

# **CODIC:** A Low-cost Substrate for Enabling **Custom in-DRAM Functionalities and Optimizations**

Lois Orosa<sup>1,2</sup>, Yaohua Wang<sup>3</sup>, Mohammad Sadrosadati<sup>1</sup>, Jeremie Kim<sup>1</sup>, Minesh Patel<sup>1</sup>, Ivan Puddu<sup>1</sup>, Haocong Luo<sup>1</sup>, Kaveh Razavi<sup>1</sup>, Juan Gómez-Luna<sup>1</sup>, Hasan Hassan<sup>1</sup>, Nika Mansouri Ghiasi<sup>1</sup>, Saugata Ghose<sup>4,</sup> and Onur Mutlu<sup>1</sup>



<sup>1</sup>ETHzürich <sup>2</sup>///CESGA











SAFARI



## 1: DRAM Background



# **Internal DRAM Signals**

sense\_n controls the NMOS amplifier in the SA





# **2:** Motivation

## **Conclusion:**

**DRAM Latency PUF** 

**PreLatPUF** 

**CODIC-sig PUF** 







~17%

~12%



~0%

Power







