

Axion like particles

Scalar bosons

Spin-2 bosons

Gauge bosons

Y. Manita+, [PRD 107, 104007 \(2023\)](https://arxiv.org/abs/2310.10646)

Y. Manita+, [arXiv:2310.10646](https://arxiv.org/abs/2310.10646)

**Spin-0 and 1 ... or 2!**  
**Talk by Yusuke Manita**

