



# NEW HORIZONS SUBARU TARGET SEARCH

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# NEW HORIZONS

- Survey using The Subaru Telescope's Hyper Suprime-Cam in a search for observable targets
- This has been one of the deepest searches of the Kuiper Belt performed to date with an unprecedented level of tracking
- Resulted in numerous targets for New Horizons remote observation (observations ongoing)



Pluto

Credit: [NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute/Alex Parker](#)

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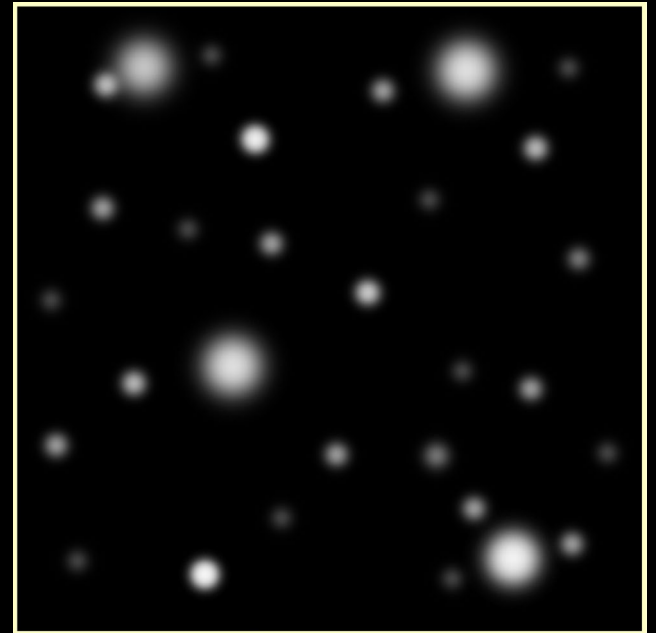
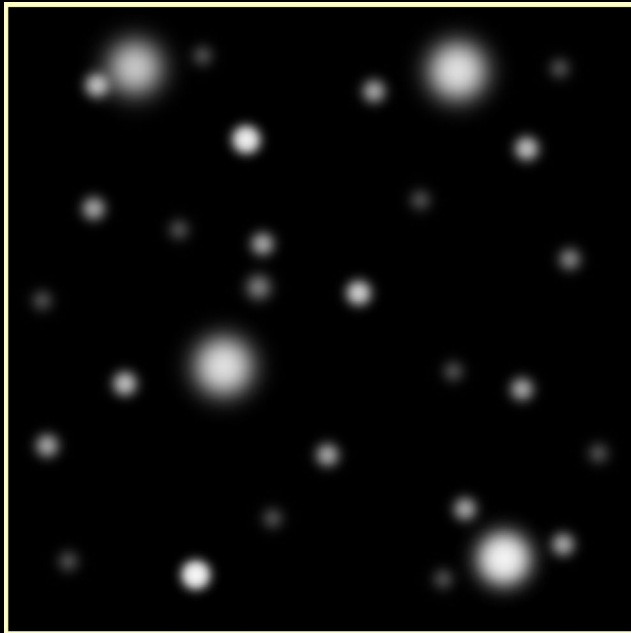
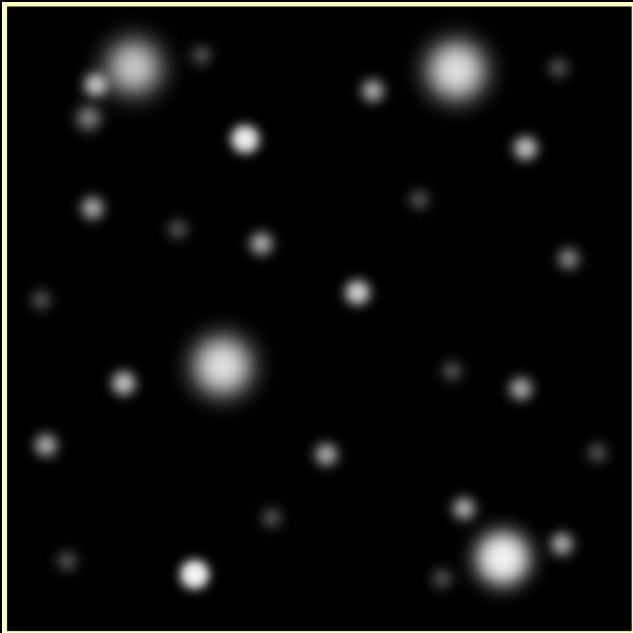


Arrokoth

Credit: [NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute//Roman Tkachenko](#)

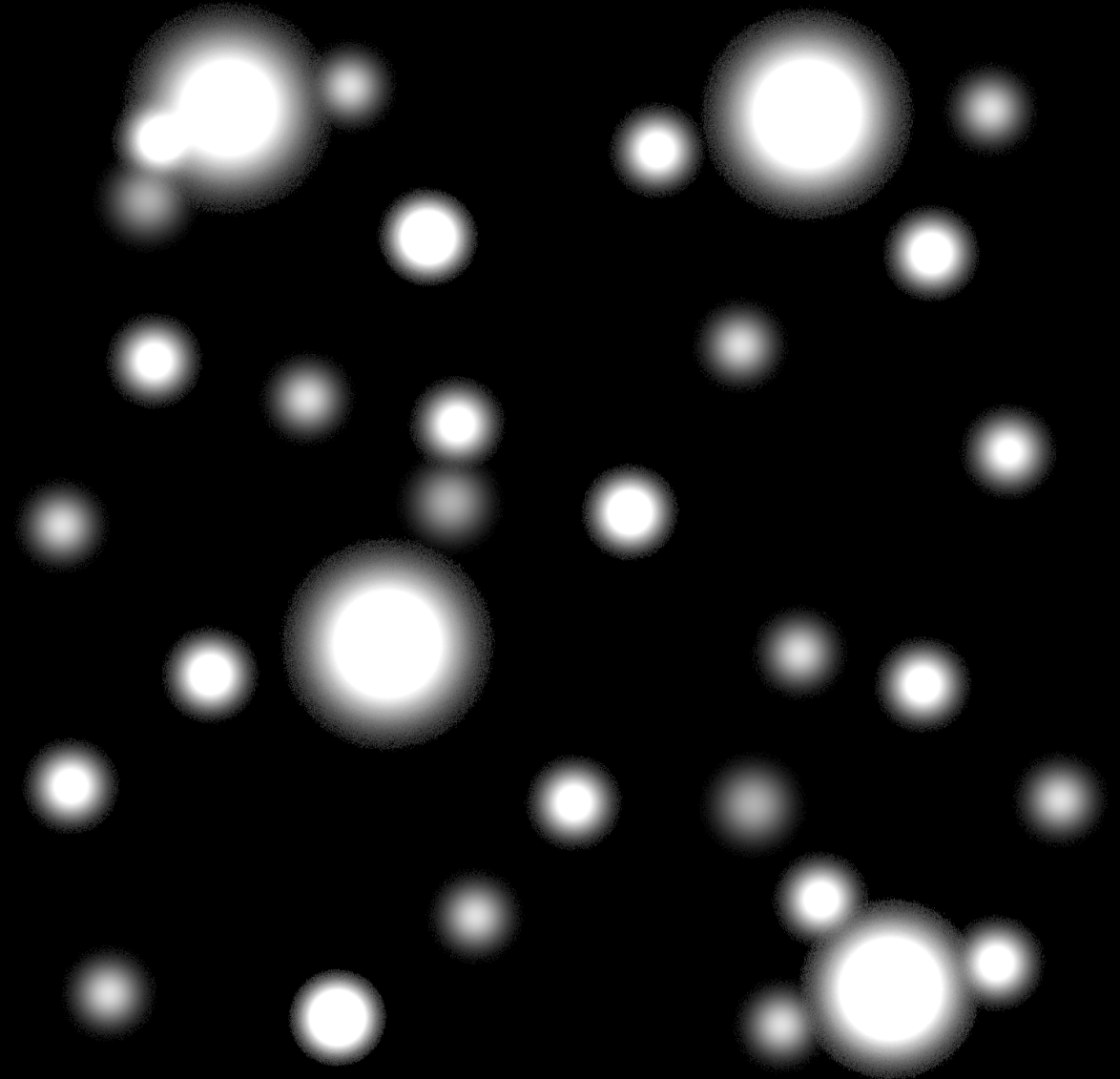
# SHIFT 'N' STACK

- Trans-Neptunian Objects (TNOs) are moving objects
- Long exposures cause trailing
- Instead, we take numerous images separated by time



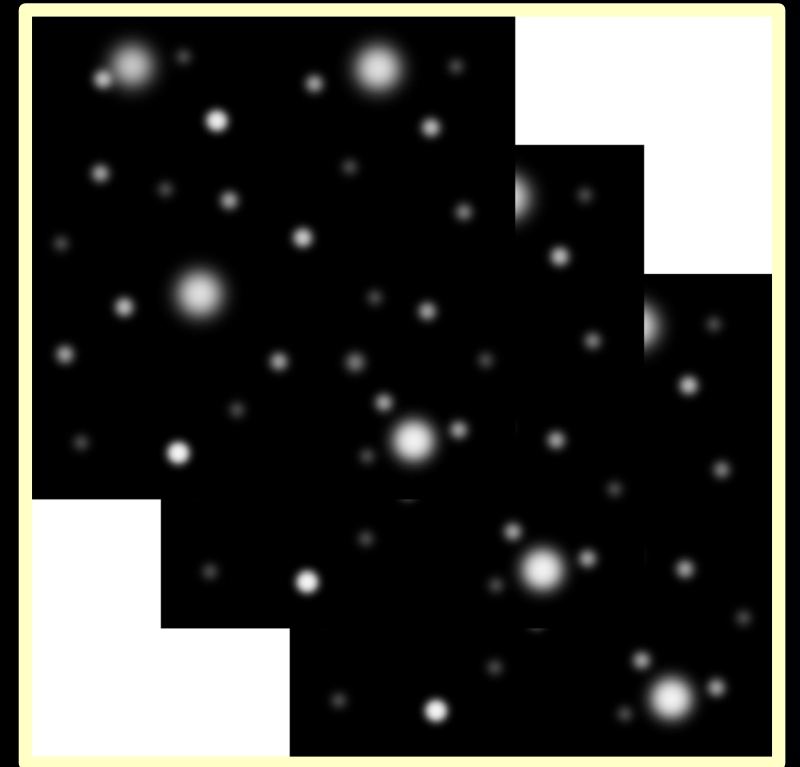
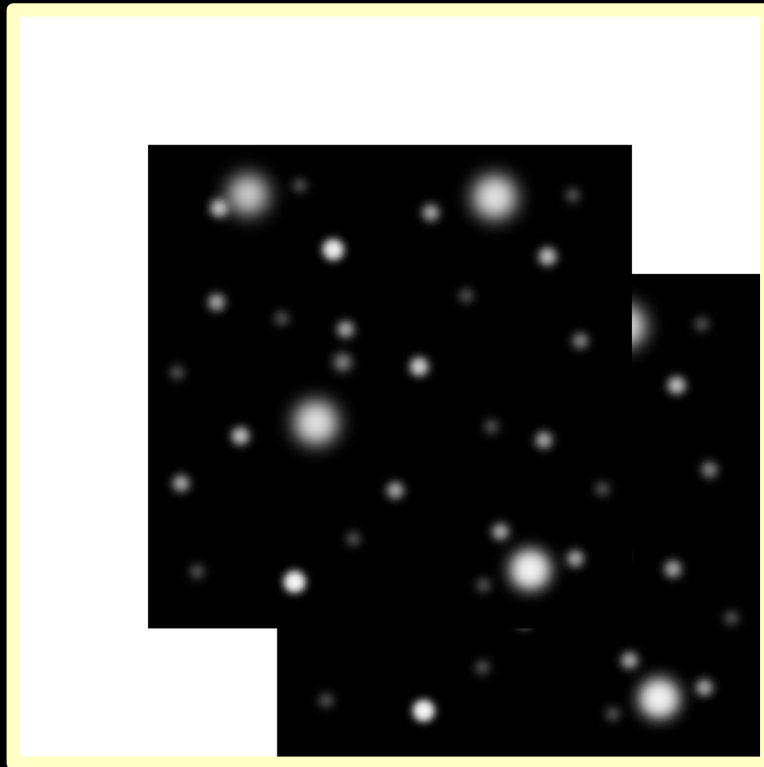
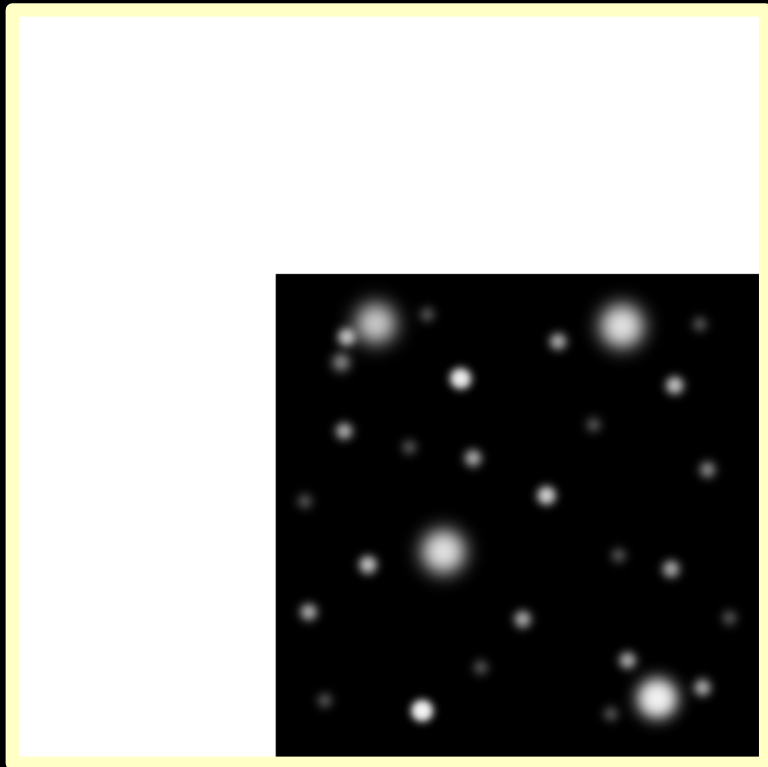
# SHIFT 'N' STACK

- Separate images can be “Stacked” simulating long exposure
  - Same trailing problem
- Makes stationary objects brighter without enhancing moving objects



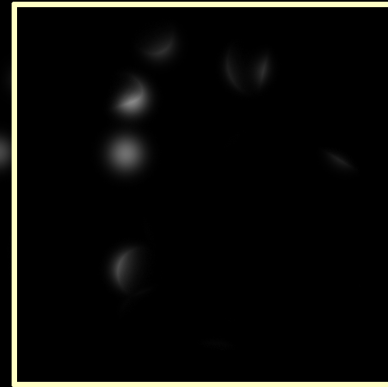
# SHIFT 'N' STACK

- First we “Shift” the images along angles and rates of motion that correspond to possible TNO orbits
- Must be repeated for all possible rates and angles



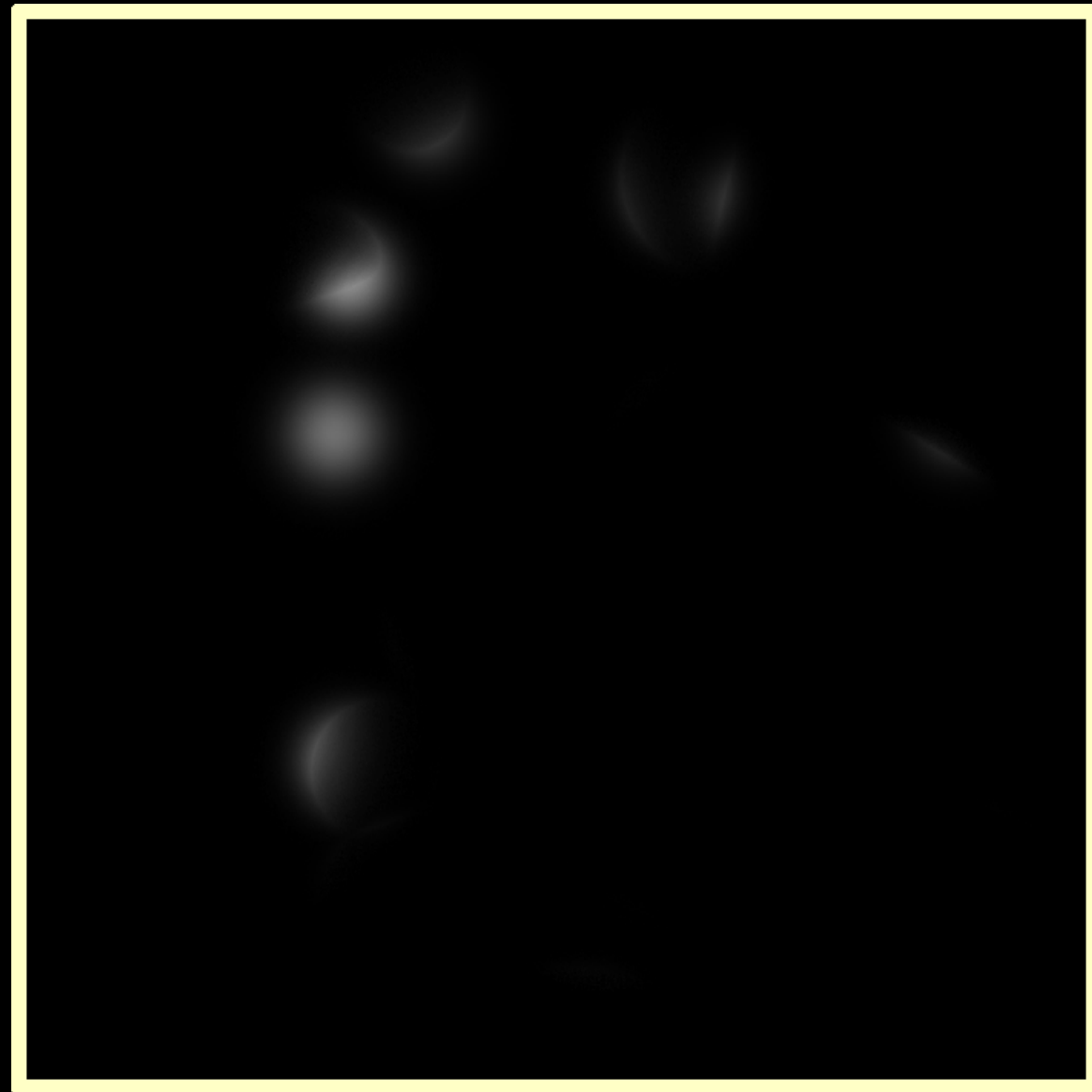
# SHIFT 'N' STACK

- Only after shifting can the images be stacked
  - Not additive, we use median (or mean)



# SHIFT 'N' STACK

- After the median, moving objects for nice round sources
- Stationary sources have odd shapes





# SUMMARY

- Shift 'n' Stack techniques allow us to discover sources too faint to be found in single images
  - Provide immediate information on orbital parameters
  - This project has discovered hundreds of TNOs
    - Several have been observed by the New Horizons spacecraft
  - Observations are ongoing
  - 20+ newly discovered TNOs in the last weeks
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