Supersolid and Quantum theatre

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Why in News?

A team of researchers from Italy, recently froze light into a 'supersolid' using 'quantum theatre.'

• **Supersolid** - A super solid is an *exotic phase of matter* in which particles are arranged in a crystalline structure but also move like a non-viscous fluid, exhibiting properties of both a solid and a superfluid.
• **First created in -** 2017 in a laboratory, but Physicists predicted the idea of a super solid in the 1960s.
• It combines the friction-free flow of a superfluid with the ordered structure of a crystalline solid.
• Usually, solids do not move on their own, but super solids ***change direction and density*** depending on their particles' interactions while maintaining an organised internal structure.
• **Properties of light -** Light always travels at *3 lakh km per second in a vacuum.*
• It cannot be trapped and solidified because the particles of light, photons, have no rest mass and do not interact strongly with each other.
• Light exists only as a particle or a wave.

- **Recent Findings –** It marks the first time scientists have managed to couple light with matter to create a supersolid.
- It used a quantum mechanical approach that relied on the properties of polaritons.
- These are hybrid particles that sometimes behave like light and sometimes like matter.
- They are created by coupling photons with packets of energy inside materials, like phonons (vibrational energy) or excitons (electron-hole pairs).
- The researchers used an aluminium gallium arsenide semiconductor platform as a waveguide, a channel through which waves can pass, fitted with a source of excitons and a laser.
- The waveguide had a microscopic structure with a periodic grating.
- The etched ridges influenced the polaritons' motion, trapping them in a regular pattern.
- The team used a pulsed laser to maintain a dense polariton condensate at a temperature of about –269ºC.
- **Quantum theatre -** This framework uses concepts from quantum mechanics to analyse theatrical performances, exploring themes like identity, observation, and play.
- **Potential applications -** Through this experiment photonic supersolids become more

accessible for experimentation.
- Helps in producing lossless optical energy transport and optical computing elements.

Reference

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