

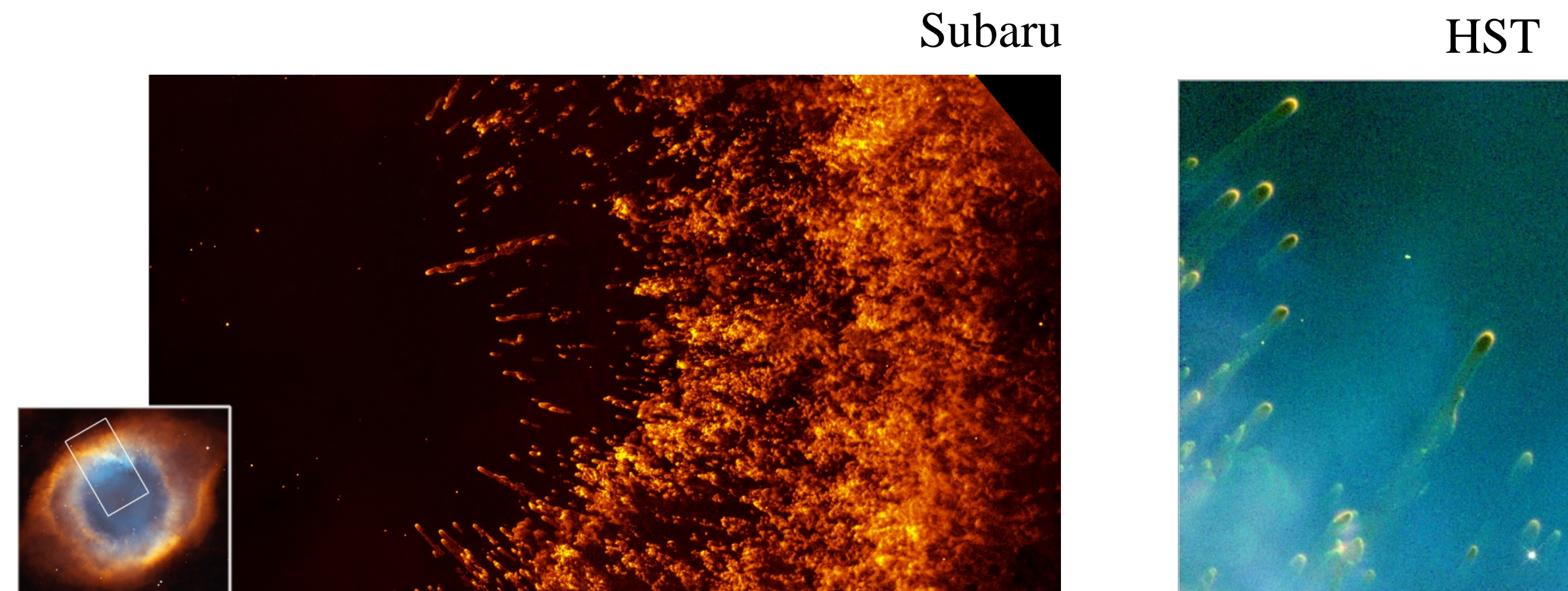
# Exoplanets from supernova explosions

Shlomo Dado, Arnon Dar and Erez N Ribak

Physics Department, Technion – Israel Institute of Technology, Haifa 32000, Israel

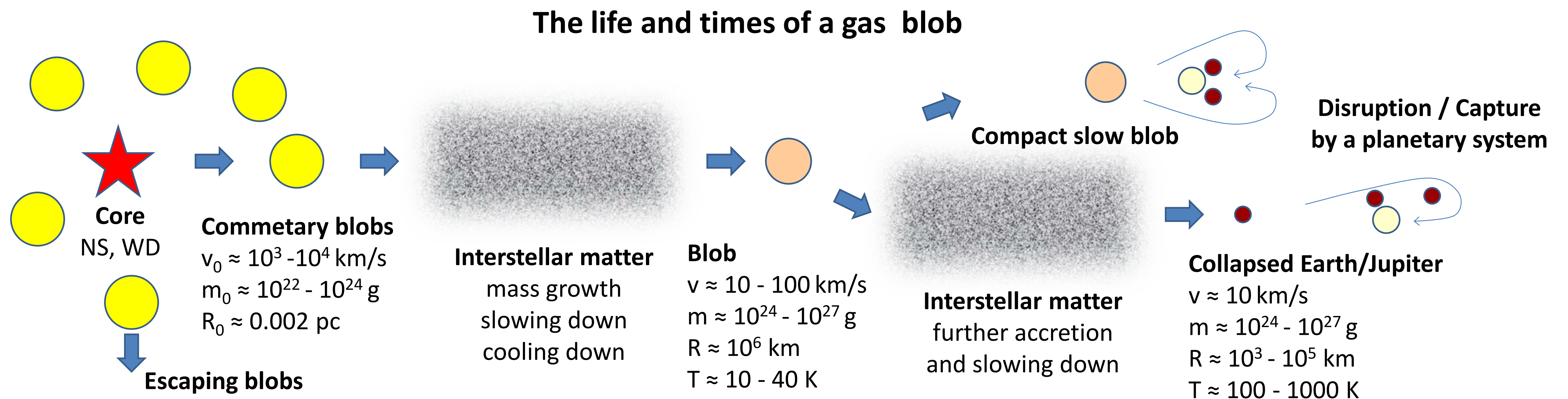
## ABSTRACT

We propose that high-speed gas blobs, which are observed in huge numbers in supernova remnants and planetary nebulae, could end up as exoplanets, or strongly affect planetary systems. These blobs grow in mass and slow down in the interstellar medium by accretion, while cooling by radiation. Once their mass exceeds the Jeans mass, they collapse into hot giant gas planets. It could be that significant galactic material has been swept into such free-floating objects. More condensed blobs could perturb stellar planetary systems, kick bound planets into misaligned orbits or be captured themselves into misaligned orbits. Extended blobs could then collapse or be tidally disrupted into a tilted gas disk to form planets, some of them misaligned. Giant floating Jupiters were occasionally detected by their microlensing effects and by radio scintillations of compact extragalactic sources such as quasars and gamma ray bursts, and the hotter ones could be observed in the future by deep photometry



At an approximate distance of 700 light years, the Helix Nebula is the closest example of a planetary nebula created at the end of the life of a Sun-like star. The Helix nebula is a collection of more than 40,000 distinct gas blobs that resemble comets due to their compact heads and long,

streaming tails. Each such blob is about twice the size of our solar system and has about an Earth's-mass of hydrogen and other gases that were expelled from the nebula's central star thousands of years ago. Intense radiation from the PN core heats the blobs edges, making them visible.



## DETAILS

- $(N_{PN} + N_{SN}) \times N_{blobs} \times \text{galaxy age} / \text{volume} \rightarrow 200/\text{pc}^3$
- $N_{blobs} \approx 1000 N_{stars}$  in Milky Way (before escape)
- Blobs moving in galactic plane grow, others can escape
- Galactic gas accumulates in sweeping blobs

## EVIDENCE

- Microlensing:  $N_{blobs} \approx 2N_{stars}$
- $M_{stars} \approx 10 M_{gas}$  in Milky Way
- Radio scintillation from blobs' ionised skins  $N_{blobs} > N_{stars}$
- Retrograde planets (~30%)
- Warped protoplanetary disks (few)

More? See "Misaligned And Alien Planets From Explosive Death Of Stars" by Dado, Dar and Ribak, astro-ph 1102.2622