

# Issues in charging research

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- **DC forces**
  - Dynamic range of actuators
  - Alignment issues
- **Reduction of charging**
  - Cleaning and handling
  - Conductive coatings
    - Effects on thermal noise, absorption, thermal properties, etc
- **Causes of noise**
  - Markov processes
    - See R. Weiss, T960137-00-E
    - Measure correlation time on sapphire and silica with Kelvin probe
  - Glitch events
    - Vetoes
    - Shielding

# Noise from Markov process

$$S_F(f) = 2 \langle F^2 \rangle / (\pi \tau_0) (1/\tau_0^2 + (2 \pi f)^2)$$

- **Charge level**
  - $10^{-10}$  C/m<sup>2</sup>, typical low value (MSU)
  - $10^{-7}$  C/m<sup>2</sup>, typical high value after charging event (MSU)
  - $10^{-4}$  C/m<sup>2</sup>, typical value after rubbing (MIT)
- **Assumed values**
  - 1/10, ratio of charged area to uncharged
  - 1 m, distance between charged optic and ground
  - $\tau_0 > 1/f$
- **Results are encouraging, for small  $\tau_0$** 
  - $S_x^{1/2}(2 \text{ Hz}) < 10^{-26} \text{ m/Hz}^{1/2}$  at  $\tau_0 = 2 \text{ s}$
- **Need better values for parameters**
  - $\sigma$ , charge density
  - $A$ , charged area
  - $\tau_0$ , correlation time – biggest unknown