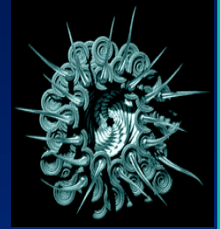
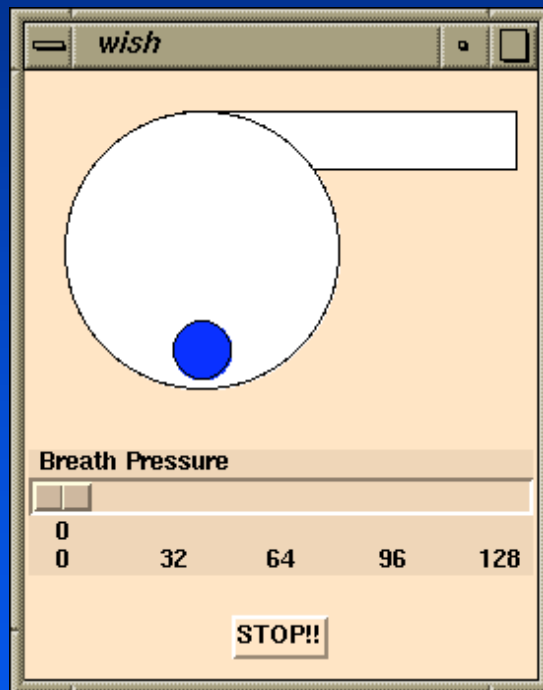


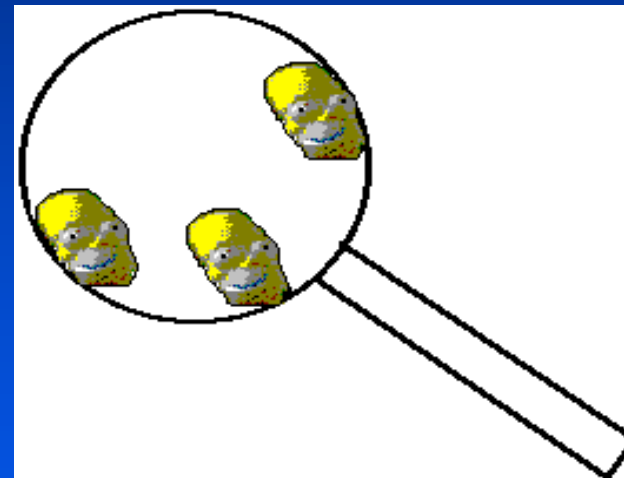
# Physical Models: Particles



*Whistle: Single particle influences oscillator*



**Homeraca: Many particles launch PCM or parametric sounds**



**Also good for "flock-like" sounds: applause, rain, birds, etc.**

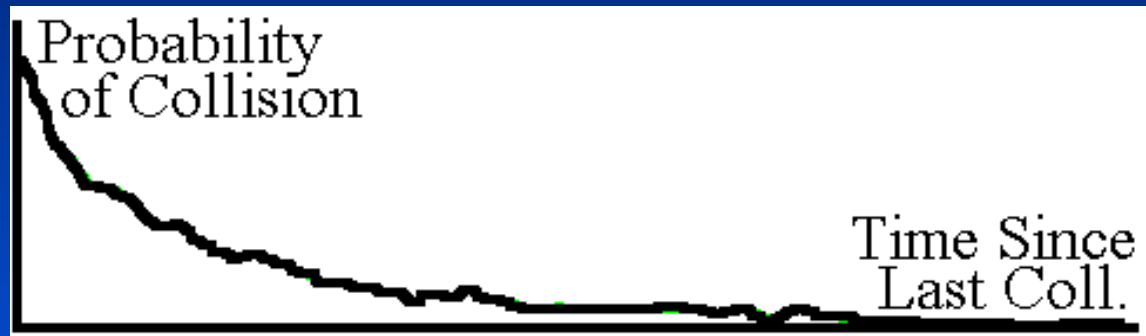
# Stochastic Event Synthesis



*Run model w/  
lots of particles*

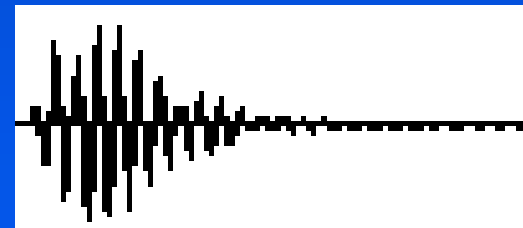


*Collect statistics -> Poisson*



*System energy decays exponentially.*

*Particle collision causes decaying  
burst of filtered noise*



# PhISEM Algorithm



*Exponentially decaying system energy*

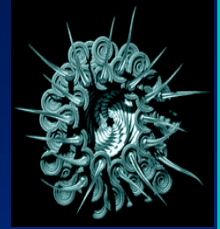
*Particle sound energy is exponentially (fast) decaying white noise. Sum of exponentially decaying noises is an exponentially decaying noise.*

*Each time step, compute likelihood (based on #of particles) of new sound-producing event*

If so, add to net particle sound envelope energy

*Filter result with system resonances,  
with reallocation if needed*

# PhISEM Code Example



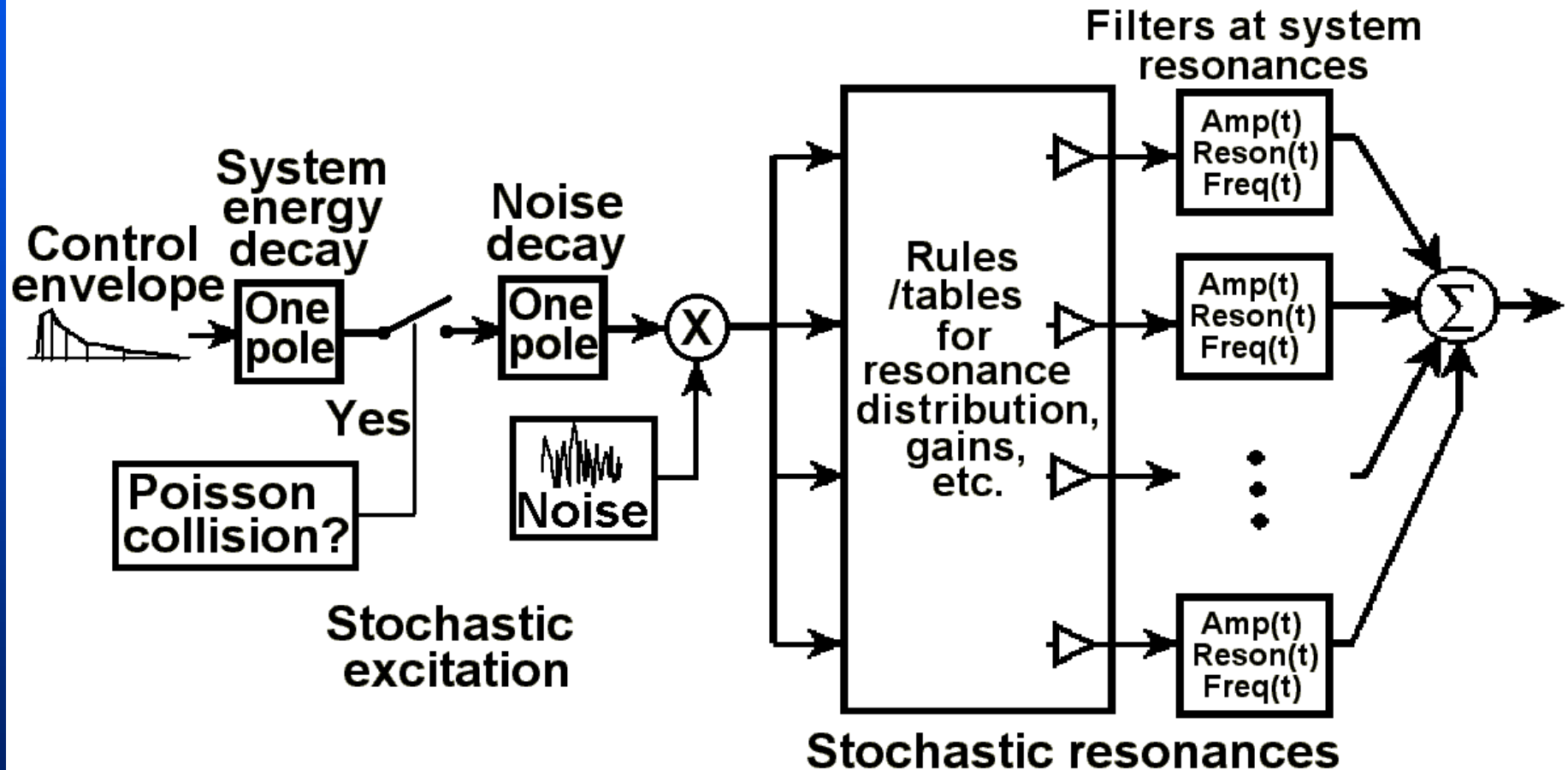
```
#define SOUND_DECAY 0.95
```

```
#define SYSTEM_DECAY 0.999
```

**EACH SAMPLE:**

```
shakeEnergy *= SYSTEM_DECAY;           // Exponential system decay
if (random(1024) < num_beans)           // If collision
    sndLevel += gain * shakeEnergy;       // add energy
input = sndLevel * noise_tick();         // Actual Sound is Random
sndLevel *= SOUND_DECAY;                 // Exponential Sound decay
input -= output[0]*coeffs[0];            // Do simple
input -= output[1]*coeffs[1];            // system resonance
output[1] = output[0];                   // filter
output[0] = input;                       // calculations
```

# PhISEM: Stochastic Modal Synthesis



# Particles, PhISM



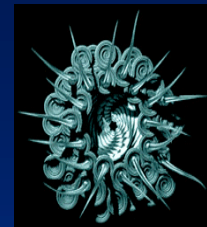
## ***Strengths:***

- Cheap
- Meaningful parameters
- Good for lots of real-world sounds

## ***Weaknesses:***

- Not “exact” (statistical)
- No complete system ID (analysis) process (yet, hang on, we’ll talk about this later)

# Related Techniques



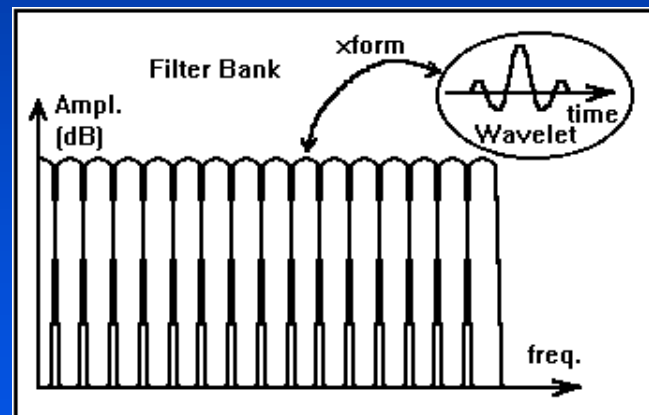
## ***Particles:***

***Granular Synthesis (Many authors)***

***Cut sound and randomly remix***

***Wavelets (Miner '99)***

***Time/Freq transform***

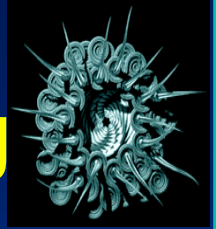


## ***Modes:***

***Independent Components (Casey 98)***

***Interactive Sinusoidal Modeling (Pai et al)***

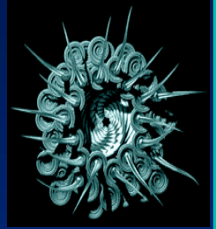
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