Supplementary Information: Imaging quantized vortex rings in superfluid helium to evaluate quantum dissipation

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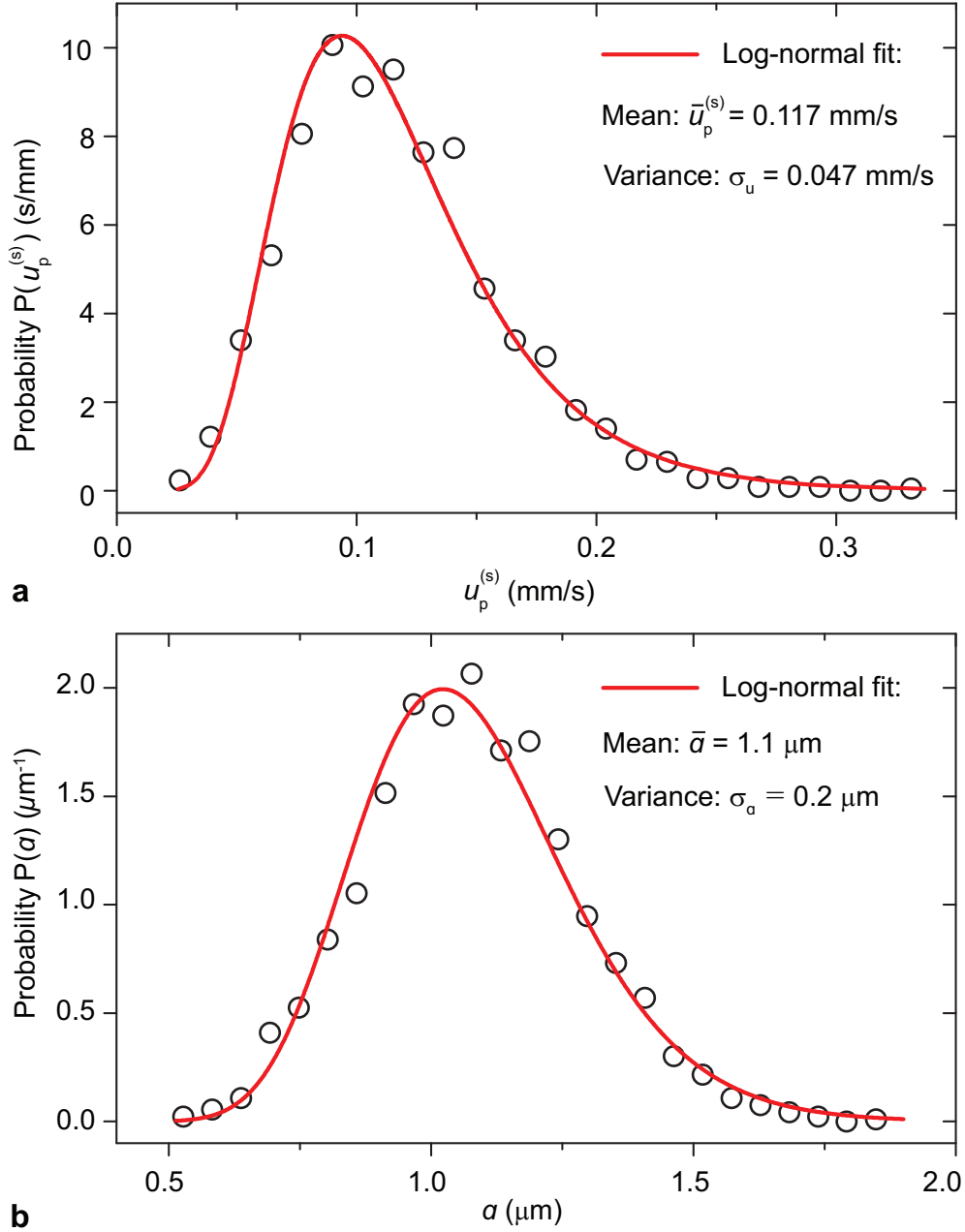*4-1-1 Hiyoshi, Kohoku-ku, Yokohama 223-8521, Japan*

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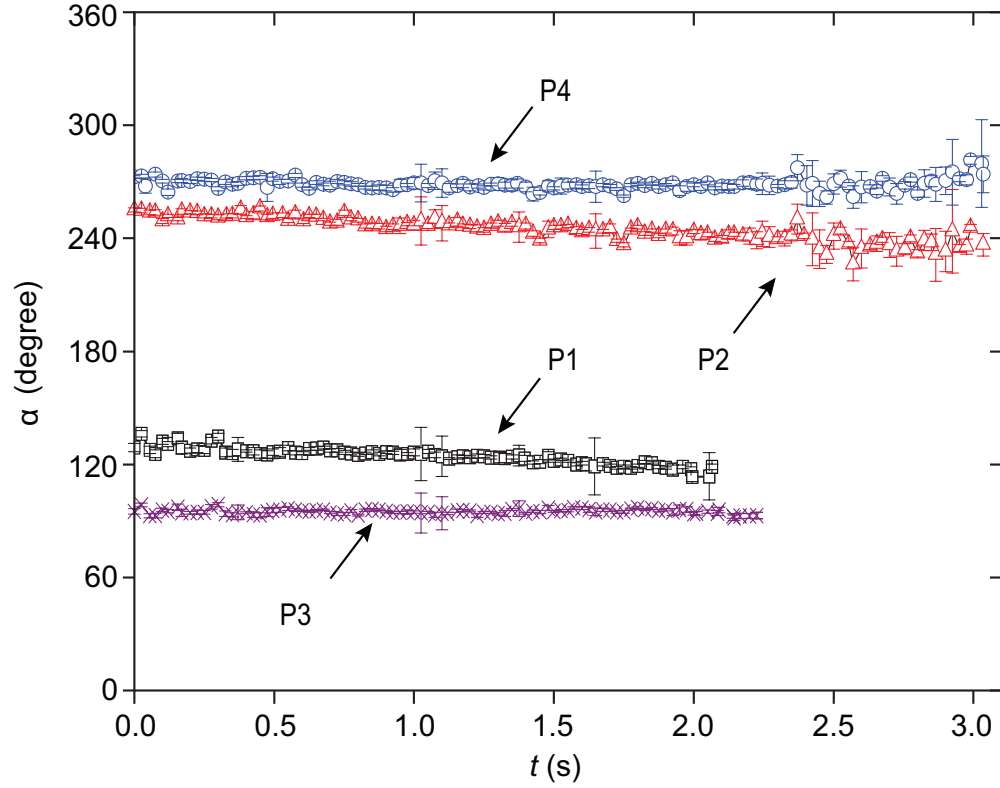*Osaka Metropolitan University, Osaka 558-8585, Japan*

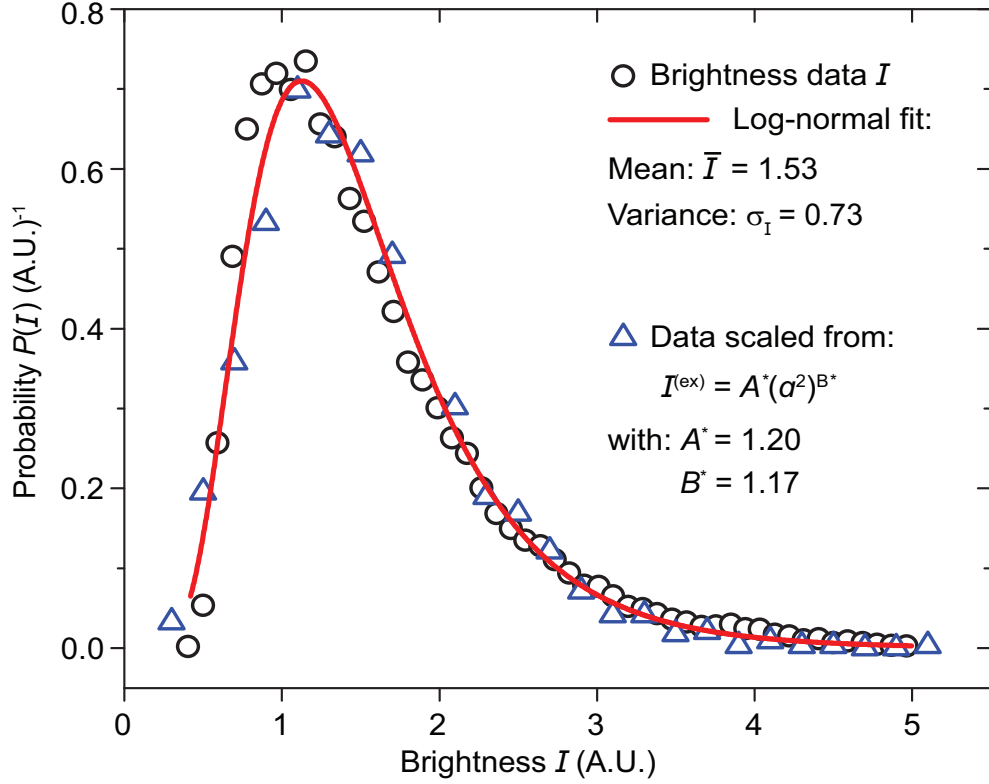[7]*Department of Physics, Florida State University, Tallahassee, FL 32306, USA*

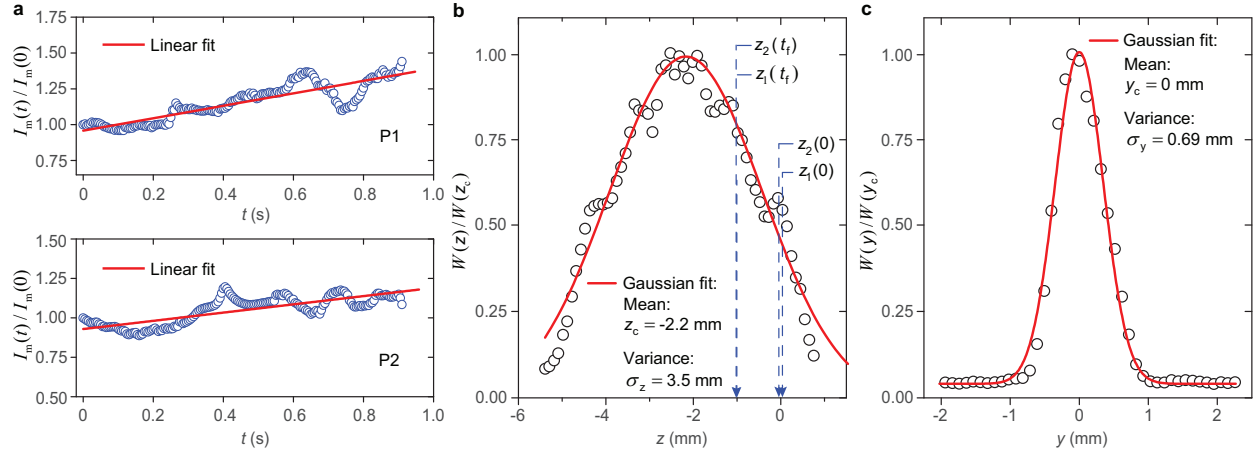[*] Email: wguo@magnet.fsu.edu

Supplementary Fig. 1. Settling velocity and radius distribution of the D_2 particles in He II at $T=1.65$ K. a, Distribution of the settling velocity $u_p^{(s)}$. **b**, Distribution of the particle radius a.

Supplementary Fig. 2. **Time evolution of the angular position** α **of representative trapped particles for the 9-particle ring event.** The definition of the angle α is given in the main text. The error bars denote the standard deviation associated with the data due to the uncertainties of the particle positions.

Supplementary Fig. 3. **Distribution of the brightness I of the D_2 particles.** The black circles represent the measured brightness I. The blue triangles are $I^{(\text{ex})}$ calculated using the distribution of particle radius a, where $A^* = 1.20$ and $B^* = 1.17$ are the optimal correlation parameters that render the best agreement between the two distributions.

Supplementary Fig. 4. **Trapped particle's brightness variation and laser-intensity cross-sectional profile. a**, Time variation of the directly measured brightness $I_{\mathrm{m}}(t)$ of the two trapped particles as shown in **Fig.2a**. **b**, Measured laser intensity W as a function of z (i.e., height direction). The red curve is a Gaussian fit to the data. The z-coordinates of the two particles at $t = 0$ and $t = t_{\mathrm{f}}$ are indicated. **c**, Measured laser intensity W as a function of y (i.e., thickness direction).

Supplementary Table. 1. Radiuses and initial positions of the trapped particles for the 9-particle vortex ring in **Fig.1** and the 2-particle vortex ring in **Fig.2**.

9-p ring	x (mm)	Δx (mm)	y (mm)	Δy (mm)	z (mm)	Δz (mm)	a (μm)	Δa (μm)
P1	-0.271	0.003	-0.209	0.005	0.204	0.002	0.87	0.18
P2	-0.186	0.002	0.261	0.004	-0.074	0.002	1.32	0.53
P3	-0.101	0.003	-0.269	0.005	0.220	0.002	1.04	0.30
P4	-0.093	0.002	0.270	0.004	-0.089	0.002	1.69	0.38
P5	-0.008	0.002	0.254	0.003	-0.089	0.002	1.74	0.33
P6	0.154	0.003	0.155	0.004	-0.051	0.002	1.03	0.37
P7	0.215	0.002	0.027	0.003	0.016	0.002	0.92	0.26
P8	-0.358	0.002	0.146	0.005	0.011	0.003	0.78	0.19
P9	0.216	0.002	-0.046	0.003	0.058	0.002	1.09	0.24

2-p ring	x (mm)	Δx (mm)	y (mm)	Δy (mm)	z (mm)	Δz (mm)	a (μm)	Δa (μm)
P1	-0.008	0.005	–	–	0.047	0.004	1.18	0.08
P2	0.271	0.004	–	–	-0.047	0.004	1.12	0.07