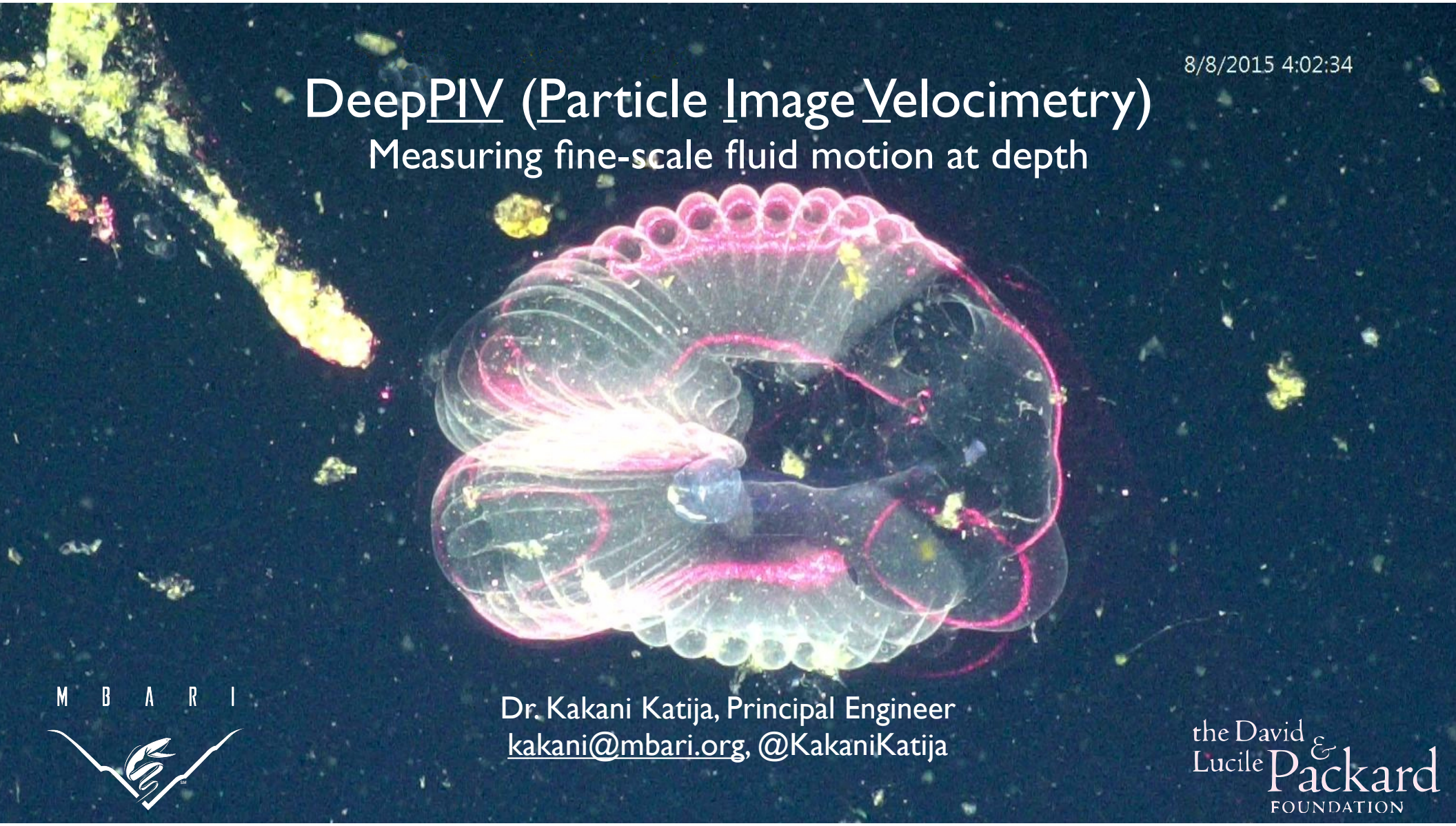
DeepPIV (Particle Image Velocimetry)

Measuring fine-scale fluid motion at depth



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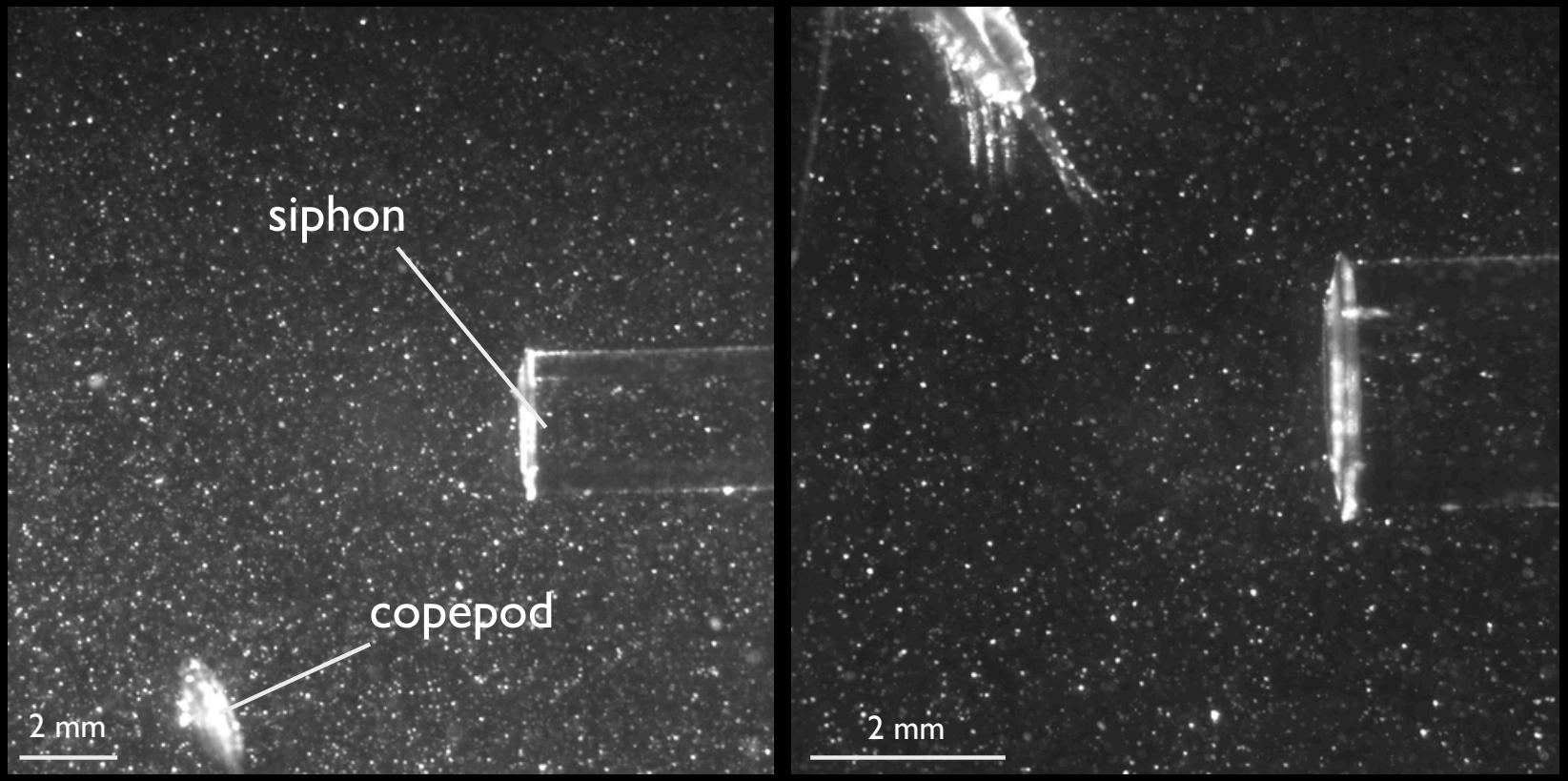
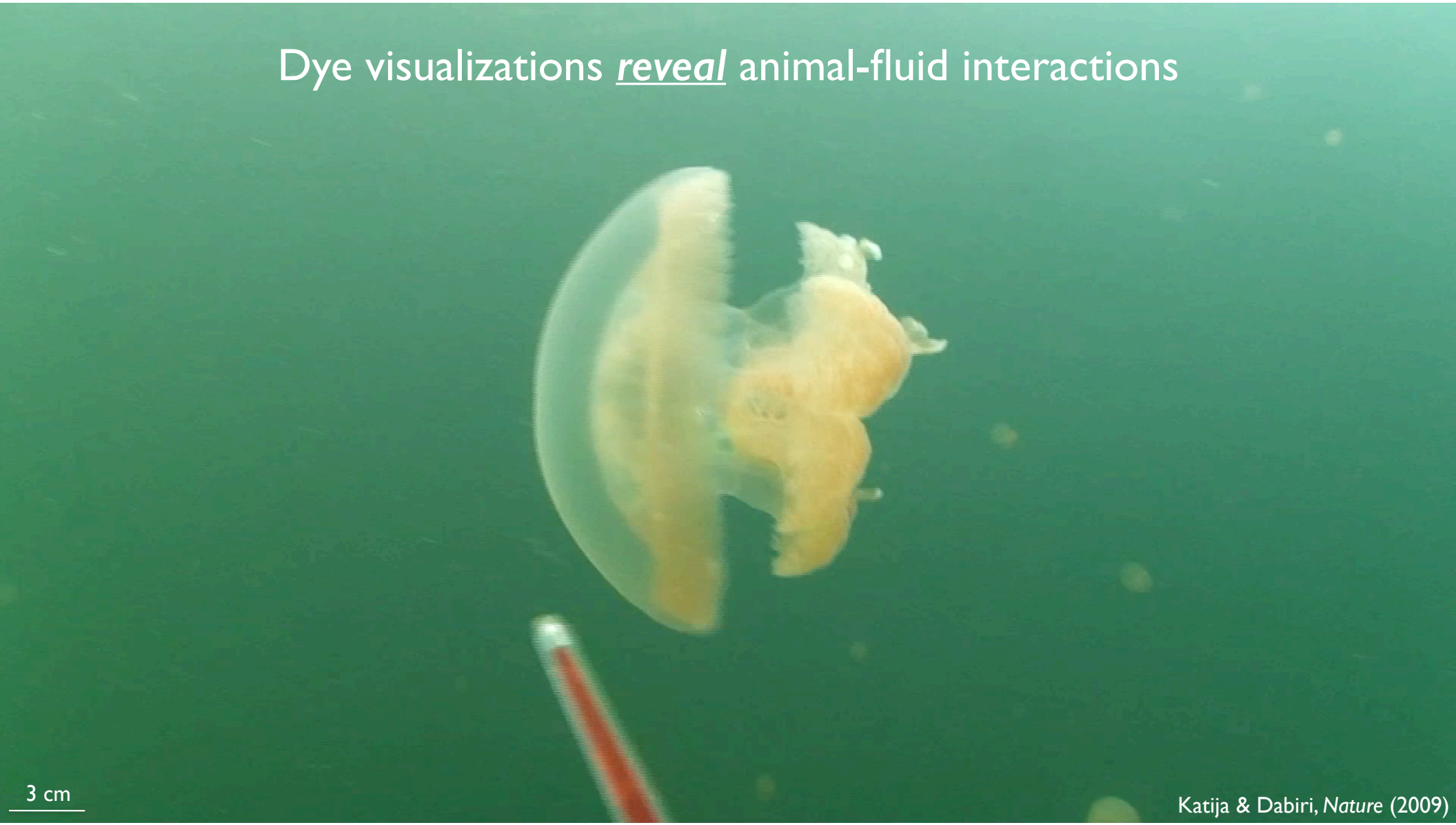
Organism survival depends on ability to decipher sensory-rich ocean environment

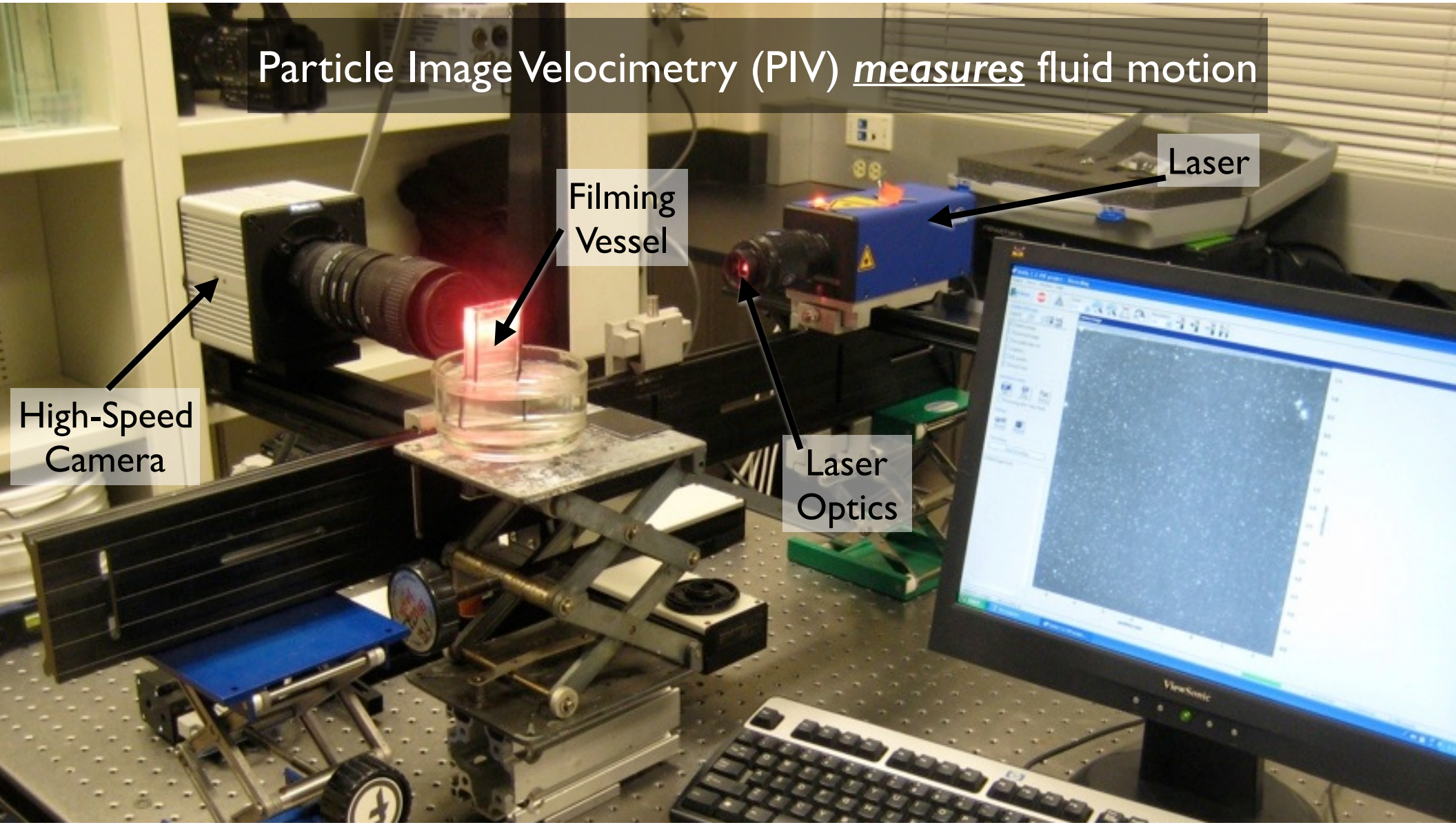


Siphon flows established in the laboratory simulate suction feeding flows of fish that prey on copepods.

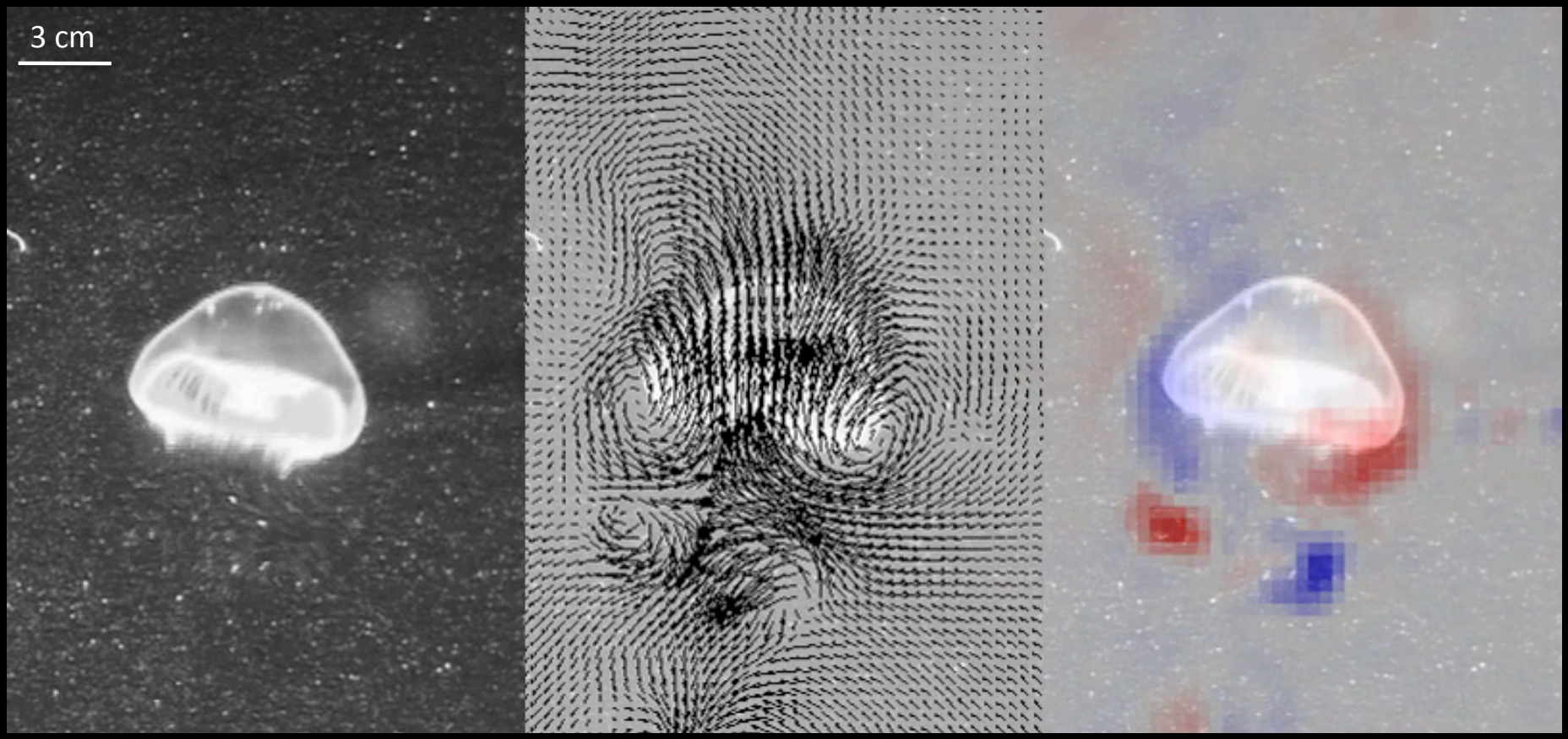
Dye visualizations *reveal* animal-fluid interactions



Katija & Dabiri, *Nature* (2009)


Particle Image Velocimetry (PIV) *measures* fluid motion
Laser
Filming Vessel
High-Speed Camera
Laser Optics

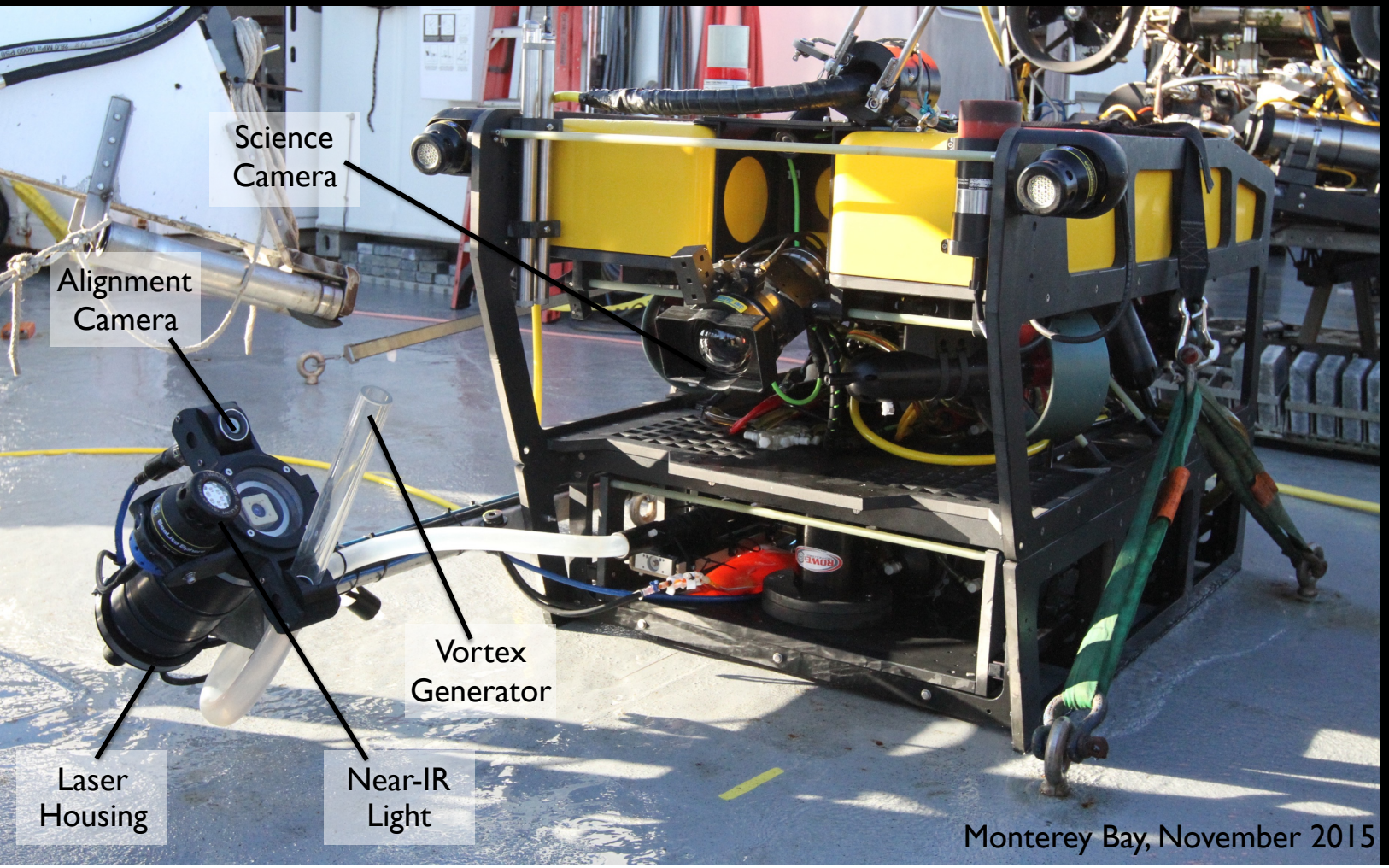
PIV generates velocity and vorticity fields

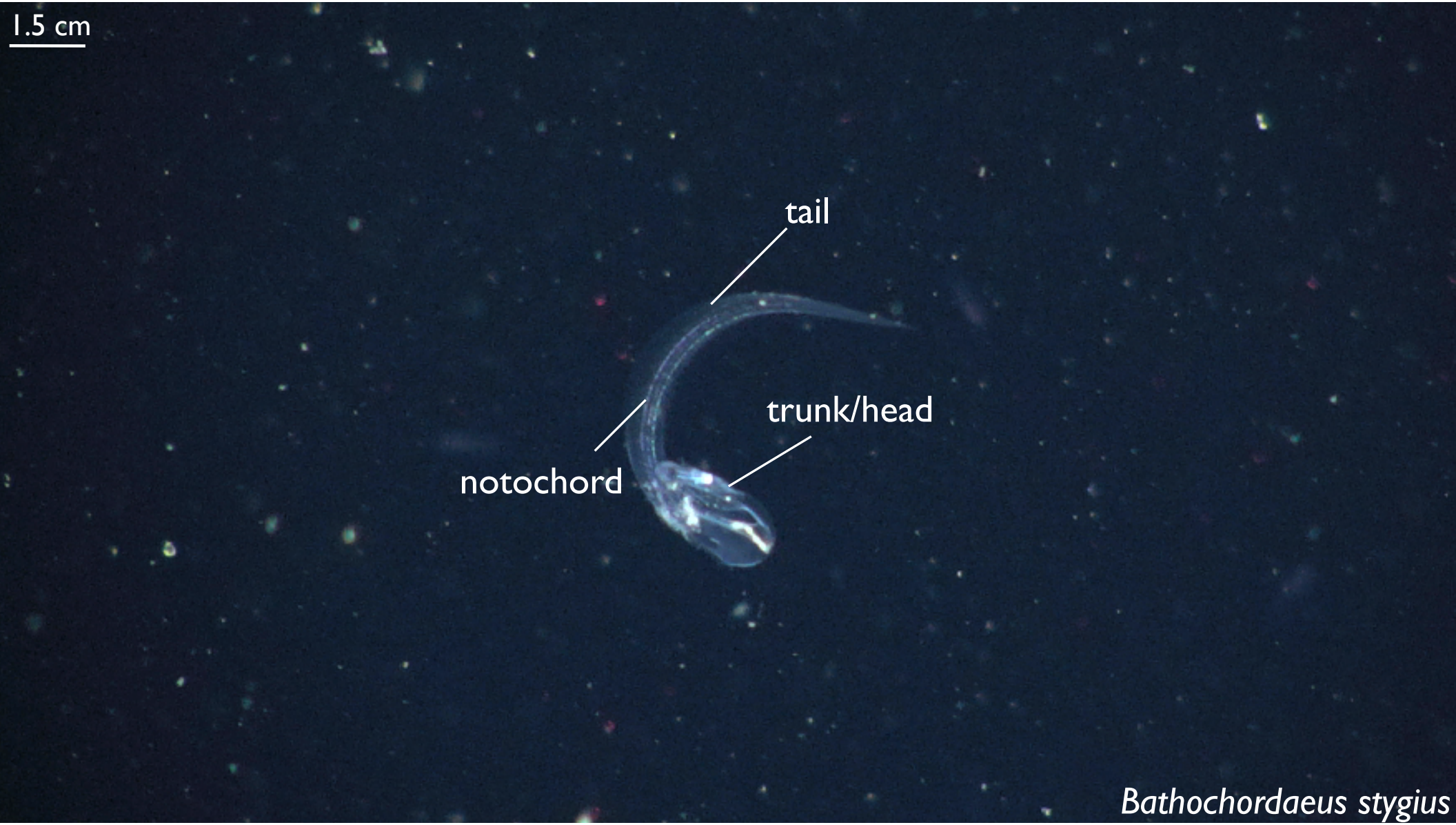


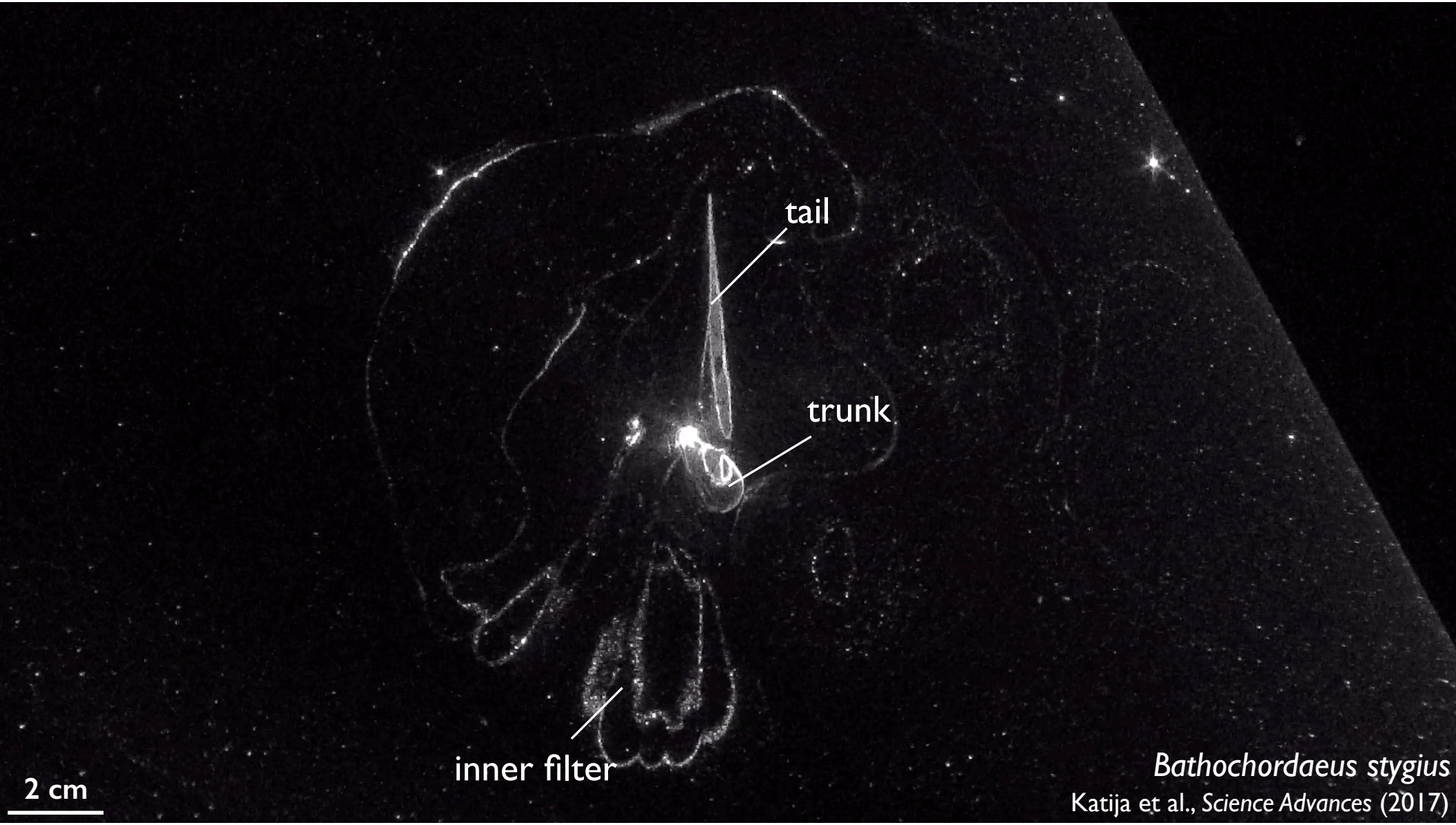
(Left): Raw images of free-swimming *Aequorea victoria* used for PIV. (Center) and (Right): Velocity and vorticity fields, respectively. Videos are played back at real time.

Katija et al., *Mar. Ecol. Prog. Ser.* (2011)

Deploying DeepPIV on ROV *MiniROV* during Midwater Cruise (Summer 2015)




1.5 cm
tail
trunk/head
notochord
Bathochordaeus stygius



Bathochordaeus stygius

Katija et al., *Science Advances* (2017)

Hourly
filtration rate
(estimated)

Alldredge (1977), Silver et al (1998)

Hourly
filtration rate
(measured)

Katija et al., *Sci. Adv.* (2017)

Hourly filtration rate (measured)

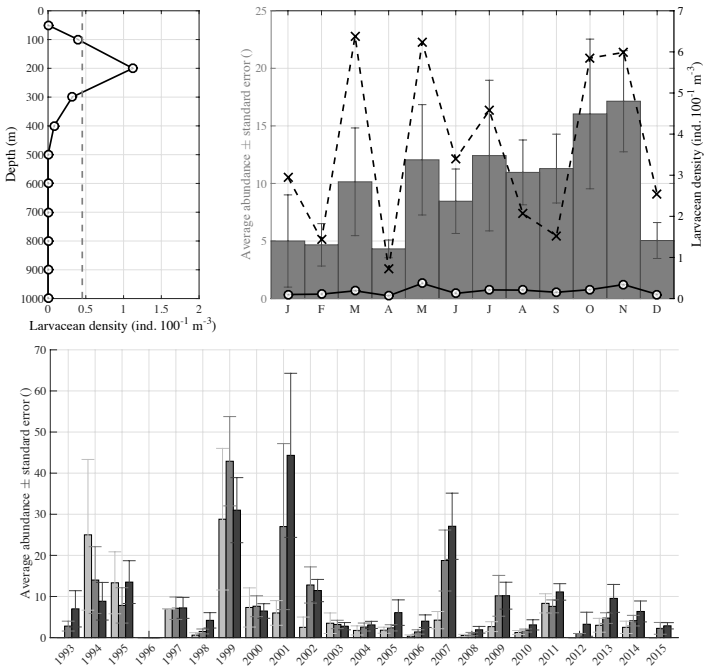
Katija et al., *Sci. Adv.* (2017)

Estimate total abundance and average density using transect data from 100 to 300 m:

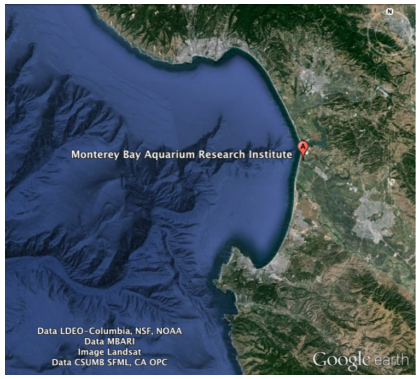
max ~ 6.4 ind.100^{-1} m^{-3}

ave ~ 0.3 ind.100^{-1} m^{-3}

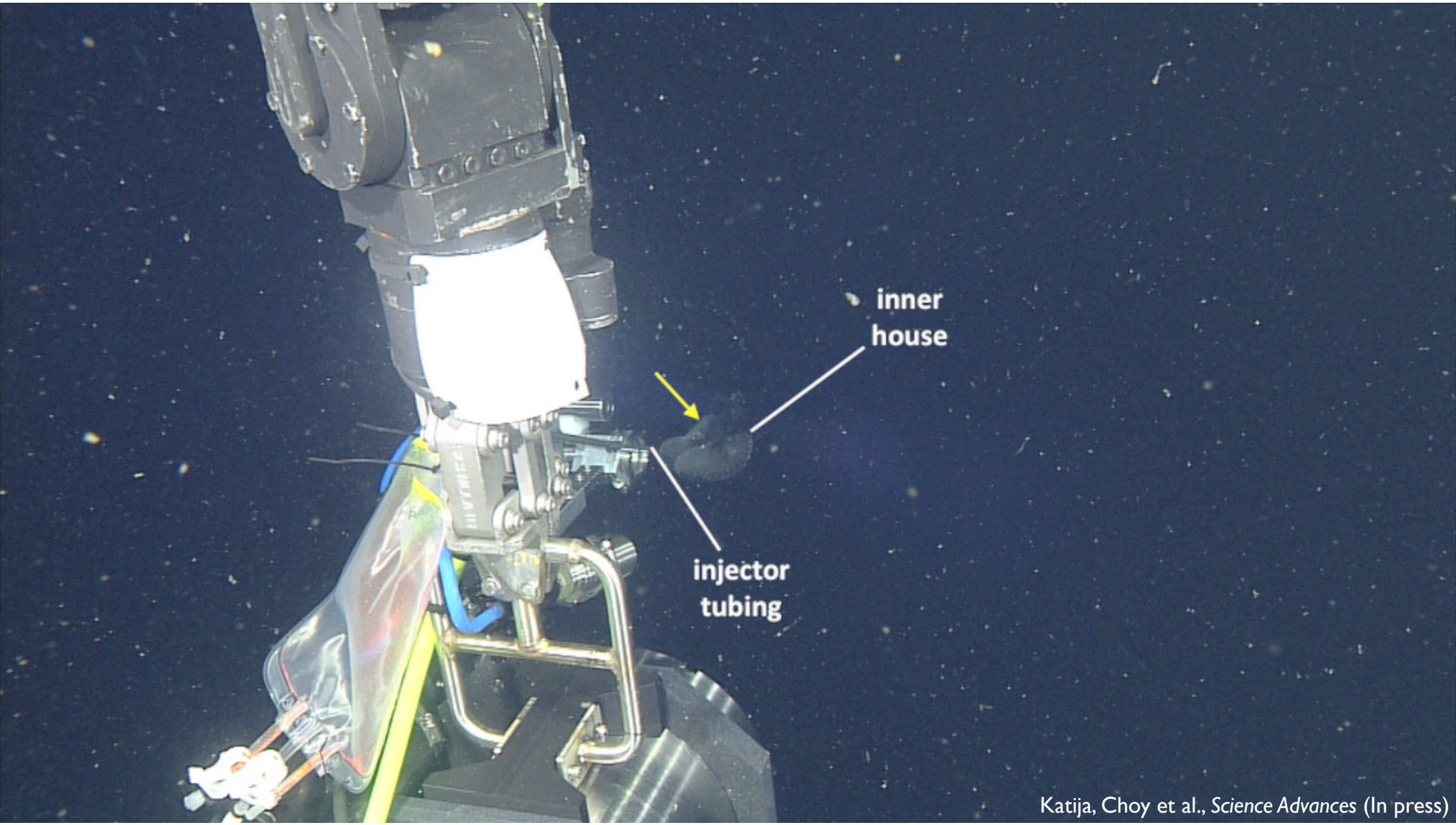
Robison et al (2007), Katija et al., *Sci. Adv.* (2017)



~500 Olympic-sized swimming pools filtered per hour (max)

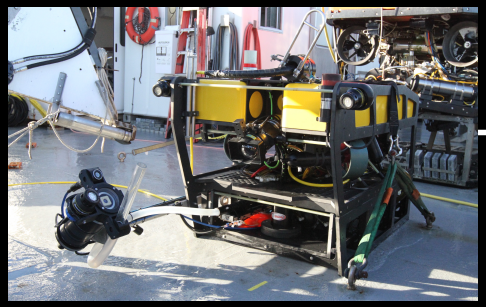


~13 days to filter 200 m of Monterey Bay (max)

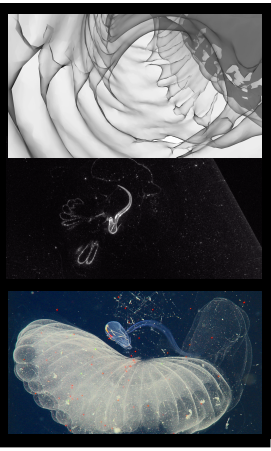


Katija, Choy et al., *Science Advances* (In press)

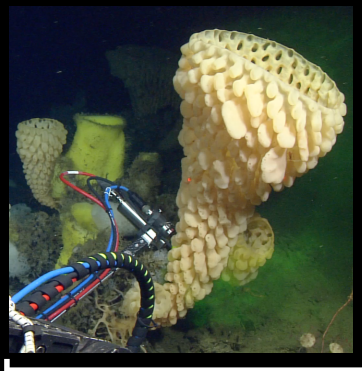

2 cm
Katija, Choy et al., *Science Advances* (In press)



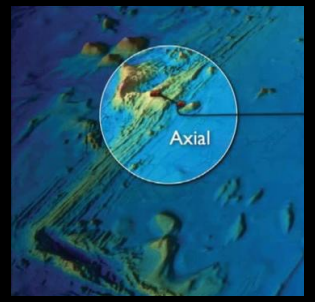
DeepPIV on MiniROV (v1.0)



Larvacean ecology



Sponge feeding ecology

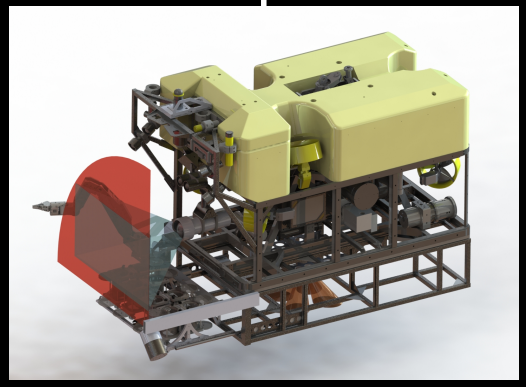


Vent fluxes at Axial?

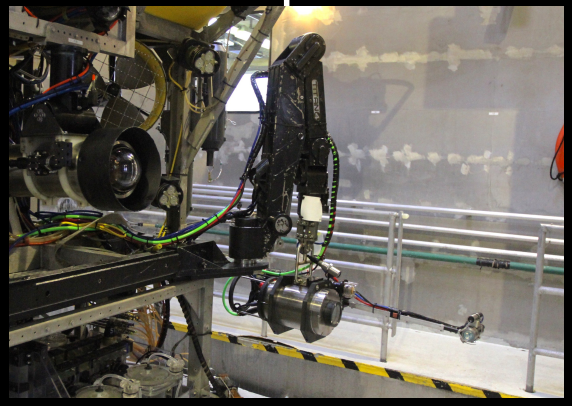
2014 2015 2016 2017 2018 2019

58 deployments

DeepPIV on all MBARI ROVs (v3.0)



DeepPIV conceptual design



DeepPIV on Doc Ricketts (v2.0)

What's next for DeepPIV?

- miniaturization?
- payload for Mesobot, AUV, float?
- particle sinking dynamics, 3D reconstructions of particle/ aggregate field, turbulence?

DeepPIV Instrument Development (MBARI)

Project Manager - Alana Sherman
Electrical Engr. - Chad Kecy, Denis Klimov
Mechanical Engr. - Dale Graves, Jon Erickson
Software Engr. - Brian Schlining

Thank you!

Kakani Katija
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DeepPIV Scientific Efforts

Larvacean feeding ecology - Bruce Robison (MBARI)

Microplastics - Anela Choy, Bruce Robison (MBARI), and Kyle Van Houtan (MBA)

Sponge feeding ecology - Joshua Lord and Jim Barry (MBARI)

Venting fluid fluxes at Axial Seamount - Chris Algar (Dalhousie) and David Butterfield (UW-NOAA)

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