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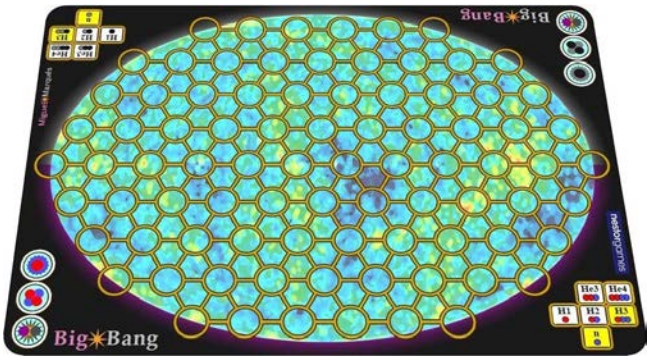
Miguel Marqués

Big✳Bang

The fate of the Universe in the hands of 2 players



A second after the Big Bang, the matter and antimatter that had just been created annihilated into light. Hopefully, a tiny excess of matter survived, about 1 particle per billion, providing the building blocks of the Universe we live in. Find your antiplayer and re-fight that clash between matter and antimatter. Physics is the only rule!

OVERVIEW

A **Big✳Bang** set includes:

- 1 board & 3 white victory tokens.
- 84 'particles', 21 of each of the 4 types:

  ● = **protons** } **matter**
  ● = **neutrons** }
  ● = **antiprotons** } **antimatter**
  ● = **antineutrons** }

The board represents an elongated and irregular hexagonal grid with 84 circles, on which the particles will be placed. The background picture evokes the cartography of the temperature difference in the "*cosmic microwave background*", the light flash that followed the annihilation of matter and antimatter, measured by the WMAP satellite.

Both players fill the board randomly with the 84 particles *, and then the **younger** one chooses to be:

- The **player**, using **matter** (● & ●).
- The **antiplayer**, using **antimatter** (● & ●).

Players sit on their respective side of the board (top for the antiplayer on the picture). You should avoid direct contact, if you don't want to annihilate! The **elder** player starts.

Both players alternate turns trying to: produce **light** by annihilating particles; fuse theirs into **Helium** stacks; and build the most **massive star** (group).

*. *We suggest to mix them all on the board, split them in four groups towards each corner, readjust the groups if needed, and then place them on the circles starting from each corner.*

PARTICLES & NUCLEI

Particles start alone on a circle, but during the game they may *Fuse* to form **nuclei** (stacks), or *Annihilate* to disappear into light. The only stack combinations allowed by Physics are noted on the charts at each side of the board:

- With **0** protons, the **neutron**.
- With **1** proton, the three forms of **Hydrogen** (with 0, 1 or 2 neutrons), known as H1, H2 and H3.
- With **2** protons, two forms of **Helium** (with 1 or 2 neutrons), known as He3 and He4.

✗	He3	He4
H1	H2	H3
	n	✗

✗	He3	He4
H1	H2	H3
	n	✗

Exactly the same ones exist with antimatter (on the right), and are usually noted with "anti-" or a 'bar' over the symbol, but in the following we may use the same name for simplicity. All other combinations are **forbidden**! In short, you cannot have more than 2 protons or neutrons per stack, and not only 2 of them alone †.

PLAYER TURN

Every turn you may choose **one action**:

1. **Fusion**. Move a stack of yours to an adjacent circle, or along a straight line of empty circles, in order to place it on top of another stack of yours. You cannot fuse into a forbidden combination, though:

   ●● ⟶ ●● = ●●● (fusion into He4)
   ● ⟶ ● ✗ (He2 does not exist)

2. **Annihilation**. Move a stack of yours to an adjacent circle, or along a straight line of empty circles, towards exactly the 'mirror' (equivalent) stack from your opponent ‡. Remove both from the board and keep their particles in front of you as a **reserve of light** that you have produced:

   ●● ⟶ ●● = ✳✳✳ (H2 annihilation)
   ●●● ⟶ ●●● ✗ (He3/H3 are not mirror)

If you cannot **or** do not want to, you **may pass**. However, if both players pass consecutively, the **game ends**!

†. *Two combinations are allowed but unstable (in yellow), the neutron and H3. They stabilize after a given time 'decaying' (one neutron becomes a proton) respectively into the corresponding H1 and He3. But in the base game you can forget about this and consider all of them stable!*

‡. *In order to better distinguish the two possible stacks of 3 particles (He3 and H3), we suggest to always order them so that He3 has a proton on top and H3 has a neutron.*

GAME END

Once both players have passed consecutively, check the three victory conditions that are printed on each side of the board:

Light. Count the number of **particles** on your reserve, that represent the light you have produced through annihilation. Place a victory token on your 'light' space if your number is higher.

Helium. Count the number of **He4 nuclei** on the board. Place a victory token on your 'Helium' space if your number is higher. In case of a draw, count also the **He3** nuclei.

Star. A linked group of nuclei from one player is considered a star. At the endgame, count the maximum number of **particles** in one of your stars. Place a victory token on your 'star' space if you have built the most **massive** one (the one with more particles).

The player or antiplayer with more victory tokens wins! If you play a series of games, keep the token score.

However, there is an **automatic victory** condition. If at any time during the game you create a linked group of **three contiguous He4** (in any shape):

they are supposed to fuse into **Carbon** (a stack of 6 protons and neutrons) and you **win**! Carbon, the basis of life, is in fact created inside stars with this reaction, $3\,\mathrm{He4} \rightarrow \mathrm{C12}$. During a series of games, count this victory as 3-0.

SOLITAIRE PUZZLES

If you want to enjoy Big✳Bang on your own, we propose the following puzzles. In all of them set up the game as usual, but now there are no matter and antimatter turns! Just keep choosing *Fusion* or *Annihilation* of any type of pieces, until you cannot or do not want to [§].

These are the puzzles, by increasing difficulty:

Universe of Light. Annihilate all the particles. The number of particles left is your (negative) score.

Parallel Universes. Create stars of matter and antimatter separated by at least one empty space with the minimum *Annihilation* possible. The number of annihilated particles is your (negative) score.

Universe of Life. Create Carbon and antiCarbon nuclei (groups of three contiguous He4 or antiHe4 in any shape). Their number is your score (maximum of 6).

§. *You may also solve them as a cooperative exercise between two players, that would as usual alternate matter and antimatter turns.*

VARIANTS

These simple variants can be used together or individually to increase variety and introduce some new challenges.

1. SMALL*BANG

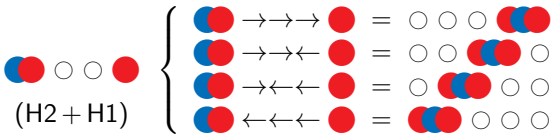
For a shorter Big✳Bang experience, put 6 particles of each type back in the bag, and play thus with **15** protons and neutrons. Therefore, 24 circles will start empty.

2. MASS

The production of light is **not a victory condition**, only the production of Helium and of the most massive star are. *Annihilation* fills a **common reserve** beside the board.

3. GRAVITY

When you use *Fusion*, you can move **both** stacks towards each other, and **choose** the location of the fused stack along the line defined by the two initial circles:



4. DARKNESS

During setup, replace 1 particle of each type with any 4 tokens at hand (small cubes, coins...). They represent **dark matter**, that does not interact with the particles on the board. Treat those 4 tokens as fixed obstacles that cannot be crossed in the way to *Fusion* or *Annihilation*.

5. TIME

For a deeper (and closer to Physics) Big✳Bang experience, you may consider the time dimension related to the unstable stacks (with yellow background) by adding a **third option** to your turn choice:

3. **Decay**. If protons become available in **your** reserve, from previous annihilations, choose **any** one unstable stack (neutron or H3, yours or not) and replace a neutron with its **corresponding** proton:

The removed neutron goes to **your** reserve, so that its size does not change. Therefore, every turn you have now the choice between: *Fusion*, *Annihilation*, *Decay*, or pass.

We suggest to split your reserve into neutrons and **protons** (● & ●), so that it is straightforward when the latter are available. Moreover, you should order the composite stacks so that the stable ones (H2, He3, He4) have a proton on top, and the unstable one (H3) has a neutron. In this way, the particle on top of the stack tells you at a glance which ones are unstable (● & ●) and may decay.