Employing Deep Learning in Protoplanetary Systems

Recent Advancement in Physics
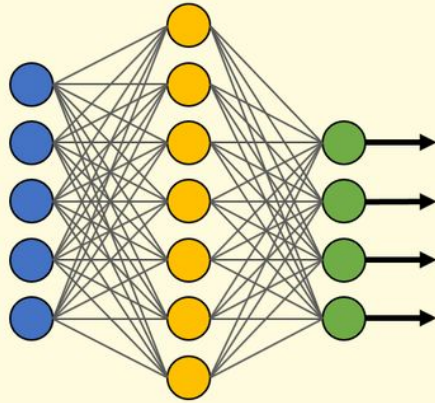
Deep Learning... AI... Aren't they the same

- **We are always wrongly insinuated that AI, ML and DL are all the same but they are not also entirely different.**

- **ML is a just subset of AI and DL is a subset of ML.**

- **AI is lot hefty, It has to do with mimic the human qualities.**

- **But DL is way "caveman" to AI, It's just building algorithms from a large amount of data and the name itself gives away that it has to deal with deep (neural) networks.**

A Dip into DL

- We know about linear regression but what if the relation is complex, you try to perform more computations and try to fit them better in this case. This is what is DL in short.
- A single set of computation block is termed a "layer" and so when you study a complex system, you need more layers in hand.
- Basically DL model is a model which learns from a multi-layered computational system.

Simple Neural Network — Deep Learning Neural Network
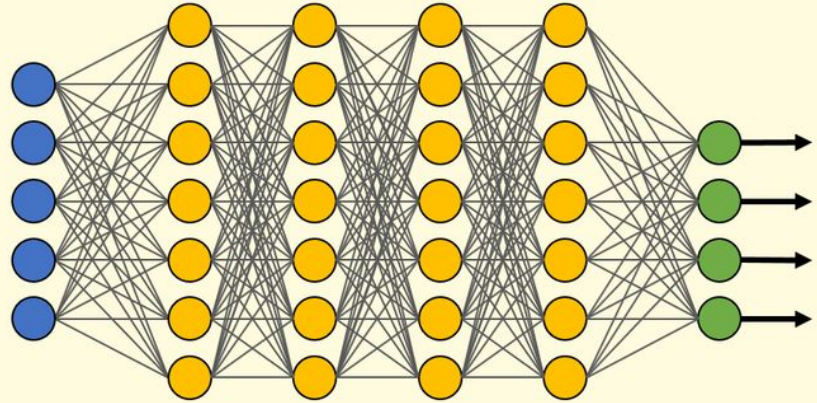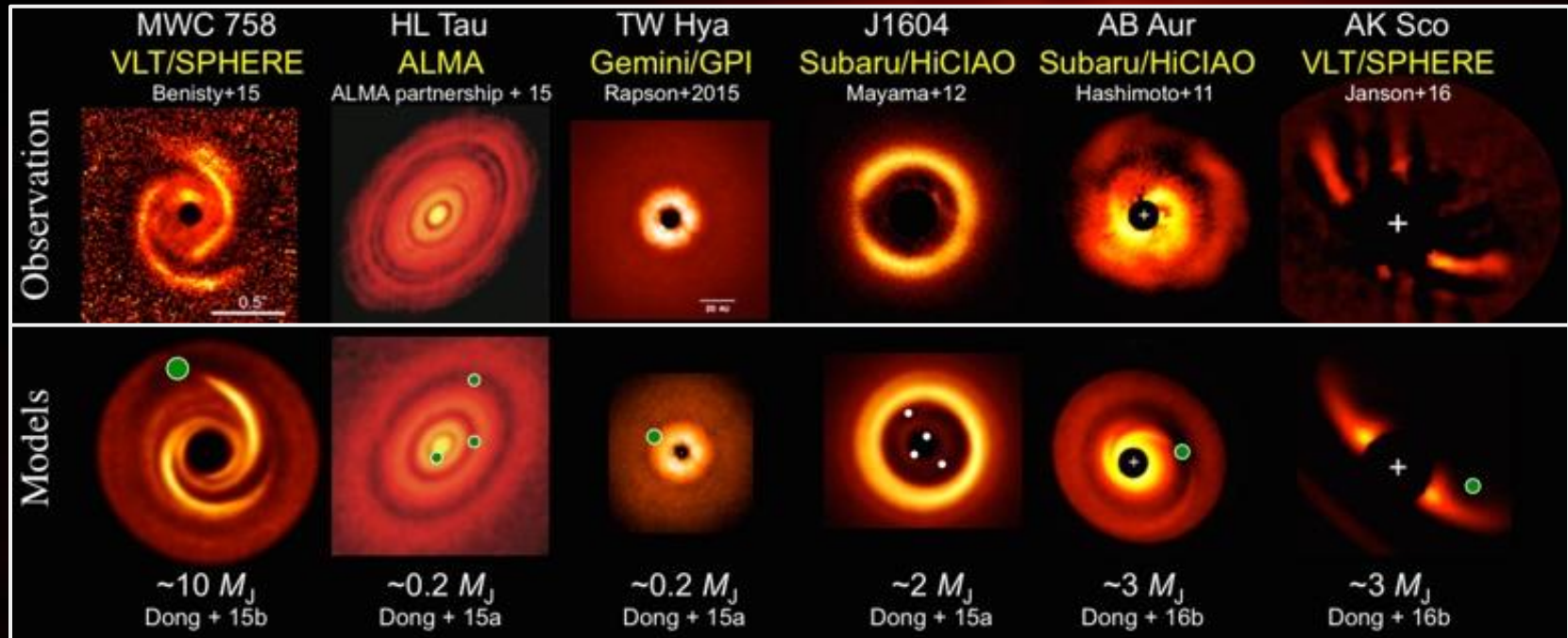
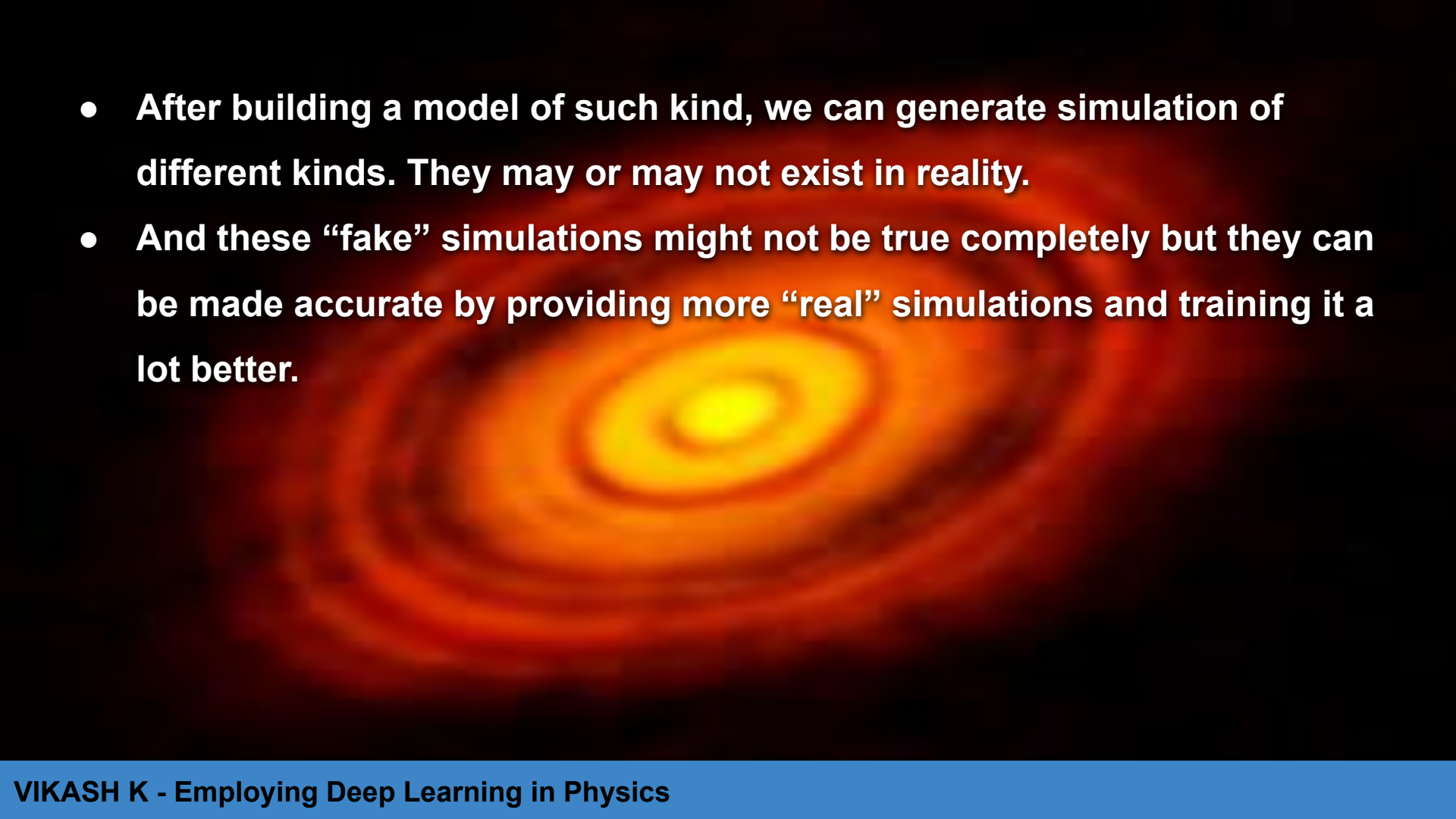Input Layer — Hidden Layer — Output Layer

Protoplanetary systems

- **Planets form from the gas and dust that remains after the star has been born.**
- **They basically condense from the dust and gas and collapse to form small structures called protoplanets.**
- **The background is an image of a planet formation and clearly it can seen that there are a lot dark rings, and you guessed it, it is where the protoplanets are located.**
- **Simple logic, the dust and gas there has become a protoplanet, so there is no gas or dust there.**

What does DL has to do with Protoplanets

- Generating simulations of these systems from observations is very hard. It tries to fit with the observations. It requires a lot of effort and computational time.

- Here is where DL comes in, For an analogy, we already know that there exists models that generate fake faces. They are very much analogous to this.

- Instead of throwing real faces, real simulations are thrown into the model and they learn to return new "fake" simulations.

| | MWC 758 VLT/SPHERE Benisty+15 | HL Tau ALMA ALMA partnership + 15 | TW Hya Gemini/GPI Rapson+2015 | J1604 Subaru/HiCIAO Mayama+12 | AB Aur Subaru/HiCIAO Hashimoto+11 | AK Sco VLT/SPHERE Janson+16 |

$\sim 10\ M_J$ Dong + 15b $\sim 0.2\ M_J$ Dong + 15a $\sim 0.2\ M_J$ Dong + 15a $\sim 2\ M_J$ Dong + 15a $\sim 3\ M_J$ Dong + 16b $\sim 3\ M_J$ Dong + 16b

- **After building a model of such kind, we can generate simulation of different kinds. They may or may not exist in reality.**
- **And these "fake" simulations might not be true completely but they can be made accurate by providing more "real" simulations and training it a lot better.**